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**Constituency Bursary Fund Information Management
Application**

Nyamboga Lilian

**Submitted in partial fulfillment of the requirements of the Degree of Master of
Science in Mobile Telecommunications and Innovation (MSc. MTI)**

**Faculty of Information Technology
Strathmore University
Nairobi, Kenya**

June, 2017

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Abstract

Constituency Development Fund (CDF) in Kenya has been hailed as one of the most innovative creations of the National Alliance Rainbow Coalition (NARC) administration (2003-2007). With the Government working hard to cultivate an image of transparency and inclusiveness for good governance in Kenya, implementation of E-Governance services for creating better relations between citizens and those in power has been a real struggle. ICT has been exploited in this relationship to help transform the accessibility, quality and cost-effectiveness of public services. The emergence of mobile technologies has further accelerated the different sectors of Government in implementing faster and cost-effective means of communication. However, there have been notable challenges in the CDF Bursary Fund application process including but not limited to delayed information relay about commencement of application window and disconnect between CDF bursary officials and the applicants.

This dissertation describes a study on the challenges and gaps in the bursary fund application process in the context of technological need. The study identified challenges such as delayed information relay on commencement and updates on disbursements as well as lack student historical data with regards being a bursary beneficiary. The study also aimed to develop, test and validate a mobile application that can be used to solve these challenges. In order to establish the relevant system requirements needed, data collection methodologies including interviews with stakeholders, questionnaires with CDF Bursary applicants were used to highlight the needs of the applicants. This data was then analysed using data analysis tool IDEA and used in the design of the application. Waterfall methodology was then used to develop the mobile application using Android Platform. The application included features that enabled capture of applicants data, SMS updates for applicants at the inception of the application window, after application, and during disbursements process. The application also enabled the applicants to obtain application forms easily during the application window. This solution was tested by the developer and validated by selected users who formed part of the test team. The solution proved to be a viable solution with 90% acceptance levels.

Keywords: CDF, CBF, Bursary, M-Governance, E-Governance, Mobile, Kenya

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List of Abbreviations/Acronyms

CDF - Constituency Development Fund

CBF - Constituency Bursary Fund

CBFC - Constituency Bursary Fund Committee

OECD - Organisation for Economic Co-operation and Development

G2C - Government to Citizens

G2B - Government to Business

G2G - Government to Government

G2E - Government to Employees

CAK - Communications Authority of Kenya

NARC - National Alliance Rainbow Coalition

CDFB - Constituency Development Fund Board

UN - United Nations

DESA - United Nations Department of Economic and Social Affairs

ITU - International Telecommunication Union

KNEC - Kenya National Examinations Council

KCPE - Kenya Certificate of Primary Education

KCSE - Kenya Certificate of Secondary Education

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1 INTRODUCTION

1.1 BACKGROUND INFORMATION

Constituency Development Fund (CDF) in Kenya has been hailed as one of the most innovative creations of the National Alliance Rainbow Coalition (NARC) administration (2003-2007). This fund was created by the Constituencies Development Fund Act, 2003 with the main objective of addressing poverty at grassroots level by dedicating a minimum of 2.5% of the Government's ordinary revenue to grassroots development and the reduction of poverty. It has since created local consume' demand through various projects, funding other local needs including education, health and infrastructure (Constituency Development Fund, 2012).

The Government has been working hard to cultivate an image of transparency and inclusiveness for good governance in Kenya by implementing E-Governance services and hence creating better relations between citizens and those in power. ICT has been exploited in this relationship to help transform the accessibility, quality and cost-effectiveness of public services. Introduction of web-based Internet applications and other information technologies combined with processes that implement these technologies to enhance access to and delivery of Government information and services to the public, other agencies and other Government entities have been put in place in the recent past. For example; electronic filing systems, documents exchange systems, procurement (IFMIS), declaration and application systems, and other tools have now been introduced in various Government departments towards E-Governance. E.g. Ministry of Information, Finance, Tourism, Devolution among others have put up websites that contain information about the economy, culture, rules of business, tenders, draft bills, CDF projects and so much more which have had a direct impact on the citizens (Amollo, 2007). The current Government has put up e-service portals such as E-Citizen where citizens can easily apply for legal documents. We have also seen an emergent trend where political persons are using SMS lines to campaign for their preferred candidate. This has proved to be very effective especially since one message can be broadcasted to multitudes of people.

Indicators show that CDF is helping provide services to communities that for many years did not benefit substantially from Government services. In particular, the poor in society have experienced serious problems accessing basic services in the past that are now made available

through CDF kitty. Nevertheless, there are increasing concerns about the utilisation of CDF fund which suggest that the funds are not being optimised. Arguments over the constitutionalism of the fund struck in the 11th Parliament and even the high court of Kenya pronounced the fund's Act as unconstitutional. Given the importance of this program, an in-depth analysis of both constitutional, institutional, design and implementation factors that impact on the efficiency of the use of funds is necessary (Kimenyi, 2005; Commission for the Implementation of the Constitution,2013).

There is an exponential need for faster, accurate and timely information dissemination mechanisms (IHub Research, 2012) in delivering Government services to the people. This has escalated the need for real time information with people turning attention to social media such as Twitter, Facebook and personal blogs as a means of obtaining faster feedback (Okune, 2012). However, for other kinds of information, it is difficult to keep track of the huge data generated from social media as this information's validity expires so fast. For instance, most people with the need to apply for CDF Funds may not necessarily be on social media. This means that issues such as timely information dissemination on the applications, application deadline alerts and application status alerts may arise.

Mobile penetration hit 87.3% during the first quarter of 2016/2017 down from 90% recorded the previous quarter. This accounted for approximately 38.5 million mobile subscriptions as at September 2016 (Communications Authority of Kenya, 2016). This is a significant show that the future is mobile and if tapped into, could be a game changer for the CDF Bursary application process. The web has been an exemplary tool in information dissemination given the large masses of people who browse through to find information each minute. Of this, a very large number of people; approximately 25.5 million users use their mobile phones to access the Internet hence making mobile web applications an integral part of mobile usage as shown in Table 1.1.

Table 1.1 Internet Subscribers in Kenya

<i>Internet/Data Subscriptions</i>	<i>Sep-16</i>	<i>Jun-16</i>	<i>Quarterly Variation (%)</i>	<i>Sep-15</i>
<i>Total Internet Subscriptions</i>	25,672,474	26,880,471	-4.5	21,628,271
<i>Mobile Data Subscriptions</i>	25,536,400	26,758,789	-4.6	21,511,638
<i>Terrestrial Wireless Data Subscriptions</i>	15,835	13,449	17.7	13,221
<i>Satellite Data Subscriptions</i>	598	280	113.6	720
<i>Fixed DSL Data Subscriptions</i>	2,583	3,063	-15.7	2,500
<i>Fixed Fibre Optic Data Subscriptions</i>	33,269	27,571	20.7	100,192
<i>Fixed Cable Modem Subscriptions</i>	83,789	77,319	8.4	25
<i>Estimated Internet Users⁵</i>	37,718,650	37,716,579	0.0	31,985,048

Source: Internet Statistics (CAK, 2016)

This has given rise to services such as M-Government. M-Government development provides countries with more developed E-Governances and the opportunity to tackle issues such as those related to the digital divide which remains a critical factor in the levels of E-Governance service-take-up which is mostly lower than expected in many developing countries. This is mainly by enabling the development of a set of Government to Citizens (G2C), Government to Government (G2G), Government to Businesses (G2B) and Government to Employees (G2E) applications and services, M-Government therefore, has the capacity to transform and extend access to existing services, expand delivery to new services, increase active citizen participation in Government operations and change the way of working within the public sector. These services enable citizens to interact with Government and other stakeholders in a way that is responsive to citizen needs by allowing them to be updated on current Government information, enquire on various Government services, request for various services, carry out transactions, send comments, report problems, request emergency services and access data (Organisation for Economic Cooperation and Development, 2011).

1.2 PROBLEM STATEMENT

Access to information about CDF Bursary Fund application is not easy. Additionally, the actual application process is long, tedious and sometimes complicated. For example, when applying for bursary funds, one has to acquire the forms at the CDF office in their constituency of registration, fill it in and then return it to the office for official evaluation. Filling in the forms follows a long procedure of traveling outside residential counties to obtain the forms in the registered counties. If the participants or signatories required live far apart, one has to make trips which might incur a considerable cost in both time and money resources. Often, the traveling meets challenges such as delay at the CDF offices, deadline for receiving the applications has already passed or the forms have all been issued out. For constituencies within Nairobi County, the process of bursary applications is fuzzy. All one needs is voter's registration, identification card and legal stamps from the county administration. Following a recent observation made on one of my visits, there is no way to prove the legitimacy and relationship between the bearer of the voter's card and the applicant. People end up making applications in more than one

constituency. What this means, another person is deprived of the opportunity to benefit from the program.

After disbursement of the funds, one has to keep calling the CDF officials or physically walk to the CDF premises to be updated on the progress of the application and when disbursements shall be made. In some cases, officials may be rude and unwilling to tackle such kinds of queries a situation that users have to put up with every time they make an application. In addition, the CDF officials do not maintain historical data for the student beneficiaries to gauge the impact of the fund.

1.3 RESEARCH OBJECTIVES

- 1) To investigate the challenges facing CDF Bursary applications in Kenya and to establish the procedures followed when making CDF bursary applications.
- 2) To identify and analyse current systems implemented for CDF Bursary funds management.
- 3) To design, develop and test a mobile/web application that will address the challenge of CDF Bursary applications.
- 4) To validate that the application bridges the information gap between CDF Bursary applicants and the CDF Bursary management.

1.4 RESEARCH QUESTIONS

- 1) What is the application process and its challenges in the current CDF application processes?
- 2) Are the solutions currently implemented sufficient to cater for the vast informational needs of CDF Bursary beneficiaries and stakeholders?
- 3) Which technology platforms are best suited in implementation of M-Governance?
- 4) Does the proposed solution bridge the information gap between CDF Bursary applicants and the CDF officials?

1.5 JUSTIFICATION OF THE RESEARCH

As noted by Kenya Youth Initiative (2011), students applying for CDF bursary funds must fill a form in which academic performance is key consideration for successful candidates. At the same

time, poor performance is attributed to the lack of school fees and hence absenteeism from school. Moreover, CDF officials do not maintain any student historical data that can measure the impact of the bursary for the student during or after the period for which the students are benefiting.

There are no known systems in place to effectively keep the citizens in know during and after the application window and very scarce research has been done to address the non-existence of public bursary management applications. This research is therefore important and key in filling these gaps.

1.6 SCOPE OF THE RESEARCH

This research was carried out in two constituencies within Nairobi County before rolling out to the extensive forty seven counties across Kenya and was carried out in collaboration with the CDF officials and citizens who were the main users of the application.

1.7 LIMITATIONS OF THE RESEARCH

Implementation of the mobile application was done only in Android platform. Also, the system implemented was limited only to CDF Bursary fund management.

2 LITERATURE REVIEW

2.1. INTRODUCTION

This chapter will dive into the history of Constituency Development Fund (CDF), M-Governance, E-Governance, the difference between E-Governance and M-Governance and the current mobile statistics as a gateway to explore the impacts of the growing telecommunication industry in realising efficient Government service delivery to citizens.

The Constituencies Development Fund (CDF) was created by the Constituencies Development Fund Act, 2003. Its aim was to address poverty at grassroots level by dedicating a minimum of 2.5% of the Government ordinary revenue to grassroots development and the reduction of poverty. The fund is managed by the Constituencies Development Fund Board (CDFB). CDF Act 2003 has been replaced with CDF Act 2013 that is more aligned to the constitution of Kenya 2010 CDF (2013).

2.1.1 Components of CDF as a Fund

Studies on CDF have indicated that although it comprises of an annual budgetary allocation equivalent to at least 2.5% of the Government ordinary revenue, which is a small share of the total budget in Kenya, this fund has been able to bring longer lasting impact on citizens (Samuel Auya, 2013). A maximum of 5% is allocated to CDF Board for Administrative services, a minimum of 95% is allocated to constituencies based on the following formula; (a) 5% of the 95% is allocated to Emergency Reserve; (b) 75% of the balance is allocated equally amongst all the constituencies; (c) balance of 25% is allocated based on the Constituency Poverty Index modelled by the Ministry of Devolution and Planning. Sectors funded by CDF include Education (around 55% of CDF allocations), Health (6%) and Water (11%). These are the sectors that have felt a great impact since the initiation of the project (Constituency Development Fund, 2012). This statistics give room for this research to flourish.

2.1.2 How Constituencies Handle Constituency Bursary Funds Applications

In his study Challenges in the disbursement of Constituency Bursary Fund to Public Secondary School students in Bobasi Constituency Kenya, Orera (2011) notes that the Constituency Bursary Fund Committee (CBFC) in the various constituencies determines the beneficiaries of the fund by using the following criteria: (a) Family status of the recipient. A

student with both parents deceased is ranked as an orphan, one parent deceased as partial orphan, unmarried mother /father as single parent and needy parents using social economic background. (b) Student academic performance with ranks of excellent, very good, good, fair and poor is used. However the bursary given according to performance remains a challenge since the fee problem contributes to poor performance and indiscipline on absenteeism grounds. I concur with his study, noting that indicators such as poor performance should not be used as metrics in awarding funds to student; these constituencies neither ask for student records from schools nor maintain a database with of the students’ history to be able to consistently make judgement of the students’ academic capabilities.

In their study Triple Tragedy: The Girl Child’s Struggle to Access Secondary Education Bursary Fund Applicants, Kenya Youth Initiative (2011) notes that all CDF bursary applicants are required to fill a means testing instrument known as FORM “A”. This form contains data on a student’s personal details including gender, academic performance, type of school, total fees paid and outstanding fee balance. The instrument also seeks for data on family’s socio-economic circumstances and head teacher’s report on student’s discipline. Based on data given by an applicant on form “A”, scores are awarded using a rating scale for three major indicators namely; a student’s family status, affirmative action/special circumstances and discipline as illustrated in Table 2.1.

Table 2.1 Form D, Scores for CDF Applicants

A. Family Status		Score
1	Total orphans	20
2	Single parent without a source of income	18
3	Partial orphan (mother/father alive) without a source of income	16
4	Both parents alive – without a source of income	14
	Maximum	20
B. Affirmative action/ Special circumstances		
1	Girls child	5
2	Boy child	4
3	Slums/pockets of poverty/marginalised	5
4	Special needs (Handicapped)	5
	Maximum	15
C. Discipline		5
1	Excellent	4
2	V. Good	3
3	Good	2
4	Fair	1
5	Poor	Maximum 5

Source: CDF Application Form (Kenya Youth Initiative, 2011)

This form although seems like a fair determination of the bursary fund beneficiaries, does not assure impact assessment nor consistency of the allocation of the fund to needy students.

2.1.3 Challenges Facing CDF

According to Centre for International Development (2010), there are no internationally accepted principles, tools and templates of administration and implementation of CDF. It is not known whether or when the direct disbursement of funds for CDFs is a more effective model than the indirect disbursement of funds. Further, numerous allegations of corruption cases have flooded operations around the fund as described in the following paragraphs.

Accountability and transparency deficiencies generally result from the lack of a clear, effective mechanism for oversight or separation of powers delineated in CDF policy, which can lead to unaccounted for or wasted money because balance sheets are improperly, dishonestly or rarely reported; Corruption when Members of Parliament use funds to buy political favours or votes; when decentralised levels of government, administration and CSOs fail to maintain and submit to central CDF administration detailed records of money used; and/or project designers or implementers are selected on the basis of clientele(ism) or nepotism. Kenya Youth Initiative (2011) note that although there is a set out criteria for selecting needy students as beneficiaries of CBF, the criteria is sometimes ignored because of corruption, nepotism and other shoddy deals by the bursary committee with members of parliament. This as a result denies genuine beneficiaries a rightful chance to benefit from the fund.

Efficiency issues arise when there is a misallocation, misuse or underutilisation of CDF disbursements as a consequence of fiscal illusion, or the inability for local populations to grasp the aggregate cost of all CDF projects for the central government and its impact on the national budget. In this case, because CDF money does not come directly from a constituency's revenue or tax base, it is treated as "free money", diminishing the degree of efficient utilisation and effort to monitor such disbursements. Also, the central government incurs long-term cost of these projects, which is a hidden cost; Project duplication with development efforts of national and county government or development efforts funded by the donor community; Poorly designed projects due to the lack of a coherent policy framework within which to propose, devise and implement projects, which ultimately promotes waste; Incompetent administration in local government that may be technically ill equipped to administer project funds due to the technical complexity of management practice.

Equity dilemmas surfacing partly because of different approaches to defining core elements of what is meant by “fair CDF distribution”. To address these elements, one must define who the deserving recipients are, what the limits are of the project or item for which money is allocated and how to gauge the fairness of the process of distribution.

In his research, Orera (2011) further notes that there is no clear way to determine who is needy for the allocation of the fund. He states that weak administrative mechanisms lead to delayed disbursement of funds from the Government and delayed feedback to the beneficiaries. As a result of this, students are sent away from school for lack of fees and therefore lose study time doing other chores that are not academic related. To further explain this scenario, in their research “The Role of Constituency Development Fund in the Provision of Secondary School Education in Kenya”, Ng'alu and Bomett (2014) outline the actual challenges experienced by the students applying for the fund. The findings provisioned clearly indicate that beyond the policy implementation structures put in place, the actual process of reaching the fund is complicated and sometimes unsatisfying. Below are their findings.

Table 2.2 Challenges Facing CDF Bursary Applications

	Strongly disagree	Disagree	Agree	Strongly agree	Total		Mean	Std. Deviation
Complicated application form	21	83	28	5	137	Complicated application form	2.12	.703
Hard to get chief and pastors to fill form	15%	60%	21%	4%	139	Hard to get chief and pastors to fill form	2.86	4.136
No clear information on when to fill bursary	30	51	41	17	139	No clear information on when to fill bursary	4.93	7.545
Inadequate amount allocated	20.7%	36.2	29.3	12.1%		Inadequate amount allocated	3.04	.925
Irregular bursary disbursement	7	12	59	59	137	Irregular bursary disbursement	3.19	.945
Forms not readily available	5.4%	9%	42.9	42.9%		Forms not readily available	3.76	5.433
No clear guidelines for identifying needy students	7	33	43	53	136	No clear guidelines for identifying needy students	3.12	.927
Inequality in bursary disbursement	5.3%	24.6	31.6	38.6%		Inequality in bursary disbursement	3.11	.939
Disbursement takes too long	12	14	47	63	136	Disbursement takes too long	3.42	.649
	8.6%	10.3	34.5	46.6%				
	5	24	66	40	135			
	3.5%	17.5	49.1	29.8%				
	12	14	54	54	134			
	8.8%	10.5	40.4	40.4				
	10	24	45	57	136			
	7	17.5	33.3	42.1				
	2	5	61	66	134			
	1.7	3.4	45.8	49.2				

Source: CDF Bursary for Secondary Schools (Ng'alu and Bomett, 2014)

From Table 2.2, Ng'alu and Bomett (2014) conclude that “majority of students disagree that the bursary forms are too complicated; shown by the mean which is less than 4. They are also not of the opinion that it is difficult to get in contact with the chiefs or pastors as shown by the mean. However, most students feel that there is no clear information on when the forms

should be filled and that the amount allocated is irregular and inadequate. They also feel that bursary forms are not readily available. The result shown by the mean that is more than 2. Students feel that there is discrimination in allocation of bursaries and there are no clear guidelines for identifying needy students”. Similar sentiments are echoed by Auya and Oino (2013) who state that “During key informant interviews, majority of the respondents maintained that needy students were able to access bursary through the CDF to further their education. However, the bursary was not enough to accommodate all the needy students.” This follows a study they conducted to ascertain the impacts of CDF in rural development in North Mugirango Constituency. These studies clearly articulate the problem as it is on the ground. However, these studies failed to address these challenges from a technology perspective.

2.2 M-GOVERNANCE AND ITS SIGNIFICANCE

2.2.1 Governance

Governance encompasses the relationships between three actors; state, market, and civil society and how these actors organise themselves and make decisions according to a set of informal and formal rules (Hellström, 2008)

2.2.2 M-Governance

M-Governance as defined by Bwalya (2014) is “strategy and its implementation involving the utilisation of all kinds of wireless and mobile technology, services, applications and devices for improving benefits to the parties involved in E-Governance including citizens, businesses and all Government units”.

Mobile technology has significantly expanded the Government’s capacity to offer and deliver citizen and business centric services; With the most notable progress being noticed in developing countries, which for a long time have been limited by poor and/or non-existent communications which constrains economic development and social improvements. These developments provide countries with more developed E-Governances and the opportunity to tackle digital divide related issues, which have remained a critical factor in lower than expected levels of M-Government services take up. This has a very powerful and transformational capacity for both extension of access to existing services, and expansion to the delivery of new services, increase active citizen participation in Government operations and hence help in

transitioning beyond the concentration of E-Governance on commerce and e-taxation to improving internal operations. This will foster civic engagement and transparent democracy, as well as educational advancement and innovative health services. This amalgamation of mobile devices and new media applications which support quick access to integrated data, location-based services, and hence empowered citizens from any place at any time is therefore the cornerstone of the emerging impact of mobile governance (Hellström, 2008).

2.2.3 Difference between M-Governance and E-Governance

According to Trim and Sheng (2011), E-Governance is a practice whereby the public sector is able to spearhead the use of wired ICT in innovative ways in delivering services, engaging citizens and hence improving efficiency in the Government's daily administrative activities. These activities in E-Governance can be categorised into: informational, transactional, and operational.

- 1) Informational functions provide access to Governmental information through Web portals, including online publishing and broadcasting.
- 2) Transactional functions allow citizens to interact with Government agencies via the Web such as online procurement and payments.
- 3) Operational functions refer to internal Governmental operations that focus on internal efficiency and effectiveness of operations and the interoperability across different E-Governances.

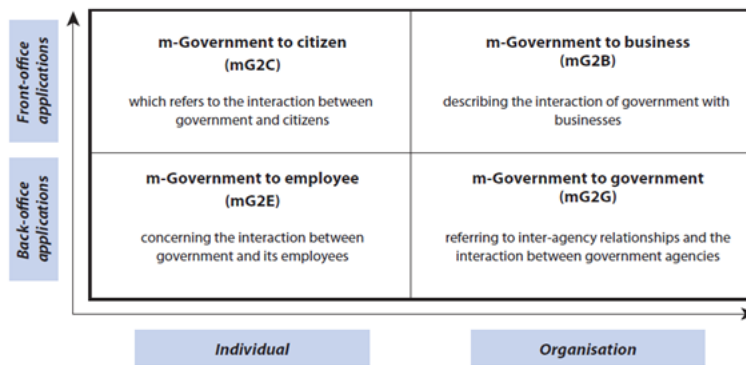
However, in the recent past, there has been an explosion in the use of mobile technologies such as mobile phones, PDAs, laptops among others that connect to wireless networks. This has enabled Governments to transition from E-Governance to M-Governance; because of the mobility and wireless nature of mobile devices, they have gained a huge applaud for the transformative impact that they can have to citizens. According to OneWorld.net (2012), M-Governance leverages on the simple, ubiquitous, affordable mobile technology to catalyse organisational efficiency and improve public service delivery. One of the major differences therefore becomes the availability of E-Governance tools, architecture, mobility and the impact the tools have on the citizens and the timeframes in which this impact can be felt. Mobile phones and portable laptops are more wide spread now than Internet cafes that offer Internet services. Users can easily connect to wireless hotspots to access the Internet as opposed to the traditional access via cables. Also, services such as SMS can be easily used in M-Governance to reach out

to large masses of people even without access to the Internet as opposed to E-Governance where users require Internet access to obtain or retrieve information and services.

2.2.4 Models of Delivery in M-Government

Table 2.3 outlines the various forms of M-Government that exist in the world today. These include; (1) Government-to-citizens (G2C), (2) Government-to-Government (G2G), (3) Government-to-business (G2B) and (4) Government-to-employees (G2E).

Table 2.3 Models of Delivery in M-Governance



Source: Types of M-Governance (KAIST, 2010)

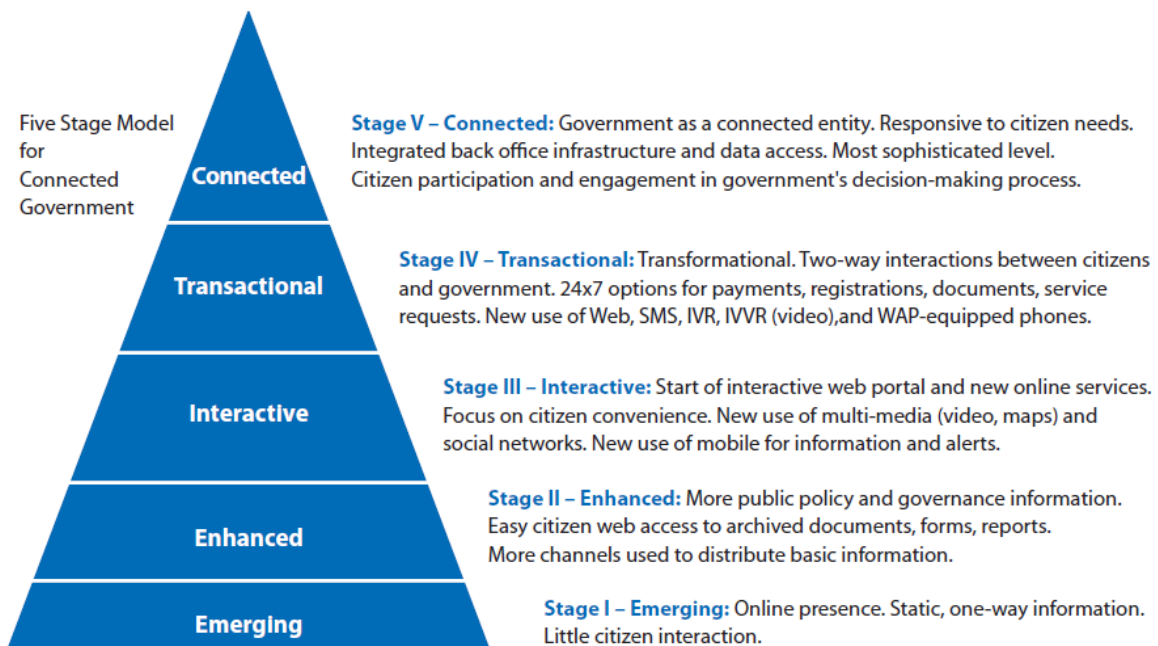
Mobile applications and services are generally considered to be Government-to-Citizens (G2C) services. In their E-Government Survey 2010, United Nations (2014) present the idea of connected governance as the means to achieve maximum cost savings and improve service delivery, which they note, determines if these services offered by the Government follow the following five stages as described in Figure 2.1. Table 2.4 and Figure 2.1 indicate the various rankings as far as e-government adoption is concerned and the various stages M-Governance takes in its course

Table 2.4 Global Leaders in E-Governance

<i>World e-government leaders</i>	<i>Regional e-government leaders</i>	
Republic of Korea	AFRICA	Tunisia
Australia		Mauritius
Singapore	AMERICAS	United States of America
France		Canada
Netherlands	ASIA	Republic of Korea
Japan		Singapore
United States of America	EUROPE	France
United Kingdom		Netherlands
New Zealand	OCEANIA	Australia
Finland		New Zealand

Source: Global Leaders in E-Governance (United Nations, 2014)

Figure 2.1 Stages of G2C



Source: Stages in Government to Citizens (DESA, 2010)

2.2.5 Reasons for Emergence of M-Government

According to OECD (2011), there are a number of reasons why M-Governance is increasingly on a sprouting spur. These reasons include: (1) Wider acceptance of these technologies by the public sector. (2) Penetration of mobile devices. (3) Ease of use for citizens. (4) Easier interoperability. (5) It can bring Government closer to citizens, and (6) the fact that M-Government services are cheaper than computer-based services. These reasons are further described below:

Better service accessibility: M-Government provides an additional reliable communication channel for users to access Government services. This can attract more users to access Government services using alternative channels that are more convenient, especially for people who are located in geographically remote areas or who are physically disadvantaged.

Better service availability: Like other m-business service models, M-Government services can be automated to provide 24/7 availability.

Better service responsiveness: Because of automation, users can access M-Government services with virtually no waiting time, whereas completing the same transaction using conventional approaches such as telephone calls or in-person visits could take longer.

Better service quality and efficiency: Success in building interest, enthusiasm and capacity of socially marginalised communities to interact and communicate via online technologies contributes to M-Government's success in achieving efficiency gains and improving services.

Service scalability: The advantage of scalability is that the provision of M-Government services has a far lower cost in comparison to traditional service delivery (e.g. printing materials, especially in regions that have higher population density). Efficiency and effectiveness are improved. Flexibility and scalability can be maintained because functional components can use a set of common interfaces to communicate with each other.

Better stakeholder participation: M-Government services, optimised by smartphones, allow citizens and businesses to take advantage of the Internet to access Government services, resulting in better perception and higher participation. DESA United Nations (2014), outlines the various leaders both globally and regionally based on the "United Nations E-Government Survey- E-Government for the Future We Want" survey. These findings clearly indicate that M-Governance is a solution to look out for especially if attainment of the sustainable development goals is to be achieved. Countries like Kenya have an impactful online presence most of which access is via mobile phones. See Table 2.5.

Table 2.5 World E-Participants

<i>World e-participation leaders</i>	<i>Regional e-participation leaders</i>	
Netherlands	AFRICA	Morocco
Republic of Korea		Kenya
Uruguay	AMERICAS	Uruguay
France		Chile
Japan	ASIA	Republic of Korea
United Kingdom		Japan
Australia	EUROPE	Netherlands
Chile		France
United States of America	OCEANIA	Australia
Singapore		New Zealand

Source: World E-Participants (United Nations, 2014)

Integration, communication and interaction: Using information technology allows better integration of functional departments in Government processes, and increases customer satisfaction with service delivery across both traditional and electronic channels. The additional electronic communication channel gives Governments the opportunity to interact with specific groups of users who otherwise may not be reached through conventional communication approaches. However, as M-Government services are typically designed in a way that requires a considerable amount of human-computer interaction (as citizens operate the services), it may be more difficult for staff to perform maintenance and administration tasks.

Reduced costs (fixed and operational): One of the major benefits to Government agencies is the flexibility M-Government allows to enable information storage and presentation. This may lead to far lower operating and maintenance costs, compared to printing all materials. Altering, correcting or updating content can be completed online without incurring costs for re-printing, waste disposal and re-delivery.

Better image and perception: According to research, using online or mobile channels to interact with citizens and engage them in decision making has a positive impact on trust, as well as public perceptions of Government responsiveness. In addition, the use of mobile channels can lead to increased citizen participation, which can in turn make it easier to design and implement policies that lead to better outcomes. Therefore, M-Government services may result in an improved image of Government operations, so political decisions may push forward the adoption of M-Government services to showcase these factors and to create a more positive international image. The summary on Table 2.6 is as an overview of E-Governance solutions for the various

stages of M-Governance as described by Organisation for Economic Cooperation and Development (2011).

Table 2.6 Stages of E-Governance in Developing Countries

Overview e-governance solutions			
	External: G2C	External: G2B	Internal: G2G
Phase Information ●:	Local / Departmental / National information (mission statements and organisational structure Addresses, opening hours, employees, telephone numbers Laws, rules and regulations Petitions Government glossary News	Business information Addresses, opening hours, employees, telephone numbers Laws, rules and regulations	Knowledge base (static intranet) Knowledge management (LAN)
Phase Interaction ●	Downloading forms on websites Submitting forms Online help with filling in forms (permits, birth / death certificates) Intake processes for permits etc. E-mail Newsletters Discussion groups (e-democracy) Polls and questionnaires Personalised web pages Notification	Downloading forms on websites Submitting forms Online help with filling in forms (permits) Intake processes for permits etc. E-mail Notification	E-mail Interactive knowledge databases Complaint handling tools
Phase Transaction ●	License applications / renewals Renewing car tags, vehicle registration Personal accounts (mytax, myfines, mylicenses etc.) Payment of (property) taxes Payment of tickets and fines Paying utility bills Registering and voting online	License applications and renewals via website Payment of taxes Procurement	Inter-governmental transactions
Phase Transformation ●:	Personalised website with integrated personal account for all services	Personalised website with integrated business account for all services	Database integration

Source: Stages of E-Governance in Developing Countries (Backus, 2001)

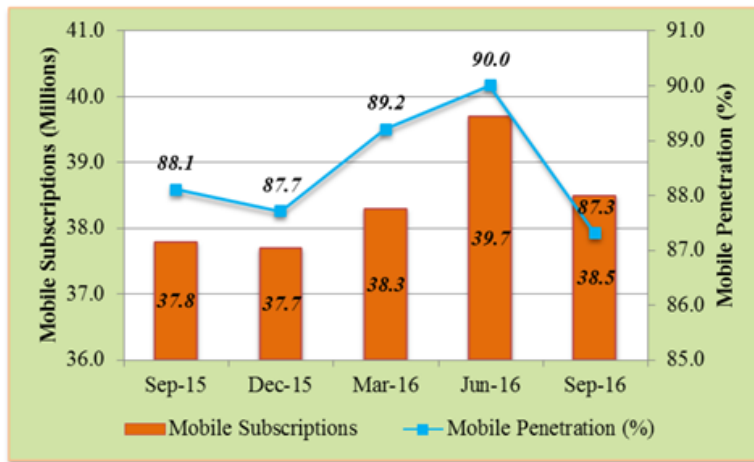
The Government of Kenya recognised the importance of ICT by launching an ambitious three-year (2003-2007) E-Governance strategy that was designed to achieve the following objectives: (1) to efficiently deliver Government information and services to its citizens, (2) to promote productivity among public servants, (3) to encourage participation of citizens in Government and (4) empower all Kenyans in line with development priorities in the 2003-2007 Economic Recovery Strategy for Wealth creation (Kelvin J.,2012). These studies show that M-

Government is a potential game changer that if adopted, can help Governments deliver services effectively to citizens.

2.3 MOBILE PENETRATION IN KENYA

Mobile penetration in Kenya stands at more than 87.3% which accounts for approximately 38.5 million mobile subscriptions as at September 2016 as shown by Figure 2.2. Internet usage registered a decline in the number of subscriptions to 25.6 million from 26.8 million subscriptions, representing a 4.5 per cent drop from the previous quarter. Communications Authority of Kenya (2016). This numbers however, show that there is huge potential in the mobile space. In his paper “The State of E-Government and M-Government Readiness in Malawi”, Belle (2012), notes that although E-government has been adopted in Malawi, M-Government could potentially be utilised to leapfrog E-Governance. This is also an applicable case to Kenya and many other African countries.

Figure 2.2 Kenya Mobile Statistics September 2016



Source: Kenya Mobile Statistics September 2016 (CAK, 2016)

The web for a couple of years now has been an exemplary tool in information dissemination given the large masses of people who browse through to find information and interact with other social circles. Taking into consideration the number of people who use their mobile phones to access the Internet, web applications have become an integral part of mobile telephony. Major uses of mobile phones according to the Kenyan mobile market are as illustrated in the Table 2.7.

Table 2.7 Internet Usage per Activities

Internet use by internet activities in last 6 months, June 2011	
Communicating (Email/social media)	88.1%
Getting information about good and services	19%
Getting information from government organizations, public authorities	18.2%
Reading/downloading electronic books, newspaper or magazine	19.7%
Playing/downloading games	18.3%
Watching movies/TV	14.2%
Getting information related to health/health services	8.3%
Purchasing or ordering goods or services	6.9%
Internet banking	3.2%
Research	33.2%
Other	3.3%

Source: Internet Usage per Activities (CCK, 2011)

As shown from the statistics in Table 2.7, 18.2% of Kenyans are seeking to get Government services online. A show on how excellent Government ICT systems could have a great impact to the citizens.

2.4 CURRENT SYSTEMS IMPLEMENTED IN CDF BURSARY MANAGEMENT

In his research, John (2010), proposes a CDF Bursary management system for Butula Constituency. Further, Focweb (n.d.), have a bursary fund management system. However, they do not state whether this bursary fund management system is applicable to CDF bursaries. There are no known implemented systems for the constituencies within Nairobi. Most applications are manually processed and the final list of qualified applicants input in excel for publishing.

2.5 EMPIRICAL REVIEW OF PAST WORKS IN M-GOVERNANCE

In the Government of Kenya today, E-Governance services have been employed to make service delivery to the citizens easier and more accessible. Such initiatives include the Huduma Centers that were launched by the president through the devolution ministry across various

counties. Through these centres citizens can get vital information and processes rapidly without much bureaucracy that existed in Government offices before. Some of the services offered by the Huduma Centres include national health insurance registration, national social fund registration, driving license application, postal communication services, registration of certificates including birth, death and marriage, police abstracts acquisition, registration of business names among other services.

In the Government's bid to digitise service delivery, the following are some of the successful stories so far; IFMIS: Integrated Financial Management System, IFMS, which helps in consolidation of all financial transactions into one screen. The objective of IFMIS is to automate and integrate PFM systems which facilitate efficient and effective execution of all financial management processes, elimination of risks, and enhancement of security and financial control in all service areas including county units (Mwenesi, 2014). Other Government E-services include; Checking KNEC exams online e.g. KCSE, KCPE etc. Checking identification cards' status online, checking job vacancies online, Filing Kenya Revenue Authority returns online through iTax system and the recent digitisation of the procurement system using Oracle based IFMIS system.

The M-services provided by the Government to enhance service delivery include; Checking Passport Status: Where one can check passport status through mobile phone by creating a new message from their mobile phone typing their passport tracking number and sending to 2030; Checking ID Card Status: One can check ID Card status through mobile phone by creating a new message from their mobile phone typing the first 9 digit of their waiting card and sending to 2031 (Ministry of Information Communications and Technology, 2014).

HealthTrack developed by Pinnacle Relational Database Systems in consultation with the Kenyan Ministry of Health Division of Vaccines and immunisation provides monitoring of vaccine supplies in health clinics to enable better communication and planning in the Division. This therefore ensures citizens have a regular and reliable access to immunisation treatments. HealthTrack allows health workers to retrieve and store data on vaccine stock levels using text messages, (UNDP, 2014). Other examples of works under M-Governance in various countries across the East African Region according to Hellström (2008) are outlined in Table 2.8.

Table 2.8 Various Works Done in M-Governance in East African Region

Financial Services	Utility bill payment (SMS Media, Electrogaz, the national electricity company)	Rwanda	The service is to sell prepaid electricity scratch cards. Using the proven airtime scratch card model, entrepreneurs purchase the prepaid electricity cards in bulk and then sell them throughout Rwanda.	
	Bill payment	Kenya	Bill Payment through the mobile phone if you are a registered Cooperative Bank customer + one must have registered their KPLC account number with the bank.	Although a private company, their services affects many citizens. Also, the company manages the Rural Electrification Programme (REP) on behalf of the Government of Kenya.
	E-bill and SMS Alert (Kenya Power & Lighting Company Ltd)		E-bill is a electronic bill querying service that allows one to check the electricity account balance and bill due date any time by SMS. Type the first part of the account number and send to 5551. SMS Alert is also part of E-bill. It gives the customer disconnection alerts and power outage alerts. Customers will be reminded via SMS to pay their bills two days prior to the due date .(Run by Adtel www.adtel.com) www.kplc.co.ke	
	SMS and Direct Email innovation (HELB, Adtel)	Kenya	The Higher Education Loans Board (HELB), which is mandated to source funds and finance Kenyan students pursuing higher education, have a service where students send an SMS to a shortcode with their ID-number. The sent SMS will query a database and send back name, loan balance and a note thanking them for using the service. www.helb.co.ke	
Crises management	Violence-Prevention Tool (Oxfam GB, PeaceNet)	Kenya	Involved in supporting mobile monitoring and reporting of post election violence. Created text messaging 'nerve centre'; a hub for real-time information about actual and planned attacks between rival ethnic and political groups. The messages were then sent to local Peace Committees for action and response.	The Violence-Prevention Tool and Ushahidi are two good example on how mobile phones provide a good complement to government lead governance by adding the dimension of quick participation and action regarding certain

Source: Works Done in M-Governance in East Africa (Hellström, 2008)

Various continents such as Asia and North America have implemented M-Governance in various capacities as shown in Table 2.10. From the table we can be able to deduce the importance and transformational aspect that is held by mobile technologies.

Table 2.8 M-Governance in Asia and North America

	Applications	Government Agencies	Description
G2C (Government-to-Citizen)	SMS alerting services	Hong Kong	- Text messages to mobile phone users during SARS
	SMS notifications	Singapore	- Provide parking ticket reminders, national service obligations, and passport renewal notification
	Download non-legally binding content	Japan	- Download information on tourism, disaster prevention, and child rearing
IEE (Internal Efficiency and Effectiveness)	M-Police	Korea	- Police officers retrieve information using mobile devices - Print tickets on the spot
	Parking enforcement	Anyang, Korea	- Parking inspectors collect parking lot information using PDAs - Print receipts on the spot
	M-local tax management system	Uijeongbu and Kunsan, Korea	- Allow officers to access tax information on the spot - Transfer the data to the local tax database
	Applications	Government Agencies	Description
G2C (Government-to-Citizen)	Tracking election returns	Commonwealth of Virginia	- Allow individuals to track election returns for statewide races on the election night
	Mobile traffic map	Seattle	- Provide the traffic map - Provide entertainment during slow-moving traffic
	Emergency notification	Federal Aviation Administration (FAA)	- Real-time airport status information via email
	Parking violation reminder	Iowa	- Reminding messages to parking violators via SMS
	Lobbyist-in-a-Box	Commonwealth of Virginia	- Track the progress of bills as they move through the legislative process
	Wireless notification	California	- Notification services through PDAs and cell phones for energy alert, lottery results, traffic updates, and articles from the governor's pressroom
	Wireless state portal	Virginia, Canada	- Make government services available via wireless and mobile devices - Offer a variety of downloadable information, such as emergency weather situation, terrorism threats, legislative information, tax-related information, tourism information, news releases, and so forth.

Source: M-Governance in Asia and North America (Backus, 2001)

2.6 CONCLUSIONS

Drawing a conclusion from the above studies, it is evident that mobile phones are capable of changing how Government interacts with its citizens. If embraced well could lead to more citizen awareness, participation in Government and eventually lead to economic growth that is

inclusive. Further, it is also evident that although there are studies on the challenges of CDF bursary funds, there are no systems/applications currently in place to manage the process of applying CDF Bursary funds in Kenya. Many researchers have studied the effects the fund has in impacting the economy of Kenya by offering an opportunity to the poor in society through the utilisation of CDF bursaries but there has been no clear research on use of technologies to solve the current process shortcomings. This research therefore fills that gap between the need for proper systems and the challenges that are facing the bursary application process.

3 RESEARCH METHODOLOGY

3.1 INTRODUCTION

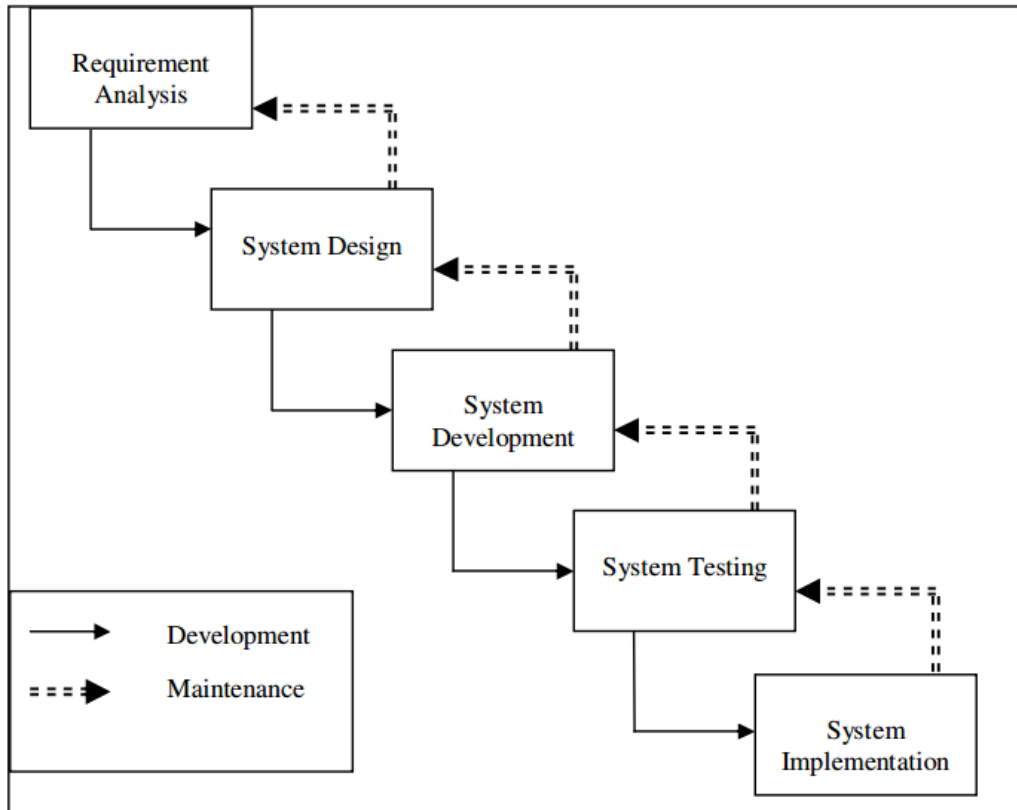
This chapter outlines the methodology that was used to design and implement this research. It also outlines steps that were covered in each phase of the methodology in achieving the objectives of the project. The study explains the use of Advanced Waterfall methodology which is a modified version of the traditional Waterfall methodology. The latter allows for the developer to go back and make changes in the previous phases based on new requirements and improvements to existing features, Despa (2014). This in turn address some of the criticisms of the traditional methodology.

The steps followed in the methodology are discussed below. The decision to follow this methodology was arrived at taking into consideration the strict timelines set out to finish the project and hence the need for a strict methodology that could help me stay focused on achieving the research objectives.

3.2 ADVANCED WATERFALL METHODOLOGY

In his book “Software Essentials: Design and Construction”, Dingle (2014) notes that Waterfall is a classic methodology that is strictly linear and that can be used to implement long projects with limited changes to project phases. He states that although with limitations, Waterfall methodology is capable of achieving great results if the requirements are articulated well at the beginning of the project. This is because Waterfall methodology requires extensive planning before the beginning of the project and often results in better documentation since each phase has milestone and deliverables that are defined.

Figure 3.1 Advanced Waterfall Methodology



Source: Advanced Waterfall Methodology (University of Malaya, 2006)

This methodology has the advantage that a developer can go back to the previous phases when need arises and hence creating flexibility in the development life cycle unlike the traditional Waterfall approach which is very rigid. Fig 3.1 illustrates the Advanced Waterfall methodology.

3.2.1 Requirements Analysis

This was the first phase in the research. In this phase, system requirement analysis was done through research to help understand the features that were incorporated in the system, both functional and non-functional and in determining the environment that was required to achieve what the users required in the system. In order to arrive at this, a pre-implementation questionnaire that contains some open ended questions for users to give their view on the current process as-is was distributed to various groups of users for which Strathmore University will form part of the participants.

The following research instruments were used for the collection of requirements from the users:

Questionnaires: These surveys were administered to both the stakeholders and the end users of the CDF application. A sample questionnaire is presented on **Appendix 1**. Administration of questionnaires was done both online and offline.

Interviews: whereby research questions were administered in order to get a detailed view of how the current system of CDF application works; the challenges facing the current administration of CDF Bursary Fund; research questions were drafted. These questions were then administered to the CDF officials so that a broader perspective of how the current system works was achieved. Sample interview questions are attached in the **Appendix 2**.

Location of Study

Due to proximity and financial constraints, the location of this study was based in Nairobi County. Administration of questionnaires was undertaken in institutions within the county so as to collect as varied opinions as could make a meaningful deduction for this research.

Target Population

The target population for this application was majorly students who apply for CDF bursary and have an android device that can support the application. These students ranged from the ages of 15-27 years. In particular this range was composed of student groups from secondary school students who are looking out for the bursary kits and students in tertiary colleges and universities across the board.

Sample Size

According to the Penn State Eberly College (2015), a sample size can be determined by use of normal distribution on the entire population. The sample that was involved in this study was 96 people drawn from various universities, colleges and secondary schools within Nairobi County. This was based on an estimated average mean of one thousand applicants, (N=1000) for each CDF Bursary application window as established during a visit to one of the constituencies in Nairobi County. This study followed a normal distribution with 95% confidence levels and error margins of 10 and an acceptable rate of 50% as described in the equation below.

$$n = \frac{(z_{\alpha/2})^2 \cdot \hat{p}_g \cdot (1 - \hat{p}_g)}{E^2}$$

Source: Sample Size Calculation Formula (Penn State Eberly College, 2015)

This formula was based on a normal distribution and the variables in the equation were represented as follows:

Population Size = N

Sample size = n

Margin of error = e

Z-score = z

NB: e was percentage, put into decimal form (for example, 3% = 0.03).

Substituting the parameters with values $N = 1000$, $e = 0.1$, $z = 1.96$, $p = 0.5$, $\sim p = 0.5$ results in $n = 96$ correspondents. Out of the 96 correspondents sampled, twenty of the respondents ($n=20$) were administered with online surveys whereas the remaining 76 were administered with printed questionnaires to fill-in. These participants were drawn from three broad categories; college students, university students and secondary school students from selected universities with the following distribution: Strathmore $n=20$, JKUAT $n=31$, Moi University $n=20$, Nairobi Technical Training Institute $n=15$ and randomly sampled high school students, $n=10$. This sample size was used because of the time constraints of travelling to the various institutions to collect the data. Feedback from the correspondents was then analysed using data analysis tool to determine if the objectives under study were weighty.

Data Collection Procedure

Data used to determine the feasibility of this study was collected in the following three ways:

Personal visits to conduct interviews with the CDF officials. This included notes-taking amid observations of how various processes were being carried out within the CDF office and the interactions and relationships between CDF officials and the applicants. Afterwards, conclusions were made based on the feedback, observations and findings acquired.

Online survey administration for the users who have access to the Internet. User feedback was collected using online spreadsheets (**Refer to Appendix 2**) and visual aids were used to present the feedback.

Administration of printed questionnaires. This was particularly the most important data collection technique not only to the younger students at secondary schools who did not have access to the Internet yet formed a good portion of the end users of the application but yet the most convenient for majority of the respondents (**Refer to Appendix 1**).

3.2.2 System Design

After the requirements analysis phase, the system design phase followed. In this phase, requirements of the project were translated into detailed design. The design discussed in this chapter incorporated an element of agility as existing applications were used to generate the Unified Modeling Language (UML) diagrams and system architectural designs that were implemented (Schardt, 2011). Special acknowledgements to design tools such as draw.io (Draw IO, 2016) that were very resourceful in implementing this phase. Other design tools used included Microsoft Visio (Microsoft, 2017) as recommended by Schardt (2011) and ArgoUML (Tigris.org, 2017). For the web designs, Pencil was used to draw the wireframes (Pencil, 2017). The following design diagrams were used to further describe the various aspects of the project:

Use Case Diagrams

In order to model the dynamic system behaviors, use case diagram was used (Tutorials Point, 2017). The actors within the system were the users and CDF officials.

Class Diagrams

To show the classes of the system, their interrelationships, operations and attributes of the classes, the UML Class diagrams was used (Ambysoft Inc, 2017). The class diagram described objects in the system, their attributes or characteristics and their behavior or functions. It also described how these objects related to each other and with what cardinality value.

Data Flow Diagrams

In order to model the flow of the various processes in the CDF application, data flow diagrams were used to present the process aspects graphically (SmartDraw LLC, 2017).

Activity Diagrams

Activity diagram is a type of flow chart that represents the flow from one activity to another. These activities were described as operations of the system (Tutorials Point, 2017).

Entity Relation Diagrams

The entity relation diagram of the application described various entities and their attributes that the system has and how they related together with their cardinalities. That is, the number of instance one entity has against the other (SmartDraw LLC, 2017)

3.2.3 System Development

This followed the object-oriented methodology as code was implemented in both Java/Android and PHP frameworks. The implementation of this project involved creating the following components and integrating them:

- i. Android application: This is the mobile application that formed part of the application that CDF beneficiaries interact with. It was based on android platform which is open source with a lot of code documentation for guidelines that made it easy to quickly customise code and develop a prototype rapidly.
- ii. Web application (formed the backend for the android application); this is the application that is updated so that data is picked up on the mobile application. The mobile application interacts with the back end via web service JSON (IBM, 2017). This application interacts and updates the database real time. The CMS framework used to build this web application was based on CodeIgnitor (CodeIgniter, 2017).
- iii. Database; the database used to store data from the web application and the mobile application was MySQL. Selection of this particular database was because MySQL is highly compatible with many PHP frameworks and it is open source (Oracle, 2017).

The following application modules were implemented:

- i. Applications module; module used by CDF beneficiaries who want to initiate the process of applying for the bursary fund.
- ii. User management module; module used by the CDF officials to manage the users in the system
- iii. Disbursements module; module used to monitor the disbursement made to the beneficiaries. Reports from this module are a good source of information for non-CDF stakeholders who want to keep track of how the funds are utilised.

3.2.4 System Testing and Implementation

The complete system was tested based on the functional and nonfunctional requirements. Each components of the coded system was tested separately to ensure there are no errors even at component integration level. This involved 5 technical people and 15 end users. The testing log included information on the program, tested item and expected action or value and remark criteria.. The number of users selected for testing the application was based on both technical

knowledge of programming, willingness to install the prototype application, knowledge of the research subject and availability.

In this research the testing was done based on the actual data to determine the system's performance in the real life-working environment. Test reports from this phase were documented and maintained. Implementation was based on CDF Bursary fund management in Kenyan context.

The following types of tests were performed:

Unit testing – This involved testing each module separately as it was being coded.

Integration testing – After each module had been coded and tested to be working properly, the modules were integrated and the final integrated system was subjected to testing.

Functional testing – This involved testing each system functionality as determined during requirements analysis to ensure the system was working properly and that user requirements were achieved.

Usability testing - Usability testing was performed by the users, to evaluate if the graphical user interface was user-friendly and to determine how easy it was for the users to learn the system. This was achieved by use of a questionnaire that was administered to the users. Refer to Appendix 3 for the questionnaire.

Acceptance testing – During usability testing, questions on how well the application satisfied the needs of the users and their continued willingness to use the application were incorporated.

Compatibility testing – In order to determine that the application was not prone to crashing as users made use it, a compatibility test was performed. This was to ensure that users with devices running on different android versions and different device sizes do not have challenges when using the application. Also, for the back end, tests were performed to ensure that the system was compatible with all the browsers.

3.2.5 Validation

In order to validate the results of the application and that the requirements of the application had been met, a validation questionnaire was created and distributed to 20 users using Google Forms. Refer to **Appendix 4**. This was due to time constraints, availability of the correspondents and willingness to take part in the test. These users interacted with the application and provided feedback which was collected on Google Spreadsheets. The collected feedback was then analysed and presented on charts.

3.3 CONCLUSIONS

In conclusion, the research methodology that was used ensured the research questions were well answered by ensuring that the design methods used best demonstrated how the end application would be achieved.

4 REQUIREMENTS ANALYSIS

4.1 INTRODUCTION

As discussed in the previous chapter, and in order to establish the requirements for the system, some research questionnaires were issued to selected categories of users. This chapter will discuss widely data analysis based on the data collected from questionnaires that were issued during the research. Further, the analysis deductions will be used in the system design of various components of the system to realise the architecture of the solution in discussion. Presentation of the research findings are motivated by factors such as the need to build a knowledge base about the challenges faced by people applying for CDF bursary funds and to satisfy if there is enough demand for a technological solution to resolve the current problem.

4.2 REQUIREMENTS ANALYSIS

According to Spence (2004), system requirements can be divided into two major categories: Functional and non-functional requirements. Functional requirements define the behavior of a system while non-functional requirements define constraints or benchmarks for which the system must conform regarding the security, performance, reliability among other factors. This is to say that non-functional requirements cannot exist without the functional requirements. The function requirements include the various components (modules) of the system that must perform that which they are supposed to without fail. For JazaCDF Application, the functional requirements can be categorised based on the users who interact with the system as described below:

i. **CDF Officials**

These officials are charged with the task of updating CDF bursaries as they become available. They also handle updating of user details with regards to the applications submitted, disbursements allocated and to send out SMS notifications to successful applicants. These officials only get to interact with the web portal where they login to post any new information that needs to reach the end users. Factors such as integrity, security, reliability, tolerance etc. must be achieved in this portal. An audit trail module was also in place the purposes of continuous monitoring of the officials' interactions with the system. This is as a result of requirements during data analysis in the previous chapter, where users claim that there is lack of

integrity and corruption from the officials, something that can be managed from the portal since it is able to capture who received the application and who granted the bursary in some kind of maker and checker scenario.

ii. End Users

These users interact with the mobile application and use it to make applications and request for status updates. These users also supply their details to the JazaCDF database. A user creates an account, then starts on the process of applying for the fund or checking the status of their application through SMS based queries from the application. From the non-functional requirements point of view, system reliability shall be key, security of the data transmitted across the various platforms and the data integrity as the data moves across the platforms to ensure that it does not change while on transit.

4.3 ANALYSIS BASED ON RESEARCH QUESTIONNAIRES

Data Analysis is the process of systematically applying statistical and/or logical techniques to describe and illustrate, condense and recap, and evaluate data. It is the process of applying mathematical formulae to make deductions from findings obtained during research process. These deductions must be in line with the intended objectives of the research. The techniques used in seeking respondents' answers included online questionnaires and printed questionnaires and in some cases direct talks with the beneficiaries of the bursary fund.

4.3.1 Response Rate

Questionnaires were distributed to ninety six users in various categories and from various universities and college institutions. Ten (10) of the surveys were administered to high school students but only one was returned rendering 9 of the questionnaires unusable. A link to the online survey was sent to twenty (20) students in Strathmore University. Sixteen (16) out of the twenty (20) yielded responses. The remaining seventy (70) questionnaires were administered in printed copy to two universities, JKUAT and Moi and one tertiary college, Nairobi Technical Training Institute. The response rate from JKUAT was 25 while that of Moi University was 15 and that of Nairobi Technical Training Institute was 14.

4.3.2 Respondents' Responses

i. Age

The age gap for the correspondents ranged from 16 years to above 40 years distributed as shown in Table 4.1.

Table
Age

4.1

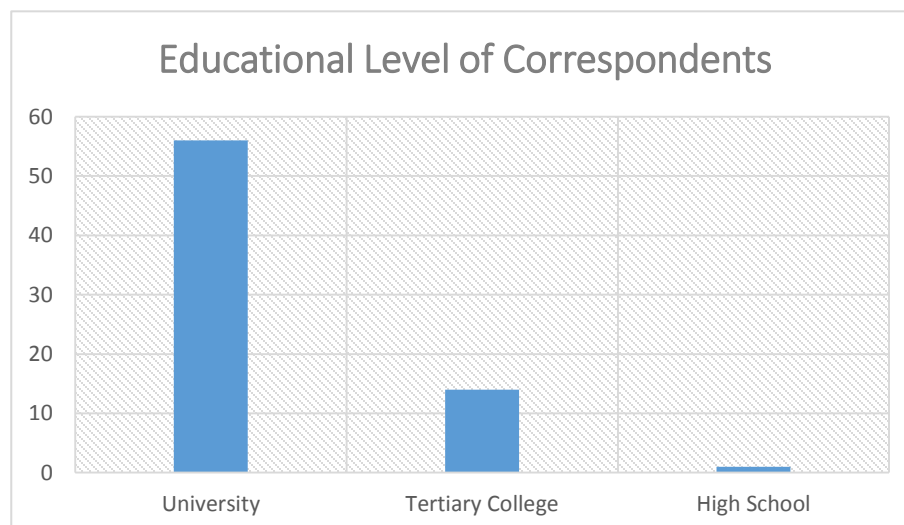
Range in Years	Number of Correspondents
16-18	1
19-24	55
25-30	14
31-35	0
36-40	0
Above 40	1

Distribution of Respondents

ii. Education level

Correspondents' education level was distributed as shown in Figure 4.2. 56 out of the 71 responses were provided by university students, 14 of the responses were provided by students in a tertiary college and 1 respondent was a high school student.

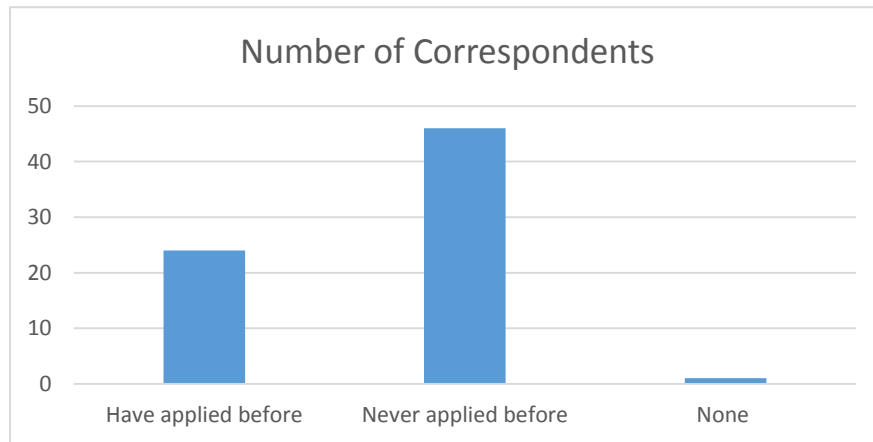
Figure 4.1 Educational Level of Correspondents



iii. Applied for CDF Bursary

The number of people who had applied for the bursary fund at a given point and took part in the survey is shown on Figure 4.3.

Figure 4.2 Distribution of Applicants Who Have Applied for Bursary



iv. Willingness to Make CDF Bursary Application

For the correspondents that said they had never applied for the fund, 24 correspondents (52%) show willingness to make an application if they're given the chance. However, 4% were not decided as to whether they would apply for the fund; a further 4% don't say anything about making an application or helping someone else make the application. 40% of the correspondents were however not interested in making the application. They attribute this to the long process incurred during the entire process, corruption and favoritism with the CDF officials, the need for signatures from the chiefs and finally the fact that they don't have knowledge of the process and criteria used to award bursaries to the beneficiaries. They also dislike the current application process.

v. Make Use of a Mobile Application

100% of the correspondents who had applied for the bursary before said that they would welcome a mobile application to help them in reducing the long procedures involved in the application process. For those who said they had never applied for bursary funds, 40% say if they

were given an application detailing the process of applying, they are willing to try the application process.

vi. Most Preferred Type of Application Beside Mobile Application

80% of the correspondents feel that beside the mobile application, there should be a web version of the application.

4.4 CONCLUSIONS

The responses received were positive in determining if building the application was a viable idea. It also helped understand the challenges facing the current system where forms are issued on the basis of nepotism and “clanism”. It was evident that a mobile application alone would not be sufficient to serve everyone’s need as majority of the respondents wanted the mobile application to be complemented with a complementary web application.

5 SYSTEM DESIGN

5.1 INTRODUCTION

In this topic, after analysing data collected from the field and deducing conclusions based on what the users want, an architectural overlay of the systems to be implemented was presented. The architectural design implemented took into consideration two sets of users of the system, the CDF officials who are the custodians of the data to be disseminated and the bursary applicants who are the end receivers of the information. The designs presented in this chapter follow the standard UML procedures for object oriented design. Various UML diagrams shall be discussed, elaborated and presented to show how various functional and non-functional requirements of the applications were implemented. The two broad categories to be modelled in this chapter include the database and user interface.

5.2 GENERAL OVERVIEW OF THE SYSTEM

The general overview of the system follows the illustration on Figure 5.1. This is an improvement of the as-is process in CDF bursary applications procedures where opening of the application window is advertised on the CDF office notice boards for interested candidates to apply. Once submission is done, the applicants have to wait for an uncertain length of time before they can get feedback. Figure 5.1 demonstrates the general framework for JazaCDF application.

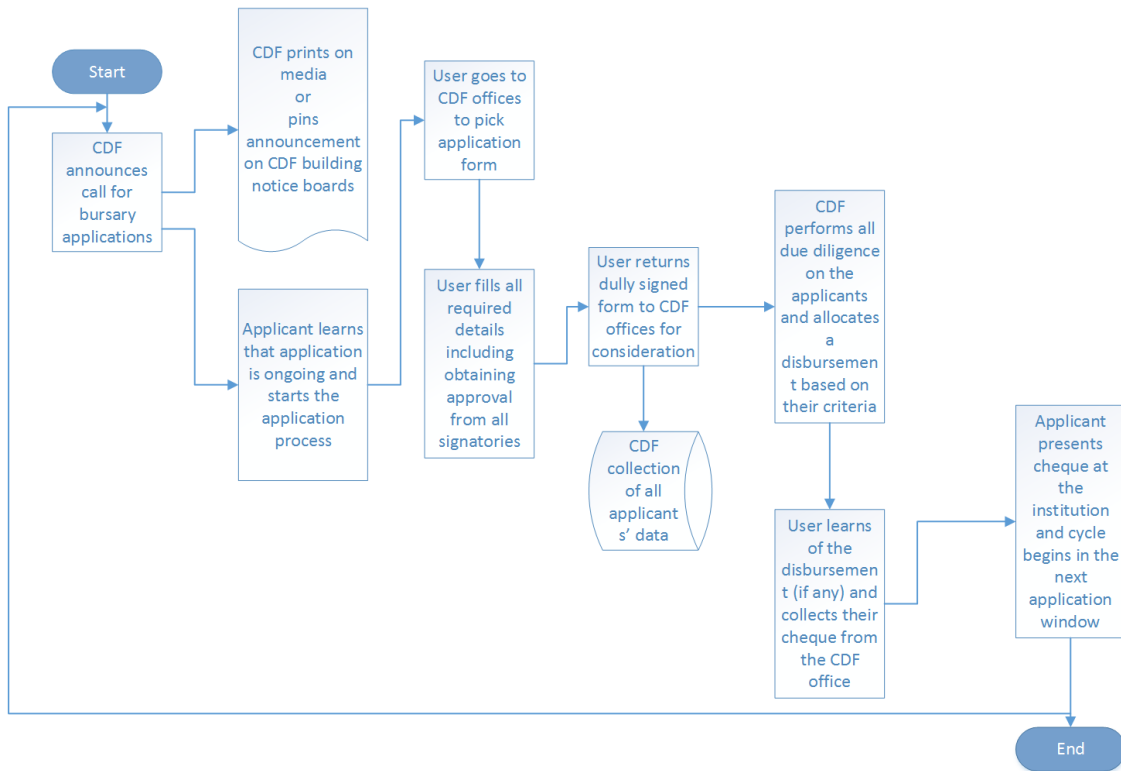


Figure 5.1 Current CDF Bursary Application Process

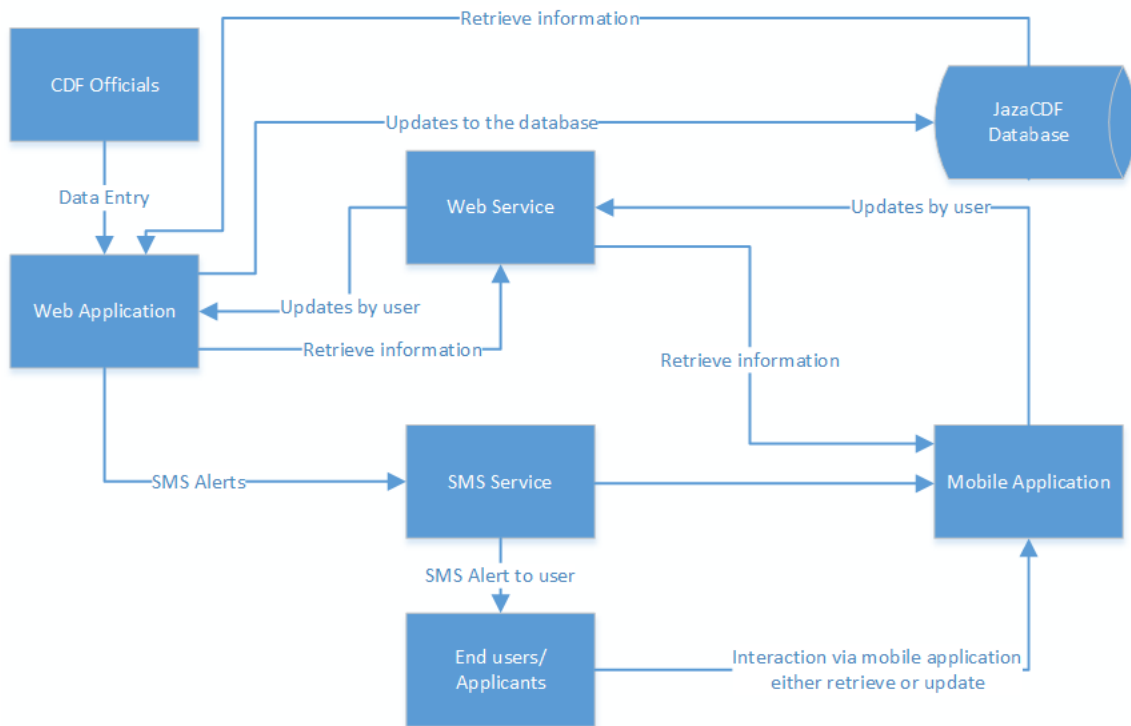


Figure 5.2 General System Framework for JazaCDF

This architecture is based on client-server architecture with two main modules, web application and mobile application. The Web module has interface for updating applicant's details, disbursements and status updates. The Mobile module provides the interface for requesting status updates and initiating a new application. Both modules are connected to the database. Every request of data from either the client or the server shall be retrieved from the database. Also, every data that is sent from either the client or the server shall be stored in the database. Interaction between the mobile interface and the database shall be done through a web service.

5.3 DATA AND PROCESS MODELLING

A process model describes business processes i.e. the activities that people do. Process models are developed for the as-is system and/or the to-be system. This section describes data flow diagramming, one of the most commonly used process modeling techniques. This follows design of various UML diagrams with the actors of the JazaCDF application including the CDF officials and the student users who make the application.

5.4 DATA FLOW DIAGRAMS

5.4.1 Context Diagram

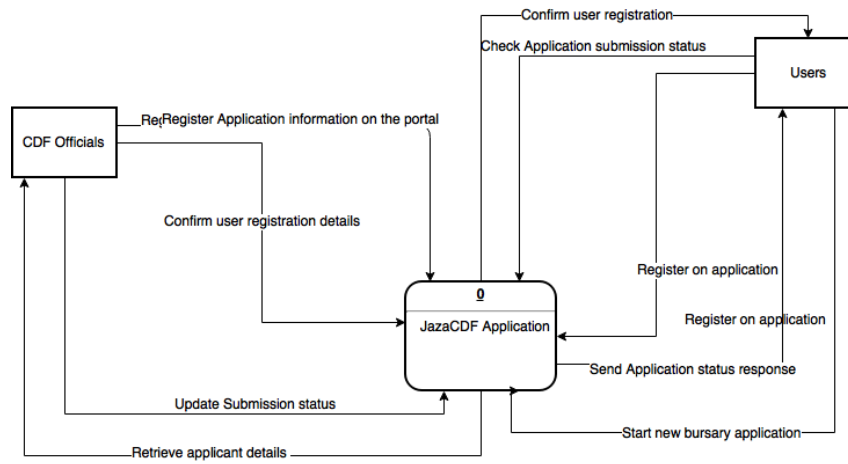


Figure 5.3 Context Diagram

5.4.2 Level 0 DFD

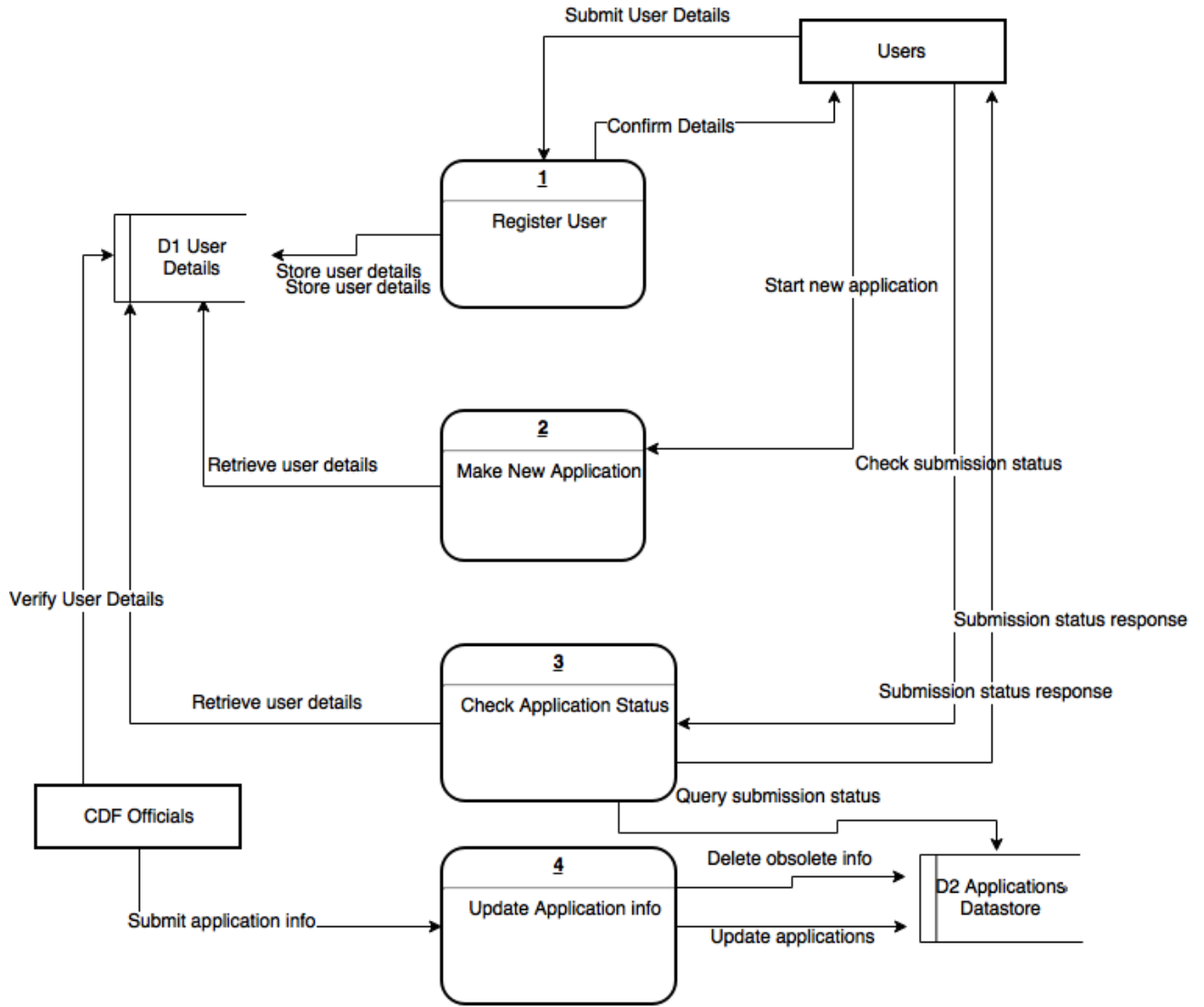


Figure 5.4 DFD Level 0

5.4.3 Level 1 DFD

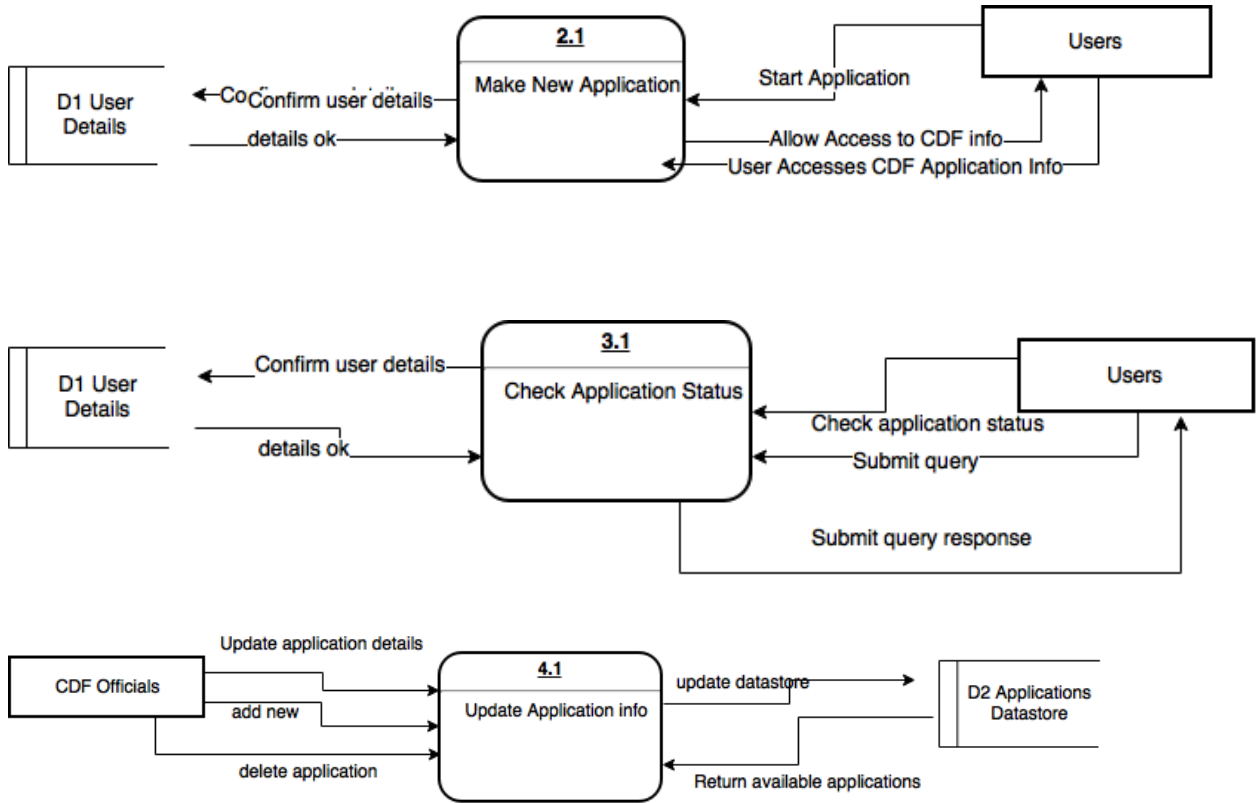


Figure 5.5 DFD Diagrams Level 1

5.5 USE CASE DIAGRAM

Actors

Below is a list of actors who will interact with the system:

- i. **CDF Official** – this is a person who is in charge of managing all web portal content including updating disbursement data.
- ii. **User** – a user is a person who has the access to make applications and query for their status updates.

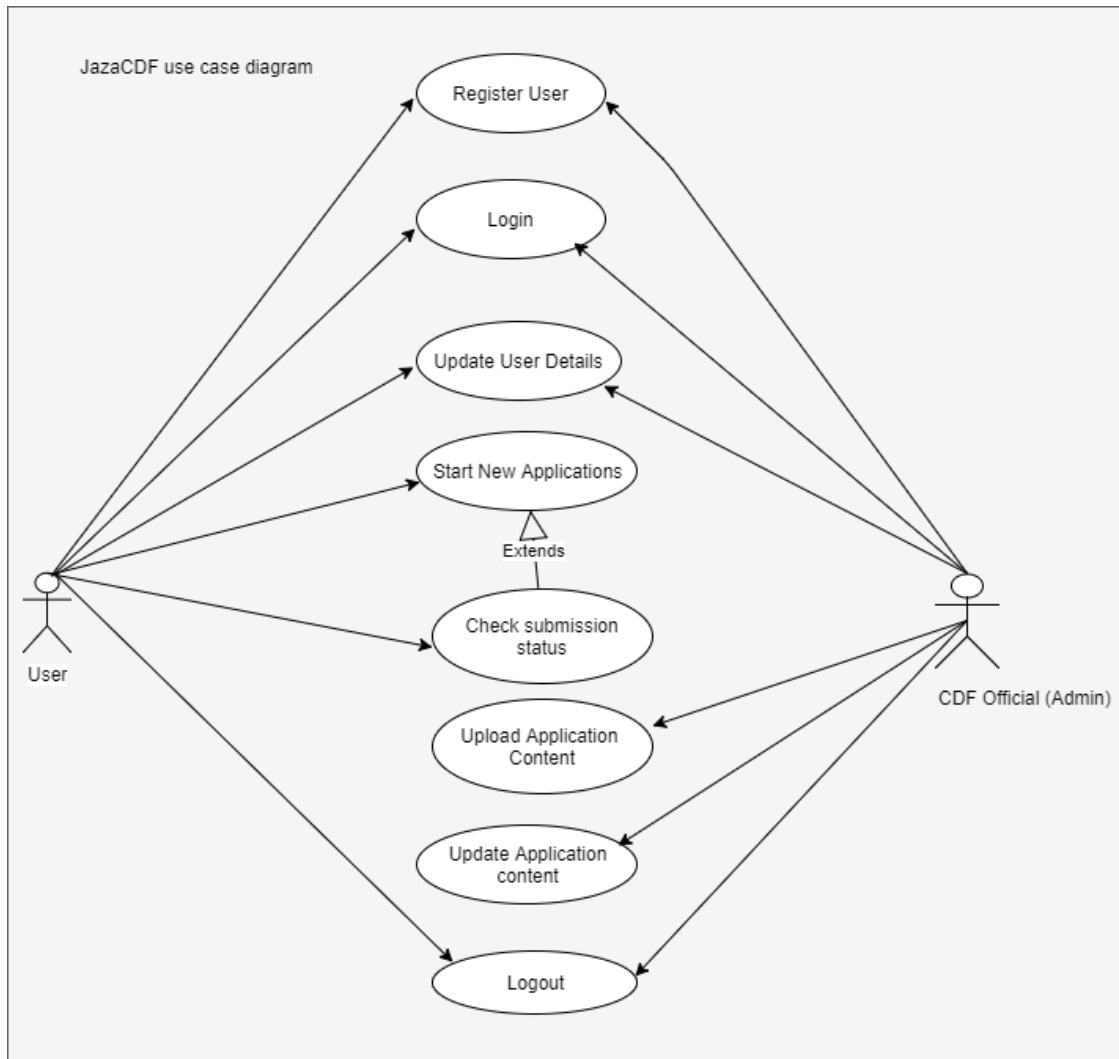


Figure 5.6 Use Case Diagram

5.6 ACTIVITY DIAGRAM

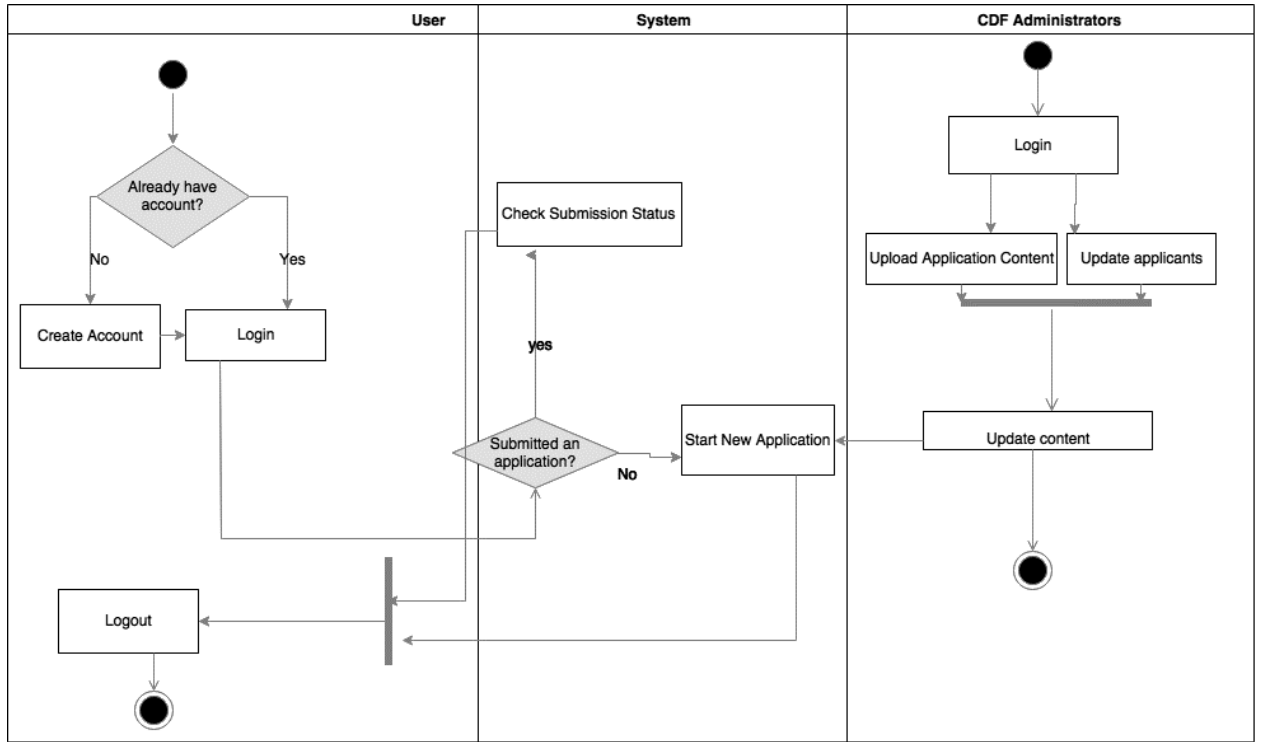


Figure 5.7 Activity Diagram

From Fig 5.7, a user can create an account or login. Once they have access to the system they can submit an application if they haven't submitted one or check the status of their application by querying via SMS. On the other hand, a CDF official will login into the system and update content and the disbursements allocated to a user.

5.7 CLASS DIAGRAM

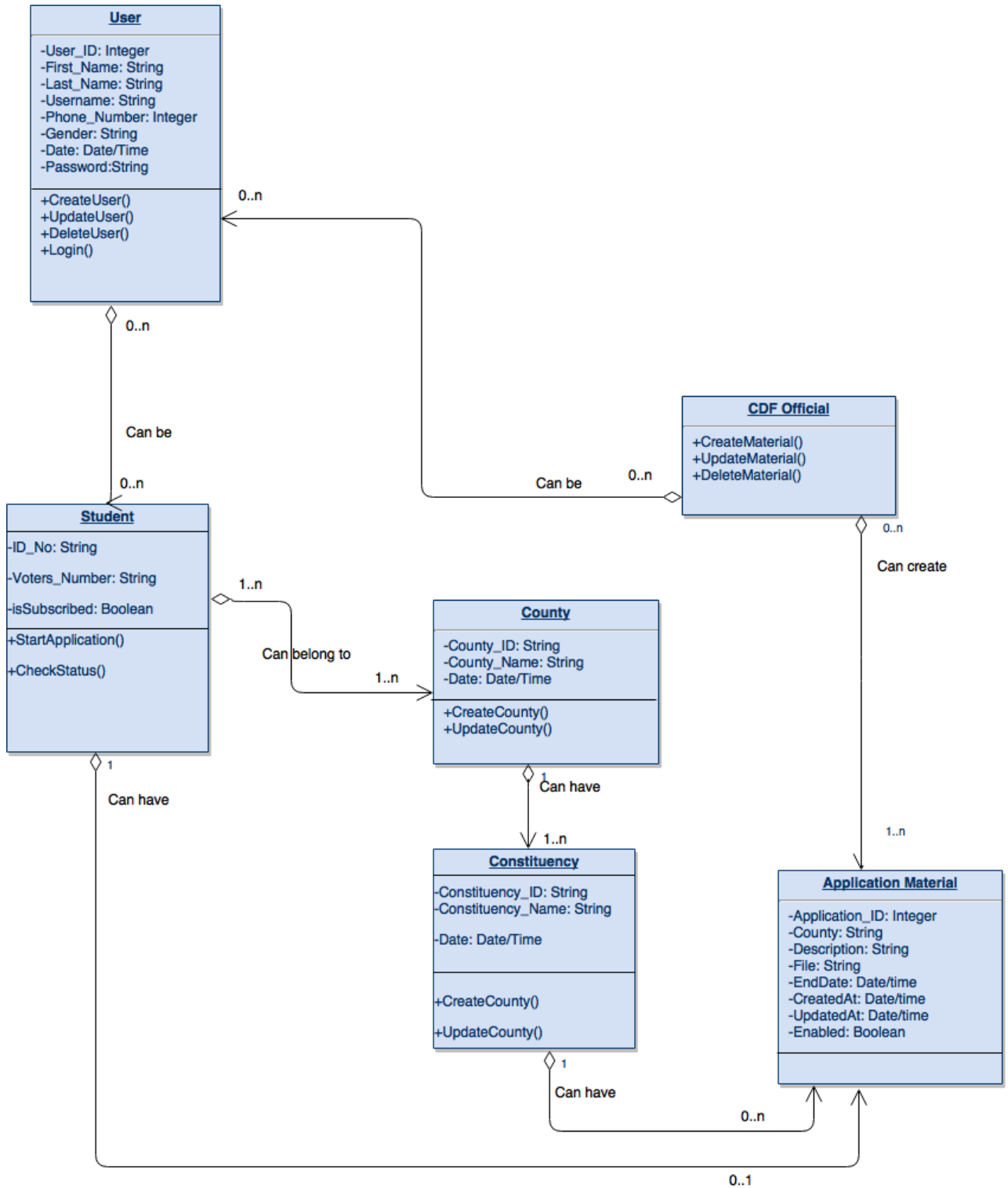


Figure 5.8 Class Diagram

5.8 DATABASE SCHEMA

Members Table

Table 5.1 shows the Members table that is used for recording the applicants who have registered in the JazaCDF application. The table has the memberID as a primary key.

Column	Type	Null	Default	Index
memberID	int(11)	No		Primary Key
firstname	varchar(256)	No		
lastname	varchar(256)	No		
cellphone	varchar(256)	No		
email	varchar(256)	No		
gender	varchar(256)	No		
admission_number	varchar(256)	Yes		
Id_no	int(11)	Yes	NULL	
Voters_number	int(11)	Yes	NULL	
subscribe	int(11)	No		
password	varchar(256)	Yes		
created_by	int(11)	Yes	NULL	
modified_by	int(11)	Yes	NULL	
created_on	int(11)	Yes	NULL	
modified_on	int(11)	Yes	NULL	

Table 5.1 Members Table

Applications Table

Table 5.2 describes the Applications table that is used for recording information about an applicant's application for each application window. This table is related to the Members table since an application is initiated by a member. ApplicationID is the primary key while MemberID is a foreign key.

Column	Type	Null	Default	Index
applicationID	int(11)	No		Primary Key
memberID	int(11)	No		Foreign Key
date	int(11)	No	Null	

institution	varchar(256)	No		
status	varchar(256)	No		
created_by	int(11)	Yes	NULL	
modified_by	int(11)	Yes	NULL	
created_on	int(11)	Yes	NULL	
modified_on	int(11)	Yes	NULL	

Table 5.2 Applications Table

Counties Table

This table records all the counties and constituencies with application window open. It is this table where application forms are loaded when CDF officials update. The table has the applicationID as the primary key and the constituency as a foreign key from Constituencies table.

Column	Type	Null	Default	Index
countyID	int(11)	No		Primary Key
name	varchar(256)	No		
file	varchar(256)	No		
description	text	No		
created_by	int(11)	Yes	NULL	
modified_by	int(11)	Yes	NULL	
created_on	int(11)	Yes	NULL	
modified_on	int(11)	Yes	NULL	

Table 5.3 Counties Table

Constituencies Table

This table is used to add a constituency to the JazaCDF backend.

Column	Type	Null	Default	Index
constituencyID	int(11)	No		Primary Key
countyID	int(11)	No		Foreign Key
name	varchar(256)	No		
description	varchar(256)	No		
created_by	int(11)	Yes	NULL	

modified_by	int(11)	Yes	NULL	
created_on	int(11)	Yes	NULL	
modified_on	int(11)	Yes	NULL	

Table 5.4 Constituencies Table

Shortlists Table

All shortlisted candidates that have been allocated a disbursement will be recorded on this table. The table has foreign keys from the members and applications tables.

Column	Type	Null	Default	Index
shortlistID	int(11)	No		Primary Key
memberID	int(11)	No		Foreign Key
application_status	varchar(256)	No		
amount_allocated	varchar(256)	No		
description	text	No		
created_by	int(11)	Yes	NULL	
modified_by	int(11)	Yes	NULL	
created_on	int(11)	Yes	NULL	
modified_on	int(11)	Yes	NULL	

Table 5.5 Shortlisted Applicants Table

5.9 ERD DIAGRAM

According to Lucidchart.com (2016), an Entity Relationship Diagram (ERD) is a data modeling technique that creates an illustration of an information system's entities and the relationships between those entities. The contents of an ERD Diagram are based on the following:

- **Entities**, which represent people, places, items, events, or concepts.
- **Attributes**, which represent properties or descriptive qualities of an entity. These are also known as data elements.
- **Relationships**, which represent the link between different entities.

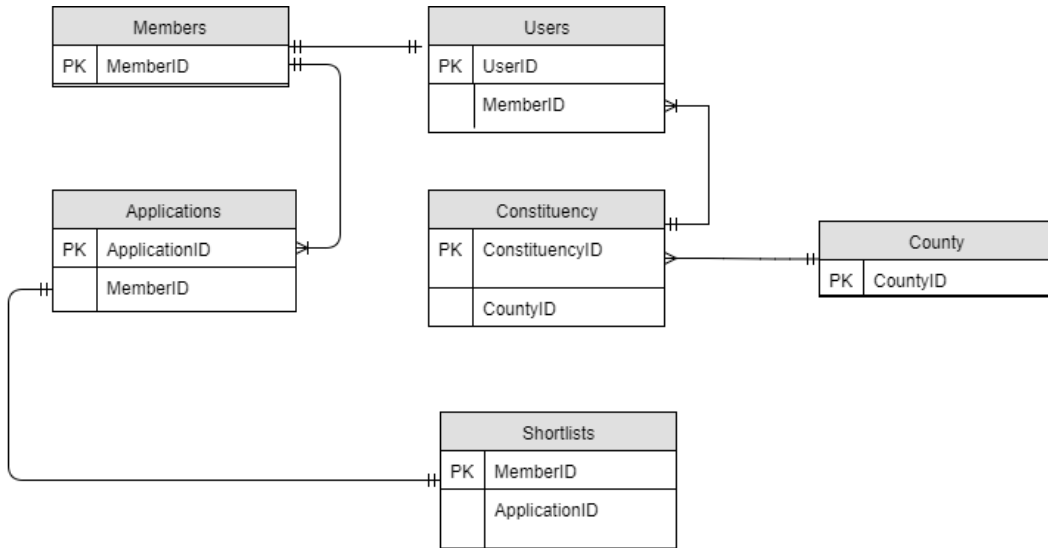


Figure 5.9 ERD Diagram

From Figure 5.9, a student can only make one application or check status for one application at a time. However, CDF officials may update several applications on the portal. Also, in a county, we can have several constituencies which can have the same application material.

5.10 WEB APPLICATION WIREFRAMES

Dashboard

The dashboard in Figure 5.10 will contain a snapshot of the recent activities within the system since it is the landing page for the backend. It will show recent registered members and recent applications received. From the dashboard one should be able to access all other modules

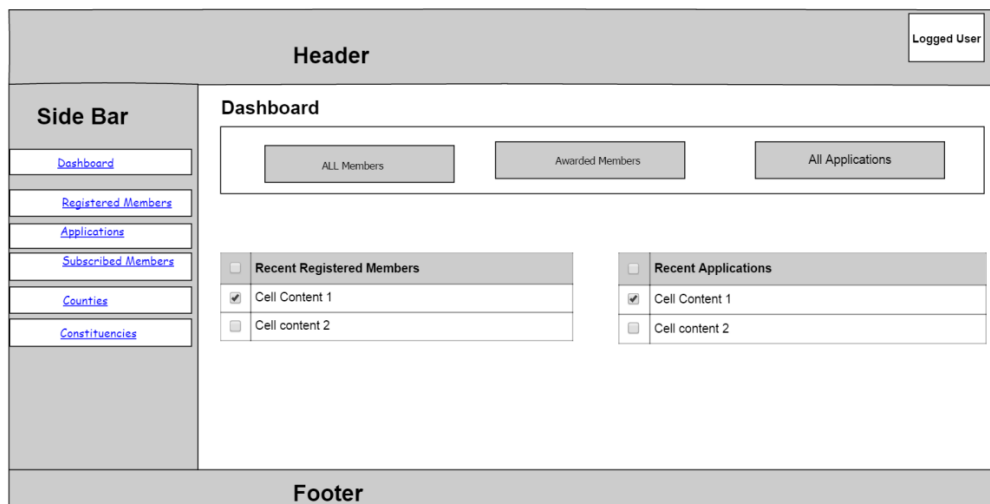


Figure 5.10 Dashboard Wireframe

Registered Members Page

As shown in Figure 5.11, this page will list all the applicants (referred to as members). It is on this interface that CDF officials will have an opportunity to amend any details that had been captured incorrectly by the applicants.

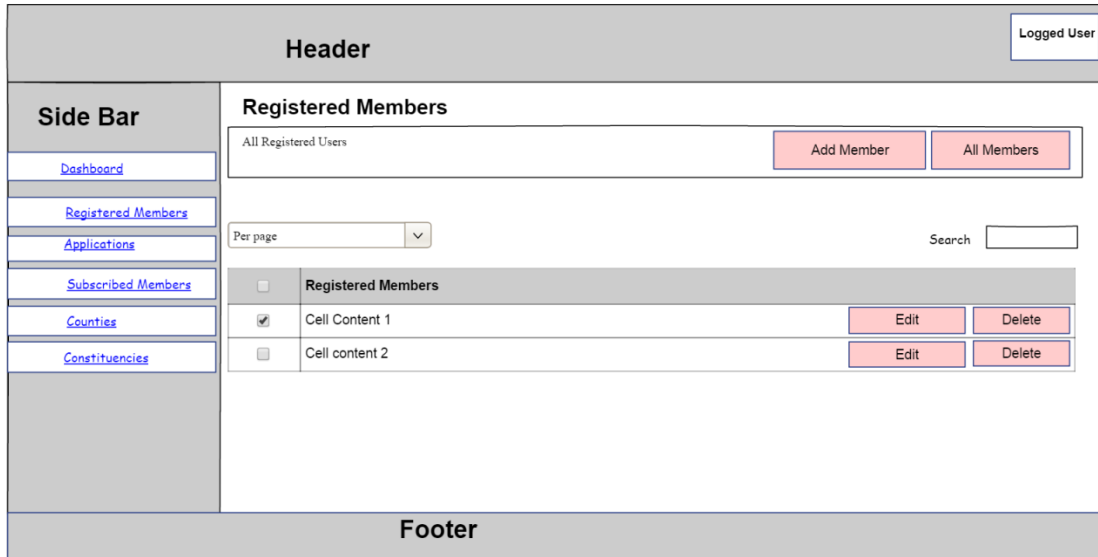


Figure 5.11 Registered Members' Wireframe

All Applications Page

As shown in Figure 5.12, this page will list all the submitted applications. Any applications that were not initiated from the mobile application can be captured by the CDF officials by clicking on "Add Application"

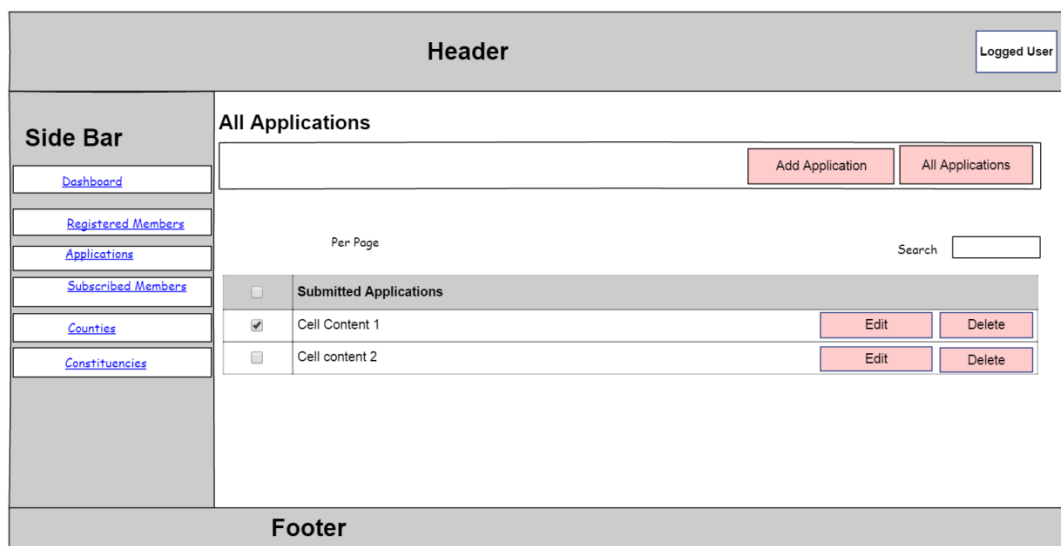
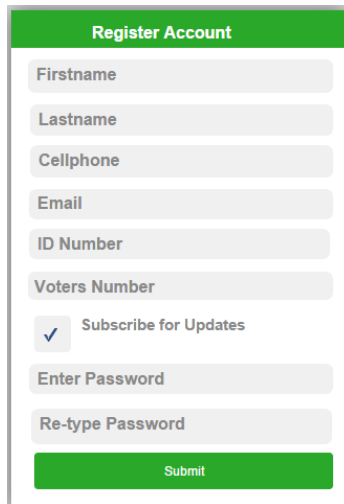


Figure 5.12 Applications Wireframe

5.11 MOBILE APPLICATION WIREFRAMES

Register Wireframe

As shown in Figure 5.13, the register wireframe will be used to capture all relevant details about the applicant. The information captured in this form is part of the mandatory data required evaluation by CDF officials.

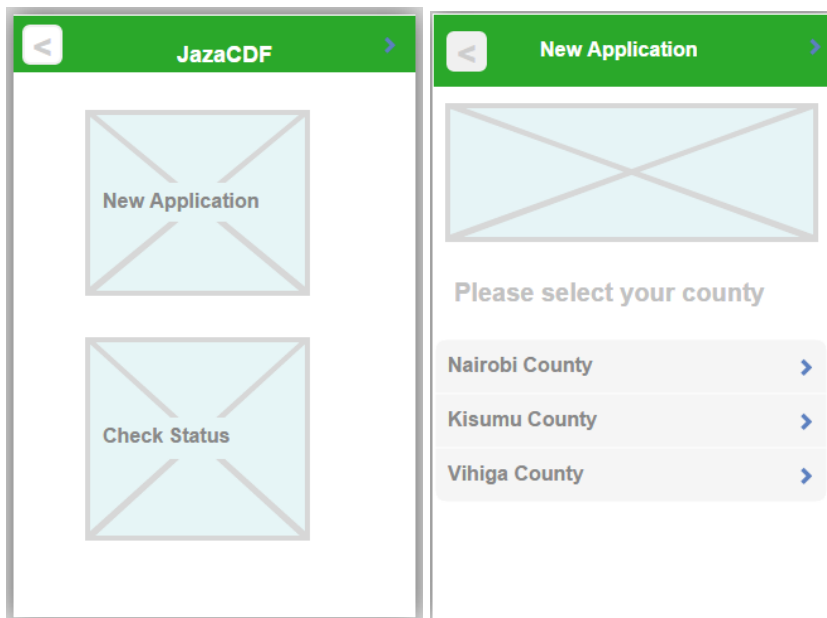


The wireframe for the 'Register Account' page features a green header with the title 'Register Account'. Below the header, there are seven input fields: 'Firstname', 'Lastname', 'Cellphone', 'Email', 'ID Number', 'Voters Number', and 'Enter Password'. A checkbox labeled 'Subscribe for Updates' is checked. Below the password fields is a 'Re-type Password' field. At the bottom is a green 'Submit' button.

Figure 5.13 Registration Wireframe

Homepage and Start New Application Page

As shown in Figure 5.14, the landing page has buttons for either starting a new application or requesting for the status for their already submitted application.



The figure shows two mobile application wireframes side-by-side. The left wireframe is the 'JazaCDF' landing page, with a green header and two large buttons: 'New Application' and 'Check Status'. The right wireframe is the 'New Application' page, also with a green header, a placeholder image, and a list of counties: 'Nairobi County', 'Kisumu County', and 'Vihiga County', each with a right-pointing arrow.

Figure 5.14 Landing Page and Application Page Wireframes

Check Status

Figure 5.15 shows the screen that queries the status of the application once an applicant has submitted an application for consideration.

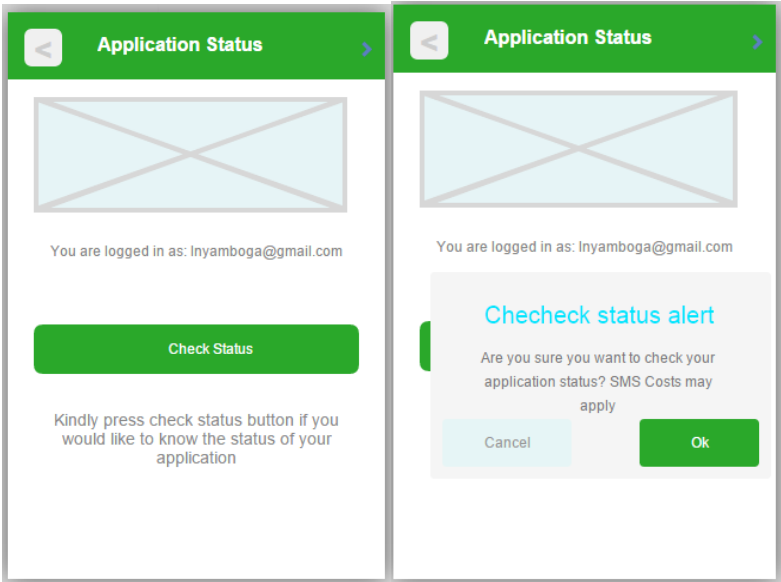


Figure 5.15 Check Status Wireframes

6 SYSTEM DEVELOPMENT

6.1 INTRODUCTION

This chapter describes how the designs presented in the previous chapter were implemented to realise a working system. In this chapter we shall describe the mobile and web environments that were used to achieved the system as well as the database.

6.2 DATABASE

MySQL database management system was used to store application data for web application. The mobile application also interacted with the database via the web application.

6.3 MOBILE APPLICATION

The mobile application was implemented on the Android operating system. The source code was written in Java, utilising Android classes. The application was compiled and tested using the Android Software Development Kit (SDK) emulator and Infinix smartphone. The application is optimised for Android version 5.1 (API 18) that allows compatibility with higher versions. JSON was used as the web service that provides the interface between the Android application and the database.

6.4 WEB APPLICATION

The web application was built using CodeIgnitor content management systems (CMS) written in PHP5. The website is hosted on an online Apache HTTP server. The web application for which CDF officials interact with the system entailed the functionalities such as; capabilities to capture new users in the system as well as view already registered members, upload of bursary application forms, and allocation of disbursements for qualified candidates and extraction of required reports.

6.5 IMPLEMENTED SYSTEM COMPONENTS

6.5.1 Web Application

Dashboard

Once a CDF official is authenticated to the system, they land on the dashboard. On this page the user is able to see the most recent activities that have taken place in the system. Figure 6.1 shows a screenshot of the dashboard.

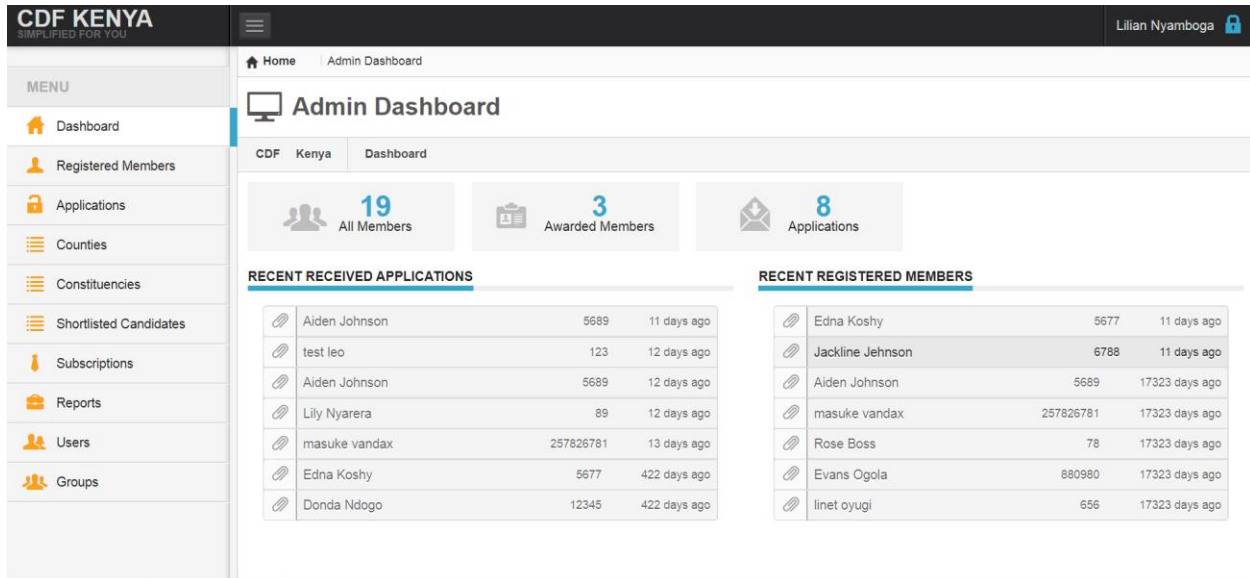


Figure 6.1 Dashboard

Registered Members' Screen

CDF officials will be able to see all members registered on the application. They can be able to amend the details of the registered members. This members can be registered directly from the mobile application or through the back end by being signed up by a CDF official. Figure 6.2 is a screenshot showing the registered members' page.

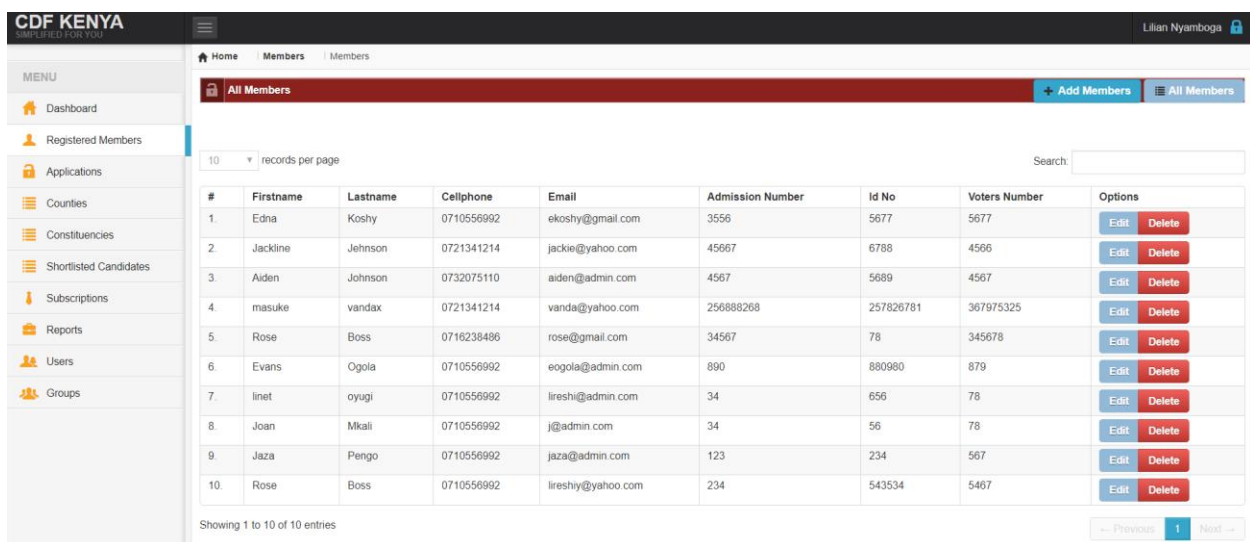


Figure 6.2 Registered Members

Submitted Applications

Once a user completes an application process, their details are captured in the ‘Applications’ screen as shown on Figure 6.3. Users captured on this screen are the ones whose application has been received by a CDF official.

#	Member Name	Admission Number	Id No	Institution	Status	Date of Submission	Options
1.	Aiden Johnson	4567	5689	Strathmore University	Orphan	1495832400	Edit Delete
2.	test leo	123	123	Strathmore University	Arid Areas	1494968400	Edit Delete
3.	Aiden Johnson	4567	5689	UONBI	Both Parents	1495573200	Edit Delete
4.	Lily Nyarera	56676	89	NTTI	Orphan	1493672400	Edit Delete
5.	masuke vandax	256888268	257826781	Kariobangi High	Single Parent	1493758800	Edit Delete
6.	Edna Koshy	3556	5677	NTTI	Both Parents	0	Edit Delete
7.	Donda Ndogo	123344	12345	KCA	Orphan	1459717200	Edit Delete
8.	Liresh Nyamboga	123hh	12345	JKUAT	Single Parent	1459458000	Edit Delete

Figure 6.3 Submitted Applications

Shortlisted Members

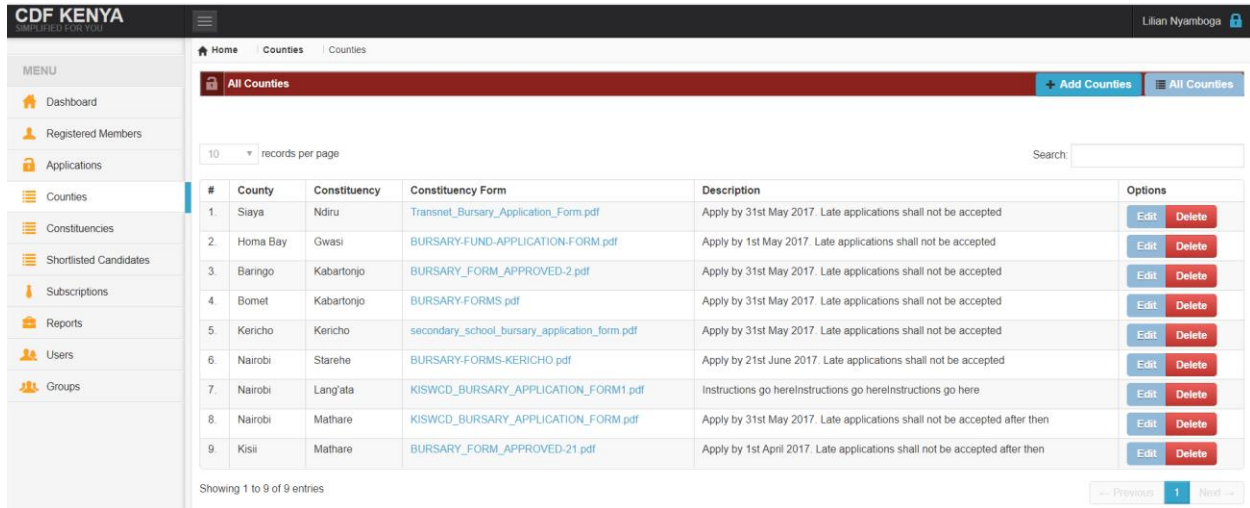
All applicants who submitted an application and qualify to receive a disbursement will be listed on the screen shown on Figure 6.4 with their status updated. Update of this screen is done by CDF officials. These applicants will be able to query their application status via the mobile application and the feedback they obtain will be based on the updates on this page.

#	User Id	Application Status	Amount Allocated	Description	Options
1.	Aiden Johnson	Succeeded	4000	Test	Edit Delete
2.	masuke vandax	Succeeded	25000	Here is the description	Edit Delete
3.	Evans Ogola	Rejected	0	Double Applications	Edit Delete
4.	Edna Koshy	Pending	6000	To be disbursed on 10/06/2017	Edit Delete
5.	Donda Ndogo	Pending	0	Qualified but not priority	Edit Delete
6.	Rose Boss	Pending	5000	To be paid when Government releases funds	Edit Delete
7.	Evans Masuke	Succeeded	5000	Qualified under single parent category	Edit Delete

Figure 6.4 Shortlisted Members

Application by Constituency

When user applies for CDF bursary, their application will be based on the applicant's constituency. The CDF officials are the custodians of updating this page with relevant information regarding the commencement of the application window as shown in Figure 6.5.

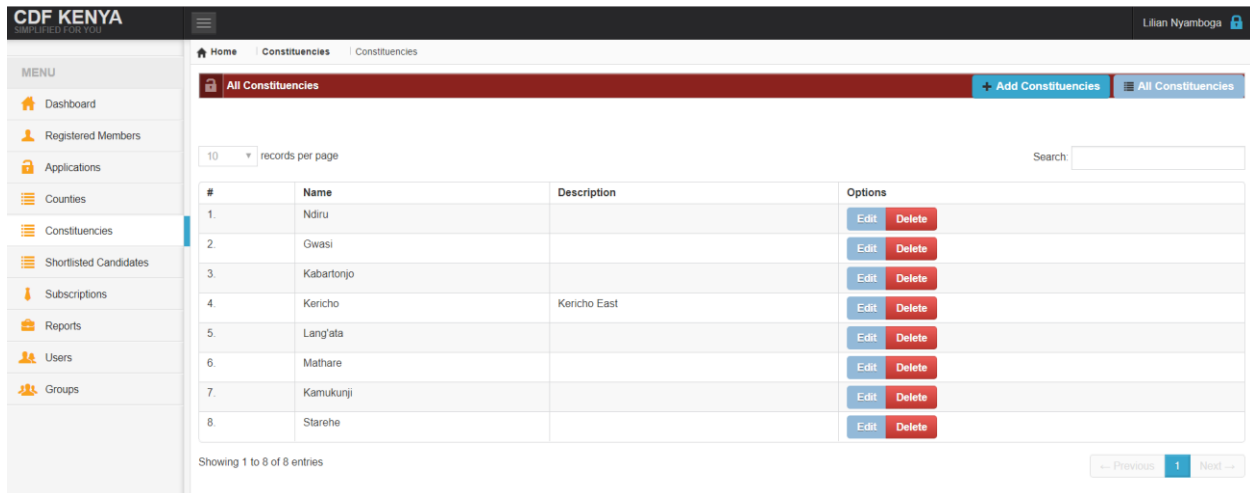


#	County	Constituency	Constituency Form	Description	Options
1.	Siaya	Ndiru	Transnet_Bursary_Application_Form.pdf	Apply by 31st May 2017. Late applications shall not be accepted	Edit Delete
2.	Homa Bay	Gwasi	BURSARY-FUND-APPLICATION-FORM.pdf	Apply by 1st May 2017. Late applications shall not be accepted	Edit Delete
3.	Baringo	Kabartonjo	BURSARY_FORM_APPROVED-2.pdf	Apply by 31st May 2017. Late applications shall not be accepted	Edit Delete
4.	Bomet	Kabartonjo	BURSARY-FORMS.pdf	Apply by 31st May 2017. Late applications shall not be accepted	Edit Delete
5.	Kericho	Kericho	secondary_school_bursary_application_form.pdf	Apply by 31st May 2017. Late applications shall not be accepted	Edit Delete
6.	Nairobi	Starehe	BURSARY-FORMS-KERICHO.pdf	Apply by 21st June 2017. Late applications shall not be accepted	Edit Delete
7.	Nairobi	Lang'ata	KISWCD_BURSARY_APPLICATION_FORM1.pdf	Instructions go hereInstructions go hereInstructions go here	Edit Delete
8.	Nairobi	Mathare	KISWCD_BURSARY_APPLICATION_FORM.pdf	Apply by 31st May 2017. Late applications shall not be accepted after then	Edit Delete
9.	Kisii	Mathare	BURSARY_FORM_APPROVED-21.pdf	Apply by 1st April 2017. Late applications shall not be accepted after then	Edit Delete

Figure 6.5 Application by Constituency

Create a Constituency

The screen on Figure 6.6 allows the CDF officials to add constituencies within counties to allow applicants to select their constituencies from an appropriate county.



#	Name	Description	Options
1.	Ndiru		Edit Delete
2.	Gwasi		Edit Delete
3.	Kabartonjo		Edit Delete
4.	Kericho	Kericho East	Edit Delete
5.	Lang'ata		Edit Delete
6.	Mathare		Edit Delete
7.	Kamukunji		Edit Delete
8.	Starehe		Edit Delete

Figure 6.6 Create Constituency

List All Subscribed Members

Figure 6.7 shows a screen with a list of all the subscribed members in the system. These are the members who can receive SMS alerts from CDF officials regarding application window commencement.

#	Member Name	Cellphone	Email
1	Liresh Nyamboga	0710556992	liresh@yahoo.com
2	test leo	07654	test
3	Donda Ndogo	12345	
4	Liresh nyarera	0710556992	
5	Evan Mtali	0710556992	
6	Lukas jagero	0721341214	
7	Lukas jagero	0721341214	
8	Lily Nyarera	0710556992	lilyamboga@gmail.com
9	Evans Masuke	0710556992	lireshi@yahoo.com
10	Rose Boss	0710556992	lireshi@yahoo.com

Figure 6.7 Subscribed Members

6.5.2 Mobile Application Screenshots

1 Start Application page

Once a user has registered in the mobile application, they will obtain their password confirmation via SMS. They will then be able to login to the application. They will first land on the dashboard with options to either start a new application or check submission status of an already existing application. The screenshot on Figure 6.8 shows the screen for initiating an application based on a particular county. Figure 6.9 shows the screens for submitting a query to check the status of an already submitted application.

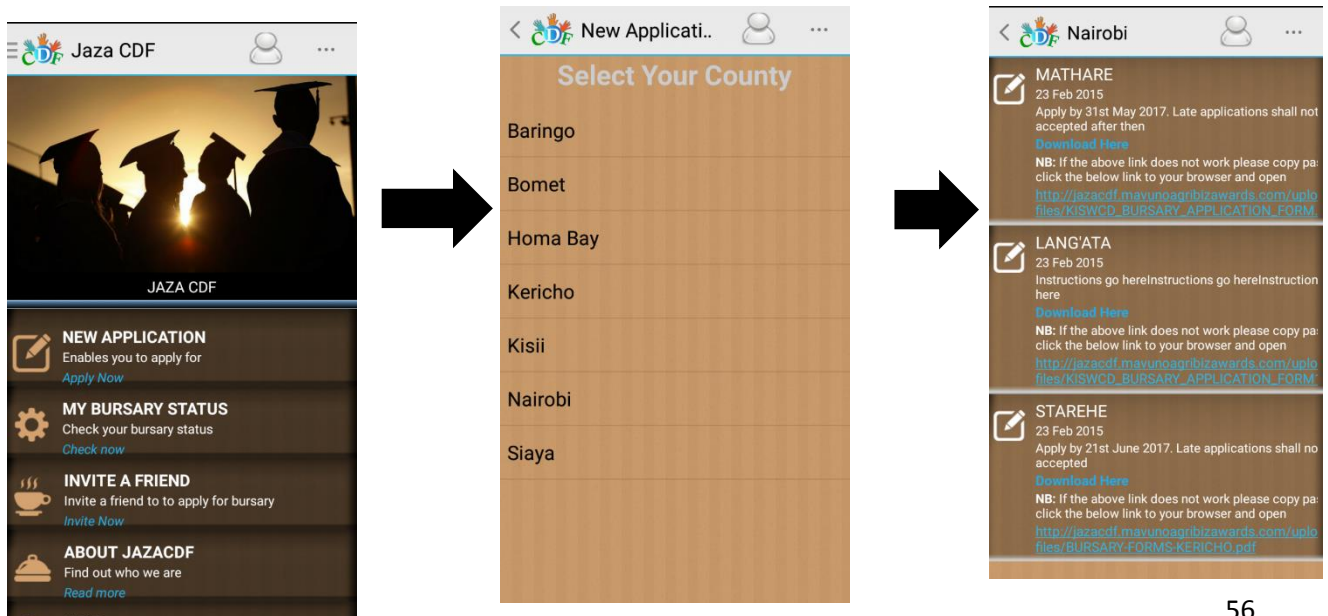


Figure 6.8 Start New Application

2 Check Submission Status Page

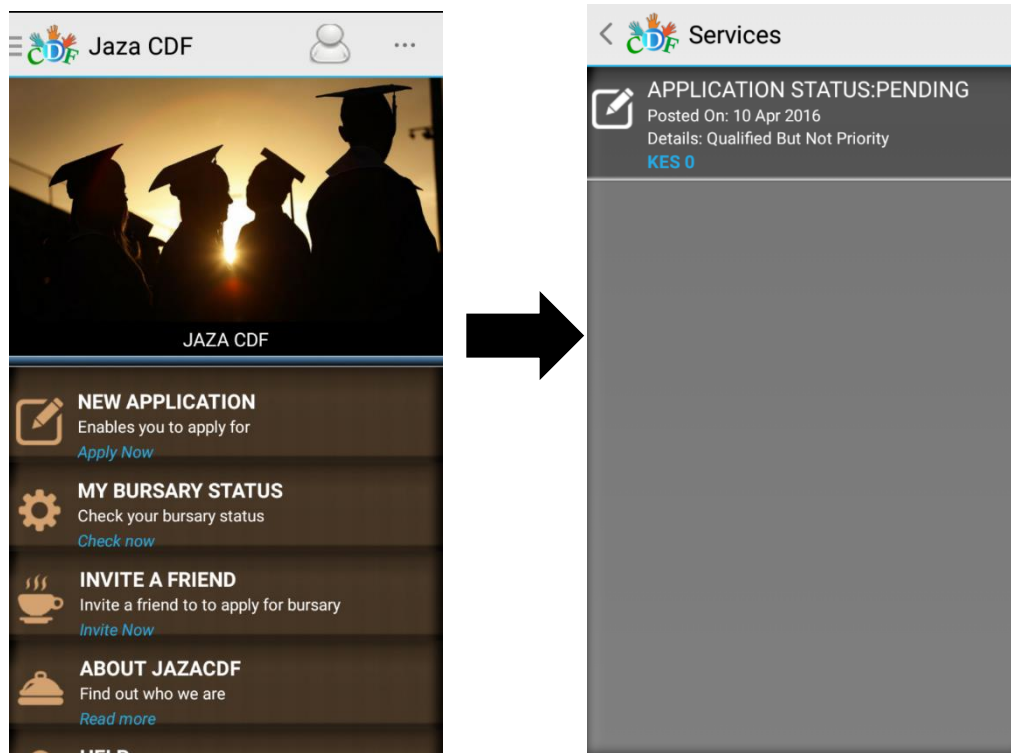


Figure 6.9 Check Application Status

From Figure 6.9, a user is able to check the status of their application by clicking on the “My Bursary Status” button on the homepage. This loads a history of all the bursary allocations they have received and that are recorded in the system.

6.6 SOFTWARE RE-USE

Re-using of software components has become a key component in software development process in the recent past. This is attributed to the many advantages that include:

- Increased productivity in software
- Shortened development time.
- Improved system interoperability
- Need fewer people to develop a software solution

- Reduced development and maintenance costs.
- Production of standardised software.

With this in mind the following descriptions outline how code re-use was achieved with JazaCDF application.

Back End Portal: Using free themes from Template Monster (www.templatemonster.com), the theme was customised and integrated with code igniter forms to suite JazaCDF application needs. This required a lot of knowledge in the structure of MVC applications and good programming practices to ensure naming conventions were dully followed and methods used properly to achieve abstraction.

Front End Application: Since Android is open source software, a lot of code assistance was obtained from Stackoverflow.com. This was especially important in ensuring that solutions provided for similar errors reduced the turnaround time in trying to work through a problem.

Open Source Africa's Talking SMS API: This was very instrumental in helping me achieve text message capability in the application. Instead of going through the hustle to write a new API, I used Africa's talking platform to achieve this functionality

Code Igniter Form Generator API: This was used to generate forms for the views in my MVC model.

7 SYSTEM TESTING AND IMPLEMENTATION

7.1 INTRODUCTION

The aim of this chapter is to confirm the quality and analysis of software items by systematically subjecting the software to defined procedures in a controlled environment. Since software testing was a pervasive stage in the software lifecycle, the assumption made was that at the end of the development stage, all modules would work properly when put together. For this chapter we shall look at functionality tests as well as some non-functionality tests to confirm that reliability, security and integrity of the data passed through the system were achieved.

7.2 FUNCTIONALITY TESTING

Based on the use cases designed during requirements gathering the following test descriptions will be used to assess if the functionality of the application were achieved.

7.2.1 Test Based on Register User Use-case

Test Case: 1	Test Case Name: Register			
System:	Date: 03/04/2017			
Short Description: User registration				
Step	Action	Expected Results	Pass/Fail	Comment
Preconditions:	<ul style="list-style-type: none">• A user downloads the app and successfully installs it on their Android device.• User then launches their app to register as a user• User has Internet connection			
1	account using predefined password parameters, a valid email address and a phone number	Error message "You must fill all required fields"	Pass	Pass

2	Enter data for some fields and not others	Error message "You must fill all required fields"	Pass	Pass
3	Create account with valid email and password	Account creation successful	Pass	Pass
4	Login with non-existing user details	Error message "Wrong Username/ Password. Try Again"	Pass	Pass
5	Login with valid email and wrong password	Error message "Wrong Username/ Password. Try Again "	Pass	Pass
Post Conditions: User should be allowed to access homepage of the application once they have successfully created an account, gotten verified and logged in.				

Table 7.1 Test Case for User Registration

7.2.2 Test Based on Update User Use-case

Test Case: 2	Test Case Name: Update User			
System:	Date: 03/04/2017			
Short Description: Update user details				
Step	Action	Expected Results	Pass/Fail	Comment
Preconditions:	User is already registered in the system and can be able to login in. User has Internet connection			
1	Enter new details on the update profile tab without excluding any required fields	Your profile was updated successfully	Pass	Pass
2	Enter data for some fields and not others	Error message "You must fill	Pass	Pass

		all required fields"		
3	Create account with invalid email and password	Error "Enter the required fields"	Pass	Pass
4	Login with non-existing user details	Error message "User does not exist. Please create account then login"	Pass	Pass
5	Login with valid email and wrong password	Error message "Password and username do not match"	Pass	Pass
Post Conditions:	User should be allowed to access homepage of the application once they have successfully updated their account and logged in			

Table 7.2 Test Case for Update User Details

7.2.3 Test Based on Start New Application Use-case

Test Case: 3	Test Case Name: Start New Application			
System:	Date: 03/04/2017			
Short Description: User makes a new application for bursary fund				
Step	Action	Expected Results	Pass/Fail	Comment
Preconditions:	User is already registered in the system and can be able to login in Internet connection			
1	Select a county	County "name of county" selected	Pass	Pass

2	Select Constituency	Constituency "xxxxx" selected	Pass	Pass
3	Click on Download form	You are downloading "xxxxx"	Pass	Pass
Post Conditions:	User successfully downloads application form to embark on bursary application process			

Table 7.3 Test Case for Creating New Application

7.2.4 Test Based on Check Submission Status Use-case

Test Case: 4	Test Case Name: Check Submission Status			
System:	Date: 03/04/2017			
Short Description: User checks the status of their application				
Step	Action	Expected Results	Pass/Fail	Comment
Preconditions:	User is already registered in the system and can be able to login in User has already submitted an application to CDF officials awaiting allocation of funds Internet connection			
1	User clicks check application status button	User is taken to a screen that loads all their allocation history	Pass	Pass
Post Conditions:	User is able to view the history of their allocations.			

Table 7.4 Test Case for Checking Submission Status

7.2.5 Test Based on Upload Application Contents Use-case

Test Case: 5	Test Case Name: Upload Application Contents			
System:	Date: 03/04/2017			
Short Description: CDF Official uploads bursary application material				
Step	Action	Expected Results	Pass/Fail	Comment
Preconditions:	CDF Official is already registered in the system and can be able to login in			
1	Official creates a constituency	Constituency added successfully	Pass	Pass
2	Official links constituency to a county	County added successfully	Pass	Pass
3	Official updates application material and uploads form	Application created successfully	Pass	Pass
Post Conditions:	The uploaded material is made available for users to start downloading from the mobile application			

Table 7.5 Test Case for Uploading Content on Portal

7.3 USABILITY TESTING

For any system to remain in the minds of the users who interact with it, it must be easy to use. This is a black box testing technique where developers and project managers simply test how comfortable users are with the end product. The main aim is to find flaws in navigation, speed and other factors. According to ISTQB (2016), usability testing includes the following five components:

- **Learnability:** How easy is it for users to accomplish basic tasks the first time they encounter the design?
- **Efficiency:** How fast can experienced users accomplish tasks?
- **Memorability:** When users return to the design after a period of not using it, does the user remember enough to use it effectively the next time, or does the user have to start over again learning everything?
- **Errors:** How many errors do users make, how severe are these errors and how easily can they recover from the errors?
- **Satisfaction:** How much does the user like using the system?

For JazaCDF application, a usability questionnaire was administered to a selected number of users who tested the application. The following are the responses with regards to the usability of the system. Refer to Appendix 3 for the questionnaire.

7.3.1 User Friendliness

In order to determine the user friendliness of the application, users were asked how easy it was to download the application and launch the services, and how easy it was for them to use the application. 15 of the users (75%) said it was easy while 5 users said it was average. The results are documented in Figure 7.1.

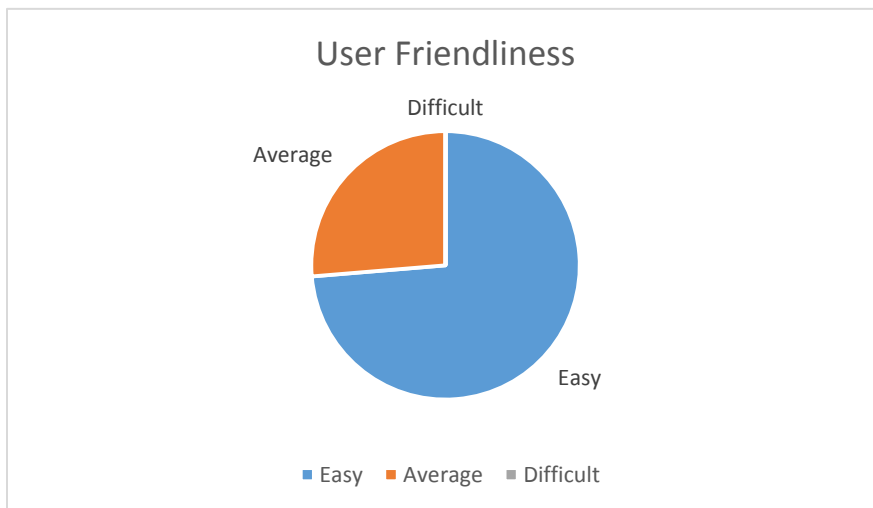


Figure 7.1 User Friendliness

7.3.2 Functionality

The respondents were asked if the application functionality met their user requirements, 90%, 18 out of 20 users said the functionality was acceptable. Figure 7.2 presents their view on the functionality of the application.

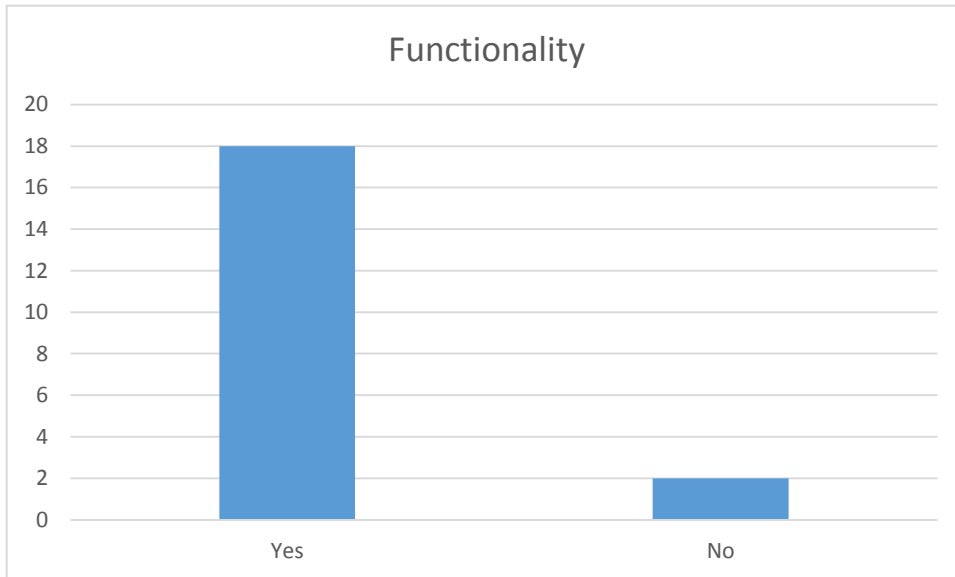


Figure 7.2 Functionality

7.3.3 Acceptability

Users were asked if they would continue using the application. The results are documented in Figure 7.3.

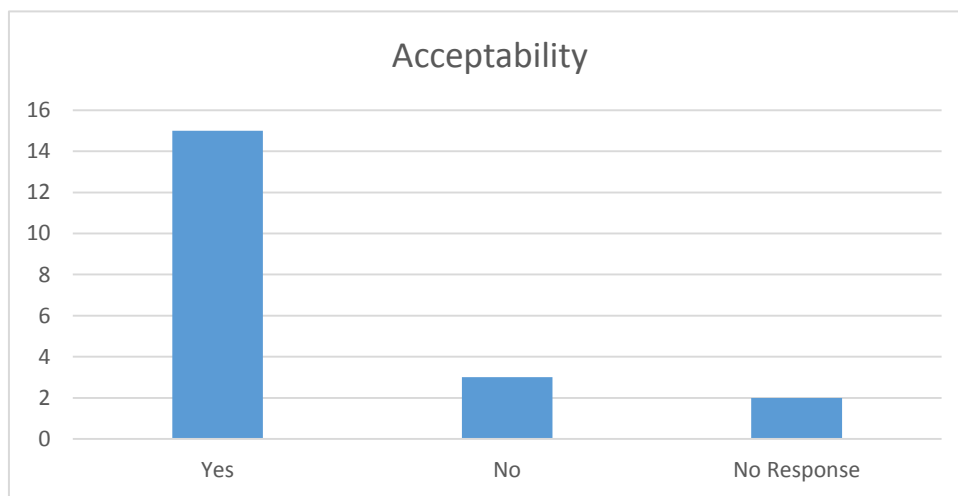


Figure 7.3 Acceptability

7.3.4 Interface Design

The respondents were asked how they felt about the look and feel of the application. 70% of the users found the application. Figure 7.4 represents the results.

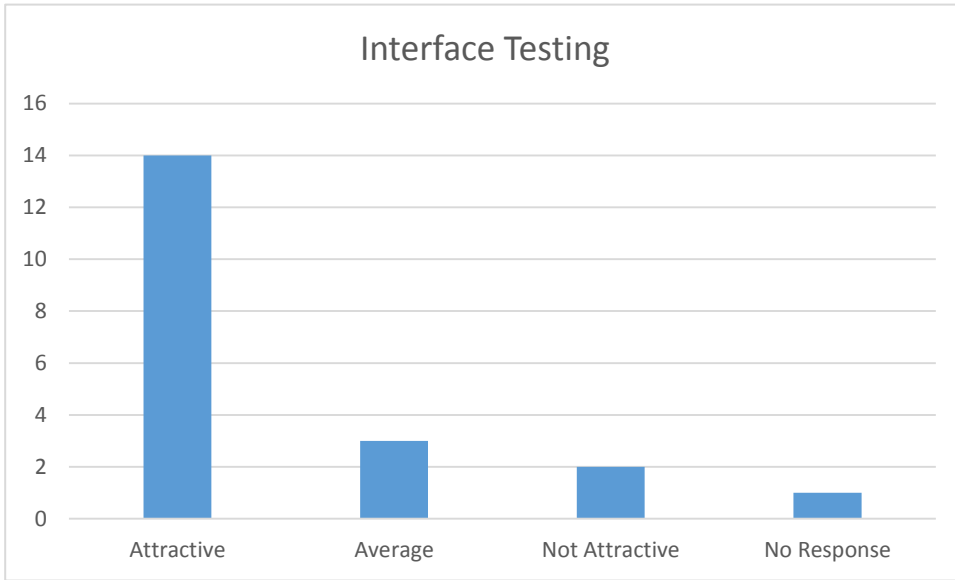


Figure 7.4 Application Look and Feel

7.4 SECURITY TESTING

System security is one of the most fundamental aspects in the life of the application if it has to remain usable for a long time. Systems which lack proper authentication or require very complex authentication put off users very easily. Measures have to be put in place to ensure users are not discouraged from using the system. Table 7.6 shows test results for the security of JazaCDF.

Test No.	Process tested	Expected Results	Pass/Fail	Comment
1	Authentication of users	For the mobile app, a user has to be authenticated to access the system. First time logon details sent in SMS verification message	Pass	Pass
2	Input Validation	Input validation is enabled. If supplied email address lacks "@" it will not accept input. Also if password length is less than six	Pass	Pass

		characters it will not complete registration		
3	System idling	For the back end portal, if the system stays idle for more than 5 minutes, authentication will be required again	Pass	Pass

Table 7.6 Results of Security Tests

7.5 VALIDATION

Validation was done to ensure that the system requirements were met. 20 users were administered with a validation questionnaire. These users were drawn from the users who had participated in the requirements gathering and were required to test the application to ascertain that their requirements had been met. Firstly, the survey inquired of the users to determine if the users had been in the group of users that had responded to the requirements gathering and usability questionnaires. Figure 7.5 below describes the results.

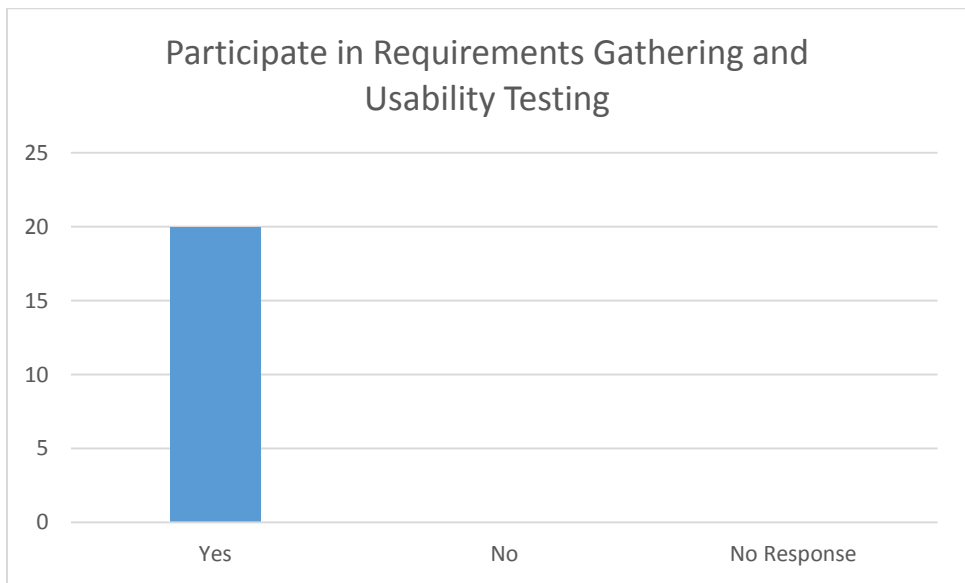


Figure 7.5 Participate in Requirements Gathering and Usability Testing

Secondly, the survey inquired if the application improved the CDF Bursary application process for the users. The results are as shown in Figure 7.6.

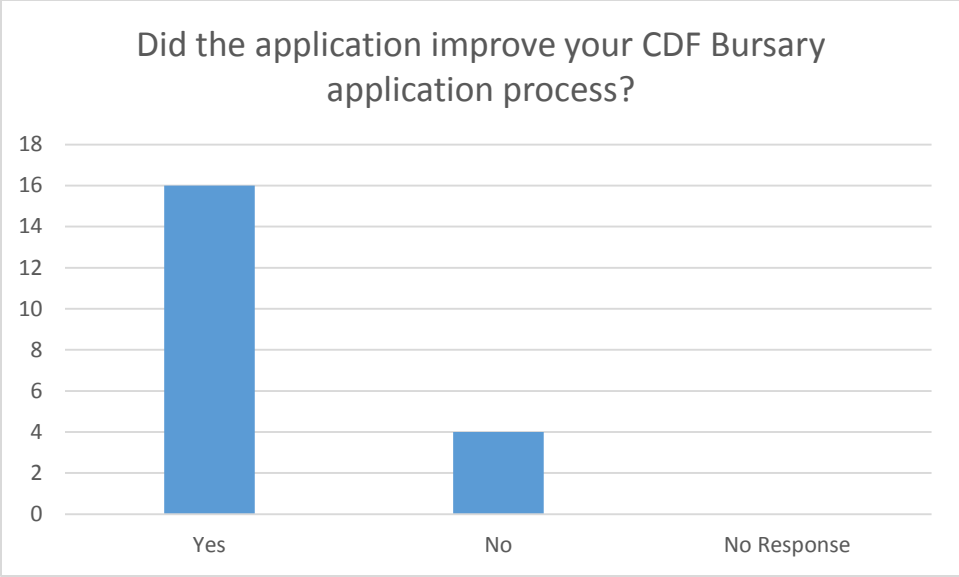


Figure 7.6 Improved CDF Bursary Application Process

Thirdly, the survey inquired of the users to indicate the functionalities that best solved their problem. 15 the applicants said that the ability to check the status of the application enabled them get updated on their application and hence reducing anxiety on the outcome of the application. 5 of the users said that the ability to have the forms in the application reduced travelling time to CDF offices. 10 of the users also said they liked the notifications on the application window opening so that they did not miss the opportunity to apply.

Finally, the users were asked if they would recommend the application to other users. The results are documented in Figure 7.7.

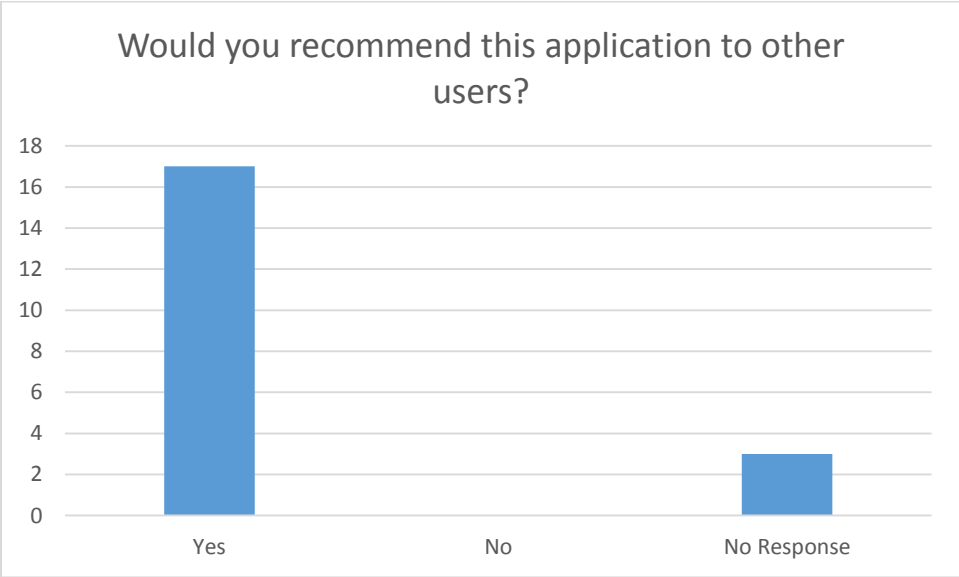


Figure 7.7 Recommend Application

7.6 SUMMARY

Based on the requirements analysis, objectives set out for the research, the system designs implemented enabled to achieve the requirements during system implementation as validated by the users.

8 CONCLUSION AND RECOMMENDATIONS

8.1 CONCLUSION

From research, it was evident that some of the things Kenyan citizens are looking out for are government services. Given the undisputed mobile penetration in the region, innovative yet simple ways of addressing citizen problems can lead to better service delivery from the government as citizens become more participatory and hence better collaboration. JazaCDF can form a basis for digitising some of the processes that are carried out by CDF officials. This can reduce cases of corruption and nepotism allegations that prevailed the research as users felt that they are not being given services according to need-basis but rather from who-knows-who basis.

8.2 RECOMMENDATIONS

CDF Bursary application has been a manual process for the longest time known since its inception. Adoption of technologies such as JazaCDF are recommended since such technologies relieve the CDF officials the burden of having to answer same queries from different people. Also, it is a way of ensuring equitable distribution of resources to the deserving students who need the fund but do not know where or how to start the entire process. It will also streamline the transparency and accountability required in the public sector that has been constantly accused of vices such as corruption and nepotism, laziness and favoritism for own people.

This solution is recommended to all constituencies in Kenya. A trial version can be obtained from the developer for a period of three months from where they can subscribe at a small fee. The solution implements SMS technologies and hence the subscriptions money will partially cover this cost. A short training will be offered to the CDF officials on how to use (especially updating) of the portal to make the content available for end users to access. Further, I recommend constituencies to embrace cloud computing technology and hence host the application on the cloud so that they enjoy the benefits of Software as a Service (SaaS).

8.3 FURTHER WORK

Due to limitation of time JazaCDF application could not be implemented 100% as users would have liked it to be. This therefore calls for a documentation of work that can be furthered to improve the overall system. Key considerations would be ensuring that there is a full

functional web based equivalent of the mobile application where users can log in and make a complete application just like HELB (www.portal.helb.co.ke). This will further make it possible for users to make applications from wherever they are without need to travel across.

Also, to be furthered is the capability of users to interact with the mobile application by providing comments and/or rating feedback on the service they received from the CDF officials using the system.

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APPENDIX

APPENDIX 1: PRE-IMPLEMENTATION QUESTIONNAIRE

QUESTIONS RESPONSES 16

Short answer text
.....

Gender

Male

Female

Age

15 years and below

16-18

19-24

25-30

31-40

Above 40

Education level

University

Tertiary colleges

O'Level

Below O'Level

Please indicate the COUNTY of residence

Short answer text
.....

Please indicate the CONSTITUENCY of residence

Short answer text

Please indicate the WARD where you reside

Short answer text

Have you ever applied for CDF Fund?

Yes

No

If your answer was yes, what do you think about the application process?

Long answer text

If your answer was NO, are you planning to make an application at some point?
Or would you help someone make an application?

Please give a detailed explanation

Long answer text

What are some of the things you don't like about the application process? Give
a list of as many as you want.

Long answer text



What are some of the things you don't like about the application process? Give a list of as many as you want.

Long answer text

Would you make use of a mobile app that helps you in the application process above?

Yes

No

What are some of the processes you would like captured on the App?

Long answer text

Beside the mobile App, what other type of application would you prefer?

Mobile Application Only

Web Application

SMS Application

USSD Application

All

Other...



APPENDIX 2: SAMPLE QUESTIONNAIRE RESPONSES

1	Name	Gender	Age	Education level	Please indicate the COU	Please indicate the CON	Please indicate the WARI	Have you ever applied for	If your answer was yes, what do you think about the application process?
2	Waigigi	Male	19-24	University	Kiambu	Juja		Yes	It is complicated and full of favors for selected individuals
3	Evans Ogola	Male	25-30	University	Kisumu	Kisumu Town West	Osisi	Yes	Its hectic with a lot of manual processes. It consumes lots of time and money especially during application when applicant is based in an institution a far away from applica It also feel that the application process is very corrupt as it is a manual one and therefore the very needy students are disadvantage There is lack of consistency in application process
4	Larvinia	Female	19-24	University	NYMIRA	WEST MJGIRANGO	NYANKONGO	Yes	It took so much time moving from Organization /institution without getting any feedback about the progress of the application.
5	Nixon Kurgat	Male	19-24	University	Bomet	Bomet Central	Chesoan	Yes	Tedious and takes time before approval
6		Male	19-24	University	bomet	konon	kimulot	Yes	lots of letters which have to be approved by the chief
7	Harry Ochieng	Male	25-30	University	Kisumu	Nyakach	Thurduoro	Yes	Tedious
8		Male	25-30	University	Kiambu	Ruru	siju jina	No	Now that there was no "Other Comments" below, lemme come back to this textbox: for other comments: I think this collection met
9									
10	Elizabeth	Female	25-30	University	Nairobi	Embakassi	Tena	No	
11		Male	25-30	University	Nakuru	Naivasha	Lakeview	No	
12	Malala	Male	25-30	University	Kiambu	Kabete	Uthru	No	
13	Musangi Meshack	Female	25-30	University	HomaBay	Karachuonyo	Rachuonyo	No	
14		Male	25-30	University	Bungoma	Webuye	Dont Know	No	
15	Doreen Metet	Female	25-30	University	Kericho	Kgkelion	Londiani	No	N/A
16		Male	19-24	University	NAIROBI	NAIROBI WEST	RIRUTA	No	
17		Male	19-24	University	Bomet	Konon	Kimulot	Yes	tedious and time consuming
18		Female	25-30	University	NAIROBI	NAIROBI	NAIROBI	No	
19		Male	19-24	University	Nairobi	westlands	kangemi	no	
20		Male	25-30	University	Nairobi	embakassi west		no	
21		male	19-24	University	Nairobi	dagoretti	mutuni	no	
22		male	19-24	University	Nairobi	embakasi	sauka	yes	long process and requires a lot of details
23		male	19-24	University	Nairobi	westlands	kangemi	yes	stressing and time consuming process
24		Male	19-24	University	Kiambu			no	
25		male	19-24	University	Nairobi	embakasi		no	

1	Name	Gender	Age	Education level	Please indicate the COU	Please indicate the CON	Please indicate the WARI	Have you ever applied for	If your answer was yes, what do you think about the application process?
24		Male	19-24	University	Kiambu			no	
25		male	19-24	University	Nairobi	embakasi		no	
26		Female	19-24	University	Nairobi	westlands		no	
27		Female	19-24	University	Kiambu	kikuyu		no	
28		male	19-24	University	Nairobi	starehe	ngara	yes	simple and easy
29		Male	19-24	University	Nairobi	kabete	gitaru	no	
30		Female	19-24	University	Nairobi	westlands	kileleshwa	no	
31		Male	19-24	University	Nairobi	westlands	kangemi	no	
32		Male	19-24	University	Nairobi	starehe	huruma	Yes	VERY TEDIOUS
33		Male	25-30	University	Nairobi	embakasi east	embakasi	No	
34		Female	25-30	tertiary colleges	Nairobi	dagoretti		No	
35		Male	19-24	University	Kiambu	kikuyu	muguga	no	
36		Female	19-24	University	Kitui	Kitui east	nzambani	Yes	complicated
37		Female	19-24	University	Kakamega	naivatholo	buryala west	No	
38		Male	19-24	University	Nairobi	langata	matira	no	
39		Female	19-24	University	meru	buuri	kibichia	yes	long and hard
40		Female	19-24	University	Nairobi	starehe	pangani	yes	long and hard
41		Male	19-24	university	busia	butula	elugutu	Yes	you are not sure if you will get the funds
42		Female	19-24	University	laikipia	laikipia west	oi-moran	Yes	long
43		Male	19-24	University	Nairobi	ruaraka	utalii	Yes	
44		Female	19-24	University	Nairobi			no	
45		Female	19-24	University	Nairobi			no	
46		Female	19-24	University	Nairobi	westlands	kangemi	no	
47		Female	19-24	University	Nairobi	westlands	kabete	No	
48		Female	19-24	University	Nairobi	westlands	kangemi	No	
49		Female	19-24	University	Nairobi	westlands	kangemi	No	
50		Female	19-24	University	kisi	bobasi	sameta	Yes	hectic, time consuming
51		Male	19-24	University	Nairobi	westlands	kangemi	no	
52		Male	19-24	University	machakos	machakos town		no	
53		Male	19-24	tertiary colleges	Nairobi	starehe	pangani	No	
54		Male	25-30	University	Nairobi			No	
55		Female	19-24	University	Nairobi	westlands	kabete	No	
56		Female	19-24	University	Nairobi	westlands		No	
57		Male	19-24	University	machakos			No	

APPENDIX 3: USABILITY QUESTIONNAIRE

JazaCDF

QUESTIONS RESPONSES

JazaCDF

This questionnaire tests the usability of JazaCDF application

How was it downloading the application

Bad

Average

Great

How is the look and feel of the mobile and web application

Attractive

Average

Not attractive

How can you gauge the easy of use of the application

Bad

Average

Great

Does the functionality meet the user requirements

No

Yes

Would like to continue using the application

MULTIPLE CHOICE

No

Yes

Add choice or add choice

Answered 0/0

APPENDIX 4: VALIDATION QUESTIONNAIRE

JazaCDF Validation Questionnaire

1. Did you take part in filling the requirements gathering and testing questionnaires? 

- Yes
 No

2. Did the application improve your CDF Bursary application process? 

- Yes
 No

3. Would you recommend someone else to use this mobile application? 

- Yes
 No

4. Which functionality best resolved issues in your application process? 

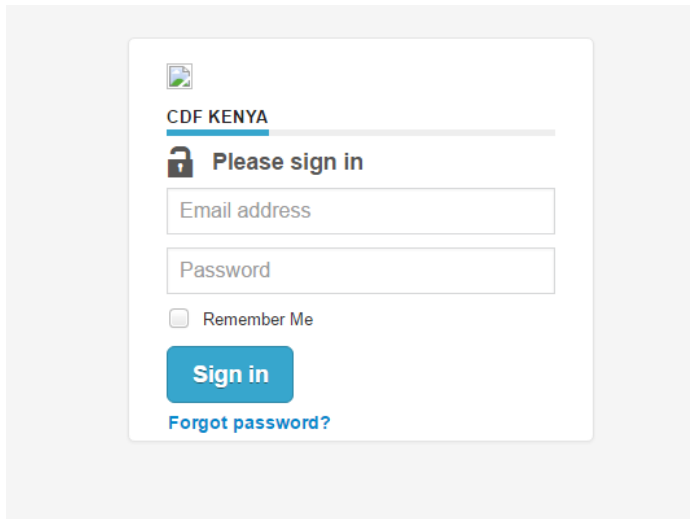
- SMS notifications on window application opening
 Application forms on application
 Status enquiries from the application

Add the functionality in the space provided below

Done

APPENDIX 5: WEB APPLICATION SCREENSHOTS

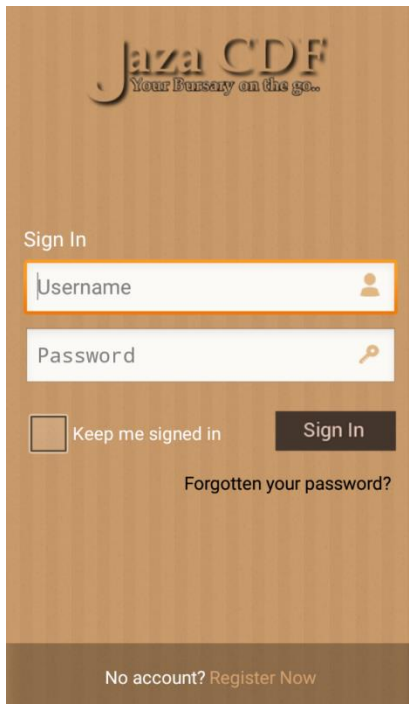
Login Page



The screenshot shows a web application login page. At the top left, there is a small logo and the text "CDF KENYA". Below this, a padlock icon is followed by the text "Please sign in". There are two input fields: "Email address" and "Password". Below the password field is a checkbox labeled "Remember Me". A blue "Sign in" button is positioned below the checkbox. At the bottom of the form, there is a blue link that says "Forgot password?".

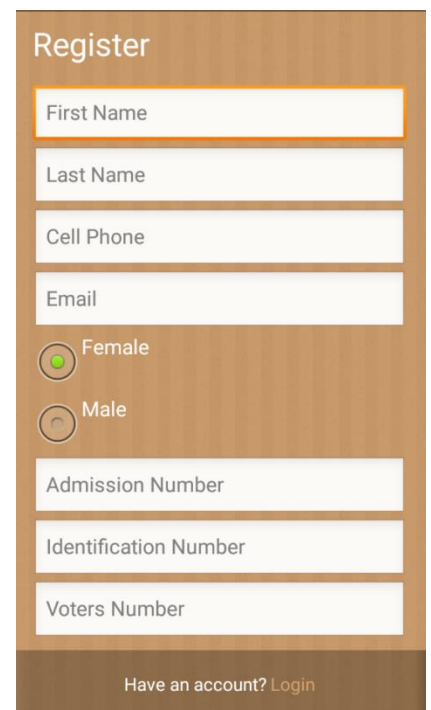
APPENDIX 6: MOBILE APPLICATION SCREENSHOTS

Login Page



The screenshot shows a mobile application login page with a wood-grain background. At the top, the logo "Jaza CDF" is displayed with the tagline "Your Fantasy on the go.". Below the logo, the text "Sign In" is shown. There are two input fields: "Username" and "Password". Below the password field is a checkbox labeled "Keep me signed in" and a dark grey "Sign In" button. Below the button, there is a link that says "Forgotten your password?". At the bottom of the page, there is a dark grey bar with the text "No account? Register Now".

Registration Page



The screenshot shows a mobile application registration page with a wood-grain background. At the top, the text "Register" is displayed. Below this, there are several input fields: "First Name", "Last Name", "Cell Phone", "Email", "Admission Number", "Identification Number", and "Voters Number". Below the "Email" field, there are two radio button options: "Female" (which is selected) and "Male". At the bottom of the page, there is a dark grey bar with the text "Have an account? Login".