Turkish Online Journal of Qualitative Inquiry (TOJQI)
Volume12, Issue 5, July 2021: 3406-3424

Research Article

Towards Requirements Elicitation and Analysis Model for Distributed Audience

[1]Muhammad Nadim, [2]Rana M. Amir Latif, [3]Khalid Hussain, [4]NZ Jhanjhi, [5]Mehedi Masud, [6]Mohammad Baz, [7]Riyaz Ahamed Ariyaluran Habeeb

Abstract

Requirement's elicitation is a challenging activity and the most important activity for the software development process. Requirement elicitation is the process of gathering information from the user and stakeholders. By reviewing the literature review, there are many challenges involved in the elicitation process, i.e., lack of proper communication and knowledge transfer between software stakeholders. Most of the companies are moving towards a globally distributed environment. Some many problems and challenges occur due to temporal, geographic, and socio-cultural diversity among stakeholders. This study proposes a new approach to the requirements elicitation and analysis phase in a distributed environment with the knowledge management technique that improves the software development process. The purpose of the paper is to develop a distributed framework based on eliciting and analyzing the customer's requirements by implementing a knowledge management technique that efficiently handles and manages the resources of an organization. This study aims to improve the elicitation and analysis process by using knowledge management techniques in a distributed environment. Thus, this study improves software development architecture. The feasibility and effectiveness of the proposed approach were evaluated in an empirical study with encouraging results.

Keywords: Software Development Architecture, Requirements Elicitation, Distributed Environment, Knowledge Management Technique, Ecolan, Vision Plus Technologies

1 Introduction

Most of the companies and the project team members are moving towards a distributed environment and geographically distributed. Many factors are well-documented in the entrepreneurs, engineers, executives, and literature are facing many challenges on cultural, social, political, and technical stages. The organizational structure and development process needs to

[1]Department of Computer Science PMAS-Arid Agriculture University Rawalpindi, Campus
[2]Department of Computer Science, COMSATS University Islamabad, Sahiwal Campus
[3]National superior institute of science and technology, Islamabad.
[4,7] School of Computer Science and Engineer, SCE, Taylor's University, Malaysia
5 Department of Computer Science, College of Computer and Information Technology, Taif University, PO Box. 11099, Taif 21994, Saudi Arabia
6 Department of Computer Engineering, College of Computer and Information Technology, Taif University, PO Box. 11099, Taif 21994, Saudi Arabia
muhammadnadim096@gmail.com, ranaamir10611@gmail.com, khalid.hussain@superior.edu.pk , noorzaman.jhanjhi@taylors.edu.my, mmasud@tu.edu.sa, mo.baz@tu.edu.sa, riyaz.a@taylors.edu.my

support DSD compared to those from the collocated environment. There are different impacts in the DSD environment on many stages, i.e., cultural issues, strategic issues, technical issues (technological infrastructure and technical knowledge), and knowledge management issues improve organization effectiveness [1]. These issues and challenges affect the whole software development process in the DSD environment. These problems, like cultural issues, strategic issues, technical issues, temporal issues, reduce the performance of significant software development [2]. The availability of the right knowledge is a significant challenge in software organizations due to knowledge de-contextualization, fragmentation, and overload.

The distributed collaborators abstracted software development as global software development. The software development is based on the abstraction that progressively a multiethnic, multisite, and globally distributed commission. The three concepts that were mentioned above are conceptually followed by global software development [3]. For instance, the emphasis of the extensive technology-supported communication and teamwork in global software development research emphasizes enhancing communication and teamwork between the dispersed teams and stakeholders.

It is virtual team research and acts virtually on multiple sites. In global software development, the software development emphasizes developing the programs and projects by using geographically dispersed teams and focuses on reducing the challenges and issues that more of the development teams faced during the software development process [4]. It is essential to figure out the challenges and issues that the geographically dispersed teams faced while developing the software and focus on minimizing and reducing these identified challenges and issues by following the proper strategies. To elicit user requirements and define the project scope, requirement elicitation is one of the first activities [5]. The requirement elicitation's activity is sure of in cooperation and communication between stakeholders. It makes collaboration critical for accomplishing this activity, particularly in global software development schemes with distributed teams and stakeholders.

The software development process in organizations focuses on software quality as software reflects the excellence and maturity of the organization's software development process. The study of specifications involves automated process models, including cascade, spiral, and quick models. Dependent on the caught requires the final output of the distributed program. The researchers recommend that in the software lifecycle, the maintenance phase is difficult to correct the software defects and requires two hundred times to implement the corrections compared to the requirements specification phase [6]. Most software development organizations are geographically distributed all over the world. In distributed software development, there is a high demand for skilled technical staff and high travel costs.

Information management, which has been a core principle and company enterprise, has been dramatically expanding over the past decades and has been ready because it is already the most crucial element in the usage and adoption of IT technologies by computer hardware and software providers. It helped us in defining their purposes, more than effort than land than tools. Author deliberate that strategies used for socialization can be employed to manage knowledge primarily [7]. It is challenging to achieve practical knowledge management in the distributed team because team members hardly ever meet in a distributed team environment. There are minimum chances to meet the teams frequently in a distributed environment. A common understanding that architectural knowledge refers to designs only is now rapidly changing. The architectural knowledge comprises not only the design itself but also the other information relating to it. The design process involves multiple stakeholders, which makes it challenging to share and transfer

knowledge. In distributed location conditions, the complexity of managing architectural knowledge becomes immense [8]. Distributed environments add to the challenges of managing architectural knowledge in a significant way. The issues of culture, management, and organization of design knowledge are key to defies in a distributed environment.

Architectural development is a knowledge-intensive process. For enhancing the quality of the architectural process, it is essential to evaluate and verify the knowledge. Furthermore, multiple stakeholders are involved in the decision-making process, which makes it a more complicated process. To address these issues and improve cooperation and coordination, recognized the need for a strategy to improve the design process. The researcher highlighted that coordination activity in the distributed environment had lacked attention [9]. A method was proposed for architectural knowledge management collaboration that employees trust to evaluate and verify new knowledge. The method was designed to reduce cost and increase accuracy by collecting and storing architectural knowledge. The method was evaluated using the ATAM evaluation method.

The author proposed an RGT tool that supports decision apprehending, decision-based analysis, and architectural group decision-making. The hundred-dollar approach is supported by a tool that concerns prioritization. The author conducted an empirical study of architectural knowledge management practices. The conducted study was aimed to understand the practices of AKM in the industry empirically [10]. The results are established based on a systematic analysis of 29 industrial projects using different AKM practices. The results of the conducted study indicate the fact that most of the studies are aimed at identifying the issues or challenges associated with architectural knowledge management. However, the need for serious efforts has been identified in empirical studies and identifying the most used practices in real-time projects [11].

The management of architectural knowledge has now been considered an integral part of Software specification. Architectural knowledge is considered a combination of rationales and design decisions. To achieve practical storage and search goals, an approach to use Linked Data techniques for managing architectural knowledge has also been introduced. For proposing the approach, the author has highlighted different features of the Linked Data tools. The author suggested that retrieval of design decisions using SPARQL queries will be efficient if the RDF format has been utilized to store decisions. In recent years, capturing, sharing, and reusing architectural knowledge has become an antler essential for IT to service providers [12]. The author also said that there are still many challenges in this field that needs to be addressed. In this paper, a meta-model was proposed to overcome challenges and satisfy the user requirements for IT service solution proposals. Afterward, a tool was developed and established a principle comprising of twelve decisions. It can capture experience details and lessons learned during our decision modeling concepts to both level proposal development and architecture design work [13]. The author has studied knowledge management in dispersed agile teams. The knowledge process is much valued to achieve benefits from knowledge-intensive development activities. The agile manifesto depends on effective communication and sharing of knowledge between cross-functional teams through numerous head-on interactions and stakeholder collaborations. A few reasons like cultural barriers, spatial and temporal, were indicated, making knowledge sharing a difficult task in a distributed environment [14]. It will have led to effects during communication, collaborations, and interaction between stakeholders. Very few studies have been showing that seem to emphasize the management of knowledge in the distributed team's environment. The researcher has performed a study by employing grounded theory that involves experts from different in India, Australia, and the USA. They have investigated how distributed development teams capture, save, reuse, and share knowledge [15].

The author stated that it is essential to develop software architecture, to face the challenges of global software development. These challenges may include requirement control, communication, and coordination. For overcome these challenges, a comprehensive architecture with feasible design decisions should be developed. A framework is proposed to develop such an architecture that supports global situations. The framework is supported by developing a Global tool Architect. The tool contains predefined questions regarding the rules of abstract design. The tool can generate architecture while selecting the rules based on the answer provided to the questions [16]. The author researched architectural knowledge management and highlighted its value for distributing software development.

The author in previous work has also enlightened the concepts of architectural knowledge and stipulated numerous practices for effective management of architectural knowledge in a multisite situation. The study was conducted by performing a survey on development houses in a globally distributed environment. The interviews were conducted on the 38 users, and the development site was distributed in three different locations. The study was aimed to explore practices for managing architectural knowledge in distributed locations [17]. The case study outcomes illustrate that organizations should follow practices with coordination and collaboration to gain more advantages.

Business organizations can generate new knowledge that is detected as a primary foundation of competitive advantage. The central focus of business organizations is to identify and detect knowledge. Nowadays, this concept is a hot issue, and so today and gradually so in the future. The researchers have been focusing on this issue and finding ways to support the processor's organizational knowledge actively [18]. Organizational knowledge creation is a movement that should be the lineup. The experts have been using the knowledge management techniques in the focal areas like focus group sessions, social network analysis, processing mapping, and one-on-one interviews.

The author conducted a literature review for studies of architectural knowledge management in the context of globally distributed conditions. The authors have synthesized the architectural knowledge management process, tools, practice, and concepts in detail in the conducted review. A few challenges were highlighted, along with the entities and relationships of AKM in a meta-model. The author proposed a tool for managing architectural knowledge [19]. The Knowledge Architect tool suite was developed for handling, catching, and sharing AK. The technology suite includes many applications focused on a client-server pattern: a Microsoft Word plug-in and an Excel plug-in, which can be used and AK inside software development documents and tablets. The program Python is used to derive information and is a method for evaluating source code.

2 Literature Review

This study presents a danger as a tool extension for obtaining computer-mediated program features linked to confidence (CMI) CMI identifies social networking sites that familiarize strangers with compatible interests online and build confidence relationships. CMI includes threats to security and security, for example, data abuse, misconception, or harassment. This methodology includes a risk evaluation of customer needs and criteria for their application rankings. Conflicting criteria may be balanced based on the prioritization, claim the authors. The results are given concrete descriptions of the online dating application area [20].

A vision report on cutting-edge science at the crossroads between AR and specifications engineering. The author determined that the capability of AR to provide on-the-fly material, such

as enlarged prototypes, supported elicitation of specifications and review. The paper charts the RE concerning facets of AR that can increase competitiveness and user experience [4].

IoT systems have a range of tools and functionalities that reduce ambiguity, meaning the software can be developed and introduced. The author proposes a tailored approach to eliciting specifications and mapping them on IoT framework tools. It will use empathy, description, and imagination approaches to help developers. The authors say DT technologies cover the stages of empathy, meaning, and conception with well-accessible materials. The aim is to easier demand elicitation by DT technologies that cover all stages of the development of IoT applications [21].

This paper attempts to systematize conceptual variables that affect utilizing networks introduced by people and governments. The findings revealed that "users considered donations," the "people worried about city problems," were the most influential influences. Several techniques are presented to support city planners and developers to leverage essential variables [22].

This study attempts to analyze state of art in the development of data-driven specifications. The author uses two approaches to our theme in this research. The monitored method will allow one to realize whether or not the approach works. These approaches are focused on natural language specifications, utilizing data, and management data. In this article, the author attempts to alter a non-relevant RI analytics classification twitter technique in the experiment section. It also obtains a modern paradigm for the classification of data and data specifications. It concludes difficulties of utilizing methods for eliciting data-driven criteria and provides a method to address realistic achieving data-based specifications [23].

Crowd-based requirements elicitation (CBRE) is a modern approach to define requirements that provide the advantages of relationships with several separate stakeholders. CBRE is carried out by crowd-sourcing involving participants. The Ph.D. study proposal aims to define certain socio-technical obstacles involved in the crowd's demands and establish a plan to evoke requirements to help cope with CBRE problems. The findings would be obtained in the context of a socio-technical challenge system in the CBRE [3].

For software systems to function, it is important to combine creator and end-user expertise through requirement engineering. In this article, the author shares the results of a literature study on crowd-based engineering research criteria. It allows one to consider the outcomes of existing studies, areas of interest, and how crowd knowledge will boost demands-related operations [2].

Some scholars call for the usage of "creative design" in the creation of modular applications. Convergence between imagination and versatility has been developed as a modern direction to offer more and more challenging technological innovation and flexibility. In particular, the author noted using these methods as strong candidates for user-interface creation programs, such as those for smartphones or web apps. The author also concluded that new criteria do not necessarily suffice, as consumer participation and a specific context must be accompanied by suitable circumstances. The present analysis aims to use a holistic examination to research the state-of-the-art methods to maximize innovation and advantages [24].

Specifications are a crucial task in the field of regulatory innovation. Few structural literature reviews offer empirical proof of the efficacy of the program involving techniques. What are innovative technologies commonly used to generate program specifications? And what advanced strategies maximize the potency of elicitation? [7].

Community modeling and crowd-based modeling as a method to collectively create market environment modeling. Investing in crowd-driven modeling in group operations promotes value ideas in organizational environments. Such collaborative actions build popular network-level, IS-embedded tools that connect different ecosystem players [5].

Elicitation is one of the most critical practices of software development processes. One test shows that the mechanism of eliciting criteria needs to be strengthened. The effect has been cross-analyzed to identify which behaviors are protected by the method of elicitation. This paper aims to define the most recent program specifications research using a general literature review context [6].

Malicious web pages that seem to be legitimate web pages can engage in a type of illegal activity known as phishing. Using such websites, an intruder may conduct this type of phishing or theft, posing a danger to web users' personal and sensitive details. This paper aims to distinguish between legal, suspect, and phishing websites. These features are fed into the machine learning algorithms developed into WEKA and are used to compare and validate the algorithm's accuracy. This prediction model can be used to determine the validity of every e-commerce website before making a purchase. The algorithm chosen automates the method of website analysis [25].

Any day, developers upload millions of applications. Duplicate apps erode users' interest in the Google Play store and can steal sensitive details. Scraping at least 550 applications from each game group, both free and charged, using Google Play scraper. In this paper, the author will visualize the InAppPurchase rate of free and paid applications and the percentage of free and paid applications that fund advertising. Ratings of free and paid applications using a histogram installs of free and paid applications using a histogram for all types of games applications, and ratings for all categories of games applications [26].

The author has scraped 506259 customer feedback and device ratings from 14 separate groups on the Google Play Store. According to the article, the optimal algorithm for reviewing Google Play store applications is logistic regression. The rapid advancement of web technologies allowed people to communicate and express their opinions on, rate, and exchange their input on, apps. The findings have been statistically validated. It is discovered that the consistency of the logistic regression algorithm for categorizing feedback into three categories, namely positive, negative, and neutral, is rather large [27]. Requirement's elicitation is a demanding job, and vital for the software development process, information gathering from users and stack holders can be processed. Requirements Elicitation, and global software development [28-30] plays a vital role in speedy software development by making this possible where contributors can be from several different geographical locations. At the same time the improving the sharing and quality improve the software development process [31-33]. Developer can use different best suited development methodologies. In a distributed environment, there are many challenges that the developer's team faced during the software development phase. So, there is a need for a framework that improves the software architecture by improving the elicitation and analysis phase by applying the knowledge management techniques.

- The evidencing of individual factors prohibits easy contact between consultant/analysts and consumers.
- Consumers have limited machine comprehension and boundaries
- Change in specifications in the process of the project
- Administration of information has not been achieved correctly
- Consumers can request specifications not required by the company
- The consumer cannot tell what the organization wants
- No clear study of vital device conditions
- Individual consumers do not want to help you with the project
- The method of eliciting criteria did not succeed because it was not performed correctly

3 Materials and Methods

3.1 Proposed Approach

The outcomes from the conducted literature review from selected papers have highlighted the requirement and limitations in the existing work. Our research will focus on overcoming the identified challenges associated with using architectural knowledge effectively in a distributed environment. For the said purpose, we will try to develop an appropriate solution that accounts for the technical hitches in existing practices of AKM in a multisite environment. The solution will be comprised of three steps. Firstly, we will understand the concrete and fundamental facts of managing architectural knowledge in a distributed environment. Secondly, identification of the limitations and comparison of existing practices that cater to the problem associated. By doing the learning and analysis of the existing practices, a set of features will be identified, which serves to manage AK in the required situation.

Based on the findings of the conducted literature review, we will try to improve the existing short by proposing a framework. The objective of our proposed work will be to focus on and overcome the identified challenges associated with using architectural knowledge effectively in a distributed environment. Finally, keeping in view the research problem, Action Research will be chosen to solve the current issues of AKM Practices. A tool will be developed based on the proposed framework, and a case study-based experiment will be performed on the developed tool to testify whether the laid down objective has been achieved.

Knowledge management is elaborating and identifying ideas, communicating, sharing, and collaborating these ideas with the stakeholders and customers, and retrieving the knowledge and innovating it. In organizations, knowledge can accumulate, reuse, and produce more knowledge. In the requirement engineering process, a large amount of information needs to be communicated between different stakeholders. Still, it is difficult to collaborate between stakeholders and customers and pass the knowledge because of the geographical dispersion of teams.

3.2 Proposed Framework

This research study begins with a sufficient review of architectural knowledge management approaches to accomplish the desired benefits in a distributed environment. Afterward, strengths and shortcomings will be heightened by comparing the existing approaches acknowledged as the outcomes of the literature review. Figure 1 shows the flow involved in the proposed methodology.

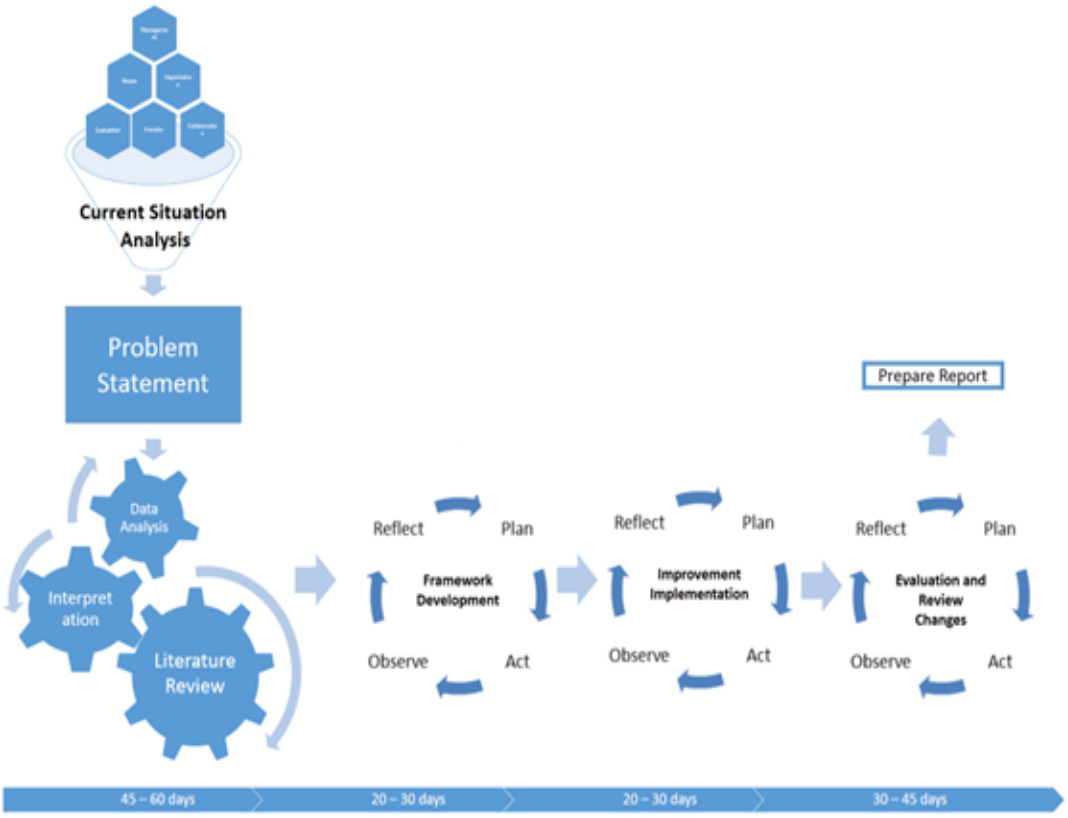

Figure 1 Flow of the Research

The proposed framework consists of four phases, shown in Figure 2. In the first phase, the business analysts collect the customer business requirements and pass to stakeholders. This phase shows the complete overview of handling customer's requests. The second phase shows the complete detail of the elicitation process. This phase depicts the complete description and flow of steps of the elicitation process. The third phase shows the knowledge management process. This phase demonstrates the management of knowledge of the elicited requirements of the customer/user. The fourth phase shows the analysis process and steps. After completing the last step, the requirements move to the requirement specification phase, build SRS, and validate the requirements. All the phases are implemented in a distributed environment. The geographically dispersed team members are distributed at different sites. The complete detail is in the coming section.

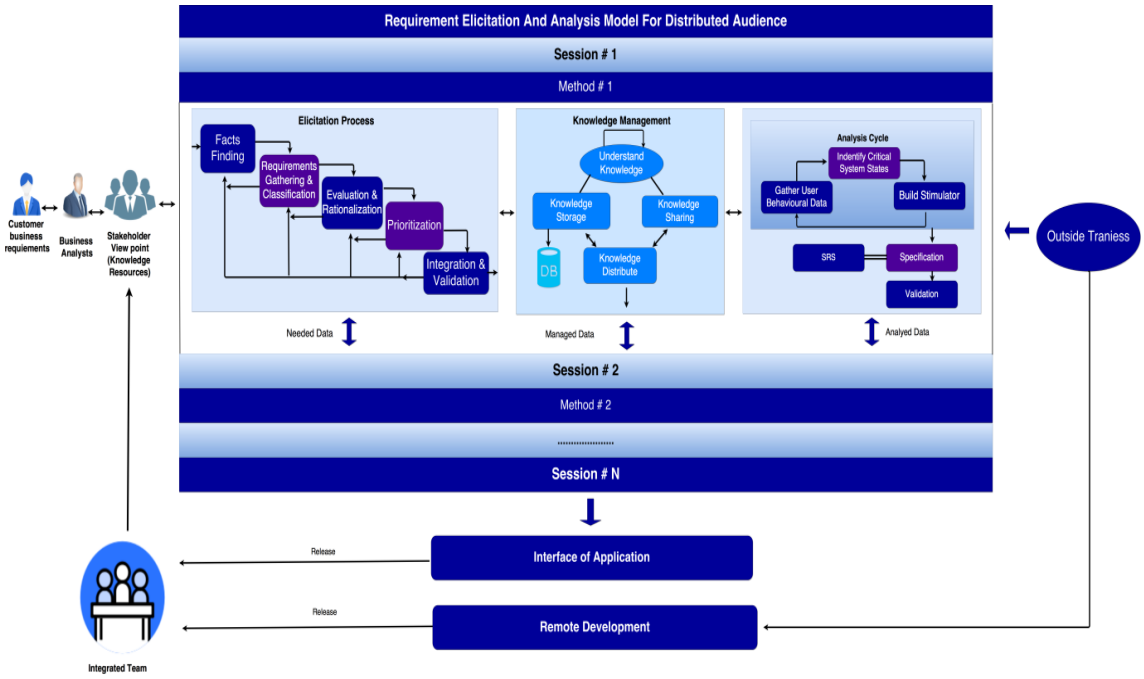

Figure 2 Requirements Elicitation and Analysis Model for the Distributed Audience

3.2.1 Phase 1

This phase shows the complete overview of handling customer's requests. In the first phase, the business analysts collect the customer business requirements and pass to stakeholders. The geographically dispersed team members are distributed at different sites.

3.2.2 Phase 2

The second phase shows the complete detail of the elicitation process. This phase depicts the complete description and flow of steps of the elicitation process. In the elicitation phase, there are sequential sessions, and each session has separate methods. In phase 2, there are five steps. Each step is bi-directional:

3.2.2.1 User-Oriented Tasks Fact-Finding

Identify acceptable multi-level groups. Determine the tactical and challenge framework, including, where necessary, the description of operating types, priorities, and task scenarios. Related structures are described, and conduct background research.

3.2.2.2 Requirements Gathering and Classification

Receive the wish list on several levels for each member.

3.2.2.3 Rationalization and Evaluation

Remember the type of questions: "Why do you need X? Abstract "; in practice, everything switches from "if" to "what" sentences. Capture reasoning for further advancement of specifications.

3.2.2.4 Prioritization

Determine criticality, i.e., the mission's central roles.

3.2.2.5 Integration & Validation

Validate the criteria following the targets stated. Get permission/verification to transfer to, e.g., demonstration and validation level, the next level of progress.

3.2.2.6 Developer-Oriented Tasks Fact-Finding

Topic experts (applications and software experts) should also be listed. Domain and architectural models are established and conducted technical tests and risk evaluations, with eventual feasibility analyses. Evaluation of the sponsor's cost/implemental limits.

3.2.2.7 Requirements Gathering and Classification

Classify request lists by functional, non-functional, context, and architecture limitations and domain models and application method partitions (for example, functional or object-focused top-down decomposition).

3.2.2.8 Rationalization and Evaluation

The evaluation of risk, technological, cost- and schedule considerations (including cost-benefit filtering and resource availability-based feasibility analysis).

3.2.2.9 Prioritization

Prioritize expense, and dependency-based criteria, search how the structure can be enhanced, and define suitable design models to promote sustainable change.

3.2.2.10 Integration & Validation

Resolve conflicts for (consistency checking).

3.2.3 Phase 3

The third phase shows the knowledge management process. This phase demonstrates the management of knowledge of the elicited requirements of the customer/user. In this phase, the elicited knowledge is managed in the knowledge management phase. In this phase, there is a

complete detail of knowledge management. This phase elaborates the knowledge management steps:

- Understand Knowledge
- Knowledge Storage
- Knowledge Sharing
- Knowledge Distribution

3.2.3.1 Understand Knowledge

In this step, it is most important to understand knowledge. First, we have to understand the knowledge.

3.2.3.2 Knowledge Storage

Secondly, knowledge is store in the database properly.

3.2.3.3 Knowledge Sharing

In a distributed environment, the focus is to choose the mechanism of sharing knowledge among all.

3.2.3.4 Knowledge Distribution

Fourthly, choose the mechanism that properly distributes the knowledge.

3.2.4 Phase 4

The fourth phase shows the analysis process and steps. In this phase, the requirements are analyzed to be specified and validated in further processes.

4 Results and Discussion

In this section, we have discussed the results of the proposed framework.

4.1 Survey Questions

The focal objective of this evaluation of the proposed work is to figure out how the proposed framework meets the elicitation and analysis process requirements and resolve the challenges of the distributed environment, as shown in Figure 3.
Q1. Does this framework give expected out/result?
The result shows that 83% agree, and 17% disagree.
Q2. Have you any experience working in a distributed environment?
The result shows that 76% agree, and 24% disagree.
Q3. In this framework, improving requirement elicitation?
The result shows that 65% agree and 9% disagree, 12% are Satisfactory, and only 14% are Neutral.

Q4. Is this framework being flexible for a large project? Is it true?
The result shows that 79% agree, and 21% disagree.
Q5. Is this framework clear and applicable?
The result shows that 82% agree and 5% disagree, 7% are Satisfactory, and only 6% are Neutral.
Q6. All the phase is in flow?
The result shows that 87% agree, and 13% disagree.
Q7. Give your opinion on adopting this framework in a distributed environment?
The result shows that 88% agree and 3% disagree, 6% are Satisfactory, and only 3% are Neutral.
Q8. Is this framework improving the Requirement elicitation and analysis process in a distributed environment?
The result shows that 91% agree and 2% disagree, 5% are Satisfactory, and only 2% are Neutral.
Q9. Are the requirements of knowledge management appropriately evaluated in a distributed environment?
The result shows that 79% agree and 4% disagree, 8% are Satisfactory, and only 9% are Neutral.

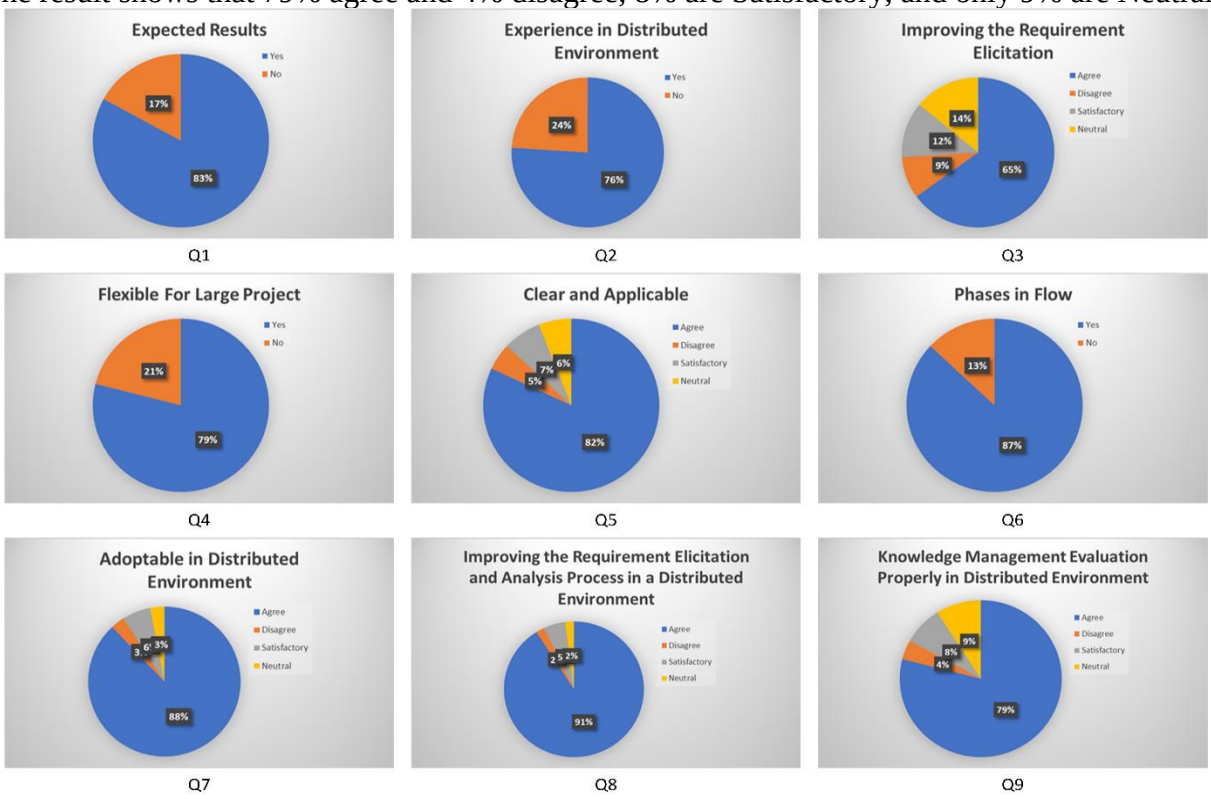

Figure 3 The graphical view of the requirements of the elicitation and analysis process

4.2 Case Studies

For evaluating the proposed framework, a case study is used to report and record the data.

4.2.1 Project in Pakistan with Ecolan

Following projects of the company adopted for case studies.

4.2.1.1 Information about the Company

The second example is Ecolan Pvt Ltd. This corporation is multinational. Ecolan is a Pakistani-based leading business in telecom value-added software, giving businesses strategic advantage by integrating mobiles with cloud/web apps. It has spread its ecosystem, and its listed office is in Karachi, or its subsidiary is in Islamabad. The company's mission is to build, operate and provide a wide variety of technologies in digital text messaging, IVRs, smartphone software, smartphone gaming, revenue management tools, social networking, and mobile banking services. The whole team consists of over fifty people. Twenty plus staff managers compose the sub-office unit. The business employs agile methods. For additional build resources, scrum is used.

4.2.1.2 Software development in Ecolan Company

The company is using scrum in practice. The company team consists of analysts, designers, developers, and project managers. The headquarter of the company has more than five project managers. The Islamabad company has three project managers. The project teams tried to work on scrum practices. They use different mediums for communication like email, skype, etc. The tasks are assigned to the dispersed teams through multiple sites as an assignment. The primary issue faced by dispersed teams is to communicate and coordinate with each other. They faced difficulty with understanding the code of each site and face the problem of low net issues. They faced difficulties in terms of communication and data collection because discussion over social media in the dispersed team is not clear in a way to understand the code in case of facing net issues or other difficulties.

4.2.2 Project in Pakistan with Vision Plus Technologies

The following are the descriptions of vision plus technology projects.

4.2.2.1 Information about the Company

The considered company as the first case is Vision Plus Technologies. This company is a multinational company. The Vision Plus Technologies company used to develop web, mobile, and desktop applications worldwide. The Vision Plus Technologies company is distributed among several countries. The company is distributed in Lahore, Karachi. The goal of the project is to develop mobile, web, and desktop applications. The total number of members of the team is fifty plus. The Karachi team consists of thirty members. The Lahore team consists of twenty-plus team members. The Vision Plus Technologies company follows agile methodologies. Scrum is used for web, mobile, and desktop development applications.

4.2.2.2 Software development in Vision Plus Technologies Company

The Vision Plus Technologies company is using Scrum practices. There are five project managers in Vision Plus Technologies company. The Karachi company has two project managers, and the Lahore company has two project managers. The project teams are distributed, Lahore and Karachi companies tried to work on scrum practices. They use different mediums for communication like Facebook, Skype, etc. The tasks are assigned with the dispersed teams at multiple sites through

the assignment. The primary issue faced by dispersed teams is to communicate and coordinate with each other. They faced difficulty with understanding the code of each site among each other. They faced difficulties in communication and control because discussion over social media is not an exact way to understand the code between the dispersed team.

4.3 Case Studies Implementation

The implementation of case studies: Ecolan and Vision Plus Technologies shows in Table 1.

Table 1 Case Studies Implemented on Proposed Framework

Proposed Modules	Case 1 Ecolan	Case 2 Vision Plus Technologies
User request	The user request to create, manage, and delivered a rich portfolio of services that continue to grow in the area of integrated SMS, IVRs, mobile applications	The user request to develop a mobile and desktop application
Eliciting requirements	The Ecolan, the requirements of the user	The Vision Plus Technologies the requirements of the user
Knowledge management	The Ecolan company maintains the knowledge and delivers to the customers	The Vision Plus Technologies company maintains the knowledge and delivers to the customers
Analysis process	The Ecolan company requirements and analysis to be specified and validated in the further process	The Vision Plus Technologies company requirements and analyze to be specified and validated in the further process

4.4 Home Screen

The home screen image where the location base session in the organizations is shown in Figure 4.

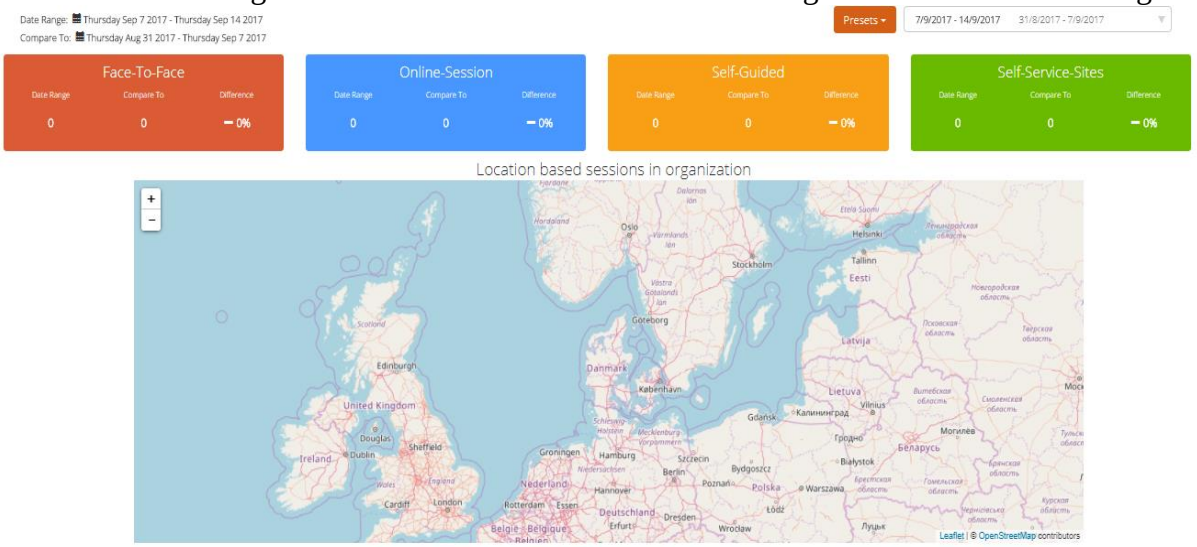

Figure 4 Home Screen

4.5 Create New Customer

The screenshot of the create new customer and presentation is shown in Figure 5.

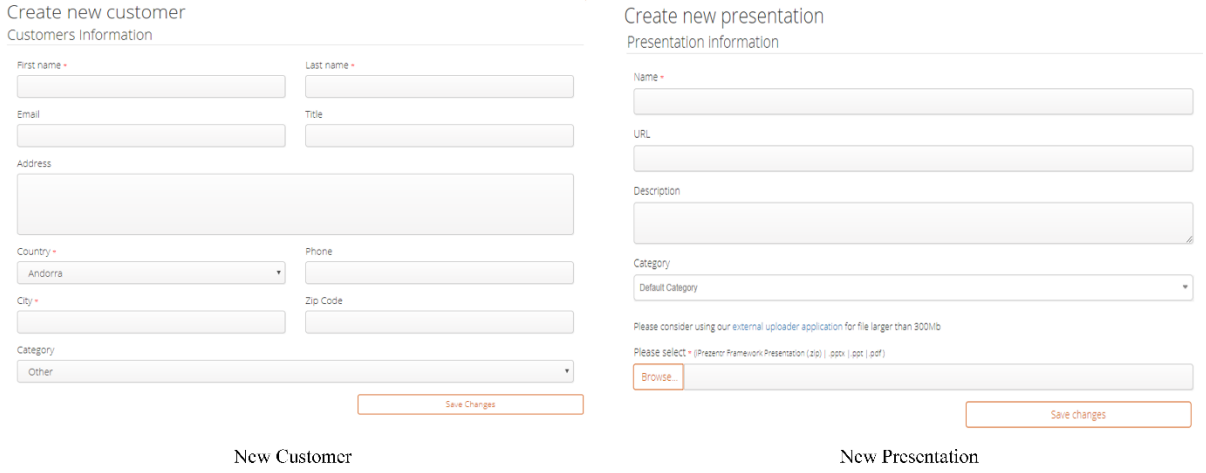

Figure 5 Create New Customer and presentation

4.6 Results of Proposed Framework in Case Studies

The results of case studies have been shown in Figure 6. In which we have discussed the impact of the proposed framework on different aspects. We have evaluated that the impact towards requirements elicitation and analysis model for the distributed audience for improving communication is 57%, improving coordination and control is 60%, improving elicitation process is 63%, improving analysis phase is 73%, and at last, the improving knowledge management process has the highest impact which is 76%.

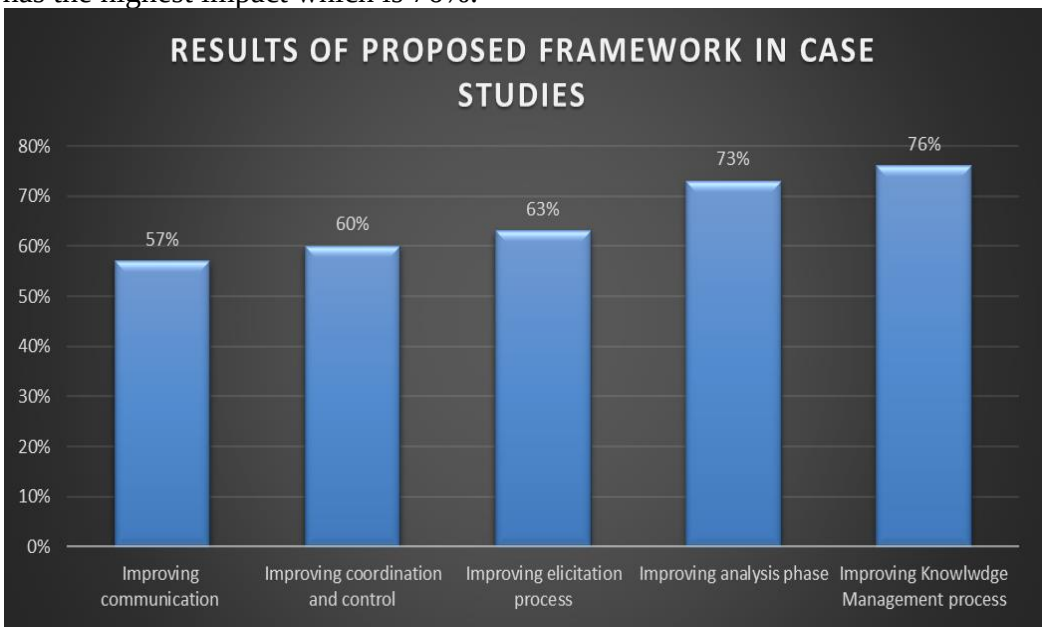

Figure 6 Results of Proposed Framework in Case Studies

5 Conclusion

In summary, we discussed the model of requirements elicitation and analysis model for the distributed audience. we discussed the requirement elicitation process and the analysis process in the distributed environment. There are a complete description and definitions of the proposed framework are mentioned in the thesis. The introductory chapter. In the introductory chapter, the introduction of the requirement elicitation and analysis process is elaborated. The concept of a distributed environment is also discussed. The scope and aim, and objectives of the project are depicted efficiently. The problem statement is also discussed. The overall structure of the project. The detailed research is done in a distributed environment. There is a complete overview of the requirement elicitation, and the analysis process is elaborated. Also focused on the problems and issues that are involved in the distributed environment. The benefits and challenges of the distributed environment are also discussed. There is the concept named requirement engineering is also elaborated. In this chapter, the requirements elicitation techniques in a distributed environment are also elaborated. Knowledge management techniques are also discussed.

The proposed framework is discussed. Our research focused on overcoming the identified challenges associated with using architectural knowledge effectively in a distributed environment. For the said purpose, we tried to develop an appropriate solution that accounts for the technical hitches in existing practices of AKM in a multisite environment. The solution will be comprised of three steps. Firstly, we understood the concrete and fundamental facts of managing architectural knowledge in a distributed environment. Secondly, identification of the limitations and comparison of existing practices that cater to the problem associated. By doing the learning and analysis of the existing practices, a set of features will be identified, which serves to manage AK in the required situation.

Based on the findings of the conducted literature review, we will try to improve the existing short by proposing a framework. The objective of our proposed work will be to focus on and overcome the identified challenges associated with using architectural knowledge effectively in a distributed environment. Finally, keeping in view the research problem, action research will be chosen to solve the current issues of AKM Practices. A tool will be developed based on the proposed framework, and a case study-based experiment will be performed on the developed tool to testify whether the laid down objective has been achieved. The focal objective of this research is to evaluate the proposed work to figure out how the proposed framework meets the requirements of the elicitation and analysis process and resolve the challenges of the distributed environment.

References

[1] N. Seyff *et al.*, "Crowd-focused semi-automated requirements engineering for evolution towards sustainability," in *2018 IEEE 26th International Requirements Engineering Conference (RE)*, 2018, pp. 370-375: IEEE.

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

[3] T. Ambreen, "Handling Socio-Technical Barriers Involved in Crowd-Based Requirements Elicitation," in *2019 IEEE 27th International Requirements Engineering Conference (RE)*, 2019, pp. 476-481: IEEE.

[4] N. Patkar, L. Merino, and O. Nierstrasz, "Towards requirements engineering with immersive augmented reality," in *Conference Companion of the 4th International Conference on Art, Science, and Engineering of Programming*, 2020, pp. 55-60.

[5] A. Faber, S.-V. Rehm, A. Hernandez-Mendez, and F. Matthes, "Collectively constructing the business ecosystem: towards crowd-based modeling for platforms and infrastructures," in *International Conference on Enterprise Information Systems*, 2018, pp. 158-172: Springer.

[6] L. R. Wong, D. S. Mauricio, and G. D. Rodriguez, "A systematic literature review about software requirements elicitation," *J Eng Sci Technol*, vol. 12, no. 2, pp. 296-317, 2017.

[7] C. Pacheco, I. García, and M. Reyes, "Requirements elicitation techniques: a systematic literature review based on the maturity of the techniques," *IET Software*, vol. 12, no. 4, pp. 365-378, 2018.

[8] T. Iqbal, N. Seyff, and D. Mendez, "Generating Requirements Out of Thin Air: Towards Automated Feature Identification for New Apps," in *2019 IEEE 27th International Requirements Engineering Conference Workshops (REW)*, 2019, pp. 193-199: IEEE.

[9] A. Alwadain and M. Alshargi, "Crowd-Generated Data Mining for Continuous Requirements Elicitation," *Editorial Preface From the Desk of Managing Editor…,* vol. 10, no. 9, 2019.

[10] H. Dar, M. I. Lali, H. Ashraf, M. Ramzan, T. Amjad, and B. Shahzad, "A systematic study on software requirements elicitation techniques and its challenges in mobile application development," *IEEE Access*, vol. 6, pp. 63859-63867, 2018.

[11] R. Sharma and A. Sureka, "CRUISE: A platform for crowdsourcing Requirements Elicitation and evolution," in *2017 Tenth International Conference on Contemporary Computing (IC3)*, 2017, pp. 1-7: IEEE.

[12] K. Villela *et al.*, "Towards ubiquitous RE: A perspective on requirements engineering in the era of digital transformation," in *2018 IEEE 26th International Requirements Engineering Conference (RE)*, 2018, pp. 205-216: IEEE.

[13] J. J. Y. Chung, J. Y. Song, S. Kutty, S. Hong, J. Kim, and W. S. Lasecki, "Efficient elicitation approaches to estimate collective crowd answers," *Proceedings of the ACM on Human-Computer Interaction*, vol. 3, no. CSCW, pp. 1-25, 2019.

[14] A. Bhimani and P. Spoletini, "Empowering Requirements Elicitation for Populations with Special Needs by Using Virtual Reality," in *Proceedings of the SouthEast Conference*, 2017, pp. 268-270.

[15] H. Sammaneh, "Requirements Elicitation with the Existence of Similar Applications: A Conceptual Framework," in *2018 International Conference on Computer and Applications (ICCA)*, 2018, pp. 444-9: IEEE.

[16] B. Morkos, S. Joshi, and J. D. Summers, "Investigating the impact of requirements elicitation and evolution on course performance in a pre-capstone design course," *Journal of Engineering Design*, vol. 30, no. 4-5, pp. 155-179, 2019.

[17] K. J. Gülle, N. Ford, P. Ebel, F. Brokhausen, and A. Vogelsang, "Topic Modeling on User Stories using Word Mover's Distance," *arXiv preprint arXiv:2007.05302*, 2020.

[18] M. v. Vliet, "A Crowdsourcing Technique for the Requirements Elicitation from Online Reviews," 2019.

[19] D. Carrizo, O. Dieste, and N. Juristo, "Contextual attributes impacting the effectiveness of requirements elicitation Techniques: Mapping theoretical and empirical research," *Information and Software Technology,* vol. 92, pp. 194-221, 2017.

[20] A. Borchert, N. E. Díaz Ferreyra, and M. Heisel, "Balancing trust and privacy in computer-mediated introduction: featuring risk as a determinant for trustworthiness requirements elicitation," in *Proceedings of the 15th International Conference on Availability, Reliability and Security*, 2020, pp. 1-10.

[21] D. L. Dantas, L. V. L. Filgueiras, A. A. F. Brandão, M. C. M. Domingues, and M. R. Ferreira, "Detecting IoT Applications Opportunities and Requirements Elicitation: A Design Thinking Based Approach," in *International Conference on Human-Computer Interaction*, 2020, pp. 85-100: Springer.

[22] A. M. Nascimento, D. S. da Silveira, J. S. Dornelas, and J. Araújo, "Exploring contextual factors in citizen-initiated platforms to non-functional requirements elicitation," *Transforming Government: People, Process and Policy,* 2020.

[23] T. Zhang and L. Ruan, "The challenge of data-driven requirements elicitation techniques: Systematic Literature Review & Controlled Experiment," ed, 2020.

[24] A. Aldave, J. M. Vara, D. Granada, and E. Marcos, "Leveraging creativity in requirements elicitation within agile software development: a systematic literature review," *Journal of Systems and Software,* vol. 157, p. 110396, 2019.

[25] R. M. A. Latif, M. Umer, T. Tariq, M. Farhan, O. Rizwan, and G. Ali, "A smart methodology for analyzing secure e-banking and e-commerce websites," in *2019 16th International Bhurban Conference on Applied Sciences and Technology (IBCAST)*, 2019, pp. 589-596: IEEE.

[26] R. M. A. Latif, M. T. Abdullah, S. U. A. Shah, M. Farhan, F. Ijaz, and A. Karim, "Data Scraping from Google Play Store and Visualization of its Content for Analytics," in *2019 2nd International Conference on Computing, Mathematics and Engineering Technologies (iCoMET)*, 2019, pp. 1-8: IEEE.

[27] H. Aldabbas, A. Bajahzar, M. Alruily, A. A. Qureshi, R. M. A. Latif, and M. Farhan, "Google Play Content Scraping and Knowledge Engineering using Natural Language Processing Techniques with the Analysis of User Reviews," *Journal of Intelligent Systems,* vol. 30, no. 1, pp. 192-208, 2020.

[28] Humayun, M., & Jhanjhi, N. Z. (2019). Exploring the relationship between GSD, knowledge management, trust and collaboration. Journal of Engineering Science and Technology (JESTEC), 14(2), 820-843.

[29] Hamid, M. A., Hafeez, Y., Hamid, B., Humayun, M., & Jhanjhi, N. Z. (2020). Towards an effective approach for architectural knowledge management considering global software development. International Journal of Grid and Utility Computing, 11(6), 780-791.

[30] C. Diwaker et al., "A New Model for Predicting Component-Based Software Reliability Using Soft Computing," in IEEE Access, vol. 7, pp. 147191-147203, 2019, doi: 10.1109/ACCESS.2019.2946862.

[31] Waheed, S., Hamid, B., Jhanjhi, N. Z., Humayun, M., & Malik, N. A. (2019). Improving knowledge sharing in distributed software development. IJACSA) International Journal of Advanced Computer Science and Applications, 10(6).

[32] Saeed, S., Jhanjhi, N. Z., Naqvi, M., & Humayun, M. (2019). Analysis of Software Development Methodologies. International Journal of Computing and Digital Systems, 8(5), 446-460.

[33] Alsaade, F., Zaman, N., Hassan, M. F., & Abdullah, A. (2014). An Improved Software Development Process for Small and Medium Software Development Enterprises Based on Client's Perspective. Trends in Applied Sciences Research, 9(5), 254.