International Journal of Scientific Research (IJSR)

المجلة الدولية للبحوث العلمية

Vol. (2), No. (5) May 2023 الإصدار (2)، العدد (5)

"Developing Emergency Location-Based Services Applications using Agile Methodology"

Adel Khalil Reda
M.Sc. of Computer Science, Faculty of Computers and Information,
Mansoura University, Egypt
adel.redakh@gmail.com

Moataz Saleh Menshaway
M.Sc. of Information Systems, Faculty of Computers and Information,
Mansoura University, Egypt
mizomenshawy@mans.edu.eg

Abstract:

Mobile phone applications have gained tremendous attention over the past few years due to increased mobile phone downloads and revenue. However, the more applications are produced, the more applications fail. Mobile application statistics indicate that the main drivers of application failure include high consumer/consumer expectations, inadequate marketing efforts, and technical problems resulting from developers failing to use appropriate methodologies. Some of these applications may not be important, but failures in mobile applications used by civil protection to provide important information in times of crisis, such as location-based services, are not acceptable in any way. This paper provides a framework that uses the Scrum methodology to develop a mobile application to alert citizens to risks and manage the team to improve collaboration, coordination, and communication between the team (s) to get quick feedback from users to address rapid developments in context and achieve desired goals.

E-ISSN 2755-3418
https://doi.org/10.59992/IJSR.2023.v2n5p2

Keywords: Emergency Services, Location Based Services, Agile Methodology, Mobile Application, Scrum, Wireless Communications.

1. Introduction

The number of failed mobile applications is growing exponentially, mainly because developers do not adopt a standard development life cycle for application development, or use traditional ones, such as the waterfall model that develops mobile applications in stages with a lot of documentation. The main drawback of this model it requires more than 80% understanding of the project before the start of the project, and users receive the full application after the end of the development life cycle, such models are not suitable for mobile Location Based Services (LBS) applications where speed is a vital requirement, in addition the requirements are changeable greatly according to the nature of the domain and the context [1].

LBS is the ability to find the geographical location of the mobile device and provide one or more of many kinds of services based on this location information, LBS make it easier for people to do their work, and organize their lives. They can save money, time, and even lives [2].

LBS applications are used in many areas (such as security, vulnerability, emergency, marketing, health, etc.) [3]. This paper focuses on mobile LBS application development in case of emergency alerts and management.

Contemporary human societies have faced new challenges in the form of natural or man-made situations, resulting in extensive destruction of property, loss of human life, and social instability. Since the community is primarily affected by such emergencies, it is important to pay attention to the role of the Department of Civil Protection and Emergency Management (EM) in protecting individuals and their

E-ISSN 2755-3418 https://doi.org/10.59992/IJSR.2023.v2n5p2

property, especially in areas at risk, and building community capacity to cope with any emergency [4].

The civil protection department is one of the most important sectors in the country, and the progress of the state is measured by the extent of its interest in this sector. The EM in the civil protection department is the organization that undertakes a set of measures and actions necessary to protect the public and private residents from the dangers of fire, emergency, war, various accidents, relief of the affected people, the safety of transportation, communications, and workflow in public facilities and protection of national sources of wealth in times of peace and war situations. EM is a special type of complex human organization in which heterogeneous human actors of different authorities cooperate and work together to jointly resolve or reduce the emergency situation at least. Thus, cooperation in this case within team (s) members and with other teams operating in the emergency location (s) is critical and complex, the achievement of the desired goal depends heavily on such cooperation. The interactive services and ease of use in these scenarios are very valuable and necessary as they can improve collaboration, coordination, and communication between the team (s) to achieve the desired goals [5].

LBS applications rely heavily on response speed, the accuracy of results and adaptation to both changes in user requests and constraints, and the team (s) members' collaboration. Due to the urgent need for the information provided by LBS applications to be accurate and responsive, the high-quality application must be from the beginning to work properly on different types of mobile phones.

Similarly, according to the Agile manifesto, agile represents a set of values and principles to help organizations achieve the ability to respond quickly, adapt to changes, jump or compete with their competitors. Also, agile relies on getting quick

IJSR, VSRP Publishing, UK
https://ijsr.vsrp.co.uk
E-ISSN 2755-3418
https://doi.org/10.59992/IJSR.2023.v2n5p2

feedback from users and working on finding solutions to the problems that appear as well as accepting changes in requests according to the needs of users [6].

Mobile applications such as Java, Android, and low-cost or free applications are downloaded worldwide thousands of times a week, developers can do so using the Scrum development principles to launch the release faster, so they get quick user feedback for this release, errors are then processed in these next releases so that the requirements of users in the next release are met in just a few weeks [7].

This paper is organized as follows: section (2) presents mobile development challenges, section (3) presents methodologies for designing EM systems, section (4) shows the related works, in section (5) "Appling scrum for mobile applications developing" are discussed, and finally, the paper conclusion is presented in section (6).

2. Mobile Development Challenges

The importance of LBS and the Information and Communication Systems (ICTs) are to facilitate coordination activities among developers, members of the teams involved in the civil protection department, and community members (who will get the automated alerts). However, mobile LBS development in EM is very complex and faces many diverse challenges [8]. Those challenges may be due to devices' technical characteristics, or due to domain-specific limitations.

Technical limitations such as:

- Limited capabilities and differences in physical characteristics of mobile devices, such as size, weight, display size, data input mechanism, expandability, processing power, memory space, battery capabilities, and the operating system.

IJSR, VSRP Publishing, UK E-ISSN 2755-3418
https://ijsr.vsrp.co.uk https://doi.org/10.59992/IJSR.2023.v2n5p2

- Rapid evolution of mobile and positioning devices.
- Standards, protocols, and techniques are diverse.
- Need to operate on a variety of different platforms.
- Weak support tools for Test-Driven Development.

Domain limitations such as:

- Lack of appropriate skilled team to deal with LBS.
- High consumer/consumer expectations
- High skills requirements for development platforms.
- Need of adapting to rapid release cycles.
- Strict time-to-market requirements.
- Social challenge in case of emergency is very complex
- EM involves different resolution scenarios [9].

3. Methodologies for Designing EM Systems

There are many possible alternatives to develop mobile EM systems that sense the risk and disseminate information at the same critical times, such as Service Oriented Architecture (SOA) [10],[11], User Centred Development UCD [12], and Agile methodologies [13], However, these approaches vary in nature and cover different areas as follows: State of the art on UCD, SOA, and Scrum Approaches

E-ISSN 2755-3418 https://doi.org/10.59992/IJSR.2023.v2n5p2

3.1 User-Centered Development

A user-centered approach may encompass a range of different techniques in order to "develop with the user". This can include background interviews, questionnaires, focus groups, on-site observations, co-design, testing prototypes, and usability testing that focus on designing for users and involving them in the design process, Human Centred-Design (HCD) is an "approach to developing interactive systems that aim to make systems usable and useful by focusing on users, their needs and requirements, and the application of human factors/environment, knowledge of usability and technologies" [14]. The objective of this approach is to enhance efficiency to improve human well-being, user satisfaction, accessibility, and sustainability; and to address possible adverse effects on human health, safety, and performance [15].

3.2 Service-Oriented Architecture (SOA)

Service-oriented architecture (SOA) is an approach where software resources available are considered as services. SOA is considered to be the future enterprise technology solution that promises the agility and flexibility the business users have been looking for by leveraging the integration process through the composition of services spanning multiple enterprises [16]. SOA promises to close the gap between industrial devices and enterprise applications. It allows the conversion of all business needs into business services. In addition, various old systems in the Civil Protection Organization can be analyzed and reused [17].

3.3 Agile Scrum development process

Scrum is the most commonly used subdomain of the agile methodology, which has quickly expanded to handling big, complicated projects that might have otherwise

taken a lot of time to finish. Used mostly by mobile app development companies or software-based agencies, the scrum team divides their work namely "product backlogs" into “sprints”, which they could cover within the four weeks cycles. With the completion of every sprint, the team is expected to produce a working mobile application, which they continue to work on and improve. Every sprint comes with a time box that extends from 2 weeks to a maximum of 6 weeks, and each of them has the following components to make agile mobile app development more efficient [18].

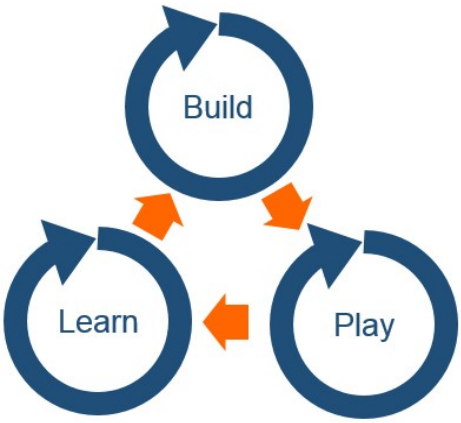

Fig.1 Scrum iterations

The main differences between the three approaches

1. UCD approach puts the end-user of the system in the development process centre. In addition, UCD aims to produce highly usable systems or programs that include user-centric methods and techniques. However, this approach takes a longer time while eliciting the requirements of end users [14].
2. While the SOA is a development approach, which divides system functions into services (software components), but it does not focus on end-user comments and feedback (which Agile cares about strongly).

IJSR, VSRP Publishing, UK
https://ijsr.vsrp.co.uk
E-ISSN 2755-3418
https://doi.org/10.59992/IJSR.2023.v2n5p2

3. SOA does not take into consideration how to make it easier for end users (which is concerned with the UCD and Scrum approaches) [16].
4. Agile methodologies focus on application code development, and how to organize the programming work that is provided over iterations, but most of them do not provide a framework for managing the working teams.

To overcome those disadvantages, we propose a new framework for developing LBS in EM systems using the Agile scrum principles that combine the characteristics and principles of Agile and the characteristics of the UCD (where the end user is represented in the development team) and the SOA model introduction (where the product owner identifies the needed services in the product backlog and prioritize those services). The new framework is designed to be easy to use, and it takes into account the needs of the users in the Civil Protection Department, through the process of iterative development of the mobile application to alert the closest citizens and team (s) members of the incident, as well as to improve the participation and cooperation of active management personnel, and to allow any changes to the production of cooperative services identified through appropriate development and implementation activities that are performed during scrum development, such as (user stories, unit tests, etc.). This framework improves collaboration, coordination, and communication among team (s) members to get quick feedback from each of them and to achieve effective engagement to achieve the desired goals.

Applying Scrum principles in LBS, especially in applications used in EM leads to great success in achieving goals quickly and accurately. For this purpose, we extend our papers published in: (ECS, 2018 [19] & IRJAES, 2018 [20], and IRJAES, 2019 [21]), to propose a new framework designed for LBS in EM applications.

E-ISSN 2755-3418 https://doi.org/10.59992/IJSR.2023.v2n5p2

The short, iterative cycle of sprints offers the team a lot of opportunities for learning and improving such as:

1. It Improves business agility: A structure based on agile methods is the proper solution for LBS applications to deal with informational chaos. Scrum methodology reduces the trauma that paralyzes many businesses attempting to adapt to fast-changing tech markets.
2. It enhances productivity: At the end of the Sprints, the work will be finished, which means that the code was integrated, fully tested, and ready to be delivered.
3. It improves the mobile application quality: Since the testing phase is integrated at every sprint throughout the agile process, the app is checked at all stages, ensuring that it is developed according to the quality standards, thus guarantees its future in terms of high performance and acceptance.
4. Increase user satisfaction: Since the Scrum method is based on involving the customer/user at every point, they have clear access to the app progress, as they are given a working part of the app with every set of newly added features after every sprint, (this competes for UCD principles).
5. Greater transparency: Since the practice of scrum methodology is based on involving everyone who is a part of the app development process plus the user, everyone knows the exact work that is to be done and its current status.
6. Faster return on investment (ROI): One of the motivations that come associated with agile methodology is faster development and ROI. With the help of agile, companies are able to start the development process much faster and are able to take up multiple areas of the process at the same time. Add this with the ease of testing the app function by function on the go, and developers will get an expedited app development timeline.

IJSR, VSRP Publishing, UK
https://ijsr.vsrp.co.uk

E-ISSN 2755-3418
https://doi.org/10.59992/IJSR.2023.v2n5p2

Scrum is about promoting distributed teamwork and collaboration. The success of a project and the quality of the produced sprint requires the user to be engaged and in an active collaborative role. There is constant interaction among the development team (s) members, and end-user at every phase of the project, so, this is an integral component of the scrum process.

In our proposed framework, we rely on the agile development process because they allow us to prioritize needs and begin the development with needs having the highest priority. As a result, the Scrum method allows us to deliver several small releases for the emergency team (s) members, consequently, we get frequent feedback.

The development of mobile applications is a challenging task due to the development technologies and methodologies used are varied. To ensure the proper operation of the product on multiple mobile platforms as soon as possible, and to improve the ability to change requirements quickly, Agile methodologies are specifically adapted to the development of mobile applications, where user interaction and the time required to enable users to benefit from the feature produced are necessary. Also, cloud services should be involved to help use a large number of servers for development, testing, deployment, and rapid feedback acquisition in a fraction of a second.

4. Related Works

Agility is the ability to react quickly and easily to changeable events and their requirements. Applied to EM, this will be a useful concept to face both well-defined procedures and processes but at the same time should be able to deal with them during extreme conditions in order to solve unanticipated events [22].

E-ISSN 2755-3418 https://doi.org/10.59992/IJSR.2023.v2n5p2

Mobile applications, such as (3D VR, PME, and UGS applications), have been developed as an interactive generic tool to gather requirements and engage stakeholders in city urban planning and policy development. For the development of these tools, scrum is applied [23].

Electronic Risk Management Architecture (ERMA) is a disaster management system, designed and built to help authorities perform their tasks successfully. The main concept of building ERMA relies on a UCD methodology as well as on SOA [24].

Humayoun et al. (2009) made a distinction in the collection of user requirements in a situation of crisis while the ERMA does not do it. They propose a methodology for designing an interactive system to be used in mobile for widespread scenarios of EM. For this, they combine UCD approaches and software engineering approaches [25].

Wood et al. (2013) focus on agile response for crisis management. They have developed a proposal based on the idea of collaborative agile workflows. Here, agility means people's ability to reconfigure knowledge, skills, and resources on the fly at runtime during the occurrence of a crisis [26].

Nawaz and Zualkernan (2009) present an analysis of unpredictable low base rate events in the context of agile software development in crises, to ensure business continuity of geographically dispersed agile team in the face of a catastrophic event like a terrorist attack or a hurricane [27].

Jiugang et al. (2009) propose a Web-based Geographical Information System (WebGIS) for government comprehensive EM, this system is based on SOA [28].

IJSR, VSRP Publishing, UK E-ISSN 2755-3418
https://ijsr.vsrp.co.uk https://doi.org/10.59992/IJSR.2023.v2n5p2

Braune et al. (2011) identify the core requirements of EM systems and present a new generation of semantic-web based for EM systems, based on SOA [29].

5. Appling Scrum for Developing Mobile Applications

In our work, we focus on agility adaptation in the sense of how we can plan and organize the project of development of EM system as a series of iterations that will be guided by user needs in a scrum process and accept any change of requirements of the EM officers. The EM system is developed and implemented for providing the nearby citizens of the risky location immediately automated alerts of what they should to do, as a LBS, at the same time, this system will be used as a collaboration tool for EM officers.

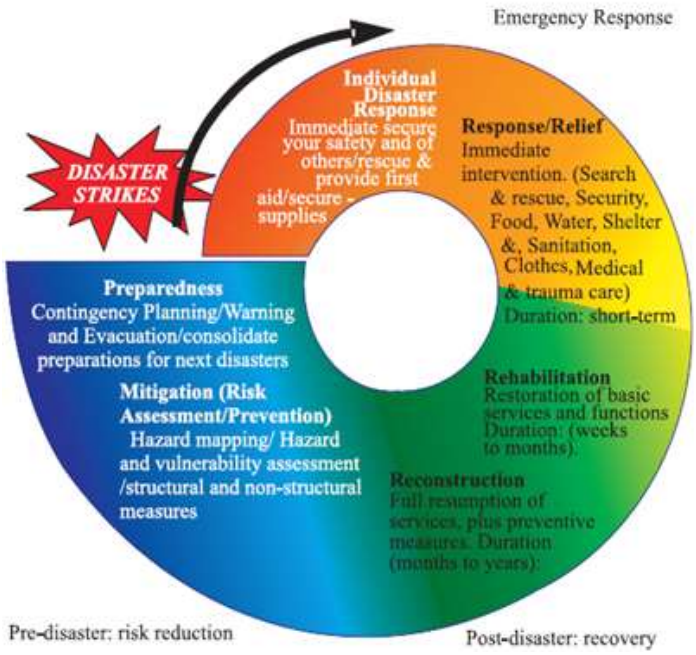

Fig.2 EM Cycle: An Overview [29]

IJSR, VSRP Publishing, UK
https://ijsr.vsrp.co.uk
E-ISSN 2755-3418
https://doi.org/10.59992/IJSR.2023.v2n5p2

The framework is based on Scrum principles to transform the conceptual models developed during the different phases of the framework and described in UML diagrams into a visual structure (i.e., Mobile based app screens) and (interactive prototypes). This framework is applied to the firefighting management case study.

5.1 Global View of Proposed Framework

The proposed framework is based on four phases (Figure 3):

1. EM study (business analysis): The Framework begins with the study of the Organization (Civil Protection Department) to define the business objective of EM phases and processes.
2. On-time EM analysis and development needs: Considering user requirements in a timely manner is essential. In other words, to enable end-users to express their business needs in a timely manner. These needs are expressed through short and simple user stories.
3. Setting priorities and planning for the next sprint: Prioritization of business services is carried out in close collaboration with the product owner and development team to develop a high-level plan for the current release.
4. Release issuing: Provide interactive evaluation by considering the user interface in each iteration. For this, the aspect of usability assessment is used.

5.2 The key roles associated with achieving the framework are:

1. Business analyst.
2. Product owner.
3. Development team (business designer, developing engineers, architects).
4. Testers and evaluators.

The main development activities are iterative and incremental.

IJSR, VSRP Publishing, UK
https://ijsr.vsrp.co.uk
E-ISSN 2755-3418
https://doi.org/10.59992/IJSR.2023.v2n5p2

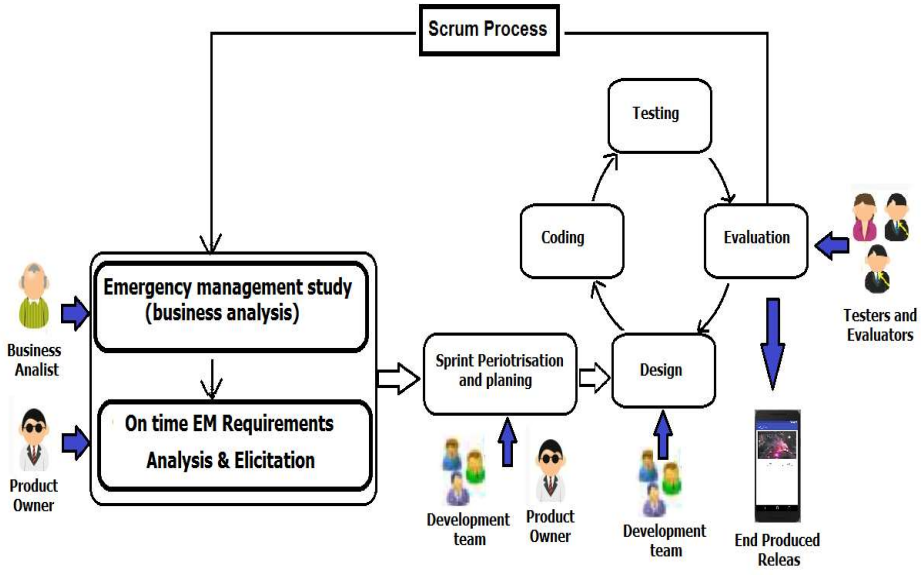

Fig.3 The Framework Life Cycle

5.3 The case study- EM in The Civil Protection Department of Luxor City (Egypt):

This paper focuses on issues of coordination and communication that take place within the Civil Protection Department (CPD) in Luxor city and decision-making procedures. In this section, we provide further details on the various phases of the proposed framework and its application to the case study.

IJSR, VSRP Publishing, UK
https://ijsr.vsrp.co.uk
E-ISSN 2755-3418
https://doi.org/10.59992/IJSR.2023.v2n5p2

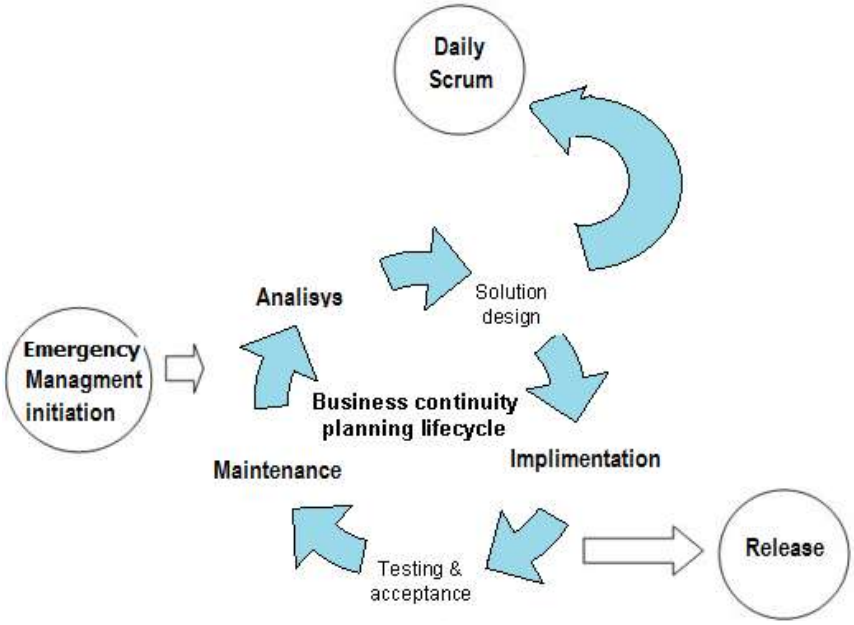

Fig.4 Case Study of EM Framework Life Cycle

Phase 1: Emergency Management Study (Business Analysis):

This first phase aims to study the Department of Civil Protection environment and communications, by identifying and analyzing EM Business requirements and its objectives. EM activities can be grouped into four phases: Prevention, Preparation, Response, and Recovery.

Collaboration is essential in all phases of EM phases [30]. This paper focuses on the preparation phase. In such scenarios, the process of Emergency preparation is divided into two business processes:

1. Infrastructure building processing (i.e., sensors' networks, surveillance cameras, and cloud remote servers)

IJSR, VSRP Publishing, UK
https://ijsr.vsrp.co.uk

E-ISSN 2755-3418
https://doi.org/10.59992/IJSR.2023.v2n5p2

2. Mobile application development to receive sensors' signals, and immediately alerts citizens in the neighborhood, and team members of the EM to make a quick decision to intervene and start evacuations and rescue operations for the wounded and injured.

This step is carried out by a business analyst designed to develop an initial functions or services model that includes a first set of candidate services that can support EM services, processes, and objectives as follows:

1. Infrastructure building processing (i.e., sensors networks and surveillance cameras): As mentioned in our last paper "Sensors Compatibility Requirements for Location Based Services"[9], the System analyst should identify the kind of candidate sensors in specific urgent locations (i.e., schools, hospitals, hotels, clubs, etc.). Sensors network installment and testing are done at this stage. Emergency sensor networks may be satellite-based, Wi-Fi, Bluetooth, and GSM sensors, or any other kind of communication protocol.
2. Mobile application development to receive sensors' signals and immediately alert closest citizens (android application).

The Main functions/services that the application is provide as shown in [Fig 5] are:

"Sensor" button to enter the required data for the new sensor (i.e. the geo-location data, and best bathe to arrive to it).

"Notification" button for entering the predefined notification that will be assigned to this sensor.

IJSR, VSRP Publishing, UK
https://ijsr.vsrp.co.uk

E-ISSN 2755-3418
https://doi.org/10.59992/IJSR.2023.v2n5p2

"Track phone" button to present the last updated location data which is stored in the remote server for the mobile holder. This feature will be useful in many other fields such as (chilled tracking, rape crimes, and anti-terrorism).

Finally, "Active Sensor" button that proposed to be used by the EM team members to show the current active sensors' data and their spatial attributes. This service for displaying the essential data for the active sensors, the collaboration between deferent participant teams could be don throw this screen, such as police stations, ambulance, to immediately tacking the needed action against the sensed risk.

Fig. 5 The application home page screen

Phase 2: On Time EM user's requirements analysis and elicitation:

This phase aims to capture, analyze and identify the requirements of EM users On Time when they are needed.

E-ISSN 2755-3418
https://doi.org/10.59992/IJSR.2023.v2n5p2

Step 2.1 Identifying and creating user stories:

By using agile methods and scrum in particular, in collaboration with the Civil Protection Department, the requirements are identified and expressed in terms of user stories by the product owner.

Step 2.2 Description of business scenarios:

Description of business scenarios of the "business objective" (supported by business use cases) identified in the previous step. As a result, we can obtain verified activities that can identify new functions/services to be developed in the next sprint.

Phase.3 Sprint Planning and Prioritization:

Planning the next sprint and prioritization of backlogs is a process whereby the product owner and the developers, who collaborate to put a number of business services in a ranked order, based on their perceived or measured importance. This phase aims to prioritize the first business services identified in the previous phase, which aims to develop a high-level plan quickly for the next sprint. We begin to prioritize business services by the degree of importance. Before choosing business services for the current sprint, we need to check the standards of dependency between business services.

In this case study, the sensors kinds' identification, network installation and tests, and assigning tasks to technicians, have the most upper rank in order of infrastructure phase processes. For the Mobile application development process, the Scrum master prepares the experienced team, the required developing platform (i.e., Run time, and required software), and infrastructure (servers, network…etc.), this stage is highly recommended to benefit from cloud services to reduce the time and cost. In this stage, scrum sprint acts as an SOA methodology. To achieve this, business services that

IJSR, VSRP Publishing, UK E-ISSN 2755-3418
https://ijsr.vsrp.co.uk https://doi.org/10.59992/IJSR.2023.v2n5p2

rely on each other must be clustered so that business services are independent and grouped into one sprint, whenever possible.

Phase.4 Release issuing:

This phase is achieved by the development team (business designer, developer/s and architects' teams) [Fig.3]. It consists of several iterations of the EM system prior to the first release. The releasing phase has iterative and incremental four basic steps.

Step 4.1 Design collaborative services:

In this step, the framework starts to design the required functions/services which in the product backlog as service components of the EM system. This step consists of transforming the modules developed during the business analysis phase (Business domain analysis, user analysis, etc.) described in the UML schemas (use-cases, sequence schemas, class diagrams, and Entity relation disarms), into a set of conceptual models that describe the sequence of activities, work rules, etc. This module highlights a range of elements such as user tasks, (new sensor identification, notification delivery, etc.), and communications, which allow identification of abstractions and selection of fine details.

Step 4.2 Code collaborative services:

At this stage, the developers use several best practices for rapid development such as coding standards, proprietary code, continuous integration, continuous testing, and re-processing, etc. The coding process needs continuous testing and processing. The practice of continuous integration is very important in the process of coordinating new services in EM. In this step, the application relies on Android and language technologies such as J2EE, Java Server Pages (JSP), HTML, JavaScript, and XML.

IJSR, VSRP Publishing, UK
https://ijsr.vsrp.co.uk
E-ISSN 2755-3418
https://doi.org/10.59992/IJSR.2023.v2n5p2

As a result of this phase, the development team gets a prototype of the implementation of the key EM services identified in advance.

Step 4.3 Test collaborative services:

The main goal of this step is to make sure that users can use the services successfully. This test will highlight errors in the code. For this purpose, developers use unit tests. This process helps programmers understand all encoding problems by evaluating certain pieces. Early testing of an EM system reduces risks such as delaying the schedule or exceeding costs due to incomplete or unacceptable components.

Step 4.4 Evaluations by Emergency Department Officers:

In this step, the framework proceeds to assess the EM system by the Emergency department. Based on scrum principles, Product owners are actively involved in usability assessments throughout the entire project lifecycle to ensure an interactive and user-friendly system. For this purpose, many evaluation techniques, especially interviews and a way of thinking aloud could be used in addition to the sprint daily meeting and release meeting, to study how team members use this system, the problems encountered and their views on the system.

6. Conclusion

The EM system is one of the critical systems in which error or failure is unacceptable. It is considered a cooperative activity; so, the organization, coordination, and communication dimensions must be considered in the representation of this type of situation. In this context, heterogeneous actors belonging to different organizations need to collaborate and work together with the shared aim to solve, or at least reduce the emergency. This framework allows the gathering and validation of the

requirements incrementally. In this paper, we have proposed a framework for designing and implementing an EM system. For this, we have used scrum methodology principles for the development of interactive and collaborative services for EM and for managing the involved team's members.

The framework described is aimed at transforming the conceptual models developed during the different phases of the framework and described in UML diagrams into a visual structure (i.e., Mobile based app screens) and (interactive prototypes). The proposed framework is applied to the firefighting management case study. The major importance of this framework is that the work is organized in a series of iterations in which the user goals to be dealt with are developed. Moreover, it concentrates only on the functions/ services needed immediately, delivering them fast, collecting feedback, and reacting rapidly to business and technology changes.

References

[1] Venkata N Inukollu et al, "FACTORS INFLUENCING QUALITY OF MOBILE APPS: ROLE OF MOBILE APP DEVELOPMENT LIFE CYCLE",2014

[2] Maneesh Prasad, Sonal Bahuguna, "Location Based Services- An overview of prospects and applications", New Delhi: FICCI, Federation House, Tansen Marg, 2013

[3] Prashant Solanki and Huosheng Hu, "Human Centred Robotics Group Department of Computer Science University of Essex",2005

[4] Smith ،Melissa, "Architects of Armageddon: the Home Office Scientific Advisers' Branch and Civil protection in Britain, 1945–68†". 43, 2010.

[5] Hans M. Kristensen, "Estimated US-Russian Nuclear Warhead Inventories 1977-2018.", 2012.

[6] State-of-ScrumReport_062713_final, "How the world is successfully applying the most popular Agile approach to projects", 2013.

[7] The Scrum Guide, at [https://www.scrumguides.org/], 2017.

[8] Janssen M., Lee J., Bharosa N., and Cresswell A. 'Advances in multi-agency disaster management: Key elements in disaster research. Information Systems Frontiers', Vol. 12, No.1, pp.1-7, 2010.

[9] Benssam, A., Nouali-Taboudjemat, N., and Nouali, O., 'Towards in IT-based platform for disaster risks management in Algeria', In Proceedings of the 10th international ISCRAM conference: Baden-Baden, Germany, pp. 72-77, 2013.

[10] Arsanjani, A. 'SOMA: Service-oriented modeling and architecture. IBM Corporation, 2005.

[11] Arsanjani A., Booch G., Boubez T., Brown P.C., Chappell D., Vadoss J., Erl T., Josuttis N., Krafzig D., Little M., Loesgen B., Manes A.T., McKendrick J., Talbot S. R., Tilkov S., Utschig-Utschig C., and Wilhelmsen H. 'The SOA manifesto,' SOA Manifesto, October, (Accessible at: http://www.soa-manifesto.org), 2009.

[12] Loup-Escande E., Burkhardt J M., Christmann O. and Richir S, 'Needs' elaboration between users, designers and project leaders: Analysis of a design process of a virtual reality-based software', Information and Software Technology, Vol (56), No.8, pp.1049-1061, 2014.

[13] Agile Alliance. 'Manifesto for Agile Software Development', Technical report. (Accessible at: http://www.agilealliance.org), 2019.

[14] Nicole Costa, "Human Centred Design for Maritime Safety: A User Perspective on the Benefits and Success Factors of User Participation in the Design of Ships and Ship Systems", 2016.

[15] Abras, Chadia & Maloney-Krichmar, Diane & Preece, Jennifer, "User-centered design. User-Centered Design". 445-456, 2004.

[16] Farhana H. Zulkernine, "Service Oriented Architecture (SOA)", 2019.

[17] Karnouskos, S.; Guinard, D.; Savio, D.; Spiess, P.; Baecker, O.; Trifa, V.; de Souza, L.M.S. Towards the real-time enterprise: Service-based integration of heterogeneous SOA-ready industrial devices with enterprise applications. IFAC Proc. Vol. 2009, 42, 2131–2136, 2009.

[18] Peeyush Singh, "A Guide To Agile Scrum Methodology in Mobile App Development", at[,https://appinventiv.com/blog/agile-scrum-methodology-in-mobile-app-development], 2018.

[19] Nicole Costa, "Human Centred Design for Maritime Safety: A User Perspective on the Benefits and Success Factors of User Participation in the Design of Ships and Ship Systems", 2016.

[20] Hanachi, C., Charoy, F., and Stinckwich, S. 'Introduction to the Collaborative Technology for Coordinating Crisis Management', IEEE 21st International Workshop on Enabling Technologies: Infrastructure For Collaborative Enterprises (WETICE), pp. 349-351, 2012.

[21] Nawaz, A. I. and Zualkernan, I. A., 'The role of agile practices in disaster management and recovery: a case study', In Proceedings of the 2009 Conference of the Center for Advanced Studies on Collaborative Research, pp. 164-173, IBM Corp, 2009.

[22] Abras, Chadia & Maloney-Krichmar, Diane & Preece, Jennifer, "User-centered design. User-Centered Design". 445-456, 2004.

[23] Khan, Z., Ludlow, D., Loibl, W. and Soomro, K., ICT enabled participatory urban planning and policy development: The UrbanAPI project. Transforming Government: People, Process and Policy, 8 (2). pp. 205-229. ISSN 1750-6166, 2014.

[24] Affeltranger, B., Berger, E., Peinel, G., Rose, T. and R.A. Mlesnita, "IT for risk and EM: Consolidating methodologies for user -centered design', In Proceedings of the 6th international symposium on environmental software systems", 2007.

[25] Humayoun, S. R., Catarci, T., de Leoni, M., Marrella, A., Mecella, M., Bortenschlager, M. and Steinmann, R., 'Designing mobile systems in highly dynamic scenarios: The workpad methodology', Knowledge, Technology & Policy, Vol. 22, No. 1, pp. 25-43, 2009.

[26] Wood, L., Büscher, M., Van Veelen, B., and Van Splunter, S., 'Agile response and collaborative agile workflows', International Journal of Information Systems for Crisis Response and Management (IJISCRAM), Vol.5, No.3, pp.1-19, 2013.

[27] Nawaz, A. I. and Zualkernan, I. A., 'The role of agile practices in disaster management and recovery: a case study', In Proceedings of the 2009 Conference of the Center for Advanced Studies on Collaborative Research, pp. 164-173, IBM Corp, 2009.

[28] Jiugang, L., Xinming ,T., Zhengjun, L. and Minyan, D., 'Design and implementation of WebGIS for government EM based on SOA', International Archives of the Photogrammetry Remote Sensing and Spatial Information Sciences, Vol. 28, No.7, 2009.

[29] Braune, S., Brucker, A. D., Kleser, G., Li, K., Meijler, T. D., Paulheim, H. and Probst, F. 'A Service-oriented Architecture for EM Systems," In Software Engineering (Workshops), pp. 225-232, 2011.

[30] "EM Cycle: An Overview",

http://medseanaturalhazardmanagment.blogspot.com/2015/11/theories-about-environmental-hazard_20.html, 2015.

[31] Rivero J M., Grigera J., Rossi G., Robles Luna E., Montero F. and Gaedke M. (2014) 'Mockup-Driven Development: Providing agile support for Model-Driven Web Engineering', Information and Software Technology, Vol (56), No.6. pp. 670-687.

E-ISSN 2755-3418 https://doi.org/10.59992/IJSR.2023.v2n5p2