Issues with Requirements Prioritization in MDRE

Visamsetty V S Sasank[1] Sasank.it@anits.edu.in
A Durga Praveen[2] adurgapraveen@gmail.com
Dr. V Suresh[3] Vsuresh.it@anits.edu.in
Sairam Vakkalanka[4] Vsairam.it@anits.edu.in

[1,2,3,4] Assistant Professor, Department of IT
ANITS, Vizag

Abstract *– This paper addresses on requirements prioritization issues that are faced in Market Driven Requirements Engineering. Along with the challenges related to requirements prioritization, the solutions were also addressed. Based on the results and sources that we gathered, conclusions and analysis were made with respect to the given aspects.*

I. INTRODUCTION

Market Driven Requirement engineering (MDRE) is one of the approaches that are involved in requirement engineering process [1]. Development of a software product with the market driven approach can be done by considering the current market trends that are in existence at the time of developing the product [2]. When compared with the organizations that focus on developing software for a particular client, this approach is more efficient for the organizations that develop products to large market areas.

In order for software to get developed, it is quite essential and basic for any organization to have knowledge on what is going to be developed and this can be achieved by proper accumulation of requirements. These requirements can be accumulated from different sources that are going to get an impact from the software that is going to be developed.

For the market driven process, these requirements play an important role in developing a product. For any organization to implement this approach effectively, managing and prioritizing these requirements will be very crucial. This paper focuses on market driven challenges in requirements prioritization and also describes the available solutions that are addressed in literatures. In this paper section II describes briefly on what Market driven requirement engineering is and how it will be useful for developing software. This section also describes the characteristics of MDRE. Section III illustrates on requirement prioritization and methods that are involved in market driven approach. This section will be helpful for providing an overview on the subject which we are mainly going to focus on. Section IV contains the center part of the article which explains about the challenges that are present in market driven requirement engineering process. This section makes an in depth analysis about the problems that are identified and its implications and consequences were stated. Section V addresses the solutions that are suggested by the authors in their respective articles. It also provides discussions on how these solutions were tested, validated and also provides discussions on whether or not the provided solutions solved the problems. Section VI provides analysis and our experiences and also covers the required aspects that have to be mentioned. Finally section VII provides conclusion for this article.

II. A BRIEF ACCOUNT ON MDRE

Requirements engineering is considered as a prominent job in the development of software because the development of the software should be done according to the requirements or to the needs of its user. While taking the objective of development into account, MDRE is classified as one of the approach that is being followed in requirements engineering

[4]. For the evolution of market driven software, requirements engineering process includes objectives like fostering and envisioning of new requirements for existing products which helps in providing competitiveness in market conditions [3].

MDRE makes use of market conditions and trends while developing a software product. In the market, MDRE mainly consists of two categories of customers where one is said to be a pure MDRE in which customers are not known [7] [8]. The other belongs to a combination of MDRE and bespoke which has knowledge in market area and their customers group but lacks in knowing the specific customers present in the group [7][8].

When compared with traditional requirements engineering MDRE possess several differences where the major difference lies in schedule constraints and stake holding [8]. Managing the constant flow of new requirements is also a major difference and an important characteristic of MDRE [8]. Along with these, there exist several peculiar characteristics such as specification and validation, elicitation, release planning and process quality which defies MDRE a unique process.

III. REQUIREMENTS PRIORITIZATION

The market driven development has become more significant due to the fact that there is a market for packaged or off-the-shelf software and it showed significant impact on requirements engineering area [5]. This is because, unlike bespoke the requirements doesn't come from a particular client or customer rather they come from developers, sales team, marketing and support groups and so on [6]. Along with these there are other requirements which come from customers, different users, focus groups, and competitor surveys which make the number of requirements huge for this market driven process [6]. This significantly increased number of requirements made the requirements engineering process quite challenging.

According to Somerville(1996)-"Requirement prioritization is defined as an activity during which the most important requirements for the system are discovered" [9]. Finding right priorities for the requirements is important and decisions regarding these priorities are made within the organization. But in the field of software development, prioritization of requirements is considered as a challenging task [9]. This would become more challenging in MDRE when customer expectations become high and possessions such as time and money become finite [9]. It would also be quiet challenging in decision making process where decision makers find it tough to determine on what basis these prioritization decision should be made and it would be challenging to find out the actual data which acts as basis for the decisions [9].

According to L. Lehtola et.al, Requirements prioritization can be divided into two categories namely: Negotiation Approaches and 'Methods' in which these Methods are based on giving values to different factors

of requirements [9]. Along with these, there are several prioritization techniques that are addressed by several authors. Wieger's method (Wieger,1999) can be determined in a way that "the priority of a requirement can be calculated by dividing the value of a requirement by the sum of the costs and technical risks associated with its implementation" [9]. In this method the evaluator must evaluate every requirement based on its value to the client and issues such as implementation costs and penalties are evaluated if not previously included [9]. Karlsson's method (Karlsson, 1996) which is called "Pair Wise Comparison Technique" follows Analytical Hierarchy Process (AHP) where all possible pairs of hierarchically classified attributes are compared Pair-Wise based on how they contribute the attributes in the upper hierarchy level. In this method the evaluator must compare each of the possible requirement pairs and decide how much more valuable the other requirement is [9]. "Priority groups" is a method where all the requirements are divided into categories and this is considered as the most traditional and best known requirements prioritization practices [9]. In this method the evaluator divides the requirements into three categories with respect to the scale such as Essential, conditional and optional [9].

Along with these techniques, there is a specific Requirements Engineering process called as REPEAT (Requirements Engineering Process at Telelogic). This was developed by Swedish Case-Tool vendor named "Telelogic AB" [10]. This is used as an in-house process at Telelogic for eliciting, managing and selecting requirements for a family of products in their organization [10]. This process manages requirements throughout the entire release cycle and covers several requirement engineering activities such as elicitation, validation and documentation. This process generally has Requirements Management Group (RQMG), Issuer, Requirements team, customers and users who provide feedback, Construction and Test team, Expert and Requirement Database (RQDB) [10]. The organization faced several issues while using this process which lead to the development of this method to REPEAT-1.

Distributed prioritization process is one of the prioritization techniques in requirements engineering. This came into light while selling off-the-shelf or packaged software products in marketing conditions that spread across the globe [14]. The tasks in this process are carried out in a sequence of five steps. The first step involves a Project strategy team (PST) that makes list of high level requirements and the list is divided into two abstraction levels. The items are feature groups at high level where as the items are individual features in the next level [14]. Step two involves the distribution of list to different stake holders across the globe. Here the stake holders make prioritizations to the list and also add new features to the list [14]. In step three the PST makes a combined list by considering the separate priorities of each stake holder as well as with an aggregation of individual priorities. The decision will be passed on to all the stake holders in step four. Step five deals on feedbacks of the stake holders with respect to the decision given by the PST. Iteration will be started if needed or else the process results in a decision on high level requirements priorities for next release [14]. The list can be used as guidance for making tradeoffs between value and cost [14].

Cumulative voting which is also called $100-Dollar test is one the prioritization technique. In this technique, stakeholders were given an amount of hundred dollars to distribute on requirements [11]. Upon the distribution, requirements are ranked in a way that the most essential requirements will be represented by the highest share it gets in distribution [11]. Another one of the methods that follow Analytical hierarchy process (AHP) is the cost value approach. From a customer and user perspective, the value of every requirement is assessed by AHP and followed by an assessment of the requirements costs from an implementation perspective [11]. This approach makes use of a 2D graph which shows the requirement values against its costs there by plotting it into a cost-value diagram which will be helpful in analyzing the requirements.

Numerical assignment is also a prioritization technique which works on grouping the requirements into three categories such as High, medium and low [11]. According to [11], these categories may mislead the stake holders due to the fact that each of them will obviously have a different view on what these high, medium and low terms correspond to. 'Ranking' is also a requirement prioritization technique. This technique is based on ordinal scale in which the crucial one will be ranked first and less bothered one will be given last rank. Relative priority among these requirements cannot be seen [11]. "Top Ten Requirements" approach is one of the techniques in which the stake holders select their top ten requirements without assessing an internal order between requirements making the approach suitable for multiple stake holders [12]. The main issue that may arise in this technique is about prioritizing the top 10 requirements equally to all stakeholders.

IV. CHALLENGES WITH RESPECT TO REQUIREMENT PRIORITIZATION

As described earlier that MDRE is done for the market-driven products and the prioritization of the requirements and selection of prioritization techniques depends upon the product and organization [13]. After critical study of prioritization in MDRE, the major problems or challenges found are

A. No prioritization technique for Quality Requirements in MDRE.

B. Ignorance of importance of Usability Requirements in Quality prioritization.

. These, we consider, to be challenges in market-driven requirements engineering. The reasons to elaborate our consideration are given in coming lines. We describe these problems one by one.

A. *No. prioritization technique for Quality Requirements in MDRE.*

In market-driven organisations, the prioritization so far is done on Functional Requirements only. For Market-Driven industry there is so far no technique to prioritize the quality requirements. But overall a survey is conducted that described the criteria for quality requirements prioritization [24]. A survey was conducted in eleven different organizations to find out how they prioritize their requirements [24]. As a result of this survey it was concluded that prioritization is done either by numerical assignment or in an ad-hoc fashion. The parameters that are taken into account are, value estimates, cost estimates and customer inputs [24]. This is a major observation of the industry so far. This means that the importance of quality requirements is based on the importance of the requirement, cost and customer input. Latter research [24] showed that only two criteria were mainly used for quality requirements prioritization, cost and value [24]. Cost is estimated numerically while *value* is estimated on "gut feelings" [24].
In market driven industry, quality requirements are so important, this will be discussed latter on in detail when we discuss a Case-Study. And so far the quality requirements are prioritized on the basis of factors like cost estimate, value estimate and customer input. We cannot consider customer input because it is market-driven scenario.

The article [24] was the latest literature found on the quality requirements prioritization. So far there is a deadlock in the MDRE for prioritization of quality requirements so this problem cannot be further elaborated. However, a detailed study of problem "B" can lead us to some solutions that can lead to the solutions of Problem "A" as well.

In coming section a case-study is done that focus on the success of a market-driven product in recent past. First we describe the second problem. The problem "B"

B. Ignorance of importance of usability requirements in prioritization

Prioritization of requirements is done so far in the market is based on different prioritization techniques [19]. Most important of the prioritization techniques that is considered to be most reliable than others and mostly used by the organizations is AHP [19] [20] [21]. This technique focuses the Functional Requirements for prioritization mostly [21]. It is important to mention that there is not even a single technique that defines the prioritization of Quality Requirements [23] [24]. The authors [23] consider this a gap in research that no technique has been found so far for the prioritization of quality requirements. But authors in [24] introduce some quality requirements prioritization techniques. Those are described earlier. In coming lines we try to focus on the importance of, if not all quality requirements then, usability requirements. A Case-Study is discussed to argue in detail the importance of quality requirements and eventually the importance of usability

requirements. In case of market-driven products prioritization of functional requirements should be done focusing on the quality requirements and eventually usability requirements aspect. It will be discussed also that for market-driven products the importance of usability aspects of functional requirements has been a very successful formula in recent past. Before going into the discussion of case-study, first a brief description of usability requirements is given.

Usability is defined by Andreas Holzinger as "*Ease of use and acceptability of a system for a particular class of users carrying out specific tasks in a specific environment"* [22]. And the *Usability Requirements* is defined as "*how easy a system must be to use"* [25]. S. Lauesen and H. Younessi described some usability factors [25]. These factors are explained as [25],

1. **Ease of learning.** In comparison to similar systems in the market, the system must be easy to learn
2. **Task Efficiency.** The system must be efficient for the frequent users.
3. **Ease of remembering.** The system must be easy to remember for occasional users.
4. **Easy to understand.** The system must be easily understood.
5. **Subjective satisfaction.** System must satisfy the user.

For the organizations that launch market driven systems there is a need to have understanding of user's perspective [15]. Keep an eye on the ongoing trends is a part of gathering usability requirements [15]. Hence those functional requirements must be given priority that fulfils the criteria in the above mentioned factors.

Also the role of stakeholders is important to agree upon the priority of quality requirements irrespective of their interests [24]. That is, some requirements are important for some stakeholders but they are not important for other stakeholders. *Stakeholders* are all parties involved in systems requirements [14]. Considering a simple example, as the product to be delivered is market-driven, let's consider only three stockholders involved Investors, developers, and end-users. Now, for investors', priority may be *low cost*, for developers the priority may be *in-complexity* irrespective of the success or failure of the product in the market, and, for end user the

priority is *Quality Requirements* like , efficiency, usability, reliability, new features etc. The case-study will show that, for the end users usability is prior to all the other quality requirements. When requirements are prioritized, all the stakeholders must target the success of the product at first place and requirements must be prioritized on this basic objective.

C. *Case-Study.*

This case study will focus on the extraordinary success of Apple's product iPhone [15] [17]. We will focus on the requirements/ features/ functionalities that were given priority in comparison to the other competitive products in the market.

In software engineering perspective the *features* are considered as *Functional Requirements* [18]. iPhone was launched in 2007 with following dominant features [17].

1. Large Touch Screen
2. Personal computer standards based Browser
3. A Touch-screen Intuitive Panning and Zooming Custom User Interface
4. iTune Music and Video Service

The above mentioned four features were a major breakthrough in market and iPhone captured the market with high dominance [17] [15]. Interestingly, by the definition of usability [22] [25], as discussed earlier, above mentioned four functional requirements are all mapped with their usability aspect. M. Hellman and K. Ronkko compared P800 from SonyEricsson and iPhone form Apple [15]. SonyEricsson used Stylus technology in their mobile sets like, P800 and after that P1i and it captured good market also but not as good as IPhone [15]. The authors [15] argue that usability requirements played a major role in the mass-success of iPhone. Other quality requirements like performance, maintainability, reliability, etc are also important but usability is prior to all [15]. The above mentioned four functional requirements are indirectly the usability requirements that accidentally or willingly given priority by the Apple iPhone team.

V. CONSEQUENCES OF THE PROBLEM

The problem focused here is problem "B". The consequences of the ignorance of usability requirements can be seen by the acceptance of the products. No Smartphone can achieve popularity from 2007 till today as iPhone got with his dominant usability features. The four major functionalities described in previous section were first discovered and implemented by iPhone team. All the competitor Smartphone industry must have given priority to other functional requirements or could not have understood the usability requirements of the customers in the market as iPhone team did. This is a crucial point that strengthens the importance of usability requirements. It does not mean that other competitors to iPhone did not focus on the quality requirements especially usability requirements, but they did not give it highest priority.

VI. ANALYSIS; WHEN AND WHY IS A PROBLEM A PROBLEM

Here we focus on problem "B". The problem is a problem because it does not give the required output. In market-driven industry the competition grows every day. The launch of P800 by SonyEricsson, N95, by Nokia was successful but the competitor iPhone captured the market [15]

[17]. What Nokia and SonyEricsson could not understand, Apple team understood. iPhone Touch screen technology dominated the Thumb keyboard, Numeric pad, and Stylus technologies [17]. The credit goes to Apple iPhone Team for the discovery of factor of un-satisfaction among the users regarding Stylus, Thumb keyboard and Numeric pad technologies and satisfying customers by providing Touchscreen. It was not only Touchscreen but also other three major functionalities that have been discussed earlier that dominated iPhone in the market. In 2009, HTC, Palm, Nokia and Apple launched new SmartPhones [17]. HTC and Palm copied iPhone in screen size and Touchscreen Technology and Apple on the other hand concentrated on other factors than the ones it had already. Again the iPhone dominates the market. HTC and Palm also got appreciation but not as much as iPhone did [17]. This is because they were just copying the iPhone with the technologies that user already know via iPhone. Hence, instead of competing the market rival, Palm and HTC admired the dominance of iPhone by copying the technology and even the screen size [17]. This act gave iPhone more importance in their (Palm and HTC) comparison as customer believes them a follower of iPhone.

In market-driven products success relies on providing ease to user as we studied in case of iPhone case-study. One who provides ease to user will dominate. The problem with HTC and Palm and Nokia is that on their new launches in 2009, they instead of giving something different than iPhone, started copying iPhone. In Software Engineering terminology, instead of gathering new usability requirements, they used the same usability requirements as their competitor (iPhone) used to build their product previously. They could have been successful if they would have studied drawbacks in the iPhone features and would have given more ease to the customers by adding different features. This was the problem; they ignored the importance of usability requirements prioritization. Their priority remained the existing usability requirements. While in 2007, when iPhone was launched, iPhone team gave priority to *ease of use* by giving four new features.

After all the study of the literature and the case-study discussion, we analyze that usability requirement in case of market driven products, if given highest priority, the product will gain major acceptance from customers. We believe that in market driven projects, whatever prioritization technique is used for the prioritization of requirements, usability requirements must be given highest priority. Especially in comparison to other similar products in the market, there is a need of a deep study of the usability requirements. If the needs of the customer are completely known and the unsatisfactory usability aspects of competent products in the market are thoroughly studied, new functional requirements under usability requirements are easy to document and implement.

VII. SOLUTIONS

Here we propose solutions for both the problems, Problem "A" and Problem "B". A new prioritization technique is proposed on the basis of Case-Study done in this article. We propose two solutions.

A. In MDRE, those functional requirements should be kept on highest priorities that are related to the *usability requirements* of the project.

B. In quality prioritization, *usability* should be given the highest priority for every new Market-Driven project.

These solutions are proposed on the basis of what we studied so far. The validation of the solutions so far is the Case-Study discussed. But eventually to further validate the solutions a detailed survey of Market-Driven industry will be required. That can take 3-4 months time. But previous study so far tells that it is possible to claim that for a successful new market-driven project, the priority of usability requirements can lead to a successful delivery of the product.

VIII CONCLUSION

After studying both the problems in detail, solutions to the problem were proposed in previous section. Requirement prioritization in MDRE is a challenge by itself because success of the MD product mostly depends upon the quality requirements. Functional requirements cannot satisfy the customer until he/she can easily use them. This "easiness" is the key to success as it was tried to prove in previous sections. The functional requirements must be gathered on the basis of the quality requirements in case of MD products.

It is not the study of Smartphone industry only that makes us believe this, but also the study of social networks like *Orkut, facebook, google+*. Our personal experience of these social networks makes us believe that prioritization of quality requirements play role in success or decline of a project. Facebook is the only social network that got the maximum popularity in the market of social networking. Facebook provided "ease" factor via its functional requirements to users the most. The "ease" factor is *Quality Requirement* and eventually, *Usability Requirement.* Orkut gave priority to other quality requirements like, security, privacy, more than usability. In other words the features that have quality attributes of privacy and security, dominated those features that have usability attribute. The basic definition of the "social network", disappeared when "privacy" factor dominated. On the other hand facebook usability factor dominated the privacy and security factor. Irrespective of the features, priority to usability requirements got recognized by the users. Although orkut was launched much earlier than facebook, still it could not provide ease to the customers as facebook did. In this case again, the usability requirements features, or usability requirements of functional requirements made facebook dominant in its market of social networks.

Overall, all the personal experience and so far study make us conclude that quality requirements play major role in the success or decline of a MD product. Although there is no specific prioritization technique for MDRE is not in the literature yet, still study make us believe that whenever in future quality requirements prioritization techniques will be developed, *usability* will get the highest importance.

REFERENCES

[1] Wohlin C. Auruma A., "*Engineering and managing software requirements*". *Springer,* 2005.

[2] Andrigo Gomes, Andreas Pettersson. "Market Driven Requirements Engineering Process Model-MDREPM", *Master Thesis, Software Engineering, BTH, January* 2007.

[3] B. Regnell, P. Beremark, and O. Eklundh, "A market-driven requirements engineering process: Results from an industrial process improvement programme," *Requirements Engineering, vol. 3, no. 2, pp. 121-129,* Jun. 1998.

[4] Jonas Bergstrom and Adreas Dahlqvist, "BESMART- a framework for shifting from BESpoke to Market-driven requirements engineering", *Master Thesis, BTH Sweden,* October 2007.

[5] Karlsson, Lena, et al, "Challenges in Market-Driven Requirements Engineering - an Industrial Interview Study". *In Proceedings of the Eight International Workshop on Requirements Engineering: Foundation for Software Quality (REFSQ '02)*, *pp. 101-112*. 2003

[6] M. A. Iqbal, A. M. Zaidi, and S. Murtaza, "A New Requirement Prioritization Model for Market Driven Products
Using Hierarchial process, 2010 *International Conference on Data Storage and Data Engineering (DSDE)*, *pp. 142-149.* 2010.

[7] Carlshamre P, Regnell B (2000) Requirements Lifecycle Management and Release Planning in Market-Driven Requirements Engineering Processes. Proc. 11th International Workshop on Database and Expert Systems Applications.

[8] Christofer Tingstrom, " Simulation of market driven requirements engineering process", Master Thesis, Department of Computer Science, Lund University, February 2008.

[9] L. Lehtola and M. Kauppinen, "Suitability of requirements prioritization methods for market-driven software product development," Software Process: Improvement and Practice, vol. 11, no. 1, pp. 7-19, Jan. 2006.

[10] B. Regnell, P. Beremark, and O. Eklundh, "A market-driven requirements engineering process: Results from an industrial process improvement programme," Requirements Engineering, vol. 3, no. 2, pp. 121-129, Jun. 1998.

[11] R. B. Svensson et al., "Prioritization of quality requirements: State of practice in eleven companies", *in Requirements Engineering Conference (RE), 2011 19th IEEE International, pp. 69-78.* 2011.

[12] Lausen S, "Software Requirements – Styles and Techniques", *Pearson Education, Essex*. 2002

[13] Martin Glinz, Roel J. Wieringa, "Guest Editors' Introduction: Stakeholders in Requirements Engineering," *IEEE Software*, vol. 24, no. 2, pp. 18-20, March/April, 2007.

[14] T. Tuunanen, H. Govindji, "Utilization of flow concept for Digital Service Requirements Prioritization", *proceedings of SIGSVC workshop*, 2011.

[15] M. Hellman, K. Rönkkö , "Controlling User Experience through Policing in the Software Development Process", *2nd Conference on Human-Centred Software Engineering (HCSE 2008), Pisa, Italy,* September 24, 2008

[16] "Sony Ericsson P800 vs Apple iPhone 4 comparison",http://www.esato.com/phones/compare.php?phone=33&cp=622

[17] J. West, M. Mace, "Browsing as the killer app: Explaining the rapid success of Apple's iPhone", *Telecommunications Policy, Volume: 34, Issue: 5-6, Publisher: Elsevier, Pages: 270-286, 2010.*

[18] M. Glinz, "Rethinking the Notion of Non-Functional Requirements", *Third World Congress for Software Quality, 2005.*

[19] A. Perini, F. Ricca, A. Susi," Tool-supported requirements prioritization: Comparing the AHP and CBRank methods", *Information and Software Technology,* 2009.

[20] P. Berander, A. Andrews, "4 Requirements Prioritization ", *Engineering and Managing Software Requirements,* 2005.

[21] Karlsson, J.; Ryan, K.; , "A cost-value approach for prioritizing requirements," *Software, IEEE* , vol.14, no.5, pp.67-74, Sep/Oct 1997.

[22] Andreas Holzinger , "Usability engineering methods for software developers", *Commun. ACM* 48, 1. 2005.

[23] R.B.; Höst, M.; Regnell "Managing Quality Requirements: A Systematic Review," *Software Engineering and Advanced Applications (SEAA), 2010 36th EUROMICRO Conference on* , vol., no., pp.261-268, 1-3 Sept. 2010

[24] Gorschek, T.; Regnell, B.; Torkar, R.; Shahrokni, A.; Feldt, R.; Aurum, A.; , "Prioritization of quality requirements: State of practice in eleven companies," *Requirements Engineering Conference (RE), 2011 19th IEEE International* , vol., no., pp.69-78, Aug. 29 2011-Sept. 2 2011.

[25] S. Lauesen, H. Younessi, "Six Styles of Usability Requirements", Proceedings of REFSQ'98, 1998

[26] Engu, Ranjith, and Sairam Vakkalanka. "Mitigation strategies to major challenges faced in market driven development scenario." International Journal of Software Engineering & Applications 3.5 (2012): 63.

[27] Engu, Ranjith, and Sairam Vakkalanka. "faced in market driven development scenario."

[28] Vakkalanka, Sairam, and Ranjith Engu. "Requirements Triage-Challenges and Solutions." International Journal of Software Engineering & Applications 3.2 (2012): 41.

[29] Madhira, Srikar, and Sairam Vakkalanka. "Can Computer Mediated communication be effective in globally distributed projects."