

Tool of Automated System Armoured Scaffold to Rank Requirements through AHP



K Glory Vijayaselvi, ThirumalaiSelvi R

Abstract: Requirement Engineering is really significant phase in software development life cycle. Construction of software and its functionalities is entirely grounded on the requirements elicited for the project[6]. In this paper, we propose a tool to prioritize the requirements only with AHP bearing in mind effortless implementation for large Scale Application, Precision of result and Stakeholder's Contribution. The tool is developed in Java and SQL. This work principally focused on applying AHP for larger projects. The proposed framework has been assessed through an exploratory case study that has fixed number of requirements and the status after the arrival of new requirements to the priority list. This is to know about the certainty of the projected framework, which has been conducted in a software firm. Then the tool was developed for the framework and used by the company to check for the certainty of result. The deployment of the tool and the result obtained from the effort are presented.

Key Words: AHP, Tool, Requirement prioritization, Users, comparisons, priority.

I. INTRODUCTION

Creation of software in addition to its functionalities is completely grounded on the requirement. Since all the provoked requirements cannot be established and delivered in a sole delivery, prioritizing the requirement that has to be developed for each and every release is vital.

According to Firesmith [7], requirement prioritization is the process of determining the implementation direction of the requirement for a software system.

From the review, it is found out that requirement prioritization condenses the development cost of the software system and time taken by forty percentage. The requirement prioritization also upsurges the gratification among the customers and also increases the excellence of a software. Hence this requirement prioritization is very important process in SDLC. Automizing the process helps the developing team to easily find out the priority among the requirements and in decision making. Hence the tool was developed with the intention to reduce the effort spend to find the priority among the requirement in quantitatively.

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II. FACTORS THAT CAN BE CONSIDERED FOR REQUIREMENT PRIORITIZATION

While prioritizing the requirement, norms are there to consider. It differs based on the nature of the project. Some common criterion are

- Status/ insistence of the requirement
- Time occupied for the enactment of requirement
- Outlay for the implementation of requirement
- Challenges to be met if the requirement is not implemented
- Others eg. perils, exterior factors, etc.,

III. RELATED WORK

Proper selection of the requirement having high significance is important to gain customer satisfaction and fruitful performance of the company^[1]

AHP is used to scrutinize relative importance of each requirement but the time taken to perform the calculation is high and the method is not scalable^[3]. When the number of requirement is too bulky, then it is intricate to adopt this method.

If the number of requirements is small, then AHP can be preferred^[5]. Since, it is accurate, this type of result is chosen. But because of its convolution in large scale projects, it is very difficult to implement.

When numerous stakeholders and requirements involved, then it is actually difficult to construct the priority list of requirements using AHP^[6]. The authors specified that AHP chomps more time and not extendable. Hence there is a need for the technique that will have the capability to put up large number of stakeholders and requirements.

Shahid Nazir Bhatti^[2], evaluated related papers to analyse the requirement prioritization approaches. AHP yields healthier result than others and very useful in decision making. Future work is proposed as complete automation of software engineering process. And also decided that the existing prioritization systems are not appropriate for all types of projects.

Tschangho John Kin^[4], improved or substitute approach for AHP was proposed. Excel spread sheet is used to calculate, which is recommended as an relaxed method.

IV. HUMAN INVOLVEMENT AND THE REQUIREMENT PRIORITIZATION

The prioritization procedure makes the user to involve in the developmental process. Since the user’s involvement throughout the development of the software is considered as very important, the HCC Model [8] is proposed with the user involvement and human inducement as a research work.

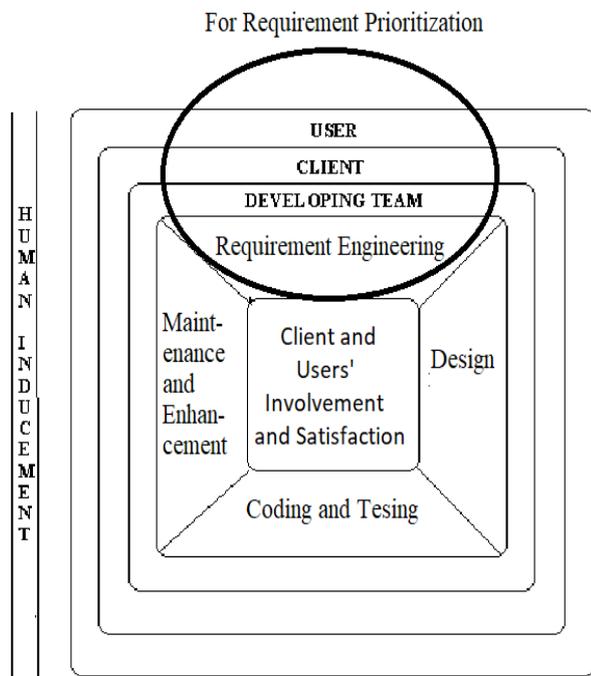


Figure 1 . New Proposed HCC Model

Including stakeholders in all the chapters helps the fruitful implementation of required requirement at required period. It lessens the software letdown. This also supports to manage the resources with bestconsumption which is very important in this current competitive world.

But collecting and consolidating the requirement prioritization from diverse stakeholder is problematic. Within the specified time, the priority list has to be prepared. Hence human inducement is very much important in this process to make the stakeholders to participate in the work interestingly.

V. AHP METHOD

In AHP, one compares all the probable pairs of requirements to find out well-organized list of the requirements according to their consequence. Usually the values 1, 3, 5,7 and 9 is used, where 1 denotes alike importance and 9 represents tremendously high importance. During the headway, if *n* number of requirements are elicited, $i \times (i-1) / 2$ comparisons want to be completed, which for the application with huge number of requirements results in scuffle. The result is a set of requirements prioritized along a measure. The AHP combines multidimensional scales of measurement into a one-dimensional scale of significances. AHP is highly trustworthy, since the great level of

redundancy in the pair wise comparisons makes the process resistant to comparison errors. Another advantage is the fact that the standards assigned in the pair wise comparisons are based on familiarity, observation and real data. Thus, AHP can handle both the qualitative and the quantitative facets of a decision problem. As a result, the fact that the resulting priorities are related and based on a scale certificates useful valuations of the requirements. The elicited value m_{ij} is inserted in the corresponding cell of the matrix (m_i, m_j) , while the cell (m_j, i) is filled with the reciprocal of the value $m_{ji} = 1/m_{ij}$

Hence AHP method is satisfactory with multi criteria decision making. The steps of AHP are as follows:

1. Entryof the criteria
2. Pair wise assessment of criteria for earnestness
3. Building of normalized comparison matrix
4. Amalgamationof matrix
5. Calculation of AHP score (priority) for each criteria

The values used for criterion comparison are

Value	Description
I	Equal weight
III	First (row) criteria is important than second (column) one.
V	First (row) criteria is much more important than second (column) one.
VII	First (row) criteria is significantly more important than second (column) one.
IX	First (row) criteria is definitely more important than second(column) one.

Table1- Priority Scale

VI. THE PROPOSED FRAMEWORK

This paper proposes innovative framework which gears only AHP in all its phases. Because of the precision of the method, the AHP entices more in prioritization. Accuracy is an essential constraint. Others stand in the following. So with this AHP, the framework is planned to prepare the prioritized list. In this work, the parameters considered are number of requirements, number of users, number of comparisons and the priority of the requirement.

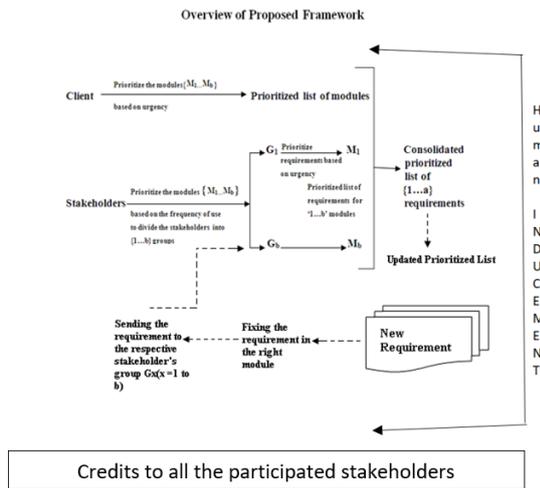


Figure 2- Framework

This framework is to identify the stakeholder’s preference on what the system should have from their former implementation to concluding implementation. This ranking will direct the developers to try their finest to satisfy stakeholders by their software. The framework practices only AHP method to find the priority of requirement. It will work for any number of requirements and any number of participants. The quantitative assessments given to the requirement leads to erroneous priority list. Also, those who tangled in this process may not work with curiosity if they will not get any benefit. Considering these limitations, the PAS framework has the parameter ‘human inducement’ to encourage and involve the stakeholders to participate in the process with enthusiasm. It is designed to give points to the stakeholders for their response given in the AHP sheet. Later, these credits can be used to give profits to the stakeholders involved in the progression.

VII. DIFFICULTIES FACED TO COLLECT THE DATA BASED ON THE FRAMEWORK PROPOSED

A. Google Forms were used for creating surveys for one of my research projects. Easy to use interface makes creating and deploying forms easy. Users can enter their "answer" and it will be submitted into a spreadsheet. The stakeholders’ mail id will be collected. They will be provided with the sheet. The forms are integrated with Google Sheets which gives a spreadsheet view of the data collected, making it easy to analyze. Calculations has to be made using the quantitative data collected. It will be easy, if separate account is maintained to all the stakeholders to have their details and credits earned.

Sample google form used

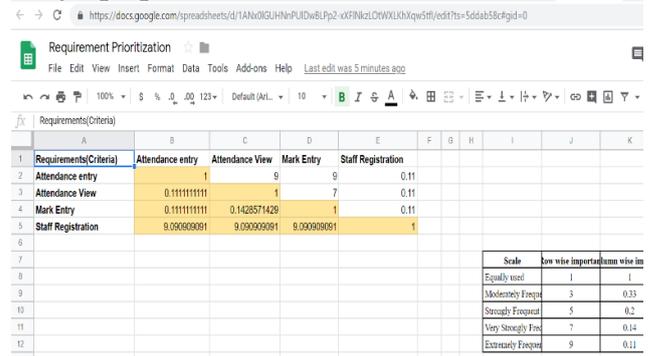


Figure 3 – Google form

B. Through Sheet (Hard copy). A sheet with AHP table is used. It is circulated among the stakeholders to collect the data. This resulted in time consuming and more effort. Then the data has to be feed in the system for further calculation and decision making. The stakeholder no need to fill the shaded cell. After collecting the data in the sheet, formula in Excel is used to perform calculation.

Requirements	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12
R1	1	9	9	9	9	9	9	9	9	9	9	9
R2	0.11	1.00	9.00	9.00	7.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
R3	0.11	0.11	1.00	9.00	3.00	3.00	7.00	5.00	7.00	5.00	7.00	9.00
R4	0.11	0.11	0.11	1.00	5.00	3.00	7.00	9.00	3.00	0.20	9.00	9.00
R5	0.11	0.14	0.33	0.20	1.00	9.00	7.00	7.00	7.00	0.11	9.00	9.00
R6	0.11	0.11	0.33	0.33	0.11	1.00	7.00	3.00	7.00	0.11	9.00	9.00
R7	0.11	0.11	0.14	0.14	0.14	0.14	1.00	0.33	5.00	0.33	7.00	9.00
R8	0.11	0.11	0.20	0.11	0.14	0.33	3.03	1.00	7.00	0.11	9.00	9.00
R9	0.11	0.11	0.14	0.33	0.14	0.14	0.20	0.14	1.00	0.11	9.00	9.00
R10	0.11	0.11	0.20	5.00	9.09	9.09	3.03	9.09	9.09	1.00	9.00	9.00
R11	0.11	0.11	0.14	0.11	0.11	0.11	0.14	0.11	0.11	0.11	1.00	7.00
R12	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.14	1.00
Total	2.22	11.14	20.72	34.34	34.85	43.93	53.51	52.79	64.31	25.19	87.14	98

Table 2 – Priority given for all requirements by a single user

C. Using Excel. Then normalization of AHP is made in excel using formulae. All the other following calculations to select the precise end user to prioritize the requirements and the priority list generation are made manually in the Excel, which is also a tedious job.

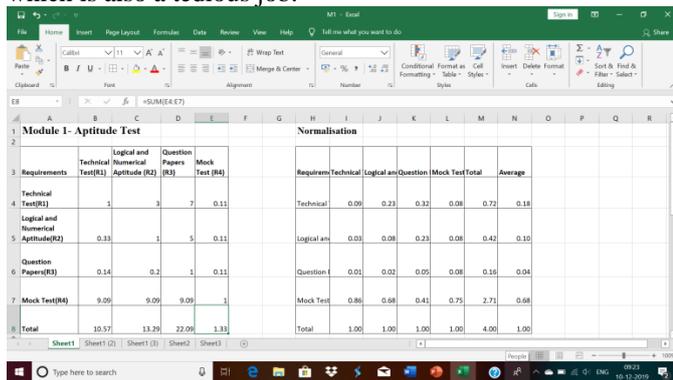


Figure 4 - Excel sheet (AHP)

VIII. THE TOOL

The tool is developed with Java and SQL. The developed web tool will be very helpful for the developers in finding the priority among the requirements. The architectural view of the proposed tool

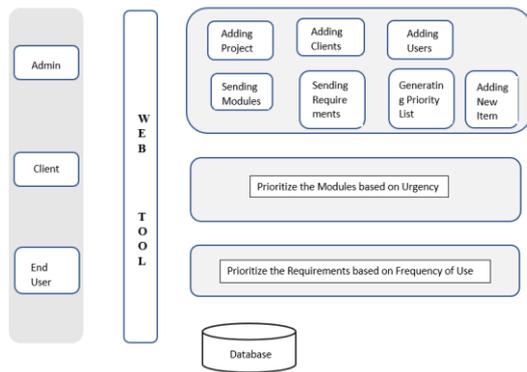


Figure 5 – Architecture of the tool

A. Advantages of Using tool

1. Capability to help decision makers to select the suitable requirement for development
2. Flexible and quantitative decision analysis tool. Quantitative verdict
3. Capability to select best substitute under dynamically changing circumstances
4. Numerous inputs can be considered
5. Ability to handle interrelationship among criteria
6. Capacity to deal with large scale problems
7. Better communication with stakeholders
8. Remote working
9. Easy document sharing
10. No need of space in the hardware.

B. GUI of tool

First, the company has to register and login. Then the development team has to select the project from menu(new/existing), add the details about the project , clients and the end users.

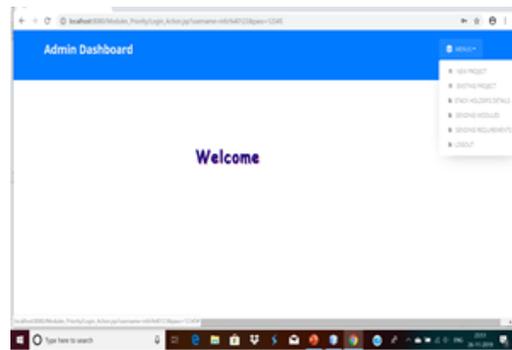


Figure 6- Home page

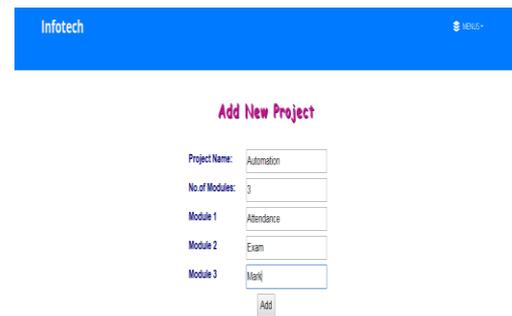


Figure 7 – Interface to add the project

Add New Requirements For Modules

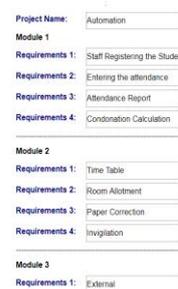


Figure 8 – Requirement specification page

After submitting the details, first the modules will be sent to the clients and end users for prioritization

Add Client & End Users



Figure 9 – Stakeholder specification page

Along with the AHP sheet, guidance to fill the cell will also be there. To encourage the responders to fill the data in the sheet, credits will be provided. Those credits will be later on used to reward the responders. This is to induce the participation of stakeholders. After receiving the responses, the admin will decide the completion of this process by clicking entry completed. After this process, no response from the user will be accepted.

Calculations will be performed by the tool and then the users will be selected for the modules. After this phase, the requirements of the modules will be send to the respective group of users. Again, after receiving the response from the end users, the requirements will be prioritized and the list will be generated.

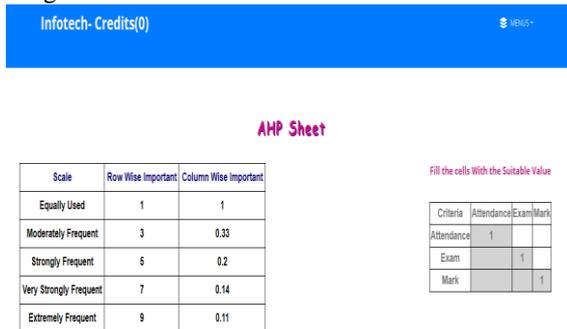


Figure 10 – AHP sheet to stakeholders

Till the list is generated, the status of the project will be ‘in-progress’. Once the list is generated, the status will be ‘completed’. The admin can view the priority list and select the requirements for the development. Those selected requirements will be removed from the list.

The ‘add’ option in the ‘action’ is used to add new requirements in the module of the project. Automatically, that requirement will be send to the respective group of users. Again, the process continues till the updated version of the priority list is generated.



Figure 11 – Status Page



Figure 12 – Priority list

C. Result of the Experiment

The result obtained through framework(Excel sheet is used) and the tool is compared.

S.No.	Requirement ID
1	R1
2	R 2
3	R 3
4	R 10
5	R 5
6	R 4
7	R 9
8	R 6
9	R 8
10	R 7
11	R 11
12	R 12

Figure 3 Through framework -Excel

The result obtained by using Excel sheet is in Fig 13 and the result obtained from the tool is given in fig 12.

Comparison of results obtained (by proposed framework) using Excel sheet and the tool

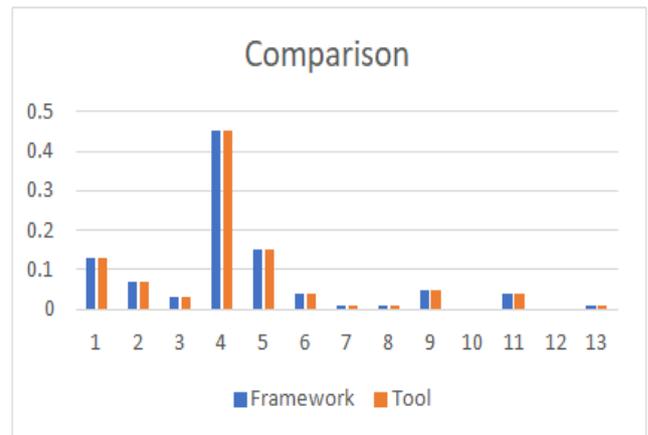


Figure 13 – Comparison of framework(Excel) and tool

Framework in Fig 14 refers using Excel and the tool refers the result obtained by the tool developed

D. Comparison of AHP and the Tool

Through the experiment, AHP and the tool was compared considering the following criteria. The experience and the result received is considered to compare them both (Table 4)

Criteria	AHP	Tool developed for the proposed framework
Number of stakeholders that can be handled	Small	Large
Number of requirements that can be handled	Small	Large
Possibility of communication with stakeholders	Low	High
Adding new requirements	Difficult	Can add effortlessly
Automation of the calculation process	Partly (If Excel is used)	Optimum
Increasing the Interest among stakeholders to involve them in prioritizing the requirement	No	High
Flexibility of the method in case of distributed stakeholders	Low	High
Result	86% Similarity in the result obtained through AHP and the tool	

Table 4 – Comparison of AHP and Tool

IX. CONCLUSION

This study was based on the existing model from the reviewed literature. Beside the model, the proposed framework is suitable to prepare the priority list of the requirements for large scale projects. Hence the framework results in the compact number of comparison of requirements, compact number of user involvement, which is suitable for large scale software development.

Further, technical team can also be added in prioritization process. They can prioritize based on cohesion in the modules and coupling among the modules. The framework can be enhanced with the technical team.



Figure 14 - Inclusion of Technical Team

First, the modules can be given to the team to find the degree of coupling among them. The result will be the matrix through which the priority among the modules in case of coupling can be assessed. Then the requirements of the modules can be given to the team members to calculate the cohesion level for each requirement.

FUTURE WORK

The future work of the research is focused on enhancing the tool for the proposed framework in the form of mobile app. Some more improvement has to be done to get 100 percent equivalent result with AHP sheet. To find the way to reduce the number of users to rate the requirements based on importance/urgency. Human inducement is required to fill the data. Points can be handled to encourage every responder considering the time taken for the response.

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