Enabling the Requirements Prioritization Techniques to Improve the Quality of Agile Practices

N. Saeed[1], E. Yasmin[2], A. R. Riaz[3], N. Khalid[4], Y. Hafeez[5], I. Rubab[6]

[1,2,4,5,6] *PMAS Arid Agriculture University, Rawalpindi, Pakistan*
[3] *University of Management and Technology, Sialkot, Pakistan*

[3]abdurrehman.ar475@gmail.com

Abstract- The agile model has become increasingly popular in most software organizations. The main objective of agile development is to deliver the software in different iterations. The requirements continuously change in agile models, which makes requirement prioritization a challenging task. Requirement prioritization is a significant task so it always requires improvements. In this research study, we performed a case study to propose a requirement prioritization model. The case study was conducted in five organizations by interviewing several professionals working on the agile project. The case study found a few factors that mostly influence the requirement prioritization process. We proposed a conceptual requirement prioritization model based on the factors that were determined during the case study. To validate the proposed model, we implemented this model on a project that was currently being developed by one of the interviewed organizations. As the proposed model was conceptual, we used the grounded theory technique for giving numerical values to the qualitative data. During the implementation of the model on the project, a professional from a software organization gave numerical values to the various factors of different requirements of the project. The prioritized list obtained after implementing the model was more efficient and effective.

Keywords- Transfer Learning, Image Recognition, Image Classification, Systematic Literature Review, Convolution Neural Networks

I. INTRODUCTION

Nowadays, world-famous organizations are adapting the incremental development of projects using the Agile Software Development (ASD) approach [1]. Agile development is an iterative and incremental approach to software development that emphasizes collaboration, flexibility, and customer satisfaction. It is based on the Agile Manifesto, which allows individuals and interactions, working software, customer collaboration and responding to change. Agile methods have proved as effective techniques for incremental development because of their iterative and collaborative characteristics. The main objective of agile development is to deliver the software in different iterations.

Requirement engineering is the process of eliciting, analyzing, specifying, validating, and managing the requirements for a software project. Its goal is to identify the needs of customers and the expectations of stakeholders. There are different factors defined in the Requirement Engineering (RE) process i.e., functionalities, cost, risk, and constraints, etc. The Requirement Prioritization (RP) is an important stage in the RE process. Requirement prioritization is the process of determining the relative importance of different requirements in the software development process. It is an important step because it helps to ensure that the most critical requirements in the project. In the ASD model, the RP practice is the process of selection and ordering of the requirements based on their significance. The RP practices are necessary because all requirements cannot satisfy the expectations of the stakeholders [2].

A few steps need to be followed for developing a more effective RP model. In the initial stage, the stakeholders of the project need to be determined during the RP process. The second stage is to select the set of requirements that needs to be prioritized in the process. In the next step, the criterion is defined for the prioritization of requirements [3]. Finally, the prioritization technique is selected for the RP process. Different RP models are already proposed for prioritizing requirements that are based on requirements volatility.

Requirements are prioritized based on many other factors along with volatility. These factors include cost, importance, external change, stakeholder satisfaction, technical assessment, complexity, dependency, and project constraints, etc., These models help in reducing time, effort and cost during the RP process, however, still some of the factors and aspects of RP process are neglected [4]. Therefore, there is a need for an RP model that fulfills the gap of previous models by considering all aspects and factors that are involved in this process.

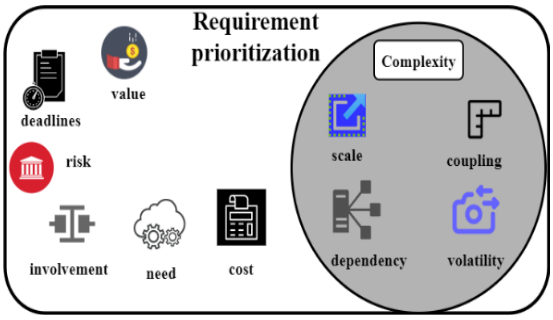


Figure 1: Prioritization factors

In this research paper, an empirical review study is carried out to evaluate former requirement prioritization models. This model is proposed for the prioritization of requirements in agile software development which can help software practitioners in choosing suitable prioritization techniques for handling continuous requirement change in ASD. Researchers evaluated the proposed model by using a case study and compared the proposed model with the previous requirement prioritization model. The proposed model should also involve iteration planning because it is closely connected to the RP process.

This study is organized into the following sections. Section 1 is related to the introduction of the research topic. It gives information about the background of the research study. Section 2 presents previous literature about requirement prioritization. The literature includes information about proposed models, reviews about the proposed model, and some other related work. Section 3 presents the methodology, case study approach and prioritization model. Section 4 presents the results and discussions of this study.

II. Background Knowledge

This section provides a review of previous studies that have been performed for requirement prioritization in ASD. This review gives the information about approaches of previous studies.

A. Requirement Prioritization Practice

RP practice performs a critical role in the software development of ASD. The decision-making is performed based on multiple criteria in RP practice [5]. RP practice is a part of the requirement analysis process. It plays an important role in enhancing software development and engaging various stakeholders by fully utilizing finite resources and mapping them into business interests [6]. Therefore, it is important to perform RP practice before developing software to address different concerns related to software development by considering finite resources, low-skilled developers and insufficient budget. Authors of [7] observed that several originations consider prioritization of requirements as an important factor in software development. These organizations believed that preferences should be assigned to the requirements and that decision-making should be performed according to balanced and quantitative data.

B. Prioritization Factors

To make software development successful, it is necessary to collect the right requirements [8], which are then ranked based on critical prioritization aspects. The prioritization aspect is described as a collection of attributes that decides a quantifying value of the requirements element. Different concerns are raised while describing which aspects need to be analyzed during RP practice [9]. There are three main aspects including their attributes given in Figure 2.1, which are incorporated from the previous literature [10].

C. Requirement Prioritization Method and Techniques

We have observed the significance of RP techniques for the prioritization of requirements from the previous section review. Different RP techniques have already been proposed, which have improved the quality of the RP process. Research in [11] described the importance of RP techniques as they assist decision-makers in the DM process for ranking requirements. The main objective of all these techniques is the same, i.e., the prioritization of requirements. However, they can contradict several things such as a few of the techniques used priority level and some of them assumed that every requirement has a separate priority value (Aurum & Wohlin (2005). The other approaches for RP techniques are based on the aspects of time taken, scalability and sophistication [12]. There are few studies in which multiple RP techniques are merged to improve the RP process [13]. There is no conventional method defined for the categorization of RP techniques. There are nine basic RP techniques reviewed for their categorization such as bubble sort, priority group, binary priority list, AHP, hierarchy, numerical assignment and CV. These nine basic RP techniques are categorized into three categories i.e., ordinal scale, nominal scale and ratio scale. This study ignored the absolute scale for the classification of these techniques [14].

Over the last two decades, the landscape of information systems development (ISD) has undergone a shift from highly structured approaches to more agile methodologies. Despite this transition, a considerable number of methods outlined in the literature for managing risks related to requirements still adhere to traditional structured ISD approaches. There are limited methods available that address the need to prioritize requirements-related risks specifically tailored for agile ISD projects. Recognizing this gap in the existing literature, we have employed the design science research methodology to collaboratively develop an agile requirements risk prioritization method in conjunction with industry experts. This method aims to identify and mitigate requirements-related risks by recognizing patterns and enabling prioritize techniques to improve agile practices.

D. Prior Model

Different conceptual RP models have been developed for the prioritization of requirements in agile software development. To develop this model, we utilized an existing conceptual model [15] as a base model. This base model was developed depending on various factors involved in the prioritization of requirements. Grounded theory was utilized in the prior model for assigning values to the requirements. The flow of the prior model is demonstrated in Figure 3.

Table 1: Prior Model Factors

Researches	Factors of Prior Model
[5]	Business Value
[7]	Negative Value
[8]	Risk
[10]	Size/Effort Estimation
[11]	Input from the developers
[13]	Learning Experience
[14]	External Change
[15]	Project Constraints

III. Methodology

The detailed methodology of the proposed model for RP is discussed in this section. The RP model is comprised of multiple steps that are required to develop a model, which can help the RP techniques in the prioritization of requirements. The proposed model in this work is developed using another previous model or framework, which was based on factors involved in RP.

A. Case Study

The case study approach helps in determining the facts related to any field in the context of the real world. This research design can be used in every field of science particularly related to information technology. Different authors have defined the case study in different ways. “The case study is related to the learning process of the case as well as our learning product” [16].

In this research work, we performed a multiple-case study to analyze different factors that should be considered during RP in ASD. This case study is conducted by taking participant-observation-based interviews of the professionals working in agile-adopted software houses. We also evaluate the current agile project of the software house according to various important factors required for the RP process of that project. The data collected from multiple sources will assist in-depth analysis of the factors influencing the RP process. The following details explain the process of the case study, participants involved in the case study, current agile project, collected data, and analysis of data.

B. Case Study Process and Participants

The primary research question guiding this case study is centered around the fundamental concepts considered during the Requirements Prioritization (RP) process, as perceived by professionals. This overarching question helps to shape the overall direction and purpose of the study. Additionally, the interviews incorporated several specific questions to delve deeper into various aspects related to RP processes. These included inquiries such as Role in the Organization: Understanding the interviewee's position and responsibilities within the organization provides context to their perspectives on RP.

Involvement in Decision-Making: Investigating whether the interviewee plays a role in decision-making for the RP process helps gauge their influence and authority. Exploring which concepts are predominantly emphasized during the RP process according to the interviewee's opinion sheds light on key considerations in their professional context. Inquiring about the criteria employed by the software house for making cost-efficient decisions in the RP process provides insights into the practical aspects of decision-making in this domain. Overall, this methodological approach and the specific interview questions aim to comprehensively explore the RP process, gathering both general insights from professionals and specific details related to their roles, decision-making involvement, and considerations in the software development context.

Different steps are performed for conducting interviews in the case study. First of all, we prepared a questionnaire for the interview and verify it through a professional analyst. Conduct participant-observation-based interviews of the professionals in a real-world context. Conduct interviews of professionals having deeper knowledge related to the particular field.

The main research question that was focused on in this case study is as follows: What are the fundamental concepts that are considered during the RP process, according to the review of professionals? The other questions that were included in the interviews are 1) What is the role of the respective interviewee in the organization? 2) Whether the interviewee takes part in decision-making for the RP process? 3) Which concepts are mostly focused on during the RP process, according to the interviewee's opinion? 4) Which criteria are used by the software house for cost-efficient decision making in the RP process?

The interview of each interviewee was held between 20 to 30 minutes, in which participants were provided with research objectives and a research questionnaire. The participants addressed all the questions of the questionnaire according to their perspectives. This study involves two ASD projects (Transroad app related to transport area, and Fusion-Inspect software related to detecting abnormalities in different apps or websites).

We also explain the companies used in this case study separately. There was a total of 5 companies that were interviewed. The details about the interviewee and their role in the organization are given below.

Table 2: Detail of All Interviewee Participants

Basic Role of Participant	**Participants**
Product Owner	7
Project Manager	11
Scrum Master	12
Developer	38
Client	8
Total Number of Participants	76

CareCloud is a healthcare information technology company that offers comprehensive software and services to help medical groups increase revenue, streamline workflow, and modernize the patient experience. The second company researchers took is UBL Digital Partners produces timelessly designed products using state-of-the-art technology. They offer the best user experience crafted and backed up by groundbreaking R&D. The third organization is the supplier of taxi booking & and dispatch systems in the world. Their bespoke cloud-based SaaS solutions help power over 1000 companies across the world. It is located in Manchester, UK. The fourth organization is Ikonami Technologies they provide on-demand developers to boost the capacity of your internal development teams. Not by outsourcing your projects but by in-sourcing their resources to work hand in hand with your internal team as embedded talent. NXM Global Software has been developing products for nearly 20 years. They were pioneers in developing Software-as-a-Service (SaaS) applications, introducing their first SaaS solution to the market in 2001 [17].

Table 3: Detail of Participants

Designation	**Total number**
Product Owner (Care cloud participant)	2
Project Manager	3
Scrum Master	3
Developer	9
Client	3
Product Owner (O3 Interfaces Participants)	2
Project Manager	2
Scrum Master	3
Developer	8
Client	2
Product Owner (Autocab Ltd participants)	1
Project Manager	2
Scrum Master	3
Developer	8
Client	0
Product Owner (Ikonami Participants)	1
Project Manager	2
Scrum Master	1
Developer	7
Client	2
Product Owner (NMX software participants)	1
Project Manager	2
Scrum Master	2
Developer	6
Client	1

C. Data Analysis Strategy and Discussions

The Grounded Theory (GT) was put forward in [18] for qualitative analysis of data gathered through verbal communication. In this theory, pieces of data are gathered during the whole case study and connected to construct a theory. The interviewees focused on various factors that are mentioned in the prior model such as business value, size estimation and input of developers. Some factors are not focused on the prior model, which was mentioned in a case study by the interviewees. According to the interviewees, the importance of DM review can create a significant impact on the RP process. In DM review, customer satisfaction must be addressed; otherwise, customers can refuse the product. The technical possibility of all customer requirements is determined in the DM review, to validate them for the RP process. If some of the requirements are not technically possible, then negotiation should be performed to satisfy the customer.

The risk factor is the second factor that is not properly addressed in the prior model. According to interviewees, the risk factor must be determined in every agile project. There are different factors involved in risk analysis such as the complexity of requirements, external change and volatility of requirements. The complexity of requirements and external change should be determined early to secure the project from decline [19].

The business value factor is mentioned in the prior model, but the various components are not explained in that model. The interviewees explained the importance of requirements and cost for requirements as the business value of the RP process. According to the interviewees, the learning experience of the agile team is an important factor in RP. The developers explained that the learning experience has a crucial impact on the cost and time of implementing requirements and iteration planning. The developer must be familiar with the language in which the requirements need to be implemented. Moreover, during iteration planning, the learning experience of developers helps in determining which developer should implement the requirements. Other factors are mentioned in the prior model. These factors have been discussed in our case study. These factors affect the RP process but in some different aspects.

Therefore, based on this case study, we proposed a new framework explained. The proposed model explains various factors involved in the RP process, we can utilize any RP technique in that model for prioritizing requirements. The proposed model is a conceptual model based on GT techniques. According to GT techniques, the evaluation of a case study is performed to meet the criteria of adequacy, relevance, and modifiability. The above-mentioned model in the previous chapter offers an effective way of prioritizing requirements. But still, different factors are neglected in this model that can affect the RP process. Moreover, the steps of the prior model require modification for more effective prioritization of requirements. Therefore, to eliminate the shortcomings of the prior model, we proposed an RP model that involves more RP factors and a modified RP process.

D. Proposed Requirement Prioritization Model

The proposed RP model is a conceptual model based on the factors involved in the prioritization of requirements. The factors involved in requirement prioritization can be dependent on both the internal and external environment of the organization. Many of these RP factors are already mentioned in the prior model such as risk estimation, business value, dependency and external change. But still, other factors can affect the requirement prioritization such as requirement volatility, review of a decision maker, and importance of requirements, etc. These factors can play an important role in the prioritization process. Therefore, we have included all those factors in our proposed model, which can influence the RP process.

This model used the same backlog technique for requirements as in the prior model, with adjustments in the sub-categories of factors and their linkage with the RP process. In this proposed RP model, the requirements are collected from the customer and stakeholders involved in the RE process on the project backlog. Each requirement is analyzed according to DM review, its business value, and the risk involved in the iteration. As it is mentioned the proposed model is a conceptual model. Therefore, this model is compatible with any other RP technique; the proposed model can be described as a framework that can enhance the RP techniques for prioritization of requirements in agile software development. We used several factors in our proposed model that can influence the RP of the project iteration.

- ➢ Risk Estimation Factors
- ➢ Business Value Estimation Factors
- ➢ Decision Maker Review Factors
- ➢ Effort/Size Estimation
- ➢ Dependency of Requirements
- ➢ Learning Experience
- ➢ Project Constraints

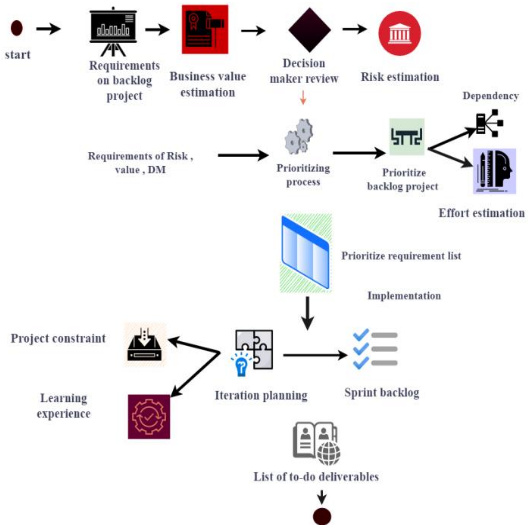


Figure 2: Purposed Model of Research

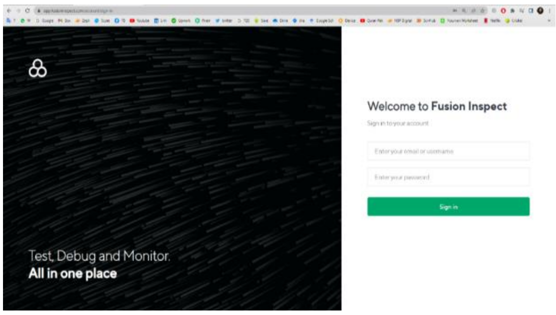
This model has been proposed based on a case study. The proposed model has also been implemented in a project discussed in the case study. Requirements are prioritized based on the factor that is given in this proposed model. We will thoroughly explain the implementation of the model and case study in the following chapter. Although this is helpful model but it has some limitation the main thing is that People who decide which tasks are most important may see things differently because of their own opinions and preconceptions. This could make them select tasks based on personal views rather than what's best for everyone. Also, important people in the project might push for what they want, ignoring what other people need or other important parts of the project. Prioritization model assumes that people involved in a project can work together to agree on what parts are most important and the project's situation doesn't change and the things considered significant. Additionally, it assumes that everyone using the end product has an equal say in deciding what's most important. In the future prospects, the findings of this study can be used to develop an enhanced requirement prioritization model.

IV. Results and Discussion

In this section, we will implement the case study on the proposed model and discuss the results and future directions

A. Proposed Requirement Prioritization Model

The interviewed organization was working on a project that was based on agile methodology, named Fusion Inspect. This is an admin panel that is used to monitor mobile applications. If there is any error occurred while using the application or the application get crashes, the whole report will automatically send to the admin panel of fusion inspect. For example, if an error or bug occurred during the testing phase, the tester can capture a screenshot of the issue, which will be pushed to the admin panel. The manager can assign that generated issue to the respective developer of the application, who will resolve this issue. Moreover, if there is any new version of the application is released, it can be easily managed by this admin panel. The detailed user interface of the case study project is given in the below Figures.


Welcome to Fusion Inspect

Sign in to your account

Figure 2.1: Login Page

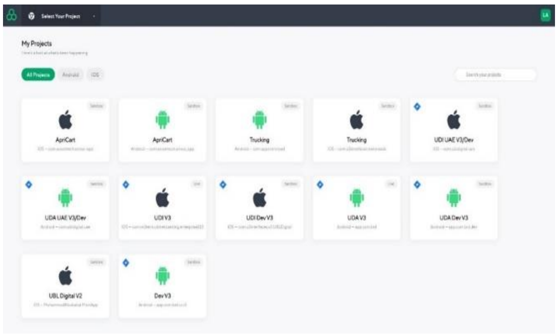


Figure 2.2: Dashboard

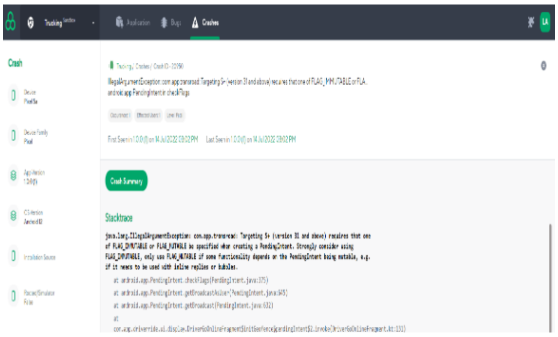


Figure 2.3: Crash Details View

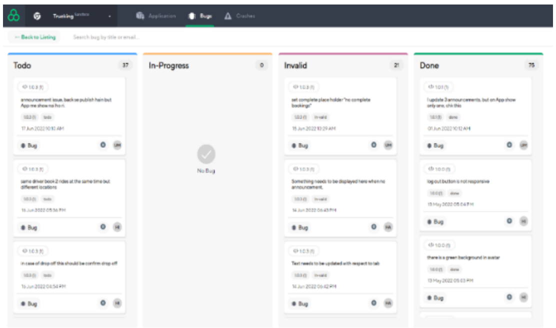
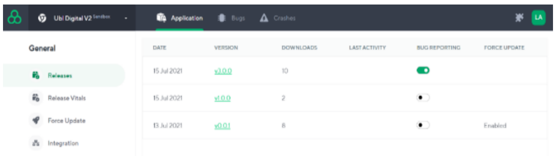


Figure 2.4: Bugs Board



DATE	VERSION	DOWNLOADS	LAST ACTIVITY	BUG REPORTING	FORCE UPDATE
15 Jul 2021	v3.0.0	10			
15 Jul 2021	v2.0.0	2			
13 Jul 2021	v0.0.1	8			Enabled

Figure 2.5: Application Module

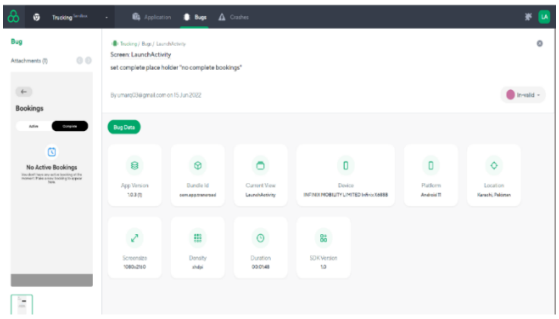
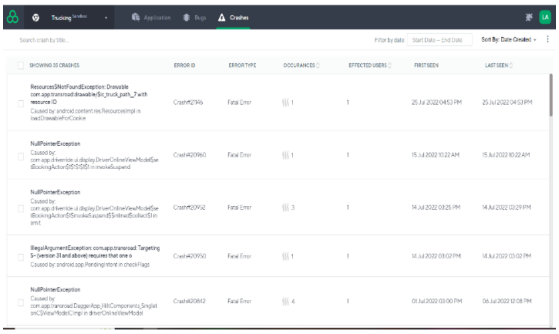


Figure 2.6: Bugs Details View



SHOWING 35 CRASHES	ERROR ID	ERROR TYPE	OCCURANCES	EFFECTED USERS	FIRST SEEN	LAST SEEN
Resources$NotFoundException: Drawable com.app.transroad:drawable/$ic_truck_path_7 with resource ID Caused by: android.content.res.ResourcesImpl in loadDrawableForCookie	Crash#21146	Fatal Error	1	1	25 Jul 2022 04:53 PM	25 Jul 2022 04:53 PM
NullPointerException Caused by: com.app.driverride.ui.display.DriverOnlineViewModel$setBookingAction$1$1$1$1$1 in invokeSuspend	Crash#20960	Fatal Error	1	1	15 Jul 2022 10:22 AM	15 Jul 2022 10:22 AM
NullPointerException Caused by: com.app.driverride.ui.display.DriverOnlineViewModel$setBookingAction$1$invokeSuspend$$inlined$collect$1 in emit	Crash#20952	Fatal Error	3	1	14 Jul 2022 03:25 PM	14 Jul 2022 03:29 PM
IllegalArgumentException: com.app.transroad: Targeting S+ (version 31 and above) requires that one o Caused by: android.app.PendingIntent in checkFlags	Crash#20950	Fatal Error	1	1	14 Jul 2022 03:02 PM	14 Jul 2022 03:02 PM
NullPointerException Caused by: com.app.transroad.DaggerApp_HiltComponents_SingletonC$ViewModelCImpl in driverOnlineViewModel	Crash#20842	Fatal Error	4	1	01 Jul 2022 03:00 PM	06 Jul 2022 12:08 PM

Figure 2.7: Crashes Listing

We will apply the RP model to this project. We will apply it only on the one iteration of this agile project. In the first iteration, the requirement engineering team gathered all requirements from the client that are required from the client. The list of requirements is given as follows.

B. Gathered Requirements

- Bugs and Crashes Attachments with audio
- Filter bugs and crashes
- Data export with excel sheet
- Dashboard Project listing
- Bugs Listing
- Bug details view
- Application module
- Releases tab and force update
- Jira Integration
- Bugs and crashes status update
- In-App Chat
- Crashes Listing
- Crash details view
- Receive alerts on Slack when performance issues arise
- Automated crash reports with advanced diagnostics
- Account management and priority support
- Bug board view with drag and drop functionality
- Registration and user profiling
- Add project
- Comments functionality for Bugs and Crashes
- Charts and Graphs data overview
- Custom integrations and API access
- Interaction with GitHub

This is the list of all requirements that need to implement for the project. For the first Iteration, the requirements were identified by the requirement engineers, and a list of requirements was collected to implement for the first iteration of this agile project. The list of requirements for the first iteration is as follows.

C. List of Requirements For The Current Iteration

- Bugs and Crashes Attachments with audio
- Filter bugs and crashes
- Data export with excel sheet
- Bug details view
- Crashes Listing
- Application module
- Releases tab and force update
- Jira Integration
- Dashboard Project listing
- Crash details view
- Login
- Bugs and crashes status update
- Bug board view with drag-and-drop functionality

This is the list of a requirement that needs to be implemented in this iteration. We will prioritize these requirements based on the proposed model. The RP process is start with gathering the requirements of various stakeholders. These above-mentioned requirements are transferred to the backlog of the project. We have used grounded theory for conceptual modeling by giving numerical values to the qualitative data. There are several factors of the proposed which we will be explained according to the given project.

D. Risk Estimation Factors

The risk influences the project negatively. Higher risk means a lower possibility of success of the project. We will use negative numerical values for the risk estimation. The -10 means the highest risk, whereas 0 means the lowest risk.

Table 4: Calculated Value of Risk Factors

Requirements	**External Change**	**Volatility**	**Complexity**	**Total Risk**
Login	0	0	0	0
Jira Integration	-4	-2	-6	-12
Dashboard Project listing	-2	-2	-2	-6
Bugs and Crashes Attachments with audio	-6	-6	-2	-14
Application module	-4	0	-6	-10
Releases tab and force update	-2	-2	-4	-8
Bugs and crashes status update	-2	-4	-4	-10
Crashes Listing	-6	-4	-4	-14
Bugs Listing	-6	-4	-4	-14
Bug board view with drag and drop functionality	-6	-8	-4	-18
Bug details view functionality	-6	-6	-2	-14
Crash details view	-4	-4	-6	-14
Filter bugs and Filter crashes	-2	-4	-8	-14
Data export with excel sheet	-4	-2	-6	-12

D. Decision Making Factors

DM has a high influence on the success of the project. The different factors involved in decision-making process. We will give values between 0 to 10. The technical possibility is graded between 0 to 10, with 0 as a lowest technical possibility and 10 as the highest technical possibility.

Table 5: Calculated Value of DM Factors

Requirements	**Ordinal Ranking**	**Stakeholder Satisfaction**	**Technical Assessment**	**T.DM factor**
Login	10	10	10	30
Jira Integration	6	8	8	22
Dashboard Project listing	8	10	10	28
Bugs and Crashes Attachments with audio	6	10	8	24
Application module	10	8	8	26
Releases tab and force update	4	4	4	12
bugs and crashes status update	6	4	6	16
Crashes Listing	8	10	10	28
Bugs Listing	8	10	10	28
Bug board view with drag and drop functionality	6	10	8	24
Bug details view	8	10	8	26
Crash details view	8	10	8	26
Filter bugs and crashes	6	10	8	24
Data export with excel sheet	6	10	24	20

E. Business Value Factors

The BV factors are important in the RP process of any agile project. We have two factors in this BV i.e., cost and importance. The cost has an inversely effect on the success of the project so we will denote it in negative between -10 to 0. Whereas, the importance will be written between 0 to 10.

Table 6: Calculated Value of BV factors

Requirements	**Importance**	**Cost**	**Total BV factor**
Login	5	-4	1
Jira Integration	4	-6	-2
Dashboard Project listing	5	-4	1
Bugs and Crashes Attachments with audio	5	-4	1
Application module	4	-6	-2
Releases tab and force update	3	-2	1
bugs and crashes status update	2	-4	-2
Crashes Listing	5	-4	1
Bugs Listing	5	-4	1
Bug board view with drag-and-drop functionality	4	-8	-4
Bug detail’s view	5	-2	3
Crash detail’s view	5	-2	3
Filter bugs and crashes	4	-4	0
Data export with excel sheet	4	-2	2

E. Total Priority Estimation

These are various factors whose value is calculated by grounded theory. Now we will apply prioritization to the requirements. The highest value requirement will be a requirement of highest priority. The dependency is also estimated between 0 to 10, where 0 is the highest dependency and 10 is the lowest dependency.

The below-mentioned Table 7 is a possible priority according to the model proposed in this study.

F. List of Prioritized Requirements

- Login
- Dashboard Project listing
- Bugs Listing
- Bug detail’s view
- Crashes Listing
- Crash detail’s view
- Bugs and Crashes Attachments with audio
- Filter bugs and crashes
- Data export with excel sheet
- Application module
- Jira Integration
- Bugs and crashes status update
- Releases tab and force update
- Bug board view with drag-and-drop functionality

Table 7: Calculated Priority of All Requirements

Requirements	**Risk**	**DM Factor**	**BV Factor**	**Dependency**	**Size-Effort Estimation**	**Total Priority**
Login	0	30	1	10	6	47
Jira Integration	-12	22	-2	4	8	20
Dashboard Project listing	-6	28	1	6	6	35
Bugs and Crashes Attachments with audio	-14	24	1	8	6	25
Application module	-10	26	-2	4	4	22
Releases tab and force update	-8	12	1	6	6	17
bugs and crashes status update	-10	16	-2	8	4	18
Crashes Listing	-14	28	1	8	8	31

Bugs Listing	-14	28	1	8	8	31
Bug board view with drag and drop functionality	-18	24	-4	4	6	12
Bug detail’s view	-14	26	3	6	8	31
Crash detail’s view	-14	26	3	6	8	31
Filter bugs and crashes	-14	24	0	8	6	24
Data export with excel sheet	-12	20	2	4	8	22

These prioritized requirements are then evaluated for implementation. At the end of the process, a sprint backlog is obtained which contains the list of to-do tasks in the ongoing iteration. Note that, all these values are given for prioritization by the professional working in the software organization. We used all these values in the given model and calculated the priority of requirements.

In this section, we explained the case study that was performed for proposing a requirement prioritization model. We interviewed several professionals working according to agile principles for their projects. Then we used one of the projects, on which a company was currently working. We gathered requirements and asked professionals to give factor values according to our proposed model. It was proved that our model prioritized requirements in a better way than the prioritized requirements of a company.

The requirement prioritization model is good at assuming out which things are most important for a project and changing the priorities when essential. It makes work well for projects that keep changing and need to adjust. Other models might do things otherwise depending on what the project needs and what the requirements are like.

V. Conclusion

This research delved into how software organizations go about prioritizing their requirements. What we discovered is that these organizations don't always follow the exact steps outlined in previous studies. Instead, they have their own unique ways of handling the requirement prioritization process, taking into account concepts like Business Value, Risk Factors, and Priority Criteria. Since our model is more of a conceptual one, there's room to make it even better by combining it with other techniques. The agile development model, which is always evolving, means that the way organizations prioritize requirements will keep changing over time. To enhance the requirement prioritization process, we suggest conducting more case studies in the future. By understanding real-world scenarios, we can propose new and improved requirement prioritization models.

This study opens up opportunities for researchers to dive deeper into our findings and develop cutting-edge requirement prioritization models. It highlights the need for ongoing investigation and adaptation to keep up with the dynamic nature of software development.

References

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

[2] Borhan, N. H., Zulzalil, H., & Sa’adah Hassan, N. M. A. (2019). Requirements prioritization techniques focusing on agile software development: A systematic literature. International Journal of Scientific and Technology Research, 8(11), 2118-2125.

[3] Gull, Saba, et al. "Current Stance on Requirement Prioritization Techniques: Challenges, Opportunities, and Future Directions." (2022).

[4] Charmaz, K. Constructing Grounded Theory: a Practical Guide through Qualitative Research, Thousand Oaks CA, Sage, 2007.

[5] Khanneh, Shada, and Vaibhav Anu. "Security Requirements Prioritization Techniques: A Survey and Classification Framework." Software 1.4 (2022): 450-472.

[6] D. Kavitha, Ananthi Sheshasaayee. (2012). Requirements Volatility in Software Maintenance, Advances in Computer Science and Information Technology. Computer Science and Information Technology. Vol 8, pp 142-150.

[7] Govil, N., & Sharma, A. (2021). Information extraction on requirement prioritization approaches in agile software development processes. 5th International Conference on Computing Methodologies and Communication (ICCMC) (pp. 1097-1100). IEEE.

[8] Gralha, C., Damian, D., Wasserman, A., Goulão, M., & Araújo, J. (2018). The evolution of requirements practices in software startups. In 2018 IEEE/ACM 40th International Conference on Software Engineering (ICSE) (pp. 823-833). IEEE.

[9] BORHAN, NOOR HAZLINI, et al. "REQUIREMENTS PRIORITIZATION IN AGILE PROJECTS: FROM EXPERTS’PERSPECTIVES." Journal of Theoretical and Applied Information

Technology 100.19 (2022).

[10] Jawale, B. B., Patnaik, G. K., and Bhole, A. T. (2017). Requirement Prioritization Using Adaptive Fuzzy Hierarchical Cumulative Voting. Proceedings -7thIEEE International Advanced Computing Conference, IACC 2017, 95–102.

[11] Kasauli, R., Knauss, E., Horkoff, J., Liebel, G., & de Oliveira Neto, F. G. (2021). Requirements engineering challenges and practices in large-scale agile system development. Journal of Systems and Software, 172, 110851.

[12] Khan, J. A., Liu, L., Wen, L., & Ali, R. (2019). Crowd intelligence in requirements engineering: Current status and future directions. In International working conference on requirements engineering: Foundation for software quality (pp. 245-261). Springer, Cham.

[13] Narayanan, T. (2021). Maximizing value creation in agile sprints (Doctoral dissertation, Massachusetts Institute of Technology).

[14] Olivoto, T., Lúcio, A. D., da Silva, J. A., Marchioro, V. S., de Souza, V. Q., & Jost, E. (2019). Mean performance and stability in multi-environment trials I: Combining features of AMMI and BLUP techniques. Agronomy Journal, 111(6), 2949-2960.

[15] Amelia, Tan, and Rozlina Mohamed. "A Review: Requirements Prioritization Criteria Within Collaboration Perspective." Pertanika Journal of Science & Technology 31.1 (2023).

[16] Omair, M., Noor, S., Tayyab, M., Maqsood, S., Ahmed, W., Sarkar, B., & Habib, M. S. (2021). The selection of the sustainable suppliers by the development of a decision support framework based on analytical hierarchical process and fuzzy inference system. International Journal of Fuzzy Systems, 23(7), 1986-2003.

[17] Oni, O., & Letier, E. (2021). Analyzing Uncertainty in Release Planning: A Method and Experiment for Fixed-Date Release Cycles. ACM Transactions on Software Engineering and Methodology (TOSEM), 31(2), 1-39.

[18] Rahim, M. S., Chowdhury, A. E., & Das, S. (2017). Rize: A proposed requirements prioritization technique for agile development. In 2017 IEEE Region 10 Humanitarian Technology Conference (R10-HTC) (pp. 634-637). IEEE.

[19] Saher, N., Baharom, F., & Romli, R. (2018). A review of requirement prioritization techniques in Agile software development.

[20] Muhammad, A., Siddique, A., Mubasher, M., Aldweesh, A., & Naveed, Q. N. (2023). Prioritizing Non-Functional Requirements in Agile Process Using Multi Criteria Decision Making Analysis. IEEE Access, 11, 24631-24654.

[21] Silva, D., Lencastre, M., Pimentel, J., Castro, J., & Lira, L. (2023, March). Applying Gamification to Prioritize Requirements in Agile Projects. In Proceedings of the 38th ACM/SIGAPP Symposium on Applied Computing (pp. 1498-1507).

[22] Tuunanen, T., Vartiainen, T., Kainulainen, S., & Ebrahim, M. (2023). Development of an Agile Requirements Risk Prioritization Method: A Design Science Research Study. Communications of the Association for Information Systems, 52.

[23] Arshad, H., Shaheen, S., Khan, J. A., Anwar, M. S., Aurangzeb, K., & Alhussein, M. (2023). A novel hybrid requirement's prioritization approach based on critical software project factors. Cognition, Technology & Work, 1-20.