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Requirements Prioritization: A Review

Mona Batra, Dr. Archana Bhatnagar

Research Scholar, Department of CSE, Birla Institute of Technology, Mesra, Ranchi, Jaipur Campus, India
Assistant Professor, Department of CSE, Birla Institute of Technology, Mesra, Ranchi, Jaipur Campus, India

ABSTRACT: For successful software progress, Requirements Engineering (RE) is the most important stage. Requirements Prioritization is another significant aspect in requirements engineering. Requirements prioritization aids requirement engineering process. It assists requirements engineer to take critical judgments regarding stakeholder's requirements. Prioritization process figure out the requirements of a software project that should be incorporated in a certain project release. There are numerous requirements prioritization methodologies, practices, frameworks and techniques have been formulated, evolve and progressed in existing literature. This research paper exemplifies different requirements prioritization practices, methodologies, frameworks and techniques and their associated detailed characteristics. It also presents several latest innovations in this field.

KEYWORDS: Requirements Engineering, Requirements Prioritization, Prioritization Techniques, Controlled analysis.

I. INTRODUCTION

Requirements engineering is the first phase of software development life cycle. This stage helps the analyst to understand actual needs of software and build economic software. Requirements are expressed as a stakeholder's demand for the proposed system. It includes the functional as well as non-functional aspects of the system. The vital objective of any system is to assure different stakeholders' demands [1]. Requirement prioritization process is a further most important aspect of requirements engineering that recognize most significant requirements for a software system [2]. It makes decision about which requirements must be included in a certain release [3]. The primary challenge of current informational organizations is to meet candidate's needs and likely increase probable expectations in economic, secure, time-effective and useful way [4]. Due to financial limits and production time-limit restriction, it may be a challenge for requirements analysts to come to a decision of arranging the requirements to be considered first that leads to high customer satisfaction. Inaccuracy in ranking requirements can effect that the software might be rejected by the end users due to deficiency in standards and sooner or later the software may be acknowledged to be unsuccessful. In order to improve the cost benefits and meet deadlines of a software system, it is required to firstly keep high priority requirements into consideration before low-priority requirements.

There is an emergent necessity for the practices and techniques to prioritize requirements [3]. Many researchers are working in this field but it is difficult to make use of right technique or framework at right time. It is has been signified to implement security aspect since the inception of software i.e. requirement phase [5]. The presented research paper discussed some current literature work in the field of requirements prioritization and helps the researchers to view various aspects of the same. At the finish node some findings and analysis are described. The paper is systematized in four sections: Section 2 discussed about numerous research papers published in literature and Section 3 describe the findings and analysis existing prioritization methods. Section 4 concludes the paper.

II. RELATED WORK

Joachim Karlsson, Claes Wohlin and Bjorn Regnell presented a paper that discussed six different prioritization methods. For the evaluation a case study of telephony system is done. Authors used all six prioritization methods on separate occasions to prioritize the requirements and found that analytic hierarchy process is the most proficient method at industrial level. Analytic hierarchy process methodology provides trustworthy results, support knowledge transfer and generate cooperation amongst project members. [6]

Donald Firesmith published a paper that focused on the major aspects of requirements prioritization, its purpose, benefits, challenges and various risks that analyst team may face while prioritizing requirements. At the end authors also discussed about major techniques for prioritizing requirements. [7]



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Paolo Avesani, Cinzia Bazzanella, Anna Perini and Angelo Susi presented a paper that described a case-based framework. Authors make use of case-based ranking for requirements prioritization, which utilize machine learning practices to defeat scalability problem as well as to depict experimental evaluations that shows its efficacy in overcoming the scalability problem. The results show that proposed approach performs better than AHP with reference to elicitation effort and prioritization correctness. [8]

Andrea Herrmann and Maya daneva performed a controlled analysis on existing requirements prioritization methods. In this analysis prioritization methods are analysed on the basis of cost and benefits of each method. Authors create a some under-researched problems and draws a schema for potential examination in this area.[9]

Maya Daneva, Andrea Herrmann induced a conceptual model of requirements prioritization based on benefit and cost. Designing of this model is based on grounded theory. Author explained every details related to the model, procedures followed and how they use the framework for classifying requirements prioritization methods.[10]

Aaron K. Massey, Paul N. Otto, and Annie I. Anton, accepts Numeral assignment prioritization technique for legal requirements. Authors employ prioritization technique on 63 functional requirements for an open-source electronic health records (EHR) system. This system must act in accordance with the U.S. health insurance portability and accountability act. Numeral assignment prioritization technique can be able to use by any systems that fulfil laws or regulations to prioritize the requirements. Results shows that among all the requirements 17 requirements have no mapping to a appropriate component of the legalized text, 19 requirements need further enhancement, and 27 requirements are lawfully operation -ready. [11]

Mohd. Sadiq and Mohd. Shahid suggested a framework that mathematically prioritizes the software requirements which is gathered using JAD technique. In this framework Analytical Hierarchical Processing and Quality Function Deployment technique is used for prioritization of software requirements. [12]

Aaqib Iqbal, Farhan M, Khan and Shahbaz. A. Khan presented a paper that illustrated an assessment of different requirement prioritization techniques based on factors such as cost, value, risk, benefit etc. The authors also suggested new procedures that describe the detail way to carry requirement prioritization process. [13]

Harunur Rosyid, Eko Prasetyo, Andy Hidayat Jatmika and Dan Daniel O. Siahaan, performed comparative analysis between Case based reasoning and Cumulative Voting methods with respect to three major factors that is time consumption, quality, and complexity. The result of the analysis may assist the practitioner/decision makers in selecting one of the techniques.[14]

Persis Voola And A Vinaya Babu presented a new approach to incorporate imprecision elements in the forms of uncertainty, incompleteness and vagueness for requirements prioritization. An approach named requirements uncertainty prioritization approach (RUPA) has introduced where numerical assignment is shaped as extensive numerical assignment by means of probability distribution and grade intervals. Interval evidential reasoning algorithm is used to aggregate the imprecise assessments of stakeholders. The usefulness of this approach is examined with the help of a case study [15].

Shams Ul Hassan & Salman Afsar Awan described a framework for examine requirements elicitation and requirements prioritization. The survey is conducted in this paper to give realistic outlook of prioritizing the requirements alongside the features that affect the requirements prioritization process.[16]

Aayush Gulati, Shalini Sharma and Parshotam Mehmi presented a novel method for requirement prioritization based on the risk measurement techniques. According to this method, security requirements must be recognized at early step of systematic analysis and then each architecture team can select the most appropriate mechanism to implement every requirements. [17]

Rami Hasan AL-Taani and Rozilawati Razali proposed a framework that outlines the contributing parameters that affect requirements prioritization procedure in agile software development. The parameters have been recognized with



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the literature review and analysis is done using the process of content analysis. The suggested framework grants empirical assistance and potential research on effectual requirements prioritization progression. [18]

Manju Khari and Nikunj Kumar presented a comparative study on six requirement prioritization techniques on the basis of number of factors. The results of this study shows that value oriented prioritization (VOP) technique gives precise outcome in least amount of time when number of requirements is increased. [19]

Shadab Siddiqui, Dr. Mohd. Rizwan Beg and Shahin Fatima performed a comparative analysis on two requirement prioritization methods named Analytical Hierarchy Process (AHP) and Planning Game (PG). These techniques are compared using various factors like risk, efforts, correctness, Simplicity, Time required, Scalability, Resource availability, Total no of comparisons, consistency, errors. Results of the analysis shows that PG is most potential technique as it grants reliable results consuming less time and works well in dynamically changing requirements. Hence, investigation shows PG technique is better-quality to AHP technique. [20]

Lipika Bose Goel and Prof. Sanjeev Thakur proposed a framework to prioritize software requirements. The recommended framework categories the requirements on the basis of business value, expenditure, efforts and risk allied with every requirement.[21]

Persis Voola A and Vinaya Babu proposed a framework named 4a prioritization framework. This framework is based on four components like attributes, assessors, ambiguity and aggregation. All the elements composing this framework are related to software requirements. [22]

Punam Bajaj and Vineet Arora presented a paper that evaluate various requirements prioritization methods through different quality parameters and suggest a novel technique to select an appropriate method for particular application. The research study gives guidance to practitioners to use the proposed novel approach for a particular application. The approach is demonstrated with the help of a case study of the travel management planning. [23]

Varun Gupta, D. S. Chauhan, Kamlesh Dutta and Chetna Gupta proposed a multilayered dynamic approach for requirement reprioritization for both agile and non agile development methodologies. Both agile and non agile development methodologies can employ any prioritization method. The proposed multilayered approach is described with the case study of library management system developed in the computer laboratory of national institute of technology, hamirpur. [24]

Nupoor Garg and Neha Malhotra presented a paper that focus on requirements prioritization in agile software development on the basis of quality approach and interactive genetic algorithm. Researchers develop a tool using interactive genetic algorithm through which disagreements between the client and the developer can be reduced. [25]

Parminder Kaur presented a theoretical facet of test case prioritization, service oriented web applications and Topsis framework. Paper furthermore spotlighted on benefits, limitations and the selection of test cases having the same priority. [26]

Saranya. B., Subha. R. & Dr. Palaniswami. S. presented a paper that increases the consciousness about the importance of non-functional requirements as well as analyzes various techniques that are used to prioritize non-functional requirements. Paper also depicts the importance of choosing the appropriate requirement prioritization technique for a particular software development process. [27]

Mohammad Dabbagh and Sai Peck Leedue proposed an approach that deals with the process of prioritizing functional and non-functional requirements. The proposed approach is compared with analytic hierarchy process (AHP) and hybrid assessment method (HAM).The effectiveness of the proposed approach has been evaluated through an empirical experiment. The results show that proposed approach is better than AHP and HAM in terms of actual time consumption and quality of the results. [28]

Javed Ali Khan, Izaz Ur Rehman, Yawar Hayat Khan, Iftikhar Javed Khan and Salman Rashid performed an evaluation of various requirement prioritization techniques on the basis of existing literature. Some of the techniques which are



taken into consideration are Binary Search Tree, AHP, Hierarchy AHP, Spanning Tree Matrix, Priority Group/Numerical Analysis, Bubble Sort, Mosow, simple Ranking And Planning Game. Evaluation depicts that AHP is the best requirements prioritization technique amongst all the requirements prioritization techniques. It provides most efficient, reliable results and support features of fault- tolerant and consistency check. [29]

Shahnawaz Ahmad and Mohd. Sadiq proposed a method which is based on recommender systems for software requirements negotiation and prioritization. Finally, the utilization recommender system is demonstrated with the help of an example. [30]

Ruby and Dr. Balkishan presented a paper that gives preliminary description of requirement prioritization techniques that are used to prioritize the requirements along with parameters which are used in prioritization process. Researchers also discussed the challenges faced during requirements prioritization and need of fuzzy logic in prioritization process. At the end authors provides a novel solution in a field of requirement prioritization using fuzzy logic. [31]

Vikas S. Chomal and Dr. Jatinderkumar R. Saini, presented a paper that described the reviews of requirements engineering and prioritizing software requirements during requirement analysis process. [32]

Varun Gupta, Durg Singh Chauhan, and Kamlesh Dutta, performed a systematic survey in the area of requirements reprioritization. To understand the actual scenarios some case studies conducted by multinational organizations are analyzed. Analysis shows that efficient reprioritization methods are needed in software engineering practices. [33]

Pradeep Kumar. G, Sandhiya .R , and Prof. Manjula. R performed a comparative analysis of various requirements elicitation techniques and proposed a most competent method among them. Authors further explain the importance of requirement prioritization in software development. [34]

III. FINDING AND ANALYSIS

In current software industries requirements prioritization methods have great importance. The analyst can easily focus on the requirements which are most important for the success of any software. Most practioners/researchers are working in this area of requirements prioritization. Below are some major concerns bring into consideration from the study of related literature review. It may also be termed as future research directions.

- Literature review depicted that incorporation of fuzzy logic in requirements prioritizing generates very effective results.
- The researchers might propose an approach that deals with prioritization of non-functional requirements as non-functional requirements are equally important.
- Researchers might work in the area of requirements reprioritization.
- Researchers might propose a methodology that includes fuzzy logic for prioritizing requirements that produces more effective and reliable results.
- Researchers might proposed a single method that addresses all the factors necessary for prioritization process E.g. cost, benefit, risk, effort, easy to learn, easy to use, confidence, understandable to non-experts, reliable, efficient, scalable and flexible etc.
- Researchers might work for developing prioritization techniques that works well in large scale and dynamically changing requirements.
- Researchers might propose an approach to select an appropriate prioritization method for the particular application. This approach may be employed for real life applications.

IV. CONCLUSION

The paper presented a detailed literature review on one of the most important aspect of requirements engineering that is requirements prioritization and discussed about the related findings. Prioritization of requirements is important because requirements phase is viewed as a foundation stone for other subsequent phases of software development. Literature shows that researchers have keen interest in the area of requirements prioritization. After studying the published research work, we introduced several research areas, in which further improvement is needed. The major parameters to incorporate in various methods and tools for prioritization are cost, effort, risk, understandablility, reliability, efficiency, scalability and flexibility etc. Potential future expansion of the research work has previously been analyzed comprehensively in the above segment.

**REFERENCES**

- [1] J. Karlsson and K. Ryan, "A cost-value approach for prioritizing requirements," *IEEE Software*, vol. 14, no. 5, pp. 67–74, 1997.
- [2] I. Sommerville, *Software Engineering*, Addison-Wesley, 2006.
- [3] Valenti, S (2002). "Successful Software Engineering". IRM Press. ISBN 1-931777-33-0.
- [4] Bergman, B., and Klefsjö, B. (2003) "Quality - From customer needs to customer satisfaction" Studentlitteratur AB, Lund, Sweden.
- [5] Mona Batra and Dr. Archana Bhatnagar "Descriptive Literature Review of Requirements Engineering Models", International Journal of Advanced Research in Computer Science and Software Engineering, Volume 5, Issue 2, February 2015.
- [6] Joachim Karlsson, Claes Wohlin and Bjorn Regnell. "An evaluation of methods for prioritizing software requirements", Information and Software Technology 39 (1998) 939–947, Elsevier Science Direct.
<http://www.sciencedirect.com/science/journal/09505849/39>
- [7] Donald Firesmith, "Prioritizing Requirements", Journal Of Object Technology, Vol. 3, No.8, Software Engineering Institute, U.S.A, September October 2004.
http://www.jot.fm/issues/issue_2004_09/column4/column4.pdf
- [8] Paolo Avesani, Cinzia Bazzanella, Anna Perini, Angelo Susi. Facing Scalability Issues in Requirements Prioritization with Machine Learning Techniques, Proceedings of the 2005 13th IEEE International Conference on Requirements Engineering (RE'05), 0-7695-2425-7/05 2005 IEEE.
<http://citeseerx.ist.psu.edu/viewdoc/download;jsessionid=E380547FB82A46B6E4C9482AAC92B85D?doi=10.1.1.103.5762&rep=rep1&type=pdf>
- [9] Andrea Herrmann and Maya Daneva "Requirements Prioritization Based on Benefit and Cost Prediction: An Agenda for Future Research", 1090-705x/08, 2008 IEEE.
<http://eprints.eemcs.utwente.nl/14559/01/RE08-Herrmann-Daneva.pdf>
- [10] Maya Daneva, Andrea Herrmann "Requirements Prioritization Based on Benefit and Cost Prediction: A Method Classification Framework", 978-0-7695-3276-9/08 \$25.00 © 2008 IEEE, DOI 10.1109/SEAA.2008.46.
<http://doc.utwente.nl/65272/1/Euromicro-Daneva-Herrmann.pdf>
- [11] Aaron K. Massey†, Paul N. Otto‡, and Annie I. Antón, "Prioritizing Legal Requirements" 2009 Second International Workshop on Requirements Engineering and Law (relaw'09), 978-0-7695-4102-0/10 \$26.00 © 2010
<http://www4.ncsu.edu/~akmassey/documents/papers/akmassey-relaw09.pdf>
- [12] Mohd. Sadiq and Mohd. Shahid, "Elicitation and Prioritization of Software Requirements", International Journal of Recent Trends in Engineering, Vol 2, No. 3, November 2009.
<http://academypublisher.com/ijrte/vol02/no03/ijrte0203138142.pdf>
- [13] Aaqib Iqbal, Farhan M, Khan, Shahbaz. A. Khan, "A Critical Analysis Of Techniques For Requirement Prioritization And Open Research Issues, International Journal of Reviews in Computing, 2009
<http://www.ijric.org/volumes/Vol1/2/Vol1.pdf>
- [14] Harunur Rosyid, Eko Prasetyo, Andy Hidayat Jatmika, Dan Daniel O. Siahaan, "Comparison Analysis Of Requirement Prioritization Methods Between Case Based Ranking And Cumulative Voting", Konferensi Nasional Sistem Dan Informatika 2011; Bali, November 12, 2011
<https://yudiagusta.files.wordpress.com/2008/09/022-027-knsi2011-004-comparison-analysis-of-requirement-prioritization-methods-between-case-based-ranking-and-cumulative-voting.pdf>
- [15] Persis Voola and A Vinaya Babu, "Requirements Uncertainty Prioritization Approach: A Novel Approach for Requirements Prioritization", Software Engineering : An International Journal (SEIJ), Vol. 2, No. 2, SEPTEMBER 2012.
http://seij.dtu.ac.in/vol_2_issue_2/paper3.pdf
- [16] Shams ul Hassan & Salman Afsar Awan , "Software Engineering: Factors Affect on Requirement Prioritization" Global Journal of Computer Science and Technology, Software & Data Engineering, Volume 12 Issue 15 Version 1.0 Year 2012.
https://globaljournals.org/GJCST_Volume12/5-Software-Engineering-Factors-Affect-on-Requirement.pdf
- [17] Aayush Gulati, Shalini Sharma and Parshotam Mehmi, "Proposing Security Requirement Prioritization Framework, International Journal of Computer Science, Engineering and Applications (IJCSSEA), Vol.2, No.3, June 2012.
<http://aircse.org/journal/ijcssea/papers/2312ijcssea03.pdf>
- [18] Rami Hasan AL-Ta'ani*, Rozilawati Razali, "Prioritizing Requirements in Agile Development: A Conceptual Framework", The 4th International Conference on Electrical Engineering and Informatics (ICEEI 2013), Procedia Technology 11 (2013) 733 – 739 Science Direct, Elsevier.
http://ac.els-cdn.com/S2212017313004064/1-s2.0-S2212017313004064-main.pdf?_tid=0fdd177c-273e-11e6-ae88-00000aab0f02&acdnat=1464705998_399c0f1f36e2d80f37f7d8580e9a8f7c
- [19] Manju Khari and Nikunj Kumar, "comparison of six prioritization techniques for software requirements", Journal of Global Research in Computer Science, Volume 4, No. 1, January 2013.
<http://jgrcs.info/index.php/jgrcs/article/viewFile/568/429>
- [20] Shadab Siddiqui, Dr.Mohd. Rizwan Beg, Shahin Fatima, "Effectiveness of Requirement Prioritization Using Analytical Hierarchy Process (AHP) And Planning Game (PG): A Comparative Study", International Journal of Computer Science and Information Technologies, Vol. 4 (1), 46 – 49, 2013.
<http://www.ijcsit.com/docs/Volume%204/Vol4Issue1/ijcsit2013040111.pdf>
- [21] Lipika Bose GoelI, Prof. Sanjeev Thakur, "Requirement Prioritization: A Study and Proposed Framework" International Journal of Emerging Technology and Advanced Engineering, Volume 3, Issue 6, June 2013.
http://www.ijetae.com/files/Volume3Issue6/IJETAE_0613_102.pdf
- [22] Persis Voola A and Vinaya Babu, "4A Frameworks for Requirements Prioritization" International Journal of Computer Applications (0975 – 8887) Volume 76– No.1, August 2013.
<http://research.ijcaonline.org/volume76/number1/pxc3890598.pdf>
- [23] Punam Bajaj and Vineet Arora "A Novel Approach to Select an Appropriate Requirements Prioritization Technique" International Journal of Computer Applications (0975 – 8887) Volume 77 – No.9, September 2013.
<http://research.ijcaonline.org/volume77/number9/pxc3891102.pdf>



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Vol. 3, Issue 11 , November 2016

- [24] Varun Gupta, D. S. Chauhan, Kamlesh Dutta and Chetna Gupta, "Requirement Reprioritization: A Multilayered Dynamic Approach", *International Journal of Software Engineering and Its Applications*, Vol.7, No.5, pp.55-64, 2013.
http://www.sersc.org/journals/IJSEIA/vol7_no5_2013/6.pdf
- [25] Nupoor Garg And Neha Malhotra "Prioritization Of Requirements Based Upon Quality Approach And Interactive Genetic Algorithm Focussed On Agile Methodologies", *International Journal Of Computer Science & Communication Networks*, Volume 4, Issue 1, January 2014.
<http://www.ijcscn.com/Documents/Volumes/vol3issue2/ijcscn2013030208.pdf>
- [26] Parminder Kaur "Requirement Based Test Case Prioritization in Service-Oriented Web Application Using TOPSIS Framework", *International Journal of Advanced Research in Computer Science and Software Engineering*, Volume 4, Issue 1, January 2014
http://www.ijarcsse.com/docs/papers/Volume_4/1_January2014/V4I1-0315.pdf
- [27] Saranya. B., Subha. R. & Dr. Palaniswami. S. "A Survey on Prioritization Methodologies to Prioritize Non-Functional Requirements" *International Journal of Computer Science and Business Informatics*, Vol. 12, No. 1. April 2014.
www.ijcsbi.org/index.php/ijcsbi/article/download/358/102
- [28] Mohammad Dabbagh and Sai Peck LeeDue, "An Approach for Integrating the Prioritization of Functional and Nonfunctional Requirements", *The Scientific World Journal*, Volume 2014, Article ID 737626, 2014
<http://www.hindawi.com/journals/tswj/2014/737626/>
- [29] Javed Ali Khan, Izaz Ur Rehman , Yawar Hayat Khan, Iftikhar Javed Khan and Salman Rashid, "Comparison of Requirement Prioritization to find best prioritization technique", *International Journal of Modern Education and Computer Science*, 2015, 11, 53-59 Published Online November 2015 in MECS.
<http://www.mecs-press.org/ijmecs/ijmecs-v7-n11/IJMECS-V7-N11-6.pdf>
- [30] Mohd. Sadiq and Shah Nawaz Ahmad, "Recommender Systems for Software Requirements Negotiation and Prioritization", *International Journal of Computer Applications (0975 – 8887) Volume 117 – No.13, May 2015*.
<http://research.ijcaonline.org/volume117/number13/pxc3903261.pdf>
- [31] Ruby and Dr. Balkishan, "Role of Fuzzy Logic in Requirement Prioritization", *International Journal of Innovative Research in Science, Engineering and Technology*, Vol. 4, Issue 6, June 2015.
http://www.ijirset.com/upload/2015/june/99_Role_NEW.pdf
- [32] Vikas S. Chomal, Dr. Jatinderkumar R. Saini "On Prioritizing and Freezing of Software Requirements", *International Journal of Innovative Science, Engineering & Technology*, Vol. 2 Issue 11, November 2015.
http://ijiset.com/vol2/v2s11/IJISSET_V2_I11_104.pdf
- [33] Varun Gupta, Durg Singh Chauhan, and Kamlesh Dutta, "Exploring prioritization through systematic literature surveys and case studies", Springerplus. 2015; 4: 539.
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4579198/>
- [34] Pradeep Kumar. G, Sandhiya R , Prof. Manjula. R. "A Comparative Study of Software Requirement, Elicitation, Prioritization and Decision Making", *International. Journal of Engineering Research and Applications*, Vol. 6, Issue 4, (Part - 5) April 2016, pp.01-07
http://www.ijera.com/papers/Vol6_issue4/Part%20-%205/A0604050107.pdf