UNIVERSITI PUTRA MALAYSIA

ENHANCING TASK MANAGEMENT IN SCRUM-AGILE USING HYBRID REQUIREMENT PRIORITIZATION TECHNIQUE

CHE SUHANA BINTI CHE WIL

FSKTM 2019 11

ENHANCING TASK MANAGEMENT IN SCRUM-AGILE USING HYBRID REQUIREMENT PRIORITIZATION TECHNIQUE

by

CHE SUHANA BINTI CHE WIL

Thesis submitted to the School of Graduate Studies
Universiti Putra Malaysia
in fulfilment of the requirements for the
Master of Software Engineering

Jan 2019

DEDICATIONS

In the name of Allah S.W.T, the most merciful, the most compassionate all praise to Allah, the lord of this world and peace be upon Muhammad S.A.W his servant and messenger.

This thesis is wholeheartedly dedicated to my husband Mohd Farhan Abd Hamid who has been my source of inspiration, and gave me strength when I felt to giving up and also he who continually provides the warmth of love, a lot of encouragement and financial support.

To my parents, family, family in laws, friends and mentors who shared strength, spirit, encouragement and motivation to complete this work.

Abstract of thesis presented to the Universiti Putra Malaysia in fulfilment of the requirement for the Master of Software Engineering

By

CHE SUHANA BINTI CHE WIL

JAN 2019

FACULTY OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

Requirement prioritization is a crucial process in Requirement Engineering which can contributes to project success. There are several requirement prioritization techniques practiced in Scrum-Agile environment. However, selecting an appropriate technique which can satisfy a quality factor such as scalability, effectiveness and efficiency can be difficult. Besides that, this technique becomes too difficult, if the stakeholders are distributed in different places and moreover, most of stakeholders tend to neglect this activity because they are busy with their routines and sometime they thinks this technique are too complex to be executed. In this study, we discusses strengths and weaknesses of the existing prioritization techniques and we also proposed a hybrid requirement prioritization technique which a combination of cumulative voting and Volere techniques, called a VoVo technique. The VoVo technique offers a structurally guided prioritization technique which can encourage user participation in prioritization process and also can mitigating the scalability issues especially in geographically distributed project. This hybrid technique is using 2 tiers prioritization process where in the first tier, the prioritization will be done by stakeholders while in the second tier requirements will be prioritized by an experts usually a scrum master or project manager. In the first tier, VoVo offers a simple and fun prioritization activity which can attract client to participate in this activity. It has been embedded in web based task management tool (scrum board) where are accessible in world wide. In the second tier prioritization activity, there are a several cost-risk factors shall be considered by an expert and also each factor will be weighted based on his/her justification. These cost-risk factors and weights maybe different for each project. The priority rate will be calculated quantitatively and the requirement which have highest rate will be displayed on the top of requirement list. This web based task management tool been evaluated through evaluation survey which been addressed directly to scrum practitioners. Its suitability and effectiveness in managing and prioritizing requirement in Sprint Backlog will be measured based on

testing and evaluation survey feedbacks. Hence, we can conclude the stakeholder's participation in requirement prioritization is important and based on evaluation survey feedbacks, proved the VoVo technique is suitable to be used for managing and prioritizing requirement in Scrum project.

Abstrak tesis yang dikemukakan kepada Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Sarjana Kejuruteraan Perisian

Oleh

CHE SUHANA BINTI CHE WIL

FAKULTI SAINS KOMPUTER DAN TEKNOLOGI MAKLUMAT

Proses pengutamaan keperluan merupakan satu proses penting di dalam kejuruteraan keperluan yang mana dapat menyumbang kepada kejayaan sesebuah projek. Terdapat beberapa teknik pengutamaan perisian yang dipraktiskan dalam projek Skrum. Walau bagaimanapun, untuk memilih sesuatu teknik pengutamaan yang dapat memenuhi faktor-faktor kualiti seperti skalabiliti, keberkesanan dan kecekapan adalah sangat sukar. Selain itu, teknik ini akan menjadi lebih sukar dilaksanakan jika pelanggan-pelanggan projek berada di tempat yang berbeza. Tambahan pula, kebanyakan pelanggan cenderung untuk mengetepikan proses pengutamaan ini, ekoran kesibukan dan juga mereka berpendapat bahawa teknik pengutamaan keperluan adalah sangat kompleks untuk dilaksanakan. Dalam kajian ini, kami membincangkan kelebihan dan kelemahan teknik-teknik pengutamaan yang sedia ada dan juga kami mencadangkan satu teknik pengutamaan hibrid, yang merupakan kombinasi teknik pengundian terkumpul dan *Volere* yang dinamakan teknik VoVo. Teknik VoVo adalah satu teknik pengutamaan yang berstruktur yang mana dapat menggalakkan penglibatan pelanggan dalam proses pengutamaan keperluan dan juga dapat mengatasi masalah skalabiliti terutamanya bagi projek yang teragih. Teknik hibrid ini menggunakan dua tingkat proses pengutaman yang mana di tingkat pertama, proses pengutamaan dilakukan oleh pelanggan manakala di tingkat kedua, proses pengutamaan akan dilakukan oleh ketua Skrum atau pengurus projek. Di tingkat pertama, VoVo menawarkan proses pengutamaan yang ringkas dan mudah difahami oleh pelanggan yang mana dapat menggalakkan mereka untuk melibatkan diri dalam aktiviti pengutamaan ini. Teknik hibrid ini dibenamkan di dalam alat pengurusan tugas yang berasaskan web (papan Scrum) yang boleh dicapai di seluruh dunia. Di tingkat kedua aktiviti pengutamaan, terdapat beberapa faktor kos-risiko yang perlu dipertimbangkan oleh pengurus projek dan setiap faktor tersebut akan diberi pemberat yang bersesuaian mengikut pertimbangan mereka. Faktor-faktor kos-risiko ini adalah berbeza bagi setiap projek. Kadar prioriti akan dikira secara kuantitatif dan keperluan yang mempunyai kadar prioriti yang tertinggi akan dipaparkan di kedudukan teratas di dalam senarai keperluan. Alat pengurusan tugas yang berasaskan web ini akan dinilai menggunakan kaji selidik yang dituju secara terus kepada pengamal-pengamal Skrum. Kesesuaian dan keberkenananya dalam mengurus dan mengutamakan keperluan dalam tunggakan Sprint akan diukur berdasarkan

pengujian dan maklumbalas kaji selidik penilaian. Diakhir kajian ini, kami dapat menyimpulkan bahawa penglibatan pelanggan dalam proses pengutamaan keperluan adalah sangat penting dalam pembangunan sesebuah projek. Selain itu, berdasarkan maklum balas yang diperolehi daripada penguji-penguji berpengalaman dalam metodologi Skrum, menunjukkan teknik VoVo adalah sesuai dan berkesan digunakan untuk mengutamakan dan menguruskan keperluan di dalam sesebuah projek Skrum.

ACKNOWLEDGEMENT

Foremost, I am deeply grateful to my supervisor Madame Ainita Binti Ban, lecturer of software engineering department who always helps and supports me during this project. Without her guidance, support and encouragement toward this work, it would be impossible to be completed.

I also own a great debt of gratitude to my advisor, Dr. Mar Yah @ Mek Yah Binti Said who continually conveyed a spirit and encouragement in regard to these research and project work.

Besides, I wish to express my sincere gratitude to Dr Saadah Hassan, my Requirement Engineering lecturer, who introduced me to Requirement Prioritization Techniques and demonstrated to me the concern of Requirement Prioritization Technique in Software Development Process especially in Agile environment.

In additional, I would like to thank the Universiti Putra Malaysia (UPM) to include the copyrighted photographs and other artworks as part of my thesis and also provides the facilities such as subscribed digital journal databases which has been used as one of my reference sources.

Last but not least, I take this opportunity to express sincere thanks to my families and friends who's always lent their hands and support during this journey. Lastly, I also expresses my gratitude to the persons whose are directly or indirectly involved in this project. Without all of them, my project would not be completed successfully. Thank you very much.

DECLARATION

I hereby confirm that:

- this thesis is my original work;
- quotations, illustrations and citations have been duly referenced;
- this project report has not been submitted previously or concurrently for any other degree at any other institutions;
- intellectual property from the project report and copyright of project report are fully-owned by Universiti Putra Malaysia, as according to the Universiti Putra Malaysia (Research) Rules 2012;
- written permission must be obtained from supervisor and the office of Deputy Vice-Chancellor (Research and Innovation) before thesis is published (in the form of written, printed or in electronic form) including books, journals, modules, proceedings, popular writings, seminar papers, manuscripts, posters, reports, lecture notes, learning modules or any other materials as stated in the Universiti Putra Malaysia (Research) Rules 2012;
- there is no plagiarism or data falsification/fabrication in the thesis, and scholarly integrity is upheld as according to the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) and the Universiti Putra Malaysia (Research) Rules 2012. The thesis has undergone plagiarism detection software.

Signature:_____   Date: _____

Name and Matric No.: Che Suhana Binti Che Wil (GS 48560)

Table of Contents

CHAPTER 4

CHAPTER 5

CHAPTER 6

CHAPTER 7

LIST OF TABLES

LITS OF FIGURES

LIST OF ABBREVIATIONS

Abbreviation	Definition
RE	Requirement Engineering
RP	Requirement Prioritization
STM	Scrum Task Management
ASP	Active Server Page
HTML	Hypertext Mark-up language

CHAPTER 1

INTRODUCTION

In the last few decades, IT researchers had tried to investigate the cause of software project failure and they had identified that one of the causes is related to the Requirement Engineering (RE) process. RE has the highest influence on the quality and success of the final software product and also known as one of key process in software development lifecycle. In general, RE means the process of defining, documenting and maintaining the software requirement ("Software Engineering, Requirement Engineering Process," n.d., para. 1). Those activities can be specified into requirement elicitation, requirement analysis, requirement specification (documentation), requirement verification and validation, and lastly is requirement management. Aside from that, RE also can be defined as a collection of methods and techniques used to determine stakeholder's expectations and needs for the new or upgraded software product. It also fully aware of different features and limitation of the software to-be developed (Batool et al, 2013). RE can enhance the software development process by providing the best choice of alternatives which can satisfy the multiple goals required by multiple stakeholders (Abou-Elseoud, Nasr & Hefny, 2016). Previous researchers also had acknowledged that RE process is a core process in the

software development which emerge throughout the development phases. It can effects the product's quality, production cost, development duration and risk if not being implemented correctly and also can causes the delivered product did not meet the requirement or satisfy the customer's needs.

The requirement prioritization, in other hand, is a technique used by software developer to determine the sequence of requirement to be implemented in order to meets the needs of stakeholders. Besides that, it also being used to resolve conflict between stakeholders, and to identify the major requirement which can effecting the project success. All the stakeholders (customers, developers, sponsors, etc.) should participate in this process so that, they can compromise about the product release and to avoid the missing requirement during the development process. In scrum-agile, requirement prioritization is crucial in order to determine the product release for every sprint. In other words, this process helps the developer to determine which requirement to be implemented in early or which requirement can be delayed for later stages especially when there are limitation such as time constraint, and limited project's resources. In those situations, it is impossible to implement all the requirements requested by the stakeholders. Sometime developer do not know which requirements are most important to customers and which can give a huge impact to their business value. Besides, there are also some customers who are too ambitious about product requirements in

2

order to achieve their business objective without considering other development issues such as project resources and technical issues. They also cannot make a wise decision due those constraints associated with the certain requirements. That is why the requirement prioritization is crucial and plays an important role in software development process especially in scrum-agile environment.

1.1 Problem statements

Most of the existing Requirement prioritization techniques are neglecting the scalability issues.

The term of scalability is used to refer the size (number) of requirement (Hudaib, Masadeh, Qasem, & Alzaqebah 2018). The software project with the bigger requirement size can increases the conflict among stakeholders. It is because, stakeholders usually comes from various working areas and they have a different working experiences. Those variation can causes the conflict among them especially when they have a different view about requirement prioritization process. Besides that, scalability issue in requirement engineering can effecting the decision making process especially in big project which involving the big requirement size. As we know, the agile project is focus on customer satisfaction and in order to do that, the development team should gathers and elicits the requirements which can

3

fulfill all the stakeholder's needs. The better prioritization techniques should be able to overcome the scalability problem and caters all the project requirements. Not limited to a certain number of requirement only (Sarhadi, & Millar, 2002).

The agile project with the distributed stakeholders faced difficulty in decision making process.

Aside from scalability, scrum-agile practitioners also faces the difficulty in decision making process especially in the distributed project. In similar to traditional development, scrum-agile practitioners also want their product releases being delivered seamlessly, without delays and also can satisfy the stakeholders. However, the problem occurs when the project's stakeholders are geographically distributed. It shows that there is tremendous need of predictive analysis in order to overcome those problems. The predictive analysis uses a combination of qualitative and quantitative data as an input in the decision making process. In additional, predictive analysis technique can be applied in requirement prioritization technique and also can be used as a concrete evidence to prove the particular requirement suitable to be assigned as low level, medium level or high level priority. Those priority levels can be used as a references during scheduling process. The development of the low level requirement can be delayed while for high level requirement shall be develop immediately.

4

Many organizations tend to choose the lowest cost and easiest requirements to be implemented without considering their importance.

Most of the software developer in scrum-agile project tend to choose the lowest cost and easiest requirements to be implemented first without considering their effect to the final product. This phenomenon happens because they tried to catchup with the sprint release. Furthermore, scrum-agile also encourage the requirement changes and continuous communication with stakeholders in order to identify and achieving their needs. However, in practice, the scrum-agile practitioners did not fully explored the importance of requirement prioritization especially during tasks scheduling process in sprint backlogs. They usually focused on product release which encourage them to select the easiest requirement first to be implement in order to catch up with the release date (Santos, Albuquerque, & Pinheiro, 2016). As a result, they had encountered several issues during scheduling and dividing tasks in sprint backlogs. The requirements which are not been selected in the first iteration, will be sent back to the initial backlogs where the reselection process will be run along with newly added requirements. This process will become more complicated because scrum-agile encourage requirement change along the development process. As a result, project will be delayed and may cause other problems such as budget overrun, resource overuse and cannot fulfill the customer needs.

It is difficult to prioritize the requirements without engagement of the quality stakeholders from the client side.

Stakeholders plays an important role in requirement prioritization process because they are the key terms for collecting the requirements and their viewpoint on particular requirement is valuable and should be taken into account especially during prioritization process. This proactive approach can reduce the requirement changes during development process or after product releases. The requirement prioritization is a complex communication and negotiation process that involves the participation of many stakeholders (Aurum & Wohlin 2003).

1.2 Objectives of the thesis

The main objective of this thesis is to provide new hybrid requirement prioritization technique called VoVo technique by integrating the qualitative and quantitative prioritization technique in order to overcome the scalability and predictive analysis problem in existing techniques. Besides, we are of view that, the existing prioritization technique are limited and frequently been used in small project only. Therefore, we introduced this VoVo technique which can be implemented not only in small project but also in the big project. We provide the mechanism for verifying the effectiveness of VoVo technique by embedding it in the Scrum Task Management (STM) tool and will be evaluated by scrum-agile practitioners. Furthermore, we also do some comparison and evaluation toward effectiveness of the technique that we introduced with the existing technique by providing an analysis from the evaluation survey we had done along with this thesis.

Our proposed technique had made concession some ideas and processes to address the problems defined above, which are:

1. To discuss the strengths and weaknesses of the existing requirement prioritization techniques.

2. To propose new hybrid requirement prioritization technique with high scalability and can increase stakeholder engagement.

3. To compare and evaluates the suitability and effectiveness of the proposed technique in prioritizing the requirement in scrum-agile project.

4. To develop Scrum Task Management (STM) tool which embedded with proposed technique for scheduling and managing the project requirement effectively.

1.3 Scope of the thesis

The focus of this study is to help the scrum-agile practitioners especially a novice scrum master to prioritize and schedule the tasks or requirements in scrum backlog effectively in order to deliver the greatest product value at the lowest cost and also can satisfy the customers.

1.4 Structure of the thesis

This thesis contains seven chapter which organized as follows. Chapter 1 is Introduction. Chapter 2 is Literature Review, which we do the content analysis from articles, journals and other publications published by previous researchers regarding the Requirement Prioritization, Requirement Engineering in Scrum-Agile and Hybrid Requirement Prioritization and then, we do some compilation and comparison among those techniques. Chapter 3 is Methodology, which we study the methods and processes involved in the requirement prioritization especially in scrum-agile environment. After that, we selects the most suitable method and process to be implemented in the proposed RE technique. In chapter 4 we elaborates all the design processes involves in VoVo and STM tool development. While in chapter 5, all the development and implementation processes will be illustrated and explained. We embedded our proposed technique in that STM tool and its suitability and effectiveness for managing the requirement in Sprint will be evaluated. In Chapter 6 we discuss the results and findings from the study and also from the VoVo and STM tool evaluation survey. The developed tool will be tested and evaluated by Scrum-Agile practitioners whose have more than 1 year experience in Scrum-Agile project. Lastly is Chapter 7 which explains about conclusion and our recommendation for the future studies.

REFERENCES

1. Abou-Elseoud, M. A., Nasr, E. S., & Hefny, H. A. (2016, December). Enhancing requirements prioritization based on a hybrid technique. In *Computer Engineering & Systems (ICCES), 2016 11th International Conference on* (pp. 248-253). IEEE. Abrahamsson, P., Salo, O., Ronkainen, J., & Warsta, J. (2017). Agile software development methods: Review and analysis. *arXiv preprint arXiv:1709.08439*.

2. Anand, R. V., & Dinakaran, M. (2017). Handling stakeholder conflict by agile requirement prioritization using Apriori technique. *Computers & Electrical Engineering*, *61*, 126-136.

3. Aurum, A., & Wohlin, C. (2003). The fundamental nature of requirements engineering activities as a decision-making process. *Information and Software Technology*, *45*(14), 945-954.

4. Batarseh, F. A., & Gonzalez, A. J. (2015). Predicting failures in agile software development through data analytics. *Software Quality Journal*, 1-18.

5. Batool, A., Motla, Y. H., Hamid, B., Asghar, S., Riaz, M., Mukhtar, M., & Ahmed, M. (2013, January). Comparative study of traditional requirement engineering and agile requirement engineering. In *Advanced Communication Technology (ICACT), 2013 15th International Conference on* (pp. 1006-1014). IEEE.

6. Bebensee, T., van de Weerd, I., & Brinkkemper, S. (2010, June). Binary priority list for prioritizing software requirements. In *International working conference on requirements engineering: foundation for software quality* (pp. 67-78). Springer, Berlin, Heidelberg.

7. Berry, D. M., & Franch, X. (Eds.). (2011). *Requirements Engineering: Foundation for Software Quality: 17th International Working Conference, REFSQ 2011, Essen, Germany, March 28-30, 2011. Proceedings* (Vol. 6606). Springer.

8. Berteig, M. (March 20, 2006) "Methods of Prioritization". Retrieved: http://Www.Agileadvice.Com/2006/03/20/Agilemanagement/Methods-Of-Prioritization/.

9. Chatzipetrou, P., Angelis, L., Rovegard, P., & Wohlin, C. (2010, September). Prioritization of issues and requirements by cumulative voting: A compositional data analysis framework. In *Software Engineering and Advanced Applications (SEAA), 2010 36th EUROMICRO Conference on* (pp. 361-370). IEEE.

10. Chen, X., Bennett, P. N., Collins-Thompson, K., & Horvitz, E. (2013, February). Pairwise ranking aggregation in a crowdsourced setting. In *Proceedings of the sixth ACM international conference on Web search and data mining* (pp. 193-202). ACM.

11. Da Silva, I. F., Neto, P. A. D. M. S., O'Leary, P., De Almeida, E. S., & de Lemos Meira, S. R. (2014). Software product line scoping and requirements engineering in a small and medium-sized enterprise: An industrial case study. *Journal of Systems and Software*, *88*, 189-206.
12. El Emam, K., Quintin, S., & Madhavji, N. H. (1996). User participation in the requirements engineering process: An empirical study. *Requirements engineering*, *1*(1), 4-26.
13. Fuqua, A. (2015). How many stories per sprint? Rule of thumb. Retrieved from https://dzone.com/articles/how-many-stories-per-sprint-rules-of-thumb
14. Handfield, R., Walton, S. V., Sroufe, R., & Melnyk, S. A. (2002). Applying environmental criteria to supplier assessment: A study in the application of the Analytical Hierarchy Process. *European journal of operational research*, *141*(1), 70-87.
15. Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative health research*, *15*(9), 1277-1288.
16. Hudaib, A., Masadeh, R., Qasem, M. H., & Alzaqebah, A. (2018). Requirements Prioritization Techniques Comparison. *Modern Applied Science*, *12*(2), 62.
17. Inayat, I., Salim, S. S., Marczak, S., Daneva, M., & Shamshirband, S. (2015). A systematic literature review on agile requirements engineering practices and challenges. *Computers in human behavior*, *51*, 915-929.
18. Joshi, B. C., Dev, K., & Chauchan, N. (2016). Scrum of Scrum Approach in Agile Development. *International Journal*, *6*(11).
19. Racheva, Z., Daneva, M., & Buglione, L. (2008, September). Supporting the dynamic reprioritization of requirements in agile development of software products. In *Software Product Management, 2008. IWSPM'08. Second International Workshop on* (pp. 49-58). IEEE.
20. Racheva, Z., Daneva, M., & Sikkel, K. (2009, June). Value creation by agile projects: Methodology or mystery?. In *International Conference on Product-Focused Software Process Improvement* (pp. 141-155). Springer, Berlin, Heidelberg.
21. Racheva, Z., Daneva, M., Sikkel, K., Herrmann, A., & Wieringa, R. (2010, September). Do we know enough about requirements prioritization in agile projects: Insights from a case study. In *Requirements Engineering Conference (RE), 2010 18th IEEE International* (pp. 147-156). IEEE.
22. Ribeiro, R. A., Moreira, A. M., Van den Broek, P., & Pimentel, A. (2011). Hybrid assessment method for software engineering decisions. *Decision Support Systems*, *51*(1), 208-219.

23. Santos, R., Albuquerque, A., & Pinheiro, P. R. (2016). Towards the Applied Hybrid Model in Requirements Prioritization. *Procedia Computer Science*, *91*, 909-918.
24. Sarhadi, M., & Millar, C. (2002). Defining a framework for information systems requirements for agile manufacturing. *International Journal of Production Economics*, *75*(1-2), 57-68.
25. Schwaber, K., & Sutherland, J. (2012). *Software in 30 days: how agile managers beat the odds, delight their customers, and leave competitors in the dust*. John Wiley & Sons.
26. Sharma, A., Ahlawat, A., Pandey, A., & Sharma, V. (2014). Issues and Challenges in Intelligent Computing Techniques (ICICT).
27. Singh, D., & Jatain, A. (2013). An Interactive Approach to Requirements Prioritization Using Quality Factors‖. *International Journal in Foundations of Computer Science & Technology (IJFCST)*, *3*(6).
28. Software Engineering, Requirement Engineering Process. (n.d). In *GeeksforGeeks*. Retrieved from https://www.geeksforgeeks.org/software-engineering-requirements-engineering-process/
29. Straker, D., and Rawlinson, G. (2011). "The Hundred Dollar Test". Retrieved: http://creatingminds.org/tools/hundred_dollar.htm
30. Volere Requirement Resource, Prioritization Analysis (2018), Retrieved from http://www.volere.co.uk/prioritisationdownload.htm
31. Volere Requirements Specification Template. (2018). Retrieved from http://www.volere.co.uk/template.htm
32. What is scrum? (2018). Retrieve from https://www.scrum.org/resources/what-is-scrum