The design and development of a personal mobile delivery management application based in Oman

A dissertation submitted in partial fulfilment of the requirements for the degree of Bachelor of Science (Honours) in Software Engineering

Faris Juma Ali Al Juma

Department of Computing & Information Systems
Cardiff School of Management
Cardiff Metropolitan University

May 2017
I hereby declare that this dissertation entitled The design and development of a personal mobile delivery management application based in Oman is entirely my own work, and it has never been submitted nor is it currently being submitted for any other degree.

Candidate: Faris Juma Ali Al Juma
Signature:  
Date:  

Supervisor: Stuart McNeil
Signature:  
Date:
ABSTRACT

This project documents the designs and development of an online mobile delivery application system that will be operating in Oman. With more than 25,000 lines of code, this project demonstrates its grand scale. This paper will determine the developmental phases, economic significance, the design, implementation and evaluation of the development of a mobile application system. This is a delivery system where all the textual information of the user will be saved on the website. This will allow the businesses and franchises to keep track of their delivery goods.

This project will be essential in the economic arena of Oman because it will act as a platform for the business visionaries and e-commerce. E-commerce has prompted the businesses to adopt a more electronic mode of business transactions to make it more profitable. In a country with a rising economy such as Oman, the current project will have huge importance and significance. This is because currently, there is no such delivery system applicable in Oman. Furthermore, it will serve as a platform to join the customers and the businesses.
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I would like to thank the members of my committee for their patience and support in overcoming numerous obstacles I have been facing throughout my research. I would like to give a special thanks to my peers for their feedback, co-operation and unrelenting friendship. I extend my deepest thanks to the staff for their continuous support and efforts. I would like to express my appreciation to my supervisor, Stuart McNeil, who has provided insightful feedback to help my polishing efforts. I am ever grateful to my professors, who never stopped challenging me to develop my ideas for my dissertation, which would not have been possible without their helpful knowledge. I am thankful for numerous friends for encouraging me since the beginning of this project and persevering with it, whilst accepting nothing less than excellence from me.

Last but certainly not least, my family: a special thanks to my parents and brothers as their moral support and spiritual uplifting has inspired me. I would like to extend a heartfelt gratitude to my father, Juma Ali Al Juma, who not only generously sponsored my education, but for bestowing his trust upon me and for his enormous support throughout. I am honoured to carry his name. This thesis would not have been complete without your help.
DEDICATION

This dissertation is dedicated to the Sultan of Oman, Sultan Qaboos, for the remarkable work He has carried out for the betterment of his country. Sultan Qaboos’s rise to power is the reason for the end of decades of chaos and anarchy, as He established stability in the region for the people of Oman. His majesty, the Sultan, is the foundation of the Renaissance of Oman. In 1970, He made a promise to his people, which he has fulfilled and exceeded by dedicating his life to his people. He has ultimately provided the Omani people with a land of enlightenment, happiness and possibilities. Under his leadership, the economy of Oman has flourished beyond belief and the illiteracy rate has decreased to just 5 percent. Oman has dramatically transformed under his Majestic Leadership, which he has led with a personal touch by being involved within all matters of the country. We are proud to be led by our father, the Sultan, in developing our beloved country Oman.
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CHAPTER 1: INTRODUCTION

1.1 Background of the Study

This project is grand as there are more than 25,000 lines of code. It documents the designs and development of a mobile delivery application that will be functional in Oman. This is an information system application for a delivery system which entails handling all the required textual information, required by the physical delivery system. It will have the capability to encompass many businesses and franchises, providing them with the opportunity to monitor the delivery process of their goods. An e-commerce platform allows for customers to interact with the sellers online. Buyers can order for goods online and can get the goods delivered to them by the sellers. Due to the increasing sophistication of modern technology, online retailing is dominating traditional shopping. An e-commerce platform should be user friendly and easy to navigate. Due to the vast technological development and the progression of cutting edge innovation, the improvement of electronic trade has become fundamental over the past couple of years. This web-based method of working together collectively has drawn in numerous agents worldwide into the electronic universe. Development of e-commerce has provided a platform for the business visionaries from all over the globe. These visionaries are risking all their previous business practices in favour of e-commerce and electronic business to make their business more profitable and successful.

Having been said so, there are many individuals who do not grasp the importance of business marketing through the internet. The distinctive ways to fail in the e-commerce extend from essential business errors to electronic or legitimate issues that may affect a business and its exercises.
By definition, e-commerce is the purchasing, offering, exchanging or trading of items, administrations or data through PC systems, including the web (Cole, 2016). Like other urban areas in Arabia, such as Muscat, the capital of the Sultanate of Oman, do not have a broadly utilised road tending to framework. Territories, roads and structures are distinguished by a far-reaching set of numbers that are excessively troublesome, making it impossible to locate delivery locations and status for service and people throughout the province.

In the year of 2012, Muscat municipality signed a contract with Norplan, which consists of three basic areas of work (norplan, n.d). These include reviewing existing system for street addressing, as well as proposing a new standard for street addressing in Oman. This is followed by the business plan and tolls and lastly, preparing a tender document for Muscat government to ask for funding.
1.2 Statement of the Problem

Despite the fact that e-commerce is rapidly gaining popularity throughout the business world, it is still lacking some mechanisms to address the potential problems that arise in the e-commerce world. For instance, in Oman there is no addressing system that enables companies to know the exact location of a house through a clear standardized addressing format. The best solution for accuracy when it comes to addressing is always GPS. The problem with GPS is that it cannot easily share coordinates through a phone or a website. For this reason, there is a need to develop a system that will solve these problems. There is still a huge market for software that will allow the solutions for such problems. Furthermore, much work needs to be done to bridge the gap between the rapidly developing e-commerce worlds, along with the opportunities in Oman.

1.2.1 Aim

The basic aim of this study is to design and develop a prototype of a mobile delivery application. This will offer solutions to users for controlling and monitoring the delivery process of goods in Sultanate of Oman, considering there is no such effective system which is already existing.

1.2.2 Objectives

The above aim will be accomplished by fulfilling the following objectives:

1. To find which fields are required by the user to be inserted and saved to the database.
2. Collect all data required to establish understanding of development project and develop into a critical literature review.
3. Designing the user interface and testing to ensure that it meets user requirements.
4. Finding the most suitable programming languages to use for the project.
5. Create the application and web application (with all required additional services).
6. To find out SMS service providers to use for SMS verification and to choose the most suitable one for Oman.
7. Test the application for effective working.
1.2.3 Research Questions

In this section the research questions are posed to enable further threads of analysis to come to light, drawing out the meaningful and important areas of reasoning. These will also enable a route of discovery through the development of a literature review in the proceeding chapter.

1. Why does Oman need a delivery system?
   - It helps to create technology in a developing world.
   - Political, economic, social and technological (pest analysis).
   - Infrastructure Development.

2. What are the perceived benefits for using the mobile number in addition to GPS?
   - The customers telephone number is unique to the individual. No other mobile customer has this number.

3. What are the perceived limitations?
   - Sometimes there are limits that the user may face whilst using services such as the mapping from terrain and satellite image. There may be restrictions using data from these mapping services.

4. What could be the practical uses of the mobile application? (can it be safety tracking)
   - The user is able to add his location easily using the GPS service
   - The company is only granted access to the user’s location if the user gives permission
   - The user is able to see who has accessed their location in the logs

5. What could be the practical uses of the web application? (can it be safety tracking)
   - It makes it easy for the delivery company to view the location of the user
   - The Admin can view the logs of companies to enable safety tracking
CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter will display the related literature and review critical aspects that relate to the development of ‘Anawen’ mobile application. This literature will be divided into themes and will aim to provide detail through supportive documentation. This will start with a broad introduction of e-commerce and lead to defining some related information about the selected topic. Different concepts which will be used in this study for the exploration of the selected topic, which will be also included in the literature review. Inclusion of various relevant concepts will be helpful in the development of the hypotheses. E-commerce and its connection with the delivery of independent mobile applications are some of the core variables which will be used in this study. Other research work will be also explored to provide a detailed elaboration of the role of e-commerce in the development of mobile market.

Literature review section of this study will also include contribution of the apple and android in the growth of the mobile market. Various technological aspects will be also included in this section of the study. General findings obtained from the research of other literature relevant to the topic will be also included in literature review. Research questions which are developed in this study will be also clarified by using the material discussed in the literature review section of the study. This section of the study will be also useful in analysing and evaluating field of the research about the selected topic. Integration of the various concepts about the selected study will provide an effective content for the understanding of the research questions and thesis statement. A coherent review of the previous literature will be carried out which will be useful in the development of a thematic study.
2.1 Introduction of E-commerce

E-commerce plays a vital role in the day to day life of the person by integrating various aspects of their life in an easy way (Cole, 2016). It has made the individual’s life easy by allowing them to purchase the products they need with less time consumption at attractive prices compared to the market price. As e-commerce is a part of business model, it aids the business to sell their products online and earn profits and revenue easily via internet network.

Mobile technology and e-commerce are strongly connected with each other. There are a large number of mobile applications which ensure online buying and selling of the products in the international market. E-commerce has provided strong business strategies for the trading market and its strategies also include mobile delivery applications. Numerous consumers of the technology are targeted by using mobile applications for e-commerce (Orrigo, 2016). A lot of the business ventures are conducted by using mobile applications. It also plays a vital role in the digitization of the markets at an international level.

Mobile technology and e-commerce are strongly connected with each other. It can be analysed from various research studies that online mobile applications have provided a wider platform for the integration of the business activities and to conduct in national and international markets. Mobile commerce has played a vital role in the satisfaction of the consumers at a larger level.
2.2 Introduction of the Mobile Delivery Applications

The versatile insurgency has changed the way businesses cooperate with their clients. There is no need to depend on bulletins or printed materials to publicise rebates and unique offers when you can do it in a more effective manner through an application. In addition, portable development has affected and changed the clients' purchasing propensities. They think about costs, look spots, merchandise and different purchasers’ audits utilizing their cell phones. The technology evolves in an organic way (Cortimiglia, Ghezzi and Renga, 2011). Online business opportunities created a diverse way for the introduction of versatility in the business elements.

Mobile delivery applications are increasing consumerisation and these are attaining a competitive edge in the business market as they are more efficient compared to other IT business systems. Mobile applications are also providing simpler and economic ways to expand business at a profitable rate (Varshney and Vetter, n.d.). These applications are also available at a wider level and these can be used by anyone to excel their business. Different shipping organisations, such as UPS and FedEx are also using mobile delivery applications for the delivery of the products and to track shipments (Tyrsina n.d.). However, independent companies can likewise locate a developing group of modest, outsider and versatile coordination applications that offer profound components for utilising various transportation organisations.

Shipment tracking via mobile delivery applications is beneficial in various ways. This allows you to locate a shipment without wasting time looking for it. Of the many delivery applications accessible on the Google Play application store, Package Buddy may be the most valuable. It is used by more than 60 shipping organizations around the world (Package-buddy.com, n.d.). Highlights incorporate the capacity to impart shipping data to others specifically from the application and provides choices to channel data by the status of the bundle and whether you are sending or receiving. The application additionally offers a valuable standardized tag checking highlight.
Mobile application delivery is facilitating business users and consumers at a wider level. The effectiveness and efficiency of such application is dependent on the experience of the users, security of the business, application architecture, capability of the devices and cross platform productivity. These delivery applications are also accelerating opportunities for the conduction of the business in more economical ways.
2.3 Contribution of Apple and Android to the Market Share

Google's Android versatile operating System (OS) snatched a record piece of the overall industry in the second from last quarter to the detriment of Apple's iOS which posted decay, as indicated by new research. Stated in a report by Strategy Analytics, Android caught 86.8 percent of worldwide cell phone piece of the overall industry in the three months to the finish of September. This implies about 9 out of 10 cell phones on the planet run Google's OS. Shipments of Android gadgets hit 328.6 million, up 10.3 percent year-on-year. In the meantime, Apple's transported 45.5 million iPhones, down 5.2 percent from the 48 million in a similar period in the previous year. This was affirmed in Apple's most recent profit outcomes, which demonstrated the third straight quarter of decreases for iPhone deals. Apple iOS piece of the pie remained at 12.1 percent in the second from last quarter, down from 13.6 percent the prior year. Figure 1 is a line graph that displays the worldwide smartphone OS market share from the third quarter of 2013 to the third quarter of 2016 (www.idc.com, n.d.).

![Worldwide Smartphone OS Market Share](https://www.idc.com)

*Figure 1 Worldwide smartphone OS Market*
2.4 Internet Speed in Oman and Its Comparison to Other Parts of the World

Speed tests in Oman demonstrates an average of 4.34 Mbps download and 1.29 Mbps transfer speeds over all portable, tablet, and desktop gadgets tried. Investigate the outlines beneath for an initially perspective of speed test comes about by gadget (Dospeedtest.com, n.d.). Oman Mobile Telecommunications, Omani Qatari Telecommunications and Awasr are among the numerous Internet Service Providers (ISPs) conveying broadband to Oman (Tra.gov.om, n.d.).

According to the telegraph, Oman ranks the 17th country with the fastest 4G speed of 27.88Mbps, which ranks second in the region after UAE with a speed of 29.61Mbps. Oman 4G users can except to find LTE signal 62.16 percent of the times, making it higher than the United Kingdom with 57.94 percent (Smith, 2016).

Internet has been available in Oman since two decades now and the official internet provider is GTO. Post and prepaid internet access cards are also still available with usernames and passwords, providing a specific number of hours.
2.5 Case Example: Uber

For this section, I will review the existing literature about Uber. Uber is a good example of how mobile Apps can be used to enhance the success of a business. Uber is a taxi company that uses a mobile app to connect with its customers. Uber Technologies Inc. is an American transportation network company which operates in 57 countries, headquartered in San Francisco, California (BBC News, 2015). It creates showcases and works the Uber application, which permits customers with cell phones to present an outing solicitation. Thereafter, the product program naturally sends to the Uber driver closest to the shopper, directing the driver to the area of the client. Uber drivers utilize their very own autos. The Uber application naturally ascertains the passage and exchanges the instalment to the driver. Since Uber's dispatch, a few different organisations have imitated its plan of action; a pattern that has come to be alluded to as ‘Uberification’ (Adeleke, 2015).

UberEATS, which is a different application, was initially guided in 2014 in Los Angeles. The service has since been extended to 58 urban communities over the world, including New York, Paris, Seattle, Bangkok, Singapore, Tokyo and Hong Kong. The administration takes a shot at two models. While in a portion of the more established markets, for example, Chicago, Houston and Los Angeles, purchasers can look over the whole menu of the eateries. Another example is a portion of the more up to date showcases offer shoppers a moment conveyance menu, consisting of a rundown of curated things that can be requested rapidly. The nourishment is conveyed either in an auto associated to Uber, or by an individual conveyance work force. The organization has encouraged people to agree to accept the conveyance benefit in urban areas including Bengaluru, Chennai, Delhi, Hyderabad, Kolkata and Mumbai (Mogg, 2016).

Uber did not uncover a dispatch date for UberEATS in India or unveil more insights about the operations. It has earned a profit of $68 billion and has carried out business speculation planning for the introduction of new applications that would integrate various functions (helft, 2016). It is also planning to introduce UberRUSH which will be based on the provision of cargo services (UberRUSH, n.d.).
2.5.1 How Uber uses the Technology and how this relates to this research

The Uber application for iOS utilizes the Core Location system to find a client's gadget. The Core Location structure provides classes and conventions to determine a device’s area conveyance and send area occasions to the server. The Core Location structure gives Uber a chance to characterize geographic districts and screen a gadget's developments as it crosses characterized limits. Geolocation for the Android form of the Uber application was actualized utilizing Google's Location APIs. They can cleverly oversee fundamental area innovation while meeting different improvement needs, as well as executing area based elements. To indicate point headings on a guide inside the application, engineers of the Uber application for iOS utilised MapKit. Enlisting the application as a steering application then makes headings accessible to the Maps application and all other mapping programming on a client's gadget (Abrosimova, 2014). Uber mainly relies on Google Maps and it used Google Maps for both iPhone and Android renditions of their application. Presently, Google Maps offers reconciliation with Uber. However, Google Maps is not the main administration that Uber utilises. To abstain from paying Google for access to their answers, Uber purchases mapping innovation organisations to settle their coordination issues.

Upon receiving a request for a ride from a client, Uber sends a few notices. The first is for the driver to acknowledge the client’s demand. The second is to display drivers who are within proximity to the client. They additionally inform the client when a ride has been cancelled for unknown reasons. Clients get these messages as SMS or push notifications. Uber's surge valuing has been vivaciously scrutinized. By charging a premium for a ride, the organization contends as it gets more drivers out and about and lessens request from potential travelers (Abrosimova, 2014).
2.5.2 How Uber works:

Uber, a technology platform, connects the drive-partners and Riders. The rider application is used to request a ride online. The nearby driver accepts your requests for connection and the application estimates the time for the driver to reach you by an inbuilt function of estimation speed and distance. Application also sends a notification for arrival. The application also provides complete information, including the name, vehicle and the license plate number of the driver who is going to pick up or drop off the client. When destination is reached, the trip is culminated and fare is calculated. The amount is charged through the payment method specified in the Uber account. Uber makes it very convenient to travel in a safe and more reliable manner at affordable rates (Uber Global, 2015).

Uber works in six simple steps:

1. **One tap Request:** Phone GPS assesses the location and a connection is developed between the nearest available driver.

2. **Clear Pricing:** Specific address for pick up and drop off allows a fare quote which is calculated before the client rides.

3. **Reliable Pickups:** After the connection is established, the driver name, phone number, rating and vehicle details are revealed.

4. **Track Your Trip:** The ETA of the driver is displayed and a push notification announces the arrival of the driver.

5. **Cashless:** A credit card or payment method chosen by the client in their Uber account is used to pay for the ride. Therefore, there is no involvement of cash.

6. **Two way rating system:** Both drivers and riders rate each other out of five.
2.6 Success of Enwani – Comparison Between Enwani and My App

Enwani is also a mobile delivery application and it has both GPS and innovative cloud-based addressing approach to make home delivery convenient. Enwani is a state of the art company with products developed in Germany and Saudi Arabia (Stcventures.com, n.d.).

2.6.1 How it works:

Firstly, the application must be downloaded. The application is available for Android and IOS users for free from the play stores, or can be accessed by signing in at from their website (Enwani.com). The sign in process is simple and easy. In two steps, information is required of the current address, the user’s address and home number, which creates a personalised account. Secondly, the user’s favourite restaurant is displayed with the phrase ‘I am at Enwani’. The application will automatically access the address of the destination, which the driver will insert it into his navigation system and deliver directly to the address mentioned in the user’s account without any delays (enwani, 2013).

2.6.2 Enwani acquired by Careem:

The Careem acquisition of Enwani will allow an effective navigation to pick up drivers, enabling Careem to now wander into territories which are quite different to its aim in the star. Careem can now explore different applications of their own offering. Careem always aims to differentiate itself, therefore, this acquisition will go a long way for Careem to develop a strong, unique and individual image (Prince, 2015).
2.7 Google Maps Integration into Anawen

The app will make use of the Google map. Google map is the best as it gets updated frequently (Low, 2016). Google Maps is not only for bearings; it is also useful for finding organizations. For instance, by utilizing Google maps, you can comprehend how to discover organizations like auto wash manufacturers on the off chance that you ever required auto wash development. Furthermore, Google Maps offer an assortment of simple components to do as such (Zamir and Shah, 2010).

2.7.1 Google Map API

The Google Maps API consider the insertion of Google Maps onto website pages of outside designers, utilizing a basic JavaScript interface or a Flash interface. It is intended to deal with both cell phones and customary desktop program applications. The API incorporates dialect confinement for more than 50 dialects, area limitation and geocoding and has components for big business designers who need to use the Google Maps API inside an intranet. The API HTTP administrations can be gotten to over a protected (HTTPS) association by Google Maps API Premier clients. Google Maps APIs for Android and Google Maps SDK for iOS are available via Google Developers website so the app can be location-aware, include data-rich maps and find relevant places nearby (Svennerberg, 2010). Google Maps API can be used for this application by integrating and executing it into different platforms where it will be available for Android, Web and iOS.
2.7.2 Google Maps available for android and iOS developers:

2.7.2.1 Google Maps API vs. Apple Maps API: Price & Availability

Both apple and Google Maps APIs are free. Apple maps come preinstalled in the phone whereas Google Maps can easily be downloaded freely from the Apple Store. For Google Maps, there are other applications, which ask for your preference of using Google or Apple Maps if both services are installed on the phone. Apple is updating iOS 9 software and will be available for free when it launches. Hence, both the Google Maps API and the Apple Maps API can be used (Painter, 2015).

2.7.2.2 Accuracy of data

Google uses Skybox to improve accuracy for maps and have human operators that manually check the maps and correct any errors. They also respond to thousands of problems that are reported daily by users by fixing any issues. Apple Maps have become more accurate but there are still a few problems regarding business markers with wrong addresses. The Apple mapping service still has errors and has included an option to report the errors (Painter, 2015).
2.8 Anawen Utilization of Technologies

There are various apps that have been developed to aid in delivery of goods and services. Most of these apps are developed for iOS and android operating systems. Some examples of the mobile applications are included in this section of the study to obtain an understanding of the usefulness of the mobile delivery applications.

2.8.1 Caviar

This app entices you to get nourishment conveyance from the best free eateries in your city. It enables you to search eateries nearby and view a menu with photographs for each item. You can plan food delivery up to seven days in advance. On the other hand, unless you're in New York or San Francisco, you can use an application called Caviar Fast Bite for suppers delivered in 15 minutes or less amid pinnacle lunch and supper hours (Solares, 2014). You can also track your supper with continuous GPS, as well as adding a note to your request to modify your food order or make a unique demand.

2.8.2 Delivery.com

This is a multipurpose application that offers delivery of food, drinks, clothing and other grocery items. It provides a variety of the food menus and enables you to order food of your choice at reasonable prices in a minimum period. Lager, wine, or alcohol with the expectation of complimentary conveyance can be discovered. This app is delivery focused, covering a large area and provides services to a great number of the consumers (Halonen, 2004).
2.8.3 DoorDash

This app offers food and beverage delivery in a short period of time from your most loved eateries or new nearby restaurants. This application has a unique feature as it also provides information about the quality of the food, its rating, time that will be needed to deliver food and availability. As well as delivering food at a reasonable price, it also provides delivery of the food for various events based on the demands of consumers (Myers, 2011). It also played a vital role in upgrading food choices of the people.

2.8.4 Eat24

Eat24 is also an effective and efficient mobile delivery application as it provides various information about the food items, various dishes, cooking styles and eating habits. This app provides services to numerous clients. It is economical, convenient and provides a diversity in the food items. It also provides a great number of the choices for the food items (Eat24.com, n.d.). This app provides services based on demographic factors and living standards of the people.
2.9 Findings from the assessments of the delivery applications for Android or iOS.

Caviar is a costly place to eat as it has an additional delivery fee of up to $8.99 depending on the distance and 18% service charges (Caviar, n.d.). However, Caviar allows ordering from a wide range of choices around your borough. They are also partnered with other franchises who are normally not involved in delivery. Overall Caviar is a pricier option than other delivery restaurants. Delivery.com has no delivery charges besides the cost of order, tax and tip -if applicable. As well as operating food delivery, they also operate grocery delivery and laundry service, unlike the Caviars (Brick Underground, 2015). The options vary from Caviar and other delivery systems as is a lot eco-friendlier.

iOS and Android Operating systems also provide unique delivery applications and these applications are contributing in the achievement of high profitability. These applications are also time efficient and are capable of satisfying consumers.

2.10 Company’s Strategies

Different companies use different strategies as their strengths to reduce their capitals and improve their profit margins. In terms of Anawen, it does not pay for drivers to reduce capital and lean development. On the other hand, Uber is the largest taxi service in the world, however, it does not own any car. Similarly, Airbnb is the largest hotel and room chain and yet, it does not own any hotels. Additionally, Netflix does not produce any movies, nevertheless, it is the largest movie database. (McRae, 2015) These are the strategies which work for them.
2.11 Conclusion

Mobile delivery applications are increasing all over the world and these applications have provided ways which are economical and convenient for the consumers. Mobile delivery applications are playing an effective role in the delivery of various household items, food, clothing and other services related to transportation and shipment. These are contributing to the generation of higher profits from the business. This study is based on the introduction of a new mobile delivery application in Oman, which shall be based on the usage of GPS and navigation systems to minimize time gap and to deliver items to the consumers in a minimum period of time.

This study has provided a deep analysis of the various mobile delivery applications already existing in the market and the various types of services. It is found from the analysis that these apps are highly productive and profitable. The new mobile app, Anawen, is to be introduced in the market of Oman and will be based on the unique features that will be useful for the consumers to meet their demands. This study also included an evaluation of the IOS and android apps and some of the other same apps such as Uber, Careem and other food delivery applications. Development of the new mobile delivery application will be based on market surveys that will provide information about the highly-demanded items. This new app will also consider internet facilities in Oman as it will be dependent on the internet speed and coverage of the area. There are various technologies that can be used by Anawen, which are also discussed in this study. Development of the new mobile delivery application also needs information about the existing condition of the market and economy, as well as the success of other similar mobile apps. As mobile delivery application is a great source of the e-commerce, it shall be based on strategic decision-making that would yield better results.
CHAPTER 3: Methodology

3.1 Introduction

The chosen methodology for this project is the User interface Design instead of the conventional UTAT. Jakob Neilson has developed 10 general principles for interaction design. They are called ‘heuristics’ because they are very broad in spectrum and are not used for specific usability guidelines. They are applicable over a large set of applications. This method was specifically chosen for the design of this application because this application will cater to a large group of people and will target a large domain, where user interaction is very important. The ten rules of this heuristic designs are:

3.1.1 Visibility of system status
The system should always keep users informed about what is going on through appropriate feedback, within reasonable time.

3.1.2 Match between system and the real world
There should be appropriate connection between the application and the system. The system should display the language of the user, as well as being aware of the contexts and the meaning behind the language.

3.1.3 User control and freedom
Users can access functions by mistake. For this reason, there should be a clearly marked ‘emergency exit’ to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.
3.1.4 Consistency and standards
The system should be based on the conventional platform and the language should be clear and precise rather than ambiguous.

3.1.5 Error prevention
Eliminate any conditions which can cause error. Furthermore, there should be a confirmation state or message displayed before the user can carry out the action.

3.1.6 Recognition rather than recall
Minimize the user's memory load by making objects, actions and options visible. The user should not have to remember information from one part of the dialogue to another.

3.1.7 Flexibility and efficiency of use
Accelerators are used to speed up the systems, allowing ease of usage for both inexperienced and experienced users.

3.1.8 Aesthetic and minimalist design
Avoid irrelevant display of information on the application.

3.1.9 Help users recognize, diagnose, and recover from errors
Error messages should be expressed in plain language (no codes). It should precisely indicate the problem and constructively suggest a solution.

3.1.10 Help and documentation
Although it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search and readily available (Nielsen, 1995).
3.2 Research design

The research design that we will employ for this project is Qualitative research design. Qualitative research design is based on a social constructivism perspective, which is based on the observation of how people learn and studying them scientifically. It suggests that people construct their own understanding and knowledge of the world through experiencing things and reflecting on those experiences. Research problems are the research questions which are based on prior research experience. The samples sizes are small and the data collection methods that we employ are interviews, observations and archival content data. Interpretation is based on a combination of researcher perspective and data collected.

3.2.1 Appropriateness of the design:

To determine the appropriateness of the design, the research methodologies that we have used are interpretivism. Interpretivism allows the researchers to interpret elements of the study and integrates human interest into a study. These researchers believe that access to reality is through social mediums such as language, consciousness, shared meaning and instruments. According to interpretivist approach, it is important for the researcher, as a social actor, to appreciate differences between people. Moreover, interpretivism studies usually focus on meaning and may employ multiple methods to reflect different aspects of the issue (Saunders, Thornhill and Lewis, 2009).

Keeping in accordance with the interpretivism research philosophy, the research approach employed in this project will be deductive and our results will be determined after collecting the views of our users. The research methodological choice is of mono-method and we will utilize the research strategies of different case studies and action research.
3.2.2 Research Philosophy

The research philosophy used is that of interpretivist approach and according to this approach, it is important for the researcher, as a social actor, to appreciate differences between people.

3.2.3 Research Methodological Choice

The methodological choice for research is that of mono-method, followed by the research strategies of action research and different case studies.
3.3 Project Timeline

Gantt charts are valuable for scheduling and planning projects. They help you evaluate how extensive a project should be, determine the resources required, and plan the direction in which you'll complete tasks. They're also helpful for handling the dependencies between tasks.

Following the selection of system development and analysis model, a Gantt chart is created to schedule the different stages of the methodology appropriately. Figure 2 contain the full view of the gantt chart. A full size copy of the timeline is available in Appendix C.
CHAPTER 4: REQUIREMENTS ANALYSIS

4.1 What are Requirements?

A requirement is the ability or state that must be met to guarantee that a result comes across the wants of its stakeholders (Skidmore and Eva, 2004). There is often healthy debate about accurately what constitutes a requisite. Some followers will include concepts such as Business Rules and Business Drivers and Policies while others will have a much extra restricting opinion of the requirements. In addition, many requirement approaches are Use Case centric and only articulate requirements at a commercial level while others augment the use cases with in-depth functional requirements requisite by the designers (Rogers, Preece and Sharp, 2013). The highly iterative approaches such as Agile usually use User Stories and Requirements together but give way the amplification of requirements until a sprint is being scheduled. Innovativeness Architect provides general tools to support any requirements process and any type of requirement can be shaped and accomplished using built-in types or by stereotyped features and Tagged Values.
4.2 Stakeholder interviews: requirements analysis

Interviews with stakeholders are one-to-one chats about a particular subject matter or issue. The main aim of these interviews is to get project-related information and elicit stakeholder responses as well as recommendations. Stakeholders tend to have information, perception and vision that can help an agency with their conclusion process. Stakeholder interviews provide a comprehensive impression of the interviewees’ sentiments about an exact topic that may disclose hidden worries or ideas that would not be spoken in response to a set number of exact questions. Unfortunately, I will not be using primary data for this study, however, this study will define where the further primary data can be sort.

4.2.1 High level requirements

It is a smartphone application which provides different GUI’s to the user in order for them to add new locations using google map. The application must provide the locations of users to delivery companies. The user will be able to add new locations by using google map and then the system verifies that location. Companies will need to gain permission from the user to access their location.

Another important part of this system is administrator, which will have access to the locations of user and companies. Administrator, however, does not need to gain any permission from the user to access the location. Administrator will also add new companies to the system by the process of registration. Users will be registered through their numbers. Therefore, this application will help the delivery companies gain access to user location and deliver packages.
4.2.2 Improvements to System

One of the most important questions asked during the interviews is how we would improve the system in the future. The answer is to implement this system globally so it will be helpful for underdeveloped countries where there are delivery problems. For this reason, the improvement is the primary requirement, which will be to add more details regarding maps.

4.2.3 System Limitations

The most important technical question asked during the interviews was regarding the limitations of this system. The response was that users need internet connection to stay connected to the application and provide feedback on request.
4.3 Modeling the requirements

4.3.1 MoSCow Model

In an Atern project where period has been permanent, understanding the comparative importance of things is vital to making progress and keeping to deadlines. Prioritising can be applied to requirements, tasks, products, use cases, user stories, acceptance principles and tests. MoSCow is a method for facilitating to understand primacies (Weese, 2011). The letters stand for:

- Must Have
- Should Have
- Could Have
- Won’t Have this time

The purpose of using MoSCow in Atern is because there is an issue with simply declaring that necessities are of high, medium or low importance as the definitions of these priorities are missing. Using MoSCow resources demonstrates that priorities are exact (Famuyide, 2013). The exact use of Must, Should, Could or Won’t Have provides a definite structure to deliver that requirement.

These are some promising definitions of what the different priorities mean. It is important to decide the meanings with the users. Firstly, this is agreed before the requirements are taken, i.e. before it becomes affecting (Haughey, 2013).
Must Have

These provide the Minimum Usable Subset (MUS) of necessities which the project promises to deliver. This may be defined using some of the following:

- Cannot decide a goal date without this
- There is no need in supplying on goal date without this; if it were not transported, there would be no topic positioning the explanation on the planned date
- Not lawful without it
- Dangerous without it
- Cannot convey the Business Case without it

Regarding the question, “what are the chances if this requirement is not met?”, if the answer is “cancel the project – there is no need in applying a solution that does not meet this requirement”, then it is a Must Have requirement (Agile Business Consortium, 2008). If there is some way around it, even if it is a physical workaround, then it will be a Should Have or a Could Have requirement. Reduction of a requirement to a Should Have or Could Have does not mean it will not be delivered, simply that delivery is not certain.

Should Have

- Significant but not vital
- May cause a drawback if left out, however, the solution is still feasible
- May need some kind of workaround, e.g. management of hopes, some inefficiency, an existing answer, paperwork, etc.

A Should Have may be distinguished from a Could Have by studying the degree of drawback caused by it not being met, in terms of professional value or numbers of people affected.
Could Have

- Required or desirable but less significant
- Less impact if left out (as equated with a Should Have)

Won’t have this time

These are requirements which the project team will decide whether it will deliver or not. They are logged in the Arranged Requirements List where they support and clarify the scope of the project to avoid it from being restored ‘via the back door’ at a later date. This helps to achieve expectations that the requirements will simply not make into the delivered answer, at least not this time round.
4.3.2 Physical Model: MoSCow Table:

Table 1 divided all the basic functionalities according to MoSCow attributes.

<table>
<thead>
<tr>
<th>MoSCow Category</th>
<th>Function/Features</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Must have</td>
<td>• Add new number</td>
<td>• User may use more than one number</td>
</tr>
<tr>
<td></td>
<td>• Add new location</td>
<td>• User may live in more than one location</td>
</tr>
<tr>
<td></td>
<td>• Allow the access to company</td>
<td>• Company need permission from user to access location because of privacy of user</td>
</tr>
<tr>
<td></td>
<td>• Admin add new company</td>
<td>• Company cannot have direct access to system so admin register the company first</td>
</tr>
<tr>
<td>Should have</td>
<td>• User can view company profile</td>
<td>• Due to privacy issues</td>
</tr>
<tr>
<td></td>
<td>• Notification alert if company need location access</td>
<td>• User has to be notified by application if company needs its location access to deliver package</td>
</tr>
<tr>
<td></td>
<td>• Delivery report</td>
<td>• Company get the delivery report after package is delivered</td>
</tr>
<tr>
<td>Could have</td>
<td>• User can write its location or select from map</td>
<td>• For easiness of user</td>
</tr>
<tr>
<td>Won’t have</td>
<td>• Location access to company without user permission</td>
<td>• User privacy</td>
</tr>
</tbody>
</table>
4.3.3 Data Requirements

Data requirements are recommended directions or consensual contracts that define the content and/or configuration that establish high quality data instances and values. Data requirements can thereby be stated by different entities or groups of people. Furthermore, data requirements may also be based on rules, morals, or other directives. They may be agreed upon or contrary to each other.

However, data necessities are required as a precondition to measure data quality. Hence, they help as a standard that defines the wanted state of data. In the following, we define how you can exact your data requirements via the DQM-Vocabulary. Table 2 clearly display the data requirements.

<table>
<thead>
<tr>
<th>Data Requirements</th>
<th>Type of Data</th>
<th>Information about data</th>
</tr>
</thead>
<tbody>
<tr>
<td>User data</td>
<td>Character inside database</td>
<td>Information about user, locations and numbers</td>
</tr>
<tr>
<td>Company data</td>
<td>Character inside database</td>
<td>Company name, data and locations</td>
</tr>
<tr>
<td>Location data</td>
<td>Location information</td>
<td>Data of different locations</td>
</tr>
</tbody>
</table>

*Table 2 Data requirements table*
4.3.4 Physical Requirements

The physical requirements are regarding the environments in which the application will be used. A list is given about the physical requirements. Basic physical requirements are mentioned in table 3.

<table>
<thead>
<tr>
<th>Physical requirements</th>
<th>Example of software</th>
<th>Information and requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Database</td>
<td>PostgreSQL</td>
<td>Stores the information</td>
</tr>
<tr>
<td>Server languages</td>
<td>Ruby On Rails</td>
<td>Act as go between database and application</td>
</tr>
<tr>
<td>Map server</td>
<td>Google map</td>
<td>Display the information inside the map interface</td>
</tr>
<tr>
<td>Web application</td>
<td>Ruby</td>
<td>Ruby is used for the development of web application.</td>
</tr>
<tr>
<td>Ios application</td>
<td>Objective-C</td>
<td>Used for development of application for ios</td>
</tr>
<tr>
<td>Android application</td>
<td>Java</td>
<td>Use java for android application development</td>
</tr>
</tbody>
</table>
4.4 Requirements conclusion

Requirements gathering is the most important part of SDLC software development life cycle; without knowing the needs of the customer, it is not possible to understand the demands and their implementation.

The requirements allow us to choose the platform to develop the appropriate functionalities in the system as described. It will indicate which methods will be suitable and which technique will be effective for the development of the software. Therefore, it will function as a counter check to ensure the quality of the application.
CHAPTER 5: DESIGN

5.1 Modelling the requirement for design

The next most important step after requirements, which is explained in the previous chapter, is modelling the gathered requirement, thus each functionality should be clear for design phase. Software development modelling language that is used is usually the Unified Modelling Language (UML), which provides many modelling diagrams for different purposes (Bell, 2003).

The Unified Modelling Language is a typical visual modelling language proposed to be used for the following purposes:

- demonstrating business and like procedures
- study, plan, and implementation of software-based methods

UML is a common language for professional experts, software designers and developers used to define, state and design; artifact current or new business procedures; structure and behavior the document of software methods. UML can be practical to varied application domains (e.g., internet, aerospace, financial transactions, economics, healthcare, etc.) It can be used with all main object and constituent software development methods and for many deployment stages (Ogata, Lawford and Liu, 2016). UML is a typical demonstrating language, not a software development process. UML Specification give details that:

- Provides direction to the order of a team’s actions
- States what documents should create
- Guides the objectives of specific developers and the team as a whole
- Offers principles for observing and gauging a project’s products and accomplishments
UML is purposefully process self-governing and could be useful in the environment of many processes. However, it is most appropriate for use in case driven, incremental and iterative development procedures.

UML is not comprehensive and is not completely graphical. Given some UML diagram, we cannot be sure to recognise illustrated parts or performances of the system from solely the diagram. Some information could be deliberately misplaced from the diagram, whilst some information denoted on the diagram could have more than one explanations. Moreover, some conceptions of UML have no graphical representation at all, consequently, there is no way to describe those on diagrams.
5.1.1 List of UML Diagram Types

UML diagrams are divided into two categories: behavioral and configuration diagrams (www.tutorialspoint.com, n.d.).

Configuration Diagrams
1. Class Diagram
2. Component Diagram
3. Deployment Diagram
4. Object Diagram
5. Package Diagram
6. Profile Diagram
7. Composite Structure Diagram

Behavioral Diagrams
8. Use Case Diagram
9. Activity Diagram
10. State Machine Diagram
11. Sequence Diagram
12. Communication Diagram
13. Interaction Overview Diagram
14. Timing Diagram
5.1.2 Use Case Diagrams

Use case diagrams are typically denoted as behavior diagrams used to define a set of actions (use cases) that some system or systems (subject) should or can perform in association with one or more outside users of the system (actors) (Uml-diagrams.org, n.d.). Figure 3 is a clear view of use case diagram.

![Use case Diagram](image-url)
In this scenario we have 3 actors:

- Admin
- Client
- Company

Scenario:

- Client can add number (with the extension that every time a new number is added to the system, the first system will check whether the number already exists or not. If not, then proceed further
- Number verification (SMS service) will be used to verify the actual user
- Add profile details
- Add new location
- Delete location
- Update location
- Change mobile number (with the extension to check that the number already exist or not and check sms verification)
- Allow location access
- Admin can view the location without the client’s permission and that will be through a web portal
- Admin will add a new company by assigning user name and password through a web portal
- Company need permission from user to access location
5.1.3 Sequence Diagram

A sequence diagram is a communication diagram that demonstrates how objects work with one another and in which direction. It is a concept of a message sequence chart. A sequence diagram shows object interactions decided in time sequence (Bell, 2004). Figure 4 includes all the basic sequences used in the system.

![Sequence Diagram](image)
Actors:
- Admin
- Client
- Company

Object lifeline:
- Interface
- System Module
- Database

Scenario:
- The client can add their number by interacting through interface. Every time a new number is added to the system, the first system will check whether that number already exists or not. If not, then proceed further.
- Number verification (SMS service) will be used to verify whether it is the actual user or not. The system will send a notification through interface to add the sms code to verify through database.
- Add profile details to update the database and the user will be notified.
- Add new location to update the database and the user will be notified.
- Delete location to update the database and the user will be notified.
- Update location to update the database and the user will be notified.
- Change mobile number after verifying. If it exists, then request to add another number. If not, then sms verification.
- Allow location access if allowed. The system will proceed give access to company. The admin does not need permission from the client to access location.
- Admin can view the location without the client’s permission.
- Admin will add a new company by assigning a user name and a password. The Admin is able to put a request to the system so the database can be updated.
- The company need permission from user to access location.
5.1.4 State Process Diagram:

In a multitasking system, processes may conquer a variety of states. The numerous process states, showed in a state diagram, with projectiles indicating possible transitions between states (www.tutorialspoint.com, n.d.). The state process diagram of the delivery system appears in Figure 5.

Scenario:

- The client can add their number (with the extension that every time a new number is added to system, the first system will checked against the records to see if it exists or not. If not, then proceed further).
- Number verification (SMS service) will be used to verify whether it is the actual user or not.
- Add profile details
- Add new location
- Delete location
- Update location
- Change mobile number (with the extension to check numbers to see if they already exist or not and check sms verification)
- Allow location access
- Admin can view the location without client’s permission
- Admin will add a new company by assigning a user name and a password. The company requires permission from users to access location. Figure 3 display the state process diagram of system.
Figure 5 Process state diagram
5.2 Interface Diagrams

5.2.1 Usability prototyping:

A prototype is a draft form of an item for consumption that allows you to search your thoughts and show the purpose behind a feature or the general design idea to users before capitalising time and money into development. A sample can vary from simple methods, such as paper drawings (low-fidelity) to allowing click-through of little sections of content, to a fully operational application (high-fidelity).

5.2.2 Benefits of Prototypes

It is inexpensive to do alteration in products early before the development process, compared to making alteration after the application is developed. Therefore, construction prototypes must be thought through early in the process. Prototyping allows the collection of responses from users, however, the application must be personally organized and designed.

Nielsen (1995) has bought into being the biggest enhancements in user experience, which was done by collecting usability data as timely as possible. He directed that it is inexpensive to make alterations before any code has been written, compared to waiting until after the implementation has been completed.
5.3 Interface development

Usability prototyping is anticipated to support the design and development of classy applications. Low fidelity is useful for evaluating several designs and screen layout problems, nevertheless, it does not contain real functionality and is a below par detailed specification. High fidelity prototyping will take place after the accomplishment of some low fidelity prototypes (Pernice, 2016). High fidelity prototyping requires much more communicating during evaluation as it contains the appearance and touch of the finished prototype.
5.3.1 Low fidelity prototyping

We use wireframes prototyping for interface development. Figure 6, 7, 8, 9, 10, 11, 12, 13 and 14 show low fidelity diagrams, which shows basic functionalities of the system.

Figure 6 Mobile - Locations menu

Figure 7 Mobile - Locations menu (with addresses)

Figure 8 Mobile - Logs menu
Figure 9 Mobile - List View

Figure 10 Mobile - Permission menu
Figure 11 Web - Login Page

Figure 12 Web - Admin Dashboard
Figure 13 Web - Company Home Page (Search Page)

Figure 14 Web - Customer Addresses Page
5.4 Interface development

After looking the usability principles required when designing a user interface to smartphone application, a mockup of application is created during this phase for the presentation.

5.4.1 Mockups

Figure 15, 16, 17, 18, 19, 20, 21, 22 and 23 is the enhanced form of low fidelity diagrams and shows the actual interface of the application.

We design each screen according to the rules of HCI human computer interaction and tried to follow the principles.

The colour scheme chosen for this application is to make it appear aesthetically pleasing. The main reason behind using the colour blue is that it is commonly liked by both men and women. Figure 15 displays the adding of a new location button in the corner so it should be accessible by using less movement of the user’s hand. Figure 16 demonstrates the utilisation of the max space by providing three manures at the top, which is accessible with just a swipe of the finger from right to left. Furthermore, it displays the location to manage the screen size to make it accessible and easy to use. Figure 17 displays the notification log which uses the logo of the company and shows the notification to make it more understandable for users.
Figure 15 Mobile Logs menu

Figure 16 Mobile Locations menu

Figure 17 Mobile Locations menu
Figure 18 displays the companies that need access to the user’s location. The logo of companies is displayed for the user’s benefit. Figure 19 displays the main menu option for users and is in a shortcut format which is accessible with just a click on the top left of the screen.
Figure 20 displays the sign in screen, displaying proper indentation and contains the same colour scheme used in the application to look pleasing to the eye. Figure 21 displays the admin dashboard, showing a list to present companies and user data in order to look appealing.
Figure 22 displays the add number screen. A simple display of just a logo and search button is presented on this page. Figure 23 displays the location of customer to admin and the details of the customer.
5.5 Design Conclusion

To conclude this chapter, certain decisions have been made for the selection of technology to be used within the system. For this system, Google Maps has been chosen as the mapping API. Low fidelity diagrams help to remove the ambiguities in the interface screen and to overcome the generic problem faced by users.
CHAPTER 6: IMPLEMENTATION

6.1 Web mapping

6.1.1 What is Web Mapping?

Web mapping is the method of utilizing maps that are found by an info system for 3-D and geographical data. Web mapping is more comprehensive than its precise meaning and it is seen from both the consumer point of view and service (E-education.psu.edu, n.d.). Maps accessible on the World Wide Web serve many purposes, relying upon the type of manipulator being assisted. Communicating Web mapping software can handle the online maps on the user’s side. It is also identified as online mapping.

6.1.2 Web Map Users

Here we have two main web map users:

- Service provider means companies
- End-user

6.1.3 Different Kinds of Web Mapping

One very effective way to show map data available to a group of non-technical end users is to make it obtainable through the use of web page. Web mapping sites are becoming progressively and broadly held.
There are two types of web mapping:

- static
- interactive

Statics are displayed as an image on a web page which are very common. Static map is scanned or copied from a digital map and it can be up and running very fast with the webpage.

Interactive maps are not common because they require special skill sets in order to use them and gain useful information from interactive maps. The term ‘interactive’ suggests that the observer can someway act together with the map. This can mean choosing different map information layers to view or zooming into a specific portion of the map that you are interested in. All of this is done while working together with the web page and a map image that is frequently updated.

Interactive maps that are able to gain access through web pages and are known as ‘web maps’. These maps can be very influential, however, they can also be problematic to use and set up because of the technical expertise needed for keep up a web server, a mapping server and organization of the underlying map data. These types of maps are essentially poles apart from static maps. Figure 24 shows a basic illustration of how an end user request a map from the end to end web mapping site and subsequently receives it (Safaribooks, 2017). A user requests a map from the web server and the server permits the appeal to the web mapping server, who then tweaks together all pf the data. The map is then delivered all the way back to the user.

*Figure 24 Web mapping process*
6.2 Development- stage one

The implementation of this system is for 3 different platforms

- Web base admin panel
- Android
- iOS

The following table was the first step in the implementation of web mapping application. Table 4 displays the list of software that are selected on purpose to develop the application.

<table>
<thead>
<tr>
<th>Required software</th>
<th>Purpose</th>
<th>Software options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web database system</td>
<td>Storage of spatial data</td>
<td>• PostgreSQL</td>
</tr>
<tr>
<td></td>
<td>Querying ability</td>
<td>• Geo server</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Google fusion</td>
</tr>
<tr>
<td>Mapping Ape</td>
<td>Display Spatial data from database</td>
<td>• Google maps</td>
</tr>
<tr>
<td>Data Representation</td>
<td>Format in which data is queried and represented</td>
<td>• KML files</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• GeoJSON</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Shapefiles</td>
</tr>
<tr>
<td>Server Language</td>
<td>Web Page</td>
<td>• Ruby on rails</td>
</tr>
<tr>
<td>Authentication process</td>
<td>Used for the authentication of user</td>
<td>• Html/CSS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Java script</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Devise gem</td>
</tr>
</tbody>
</table>
The following table was the first step in the implementation of smartphones. Table 5 displays the technologies used for the implementation of mobile.

<table>
<thead>
<tr>
<th>Required software</th>
<th>Purpose</th>
<th>Software options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web database system</td>
<td>Storage of spatial data</td>
<td>• PostgreSQL</td>
</tr>
<tr>
<td></td>
<td>Querying ability</td>
<td></td>
</tr>
<tr>
<td>Mapping Api</td>
<td>Display Spatial data from database</td>
<td>• Google maps</td>
</tr>
<tr>
<td>Authentication process</td>
<td>Used for the authentication of user</td>
<td>• Devise gem</td>
</tr>
<tr>
<td>Attachments</td>
<td>Send photos and documents</td>
<td>• Paperclip gem</td>
</tr>
<tr>
<td>Communication</td>
<td>For communication between companies users and admin</td>
<td>• Firebase cloud Messaging</td>
</tr>
</tbody>
</table>
6.3 Development-stage two

There are more than twenty five thousand lines of code in the full system. Therefore, in this section I have only included the main parts of the codes that are significant, along with that I have provided

6.3.1 Open source software used in implementation:

Open-source software (OSS) is a computer software with its source code made available with a license in which the copyright owner offers the rights to change, study and dispense the software to anybody, for any purpose (Opensource.com, n.d.). The Open source software used in this application are as follows:

- **Google Maps:**
  These are used for implementing web mapping. Google Maps is a web mapping service and it is developed by Google. It suggest satellite images, street maps and 360° panoramic sights of streets (WhatIs.com, 2013).

- **Firebase Cloud Messaging (FCM):**
  This is used for push notification on android and iOS. Firebase Cloud Messaging (FCM) is a cross-platform messaging solution that allows you to reliably deliver messages at zero costs (Firebase, n.d.). By using it, a client on the app can be notified that the new data is ready to sync.

- **Paperclip gem:**
  Paperclip is a simple, abstracted Ruby library that decreases the density of file uploading and processing. Using Paperclip with an external storage service, such as Amazon S3 or Rackspace Cloud Files, which allows you to scale your application's files and codebase independently (Devcenter.heroku.com, n.d.). This is used for uploading of attachments (images).
• Devise gem:
  The Devise gem is put together on top of Warden. Warden is a Support application, which means that it runs as a discrete and separate module and is usually executed earlier than the chief Rails application is appealed (Go Rails, 2015). It is used or user authentication process.

• PostgreSQL:
  PostgreSQL, pronounced as "post-gress-Q-L", is an open source relational database management system (DBMS), advanced by a worldwide team of volunteers. It is not controlled by any organization or private unit and the source code is available free of cost (Postgresql.org, n.d.). PostgreSQL is a powerful, open source object-relational database system.
6.3.2 Selection of languages for implementation

6.3.2.1 Ruby on Rails
Ruby is often related with the Rails structure that assisted to promote it. It is used extensively between web start-ups and big companies alike. Ruby and Rails jobs are pretty easy to come by. Ruby and Rails make it easy to transform knowledge into a operational application and they have been used to bring us Twitter, GitHub and Treehouse (Cleverism, 2015).

1. Faster development time lapse
2. Easy code maintenance and update
3. Cost-effectiveness
4. Many free gems and libraries available that help a lot.

6.3.2.2 JavaScript
JavaScript is the first complete programming linguistic for numerous people, since it is the coherent next step after knowing HTML and CSS. JavaScript offers the manners portion of a website. For example, when you see a form field indicate an error, that is most likely JavaScript at work. JavaScript has become progressively widely held and it now exists outside web browsers (Cleverism, 2015). Learning JavaScript is essential as it is a more general-purpose language. JavaScript appears to be universally modern.

1. Easy to learn
2. Easy to Debug and Test
3. Used for validations and pop ups etc
6.3.2.3 HTML/CSS

People frequently start by learning HTML and CSS. These two languages are vital for making static web sheets. HTML (Hypertext Markup Language) constructs all the text, links and other content visible on a website (Cleverism, 2015). CSS is the language that styles the appearance of a web page, such as the colour, layout and other graphics that we call style.

1. HTML is easy to code.
2. HTML also allows the use of templates, which makes designing a webpage easy.
3. Very useful for beginners in web designing field.
4. Learning HTML is the basic thing to do if we want to learn web technologies.

6.3.2.4 Java

In spite of its name, Java is not connected to JavaScript in any expressive way. JavaScript was named when Java was becoming widespread. Some advertising thinkers decided to confuse us all in an attempt to make the Live Script language more general by altering its title to JavaScript (Cleverism, 2015). In conclusion, Java is not JavaScript. Java can be used for anything from web applications to desktop and mobile apps. Java has a solid attendance between big enterprise applications like bank, hospital and university software. It also controls Android apps so it is a decent choice for those inclined toward mobile development.

1. Can develop on any OS
2. Java is a fairly simple language to learn
3. Android is a very popular platform and it has a massive user base
4. Documentation is structured and easy to find
5. Releasing an app is extremely streamlined thanks to Google 6.4 Implementation of functionalities
6.3.2.5 Objective-C

Objective-C is a general-purpose, object-oriented programming language that adds Smalltalk-style messaging to the C programming language. This is the main programming language used by Apple for the OS X and iOS operating systems and their respective APIs, Cocoa and Cocoa Touch (www.tutorialspoint.com, n.d.).
6.3.3 Google map implementation

Google Maps API is used to show maps to the end-user. Firstly, we make an account on https://developers.google.com/ and then get the API Key for our map so that we can implement them. In this case, our API Key is: Figure 25 is a complete display of how maps functionality is implemented, and Figure 26 is the screenshot of the map. We are using the latitude and longitude to pin point the location on Google Map. Figure 25 includes the code for the implementation of map.

```html
<iframe width="750" height="500"
src="https://www.google.com/maps/embed/v1/place?key=AlzaSyD3rse-PrVoKb6fVn7vIE4S_FXY6bmmqmdQ&q=location:locationLatitude %,location:locationLongitude %&zoom=18&maptype=satellite">
</iframe>

Figure 25 Code for Google Map
```

Figure 26 Google map
6.3.4 Implementation of location selection for smartphones

Public place picker is used, which is the function we intend to use for setting the map for android. With the help of this place picker, we are calling the maps and performing the required map functionalities. Place picker is used to call Google Maps. Figure 27 is the code part of location picker for android and Figure 28 is the code part for iOS. It also include the pick location function. Furthermore, I have included 'try and catch' to prevent the program from crashing if an exception occurs, as seen in Figure 27. Figure 29 and 30 displays the screenshot of the location picker on android and iOS, showing a good graphical map and a pin point to show the exact location picked by the user.

```java
public void callPlacePicker() {
    PlacePicker.IntentBuilder builder = new PlacePicker.IntentBuilder();
    try {
        startActivityForResult(builder.build(getActivity()), PLACE_PICKER_REQUEST);
    } catch (GooglePlayServicesRepairableException e) {
        e.printStackTrace();
    } catch (GooglePlayServicesNotAvailableException e) {
        e.printStackTrace();
    }
}
```

*Figure 27 Code for location picker for android*
(void)pickLocation
{
    CLLocationCoordinate2D center = CLLocationCoordinate2DMake(currentLocation.coordinate.latitude, currentLocation.coordinate.longitude);
    CLLocationCoordinate2D northEast = CLLocationCoordinate2DMake(center.latitude + 0.007, center.longitude + 0.007);
    CLLocationCoordinate2D southWest = CLLocationCoordinate2DMake(center.latitude - 0.007, center.longitude - 0.007);
    GMSCoordinateBounds *viewport = [[GMSCoordinateBounds alloc] initWithCoordinate:northEast coordinate:southWest];

    GMSPlacePickerConfig *config = [[GMSPlacePickerConfig alloc] initWithViewport:viewport];
    GMSPlacePicker *_placePicker = [[GMSPlacePicker alloc] initWithConfig:config];

    [_placePicker pickPlaceWithCallback:^(GMSPlace place, NSError error) {
        if (error != nil)
        {
            NSLog(@"Pick Place error %@", error.localizedDescription);
            return;
        }

        if (place != nil)
        {
            AddLocationViewController* view = [self.storyboard instantiateViewControllerWithIdentifier:@"AddLocationView"];
            view.location = location;
            view.isUpdate = YES;
            view.latitude = place.coordinate.latitude;
            view.longitude = place.coordinate.longitude;

            [self.navigationController pushViewController:view animated:YES];
        } else
        { NSLog(@"No place selected");
        }
    }];
}

Figure 28 Code of location picker for iOS
Figure 30 Android screenshot of Place picker

Figure 29 iOS screenshot of Place picker
6.3.5 Libraries used for smart devices

In programming, a library is a group of precompiled practices that a platform can use. The practices, occasionally called modules, are deposited in object format (techtarget, 2005). Libraries are mainly valuable for storing repeatedly used practices because you do not need to openly link them to every program that uses them. Figure 31 and 32 show the libraries used for android and iOS respectively.

```
compile files('libs/android-query-full 0.26.8.jar')
compile project(':FloatingFabMenu')
compile 'com.google.firebase:firebase-messaging:10.0.1'
compile 'com.google.firebase:firebase-core:10.0.1'
compile 'com.google.firebase:firebase-auth:10.0.1'
compile 'com.google.android.gms:play-services-auth:10.0.1'
compile 'com.android.support:appcompat-v7:25.1.0'
compile 'com.android.support:design:25.1.0'
compile 'com.google.code.gson:gson:2.5'
compile 'de.hdodenhof.circleimageview:2.1.0'
compile 'com.google.android.gms:play-services-places:10.0.1'
compile 'com.android.support:multidex:1.0.1'
compile 'com.squareup.picasso:picasso:2.5.2'
compile 'com.android.support:support-v4:25.1.0'
testCompile 'junit:junit:4.12'
compile('com.crashlytics.sdk.android:crashlytics:2.66.0@aar') {
    transitive = true;
}
```

*Figure 31 Code for included libraries*

```
pod 'YSLContainerViewController'
pod 'GoogleMaps'
pod 'GooglePlaces'
pod 'GooglePlacePicker'
pod 'Firebase/Core'
pod 'Firebase/Messaging'
```

*Figure 32 Libraries used for iOS Pods*
6.3.6 Implementation of Notification Codes

For using notifications, we firstly create the project at fire base web. It then returns to us, as a JSON file which we then include in code and other added libs for Google play service. Furthermore, we write a listener or FCM service in code that is used to listen to incoming GCM push and populate notification. Figure 33 displays the code for the notification which takes data from the web and returns it in JSON file.

```java
@override
public void onMessageReceived(RemoteMessage mMessage) {
    Log.e("Json", mMessage.getData().toString());
    String from = mMessage.getFrom();
    Map data = mMessage.getData();
    title = data.getString("title");
    userID = data.getString("user_id");
    companyID = data.getString("company_id");
    message = data.getString("message");
    type = data.getString("type");
    sendNotification(mMessage);
}
```

*Figure 33 Code for notification*
Figure 34 displays the code for iOS which generates a notification when the company asks access for a location. If and else were used in this part, where “if” allows the company to access and the system will give access to the user’s location and “else” returns the notification. Figure 35 displays the screenshot of how the notification appears on the android and iOS systems.

```swift
(void)registerForRemoteNotifications
{
    if( SYSTEM_VERSION_LESS_THAN( @"10.0" ) )
    {
        [[UIApplication sharedApplication] registerUserNotificationSettings:[UIUserNotificationSettings settingsForTypes:(UIUserNotificationTypeSound | UIUserNotificationTypeAlert | UIUserNotificationTypeBadge) categories:nil]];
        [[UIApplication sharedApplication] registerForRemoteNotifications];
    }
    else
    {
        UNUserNotificationCenter *center = [UNUserNotificationCenter currentNotificationCenter];
        center.delegate = self;
        [center requestAuthorizationWithOptions:(UNAuthorizationOptionSound | UNAuthorizationOptionAlert | UNAuthorizationOptionBadge) completionHandler:^(BOOL granted, NSError * _Nullable error)
        {
            if( !error )
            {
                [[UIApplication sharedApplication] registerForRemoteNotifications]; // required to get the app to do anything at all about push notifications
                NSLog( @"Push registration success." );
            }
            else
            {
                NSLog( @"Push registration FAILED" );
                NSLog( @"ERROR: %@ - %@", error.localizedDescription, error.localizedDescription );
                NSLog( @"SUGGESTIONS: %@ - %@", error.localizedRecoveryOptions, error.localizedDescriptionRecoverySuggestion );
                ]];
            }
        }];
    }
}

// [[FIRMessaging messaging] setRemoteMessageDelegate:self];
```

*Figure 34 Code for iOS notification*
DHL is requesting to access your location

Name: DHL
Location: No Location
Request Time: 01:00 am

Figure 35 Notification screen
6.3.7 Adding a new location functionality

The most important part of this application is the function of adding a new location by the mobile application user, both on android and iOS. Without this function the system has no usefulness. The reason being is that the full system relies upon the users location.

Figure 36/37 shows the java code that is used in the android operating system for adding a new location. Figure 38/39 shows the code used for adding new a location to the system on iOS.

Figure 37 displays the code that includes try and catch. The try block, holds a block of program statements within which an exception might occur. A try block is continuously followed by a catch block which grips the exception that occurs in associated try block.
```java
public void addLocation(String locationName, String locationAddress, String locationLat, String locationLong, boolean isChecked, boolean showProgress, CallBack obj) {
    String Url = Constants.ADD_LOCATION_URL;
    String id = String.valueOf(Awanyi.db.getInt(Constants.USER_ID, 0));
    String password = Awanyi.db.getString(Constants.USER_PASSWORD, null);
    HashMap<String, String> params = new HashMap<String, String>();
    params.put("user[id]", id);
    params.put("user[code]", password);
    params.put("location[locationName]", locationName);
    params.put("location[locationAddress]", locationAddress);
    params.put("location[locationLatitude]", locationLat);
    params.put("location[locationLongitude]", locationLong);
    params.put("location[is_main_address]", String.valueOf(isChecked));
    
    this.post(Url, params, obj, AddLocationModel.getInstance(), false);
    Log.e("Url", Url);
}

/**
 * @param url
 * @param params
 * @param callBack
 * @param model
 * @param showProgress
 */
public void post(String url, HashMap<String, String> params, final CallBack callBack, final Object model, final boolean showProgress) {
    if (!NetworkUtil.isInternetConnected(context)) {
        NetworkUtil.internetFailedDialog(context);
        return;
    }
    
    if (showProgress) {
        dialog = new ProgressDialog(context);
        dialog.setMessage("Loading. Please wait...");
        dialog.show();
    }
    
    if (aq.id(R.id.progress_bar).isExist() && showProgress) {
        progressBar = (ProgressBar) aq.id(R.id.progress_bar).getView();
        progressBar.setVisibility(View.VISIBLE);
    }
```
Figure 37 Code for adding new location android
Figure 38 Code for adding new location in iOS
```objective-c
@end

Figure 39 Code for adding new location in iOS
```
### 6.5 Requirements Reviews

The following table contains the review of the MoSCow requirement table created in the requirement chapter, providing proof of completion of each of the important requirements. Table 6 displays the review of the MoSCow table:

**Table 6 Review of MoSCow table**

<table>
<thead>
<tr>
<th>MoSCow Category</th>
<th>Function/Features</th>
<th>Achieved</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Must have</td>
<td>• Add new number&lt;br&gt;• Add new location&lt;br&gt;• Allow the access to company&lt;br&gt;• Admin add new company</td>
<td>Yes</td>
<td>• User may use more than one number&lt;br&gt;• User may live in more than one location&lt;br&gt;• Company needs permission from user to access location because of the privacy of the user.&lt;br&gt;• Company cannot have direct access to system so the admin must register the company first.</td>
</tr>
<tr>
<td>Should have</td>
<td>• User can view company profile&lt;br&gt;• Notification alert if the company need location access&lt;br&gt;• Delivery report</td>
<td>Yes</td>
<td>• Privacy issues&lt;br&gt;• User has to be notified by application if company needs its location access to deliver package.&lt;br&gt;• Company gets the delivery report after package is delivered.</td>
</tr>
<tr>
<td>Could have</td>
<td>• User can write its location or select from map</td>
<td>Yes</td>
<td>• For the ease of the user.</td>
</tr>
<tr>
<td>Won’t have</td>
<td>• Location access to company without user permission</td>
<td>Yes</td>
<td>• User privacy</td>
</tr>
</tbody>
</table>
6.6 Conclusion of the development stage

The review of the MoSCow model brings the implementation/development stages of this project to a close. The smartphone application is uploaded to Apple Store and Google Play Store, whereas the web is uploaded to the internet. The user can download the application for android and iphone. The admin and company user has access through a web portal and performs various functionalities as mentioned in the requirement chapter. Mockup and screenshots are also included on the designing phase.

The full codes for the web and the mobile applications (iOS and Android) are available on the CD marked as Appendix D.
CHAPTER 7: TESTING

7.1 Suggested Methodology

A combination of black box and white box testing are used as the selected methodology for the testing of this application. The purpose of this is to gain the most thorough view and analysis on the performance of the system. This is done by carrying out tests on both code and high function level.

At this level, the basic functionalities of the system are tested in three stages: The first is the ability of a program to access the user’s location accurately by using Google Map API. The second is the ability of the system to update the location numbers of the user. The third is to successfully update and retrieve data from the database.

7.2 Testing

We have adopted a few of the best practices for the software quality assurance and the testing of this product. The following list briefly describes several of the practices in subsequent sections:

7.2.1 Verification

Verification was done after the completion of each phase, i.e. after specify input, database connection, chromosome and population function (Zafar, 2012). All the functions were found to completely adhere to the requirements that were established during the project approval.

7.2.2 Validation

Validation was done at the end of the development process of each module. The modules are merged with less effort and the system was integrated entirely to form a desired system (Zafar, 2012).
7.2.3 Usability Testing
Usability testing was done after the business logic of the system was completed and the interface was conforming to the design document. The results proved to be a successful implementation of the user interface. The users could understand and recall the process easily, allowing them to use the system with ease (Softwaretestinghelp.com, 2017).

7.2.4 Unit Testing
All the units (functions) were individually tested for any malicious errors and memory leaks. All the errors found were removed successfully, bringing the system unit into operation (Zafar, 2012). The units were tested rigorously whilst the system was kept operational for 4 hours to observe if any memory leaks were identified that could crash the system.

7.2.5 Integration Testing
Top down approach was used for integration testing. Stubs were created for component and the system’s outputs were verified, displaying positive results (Softwaretestinghelp.com, 2017).

7.2.6 System Testing
The system was integrated and was fully tested overall. Subsequently, the partial integrations were tested successfully (Softwaretestinghelp.com, 2017). Any errors which were identified were removed successfully.

7.2.7 Acceptance Testing
Acceptance testing was done with internal supervisors. The test was yielded successful when the outputs were matched and the expected results were achieved (Zafar, 2012).
7.2.8 Black box testing

Black Box Testing, which is also referred to as Behavioural Testing, is a software testing technique whereby the tester is unaware of the internal structure, design and implementation of the item that is being tested. Although usually functional, these tests can also be non-functional (Softwaretestinghelp.com, 2017). Table 7 displays the black box testing result and includes the attributes that are defined in the Methodology section (Chapter 3).

The tests in Table 7 are created to test the system’s functionality.

<table>
<thead>
<tr>
<th>Test</th>
<th>Test data</th>
<th>Expected</th>
<th>Pass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whether the system is visible</td>
<td>Keep the user informed</td>
<td>The user should be informed and updated with the latest update by notification</td>
<td>Yes</td>
</tr>
<tr>
<td>Whether there is a match between the system and the real world</td>
<td>Display appropriate meaningful language</td>
<td>The system should display the appropriate and meaningful language to the user</td>
<td>Yes</td>
</tr>
<tr>
<td>Consistency and standards</td>
<td>Errors</td>
<td>No Errors, System works fine</td>
<td>No</td>
</tr>
<tr>
<td>Recognition rather than recall</td>
<td>Minimize the memory load of user</td>
<td>The application should remember the information and minimise the memory load of the user</td>
<td>Yes</td>
</tr>
<tr>
<td>Flexibility and efficiency of user</td>
<td>Speed of system</td>
<td>The system should provide appropriate shortcuts to improve the speed for experience and inexperienced person</td>
<td>Yes</td>
</tr>
<tr>
<td>Aesthetic and minimalistic design</td>
<td>Irrelevant display of information</td>
<td>The design is simple and elegant and there is no extra information</td>
<td>Yes</td>
</tr>
<tr>
<td>Help user recognize, diagnose, and recover from error</td>
<td>Display information in simple and understandable language</td>
<td>Error messages should be clearly understandable</td>
<td>Yes</td>
</tr>
<tr>
<td>Help and documentation</td>
<td>Help user by providing appropriate solution to user’s problem</td>
<td>It should display appropriate help information regarding the problems</td>
<td>yes</td>
</tr>
</tbody>
</table>
7.2.8.1 Requesting Location error

Table 7.1 includes the test case for requesting the location error. The error was related to the web server site when the company requests for the user’s location. An error message appeared, showing that the user was not registered with FCM. The reason of error was because the user had no GCM Key. To overcome that, I added an if statement to check whether the value of that code was present in parameters. Therefore, we are now validating GCM Key in Parameters. Figure 40 displays the solution to the problem.

```ruby
if params[:user][:gcm_key].present?
  //Code of creation of user
end
```

*Figure 40 Code solution for requesting location error*

7.2.8.2 Request location permission on and off error

Table 7 includes the test case for request permission on and off error. The error is related to enable and disable the company from viewing the user’s location. When the user allows permission for the company to access the location. When the user navigates back to the home screen, the application automatically disables the permission so the company will not be able to view the user’s location.

Essentially, we changed the two variables that were going inside the ‘company_list’. This error was on both iOS and android for on and off permission but the problem was from the web server’s side. This was fixed by replacing the old code with new code as seen in Figure 41 and 42.
def get_company_list

    if params[:user][:id]
        user = User.find(params[:user][:id])
        @company_logs = CompanyLog.where(user_id: user.id)
        if @company_logs.any?
            @company_ids = @company_logs.pluck(:company_id)
        else
            @company_ids = []
        end
    end

    @company_list = Company.all
    @categories = Category.all

else
    end
end

Figure 41 Old code for request location on and off error
new code

def get_company_list
    if params[:user][:id]
        user = User.find(params[:user][:id])

        render json: {
            company_list: Company.all.map { |com|
                { id: com.id,
                  name: com.name,
                  blocked: com.company_logs.where(user_id: user.id).order("created_at DESC").first.present? ? com.company_logs.where(user_id: user.id).order("created_at DESC").first.blocked : false,
                  statement: com.company_logs.where(user_id: user.id).order("created_at DESC").first.present? ? com.company_logs.where(user_id: user.id).order("created_at DESC").first.statement: nil,
                  logo: com.avatar,
                  category_id: com.category_id
                }
            },
            categories: Category.all.map { |cat|
                { id: cat.id,
                  name: cat.name
                }
            },
            success: "true"
            }
    else

end

Figure 42 Solution code for request location on and off error
White-box testing is also known as clear box testing, transparent box testing, glass box testing and structural testing. It is a method of testing software that tests internal structures of an application, as opposed to its functionality, which is executed through black-box testing (Zafar, 2012).

The word ‘white box’ was used for the see-through box concept. The clear box or white box name represents the capability to see through the software's outward shell (or ‘box’) into its internal mechanisms. Similarly, the ‘black box’ in ‘black box testing’ represents not being able to see the internal workings of the software so that only the end-user experience can be tested (Softwaretestinghelp.com, 2017).
7.3.1 TEST CASES

In software engineering, a test case is a set of conditions or variables (Softwaretestingfundamentals.com, n.d.). This works by using a tester to determine the functionality of an application or software system. A test oracle is a mechanism that determines the accomplishment or failure of a software program. Table 8 display possible scenarios for application and define the original/basic flow, alternative flows and next flow for every scenario.

<table>
<thead>
<tr>
<th>Test case ID</th>
<th>Scenario/Condition</th>
<th>Data value 1</th>
<th>Data value 2</th>
<th>Data value 3</th>
<th>Exp. Results</th>
<th>Actual results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Scenario 1</td>
<td>Click on anawen icon</td>
<td></td>
<td></td>
<td>Home page will appear</td>
<td>Successful click</td>
</tr>
<tr>
<td>2</td>
<td>Scenario 2</td>
<td>Change number</td>
<td>Number is not verified</td>
<td>Wrong entry</td>
<td>Number is verified</td>
<td>Successful click But not in first attempt.</td>
</tr>
<tr>
<td>3</td>
<td>Scenario 3</td>
<td>User adds new location</td>
<td>Location is not added</td>
<td>Unable to get user location</td>
<td>Location added successfully</td>
<td>Successful click</td>
</tr>
<tr>
<td></td>
<td><strong>Scenario</strong></td>
<td>Action</td>
<td>Description</td>
<td>Result</td>
<td>Comment</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>--------------</td>
<td>--------</td>
<td>-------------</td>
<td>--------</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td><strong>Scenario 4</strong></td>
<td>User clicks on dashboard</td>
<td>Application terminated</td>
<td>page will be open</td>
<td>Successful click</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td><strong>Scenario 5</strong></td>
<td>User clicks on profile</td>
<td>Application terminated</td>
<td>page will be open</td>
<td>Successful click</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td><strong>Scenario 6</strong></td>
<td>User clicks on change number</td>
<td>Number is not verified enter again</td>
<td>Application terminated</td>
<td>Number added successfully</td>
<td>Successful click</td>
</tr>
<tr>
<td>7</td>
<td><strong>Scenario 7</strong></td>
<td>User clicks on about page</td>
<td>Application terminated</td>
<td>page will be open</td>
<td>Successful click</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td><strong>Scenario 8</strong></td>
<td>User clicks on sign out</td>
<td>Application terminated</td>
<td>sign-out successful</td>
<td>Successful click</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td><strong>Scenario 9</strong></td>
<td>User clicks on locations and adds a comment</td>
<td>Keyboard error</td>
<td>Application terminated</td>
<td>page will open and comment added successfully.</td>
<td>Successful click but not in first attempt. Keyboard error while adding comments</td>
</tr>
<tr>
<td>10</td>
<td><strong>Scenario 10</strong></td>
<td>User clicks on logs</td>
<td>Application terminated</td>
<td>page will be open</td>
<td>Successful click</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td><strong>Scenario 11</strong></td>
<td>User clicks on permissions</td>
<td>Application terminated</td>
<td>page will be open</td>
<td>Successful click</td>
<td></td>
</tr>
</tbody>
</table>
7.3.1.1 Change Number error

Scenario 6 in Table 8 is related to the change number error. The error was on the application’s side so when the user tries to enter a new number, the system does not accept the change. The error occurs because Change Number Fragment are DE attached from Activity and when we are click on the change number button, we are receiving a Null Pointer Exception. Figure 43 shows the code for the service.

```java
service = new ChangeNumberService(getActivity());
```

*Figure 43 Code for service*

Figure 44 displays the old code which causes the change number problem and the new code to the solution of the problem.

```java
Old Code
@Override
    public void setUserVisibleHint(boolean isVisibleToUser) {
        super.setUserVisibleHint(isVisibleToUser);
        service = new ChangeNumberService(getActivity());
    }

@Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
    }

New Code
@Override
    public void setUserVisibleHint(boolean isVisibleToUser) {
        super.setUserVisibleHint(isVisibleToUser);
    }

@Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        service = new ChangeNumberService(getActivity());
    }
```

*Figure 44 Code related to problem and solution to change number error*
7.3.1.2 Comments Keyboard error

Scenario 9 in Table 8 is related to comments keyboard error. Figure 45 clearly shows the code and replaced code which caused the problem on the ‘add new location’ screen. The user is not able to write comment as the keyboard only allows the user to enter numeric so we must change the type of Edit text in XML from numeric to alphanumeric as seen on Figure 45

```xml
old code
android:Inputtype="numeric"

new code
android:inputtype="alphanumeric"
```

*Figure 45 Code for comments keyboard error*
7.3.2 Scenarios are for web portal

<table>
<thead>
<tr>
<th>Test Scenario No: 01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Case ID: TC1</td>
</tr>
<tr>
<td>Purpose: Company search for user</td>
</tr>
<tr>
<td>Cross-Reference:</td>
</tr>
<tr>
<td>Pre-condition: user should be registered</td>
</tr>
<tr>
<td>Inputs:</td>
</tr>
<tr>
<td>Enter user mobile number &quot;91234567&quot;</td>
</tr>
<tr>
<td>STEPS</td>
</tr>
<tr>
<td>System ask user number</td>
</tr>
<tr>
<td>user enters &quot;91234567&quot;</td>
</tr>
<tr>
<td>User presses on search.</td>
</tr>
<tr>
<td>System finds user details.</td>
</tr>
<tr>
<td>Expected:</td>
</tr>
<tr>
<td>System displays user details (name and email)</td>
</tr>
<tr>
<td>System displays request location button</td>
</tr>
<tr>
<td>Post-Conditions:</td>
</tr>
<tr>
<td>System finds the user</td>
</tr>
<tr>
<td>Author: Faris</td>
</tr>
<tr>
<td>Cross-Reference:</td>
</tr>
<tr>
<td>Execution History</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Result</th>
<th>Version</th>
<th>Run By</th>
</tr>
</thead>
<tbody>
<tr>
<td>16, April</td>
<td>Pass</td>
<td>1.1</td>
<td>Faris</td>
</tr>
</tbody>
</table>
Test Scenario No: 02

Test Case ID: TC2

Purpose: To Test the ‘set new password’

Cross-Reference: 01TC1

Pre-condition: User verifies the old password

Inputs:
Enter new password "new1234"

STEPS
System asks for new password
user enters "new1234"
User presses ok.

Expected:
System updates the log.

Post-Conditions:
System displays success message

Author: Faris

Cross-Reference:

Execution History

<table>
<thead>
<tr>
<th>Date</th>
<th>Result</th>
<th>Version</th>
<th>Run By</th>
</tr>
</thead>
<tbody>
<tr>
<td>16, April</td>
<td>Pass</td>
<td>1.1</td>
<td>Faris</td>
</tr>
</tbody>
</table>
### Test Scenario No: 03

**Test Case ID:** TC3  
**Purpose:** Add new company  
**Cross-Reference:**

**Pre-condition:** User logged in as admin

**Inputs:**  
Add new company  
Add company details

**STEPS**  
User clicks on Add new company  
System asks for Description, details  
User provides Description, details

**Expected:**  
System updates the log.  
System saves the company into database.

**Post-Conditions:**  
System displays success message  
System displays the company in the company list.

**Author:** Faris

### Cross-Reference:

### Execution History

<table>
<thead>
<tr>
<th>Date</th>
<th>Result</th>
<th>Version</th>
<th>Run By</th>
</tr>
</thead>
<tbody>
<tr>
<td>16, April</td>
<td>Pass</td>
<td>1.1</td>
<td>Faris</td>
</tr>
</tbody>
</table>
7.3.3 Test cases for privacy

Table 9 displays the test cases for privacy.

<table>
<thead>
<tr>
<th>Test case ID</th>
<th>Scenario/Condition</th>
<th>Data value 1</th>
<th>Data value 2</th>
<th>Data value 3</th>
<th>Exp. Results</th>
<th>Actual results</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Scenario 12</td>
<td>Company accesses the users location without permission</td>
<td>Give access to company</td>
<td>Give access only to the admin</td>
<td>System should not give access to anyone other than the admin</td>
<td>Unsuccessful (system working fine)</td>
</tr>
<tr>
<td>13</td>
<td>Scenario 13</td>
<td>Company access to other companies profile</td>
<td>Give access to company</td>
<td>Give access only to the admin</td>
<td>System should not give access to anyone other than the admin</td>
<td>Successful In first attempt. Company can access other companies profile. Now the problem is resolved. Now unsuccessful (system working fine)</td>
</tr>
<tr>
<td>14</td>
<td>Scenario 14</td>
<td>Company accesses the user admin panel</td>
<td>Give access to company</td>
<td>Give access only to the admin</td>
<td>System should not give access to anyone other than the admin</td>
<td>Unsuccessful (system working fine)</td>
</tr>
<tr>
<td>15</td>
<td>Scenario 15</td>
<td>User accesses the mobile application without phone number verification</td>
<td>Give access to the user without phone verification</td>
<td>Give access to the user after phone number verification</td>
<td>System should not allow the user to access the mobile application without the phone number verification</td>
<td>Unsuccessful (system working fine)</td>
</tr>
</tbody>
</table>
7.3.3.1 Privacy issue error

Scenario 13 in Table 9 is related to the privacy issues. The privacy error was related to the company profile, when attempting to edit the company profile, there is a specific ID for each company in the URL link and if it is replaced with a different company ID, then the system will allow access to other company profiles as well. You can access the profile of any company by just replacing the number. Figure 46 includes the code solution related to privacy error.

```ruby
if !current_user.is_admin && (current_user != @user)
  redirect_to edit_admin_user_path(current_user)
end
```

*Figure 46 Code related to privacy issue error*
7.4 Conclusion

Throughout the completion of test cases in this chapter, only a small number of errors were found. The successful completion of ‘black box testing’ proves that the system runs as envisioned. The user can access the system, add a number and multiple locations, as well as get notified if the company requires access to the location. Certain errors inside the application were highlighted with the completion of the white box tests. The failed tests were repeated once these errors were corrected. This was done to ensure that the problems were solved effectively, allowing the initial testing to presume as usual.
CHAPTER 8: EVALUATION

The mobile application business has both increased in number as well as in popularity. Therefore, there is a need to shed light on the architecture, composition, and quality of the application in terms of visibility, ease of use and accessibility. Indeed it is very essential to understand the paradigm of mobile application which will be suitable to our application and usage. Such understanding has direct consequences on the user experience, the development cost and sale revenues of mobile apps.

For the evaluation, we did not carry out any stakeholder interviews to assess the performance of the mobile delivery application but rather we conducted a pre-launch session where we invited our stakeholders for a free reign of the application, and allow them full usage. At the end of the day, the thoughts, opinions, and suggestions of the stakeholders were recorded in the form of one to one discussion forum, where each of the stakeholder were asked to give their opinions regarding their use of the application through polls and forms. These forms were then analysed to highlight the positive and negative aspects of the application in terms of ease of understanding, graphics, accessibility, and efficiency. In this regard, we took comments from two of the major players and stakeholders involved in the development of the application: the developer and the service provider. Unfortunately, the comments from the user (the third stakeholders) could not be taken unless until the application was officially launched.
The specific aspect on which our application was tested was from the viewpoint of the developer and service provider. The studied aspect in both the cases include, ease of testing on both an emulator and onto a real device, compatibility, applicability, user interface, the application usage of the device’s services such as the camera, keyboard etcetera, performance and operation.

The feedback process also work best when there are regular opportunities to present our ideas to the stakeholders, and then provide the stakeholders with the opportunity to absorb the concepts, and the details which are so inherent in the design. Therefore, there were regular meetings with the stakeholders to present our ideas to them, and get their approval at every stage of the development of the application system. There is no doubt, that this was a lengthy procedure, but it gave the stakeholders the opportunity to review the designs at every crucial stage, and get their approval for every step, rather than starting with the application development process again from the start, if the stakeholder finds something or some aspect of the application unsatisfactory. Plus, we found that setting specific deadlines is good project management and helps keep momentum on a project going. This application, along with the data collected for it, needs to be taken for further research in order to improve it and to evaluate it on a larger scale.

The summary of the evaluation of the project’s methodology, the negative and positive aspects of the projects are given below in the ensuing sections.
8.1 Evaluation of the project methodology

The use of RAD as the methodology for the development of the system was intended to provide lots of opportunity to gain feedback, during the project development, and expand further on the requirements of the projects. One issue with RAD was that it was very time consuming, therefore, it delayed the deadline for the evaluation procedure and feedback from the Developers. This time constraint meant that there was insufficient time and therefore many of the developer workshops could not take place after each development phase. The time taken for ethical approval of the project was also very lengthy and already cut into the short amount of time we had for the gatherings of the developers.

However, even having said so the prototype of the application was highly successful and garnered interest and praise from the developers on the pre-launch. Furthermore, each prototype was tested for suitability and adaptability, after each and every step of the procedure to maintain the approval from the developers. The data for this application was drawn from think-aloud protocols and walkthroughs with additional code literate developers.
8.2 Comments on the application

The negative issue with the application was the positioning of the map on the page loaded, and required the user to scroll down the page to view the map in the centre of the page. This is an issue directly related with the usability option and superficial as the website operates on a prototype platform where the map is evaluated and tested. The future implementation of the map on the application will require a complete redesigning of the structure of the website, or its incorporation into the pre-existing website architecture.

Encouraging remarks were made about the application and its functionality. The speed of the application was highly appreciated. Furthermore, there were no problems faced by the developers when the time came for the testing of the order pages on the internet. The functionality of the order pages implied that the format and order is perfectly applicable for the prototype system.

The instructions on the map were said to be very clear and precise, and the review of the user interaction was also seen to be very positive. The most important part of the pre-launch was the testing of the application, adaptability and transferring nature of the application. The application was developed with the viewpoint that it will be suitable for both android and IOS users. Therefore, it was needed to develop a website with strong adaptability and transferable features which allows it efficient running on both the platforms. After the pre-launch, the application was considered very efficient, and the running was smooth and efficient in both the platforms of Android and iOS. The data for this application was drawn from think-aloud protocols and walkthroughs with additional code literate developers.

The application was considered to be fast and efficient, making it user friendly. The application did not have extra features which would make the operating of the application difficult on the part of the user. Furthermore, it was evaluated that the graphics of the application overall were friendly and pleasing to the eye, rather than being offensive to any race or colour. The content of the application was also devoid of any racial discrimination, and was evaluated to be well received by all the residents of the Oman, because of its ease of usability, transferable nature, efficiency, and low processing time.
8.3 Conclusion

As a conclusion of the evaluation, I did not carry out any interviews to assess the performance of the mobile delivery application, however, I conducted a pre-launch session where developers were invited for a free reign of the application and were allowed full usage of it. The specific aspect on which the application was tested was from the viewpoint of the developer and service provider. Comments on the application state that the negative issue with the application was the positioning of the map on the page loaded, which required the user to scroll down the page to view the map in the centre of the page. Additionally, encouraging remarks were made about the application and its functionality. The speed of the application was highly appreciated. The application was considered fast and efficient, making it user-friendly.
CHAPTER 9: CONCLUSION

9.1 Project Review

This is an information system application, for a delivery system, this entails handling all the required textual information required by the physical delivery system for a will have the capability to encompass many businesses and franchises, and provide them with the opportunity to monitor the delivery process of their goods. An e-commerce platform allows for customers to interact with the sellers online. Buyers can order for goods online and they get the goods delivered to them by the sellers. The world is moving towards this direction where shops that sell almost everything are online. An e-commerce platform should be user friendly and easy to navigate.

Due to the vast technological development and the progression of cutting edge innovation, the improvement of electronic trade has become fundamental over the past couple of years. This web-based method for working together has pulled in numerous agents worldwide to wander into the electronic universe of working together. Development of e-commerce has provided a platform for the business visionaries for all over the globe, to jeopardize all their previous business practices in favour of e-commerce and electronic business, to make their business more profiting and successful.
9.1.1 Aims and Objectives Review

The aim of this project was to use the building popularity of the e-commerce throughout the business world. In spite of the rapidly developing popularity, there were glaring problems for e-commerce world. In this aspect, we studied the country of Oman and the availability of any such platform where the residents of Oman have an internet platform for an online mobile delivery system. Oman has no addressing systems that enabled the companies to know the exact location of the house through a clear standardized addressing format. The Global positioning system is always a very feasible option but unfortunately, the GPS does not allow easy sharing of coordinates through a phone or website. There was, therefore a need to develop a system that will solve these problems. There was still a huge market for software that will allow the solutions for such problems, and much work needs to be done to bridge the gap between the rapidly developing e-commerce worlds, with the opportunities in Oman.

The aim of this study was to develop a prototype of a mobile delivery system that will offer solutions to the users and aid them in monitoring of their delivery, as well as keep track of the status of their delivery of processed goods in the sultanate of Oman, providing the essential fact that there is no such existing system that is effective and efficient. The application combined the features and took influence from the Uber, Careem and Enwani mobile services, which are so popular in the world, and financially very stable. Furthermore, there are some examples and their success rate, mentioned in the study to set up the basis for the reasoning of the online application for delivery purposes in the state of Oman.
The new application “Anawen” was aimed to be introduced in the markets of Oman, and was expected to have incorporated the features of the leading applications such as Careem, Uber and Enwani, in order to meet the requirements of the consumers. The new application was expected to consider the internet facilities and status in Oman as it’s functioning will be primarily focused on the internet speed and coverage of the area. The technologies used in Anawen are also summarized in this study. The new mobile delivery system application needed the information of existing condition of the market and economy, and the evaluation of the success factor of other mobile applications. As mobile delivery application is a great source of the e-commerce so the development of the mobile delivery application was based on strategic decisions making that was expected to yield better results.

The summary of the chapters in this study is presented in a tabular form below, Table 10, with the name of the chapter, their content and the aim of the chapter.

Table 10 Summary of Chapters

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literature review</td>
<td>Review of the existing literature regarding the research, and review the critical aspects that relate to the development of “Anawen” mobile application</td>
</tr>
<tr>
<td>methodology</td>
<td>Discussion on the methodologies and software’s used in the dissertation</td>
</tr>
<tr>
<td>Requirement analysis</td>
<td>What methods will be suitable and which technique will be best for the development of software. So it will be a counter check to ensure the quality of the application.</td>
</tr>
<tr>
<td>Design</td>
<td>certain decision have been made for the selection of the technology to be used for this application</td>
</tr>
<tr>
<td>Conclusion and evaluation</td>
<td>The future aspects of the projects are discussed. Furthermore, the project evaluation based on the feedback of the developers on the prelaunch is mentioned.</td>
</tr>
</tbody>
</table>
9.1.2 Methodology Review

The methodology employed for this project was based on a user interface design rather than the conventional UTAT. In the development of this application, the 10 heuristic principles of Jakob Neilson were strictly followed for interaction design. This method was specifically chosen for this design because this application is intended for mass scale use, and user interaction is a very important aspect of the design.

The research design adopted was qualitative research design, because it is based on a social constructivism perspective: observing people and their needs and then analysing them scientifically. Research problems were the based on prior research experience, the samples sizes were small, and the data collection methods employed were interviews, observations and archival content data. Interpretation was based on a combination of researcher perspective and data collected.

During the designing phase, certain decision were crucial and were undertaken for the selection of technology which was to be used for this application. Google map was incorporated in the design and was the mapping API. The low fidelity diagrams were used to remove all the ambiguities, and were intended to remove the generic problems that a potential user could face. The design was completed by following the international standard defined by experts after collecting data from thousands of end users.
9.2 Future expansion and further work

The current application is a delivery system that will help the customers to know the status of their delivery, through interactive user graphic design and efficient database design. The application has incorporated the designing features of Uber and Careem when designing the application. The pre-launch was highly successful, and all the developers were satisfied with the development of the application, and the delivery system was well-appreciated and well received.

But the application does not have a tracking system in built that would allow the users to track the position of their shipment. This was the primary concern raised by the developers who wanted to see a tracking system in addition to the delivery system, to allow more user friendly interface and increase the appreciation of the crowd for the application.

In future, it is the goal of the developers to develop a fast and efficient tracking system. The delivery system of the application will allow the users to not only aid in online delivery procedures, it will also enable the customer to know when the shipment is on its way using the tracking systems, where is it in that specific moment. It will additionally enable the customer to track its progress from dispatch to its destination. Moreover, future expansion of the application would also address the primary research for deeper analysis of the application. Analysis will be done by evaluating the application from customers and drivers in terms of its user interface and how easy it is to use the application.

The tracking system could be used for the observing of persons and the objects on the move. The methodology will be similar to the ordinary tracking software, where the tracking system will provide the timely-ordered sequence of the location data, and then applying it to a model, which will then depict the motion on to a display device, which will be visible to the user.
9.3 Overall conclusion

The project’s success is determined by the completion of the aims and the objectives of the project mentioned in the introduction of the document. At the end of the project, the objectives and aims of the project have been met through the design, analysis and development of the final system. The prototype which was developed, was delivered to the developers on various stages, and finally on the pre-launch, which was met by approval and very positive feedback received in the evaluation stage of the project.

The project was aimed at producing an online mobile delivery application that would be operated at a wide scale in the country of Oman. It was intended to be an information system for the delivery of processed goods. The application was to be efficient in handling the text information entered by the user, and have the capability to include the delivery aspects for many business and franchises all over Oman. It was intended as an e-commerce plan that would provide an e-commerce platform between the customers and the sellers online. Buyers can order for goods online and they get the goods delivered to them by the sellers. The implementations of the project are more unique than ordinary goods deliver system. It is because, it is intended for mass scale use in the state of Oman, in which there is no delivery system operating on a wide scale, allowing people to know about their delivery status and process. The application will be a step up in the world of e-commerce and will provide the ordinary customer as well as large business agglomerations an opportunity to view and always stay up to date regarding their delivery and up until the parcel/delivery has reached its required destination.
The fact there is no existing platform for the companies and manufacturers which allow them tracking for their delivery goods is an automatic indicator of the fact that the project can yield great economic benefits for the developers, once when the project is operational. Furthermore, the user friendly design of the application will render it highly popular among the common population, as well as the more sophisticated of the corporations and companies. The use of RAD platform for the development of the project has undoubtedly increased the timeline for the completion of the project, as the ethical permission of the project became more time consuming, but the efficiency of the project was increased. The project will serve as a platform between the companies and the e-commerce.

The project was well received by the developers, but the one question that was raised was on the possibility of incorporation of a tracking system into the application which will track the goods, and inform the user about the location where their goods are. This is in plan for future, where a tracking system will be added into the application in addition to the user interface design. In a rising economy as Oman, the current project will have huge importance and significance. This is because currently, there is no such delivery system applicable in Oman and furthermore, it will serve as a platform to join the customers and the businesses.

In general, it can be said that this project documented the designs and development of a mobile delivery application that will be functional in Oman. This is an information system application for a delivery system which entails handling all the required textual information, required by the physical delivery system. It has the capability to encompass many businesses and franchises, providing them with the opportunity to monitor the delivery process of their goods. An e-commerce platform allows customers to interact with the sellers online. Buyers can order for goods online and can get the goods delivered to them by the sellers. Due to the increasing sophistication of modern technology, online retailing is dominating traditional shopping. An e-commerce platform should be user friendly and easy to navigate.
CHAPTER 10: REFERENCES


CHAPTER 11: BIBLIOGRAPHY

Android Mine (2016). How to implement Android Place Picker. [video] Available at:
https://www.youtube.com/watch?v=Rh9x90lqPHc [Accessed 13 Jan. 2017].


Creative Bloq. (2012). The 10 principles of mobile interface design. [online] Available at:

Developer.apple.com. (n.d.). About Objective-C. [online] Available at:


CHAPTER 12: APPENDICES

APPENDIX A Ethical Form

Ethics Number

| st20050780 | Al Juma | Faris | SE | SMcN | 2016D04859 |

Ethical Form

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**DEVELOPED ETHICS APPROVAL APPLICATION SUMMARY**

Student Name: Faris Al Juma  
Student Number: ST20050780

Module Name: Software Engineering Dissertation Project  
Module Number: BCO6010

Programme Name: BSc (Hons) Software Engineering  
Supervisor Name: Stuart McNeil

---

**To be completed by student and supervisor before submission to Ethics Approval Panel**

<table>
<thead>
<tr>
<th>Application for ethics approval</th>
<th>Student Signature;</th>
<th>Supervisor Signature;</th>
</tr>
</thead>
<tbody>
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First Submission: [X]  
Resubmission: [ ]

Date: 5/4/2017

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**For use by the devolved ethics approval panel:**

Panel Members  
Name  
Signature

Module leader, Chair:

Supervisor:

CSM Ethics Committee Representative:
When undertaking a research or enterprise project, Cardiff Met staff and students are obliged to complete this form in order that the ethics implications of that project may be considered.

If the project requires ethics approval from an external agency (e.g., NHS), you will not need to seek additional ethics approval from Cardiff Met. You should, however, complete Part One of this form and attach a copy of your ethics letter(s) of approval in order that your School has a record of the project.

The document **Ethics application guidance notes** will help you complete this form. It is available from the Cardiff Met website. The School or Unit in which you are based may also have produced some guidance documents; please consult your supervisor or School Ethics Coordinator.

Once you have completed the form, sign the declaration and forward to the appropriate person(s) in your School or Unit.

**PLEASE NOTE:**
Participant recruitment or data collection **MUST NOT** commence until ethics approval has been obtained.

**PART ONE**

<table>
<thead>
<tr>
<th>Name of applicant:</th>
<th>Fares Jumu Ali Jumu</th>
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<tr>
<td>Supervisor (if student project):</td>
<td>Stuart McNeill</td>
</tr>
<tr>
<td>School / Unit:</td>
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<tr>
<td>Student number (if applicable):</td>
<td>8720055780</td>
</tr>
<tr>
<td>Programme enrolled on (if applicable):</td>
<td>Software Engineering – BSc (Hons)</td>
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<tr>
<td>Project Title:</td>
<td>The design and development of a personal mobile delivery management application based in Oman</td>
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<td>Approximate duration of data collection:</td>
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<td>Funding Body (if applicable):</td>
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<tr>
<td>Other researcher(s) working on the project:</td>
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<tr>
<td>Will the study involve NHS patients or staff?</td>
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<tr>
<td>Will the study involve human samples and/or human cell lines?</td>
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Does your project fall entirely within one of the following categories:

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<th>No</th>
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<tbody>
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<td>Paper based, involving only documents in the public domain</td>
<td>Yes</td>
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</tr>
<tr>
<td>Laboratory based, not involving human participants or human samples</td>
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</table>
In no more than 150 words, give a non-technical summary of the project.

I can confirm there is no data collection anymore.

The project involves the making of a personal mobile delivery solution for Oman. As the country lacks an addressing system. There is no such similar mobile application or service in the country that serves the purpose of delivery solution. In this research project, I will conduct interviews based on the testing of the

DECLARATION:

I confirm that this project conforms with the Cardiff Met Research Governance Framework

I confirm that I will abide by the Cardiff Met requirements regarding confidentiality and anonymity when conducting this project.

STUDENTS: I confirm that I will not disclose any information about this project without the prior approval of my supervisor.

Signature of the applicant: Faisa Juma Ali Juma Date: 22/11/2016

FOR STUDENT PROJECTS ONLY

Name of supervisor: Stewart Monall Date: 

Signature of supervisor:

Research Ethics Committee use only

Decision reached: Project approved [ ]
Project approved in principle [ ]
Decision deferred [ ]
Project not approved [ ]
Project rejected [ ]

Project reference number: Click here to enter text.

Name: Click here to enter text. Date: Click here to enter a date.

Signature:

Details of any conditions upon which approval is dependant:
Click here to enter text.

References

APPENDIX B   PDF - User Location for the company to print out

Basic Information

Name: Faris Aljuma
Phone: 0096897011111
Email: ajuma1995@gmail.com

Addresses:
Scholars Dr, Cardiff CF23 9XR, UK (Main Address)

Home (Main Address)

51°29'53.7"N 3°08'57.0"W

View larger map

House #: 15
Way #:
Address: Scholars Dr, Cardiff CF23 9XR, UK
APPENDIX C  Actualised Gantt Chart

PROJECT GANTT CHART
APPENDIX D    Project Source Code

A disk has been attached to each printed copy of this dissertation.

The full program code is contained within.