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Master of Software Engineering

Using Social Network and Gamification to Improve Stakeholders Involvement in Requirement Elicitation, Prioritization and Negotiation

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Abstract

Stakeholders' involvement is considered a key success factor in requirement engineering process. It has been reported by many researchers that stakeholders' involvement has a positive effect on their satisfaction and system acceptance.

The traditional techniques, such as interviews, workshops, and focus groups are not easily applicable to gather requirements by geographically distributed requirements engineering teams, which require direct interaction with and amongst stakeholders.

Many studies have shown that social networks can be used in the requirement collection process to gather requirements in cases involving geographically distributed environments. However, the current social network tools still suffer from lack of stakeholder involvement.

In this study, we propose a new framework titled "Sharek", which incorporate social network features into requirement engineering activities to enable a geographically distributed Requirements Engineering team to get involved during each activity. In addition, it incorporates gamification techniques into each activity to increase stakeholders' engagement during the whole process.

A real-world case study has been conducted to explore the impact of using social network and gamification during the requirement elicitation, prioritization, and negotiation. The result has shown that social network can be used as a primary technique for the requirement elicitation and negotiation in

a distributed working environment. In addition, Incorporating Gamification with social networks has a positive effect on the requirements engineering process; it has motivated the participants to write high-quality requirements and be more productive

الملخص

تعتبر مشاركة وتفاعل (مالكي المشروع) أصحاب العلاقة من أهم العوامل الأساسية في إنجاح عملية جمع المتطلبات. وقد اشار العديد من الباحثين الى أن أهمية ذلك تكمن في تأثيرها بشكل ايجابي على رضاهم وتقبلهم للنظام المنشأ فيما بعد.

إن التقنيات التقليدية المتبعة مثل المقابلات، ورشات العمل، والتركيز على مجموعات محددة لجمع متطلبات مشروع معين من أصحاب العلاقة أصبحت غير مجدية إذا كانت تلك المجموعات موزعة على عدة مناطق جغرافية.

فقد بينت العديد من الدراسات ان الشبكات الاجتماعية يمكن استخدامها لعملية جمع المتطلبات من أصحاب المصلحة الموزعين على عدة مناطق جغرافية. وبالرغم من ذلك فإن الادوات الحالية لا تزال تعاني من ضعف في تحسين تفاعل ومشاركة اصحاب المصلحة.

تقدم هذه الدراسة إطار عمل يسمى "شارك"، يقوم يدمج تقنية الشبكات الاجتماعية في العمليات الخاصة بجمع المتطلبات، للتسهيل على أصحاب المصلحة الموزعين جغرافيا من التفاعل والمشاركة خلال مراحل عملية جمع البيانات وعناصر المشروع. بالاضافة لدمج تقنية اللعب مع كل عملية وذلك في سبيل زيادة التفاعل والمشاركة من جانب اصحاب المصلحة خلال مرحلة جمع بيانات ومتطلبات المشروع.

بينت هذه الدراسة تاثير استخدام الشبكات الاجتماعة المدمجة بتقنيات اللعب خلال مرحلة جمع البيانات، ومرحلة التقييم والتفاوض. وقد أتضح من النتائج ان تقنية الشبكات الاجتماعية يمكن استخدامها كتقنية أساسية لعملية الجمع والتفاوض في البيئة التي يكون اصحاب المصلحة موزعين ومتباعدين جغرافيا. بالاضافة الى ان عملية دمح تقنية اللعب مع تقنيات الشبكة الاجتماعية أثرت بشكل إيجابي على عملية الجمع؛ حيث انعكس ذلك على تحسين المشاركة وكتابة متطلبات عالية الجودة، كما وساعد ايضا على زيادة الانتاجية.

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With the Grace of **ALLAH** almighty, this work has been accomplished. ...

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Chapter 1

Introduction

This chapter presents the chosen subject, the problem and the objective of the study and the research question proposed.

1.1 Introduction and Motivation

The main activities of requirement engineering include requirement elicitation, prioritization, and negotiation [2]. On the one hand, requirement elicitation involves capturing and understanding the stakeholders' requirements. [56, 24]. On the other hand, the main concern of Requirement Prioritization is to achieve consensuses among stakeholders on a set of candidate requirements [4]. Moreover, Requirement Negotiation is concerned with providing new options, and resolving conflicts amongst requirements [47, 19].

Many software projects have failed to deliver within the allotted time and budget limitations due to inaccurate requirements [8]. This is often caused by lack of stakeholder involvement during the requirement engineering process [22]. In contrast, high stakeholder involvement leads to a higher acceptance rate of the system and to higher stakeholder satisfaction [26].

Stakeholder involvement is a challenge, especially when a requirement engineering team involves stakeholders who are geographically distant [45]. This geographical distance forces a team to gather requirements in a fragmented environment in which techniques such as focus groups, workshops, and interviews are not applicable, due to lack of direct interaction between the stakeholders [29]. The aim of this study is to improve geographically distant stakeholders' involvement in the requirement engineering activities i.e. elicitation, prioritization, and negotiation. We propose a new framework titled *(Sharek)* which enables geographically distant stakeholders' involve during the requirement engineering activities. To explore the impact of using social network and gamification, we conducted a real-world case study to gather new requirements from a distributed government institution stakeholders' in Palestine Government Institution. The case study result shown that Social Network has allowed a geographically distributed stakeholder to involve during the elicitation, prioritization, and negotiation. In addition, social network features including posting, comment on a post, voting/rating can support the requirement engineering activities tasks including elicitation, prioritization, and negotiation respectively. Furthermore, Gamification has improved the stakeholder involvement, during the requirement elicitation, prioritization, and negotiation; it motivates stakeholders, increased their productivity and performance.

1.2 Research Problem Statement

Stakeholders' involvement is a challenge especially when we need to gather the user requirements from a geographically distributed stakeholders [45]. The traditional techniques such as focus group, workshops and interview required direct interaction between requirement engineering and the stakeholders. In addition, they are not appropriate when we need to gather requirements from a large number of a geographical distributed stakeholders [29]. There are a group of collaborative support tools such as video conferencing, email, chatting and bug system tools and others. These tool can be used for allow a distributed stakeholders for communicating. However, these tools can solve some of the problem, but not all. Moreover, they bring a new challenges [35].

1.3 Research Objectives

In this study, we need to achieve two objectives. The first one is to allow a geographically distributed stakeholders to involvement in requirements elicitation, prioritization, and negotiation. The second objective is to improve stakeholders' involvement and keep them motivated during the whole software engineering activity task.

1.4 Assumption

A possible means to achieve our objective is by using a social network for making stakeholders' involve during elicitation, prioritization, and negotiation. Furthermore, using gamification to improve their involvement, and keep them motivated during the whole process See Fig.1.1.

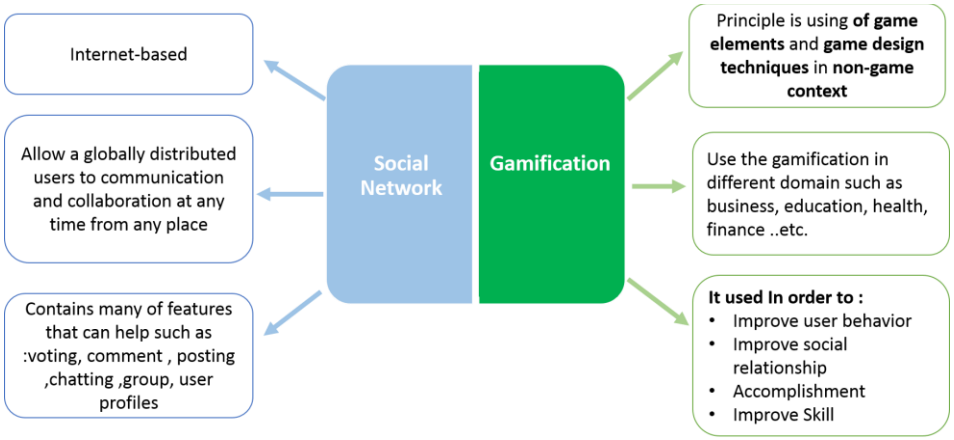


FIGURE 1.1: Possibility to achieve the objectives

1.4.1 Social Network

A social network is Internet-based community; built on web 2.0 technologies, and allows globally distributed users to communication and collaboration at any time from any place. Furthermore, it contains many features such as posting, comment on the post, chatting, voting, user profile, and groups [15] which encouraging stakeholders participation, during requirements elicitation, prioritization and negotiation.

1.4.2 Gamification

The gamification principle is using game elements and game design techniques in non-game context [52]. It initially was used by marketers and website product managers for maximizing the customer engagement. An example of that is the Stack Overflow which is a question-and-answer website for the developer; users receive points and badges when they are performing a specific action or task [1].

Many researchers started to use gamification in numerous domain such as education, health, finance, productivity and entertainment media etc., in order

to improve the user behavior, social relationship, accomplishment and their skill [52].

1.5 Research Questions

In this study, we focus on answering twoquestions.

1. How can social network improve requirement elicitation, prioritization, and Negotiation?
2. How can gamification increase stakeholders' involvement during elicitation, prioritization, and negotiation?

1.6 Summary of Our Work

1. Discussing the limitation of the current studies
2. Proposed a new Framework titled "Sharek" for involving distributed stakeholders and for improving their involvement.
3. Implement a tool that applies Sharek framework.
4. Conduct a case study in a real government environment, in order to answer the research questions, and evaluate Sharek framework.

1.7 Overview of this thesis

- **Chapter 2: Theoretical Background:** This chapter aims to present a theoretical background about the Software Requirement Engineering and stakeholders' involvement. It begins by Definition, theories, challenges, and practices in the requirement engineering.

- **Chapter 3: Literature Review:** The purpose of this chapter is to obtain the current knowledge of the current studies that focus on involving distributed stakeholders in software engineering. So that, we can identify the areas where additional information is needed. In addition, it discuss the current related study limitation.

- **Chapter 4: Sharek: A Framework for Involving Distributed Stakeholders during Requirement Elicitation, Prioritization, and Negotiation.** In this chapter, we propose a new framework title as "Sharek". At the beginning of this chapter, we start with Sharek framework core definition. Section 5.1 discusses Requirement Engineering Activities that are supported by the Sharek framework. Section 5.2 discusses the Sharek process which consists of a set of activities that allow distributed stakeholders to be involved in the requirement engineering activities. Section 5.3 discusses how the 6D Gamification Design Framework has been adapted to gamify Sharek activities. Gamifying the Requirements Engineering process aims to improve stockholders involvement during the process activities and tasks.

- **Chapter 5: Research Methodology** This chapter discuss the research methodology that was followed to conduct the research. Action research methodology was adopted, so this chapter will discuss the case study, the setting of the research case study, and how the data was collected and analyzed.

- **Chapter 6: Case Study Result** This chapter discuss the result of the case study regard to our observation, notes and the online survey result that has discussed in chapter.5.

- **Chapter 7: Discussion** In this section, we discuss our research question answer regarding the research result as illustrated in Chapter.6. In addition, we discuss the threat to validity.
- **Chapter 8: Conclusion** This chapter, represent our thesis conclusion. In addition, discussing our future work and recommendation.

Chapter 2

Theoretical Background

This chapter aims to present a theoretical background about the Software Requirement Engineering and stakeholders' involvement. It begins by Definition, theories, challenges, and practices in the requirement engineering.

2.1 Requirement Engineering Activities

The key activities in requirement engineering are [2]: Requirements elicitation, prioritization and negotiation.

2.1.1 Requirement Elicitation

Requirement Elicitation is an important factor when developing a new system; wrong elicitation practice lead the system to fail [24].

There is no stander definition of the requirement elicitation. Thayer and other [50] identify the requirements elicitation as discover, understanding, reviewing and articulating the stakeholders' needs. Zowghi and other [56] identified it as the first step in requirement engineering which responsible for learning and understanding the stakeholders needs [56]. Shadab Khan [24] define it as the first stage in requirement engineering that tries to define the scope of the system and user requirements. In addition, it depends on communication

and cooperation between in addition, it depends on communication and cooperation between stockholders.

Regarding previous definition, the requirements elicitation mainly concern with the following:

1. Identify stakeholders.
2. Gather, understand and identify the stakeholders' needs.
3. Apply a Collaboration and communication between stakeholders

2.1.1.1 Stakeholder

Stakeholder is a person, group or organization who could affective positively or negatively on the project success [37]. Stakeholders' are the source of requirement during requirement elicitation process. So, the most important step it to identify these stakeholders at begin of requirement elicitation process; missing some of stakeholder can rise to miss some of requirement and make project to fail [37].

2.1.1.2 Requirements

Wiegers and other [53] present three distinct levels of requirements including business requirements, user requirements and the functional requirements.

- **Business requirements**: describe the business objective, and the benefits that organization needs to achieve when implement the system.
- **User requirements:** Describe the task or the goals that user need to achieve with the system.

- **Functional requirements**: It defines the function of the system; describe the product behavior and software functionality that enables the end user to achieve their objective and satisfying the business requirements.

Lamsweerde [51] has define requirements regarding on the problem world and the machine solution concept; the requirements have two types:

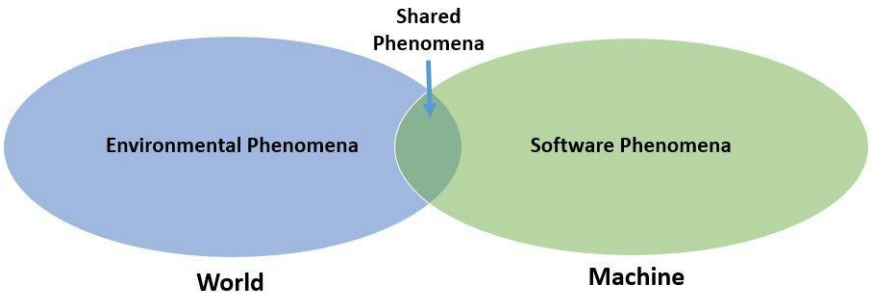


FIGURE 2.1: Problem world and machine solution [51]

- **System requirements**: It what system-to-be should be met. In addition, formulated in term of environment phenomena
- **The Requirements**: It is what software-to-be should be meet on its own. In addition, it formulated in term shared phenomena.

In this study, we focus on to identify the user requirements (or in other definition called system requirements).

2.1.1.3 Exploring the User Requirements

The most common techniques for exploring and understanding the user requirements is user story and use case. They are appropriate for requirement exploring from high-level abstraction [53]. In this study, we decided to select user stories for exploring and understanding the user's needs which is simpler and more understandable by the stakeholders [53].

The user story is a short description statement which gets from the user perspective; it represents the user need, and it represents the starting point for the discussion [53]. Moreover, the user story is one of the most technique for enabling the user to identify their needs in a semi-structured format [47]; it more easily to maintain when requirements change. Moreover, It simplicity, easy to learn and understandable by the stakeholders [53, 47].

User Story expresses Who, What, Why ant it was written using a structure template as the following format [53].

As a <User type> I want to achieve < Goal> so that <Reason>

- <Type> represent who: The role of the user in the real world environment
- <Goal> represent What: feature or functionality that user needs
- <Reason> represent Why: The returned value that user will get if the feature or the functionality exists

2.1.2 Requirements Prioritization

Requirement prioritization is a type of decision-making and is a critical step in requirement engineering [23, 4]; it made by stakeholders in order to get the right decision and identifying the most optimal set of candidate requirements that are valuable from their perspective[4].

Prioritizing requirements can take a different type of aspects. The main aspect including: ***Important, Penalty, Cost, Time, Risk and Volatility***. It is important to consider what aspects are important and most desirable before starting the requirement prioritization [4].

2.1.2.1 Prioritization Scales

They are a different type of scale that can be used in requirement prioritization [4] the main scales are:

- **Ordinal scale (OS)**: It is most effective and widely used by psychologists; it measures the numeric concepts, for example happiness, satisfaction, it is easy to remember and leads to fruitful results. In requirement prioritization, the Ordinal scale is the least powerful prioritization scale; it orders the requirements according to important. However, It just allows to see the important requirement, not how much more important [4].
- **Ratio scale (RS):** It is the more powerful scale. In requirements prioritization RS can allow us to see how much more important each specific requirements [4].

Prioritization Techniques

According to Berander and other [4], there are different types of prioritization techniques that can be used in requirements prioritization.

- **Analytical Hierarchy Process (AHP)**: It is a systematic decision method used for prioritizing the requirement. It determines the high priority by comparing all pairs of the hierarchically classified requirements. AHP is very complex and not suitable for a large number of requirements.
- **Cumulative Voting, the 100-Dollar Test**: In this technique, stakeholders are given 100 imaginary unit in order to distribute between requirements. This technique takes a problem when there are too many requirements.

- **Numerical Assignment**: It is grouping based technique and wild used for prioritization requirements. It based on grouping the requirement into different priority (e.g. optional, standard, critical or low, medium, high). It very easy to understand. However, this technique makes user confusing with grouping term i.e. low, medium, and high. In addition, each requirement in the same group have the same priority e.g. if the requirement is prioritizing regarding important, we can't distinguish which are the most important requirements in the same group because of all the same priority.

- **Ranking**: It is numeric based technique; it scale range between 1 and n. Where 1 means low priority and n mean most priority. It easy scales and there is possible to combine with others techniques e.g. Numerical Assignment. In this scale, each requirement get a unique priority so that we can't see the relative difference between these requirements.

- **Top-Ten Requirements**: In this technique the stakeholder select top ten of a large set of requirements without order the requirements. It enables to get set of requirements that are equally important and shared among the stakeholders. However, this technique can create unnecessary conflict e.g. when some of stakeholder select top five and other select top ten.

2.2 Requirement Elicitation Challenges

There are many challenges related to requirement elicitation [49, 48]:

1. Identifying tacit knowledge: When requirements are not clearly defined and the requirements appear with no clear source, this lead to further investigate these requirements.

2. Knowing the relevant and the necessary detail of the requirements, from the analyst perspective.

3. Articulating: The needed knowledge should be in a correct context and understood by all stakeholders.

2.3 User Involvements

Many studies [3] have explained the importance of stakeholders' involvement in software engineering. The Baroudi in study [3] shown when stakeholders are involvement this leads to high usage of the system and increase the stakeholder's satisfaction. Where El Emam and Madhavji in study [16] have found a lot of benefit of the early user involvement in the system. Moreover, Kujala [25] shown that the user involvement has generally positive effect on the user satisfaction, and when the user taking as a primary source of information this can lead to capturing the requirements effectively. Furthermore, the stakeholders' involvement plays an important role, where lack stakeholders involvement lead to many problems, and the early user involvement leads to better requirement quality and increases system success [26].

2.3.1 Globally-distributed Stakeholders Involvement challenges

When stakeholders are geographically distributed there are a lot of challenges. The main challenges are [21, 10,9]:

- Different Distance: It creates barrier to informal face to face communication where this can impact on building a relationship between the stakeholders, which is important on requirement negotiation. The traditionally available communication techniques e.g. email, Phone, video conference

..etc. can't enable them to communicate and collaborate efficiently and sometimes create new challenges.

- Different culture: The different stakeholder language and national culture can affect the global collaboration and communication. This can lead to damage the trust among the stakeholders. In addition, they can't effectively share their knowledge.
- Different Time zone: Different time zone can often limit the progression and create a delay. Moreover, it makes lack of the stakeholders' to well establish conversation during the requirement engineering activities.

2.4 Gamification

The purpose of this section is to understanding the Gamification main principle and context. This allows us to use the appropriate and correct incentives, in order to engage and increase user motivation to doing something. In this section we mainly focus on [52] book which contains the most and news studies in gamification.

2.4.1 Gamification Definition

There is no universal definition of the gamification, in this study we using definition form [52] where it defines Gamification as The use of game elements and game design techniques in non-game context.

The definition consists of three parts:

1. Game Element
2. Game Design techniques

3. Nongame Context.

2.4.1.1 Gamification and Other Game Context

Gamification is not playing a game. It is staying in the real world and making it better by finding elements from the games, in order to enhance the experience and to distinguish between Gamification and another game context such as serious game, game theory, playful design, and toys [52].

There is a framework which comes from a group of researchers led by Sebastian Deterding for clarifying that. They used 2x2 matrix, see Fig 2.2; the matrix classifies the context into two dimensions: The first dimension, represents the difference between the whole game and Partial one; the other dimension distinguish between the play and game[13].

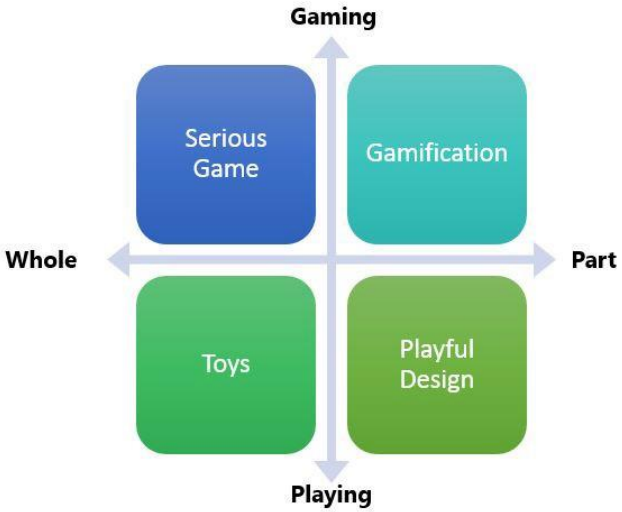


FIGURE 2.2: Different between Gamification and other game context [52]

2.4.1.2 What Are Not Gamification

- Playing the game: Making everything a game e.g. 3D game [52].

- Game in the workplace, which represent playing a game when work is boring, for example playing window solitaire [52].
- Playing a game in the business process e.g. play game when you are in the store [52].
- Serious game it type of video games which the purpose is to the simulation by putting the person into an environments [52].
- Game Theory: It using the mathematical model for strategic decision making [52].

2.4.2 Game elements

Game element is the tools box for the gamification; these elements are extracted from the game context and used in different context [52]. Werbach and Hunter in [52] have developed a framework for gamification elements that are in a form of a pyramid. The pyramid has contained the most common game elements that are found in Gamification and it was categorized into three categories of elements including dynamics, mechanics, and components. The pyramid structure represents a variety option for a gamification design. In addition, show the low levels that implement the high levels concept such as mechanic and dynamic.

a. **Dynamics**: It represents the big-picture aspects that should be managed and considers in a gamified system. However, it not directly interests into the game [52].

The Dynamics elements that are present in gamer are:

- **Constraints:** Limitation the players or force them to make a tradeoff.

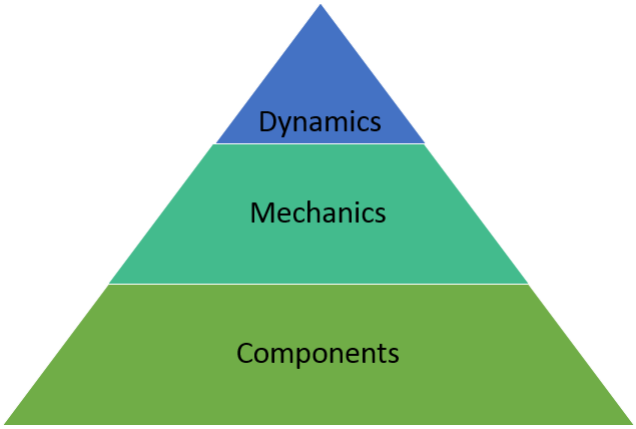


FIGURE 2.3: Pyramid of game elements [13]

- **Emotion:** Represent the competitiveness, frustration, happiness, curiosity. It can make the experience rich and joyful.
- **Narrative:** Represent the story behind the composition of the gamify system pieces in some coherent feeling whole.
- **Progression:** The player growth, it gives the player a sense that has an opportunity to improve.
- **Relationships:** It refers to the interaction between the players (Team, Friends .etc.)

b **Mechanisms**: They are known as the "Verb" of gamification. They are present the basic process that generates the user engagement into the game. Several mechanics can implement one or more dynamic, for example, both rewards and feedback can implement progression. The main Mechanisms elements are Challenges, Competition, Cooperation, Feedback, Rewards, Resource, and Transactions [52].

c **Component**: A Specific way how to do the high levels that are mechanic and dynamic. They are known as the "Noun" of gamification and they

represent the elements that can see in the interface of the game [52]. **Main of Components elements are:**

- Achievements: It kind of-of feedback. Where its focus on giving the user a reward in order to do something.
- Badges: A visual representation of achievements.
- Avatar: A visual representation of the user.
- Collection: Set of Badges or items.
- Levels: Step in the player progression.
- Points: Type of rewarded. Used for encouraging the user to do activities or some actions.
- Leader-board: Type of ranking that tells the user if they going up or going down. Moreover, it helps the user see their power, order, or their status.
- Quests: a Game notation that tells the user to do something.
- Content unlocking: The user needs to achieve something in the game in order unblock some content.
- Gifting: A free items or virtual currency that user get during the game.
- Social graph: It allows users to see their friends who are in the game and can interact with them.

The most obvious Gamification elements (The PBL Triad)

Kevin Werbach in [52] promote to use the points, badges, and leaderboards in gamification.

1. Points

    - It a way of keeping a score.
    - Determine the win state: who get the high points will be the winner.
    - Connect up with rewards: From the points, we can determine which rewards player can get up if has earned a number of points.
    - It provides feedback, where it shows a feedback how someone doing in the game.
    - It a way to display a progress
    - It provides a data for the game designer: game designer can see how many players earn a point and where they earning them and how fast they earning. This point can give an indicator of the game design what need to enhance in the gamified system.

2. Badges

    - It representation of the achievements: it represents a visual indication that player has reached a certain level, or has accomplished some objective was set for the gamified system.
    - It Flexibly: The badges can get to the player as the game designer want to motivate.

- Credential: Tell what each player has done.
- Used as Status symbol

3. Leader-boards: It have different types

   - Ranking
     - It tell the player where they stand relative to others.
     - It feedback about a competition.
   - Personalized Leader-board: Friend relative variant.

2.4.3 Game Design Techniques

The game is not just a mix of elements to gathers. The games are designed in a systematically, thoughtfully and artistically for the purpose of being fun design techniques it involves a way of thinking [52].

Prof Werbach [52] has suggested a design framework for a gamified system which is divided into six steps.

2.4.3.1 1. Define business objectives

By starting the gamification process, the first important things is to define a clear of the business objective, which represents goals need the gamified system to achieve. The goal is ***"what is this for"***. It not as getting user to accumulate point and badges. It as for examples: get a user to generate more idea or feedback, behavior change for a business purpose. From defining the goal we can find if the gamified system is a success or failed [52].

FIGURE 2.4: 6D Gamification Design Framework [52]

2.4.3.2 2. Delineate target behaviors

This step focus first, identifies what needs the users to do. Where there should be precise and specific. Next, define the success metrics that tell if gamified system achieves the goal or not. There are commonly used metrics such as DAU (average daily users)/MAU (Monthly average user) that tell how gamified system is engaging. Other metrics are Vitality and Volume of activity. It measures the social sharing rate, where the Volume of activity tell how much activity is happening such as a number of points are given per day, or how many badges user earn and how level user pass [52].

3. Describe your players

This step focuses on the user that will be participating in the gamified system. It one of the important game thinking that should be used, where the system can design in such a way that appropriate for these people. Describing the

player can be done using demographics (By describing their Age, Job title, Gender ..etc.), psychographics (by describing their value and personalities), Bartle's player types or any others frameworks [52].

2.4.3.3 Bartle's player types

Which represent a 2x2 matrix, see figure2.5.The matrix classifies the context into two dimensions the first dimension (X-axis) which represent different between exploring the world and interaction with others player. The second dimension (Y-axis) which represent the difference between the preference for interaction and unilateral action [52].

FIGURE 2.5: Bartle Player Types [52]

- Killer: The player who prefer revenge and competition with the others.
- Achiever: The player who prefer obtaining points, badges and finishing levels.
- Socializer: the player who focusing on a social aspect, helping other rather than playing.

- Explorer: The player who prefer to discover game feature and learn about the hidden place in the game

2.4.3.4 4. Devise activity cycles

They are two type of cycle to increase the user motivation in the gamified system. These cycles called engagement loops and progression stairs. The engagement loop represents consent process that gives the user something to do, some reason to be motivated to take action. After that when user accomplishes the task user will provide a feedback which makes user do another action [52].

It contains three components which can repeat endlessly:

1. Motivation: represent a specific behavior e.g. Challenge that motivates user to some task
2. Action: Task user should do e.g. add, answer some question.
3. Feedback: The result of the user action has done, which make the user do another action e.g. Point, Badges.

FIGURE 2.6: Engagement Loops [52]

However, engagement loops can't capture the user progression, which makes the player get bored. The progression stairs, represent the player journey in the gamified system. It helps to keep the gamified system more interesting [52].

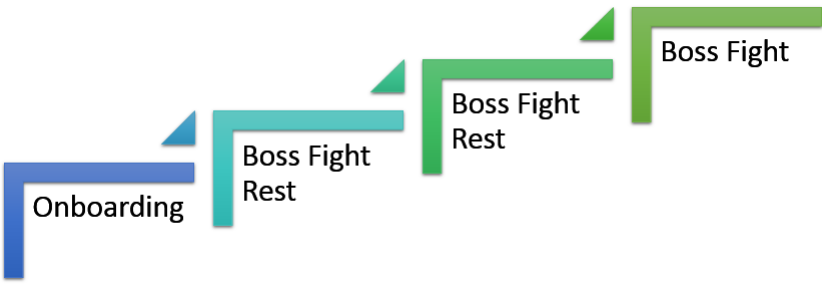


FIGURE 2.7: Progression Stairs [52]

2.4.3.5 5. Don't forget the fun

Fun is one of the most important factors in the gamification design; it more philosophical focus than the others ones, where the user should find it as a game. Werbach [52] mention the importance of making the user continue to motivate into the gamified system even without rewards.

2.4.3.6 6. Deploy the appropriate tools

This step focus on how to deploy the gamified system, what the tool, techniques used, and how the system would look like [52].

2.4.4 Non game Context

It means anything other than the game intent. When playing the game, the purposes is to have a fun. Gamification is said that stay in the real world and making it better by learn and finding elements from the games, so that can enhance the experience [52].

Chapter 3

Literature Review

The purpose of this chapter is to obtain the current knowledge of the current studies that focus on involving a distributed stakeholders in software engineering. So that, we can identify the areas where additional information is needed. Our literature review has started from 2007 to 2017 see Fig.3.1 , in order to obtain the current knowledge of the current studies that focus on involving a distributed stakeholders' in software engineering. So that, we can identify the areas where additional information isneeded.

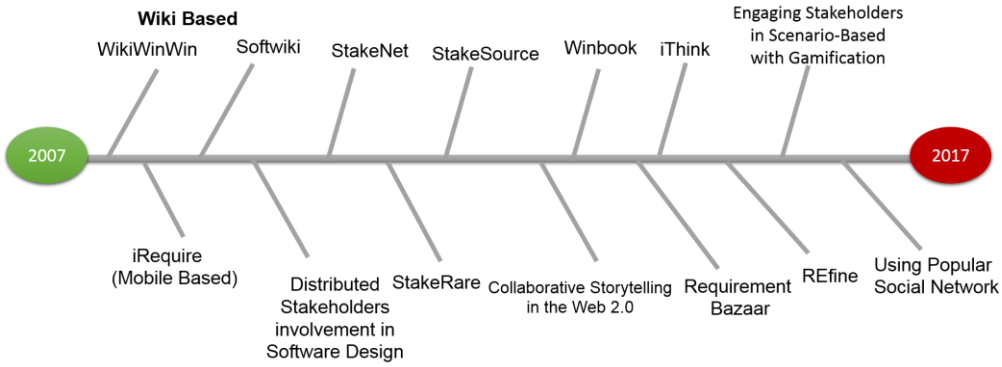


FIGURE 3.1: Studies about Involve a Distributed Stakeholders'

Involving geographically distant stakeholders in requirement engineering has been subject of multiple research efforts. We have classified the studies into three categories as following:

3.1 Studies used social network techniques to involve stakeholder in requirement engineering

This section, highlight the work that used the social network to allow stakeholder to involvement in Requirements Engineering. There are a many of works found and they that examining the impact of the social network in stakeholder involvement during the requirement engineering.

3.1.1 Wiki Based Studies

Wiki [12] is a web platform that allows a large number of stakeholders' to asynchronous collaboration and communication, grouping and structuring their requirements. Wiki allow stakeholders' to work on the same project and concurrently editing the content. Moreover, it helps for requirement traceability by providing page history. Furthermore, it helps in linking the content so that can reduce the redundancy [12].

3.1.2 Mobile Based Studies

This research based on using a mobile device which represents one of most personal the device, for involving a lot of active end-user in requirement engineering. They create iRequire, which is a mobile tool that enables end-user to (1) capturing i.e. by taking a picture for a specific object that related to their need, and (2) documenting their needs. Research has shown that iRequire, Enable end-user to continuously document and communicate their needs [44].

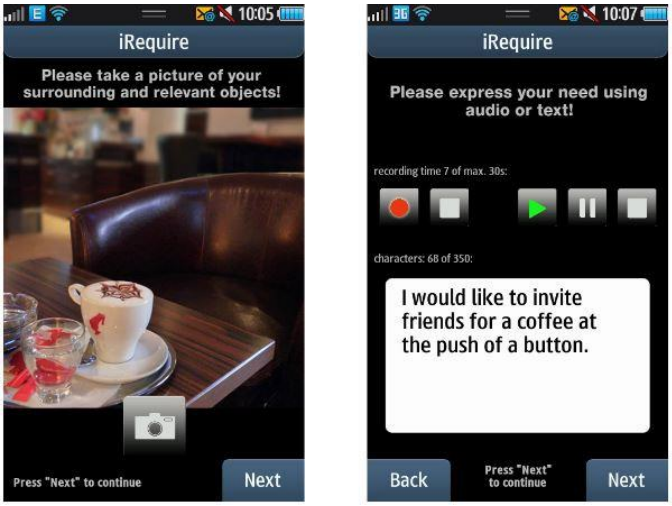


FIGURE 3.2: A screen-shot of iRequire [44]

3.1.3 WikiWinWin

WikiWinWin [55] is requirement negotiation system based on the WinWin requirements negotiation approach which represents these steps: Brainstorm and identity the stakeholders', converge on win conditions, prioritize win condition, identify the issue, provide options and reach the agreements. Moreover, it based on wiki technology. WikiWinWin allows stakeholders' collaborative negotiation and learning. The stakeholders' can share information and identify the win condition, resolving the conflict and adapting the change [55].

3.1.4 Softwiki

Softwiki [31] is a web platform that applies Social Software to requirements engineering. It supports the early phase of requirements engineering with a large number of geographically distributed stakeholders' with informal collaboration. Moreover, it focuses on fostering the engagement of stakeholders' in requirements collection, discussion, development, and structuring. It used commenting for allowing stakeholders' to identify their requirements, and it used Rating for prioritization and commenting, voting for negotiation [31].

3.1.5 Using social network and Collaborative filtering (Stake [Net, Rare, Source])

Some studies have focused stakeholder and requirements prioritization such as StakeNet [30] which is a method using the social network for identifying and prioritizing the stakeholders'. It consists of different steps: Find an initial set of stakeholders', Ask stakeholders' to recommend other stakeholders' and stakeholder roles, Get a list of recommended stakeholders' and Building the social network. The next generation of StakeNet is the StakeRare [29] which method that uses the social network and collaborative filtering for requirement prioritization. It focuses on asking the stakeholders' that are identified using StakeNet for prioritizing an initial set of requirements using their rating weight regarding their project influence. The StakeSource [28] which is a web-based tool applying StakeNet and StakeRare methods for support stakeholders' analysis and requirements elicitation and prioritization for large projects with many stakeholders' and requirements. For requirement identification, it starts by identifying the project description and scope, after that adding an initial set of requirement and use the notification email to inform stakeholders' to rate the existing requirement and suggest another one. In requirement prioritization, StakeSource using rating technique, where each stakeholder can give a requirement weight from one (Not Important) to five (Very Important) stares. StakeSource has been evaluated in the project in University College London, the result showed that method supports the prioritization accurately and identify comprehensive of stakeholders' set.

3.1.6 Winbook

Winbook [27] is a web-based social network for collaborative, negotiations and brainstorming of software requirements. It based on the WinWin methodology and it comes as the new avatar of the WinWin framework. Winbook is similar to the Facebook paradigm and its color-coded content is similar to Gmail. In requirement elicitation, the requirements are captured as win conditions. For requirement prioritization and negotiation, Winbook performs two-step for prioritization (1) prioritizing the goals: by decomposing the software that needs to develop into Minimal Marketable Features (MMFs). The prioritizing is apply using simple sliders which are Relative scale each stakeholder can select the priority score by growing/shrink the slider. (2) Prioritizing the requirements: Each High level of MMFs is decomposed into a set of requirements. And each requirement is prioritize using the scale from 1 (little contribution) to 9 (wholly contributes) [27].

3.1.7 Requirement Bazaar

Requirement Bazaar [40] is a social network focus on integrating the end-user and developers into distribution requirements elicitation, prioritization, and negotiation through building easy to use a tool (Requirement Bazaar) from the end-user perspective. Requirement Bazaar is a Web-based platform for requirement elicitation and prioritization. Moreover, it integrates between the end user and developer using the social feature in requirement negotiation process. In Requirements elicitation, stakeholders' can share there need with technical users as (comment, upload images). In requirements prioritization and negotiation, requirement bazaar supports voting requirements and support commenting on allowing more discussion and refinement. It lacks not support the voting power, consequently, the importance of requirement will absent [40, 39].

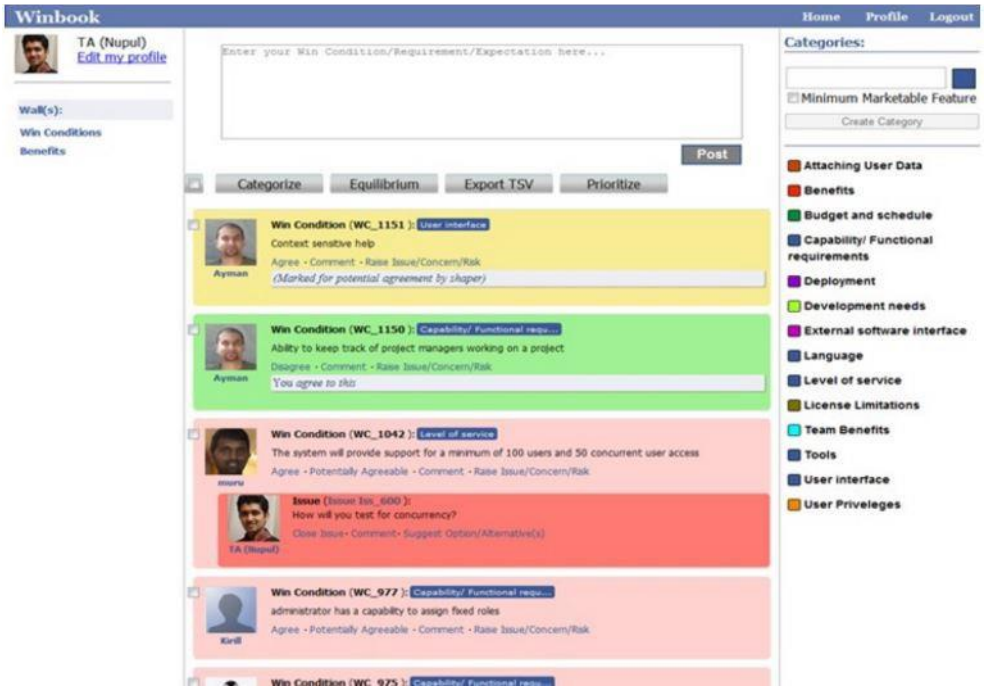


FIGURE 3.3: A screen-shot of winbook [27]

3.1.8 Using Popular Social Network (Facebook)

Seyff and other [45] presented an approach for using Facebook to support the requirements elicitation, prioritization, and negotiation. They aim to elicit needs and feedback from a heterogeneous large number of distributed and potentially anonymous stakeholders' who are not directly reachable by developer and product owner. Moreover, using a method that the end users are familiar with, to decrease the learning curve. The study finding shown that existing feature (e.g. post, comment on post and voting) of the Facebook can support requirements engineering process (i.e. elicitation, prioritization, and negotiation).

3.2 studies used the social network to involve users in others domains

This section, highlight the studies that used the social to involvement user in another domains.

3.2.1 Collaborative Storytelling in the Web 2.0

Cao and other [6] focused on combining the multimedia production with Web 2.0 in order collaborating storytelling with community i.e. represent people have a common goal. It is shown that person can collaborative to create and share their stories, and contact with an expert forget feedback.

3.2.2 A Distributed Stakeholders involvement in Software Design

Näkki and other [35] focused on involving geographically distributed stakeholders in the design and development process via social media. They based on several element of user participation that social media support such as: Openness (transparency and decisions), Interaction (user and developer can comment, voting, send feedback), Collaboration (co-creation idea and feature), Immediacy (user and developer can real-time communication and get feedback in short time) and Connectedness (user can participate from their own device from any location). The study was based on action research where it conducts over six months, and the result showed that social media provide possibilities for users' involvement in software design and development.

3.3 Studies used Gamification to improve stakeholder involvement

This section, highlight the studies that used the Gamification to increase user involvement in Requirements Engineering. There are a few works of literature found and they are limited in three main literature that examining the impact of gamification in requirement engineering.

3.3.1 iThink

iThink [18] is a gamified tool that attempted to resolve collaboration and user involvement problem. It aids collecting new requirements and increase group discussion, and getting feedback on the existing requirements. It integrated gamification concept with six thinking hats method to performing the elicitation and enhancing user involvement during the process. The Author used two case studies. First for evaluating the game mechanics and the proposed methodology and second for evaluation the prototype. The result showed both participant and the project manager are motivated and satisfied [18].

FIGURE 3.4: A screen-shot of iThink [18]

3.3.2 REfine

REfine [46] is a gamified online platform for requirement elicitation, it applies crowdsourcing and gamification to improve the process of developing new software functionalities. It allows Stakeholder to share their needs, comments on other needs, and vetoing it. It defines six type of game elements Roles, Resource, Point, Leaderboards, Group Forming, Exploration and Endorsements the research study was conduct a case study to obtaining requirement for the beta version of software from 19 stakeholders'. The case study result show the tool was useful for enhancing the requirement elicitation process and increase Stakeholders' engagements where stakeholders' felt more motivated comparing with previous experience [46].

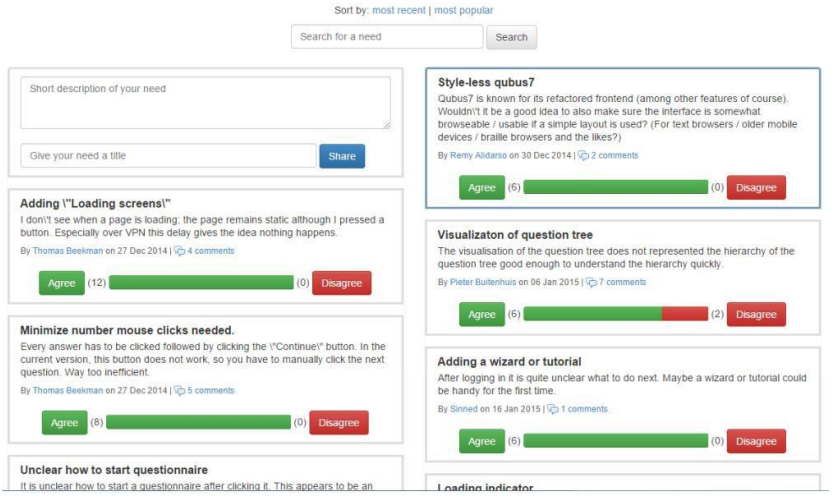


FIGURE 3.5: A screen-shot of REfine [46]

3.3.3 Engaging Stakeholders' in Scenario-Based with Gamification

Lombriser and Philipp [32] presented an online digital platform for scenario based Requirement Engineering supported with gamification. It based on user stories and acceptance test. The main objective of the study is to improve the

quality of user story and increase the creativity of requirement by improving the stakeholders' participation. The study conducted using controlled experiment used convenience sampling technique to investigate the effect of gamification on stakeholder engagement and requirements performance. The experiment was conducted at IT Consultancy Company and it involves 12 potential stakeholders', where the participant divided into two equal groups. The first group is control group with a disabled element of the game. The second is Treatment group. Each group has worked into the different case for preventing the interferences between the two groups. The Result of the experiment shown that gamification can positively influence elicitation process and increased requirements production and quality.

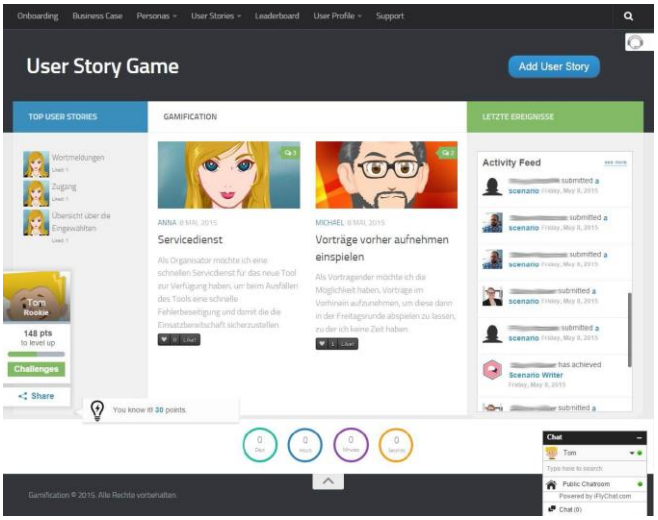


FIGURE 3.6: A screen-shot of Tool [32]

3.4 Related works Limitation

This section discusses the limitations of the current related works based on the following criteria:

TABLE 3.1: Summary of related work limitation

Tool	A1	A2	A3	A4	A5	A6
WikiWinWin [55]	-	-	-	-	-	-
SoftWiki [31]	-	-	-	-	-	-
Winbook[27]	-	-	-	?	-	-
StakeSource [28]	-	-	-	-	-	-
Requirement Bazaar[40]	-	-	-	?	+	-
Using Popular social networks [45]	-	-	-	+	+	+
REfine [46]	-	-	+	?	-	-
Artifact in study [32]	-	-	+	+	+	-

A1: Requirement Articulation, **A2**: Prioritization Efficiency
A3: User Engagement, **A4: User** Experience, **A5: Support** for Mobile Devices, **A6: Support** for Multi languages
– – – – – – – – -
(+): No Lack, **(-)**: Lack, **(?)**: Tool not evaluated.

- Support for Requirement Articulation [49] and Prioritization [4]
- Support to increase stakeholders' involvement in terms of

  1. User Engagement [52, 46, 18]
  2. User Experience [45, 27]
  3. Support for Mobile Devices [45, 43]
  4. Support for Multi languages [11]

3.4.1 Requirement Articulation

All tools have to enable stakeholders to identify their needs in the form of free plaintexts, which might lead to ambiguity, poor understanding, incomplete and inaccurate requirements [49].

3.4.2 Prioritization Efficiency

As shown in table.3.2, some of the tools have used a numerical assignment, and some others used ranking judging by the degree it allows stakeholders to prioritize their requirements. **Qualitative Assignment** techniques group the requirements into different categories, such as Low, medium, and High. However, these techniques have some limitations, since all the requirements that belong to the same category will have the same priority [4]. **Ranking** techniques help to assign a numeric value to prioritize the requirements, such as 1 for low important and 5 for most important. Therefore, the requirements would be sorted and individually ranked [4]. However, they do not provide a relative difference between ranked requirements.

TABLE 3.2: Prioritization techniques used by social network

Tool	Numerical Assignment	Ranking
WikiWinWin [55]	✓	
SoftWiki [31]		✓
WinBook [27]	✓	
StakeSource.0 [28]		✓
Requirement Bazaar [40]	✓	
popular social network [45]	✓	
REfine [46]		✓
Artifact in study [32]		✓

3.4.3 User Engagement

Analysis of tools does not include an explicit support for stakeholders' engagement during the requirement engineering process, except the tool suggested by studies [46, 32]. Stakeholders have to engage in tasks, such as, identifying requirements, Voting/Rating and negotiating.

3.4.4 User Experience

Requirement engineering tools that support the user experience will lead to a low learning curve and have a positive effect on the time to market factor [45]. Based on the data shown in Table.3.3, many tools suffer from user experience issues which has a negative impact on stakeholder involvement [45, 27].

TABLE 3.3: User Experience Issue

Tool	User Experience
StakeSource [28]	The stakeholder needs to be familiar with entering and rating requirements, which means that they need training
SoftWiki [31] and WikiWinWin [55]	The stakeholder needs to learn how to use the tool and structure and annotate the requirement
WinBook [27] , Requirement Bazaar[40] and REfine [46]	The tool design and user experience does not have evaluation studies
Popular Social Networks [45]	It is easy to use, as a stakeholder does not need training in order to use it

3.4.5 Support for mobile devices

Mobile support is an important factor which allows a large number of potential stakeholders to be involved during the requirement engineering process [45, 43]. Most of the previous tools, except for studies [45, 32, 27], do not provide sufficient support for mobile computing, which can decrease the number of user involvement [43].

3.4.6 Support Multi languages

Most of the previous tools, except the Popular Social Networks, do not support multi-languages, and this may limit their use and decrease stakeholder involvement [11].

3.4.7 Other Limitations

Regarding the previous related work, we did not find any study that provide a framework which allows a geographically distributed stakeholders to involve during requirement elicitation, prioritization, and negotiation. In addition, keep them motivated during each activity is a systematic way, from the beginning of the process to the end. Furthermore, there is no study that applied a case study in a real environment context i.e. with real stakeholder and project. Where stakeholders do not know that they are in a case study.

3.5 Summary

Regarding the literature review, we found many studies are used the social network in requirements engineering. These studies have shown that social network can help to involve geographically distributed stakeholders in requirement elicitation, prioritization and negotiation. They using posting for gathering stakeholders needs, and using on reply on posting for negotiation, and using (rating or voting) for prioritization. However, these studies still have a limitation in requirement articulation, and stakeholders' engagements, and prioritization. For requirements articulating, the studies have depended on open a plain text where can make stakeholder do not know how to write their requirements in a good way. Moreover, this can leads to a misunderstanding of their requirements from another stakeholder. For stakeholders' engagement, the studies do not provide an explicit way to engage the stakeholder during elicitation, prioritization and negotiation. Furthermore, for the requirement prioritization, some studies used voting and some of them have used rating as standalone which make the prioritization inefficiency. There are a few studies limited to three studies have proposed a new gamified social network to examine the impact of gamification on stakeholders engagement during requirement engineering.

However, they still have a limitation. Some of tool as iThink has suffered from User Experience where this can effect on the user involvement. In addition, the other tools have a limitation in requirement articulation and prioritization efficiency. Furthermore, there is a need to conducting a real-world case study to better generalize the result, and see how social network and gamification effect on a real environment.

Chapter 4

Sharek: a Framework for Involving Stakeholders during Requirement Engineering

In this chapter, we propose a new **framework**[1] title as ***"Sharek"***[2]. At the beginning of this chapter, we start with Sharek framework core definition. Section 5.1 discusses Requirement Engineering Activities that are supported by the Sharek framework. Section 5.2 discusses the Sharek process which consists of a set of activities that allow distributed stakeholders to be involved in the requirement engineering activities. Section 5.3 discusses how the 6D Gamification Design Framework has been adapted to gamify Sharek activities. Gamifying the Requirements Engineering process aims to improve stockholders involvement during the process activities and tasks.

4.1 Sharek Framework Core

Sharek is a framework used at the early stage of software development life cycle. It incorporate social network features into requirement engineering activities to enable geographically distributed Requirements Engineering Team to be more

[1]We use the terminology framework because our solution provide a set of systematic process, tools and techniques

[2]It an Arabic word meaning to involve

involved in the requirements engineering activities. In addition, it incorporate gamification techniques into each activity to increase stakeholders' engagement and keep them motivated during the whole process.

Sharek mainly based on three techniques as shown in Fig.4.1 below.

FIGURE 4.1: Sharek Core

1. **Social Network**: As discussed earlier in this thesis section.**3.5**, the social networks is a good tool to support participants' involvement. Therefore Sharek adapted the social network to support the geographically distributed stakeholders' involvement during requirement engineering activities.

2. **User Stories**: As discussed earlier in this thesis subsection.2.1.1.3, the user story is a good techniques to explore and understand the user requirements gather the user requirements; it easy to learn and understandable. Therefore Sharek adapted the user story to support gathering the user requirements in a semi-structured way, during the requirement elicitation activity.

3. **Gamification:** As discussed earlier in this thesis section.2.4, the Gamification is a good techniques to improve the user behavior, social relationship, accomplishment and skill. Therefore Sharek adapted the Gamification to gamify various requirement engineering activities in order to improve stakeholders' engagement, and keep them motivated during the whole process.

4.2 Requirement Engineering Activities Supported by Sharek

Requirements Engineering Activities consists of many tasks Fig.4.2 below shows the tasks that are supported by Sharek framework.

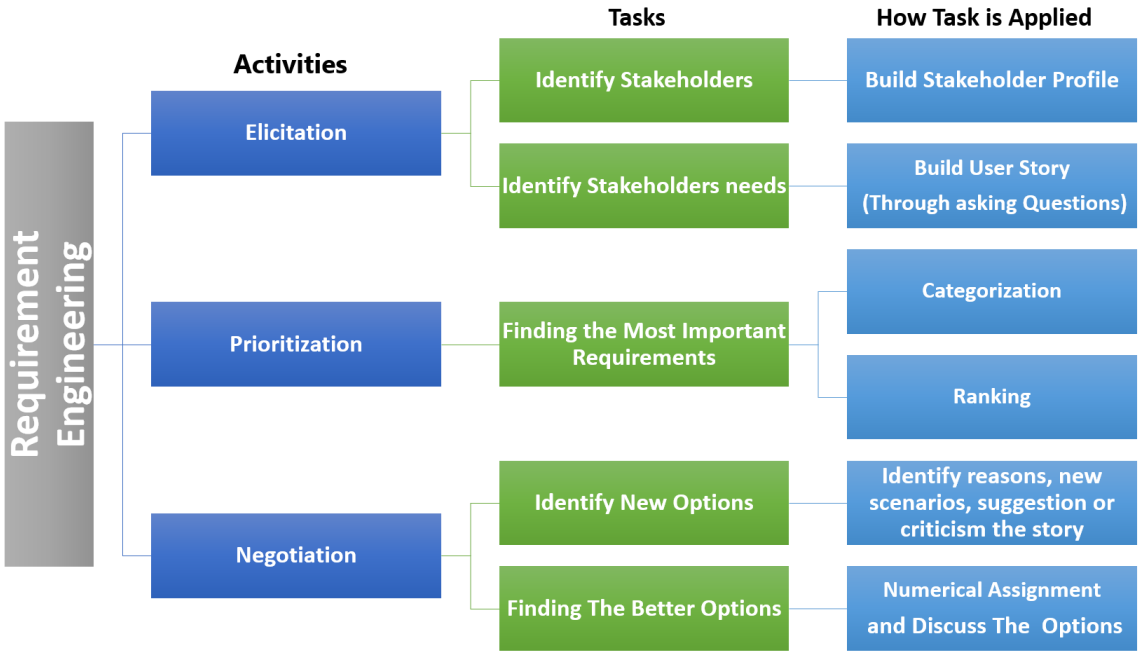


FIGURE 4.2: Requirement Engineering Activities supported by Sharek

4.2.1 Requirement Elicitation

Stakeholders Identification and defining User Requirements are two major tasks in Requirements Elicitation phase.

1. Stakeholders Identification: Identifying the right stakeholders at the early stages of Requirements Engineering process, is crucial to identify complete system requirements [37]. Sharek support iterative stakeholders involvement during the requirements engineering process, and then it support their participation in various tasks related to requirement elicitation, prioritization and negotiation. Sharek supports two groups of stakeholders: system developers and system users.

   (a) System developers are those technical people including requirements engineering, developers and testers.

   (b) System users are those people who have an interest in using the system or affected by the system, such as users, customers, business owner and other entities.

2. Defining User Requirements: Sharek has adapted the user stories to gather user requirement (See sub Sharek activity.4.3). Since user stories are used to elicit the requirements from user perspective at high level of abstraction. Each user story describe a goal a user wants to achieve, t h e r e f o r e a participant should describe its role in the system, the goal would like to achieve and reason of that goal, and the scenario to achieve the goal.

4.2.2 Requirement Prioritization

The main aim of Requirement Prioritization is to prioritize the system requirements, which used as an input to various trade-off and decision making

tasks during the software development life cycle phases [23, 4]. Requirement Prioritization is not a straightforward task since the user requirements are proposed to reflect the stakeholders' perspectives. Stakeholders' perspectives describe the system from different viewpoints, which might overlaps and contradict on different aspects of the system. Therefore the user requirements might be overlaps and conflict with each other. Sharek supports Requirement Prioritization by allowing stakeholders to classify the requirements into categories based on their importance, then ranking them. So Sharek ought to improve the efficiency of requirements prioritization by applying two prioritization techniques, mainly categorization and ranking [4].

1. Requirements Categorization: Requirements Categorization is the task of classifying the user stories into categories based on their importance to the stakeholders [4]. So each participant classifies the user stories into ***(High, Medium and Low***.

    - High: Requirements are highly important, and ignoring them might lead to a system failure.
    - Medium: Requirements are of medium importance, but the Stakeholders can tolerant their modification, either by postpone their implementation for later releases, or modify them.
    - Low: Requirements are of low importance means that stakeholders prefer to have them on the system, but ignoring them will not affect their acceptance to the system.

2. Ranking: Ranking is the task that aims to assign a numerical weight for each requirement on the same category [4]. The Weights are assigned using 5-point Likert scale in which *5 is highly important and 1 is less important* in

High and medium categories. Where *5 is high unimportant and 1 is less unimportant* in low category. Consequently it would be possible to order the requirement based on their importance.

4.2.2.1 Sorting the user story list

The final user stories will be sorted according to their importance from stakeholders' perspective, in order for the user story to be sorted it must be within the quorum (i.e. the minimum number of stakeholder who can prioritize the user story and decide if it is important or not). We used the quorum because, there is possibility stakeholder not involve all of them and there is a need to make some decision about some user story if it is important or not. The user story would be within the quorum if the number of stakeholders who would prioritize it is greater than or equal to the number of stakeholders who were involved in the activity divided by 2 plus one, see the equation below.

$$Quorum = (\frac{N}{2}) + 1$$

Where N represent the number stakeholders were involved.

Sharek then calculates the user stories score by calculating the summation of multiplication of stakeholder voting by stakeholder rating for each user story, as shown by the equation below.

$$UserStoryScore = \sum_{n=1} Vn * Rn$$

Where V and R denote User categorization value (i.e. it classified into a three categories including Low:-2, Medium:1 and High:2) and User Ranking value (i.e.

from 1 to 5) respectively of each user story. The n refers to the number of stakeholders were involved. After that Sharek sort the user story list as descending which based on score value.

4.2.3 Requirement Negotiation

The main aim of negotiating the requirements is to identify conflicts between the requirements and then negotiate their resolutions [14].

1. Negotiate User Story: Based on Issue-Based Information System (IBIS) [5], stakeholders would be able to create new issues related to the user stories, such as an alternative scenario, enhancement/modification suggestion, objections and Criticism see Fig.4.3.

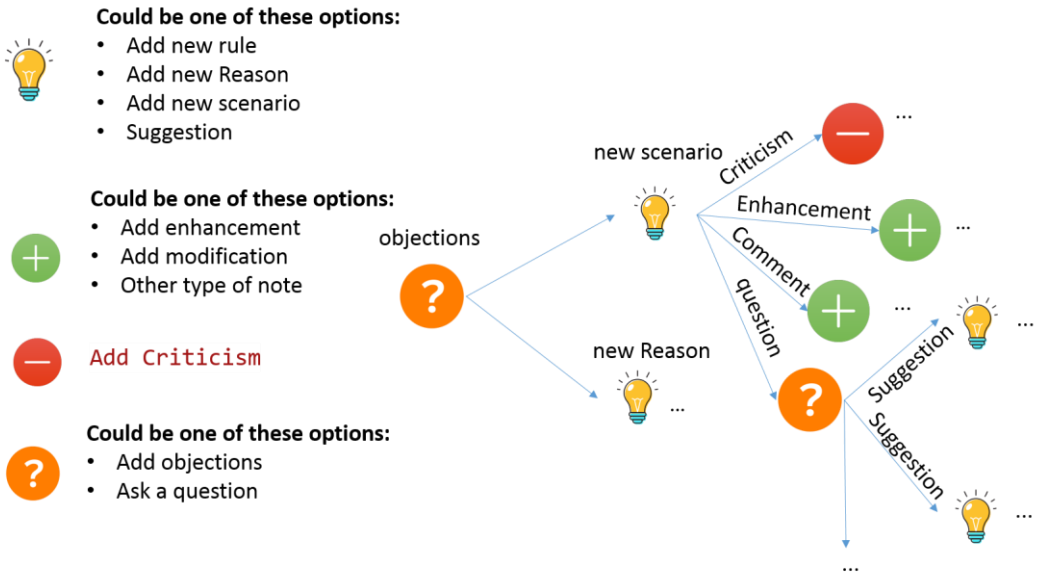


FIGURE 4.3: User story negotiation based on IBIS

2. Finding a resolution: this task aim to trade-off between various options that have been collected from "Negotiate User Story" step and decision

will be made to close the discussion. This task include ranking for the options and voting on alternatives.

4.3 Sharek Framework Process

Sharek contains a set of activities that facilitate stakeholders' collaboration during requirement engineering tasks, see Fig.4.2. It adapts social networks features [15] to facilitate a large requirements engineering team to collaborate in a geographically distributed environment. In addition, Sharek gamifies the requirements engineering activities to improve stakeholders' involvement. Fig.4.4 illustrates the Sharek Framework process which begins by identifying the system's stakeholders and ends with a list of user stories that are prioritized and approved by the stakeholders.

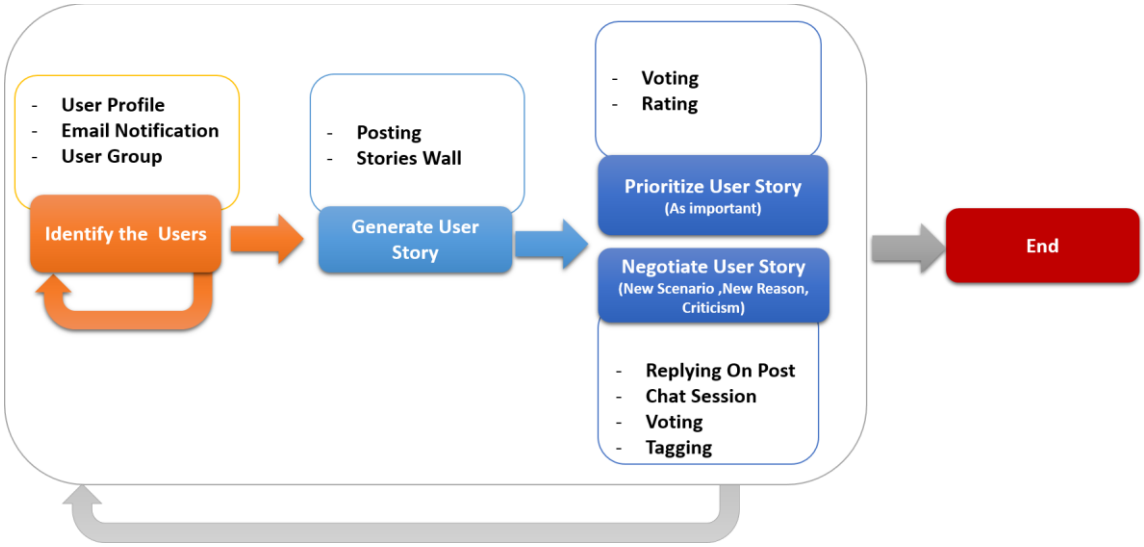


FIGURE 4.4: Sharek Process

First Activity: *Identifying Stakeholders*

Stakeholder identification is an iterative and collaborative process in Sharek. At the beginning, an initial set of stakeholders is identified by the requirement engineer, who send invitations to participate in requirement gathering tasks. During the course of a task, the stakeholder list is maintained and updated. Accordingly, the current stakeholders can invite more candidate stakeholders, whose involvement is important, to participate in the following requirement gathering task; this will ensure that none of the important stakeholders are excluded. In order for stakeholders to participate within the Sharek workspace, stakeholders must create their profiles, which is a task similar to a sign-up on any social network. In addition to the general information, such as *e.g. Stakeholder name, Gender, Age, email .etc.* the profile collects information related to the project, such as the role of the stakeholders and their responsibilities or duties. Invitation messages are sent to the stakeholders, to their emails.

Second Activity: *Generate User Stories*

This activity aims to gather user stories in a semi-structured format. In order to articulate a better user requirements [49]. Sharek adapted a question-and answer method to gather the user stories as illustrated in table.4.1 Below:

TABLE 4.1: Adapted a question-and-answer method to gather the user stories

User Story Element	Question
Rule	Please, tell us what is your role?
Goal	Please, specify the goal you need to accomplish with the system
Reason	Please, identify the reasons that justify the importance of the goal
Scenario	Please, provide a scenario that illustrate how would you achieve the goal.

After stakeholders post their user stories to a story wall, they become visible to all stakeholders in the same group.

Third Activity: *Prioritize the User Stories*

The aim of this activity is to prioritize user stories, during which stakeholders prioritize the user stories that were published on the story-wall. The Prioritization process has been explained in section.4.2.2

Forth Activity: *Negotiate the User Story*

Negotiate the User Story including two tasks:

1. Collecting new options: user stories are extended by attaching new options to them. Options can be: new scenarios, rationales, rules or suggestions.
   There are two techniques Sharek has applied to collect options from stakeholders:

   (a) Reply to a post, which is a mechanism that is used by the social network systems to enable stockholders to comment on a specific post [15]. Stakeholders select a user story to negotiate and then post an option. Sharek prompts Stakeholder to tagging the option by select the appropriate hash-tag from the hash-tags list such as: new scenarios, rationales, rules or suggestions .etc.

   (b) Chatting: is a mechanism to allow stakeholders to communicate in a synchronous mode. The chatting threads are added to the user stories.

2. Voting: is a mechanism that allows the Stakeholder to rank the options as discussed in section 4.2.2 above.

4.4 Gamify Sharek Process

This section discuss the Gamification strategy that has been used to gamify Sharek process. The Gamification strategy has been design based on the **6D Gamification Design Framework** [52], which proposed by Kevin Werbach see Section.2.4.3. The **6D Gamification Design Framework** is one of the most used gamification design frameworks [34]. It is a design process with the a six elements steps including Define Business Objectives, Delineate target behavior, Describe your players, Devise activity loops, Don't forget the fun, Deploy appropriate tools [34, 52].

4.4.1 Define the Business Objectives (Goals)

The main goals of the Gamify Sharek Framework is to improvement of the stakeholders' engagement, motivation, productivity and performance during the requirement elicitation, prioritization and negotiation.

4.4.2 Define Target behaviors

This subsection discusses the target behaviors of the stockholders. The stockholders in Sharek are the system stakeholders who participate in the requirement engineering process. The target behaviors will be based on Sharek Framework, which is discussed in section 4below.

1. **Stakeholders Identification:**

- The target behavior of this task is to motivate stakeholders to accept The invitation to participate in the requirement engineering process. In addition, encourage them to involve new stakeholders in the process by inviting them to the Sharek workspace.

2. **During Requirement Elicitation:** The target behaviors in this task are:

   - To encourage stakeholders to identify new user stories (Influence decision making).
   - To motivate stakeholders to complete their user stories (Get completed user story).
   - to motivate stakeholders to enhance the quality of their user stories (Get accurate user story)

3. **During Requirement Prioritization:** The target behavior of this task is to encourage stakeholders to prioritize user requirements, which include vetoing and ranting all user stories that are listed on the user stories wall.

4. **During Requirement Negotiation:** This task aims to involve stakeholders in discussing the user requirements, so the target behaviors are:

   - To motivate stakeholder to be engaged in discussing the user stories by creating new options. An option could be a new scenario, a rationale, an objection or a suggestion.
   - To motivate stakeholders to vote on conflict resolutions.

4.4.3 Define Players

Different types of players have been identified:

1. System Developers, such as software engineers, and business analysts, who are considered socializer and explorers based on the 6D Gamification Design Framework.

2. System Users, such as system users and customers, who are considered to be the achievers or killers.

4.4.4 Devise activity loops

There are two types of activity loops in a gamified system to increase Stakeholder motivation [52].

1. **Engagement loop** which represents the consent process that gives the Stakeholder tasks to do in order to be motivated to take action. Then, when the Stakeholder accomplishes a task, feedback will be provided; this motivates the Stakeholder to do more actions [52].

2. **Progression stairs** represents the Stakeholder's journey in some gamified task which helps to keep the gamified task more interesting. In addition, it captures the stockholders progression in order to keep stockholders motivated and avoid boredom [52].

This section discusses the implementation of the above two loops on Sharek process, in order to gamify its activities, and achieve the target behaviors as illustrated in section.4.4.2 above. Figure.4.5 shows the gamified result.

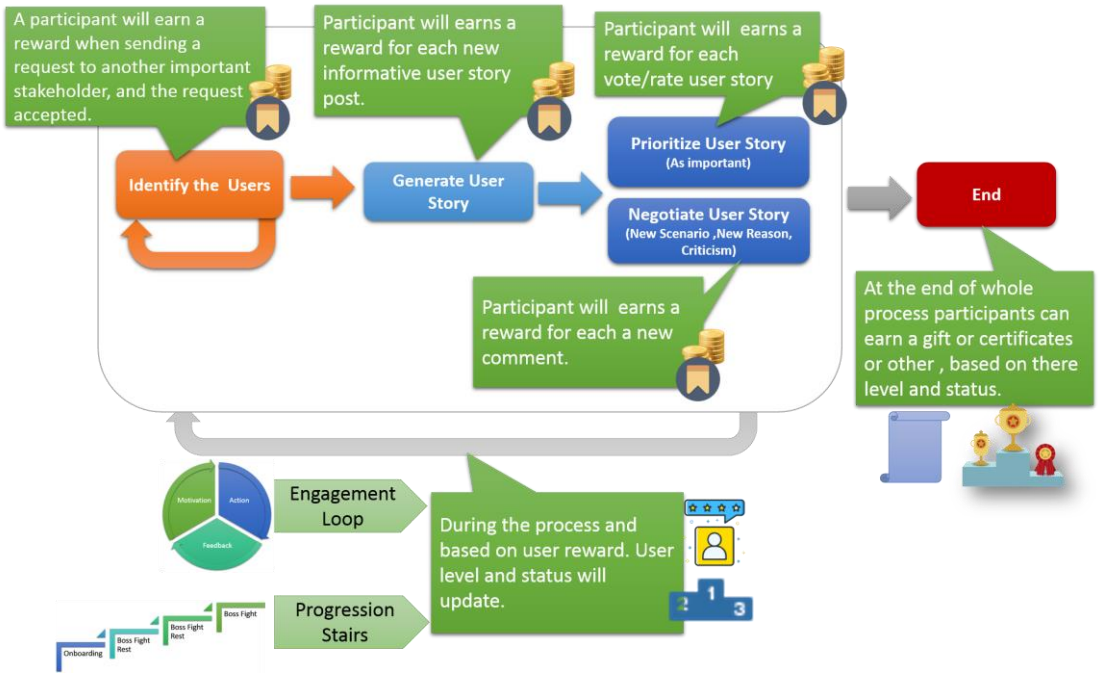


FIGURE 4.5: Gamify Sharek Process

4.4.4.1 First Activity Loop: Engagement Loops (Motivators, Actions and Feedback)

For each stakeholder, the Sharek engagement loops are starts when the stakeholder is invited into Sharek group, in order to participate during the requirements elicitation, prioritization, and negotiation activity.

In order to motivate stakeholders during the requirement engineering process, stakeholder will be informed when a task is completed. Feedback is given to stakeholders after completing the tasks. Feedback is communicated in various ways, such as points, resources, badges and leader-boards. Table 4.2 summarizes the actions which stakeholders need to take to accomplish a requirement engineering task and give feedback.

Motivation	Action	Feedback
Inform stakeholder that she/he will get a gift or a certification when accept to involve in Sharek process.	Stakeholder accepts invitation to join the group	stakeholder obtains a 15 points and 15 coins to start his/her journey during the whole process.
Notify Stakeholder to invite a new stakeholder into the (RE) team , in order to improve his/her status in the leader-board and Stake-	Stakeholder sends an invitation to candidate stakeholders to join the RE team	Stakeholder will obtain 10 coins for each stakeholder response
Inform Stakeholder to add a new user story in order to improve his/her status in the leader-board and Stakeholder level	Stakeholder adds a new story by answering a set of questions	If the Stakeholder completes answering the question, the Stakeholder will obtain 10 Ideator points and 7 coins. Alternatively, the Stakeholder will only obtain 5 Ideator points and 4 coins if he/she misses any of the questions .

Inform Stakeholder about a new user story is added by other stakeholders in order to prioritize and negotiate it.	Stakeholder prioritize a user story. In addition, Stakeholder may add some of a new scenarios, reasons, suggestions, circumstances or other comments.	Stakeholder will obtain 1 Evaluator point and 1 coin for each prioritization task. In addition, theStakeholder obtains 3 Commenter points and 3 coins for each new comment added by the Stakeholder .Furthermore, when Stakeholder join the negotiation during the chat session ,Stakeholder will obtain 1 Communicator point for every 5

TABLE 4.2: Engagement Loops (Motivators, Actions)

A Detailed Description of Sharekfeedback

1. **Points**

   Points are types of rewards that are used for encouraging stockholders to perform activities and take action [52]. A Stakeholder can earn the points in accordance with the actions taken. The point's value were determined in an exploratory manner. These points still not validated. However, their value emphasizes the importance of stakeholders' involvement during the requirement elicitation, prioritization, and negotiation.

   There are different types of points to be earned as follows:

(a) Ideator: It has used to reflect the stakeholder performance (i.e. unambiguous and not poor structuring [51]), during the user story generation; given when stakeholders add new user stories.

(b) Evaluator: It has used to reflect the stakeholder collaboration during the prioritization activity; given when stakeholder prioritizes new user stories.

(c) Commenter: It has used to reflect the stakeholder collaborative during the negotiation activity; given when stakeholders collaborate during the comment on the post.

(d) Communicator: It has used to reflect the stakeholder collaborative during the negotiation and discussion; given when stockholders collaborate using the chat system.

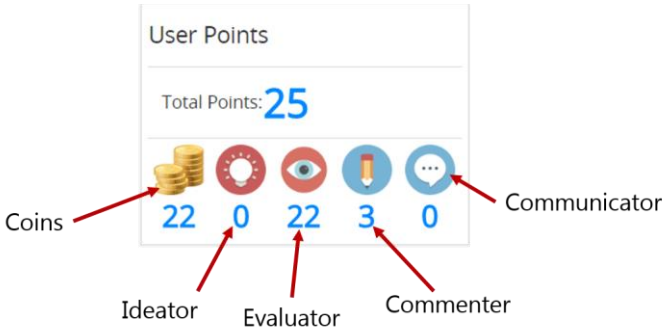


FIGURE 4.6: A Prototype of Sharek Points

2. **Badges**

Badges are a type of reward that is considered a visual representation of stakeholders' achievements [52]. Various types of badges are used in Sharek as described in table 4.3 which describes each one of them.

English Name	Arabic Name	Image	Description
Ideator	Mufakkir		When number of Ideator point more than 50 points
Evaluator	Mmuqim		When number of Evaluator point more than 20 points
Commenter	Mueallaq		When number of Commenter point more than 20 points
Communicator	muhawir		When number of Communicator point more than 50
Collaborator	Mutaeawin		When Stakeholder get Ideator , Evaluator, Commenterbadges
Social	Aijtimaei		When Stakeholder invite at least one stakeholders and if have at least 5 a friends on Sharek when the average number of

Persistent	Mathabir		hours Stakeholder login in Sharek are more than or equal3 hours.
Rising star	Najam Saeid		When Stakeholder get Collaborator and Social badges.
Veteran	mukhaddarim		When Stakeholder get Persistent and Rising star badges.

TABLE 4.3: Badges Table

3. **Leaderboard**

   It a visual feedback that shows the stockholders' rank within a group [52]. Sharek implements leader-boards to rank stakeholders involvement in the requirements engineering process. The stockholders ranked based on the total number of coins that have been collected during the requirement engineering process, an illustration example has been given in Fig.4.7.

4.4.4.2 Second Activity Loop: Progression Stairs

The progression stairs is a visual feedback to indicate the level of a stockholders experience. In addition, it represents the Stakeholder journey in the gamified system [52]. Sharek defines four level of Stakeholder experience including Newbie (100 points), Regular (between 100 and 250 points), and Expert (Between

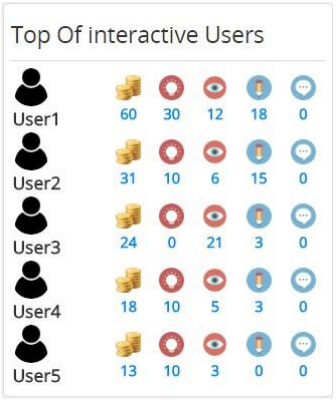


FIGURE 4.7: A Prototype of Sharek Leader-board

250 and 500 points) and Master (More than 500 points) see Fig.4.8. The levels points are collected from participation in the requirement engineering activities and calculated according to the total number of point's achievement (i.e. Ideator, Evaluator, Commenter, and Communicator points). The level points values determined in an exploratory manner. They are still not evaluated. However, their value emphasizes the degree of stakeholders' involvement during the Sharek group. The low level simulates the stakeholder with less involvement in the Sharek group, and high level simulates stakeholder with a higher involvement in the Sharek group.

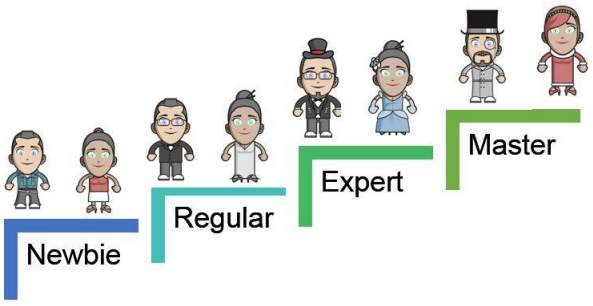


FIGURE 4.8: A Screenshot of Sharek Stakeholder Level

4.4.5 Don't Forget the Fun

This subsection discusses the main idea of gamification strategies to introduce fun in the requirement engineering process.

4.4.5.1 Encouraging Notification Messages

During the elicitation session, many notification messages are sent out in order to increase stakeholder collaboration and competition. These notifications include: top Ideator, Evaluator, Commenter and Communicator stakeholder. In addition, there is the most active Stakeholder who used the system the most. Moreover, notifications are sent to the top stakeholders whose user stories are of a high quality *(i.e. their user stories do not have any comments with Incomplete/ Miss-understandable hash tags indicating that a user story requires more enhancement)*.

Make User Story Question in Interactive Manner

In order to make user story generation more interactive. Each step addresses one question, and stockholders' action provides answers to the question.
Steps to generate a user story:

1. Step 1: the aim of this step is to elicit a stakeholder role in the system. As such, the question was formulated as follows: *Hi there, I will be your guide during the whole process. At first, I need you to select your role. After doing this step, I will give you two coins. So, do not lose them.*
2. Step 2: the aim of these steps is to identify goals the stockholders want to achieve with the system. Accordingly, the question was formulated as follows: *hello, in this step you should specify one goal you need to accomplish with the system. After doing this step, I will give you three coins. So, do not lose them.*

3. Step 3: the aim of this step is to collect the rationale of goals. With this in mind, the question was formulated as the follows *Hi again, now after telling me your goal. Please identify the reasons that justify the importance of the goal. After doing this step, I will give you a three addition coin. So, be careful and do not lose them.*

4. Step 4: the aim of this steps is to gather the usage scenarios that satisfy the goal. Stockholders can provide a text or graphic description, such as flowcharts to describe usage scenarios. The question is as follows: *Hi, this is the final step, I will give you 5 coins. So, be careful when you write your answer. Please, please, tell me a scenario that illustrates how you would achieve the goal.*

FIGURE 4.9: A Prototype of Sharek User Story Creation

Make prioritization in Interactive Manner

In order to make the prioritization activity more intuitive and interactive. Categorization which including (Unimportant, important and High important) represented as (Dislike, Like and Love). In addition, voting task represented s t a r rating range from 1 to 5.see Fig.4.10

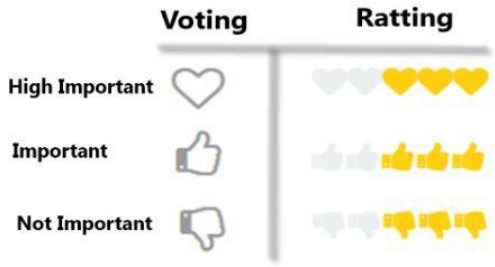


FIGURE 4.10: A Prototype of Sharek Prioritization

4.4.6 Deploy the appropriate tool

A Sharek tool (see Fig.4.12) has been developed to support Sharek framework. Sharek tool is a Social Network website; it supports multi-languages e.g. Arabic, English. In addition, it similar to other Social Network sites e.g. Facebook, Twitter; this can help to decrease the learning curve [45]. Sharek tool developed using.Net in the back end. In addition, for the database, it is based on MongoDB which a semi-structure databased store data as JSON format. Moreover, in the middle layers, a web service is used to communicate between back-end and the front end. Furthermore, HTML jQuery and Bootstrap are used in the front end. See Fig.4.11 Which illustrates Sharek tool Conceptual Design.

Sharek tool used MongoDB as repository for logs, user stories post, comment, and prioritization and chat session comments. In addition, for Gamification setting and values.

4.5 Summary

This chapter propose a new framework called Sharek. Sharek is a framework allowing a geographically distant stakeholders' involve during the requirement

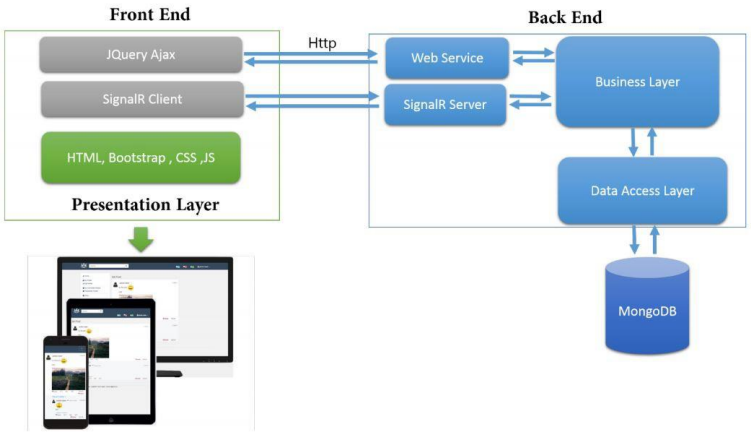


FIGURE 4.11: A screen shot of Sharek tool Conceptual Architecture

engineering activities (i.e. elicitation, prioritization and negotiation) . In addition, increases their involvement in each activity. Sharek used the social network technique to allow a globally distant user to communicate and collaborate with stakeholders at any time from any location. In addition, it contains many useful features, such as posting, replying to posts, voting, user profiles, and groups, which incorporate which requirement engineering task, in order to facilitate stakeholders involved during requirement elicitation, prioritization and negotiation. Sharek depend on gamification technique, which is the use of game elements and game design techniques in non-game context. Furthermore, Sharek utilize the user story tool to allow stakeholders defining their requirement in semi structured, simple and uniformly.

A Sharek tool has been develop which is Internet-based social network using web 2.0 technologies for automated and implement Sharek framework. It is contains a set of characteristics to improve stakeholder involvement including:

(1) Its design as popular social network in order to improve the user experience and decreasing the learning curve. (2) It supports mobile platforms to

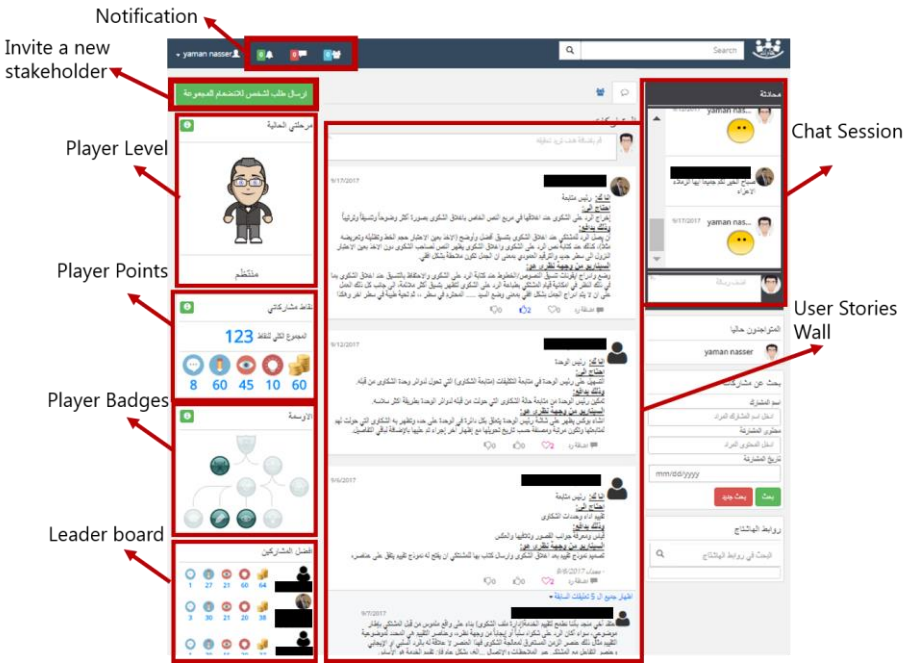


FIGURE 4.12: A Prototype of Sharek Group

allow large numbers of potential stakeholders to be involved. (3) It supports multilanguage to enable users to use it regardless of their native languages.

Chapter 5

Research Methodology

This chapter discuss the research methodology that was followed to conduct the research. Action research methodology was adopted, so this chapter will discuss the case study, the setting of the research case study, and how the data been collected and analyzed.

To investigate the impact of using the social network on requirements gathering in the distributed teams. In addition, to investigate the impact of using gamification on the stakeholders' involvement in requirements engineering process. A case study called "Palestine Ministries Study" has been conducted.

5.1 Research Question

The following are the specific research questions that will be answered based on the data collected from the case study:

1. Can social network improve requirement elicitation, prioritization, and negotiation?
2. Can gamification improve stakeholders' involvement during elicitation, prioritization, and negotiation?

5.2 Research Method

Our study is based on action research which is related to case study research [54]. Action research is originated from the social studies. It is based on the researcher and the active participant [33]. Moreover, it is suitable if the researcher needs to make a change on some of the methodologies in order to solve some particular problem in their environment, and understanding the effect and learn from it [54].

This research is part of the RE team that developed an in-house software to be implemented within the ministry and the team is distributed in many administrative regions. The current practice is not based on a methodological framework, the stakeholders communicate with the developers either in face to face meeting, emails or telephone. It has been noticed the negative impact on the quality of the produced systems. Those systems are either missing many of the main features required by the stakeholders or produced developer centered, which mean the developers of the system impose their perspectives on the users. Based on many complains from the system stakeholders, the researcher proposed a change in the current approach. Therefore action research is the suitable methodology to be followed, since the researcher proposed a change in the current practice and he will observe this change.

5.3 Case Study Participants and Project

The case study was conducted to gather user requirements for a system that will be implemented by many Ministries of Palestine. The system is an online system to publish the services provided by the governmental institution, and the requirements to achieve these services. It was in-house by the IT department

at the PMO (prime minister office Palestine). It was developed since 2013 and it contains 850 services from 30 governmental and non-governmental institution. In each institution, there is one employee who works on the system to update its service information; this information is reviewed by the Quality Gov before publishing to the public. In this study, we have gathered new requirements and features that fit the stakeholders' needs to enhance the system functionality.

5.3.1.1 Participant Types:

In this study there are two types of participants:

- **End User**: The governmental and non-governmental institution users; they are using the current system. In addition, they need to achieve new goals to enhance the system.
- **Developer (i.e. the researcher)**: The system developer; he works as facilitators, to facilitate the communication between stakeholders, and guide them to the right path. In addition, he is the requirement engineer who wants to gather the stakeholders' needs in order to improve the existing system.

5.4 Data Gathering

The data collection represent any data that can help to answer the research questions. In addition, if possible, we should try to use a variety of a data collection tools and methods [7]. Table.5.2 summarizes our data gathering methods.

In this case study, we focused on two data sources which are observation and survey. First, **observation** were used to collect the data from Sharek logs file and

the Google analytic, in order to analyze the behavior participants and their interaction during the requirements engineering. In addition, to the researcher observation which include the notes been documented on how stakeholders' interact during user story generation, negotiation, and prioritization. Furthermore, the analysis of stakeholders' recommendation and notes that have been collected from the chat session during the requirements engineering process. Secondly, **survey** has been used to collect stakeholders' feedback; it conducted using the online form. The survey has been done in two stages, first before starting the case study; the participants have answered a survey about their experiences, thus a decision would be taken to provide a training or not before start using Sharek tool. Also, it helped to distribute the participants into groups based on their experience and knowledge, so that can minimize the internal threat validity. The second stage of the survey which about the user emotion and cognition, evaluation thus can know how they were engaged.

In this case study, we focused on a set of measurements that have been used by [32] to measure the performance and the engagement of stakeholders during the requirement engineering process. These measurements have been adapted for their appropriateness to the case study.

1. **Performance:** according to Lombriser and Philipp [32], performance can measure using productivity and quality.

    (a) **Productivity:** according to Lombriser and Philipp [32] productivity is quantitative measurement to measure the throughput and the content creation. In the case study, the number of user stories that stakeholders will create, prioritize and negotiate in a given amount of time will be the inductor on team productivity. This indicator will be used study whether the social network has an effect on the team

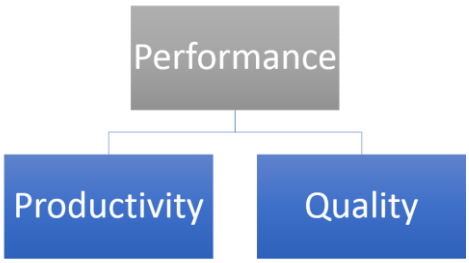


FIGURE 5.1: Measure Performance [32]

productivity or not. Also it help us to compare the productivity of the RE team with the Gamification support and without.

Data that we have gathered including:

- Total Number of valid (i.e. User Stores that are related to the domain) user stories.
- Total number of a user story that is prioritized and negotiated.
- Time spent by stakeholders to finish prioritize, negotiate each user story. (This measure by [Finish prioritize, negotiate and updating Date Created Date] of each user story)

(b) **Quality**: In this study, the quality is related to how requirements are articulating; it focusing on a two factors including the Unambiguous and poor structuring.

- **Unambiguous**: the user requirement considered unambiguous if there are common understanding and interpretation by the majority of the stakeholders [51]. In this study, the number of the negative comments which submitted by stakeholders has been used as inductor of the requirement unambiguity. The number of negative comments is also used as an indicator for

further iteration of-of requirements negotiation. Sharek hashtags is the tool used to collect the comment from the stakeholders, as illustrated in section4.2.3above.

- **Poor structuring** : the requirement is structured if it has been documented based on a general template[51]. In case study user story has been used to collect user requirement, so each story should has the following parts user role, goal, reason, and the scenario, any missing part indicate an sign of a poor structure or incomplete requirement, which require further iteration for enhancement.

2. **User Engagement**: According to Lombriser and Philipp [32] user engagement is measured by the following factors: user emotions, cognitive, and behavior.

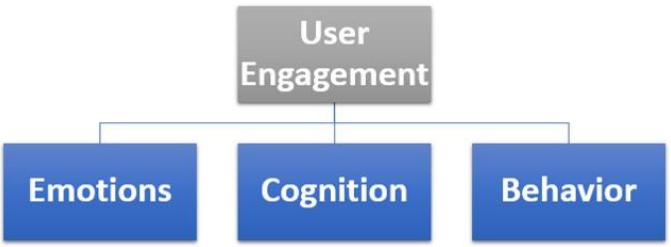


FIGURE 5.2: Measure Engagement [32]

(a) **Emotions**: According to Lombriser and Philipp [17] emotions is an indicator of the user feeling to express the user sanctification, which is collocated as happy, angry, proud, sad, excited, and disappointed. Stakeholders' motivation is very important for the case study, in order to engage stakeholders during the requirements engineering process. According to Kujala and Sari [25] stakeholders are reluctant to

share their needs during the traditional requirement elicitation, such as face to face meeting, focusing group, and workshop, which negatively effect on stakeholders' involvement. Therefore the aim of applying gamification to requirement engineering process is to increase the stakeholders enthusiastic to participate in requirement engineering tasks, which is expected to positively affect their involvement [20, 17]. So, this case study aims to investigate the use of the social network gamification on stakeholders' engagement. A 5-point Likert scale is used to collect user emotion data as illustrated in Table5.1.

(b) **Cognition**: According to Lombriser and Philipp [17] cognition is a concern with the user mental state such as challenge, satisfaction, absorption, and difficulties.

Understand how to do the task, and do it in an easy way, in addition the user satisfaction is very important for the case study, in order to improve the stakeholders' involvement during the requirements engineering process. According to Kujala and Sari [25] when the task is understandable by stakeholders, and they do it without difficulty, this can positively affect their involvement. In addition, when stakeholders are satisfied this can also positively affect their involvement and make them motivated [25]. Therefore the aim is to make Sharek tasks i.e. generate the user story, negotiation, and prioritization more easy to do and understandable. In addition, keep them satisfied during each activity. A 5-point Likert scale is used to collect user absorption, task difficulties and satisfaction data as illustrated in Table5.1.

(c) **Behavior**: the behavior of the user is an indication their interaction [17]. The following criteria has been used to measure user behavior:

- Total Number of user Posts.
- Total Number of user comments on posts.
- Total Number of voting/rating.
- Total Number of Chat comments.
- Total Number of User Have Involved during the whole process (User Story Creation, Prioritization, and Negotiation).
- Total Number Of user who has Involve during User Story Creation.
- Average Number of User Who Have Involved In Negotiation and Prioritization.

The data has been gathered using the Sharek log file and Google analytics.

Goal	Background Questions	Achieve Goal
Emotions	1. How often do you feel interested in Sharek? 2. How often do you feel excited to engage in Sharek? 3. How often do you feel afraid in Sharek? 4. How often do you feel afraid to engage in meeting and workshop? 5. How often do you feel shy in Sharek? 6. How often do you feel shy in meeting and workshop?	Using 5-point Likert including (1) Not at All, (2) A Little,(3) Moderately,(4) Quite a Bit, (5) Extremely. Which will answer by participants who have involved during the case study
Cognition	**For measure the absorption:** 1. I am totally absorbed in what I am doing during the post creation process. 2. I am totally absorbed in what I am doing during the voting and rating process. 3. I am totally absorbed in what I am doing during the negotiation and discussion	Using 5-point Likert including (1) Not at All, (2) A Little,(3) Moderately,(4) Quite a Bit, (5) Extremely. Which will answer by participants who have involved during the case study

	For measure experienced difficulty: 1. How difficult was Post creation? 2. How difficult was Voting/ Rating? 3. How difficult was add a comment on a post?	Measure using 5-point Likert scale including Using (1) Very easy, (2) easy, (3) Partly, (4) difficult, (5) very difficult. Which will answer by participants who have involved during
	General User Satisfaction: 1. How did you like the post creation? 2. How did you like the voting/rating? 3. How did you like the comment on a post for discussing and negotiating the post? 4. How did you like the chat session for discussion and negotiation? 5. How did you like the Sharek tool?	Using 5-point Likert including (1) Not at All, (2) A Little,(3) Moderately,(4) Quite a Bit, (5) Extremely. Which will answer by participants who have involved during the case study

TABLE 5.1: Survey Approach

TABLE 5.2: Summary of Data Gathering Methods

Subject	Data Collection Method
Productivity	Observation (using Sharek logsfile)
Quality	Observation (Using Sharek Post, Comments and Chatrepository)
Cognition and Emotion	Using online survey which answer by participants
Behavior	Observation (Using Sharek logs file ,Google analytics , and researcher observation and notes)

5.5 Case study Process

At the beginning of the process and in order to eliminate the internal threat of validity, we separated the participant into two group with the same number and experience. The first group has used Sharek without gamification and the second group has used Sharek with gamification technique.

To ensure research ethics; any person has register into Sharek he/she to accept a set of terms and conditions, which are related to the use of data generated by Sharek is used. Registration was not mandatory and any one can either accept or reject theagreement.

At the initial phase and before start the case study, each participant has to answer the first part of the survey which related to its experience, which was used to decide if stakeholders needs a training or not. In addition, the survey result helped to separate participants into two equivalent groups, in terms of experience which would minimize the internal validity.

The case study conducted for both groups simultaneously, upon starting the requirements engineering process the users were notified with a message consist of the following information: the objective of the Sharek tool and, how they can register, and information about the task. Furthermore, to eliminate the internal

validity which related to learning issue, we allow each group to explore the system for one week.

During the case study, we gathered the user stories and the researcher where observing the groups and provide guidance through the chat session. The guidance was to answer their questions which help them to use the tool and follow up process. Furthermore, we wrote down our observations. Moreover, stakeholders' notes and recommendation that gather during the chat session were documented for analysis. At the end of our study, we have applied the second part of the survey to measure the performance and engagements of each group.

5.6 Data Analysis

In order to be able to answer our research question regarding measures which we discussed in the previous data gathering section. We used QlikView [1] which is a Business Intelligence platform that helps for turning data into knowledge. Moreover, it help for data Cleaning, Exploring, Analysis, Visualizing, and Searching [38]. In addition, we used SPSS [2] for measure the Mann whitney U test [54], in order to determine whether the gamification and non-gamification group having the same distribution or not during the result discussion.

[1]https://www.qlik.com/us/

[2]https://www.ibm.com/analytics/data-science/predictive-analytics/spss-statistical-software

Chapter 6

Case Study Results

This chapter discusses the results of the case study with regard to our observation, notes and the online survey results that were discussed in chapter.5.

6.1 Result of User Survey Information

This section presents the result of the first part of the survey, which is about the participants' personal and working experience, in addition to their experiences in using the social networks, as Illustrated in table.6.1. The collected data were used as the criteria based on which the participants has distributed into two groups.

TABLE 6.1: Result of User Information Survey

Survey Question	**Result**
Participation Number	30 participants
Experience in Social Network	20 Good ,9 Average , 1 Excellent
Job Experience	19 between 5-10 years , 5 between 11-20 years ,6 between 1-4 years
Education	27 BSc , 2 MSc , 1 diploma

The first group that participated in a requirements engineering task using Sharek without the Gamification supports, in the other hand the second group

participated on the same task but they used that version of Sharek which supports Gamification. In order to eliminate the internal validity, which related to the learning curve, both groups were given a five-day learning period to explore Sharek functionality and features. Training scenarios were developed and then used for this purpose.

6.2 Performance Measure

This section discuss the effect that Gamification has on team performance, the data has been collected from the two groups was analyzed based on the following criteria: Productivity, Quality, and Creativity.

6.2.1 Productivity

This subsection discusses the stakeholders' productivity. The data was collected using observation method as was explained earlier in section.5.4.

TABLE 6.2: Productivity Result

Attribute	**Non-Gamiy Group**	**Gamify Group**	**Note**
Total Number of user stories	19	35	These represent the valid Number of User stories which are related the system goals.
Total number of user stories have prioritized and negotiated	16	35	
Time spent by stake-holders to finish prioritize, negotiate each user story	4.5	2	Regard to user login log Files of we find that all users do not have login during the holiday (Friday and Saturday) See Appendix..3.

Based on the data summarized in Table.6.2, we found that the Gamification has a positive impact on the productivity of the requirement engineering team. The table shows that Gamification group has generated and prioritized more user stories than the Non-Gamification group, the differences is almost double. In addition, the time required to finish task of prioritizing and negotiate the user stories by Gamification group is almost half the time that took Non-Gamification group to perform the same task. The average time was two days to perform the task by the Gamification group, in the other hand the Non-Gamification group spent four days and half to perform the same task See Appendix..3.

Reason why the non-gamification group productivity is less than gamification group:

- Gamification techniques help user engagements, the data shows that the average number of login to the system was three times per day for Non-Gamification group, in the other hand it was seven times per day for the gamification group. Thus, the Gamification group was more engaged and able to finish the task in a shorter period as shown by (see Fig.6.10).

- Gamification techniques encourages the participants to complete their tasks correctly, this supported by the data shown in (see appendix..5). The data shows that the user stories created by the Non-Gamification group were poor structured and were misunderstood, which makes affect the team productively, because it was required more iteration to revise the user stories and update the missing parts.

6.2.2 Quality

This subsection discusses the effects of Gamification on the quality of the user requirements in terms their ambiguity and structure. The result of the user

story quality per each group is illustrated in figure.6.1:

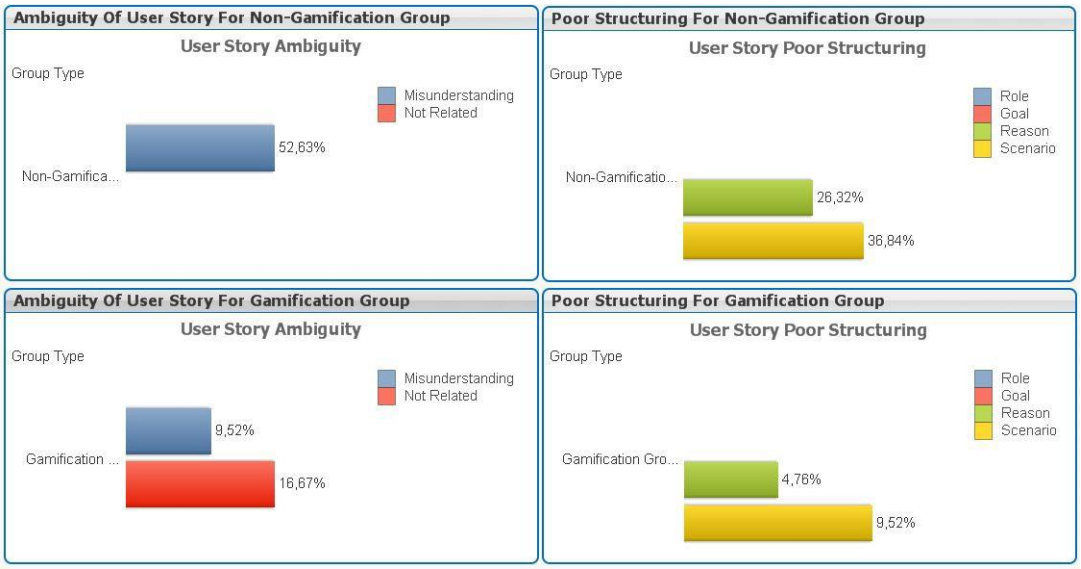


FIGURE 6.1: User Story Quality Per Each Group

6.2.2.1 Ambiguity

The ambiguity of user stories was measured by analyzing the misunderstanding issues associated with user stories, those issues were collocated using the hashtag techniques. The participants used hash-tags during the negotiation process to indicate a misunderstanding of a user story or part of it. Section.4.3 above illustrated how stakeholders can generate their user story using Sharek. The data has been collected from both groups were illustrated in Appendix..1.

Fig.6.1 shows that user stories had been generated by the Non-Gamification group were misunderstood and needed to be re-conceptualized. The reasons for that: stakeholders wrote their goals, and scenarios at an abstract level which missing important details, which cause misunderstanding the user stories, and further iteration to gather the missing details. Furthermore, many Stakeholders provided extra information, which is not important for the user stories, such as

combine goals, or combine goal and scenarios. As a consequences that makes user stories more complicated and hard to understood. Appendix.5 which illustrated the whole result.

Fig.6.1 shows that the number of the misunderstood user stories that were generated by the Gamification group were smaller than those were generated by the Non-Gamification group. Furthermore, participants were highly concerned to produce a high quality user stories before posting them on the story board, aiming to collect more Ideator points. It has been noticed that participants were evaluate their user stories and get feedback off-line before submission. Also, they were highly motivated not to lose any of the Ideator points, by not receiving any misunderstanding hash-tags, which negatively affect their Ideator level as discussed in section.4.4.5.

6.2.2.2 Poor Structuring

User requirements were collected using user story template, which has discussed in subsection.2.1.1.3 above. The user story questions were optional for both groups, we did so in order to analyze the effect of using gamification technique on stakeholders' commitments to generate a well-structured user requirement.

Regarding case study results as illustrated in Fig.6.1, it shows that the user stories were written by the Non-Gamification group have missed some of the user story parts including user story reason and scenario (for more information see Appendix..5). The stakeholders complained that filling those part of the template required a lot of time to do.

In order to make Non-gamification group answer the user story questions, we made them mandatory, and so that can investigate their behavior. The result was the user story questions were answered at an abstract level, and with ambiguity

(See the bellow user story example). This caused a high rate of misunderstanding as illustrated in Appendix.6.

An example of user story when we made the user story question mandatory:

- **As a:** employee, **I need** to order the service information , So that the it facilitates my work, **Scenario:** the system order the information
- **As a:** employee, **I need**: submit an information automatically , **So that:** This can help me, **Scenario:** there is no Scenario.

For the Gamification group, most of the stakeholders have answered all user story questions (See Appendix.6); there was a small set of a user story that has missed some of the parts such as reason and the scenario, see Fig.6.1. Furthermore, in Gamification group, we have kept the question answering optional, and most of the stakeholders answered all the questions.

6.3 Engagement Measures

6.3.1 Emotion

To measure the stakeholders' emotion we have focused on Interest, Excited, Afraid and Shy as discussed in section5.4 above. The data gathered using the survey method and the results were as the following:

- For **Interest and Excited**, which have measured using the **Q01: How often do you feel interested in Sharek?** And **Q02: How often do you feel excited to engage in Sharek?** Questions respectively. As shown in Fig.6.2 and Fig.6.3 The interest in the Requirements Engineering task, and the excitement in the task are different between the two groups. As the result

indicates the Gamification group was more interest and excited on using Shark and complete the task more than the Non-Gamification group. In order to measure the differences between the two groups a Mann Whitney U Test between has been applied on the data sets collected from the two group, the test result has been reported in the table.6. The values that compare the above Q1 and Q2 questions are 0.001 and 0.000 respectively, which are less than 0.05, which confirms that the two groups are different, as explained in Appendix..4.3.

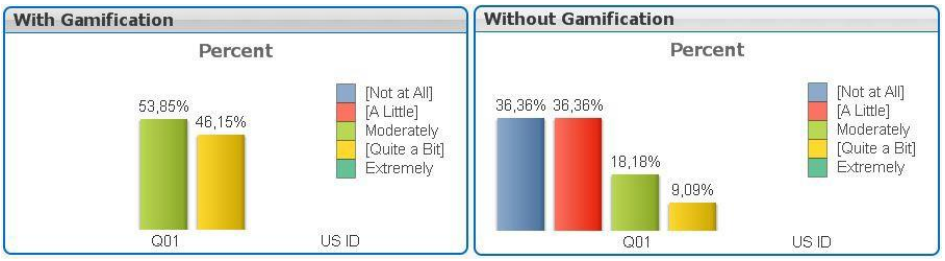


FIGURE 6.2: Interest Result

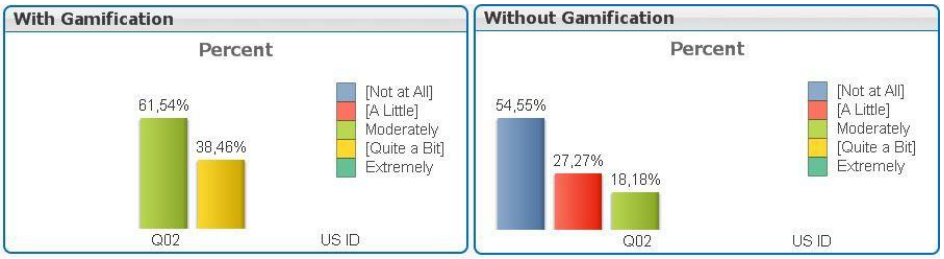


FIGURE 6.3: Excited Result

- For **Afraid and Shy** ,which have measured using the following questions including:
  - **Q03:** How often do you feel afraid in Sharek?
  - **Q04:** How often do you feel afraid to engage in meeting and workshop?

- **Q05:** How often do you feel shy in Sharek?
- **Q06:** How often do you feel shy in meeting and workshop?

The **Q03 and Q04** used to measure the afraid, and **Q05 and Q06** used to measure the shy. As shown in Fig.6.4 and Fig.6.5 Respectively, the afraid and shy are similar between the two groups. In order to measure the differences between the two groups a Mann Whitney U Test between has been applied on the data sets collected from the two group, the test result has been reported in the table.6. The values that compare the Q03 and Q04 questions are 0.436 and 0.784 respectively. In addition, values that compare the Q05 and Q06 questions are 0.209 and 0.740 respectively. Both values are greater than 0.05, which confirms that the two groups are similar, as explained in Appendix..4.3. As the result indicates the social network has a positive effect on decrees some of stakeholders' afraid and shy, during the requirement gathering; both of group, have felt less shy and afraid when they using the social network compared with previous experience into workshop and meeting (i.e. traditional technique). This has positively affected their involvement during the whole process. In addition, help the requirement engineer to gather the requirements which may not possible to gather using the workshop and meeting.

6.3.2 Cognition

Cognition has been measure using a survey which has illustrated in Table.5.1. This Subsection, discussed the result of each Cognition category regarding the survey result that in Appendix..4.

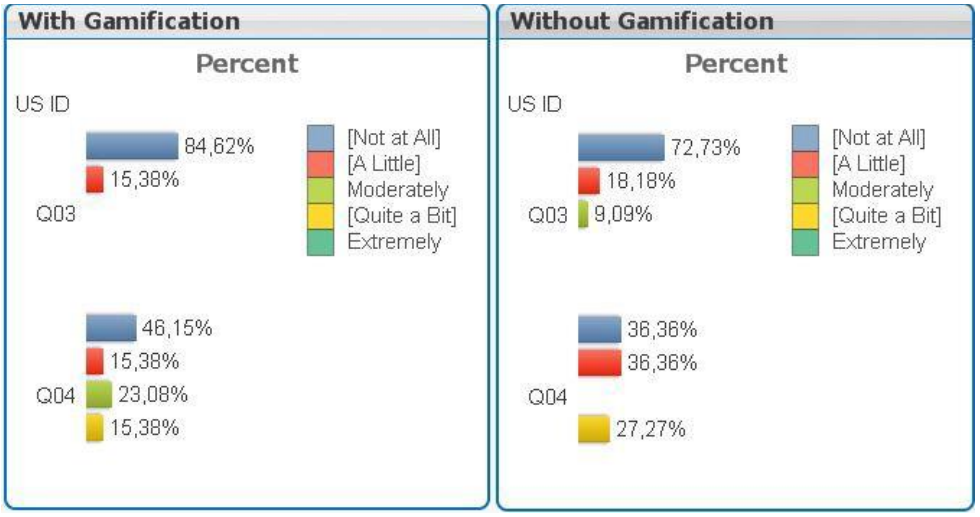


FIGURE 6.4: Afraid Result

6.3.2.1 Absorption

Absorption has been measure using a three type of questions that are focusing on how stakeholder observe the task of create their stories, task of negotiation and prioritization. The questions as following:

- **Q07:** I am totally absorbed in what I am doing during the post creation process:
- **Q08:** I am totally absorbed in what I am doing during the negotiation and discussion:
- **Q09:** I am totally absorbed in what I am doing during the voting and rating process:

In order to measure the differences between the two groups a Mann Whitney U Test between has been applied on the data sets collected from the two group, the test result has been reported in the table.6. The values that compare the questions Q07 and Q09 are 0.000 and 0.025 respectively. The values are less than 0.05,

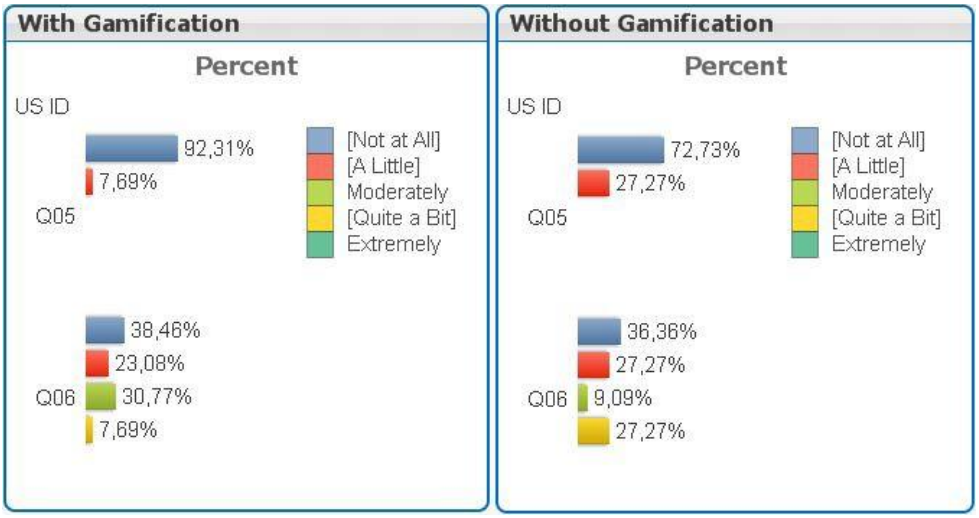


FIGURE 6.5: Shy Result

which confirms that the two groups are different, as explained in Appendix..4.3. However, the values that compare the questions Q08 is 0.258, which is greater than 0.05. This value confirms that the two groups are similar. As shown in Fig.6.6 , the two group have absorbed what they doing during the negotiation task. However, Gamification group was more absorption what to do during the user story creation and prioritization.

6.3.2.2 Difficulty

It has been measured using a three type of questions as the following:

- **Q1:** How difficult was Post creation?
- **Q2:** How difficult was Voting/ Rating?
- **Q3:** How difficult was add a comment on a post?

In order to measure the differences between the two groups a Mann Whitney U Test between has been applied on the data sets collected from the two

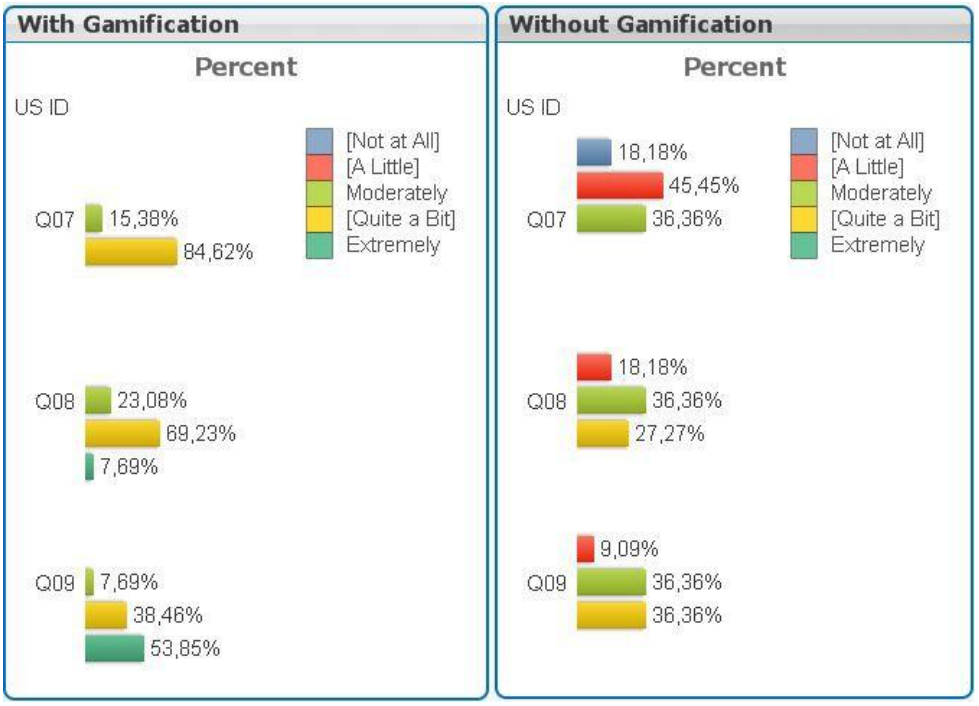


FIGURE 6.6: Absorption Result

group, the test result has been reported in the table.6. The values that compare the above questions as following: Q1 value is 0.004, and Q2 value is 0.202, and Q3 value is 0.698. Both questions values are greater than 0.05, which confirms that the two groups are similar, as explained in Appendix..4.3. As the result indicates the social network has a positive effect on decrees some of stakeholders' afraid and shy, during the process. As shown in Fig.6.7 , the two group have significantly similar result in Negotiation and the Prioritization. The result mostly around Very Easy and Easy. However, for the user story creation, we found that the Gamification group found it less difficult than the Non-Gamification group.

6.3.2.3 Satisfaction

This section discuss the result of stakeholder satisfaction. It has measured using four questions as following:

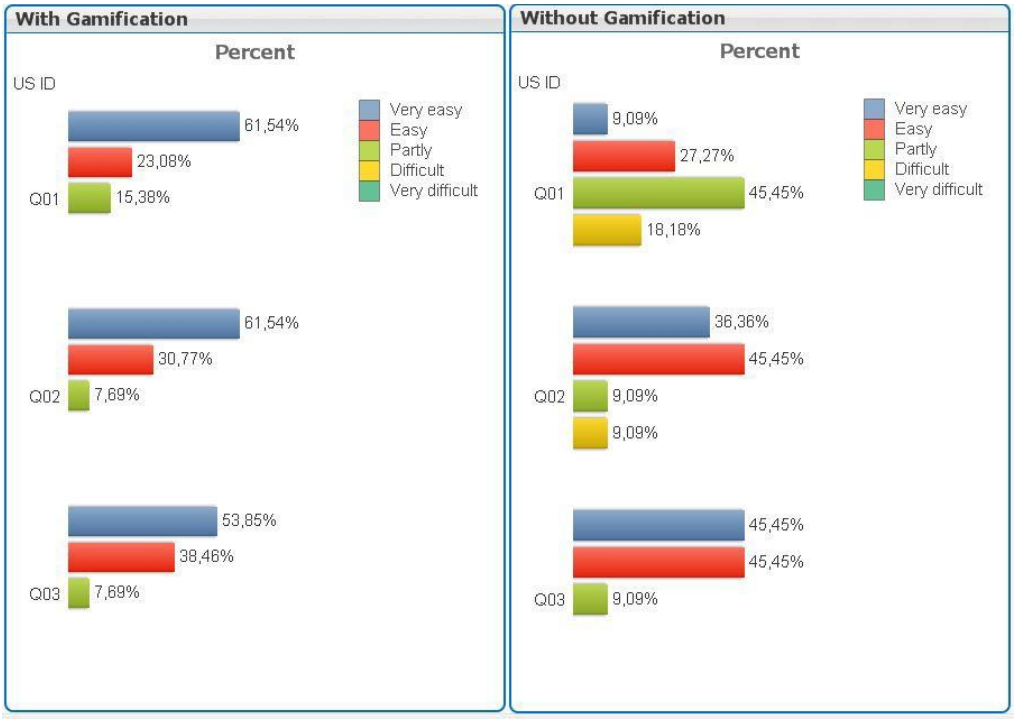


FIGURE 6.7: Difficultly Result

- **Q10:** How did you like the post creation?
- **Q11:** How did you like the comment on the post for discussing and negotiating the post?
- **Q12:** How did you like the voting/rating?
- **Q13:** How did you like the chat session for discussion and negotiation
- **Q14:** How did you like the Sharek tool?

In order to measure the differences between the two groups a Mann Whitney U Test between has been applied on the data sets collected from the two group, the test result has been reported in the table.6. The Mann Whitney values of questions shown that the two group have a different satisfaction at **Q10 and Q14** questions, and similar satisfaction at **Q11, Q12 and Q13** questions. The values

that compare the **Q10 and Q14** questions are 0.17 and 0.001 respectively. The values are less than 0.05, which confirms that the two groups are different. For **Q11, Q12 and Q13** questions the value are 0.076, 0.076 and 0.061 respectively. The values are greater than 0.05, which confirms that the two groups are equal, as explained in Appendix.4.3.

As shown in Fig.6.8, the Gamification group satisfaction is greater than the Non-Gamification group. In addition, they have satisfied with the comment on the post as a feature for discussion and negotiation, and with voting/ rating as a feature for prioritizing the user story and suggestions. Furthermore, both of them have a low satisfaction with the chat session as a way for discussion and negotiation.

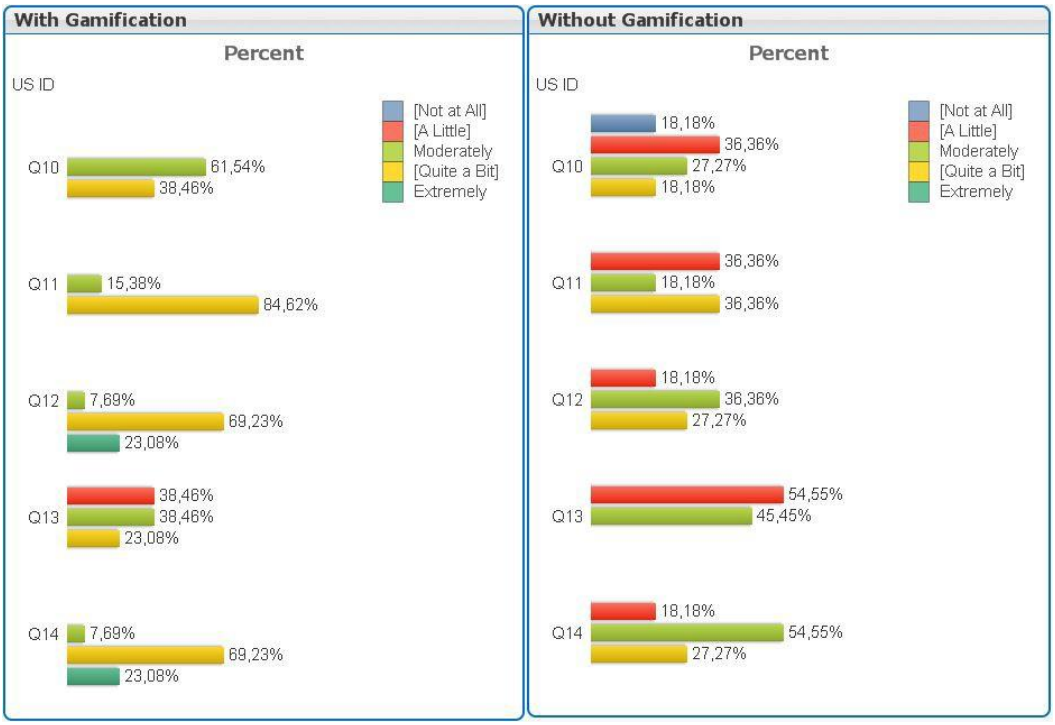


FIGURE 6.8: Satisfaction Result

6.3.3 Behavior

This subsection discusses the stakeholders' behavior. The data was collected using observation method as was explained earlier in section.5.4.

TABLE 6.3: Stakeholders Behavior Result

Attributes	**Non-Gamification Group Value**	**Gamification Group Value**
Total number of stakeholders posts	19	42
Total number of stakeholders "comments on posts"	297	771
Total number of voting/rating	251	1064
Total number of Chat comments	57	121
Total number of stakeholders have involved during the whole process	11	13
Average number of stakeholders who have involved per user story	7	11
Average number of stakeholders available per day	3	8

Regarding to Table.6.3 , we observe the following finding:

- During post generation, we found that the number of posts generated by the Gamification group is greater than the Non-Gamification group. This indicates that stakeholders' behaviors have changed when used the Gamification technique. However, this has affected negatively as Appendix..6 illustrated. The result has shown that Gamification has effect negatively also on stakeholder behaviors, it makes them some time focus on gain a point rather than focusing on the main goal.

- During Negotiation activity, we found that the number of comments generated by the Gamification group is greater than the Non-Gamification group see Fig.6.9. This indicates that stakeholders' behavior has changed when used the Gamification technique. It has kept them involve during the negotiation activity and encourage them to their notes

and recommendation. However, it also has a negative side effect; some of the stakeholders' generated comments that are not related to main purposes. This has to lead to take more effort and time to review and read what unneeded this activity.

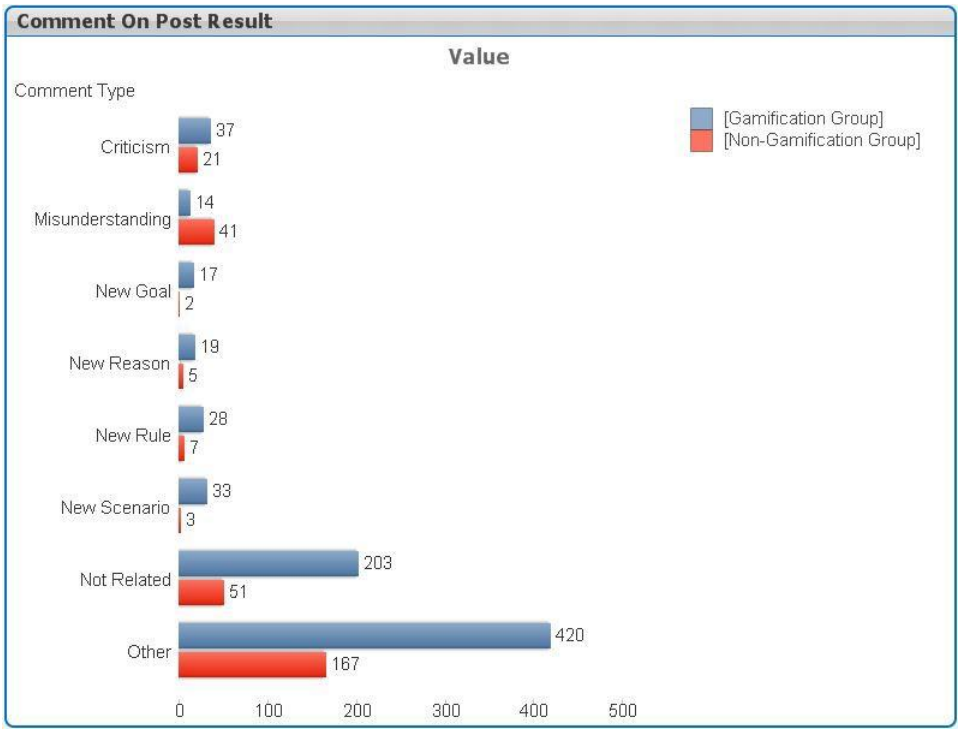


FIGURE 6.9: Comment on Post Result

- During the prioritization activity we found that the number of Gamification group Voting/Rating is greater than the Non-Gamification group. The main difference between two groups is the Gamification technique which has implement into the Gamification group as illustrated in section.4.4.4. It has encouraged them to do this task.
- Regard to average number of stakeholder who has involved during the

process per each user story behavior. The result has shown that the average number of Gamification group is greater than the Non-Gamification Appendix.2. The main difference between two groups is the Gamification technique which has implement into the Gamification group as illustrated in section.4.4.4. However, this value still not too large.

- Regard to user login behavior per day, the average number of Gamification group is greater than the Non-Gamification group see Fig.6.10. The main difference between two groups is the Gamification technique which has implement into the Gamification group as illustrated in section.4.4.4. However, regarding our observation using Sharek logs we have found that the two group did not involve during the holidays.

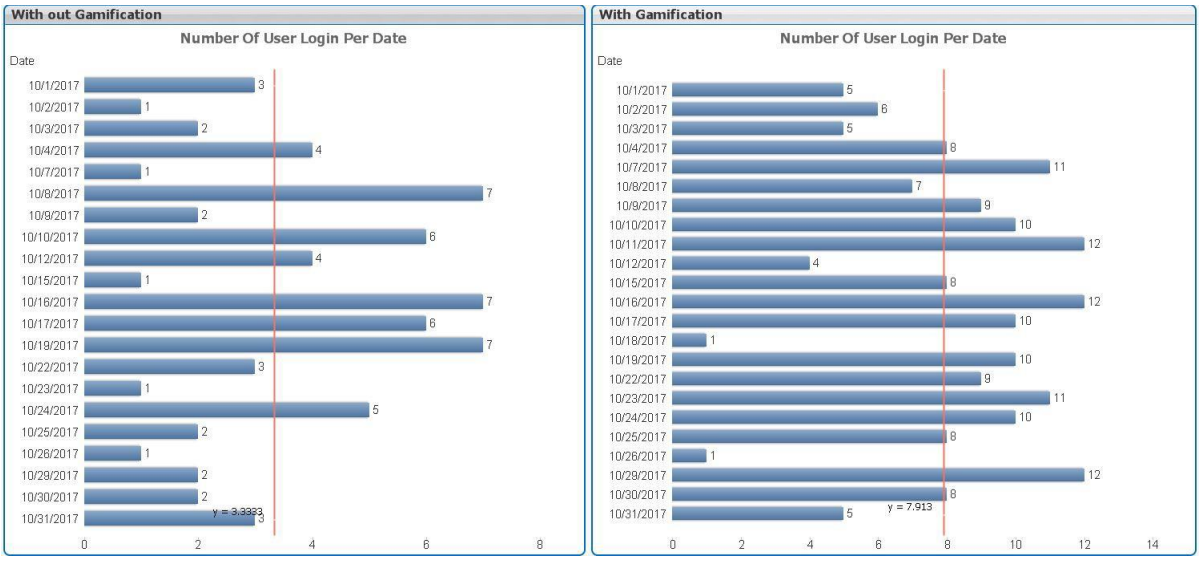


FIGURE 6.10: Stakeholders Login per Day

6.4 Summary of Stakeholders Opinions about Sharek

This section illustrates stakeholders' comments and notes about Sharek, which were collected from the stakeholders using the chat session. During the case

study, we asked stakeholders about "*how they find the Sharek tool*". Their note and recommendation were summarized below:

- The tool is easy and helpful.
- The tool has facilitated our discussion and how to write our needs.
- The tool has allows us to make a discussion from a different location and at a different time.
- For users who do not have time to write comments during the discussion stage such as managers. Theirs suggest being a mechanism that allows them to add their needs and comments using audio.
- The system is similar to Facebook, which is good and easy to use.
- The system is good. However, it can't replace to meetings and workshop.
- Some of the opinion about user story generation: At the first time of generating some of users have confused from the user story generation steps. However, when the used it frequently they have changed their opinion.
- The tool is helpful for creating a social environment and allows all users participate.
- The tool contains points and level mechanism which allow the user to be motivated.
- The tool is good for making an online discussion and reducing the number of meetings.
- The tool is a good step for allowing users who do not have time to see what happened during the whole discussing at any time he/she need.

- The chat is not appropriate for the discussion and the negotiation; there is overlap between the topic discussions.

6.5 Our Observation Notes

This section discuss our observation and notes during the case study and during the previous traditional technique which was used for the project.

- Sharek has decreased our workshops and meetings, where during the case study we didn't make any meeting and workshop.
- Sharek has reduced the lack of information problem and misunderstanding which existed during the traditional technique such as email which was used.
- The gamification technique will not be effective if it applies on a long period without something motivational e.g. gift, certification, thanks, and gratitude or other. If the period is long it should be separated into sub period, and for each period there should be something motivational (it depend on the institution culture). This can encourage them and keep them involved. At the end of our study, we observed as a participant that stakeholder involvement has little compared to the beginning because we didn't give him a gift or their thing that keep them involved for a policy issue.
- Sharek has allowed the participant to involve during suggested idea and during the discussion. During the case study, we observe the non-executive users were involved more than executive users which were the dominant individuals during the interview and focus group.

- At the end of case study, the PMO has accepted Sharek tool as Official tool in their works.

Chapter 7

Discussion

This chapter discusses the answers to the research questions based on the results that have been collected from the case study as illustrated in Chapter.6. Also, it discusses the threat to validity.

7.1 Research Questions Answers

The aim of this study was to find answers to the following research questions:

7.1.1 How can social network improve requirement elicitation, prioritization, and negotiation?

This question has been answered with the following four points:

1. **Social network has allowed a distributed stakeholder to involvement during the requirement engineering process** during this study, the researcher has gathered a user requirement from a distributed environment. The stakeholders have involved in the requirement engineering process

   i.e. elicitation, prioritization, and negotiation. Sharek has facilitated stakeholders' involvement; they have involved on different days and at a different time. Moreover, they have collaborated during user story creation,

negotiation, and prioritization which was not possible during the previous Workshop and meeting. The result shows that social networks help stakeholders' involvement in Requirement Engineering process, mainly elicitation, prioritization and negotiation activities, those findings agreed with the findings of the following studies [46, 45, 40, 28]. These studies showed that social network can help to involve a geographically distributed stakeholders in requirement elicitation, prioritization, and negotiation, which was not possible with the traditional techniques.

2. **Social Network has helped to decrease using the traditional techniques** During this study, the researcher did not use any of traditional technique which was depend on including face to face meeting, workshop, emails, and telephone. The researcher only used Sharek as a tool for involvement. The findings show the social network can be used without using any of traditional techniques. In addition, eliminate the using of the traditional techniques. Those findings are in line with the findings from other case studies including [46, 45, 28].

3. **Social Network has facilitate the requirement elicitation, prioritization, and negotiation** Regarding result, it is shown that the social network features such as posting, reply to post and rating/voting can support the elicitation, negotiation, and prioritization activities respectively. The below points discuss each of them:

   (a) **During elicitation activity** the study result has shown that Sharek post feature can support the requirement gathering. In addition, allowing stakeholders to write their needs in the same structure format. Furthermore, our findings agreed with the findings of the following studies including [46, 45, 28]. They showed that the social

network posting feature can support the requirement gathering. However, these studies expect [28], requirements result were not in same structure format. The similarities between current study and the [28] study, is that the user requirement has generated using the user story template, which has helped the stakeholders to write their need in the same structure format. The other studies did not use it, where they depend on the plain text for support the user requirement generation.

(b) **During the Negotiation** This activity has been supported using comment on a post, Voting, and Chat Session. The Comment on a post feature was useful for stakeholder discussion and negotiation comments. It views the comments as tree hierarchy see Fig.4.3. Regarding result, the stakeholders' were satisfied with it. In addition, they find it helpful and appropriate for negotiation and discussion. Furthermore, they find it simple and easy to use. However, regard stakeholders' notes, they have seen this feature needs an enhancement, in order to be appropriate to stakeholders who do not have enough time to write their needs or do not like write comments such as executive users. The voting feature was helpful during the negotiation. It to allow stakeholder vote on comments in order to make an agreement. The Chat Session was appropriate for supporting the stakeholders by answering their questions and help them during the whole process. However, the stakeholders were not satisfied with this feature to support negotiate. The reason for this is the overlap problem, which happens when a different stakeholder conducts a discussion for a different topic at the same time; this makes the discussion comments overlap. These findings agreed with the findings

of the following studies [45, 31].They showed that the Comments on posts and voting can support requirement negotiation. However, they did not use the chat session during the negotiation.

(c) **During prioritization activity** Sharek supports this activity using Voting/Rating. The Voting/Rating was very helpful and has enabled users to get the most important of user stories regard stakeholders perspective. These findings agreed with the findings of the following studies including [46, 45, 32] , these studies showed that voting and the rating can support the prioritization activity. However, these studies still have a limitation in the prioritization accuracy as discussed in previous section.3.4.2. In this study, researcher have depended on two techniques including voting and rating. This help to improve the prioritization result [4].

(d) **Improve stakeholder emotion:** This study has focused on user shy, afraid, Interest and excited as discussed in section.5.4. Regarding the survey result as Section.6.3.1 Illustrated. The result has shown that the stakeholders afraid and shy have been decreed, in addition, their excited and interested have been increased when they using the Sharek Compared with the meeting and workshop.

7.1.2 How can Gamification improve stakeholders' involvement in elicitation, prioritization, and negotiation?

This question answer has discussed into a two-points as the following:

1. **Gamification has improved the stakeholder productivity:** The result as illustrated Table.6.2, has shown that Gamification has affected positively

on the stakeholders' productivity. In addition, it has improved their interested and excited during the whole process see (Fig.6.2 and Fig.6.3); this has affected positively on their behaviors during the whole process; their productivity has increased during user story creation, prioritization, and negotiation. In addition, the time has been taken by the Gamification group in order to finish each user story negotiation and prioritization is less than the Non-Gamification group. Furthermore, these findings are in line with the findings in study [32]. It showed that Gamification has increased stakeholders' productivity; the Gamification group generated user stories greater than the Non-Gamification group.

2. **Gamification has improved the quality of user requirements:** Theresult as illustrated in Subsection.6.2.2, has shown that Gamification has played a positive factor in encouraging the stakeholder to write a high quality user story (i.e. understandable and structure). Those findings are in line with the findings in study [32], the result showed that the Gamification has improved the stakeholders' quality; the quality of Gamification group requirements was higher than the Non-Gamification group.

7.2 Threats to Validity

In this section, we want to discuss the validity and reliability of our study, in order to make our contribution to both science and society of higher quality. In the first section, we look at the internal validity that ensures that method we used and our finding is sound or not. In the second section, we have explored the external validity which concerns with generalized of our finding.

7.2.1 Internal Validity

Threat to internal validity occur when the researcher does not take into account factors that may effect on the plausible of study result [41]. In this study, we have separated population into two group regarding their social network and work experience. In addition, the stakeholders did not know that they are in a case study. However, there still are some factors that may affect the findings. Some of the factor are related to separation criteria which have depended on two attributes only. This may make the two separation groups not fully the same from characteristic and capabilities which may affect the gathering user information. Moreover, the small number of groups may make us not observe some of the unknown factors that can effect on our findings whether positively or negatively.

7.2.2 External Validity

It refers to the extent to which research result can be generalized across settings, time and the population [41]. In our study, all participants of our case study belong to government institution which may have different characteristics, culture, and work and environment context from the other none-government institution so our generalization is focusing only on government institutions.

Chapter 8

Conclusion

Many studies have used the social network in requirements engineering. These studies showed that social network can be used to involve a geographically distributed stakeholders in requirement engineering. However, those studies still have a limitation in requirement articulation, prioritization and stakeholders' engagements. For requirements articulating, the previous studies were depended on free text style, which has a negative effect on requirements documentation, and misunderstanding. In the other hand, previous studies used either voting or ranking for requirement prioritization, which is not sufficient enough to obtain a highly accurate requirements prioritization. Furthermore, the previous studies have not provided explicit frameworks for supporting distributed stakeholders involvement during requirement engineering process. There are few studies, [46, 32, 18], propose a gamified social network to improve stakeholders engagement during requirement engineering process. Although, those studies have some limitation for instance iThink [18] has some poor User Experience, which can affect the user involvement, also, it has not support geographically distributed stakeholders. The other studies including [32, 46] purposed tools which have a limitation in requirement articulation and prioritization.

This study has proposed a new framework titled as ***(Sharek)***. Sharek is a

gamified social network to support stakeholders involvement during the requirements engineering process activities mainly: requirements elicitation, prioritization, and negotiation. In order to handle the shortages that were found in the previous studies, Sharek has combined three techniques: social network, gamification, and the user story. Social network were used to support the distributed collaboration between the stakeholders who were involved in requirement engineering activities. Gamification used to improve stakeholders' involvement and keep them motivated during the whole RE process. The user story used to allow stakeholders to write their requirement in a semi structured, simple and unified way.

In order to evaluate Sharek Framework and answering our research questions, we conducted a case study in a Government Institution system. In the case study, the researcher has involved stakeholders form the Palestinian ministries which were distributed among many governmental institutions. In order to eliminate the internal threat to validity, the Stakeholders were not informed that requirement engineering is a research. In addition, the stakeholders have been split into two symmetric groups, in terms numbers of participants and experiences. The first group has used Sharek tool without Gamification, and the second has used Sharek with Gamification support.

Based on the results that have been obtained from this study, the following conclusion could be drawn.

- **Social Network has allowed a geographical distributed stakeholder to involve during the elicitation, prioritization and negotiation**.

  The traditional techniques used to gather user requirements, such as face to face meeting and workshop, are not suitable for supporting current challenges that face requirement engineering, as distributed collaboration.

The social networks have a great support to requirements engineering activities that have been performed in a distributed working context. So, the social network can used as a primary technique for the requirement elicitation and negotiation in a distributed working environment. It is crucial to train stakeholders and raised their awareness before introducing any changes in the working environment, either by applying changing working procedure or applying new techniques. So, this training will help to successfully implementation of the introduced technique, and helps in culture change and reduce change resistant. We found that the social networks could be an effective technique in the environment that need to hold periodic meetings, or require the attendance or participate of all stakeholders.

- **Incorporating Social network with User story has improved the requirement elicitation activity**.

  With regard to elicitation activity, we have found that the post feature is an effective feature to support elicitation. Using the user stories in the requirements elicitation helps on enhancing requirements articulation, since it could be used a set of questions and answers process, which could begamified.

- **Social network has support the negotiation activity**.

  With regard to negotiation activity, we have found that the comment on post feature is an effective feature to support negotiating the requirements and solve any conflicts. Particularly, if its incorporation the hashtag feature, which can help to classify and categorize the user negotiation comments. However, this feature still needs enhancement, so that can be more effective in use by the stakeholders who does not like writing comment. So that could be

supported by incorporating a voice recording to adding the comments, so adding the comments would be easier and faster. Also, add comments to a post is an effective techniques for requirement negotiation since it allows many stakeholders to post their needs and suggestion.

- **Social network has supported the prioritization activity**.

  We have found that social networks make the prioritization task more efficient by enabling the voting/rating feature, which enables a large number of stakeholders to prioritize long list of requirements fast and rather accurate.

The social networks have some challenges that can negatively affect the requirements engineering process. These challenges are mainly concern managing stakeholders' involvement during the whole process. So it is a big challenge for the task leader to control some stakeholders from writing negative staff that is not related to the task. This would require extra time and effort from the task leader to review and audit, such negative comments of staff. In addition, it is a real challenge that to validate the result of the prioritization activity, which been done using the social network, because social networks are a free and open collaboration framework. Therefore, this support our previous conclusion on the importance of stakeholders training.

- **Gamification has improved the stakeholder involvement, during the requirement elicitation, prioritization and negotiation**.

  Incorporating the Gamification with social networks has a positive effect on the requirements engineering process. It has motivated the participants

to write high-quality requirements and be more productive. Since it motivates stakeholders to actively participate in the discussion, note raising, and voting tasks. A critical and key success factor for incorporating the Gamification into the requirements engineering process is the length of the process, which should not be a long and exhaustive process. If it is inevitable long, then it must be separated into phases, where at the end of each phase participants are given material rewards such as a certificate or a moral reward. On the other hand, if the process was long and with little rewards, it may lead to the users feeling bored or a lack of trust in the Gamification process and thus becomes inefficient. The negative aspect of gamification is that it may lead to a behavior were users write needless comments and user stories just to accumulate points, in this case, productivity is decreased and therefore the need for algorithms and technologies to detect negative participants and help prevent such behavior.

8.1 Future Work and Recommendation

This section discusses the future work and recommendations, which can help to improve the current study limitation, and the domain study.

8.1.1 Conducting additional case studies

In the context of our work, we recommend future research to run several case studies in different context and domain to better generalize the results. First of all, the case study should execute in a distributed environment and with a large number.

8.1.2 Expand Sharek prioritization feature

Prioritizing requirements can take a different type of aspects such as ***Important , Penalty, Cost, Time, Risk and Volatility***. In this study, we focused on the "important" aspect to prioritize the user requirement, so there are still a lot of aspect need to explore during the requirement prioritizing activity.

8.1.3 Improve Sharek negotiation feature

From the study we found that most of the executive stakeholders were not involved, especially during the negotiation. The reason of that, some of them did not have enough time to write comments, in addition, some of them did not like the writing task. To enhance the negotiation feature, they suggested during the chat session to add a voice record feature which can help them to add their comment in an easy, fast, and with less effort.

8.1.4 Dealing with negative stakeholders behavior

In this study, we found that some of the negative behavior by stakeholder during the elicitation and negotiation process. They added a comment and post that are not related to the main goal, to gain a new reward. In order to deal with this behavior in the future, we recommend reducing the stakeholder points when they add a comment or suggestion which does not belong to the main goal. Furthermore, we recommend to apply some of machine learning method, which can help to detect negative user behavior [36] during the process. So that can decrease the human work, to monitor their negative behavior.

8.1.5 Integrate Sharek Framework and SCRUM Framework

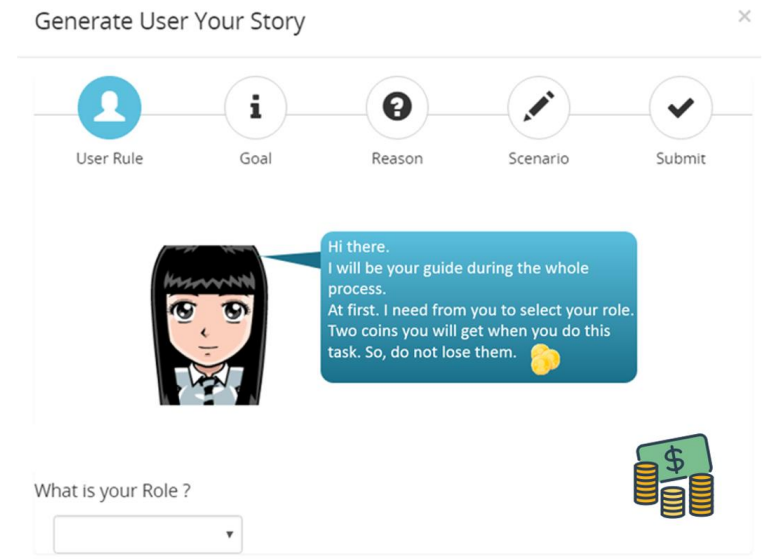
SCRUM is a framework that allows the team to collaboration on complex products. The requirement elicitation in SCRUM depends on defining SCRUM team. In addition, it depends on the user story for defining a list of needs to be done within the project (i.e. Scrum Product Backlog) [42]. Every iteration in SCRUM begins with the sprint planning. The sprint planning is meeting for the entire team to agree about the user stories in the product backlog need to be implemented in the next iteration [42].

We need to integrate Sharek framework and SCRUM activities, to see how can a distributed SCRUM team involve during define product backlog and during the sprint planning. In addition, keeping them motivated during the process.

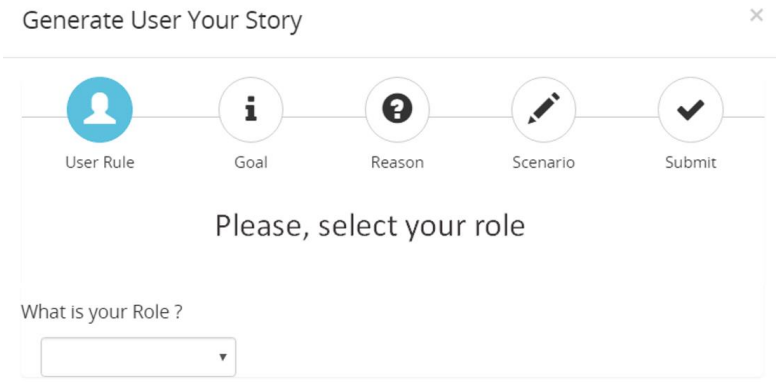
Appendices

.1 Generate User Story Screen Shot

This section represents the difference between Non-Gamification and Gamification user story creation prototype. The main difference is, in Gamification screen, there is a guide that asks a set of question in simulation and visually way.



Gamification Screen



Non-Gamification Screen

FIGURE 1: A screen shot of define User Role

.2 Number of stakeholder involved per user story

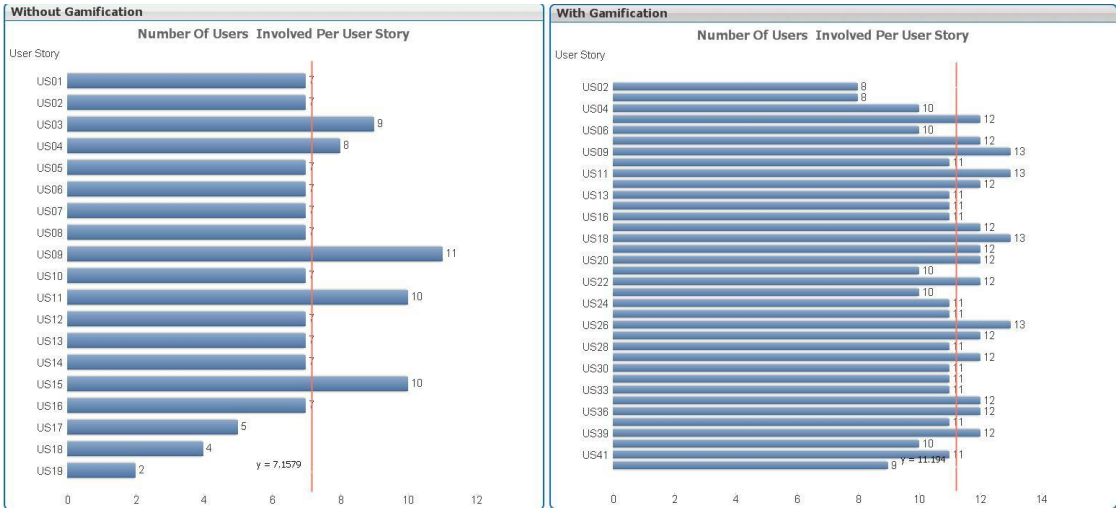


FIGURE 2: Number of stakeholder per user story

.3 Time Spent by Stakeholder per User Story

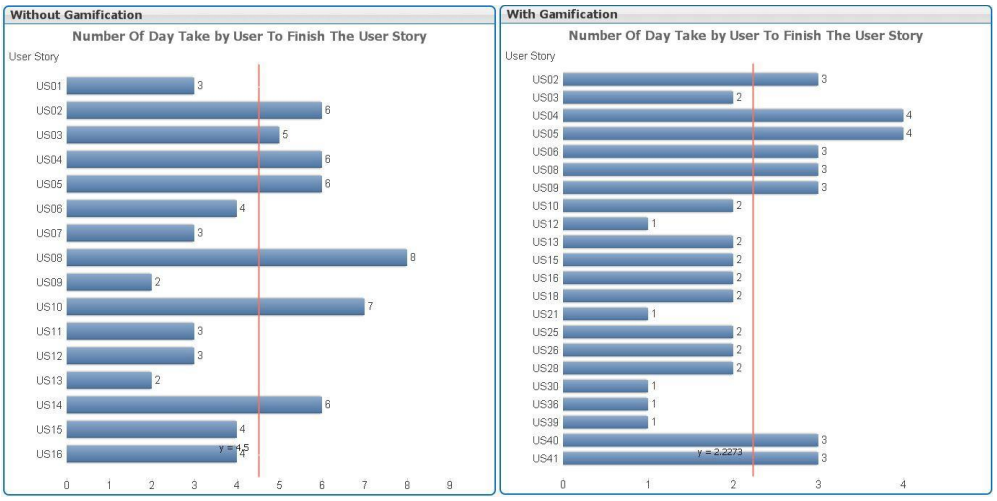


FIGURE 3: Number of day taken by stakeholder to finish each user story

.4 Analyses of the Survey Result

4.1 With Gamification Percentage Result

Main Category	Sub Category	#	Question	[Not at All]	[A Little]	Moderately	[Quite a Bit]	Extremely
Emotions	Interested	Q01	How often do you feel interested in Sharek?	0%	0%	53,85%	46,15%	0%
	Excited	Q02	How often do you feel excited to engage in Sharek?	0%	0%	61,54%	38,46%	0%
	Afraid	Q03	How often do you feel afraid in Sharek?	84,62%	15,38%	0%	0%	0%
		Q04	How often do you feel afraid to engage in meeting and workshop?	46,15%	15,38%	23,08%	15,38%	0%
	Shy	Q05	How often do you feel shy in Sharek?	92,31%	7,69%	0%	0%	0%
		Q06	How often do you feel shy in meeting and workshop?	38,46%	23,08%	30,77%	7,69%	0%
Cognition	Absorbed	Q07	I am totally absorbed in what I am doing during the post creation process	0%	0%	15,38%	84,62%	0%
		Q08	I am totally absorbed in what I am doing during the negotiation and discussion	0%	0%	23,08%	69,23%	7,69%
		Q09	I am totally absorbed in what I am doing during the voting and rating process	0%	0%	7,69%	38,46%	53,85%
	Satisfaction	Q10	How did you like the post creation?	0%	0%	61,54%	38,46%	0%
		Q11	How did you like the comment on post for discussing and negotiating the post?	0%	0%	15,38%	84,62%	0%
		Q12	How did you like the voting/rating?	0%	0%	7,69%	69,23%	23,08%
		Q13	How did you like the chat session for discussion and negotiation?	0%	38,46%	38,46%	23,08%	0%
		Q14	How did you like the Sharek tool?	0%	0%	7,69%	69,23%	23,08%

DMainCategory	DSubCategory	#	Questions	[Very easy]	Easy	Partly	Difficult	[Very difficult]
Cognition	Difficult	Q01	How difficult was Post creation ?	61,54%	23,08%	15,38%	0%	0%
		Q02	How difficult was Add a comment on post ?	61,54%	30,77%	7,69%	0%	0%
		Q03	How difficult was Voting/Rating ?	53,85%	38,46%	7,69%	0%	0%

FIGURE 4: With Gamification Group Result

4.2 Without Gamification Percentage Result

Main Category	Sub Category	#	Question	[Not at All]	[A Little]	Moderately	[Quite a Bit]	Extremely
Emotions	Interested	Q01	How often do you feel interested in Sharek?	36,36%	36,36%	18,18%	9,09%	0%
	Excited	Q02	How often do you feel excited to engage in Sharek?	54,55%	27,27%	18,18%	0%	0%
	Afraid	Q03	How often do you feel afraid in Sharek?	72,73%	18,18%	9,09%	0%	0%
		Q04	How often do you feel afraid to engage in meeting and workshop?	36,36%	36,36%	0%	27,27%	0%
	Shy	Q05	How often do you feel shy in Sharek?	72,73%	27,27%	0%	0%	0%
		Q06	How often do you feel shy in meeting and workshop?	36,36%	27,27%	9,09%	27,27%	0%
Cognition	Absorbed	Q07	I am totally absorbed in what I am doing during the post creation process	18,18%	45,45%	36,36%	0%	0%
		Q08	I am totally absorbed in what I am doing during the negotiation and discussion	0%	18,18%	36,36%	27,27%	18,18%
		Q09	I am totally absorbed in what I am doing during the voting and rating process	0%	9,09%	36,36%	36,36%	18,18%
	Satisfaction	Q10	How did you like the post creation?	18,18%	36,36%	27,27%	18,18%	0%
		Q11	How did you like the comment on post for discussing and negotiating the post?	0%	36,36%	18,18%	36,36%	9,09%
		Q12	How did you like the voting/rating?	0%	18,18%	36,36%	27,27%	18,18%
		Q13	How did you like the chat session for discussion and negotiation?	0%	54,55%	45,45%	0%	0%
		Q14	How did you like the Sharek tool?	0%	18,18%	54,55%	27,27%	0%

DMainCategory	DSubCategory	#	Questions	[Very easy]	Easy	Partly	Difficult	[Very difficult]
Cognition	Difficult	Q01	How difficult was Post creation ?	9,09%	27,27%	45,45%	18,18%	0%
		Q02	How difficult was Add a comment on post ?	36,36%	45,45%	9,09%	9,09%	0%
		Q03	How difficult was Voting/Rating ?	45,45%	45,45%	9,09%	0%	0%

FIGURE 5: With Out Gamification Group Result

4.3 Mann Whitney Test

It use to comparing between two independent samples of case on one variable which may be continuous or ordinal level, but not normally distributed. In addition, it used when the sample that need to compare small; Mann-Whintey provide a degree of the overlap between the two groups. Before doing the test , we should determine the distributed have the same shape have the same shape or not.

When it have the same shape the Mann-Whitney U will be as the following [54]:

- H0: the distributed of the two group are equal
- Ha: the medians of the two group are not equal

When the distributed have the have the same shape the Mann-Whitney U will be as the following[54]:

- H0: the distributed of score for the two group are equal
- Ha: the mean ranks of the two group are not equal

If the Mann-Whitney test value is greater than 0.05 then the null hypothesis is not rejected, else it will accepted [54].

Figure.6, illustrated the Mann Whitney U test of the study survey result. We used it for see the degree of the overlap (i.e. if they are equal or not equal) between the Gamification and Non-Gamification group.

Interested ,Excited ,Afraid ,Shy , Absorbed and Satisfaction Result

Test Statistics[a]

	Q01	Q02	Q03	Q04	Q05	Q06	Q07	Q08	Q09	Q10	Q11	Q12	Q13	Q14
Mann-Whitney U	17.000	8.000	62.000	67.000	57.500	66.000	4.000	53.500	35.000	33.000	45.000	41.500	52.500	19.500
Wilcoxon W	83.000	74.000	153.000	158.000	148.500	157.000	70.000	119.500	101.000	99.000	111.000	107.500	118.500	85.500
Z	-3.301	-3.872	-.778	-.274	-1.255	-.332	-4.169	-1.132	-2.245	-2.384	-1.775	-1.877	-1.208	-3.269
Asymp. Sig. (2-tailed)	.001	.000	.436	.784	.209	.740	.000	.258	.025	.017	.076	.061	.227	.001
Exact Sig. [2*(1-tailed Sig.)]	.001[b]	.000[b]	.608[b]	.820[b]	.424[b]	.776[b]	.000[b]	.303[b]	.035[b]	.026[b]	.134[b]	.082[b]	.277[b]	.002[b]

a. Grouping Variable: Group

b. Not corrected for ties.

Difficulties Questions

Test Statistics[a]

	DQ01	DQ02	DQ03
Mann-Whitney U	24.500	51.500	65.500
Wilcoxon W	115.500	142.500	156.500
Z	-2.858	-1.277	-.388
Asymp. Sig. (2-tailed)	.004	.202	.698
Exact Sig. [2*(1-tailed Sig.)]	.005[b]	.252[b]	.733[b]

a. Grouping Variable: Group

b. Not corrected for ties.

FIGURE 6: Mann Whitney Test

.5 User Story Quality of the Non-Gamification Group

This section represents the user story ambiguity and poor structure status of the non-gamification group. This table views only the user story id where regarding to policy issue we did not introduce the detail of each user story.

User Story ID	Ambiguity Description	Poor Structuring Parts
US01	There was a five misunderstanding hash-tags commented by stakeholders, and related to the goal which was more abstract, and for the scenario, a reason which did not exist.	Reason and Scenario

US02	There were a six misunderstanding hashtags commented by stakeholders, and related to User goal which was very long and has a lot of need in one goal and some user phrase are not understandable. In addition, the user reason and scenario have been embedded into the same goal description.	Reason , Scenario
US03	There were three misunderstanding hashtags commented by stakeholders which about that re-conceptualized of User goal. In addition, the reason and scenario was is an abstract level which Makes the user idea not understand.	
US04		
US05		
US06	User story contained five misunderstanding hashtags which about that conceptualized of the user goal.	Reason , Scenario
US07		
US08		
US09		

US10	User story has two misunderstanding hashtags which about that User goal. In addition, the scenario and reason was not existed.	Reason, Scenario
US11		
US12	User story has two misunderstanding hashtags which about that User goal. In addition, the reason was very abstract and Scenario does not exist.	Scenario
US13		
US14	User story has five misunderstandings hashtags which about that User goal, the reason was very abstract and Scenario not exist.	Scenario
US15	The user has merged the goal, reason, and scenario with each other so that other stakeholders conflict with this user need. In addition, the user story was missing the reason and scenario.	Reason and scenario
US16		
US17		
US18	There were six misunderstanding hashtags commented by stakeholders which about that re-conceptualized of User goal, In addition, Scenario does not understandable.	

US19	There was one misunderstanding hashtags commented by requirement engineer which about that re-conceptualized of User goal to be understanding by him from the business perspective.	

TABLE 1: User Story Quality of the Non-Gamification Group

.6 User Story Quality of the Gamification Group

This section represents the user story ambiguity and poor structure status of the gamification group. This table views only the user story id where regarding policy issue we did not introduce the detail of each user story.

User Story ID	Ambiguity Description	Poor Structuring Parts
US01	Not related to the topic	
US02	There was four misunderstanding hashtags commented by stakeholders, and related to goal which was more abstract, and for scenario, reason which was not exist.	Reason and Scenario
US03		
US04		
US05	User story contained eight misunderstanding hashtags which about to re-conceptualized of the user goal.	Reason and Scenario
US06		
US07	Not related to the topic.	
US08		
US09		
US10		
US11		
US12		
US13		

US14	Not related to the topic	
US15		
US16		
US17		
US18	There were one misunderstanding hashtags commented by requirement engineer and six of other stakeholders which about to re-conceptualized of User goal and reason to be understanding by him from the business perspective .In addition, User scenario was not exist.	User Scenario
US19		
US20		
US21		
US22		
US23		
US24		
US25		
US26		
US27		
US28	There were misunderstanding hashtags about user scenario which need to re-conceptualize to be understandable. In addition, concept was used on it not Clarify.	Scenario

US29		
US30		
US31		
US32	Not related to the topic	
US33		
US34	Not related to the topic	
US35	Not related to the topic	
US36		
US37		
US38	Not related to the topic	
US39		
US40		
US41		
US42		

TABLE 2: User Story Quality Of the Gamification Group

.7 Participant Information

ID	Education Level	Social Network Level	Work Experience Years	Is In Gamification Group
U00	BA	Excellent	1-4	No
U01	MSc	Average	11-20	No
U02	BA	Good	5-10	No
U03	BA	Good	5-10	No
U04	BA	Average	11-20	No
U05	BA	Good	1-4	Yes
U06	BA	Good	5-10	No
U07	BA	Average	1-4	Yes
U08	BA	Average	5-10	Yes
U09	BA	Good	5-10	No
U10	BA	Good	5-10	No
U11	BA	Good	5-10	No
U12	MSc	Good	11-20	Yes
U13	BA	Average	5-10	No
U14	BA	Good	5-10	Yes
U15	BA	Good	1-4	No
U16	BA	Average	5-10	No
U17	BA	Average	5-10	No
U18	BA	Average	11-20	Yes
U19	BA	Good	5-10	No

U20	BA	Good	5-10	Yes
U21	BA	Good	5-10	Yes
U22	BA	Good	1-4	Yes
U23	BA	Good	5-10	No
U24	BA	Good	5-10	Yes
U25	BA	Good	11-20	Yes
U26	BA	Good	5-10	Yes
U27	BA	Good	5-10	Yes
U28	Diploma	Average	5-10	Yes
U29	BA	Good	1-4	Yes

TABLE 3: Participant Information

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