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A web-based platform for reliable market linkage between poultry farmers and potential buyers in Tanzania

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**A WEB BASED PLATFORM FOR RELIABLE MARKET LINKAGE
BETWEEN POULTRY FARMERS AND POTENTIAL BUYERS IN
TANZANIA**

Cesilia Mambile

**A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of
Master's in Information and Communication Science and Engineering of the Nelson
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ABSTRACT

In Tanzania the advancement of technology has brought about affordable smartphones to most of livestock farmers. However, despite this potential, livestock farmers have limited utilization and access to livestock information to improve their business. Poultry farming is a widely practiced agricultural activity with a high potential for poverty reduction, climate change mitigation, enhancing food security and improving socio-economic transformation in pro-poor households and communities in Tanzania. The sector supports the livelihoods of 3.7 million households in Tanzania. But farmers in the sector are challenged on reliable market linkage information systems to interface with buyers for their products. Both poultry farmers and buyers rely on informal market information. Poultry farmers are equally challenged on limited exposure to technology.

Study was carried out in Tanga region to poultry farmers and buyers. The findings from this study shows that key market information required by poultry farmers and buyers are price, buyer or farmer location, Poultry kilograms, amount of poultry needed by buyers, amount of poultry products needed by buyers, types of poultry needed by buyers and kind of poultry products needed by buyers.

To overcome poultry market information gap, this study aims to develop a web-based platform for poultry market linkage with more focus on its usability and user experience (UX) design, and to assessment its usability and user experience. Eye tracking method combined with retrospective think aloud method together with facial expression was used to test user experience of the developed web-based platform while to assess its usability think aloud protocol together with pre and post assessment methods was used.

The developed web based platform is simple and not overloaded, it provide all the required market information. The platform supports buying and selling as well as order management. Furthermore, farmers can perform auctions on the platform, the payment method is cash on delivery. The application is also available in Swahili.

DECLARATION

I, Cesilia Mambile do here declare to the senate of the Nelson Mandela African Institution of Science and Technology that this dissertation is my own original work and that it has neither been submitted nor being concurrently submitted for degree award in any other institution.

Name and signature of candidate

Date

The above declaration is confirmed

Name and signature of supervisor

Date

Sabine Moebs



Name and signature of supervisor

Date

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CERTIFICATION

The undersigned certify that has read and found the dissertation acceptable by the Nelson Mandela African Institution of Science and Technology

Name and signature of supervisor

Date

Sabine Moebs



Name and signature of supervisor

Date

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DEDICATION

This work is humbly dedicated to my beloved parents for their everlasting efforts in shaping me, to be whom I am today. Also to the love of my life Christopher and our beloved sons, Christian and Clifford for their solid love, care, support and prayers.

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ABBREVIATIONS

NGRP	National Growth and Reduction of Poverty
GDP	Gross Domestic Production
WWW	World-Wide-Web
LINKS	Livestock Information Network Knowledge System
TANLITS	Tanzania Livestock Identification and Traceability System
OSS	Open Source software
HCI	Human computer interaction
CTA	Concurrent Think Aloud
RTA	Retrospective Think Aloud
ODK	Open Data Kit
GPS	Global Positioning System
UCD	User centered design
CEO	Chief Execution Officer
PHP	Hypertext Preprocessor
HTML	Hypertext Markup Language
JDK	Java Development Kit
CoCSE	School of Computational and Communication Sciences and Engineering
USS	Usability System Scale Results
IT	Information Technology
WBP	Web Based Platform

CHAPTER ONE

INTRODUCTION

1.1 Background

Agriculture has an important role towards improving food safekeeping and advancing human improvement in Tanzania and African continent at large (Conceição *et al.*, 2016). Livestock farming is one of the major agricultural activities in the country that contributes towards achieving development goals of the National Growth and Reduction of Poverty (NGRP) (Tanzanian Policy Document, 2010). The term livestock can be defined as animals kept to yield milk, meat, eggs, work and wool. Livestock comprises of swine, horses, poultry, beef and dairy cattle, sheep and goats. The livestock part adds 4.7% of National GDP and 18% of Agricultural GDP. Chickens contribute 16% of livestock GDP, 3% of agricultural GDP and 1% of National GDP. It is hypothesized that poultry farming support the livelihoods of 3.7 million households in Tanzania (Msami, 2007; Goromela, 2009). Thus indicating high significant contribution of poultry to the national economy and social status (MoHSW, 2007).

Currently, poultry is a large commercial industry compared to few years ago due to increased consumption of meat and eggs in recent years (International, 2010; Mohammad and Mohammed, 2014). Despite the fact that there has been a demand of poultry products which emphasize farmers to produce more the current market infrastructure does not support the linkage between consumer and producer (Hurrissa 2003; Lwoga, 2010; Njombe *et al.*, 2011). As a result producers experience great losses because products don't reach customers in time.

The Internet is the most used marketing channel to link buyer and seller based on the fact that it has a broader reach, and can be easily shared among users through search engine and its accessible across different platforms e.g. Phones and computer. Web-based marketing that are mentioned of comprise worldwide market coverage, effectiveness compared to other marketing channels, and chances for novel services based upon web technology (O'Keefe and McEachern, 1998). Byrne *et al.* (2010) noted that web-based simulation has many benefits in comparison to classical systems and other system. A number of advantages of Web-based simulation over classical systems have been identified and can be classified as follows: Collaboration, cross-platform capabilities, wider availability, Integration and interoperability, Versioning, customization and maintenance, Controlled access and ease of use (Byrne *et al.*, 2010).

In Tanzania a lot has been done to enhance livestock marketing information but little has been done in poultry (Njombe *et al.*, 2011). Therefore this research seeks to utilize access to Internet and its multimedia front-end, the World-Wide-Web (www), to develop interactive Web based platform for market linkage between poultry farmers and buyers. The motivation for the approach is the high penetration of mobile phones in Tanzania.

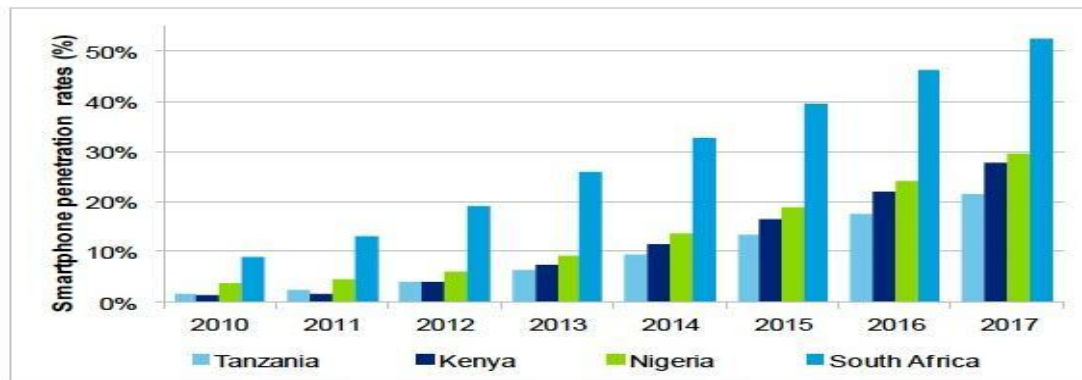


Figure 1: Smartphone penetration (Source: strategy analytics, wireless device 2012)

Web based forum will bridge the market information gap by ensuring farmers and buyers have access to market information by allowing farmers to be able to place marketing material (images, text, icons, video etc.) of poultry and poultry products on the website ranging from simple advertising to comprehensive virtual brochures and the advantage of multimedia will also be taken. Furthermore, orders will be taken via Website. On other hand buyers will be able to provoke the seller or to broadcast by advertising their needs and provide the specification including amount, type, price etc. The aim of web forum is to ensure both seller and buyer offer the precise information needed by themselves during conversation between the farmer and the buyer

1.2 Research Problem

This research aimed to provide a full poultry marketing information system to assist market intelligence for effective and operative functions of poultry marketing. Presently the poultry markets are dominated by small traders who operate as village vendors, distant wholesalers, and retailers (International W, 2010). According to Msami (2007), small-scale farmers usually depend on itinerant middlemen to sell their produce and often end up being denied fair prices. On the other hand they have been constrained on where they can sell their products

There have been efforts played by the government to enhance market accessibility to livestock farmers where there are application such as Livestock Information Network Knowledge System (LINKS) (<http://www.lmistz.net>) which is for Tanzania, Ethiopia and Kenya. Also, there is a platform for Livestock Identification and Traceability System (TANLITS) available at <http://41.59.254.106:8080/> and <http://www.thepoultrysite.com>. However, the application do not facilitate information exchange and most of the information is not relevant to poultry farmers also not updated on time and difficult to access. So the applications do not provide the linkage between poultry farmers and buyers.

The problem facing livestock farmers is that there is no consistent, reliable and timely marketing tool which will provide them information, also the absence of a good-coordinated system of collecting data, analysis and dissemination which is synchronized between farmers, buyers and other important stockholders (Njombe *et al.*, 2011). Most of Poultry farmers and buyers depend on informal sources of market information, mostly from friends, family and neighbors (Msoffe and Ngulube, 2016).

Trustworthy, well-timed and stable marketing information is crucial for well-organized, effective and open marketing operations. Unavailability of timely information constrain them from generating maximum profit from their poultry and poultry products as they get little return on what they sell, consequently they hesitate to improve the quality of the poultry and poultry products. It's further noted that, due to unreliable market farmers get loss because they sell at a cheaper price. Furthermore they fear to scale up their business. In addition they get loss in feeds since poultry will stay long until they are sold. Due to these problems there is a need to develop a system (marketing tool) which will provide a reliable market linkage between farmers and buyers.

1.3 Rationale of the study

Poultry farmers need sufficient information so as to increase their knowledge about poultry farming goings-on (Msoffe and Ngulube, 2016), also in order to increase profit. There is a need of developing web based forum which will link the poultry keepers to potential buyers since it will solve the problem of Geographical location versus universal availability, purchasers and suppliers who are normally located in different geographical areas, geographical parting cause intermediaries who led to more cost and prices. The difficulty and cost of obtaining locational

assets close to the customer has led to a small set of large retailers and intermediaries developing and maintaining competitive advantage (Sharma and Sheth, 2004).

Nowadays, even in countries which are developing, consumers and businesses bring products near to their physical location and had them taken toward their needs (Sharma and Sheth, 2004), and the good way of achieving this is through Web systems. By means of the Web, sellers and individuals were able to market their produce on the web from simple promotion to comprehensive simulated promotional material (O'Keefe and McEachern, 1998).

Upon completion of this research work, farmers will be able to place marketing material (images, text, icons, video etc.) of poultry and poultry products on the website from simple promotion to comprehensive simulated promotional materials. In addition orders will be placed online.

1.4 Objectives

1.3.1 General Objective of the Study

To identify poultry market needs and bridge market information gap by developing a web based platform for reliable market linkage between poultry farmers and potential buyers in Tanzania.

1.3.2 Specific Objectives

- (i) To identify market information requirements from farmers and buyers on poultry and poultry products.
- (ii) To develop web based forum for reliable market linkage.
- (iii) To validate and verify the web based forum for reliable market linkage.

1.5 Research Questions

- (i) Which information is required by poultry farmer and buyers for development of web based forum?
- (ii) How will the web based forum be developed to ensure a reliable linkage between poultry farmers and potential buyers in market?
- (iii) How will the system be tested to ensure that it has no bugs, have reached users satisfaction and system requirements for web based for reliable market linkage?

CHAPTER TWO

LITERATURE REVIEW

2.1 Web Technology in Tanzania

These days, web uses give a very important role in the achievement of the firm and business. Web uses have grown-up so quickly in these days market. Web uses are much more important these days and they have a very important role in the achievement of the government, entertainment, industry, education business, to our individual lives since we find nearly all solutions on the internet. Furthermore the web has turned into a part and parcel of our day to day lives, since we perform a lot of activities on internet such as business processes, emails, networking, or government application, we search nearly everything on the internet (Chawla *et al.*, 2017; Panthi and Mohapatra, 2017). Web technology is a way that allows two or more computers communicate over a network.

A website is a central place where related web pages can be accessed by visiting the home page using a browser. In context of this study it refers to all marketing information including advertisement and other relevant details collecting and broadcasting that make use of web technology as a tool for accumulating and distributing that information.

The Internet and its multimedia front-end, the World-Wide-Web (WWW), has grown so fast since its development in early 1990s by Tim Berners-Lee of CERN (Centre for European Nuclear Research), achieving worldwide recognition (Byrne *et al.*, 2010). The web technology has many benefits such as convenience and a high speed of communication in the computer world as well as worldwide market coverage, related to other marketing channels since it offers Collaboration, cross-platform capabilities, wider availability, Integration and interoperability, Versioning, customization and maintenance, Controlled access and ease of use (Byrne *et al.*, 2010). Web-based marketing is based upon electronic broadcasting. Sharma relates the web-based markets of tomorrow and the traditional one in her study and suggests that the web-based markets of coming days will have little similarity to the markets of today since the web is growing so fast and is really impacting buyers and business market behaviors in terms of market activities (Sharma and Sheth, 2004).

2.3 The Design Process

Design is looking for new thoughts in the world (Camacho, 2016). Design is process of planning upon the look and functioning of an object. Design may differ depending on product and field, “airplanes designers and fashion designers say they both design, in reality they are totally different people, since the one is investigative and the other is artist” (Camacho, 2016). Some time you can hear people say this design is “good design” or this design is “bad design”. Dieter Rams 50 years ago said that good design is useful, easy to understand, innovative, aesthetic, unremarkable, truthful, long-term, thorough down to the last detail as well as environmentally friendly (Vitsoe, 2015).

Sometimes people can refer good design as visual appearing of a product but it is not only that, good design is more than what people can see and touch. “Good design is visually attractive but as well as it meets real user needs. It has material and depth also works well and unthinkingly” (Horton *et al.*, 2013).

Creating user experience towards solving problems is a great design. Products can be termed as good designs when they create and enhance the desired experience. User emotion is very important sense in creating user experience. “Designs which hit user’s emotions are considered to perform more than just reply to their mentioned needs and deliver a greater level of user experience” (Interaction Design Foundation, 2018).

2.4 Poultry Marketing Situation in Tanzania

Chicken and eggs are sold to nearby friends or local markets within the same village or villages. These sales are directly done by the households. There are various open village markets in each region. For example, there are weekly markets in different districts in Tanzania (Kisungwe, 2012). Nowadays poultry markets are controlled by small traders who function as village wholesalers, retailers vendors and distant (International, 2010). Middlemen and small scale processors rule the market and normally act for their own profit by dropping the smallholders share and increasing final prices (El-obeid, 2012; International, 2010; Msami, 2007).

Other institutional problems associated with the current poultry marketing system include weak legal framework to enforce contracts; long supply chains between known parties which usually lead to increased cost of trading; lack of standard measurement and quality control systems; and lack of market information (International, 2010). Exporters, producers, traders and related institutions are limited by shortage of market information to depend on for improving

production, exports and marketing as well (Abate *et al.*, 2003). There is limited access to agricultural information in areas of Tanzania, although poultry researchers and information intermediaries have made efforts to reach out to poultry farmers, there are constraints to accessing information in rural areas of Tanzania (Msoffe and Ngulube, 2016).

In 2010, consumption of poultry eggs and meat in total was estimated to be 51 600 tons of poultry meat and 721 million eggs per year. The demand forecast in 2020 it is predictable to be 64 800 tons of poultry meat and 8 100 million eggs per year (International, 2010). The statistics explains to us possible demand of poultry meat and eggs is higher compared to the actual intake of poultry eggs and meat.

Currently, some information on living animals together with poultry are taken from limited markets that are reachable by mass media and electronic means like email, cell phones and website. Although there is no information about livestock products and by products, In addition market intelligence does not exist, This reduces the marketing functions (Njombe *et al.*, 2011).

2.5 Poultry Marketing Situation in Other Countries

In Bangladesh, there is a lack in statistics and information about chicken marketing practises is lacking. Producers in country are not market oriented and their production system is categorised by very little productivity, despite the fact that there is high demand for these poultry produce (Islam and Uddin, 2014). Chicken and eggs dissemination is also done through middlemen, hence farmers are not attaining actual price. For the period of last six/seven months, poultry farmers in Bangladesh have been through huge losses. This is because the cost of production very high while the selling price is very low. Producers do not achieve the required benefit since middleman burdened them and suck the larger percent of profit. Furthermore, the end users pays higher price (Islam and Uddin, 2014).

In Pakistan, study done by Hmad (2005) shows that, poultry marketing system was old-fashioned in nature. It was also discovered that middle man were taking advantage of the poultry producers by taking large percentage of profit. Therefore poultry farmers were not getting remuneration as they was supposed to get, and all these is due to lack of poultry market information. Minimizing the role of middleman and providing poultry market information and strengthening market infrastructure is something needed to be considered immediately by policy makers in Pakistan.

2.6 Other Correlated Work

There have been efforts by the government and private organization to enhance market accessibility to livestock farmers. There are several applications for livestock but they do not provide market linkage between Poultry farmers and potential buyers.

Livestock market monitoring system is one among the applications, is accessible electronically in Tanzania through Livestock Information Network Knowledge System (LINKS) (<http://www.lmistz.net>). This application is available for the whole Africa. Livestock market monitoring system is a system through which gathering, examination and distribution of information desired to help producers, middle men and traders is prepared and structured. The limitation of this system are, the market information is available only by a request via SMS (text) message system or email, Or sometimes via worlds pace radio systems and very rare on the internet, also the updates of information on LINKS is not real time (“LINKS(Version: LINKSV3.042409_testBuild),” 2017).

Tanzania Livestock Identification and Traceability System (TANLITS). This system is for Tanzania only it is available at <http://41.59.254.106:8080>. This system was developed to operationalize the Livestock Identification, Registration and Traceability, and to promote access to market and other related matters. The limitation of this system is the information provided not relevant to poultry farmers, not updated on time and also difficult to access (“Livestock Traceability System (TANLITS) — Ministry of Agriculture Livestock and Fisheries,” 2017).

The Poultry site is an application accessible through <http://www.thepoultrysite.com>. The application is accessible throughout the world and provides information about poultry and poultry feeders and poultry health. The limitation of this system is that the information available here is much more about poultry health and treatment does not link poultry buyers and farmers in a market way.

Rating system available at <http://www.greenplanetlivestock.com.au/rating-system> is accessible worldwide. The limitation of this system is, it is specializes in breeding Red Angus bulls and dams that are highly marketable for increasing genetic diversity in studs and for outcross purposes in regular herds. However, this system does not provide any market information.

Direct livestock marketing system available at <http://www.dlms.ca/default.aspx>. The limitation of this system is that it only deals with cows not poultry business.

All these limitations show that, the marketing system is poorly developed and structured. The marketing system cannot enhance efficient marketing as well as grading and standardization. This poorly structured marketing system does not provide good dissemination of poultry market information's. In addition, it does not support well promotional activities and planned marketing which are all the attributes of efficient marketing. The system is not sufficiently developed to increase efficiency in the constant movement of livestock information especially poultry, from production areas to chain of markets through livestock routes (Hurrissa and Eshetu, 2003).

2.7 Open Source Application

Open Source software (OSS) is a software system with the source code made free and open, so that anyone can read it, use it, change or improve the code (Bahamdain, 2015; Zennaro and Fonda, 2003). There is a wide range of open source software out there that differ widely in aspects of quality. Some of these open source software have been around for longer periods than others and will possibly be higher in aspects of quality and trustworthiness (Heron *et al.*, 2013; O'Neill, 2012). The challenge is to select the right software. Advantages of open source software include, low cost, since it does not require a license fee, they are flexible since you can adjust it to better fit your business or project, and you can also add or remove a particular function, furthermore open source software has good quality and also are reliable (Bahamdain, 2015; Wiggins and Aubrey, 2012). Example Linux operating system demonstrated to solve problems that MS Word operating system could not tackle or tackle a problem poorly and Apache a Web server that's offers access to internet web pages (O'Neill, 2012; Valter and Josir, 2012). Lastly but not least, availability of external support because most of these open source software's have good online community which provides active support to the users. Open source software can be system software e.g. Linux, or application software which include content management software e.g., Word press etc.

2.8 Interviews and Questionnaire

The purpose of questionnaire in information gathering is to gather significant data about the existing situation and what users need, also attitude, facts and behavior about the system at the very beginning of the development process as well as objective of the system, usage and limitations (Sadiq, 2010). An interview involves a situation whereby the participant provides the researcher with information through spoken interchange or dialog (Law *et al.*, 2011). Interview is the most common technique of information gathering with direct involvement of

stakeholder and is adopted in almost all types of software systems, interviews are basically a social activities which involves human and it depends importantly on the collaboration between the participants (Sadiq, 2010). Interview is usually a good tool if you want to understand what users do, and how they will interact with the developed web based platform for reliable market linkage. Interviews is a cheap way and quick way of gathering information from users, and are valuable when you need to explore a certain issue in depth, although interview is constrained by language (Law *et al.*, 2011).

2.9 Usability Testing

The term usability has several definitions depending on field research in Human Computer Interaction (HCI). Usability can be defined as the term in HCI in which the concentration is to remove all possible frustration the user may experience when using the interface (Davis and Jiang, 2016). Usability testing can be defined as a method in user centered design which is used to assess a product by testing it with real users. Furthermore, it assists us to get direct feedback on how actual users work with a product (Bergstrom and Schall, 2014). Nielsen (2012) define usability by using five quality components which are Learnability, Efficiency, Memorability, Errors and Satisfaction. We can say that usability is quality. To be sure the product will be good and will work well without any difficulties or confusion to the user, usability testing must be conducted.

2.9.1 Usability Evaluation Methods/Testing Methods

The usability evaluation method is a way with numerous defined actions for gathering data when a user is using a system for attaining certain usability degree (Fernandez *et al.*, 2011). There are several methods in testing system usability. Usability testing and heuristic evaluation have been the most convenient and suitable methods (Davis and Jiang, 2016; Fernandez *et al.*, 2011; Quiñones *et al.*, 2018). Heuristic evaluation is always done by evaluators. And these evaluator are usually experts based on their own decision without user involvement. In usability testing real users are given software to evaluate. Nowadays, eye tracking combined with usability testing become another technique to measure the user experience (Bergstrom and Schall, 2014). To evaluate usability in this study, usability testing method was used and to evaluate user experience eye tracking method was used.

2.9.2 Eye Tracking

Eye tracking is the procedure of determining where someone is looking. Or we can say eye tracking is the method of knowing where someone is looking in an interface at each point of time (Realpe-Muñoz *et al.*, 2018). Using eye tracking, it is easy to notice where users look at each given moment, also for how long they look at an object, furthermore the pathway their eyes follow (Bergstrom and Schall, 2014). Eye tracker is a special device needed when you want to conduct eye tracking. This Eye tracker is the tool for evaluating eye movement and eye positions (Lui *et al.*, 2017). Some eye tracker are fixed to a pair of glass and some can be attached in front of computers. The important measurements eye tracking study are saccades and fixations. Saccades are eye movement which occurs between fixations and fixation are pauses of eye movement or is a period when the eye is still (Brunyé and Gardony, 2017; Tzafilkou and Protogeros, 2017). When you give a user a certain task to perform within a system, eye tracking is used to monitor number of fixation, fixation duration, saccades (path duration and direction, blinks and pupil diameter (Realpe-Muñoz *et al.*, 2018). Depending on the context, longer fixation duration may indicate greater interest or difficulty identifying the object and regressive saccades could indicate confusion (Bergstrom and Schall, 2014). Eye tracking has several advantages such as understanding the effectiveness of interface like learning which part of the screen draw user attention and which did not, understanding whether labels has required text, and obtaining data about area of interest. Apart from these advantages “data provided by eye tracking alone is of limited use because it doesn’t tell you why a user was looking in a particular area of the screen. It only lets you know that users looked at a region” (Bergstrom and Schall, 2014). To overcome this eye tracking should be used with other usability method like think aloud. Sometimes a person can look to an object without necessary seeing it. So fixations does not always mean attention.

In past years HCI eye tracking research concentrated only on determining usability and interface design issues, but these days HCI eye tracking research also concentrate on determining the overall user experience (Tzafilkou and Protogeros, 2017). “These days eye tracking has been combined with usability testing as another method to measure user experience because, eye movements may reflect emotional states and cognitive processes, hence dimension of the user’s experience with an interface” (Bergstrom and Schall, 2014). Recent studies such as Bergstrom and Schall (2014), Tzafilkou and Protogeros (2017) and Realpe-Muñoz *et al.* (2018) show that eye tracking helps a lot to improve designs by

interpreting user behavior at various stages of the development and can be used into various systems such as home page marketing, advertising, online news etc. Analysis tools in eye tracking are heat maps, gaze plots and gaze replay (Nielsen and Pernice, 2011). According to Nielsen and Pernice (2011), gaze plots are stationary pictures which show users gaze through a sequence of dots showing fixations and fine lines showing saccades. The size of dots show fixation duration, the bigger the dot the higher the fixation time and vice versa. Heat maps uses different types of colors to show either the duration of fixation or the amount of fixation. Different parts of an interface will have different color. For example colors like red and yellow show areas which were observed longer or which attracted more fixations (Rösler, 2012). Gaze plots and heat maps are useful because they give important data like which areas of the screen draw the users' attention and the order sequence in which content is viewed.

2.9.3 Think Aloud

Think-aloud protocol is when a user is requested to verbalize his thoughts while interacting with the system. This method was invented in cognitive psychology and was taken to provide researchers in the area of usability researchers with insights into the participant's mental process when using a system (Marco-Ruiz *et al.*, 2017). Since data provided by eye tracking alone is of limited use then it is important to combine it with other method. During testing session of a Web Based platform for reliable market linkage, users was given task scenarios to perform and was asked to verbalize what they are going while interacting with the system. The advantage of using this method is obtaining accurate idea of user's problems, doubts and other feelings, so this method will gather data about usability and experience.

Rösler (2012), in his usability research said that, eye tracking is usually used in combination with the think aloud method. As stated previous think aloud method is a process in an experiment where by a user is asked to verbalize his thoughts while attempting their task. Think aloud method can be conducted in two different ways, Concurrent Think Aloud (CTA) and Retrospective Think Aloud (RTA) (Rösler, 2012). There are drawbacks of using think aloud method such as a when a user talks about an item tends to look at it more and longer, so it is slow (Nielsen and Pernice, 2011; Rubin and Chisnel, 2014). To avoid this RTA will be used since a user will be asked to think aloud only after one tasks has been completed which is viseversa for traditional CTA (Rösler, 2012) .

CHAPTER THREE

MATERIALS AND METHODS

3.1 Methodology

The study was qualitative type. This study method was used simply because the research aims to get answers on the ‘what’, ‘how’, and ‘why’ phenomena and not ‘how many’ or ‘how much’ which are more about quantitative methods. Qualitative methods are good when you have small number of respondents which may be sufficient for understanding human perceptions, behavior and attitudes, also is most applicable for ordinary setting and gives the researcher more power to control the process (Bricki and Green, 2007). Structured Questionnaire coded to open data kit was a way of data collection, where by qualitative data about the current marketing situation, required market information and challenges faced due to the lack of market information in three districts which are Tanga city, Muheza and Korogwe were collected. Also, during the survey qualified information was gathered through observation. In this section, area of the study, research design, sample size and sampling technique are described as part of the methodology used to carry out the research.

3.1.1 Description of the Study Area

The study site was Tanga Region, Tanzania, located at 39.10 longitudes and -5.07 latitude. Also is to be found at elevation of 22 meters above sea level. Furthermore the population in Tanga is around 224 876, which making Tanga one among the largest city in Tanzania. This area was nominated because of it has large numbers of poultry. In addition it has good market potential (International, 2010). The region is administratively divided into eight districts: Handeni, Kilindi, Korogwe, Lushoto, Pangani, Mkinga, Tanga and Muheza.



Figure 2: Description of the study area, 2018

3.1.2 Research Design

Data were gathered from the research area in the period of one month from January to February 2018. The period of one month was enough since the research was non-experimental which was carried out at single point in time and data was collected once, furthermore the research was time sensitive which means that the respondent will be required to adopt the technology in next 12 months.

3.1.3 Interviews, Questionnaires and Observation

Interview was conducted during the study to poultry farmers and buyers to find out market information needs through a structured questionnaire which was administered to them to obtain market information they need to have. Interview was used to provide information through verbal exchange and was a good tool for overall understanding of what users do, how and why? (Law *et al.*, 2011; Sadiq, 2010). Coding was done to Open Data Kit. Open Data Kit (ODK) is an open source software which help individuals and organizations author to accomplish mobile data collection. It has mainly three steps which are: first design a form, second you will need to setup a server, and lastly you need to connect the device to server (Opendatakit.org, 2015). Open Data Kit automate data collection and it is easy to use. Also uses Android platform to take advantage of Global Positioning System (GPS) and camera capabilities which enables the collection of reach data for later off line analysis (Washington, 2010).

Observation is one among data collection technique. It is a mode of investigation to systematically gather information about different situations or arrangements of a certain group of people. The objective of observation is to have a good understand of a certain situation located in context (Fry *et al.*, 2017; Walshe *et al.*, 2012). Based on this definition, the observations technique was also used in this study where by the researcher went to the real environment of real users and observe the selling and buying processes without direct interference. During the study enough time was used to visit the farmers and buyers of the selected district and observe the whole process of selling or buying poultry or poultry products. The observation process was done for fourteen days, two hours each day within a period of January and February 2018, at Magandini and Muheza markets located within Tanga Region. This approach provides the opportunity to discover how do they sell their products and how do them get market information. It was observed that poultry farmers get market information through customers, friends and family. The information is not reliable which leads to poultry

of the same type and kilogram be sold at different price at the same place. Also it was discovered that poultry farmers use a lot of time and energy to shout when a person pass nearby their poultry thinking that the person is a customer. They only focus to the people who pass there or who come to the market. Failure to reach more customers leads to deficit of some of the products such as eggs.

3.1.4 Sample Size and Sampling Technique

In this study the sample size included 101 poultry farmers and 103 buyers, respondents from three districts of Tanga Region namely, Tanga City, Muheza and Korogwe. Simple random sampling method was used as sampling strategy to select poultry farmers and buyers so as to get the representative sample of selected respondent. Simple random sampling means that every participant of the sample is nominated from the group of population in such a manner that likelihood of being selected for all members in the study is the study group of population is equal (Kanpur Shalabh, 2010). The strength of simple random sampling lie in its advantages of being representative of the population and simple to use. Furthermore it requires a small understanding of the study population (DePersio, 2015). All respondents were given an equal chance of being involved in the study. The equation mention below to calculate sample from population was developed by Cochran (1963), the equation is for unknown and large population. This equation was used to estimate the poultry buyers and farmers sample size since the population was not only large but also was unknown.

$$n_0 = \frac{Z^2 pq}{e^2}$$

Where by

- (i) n_0 = required sample size
- (ii) Z = when confidence is 95% the value of Z becomes 1.96
- (iii) p = proportion of the population having the characteristics
- (iv) q = 1-p
- (v) e = margin of error that is acceptable.

In this study

- (vi) Z = 1.96
- (vii) p = 0.5 because the population was unknown

(viii) e = 0.1

The sample size was 101 for poultry farmer and 103 for buyers.

3.2 System Design

The Objective was to develop web based forum for reliable market linkage. This was achieved through integrating User Centered Design (UCD), Principle of Universal Design together with nine design principle from Horton *et al.* (2013). The integration will work in this way, The UCD was used to analyze the development of prototype, Principle of universal design was used to achieve desired interface and the nine design principles form Horton *et al.* (2013), was used as a guidelines and strategies for incorporating accessibility into this system. User centered design is an idea that places the real user in the at the middle of the development process (Zaina and Álvaro, 2015). Design method like this takes into account the characteristics, needs and wishes of real user. The process will help us to understand the user needs and identify the task requirement within the system since it takes into account real user involvement and is iterative (Huang and Chiu, 2016; Nelson *et al.*, 2013). Using this approach we can question ourselves, how best can the web based platform for market linkage be used by everyone. We should think beyond the idea of average user (Horton *et al.*, 2013). User Centered Design many website usability has been improved (Huang and Chiu, 2016).

Principle of universal design (Simple, Flexible, Equitable, Low physical effort, perceptible information, Error tolerance and Size and space for approach use) should also be considered. This principles helps to consider design process that takes into account any requirements that come from angles are met by the design (Horton *et al.*, 2013).

When designing the Web Based Platform the Horton *et al.* (2013), nine design principles which are Easy Interaction, Clear purpose, People First, Solid Structure, Helpful Way finding, Clean Plain Language, Accessible Media, Presentation and Universal Usability was brought on board. The main aim of taking this onboard is to achieve accessibility and hence user experience. User was engaged through the entire project. User involvement is an important source of knowledge about the perspective of use, and it is good to use their involvement to explore solutions” (Chammas *et al.*, 2015). The purpose of the system needs be clear in such a way that the design should be able to show the user what its function is to avoid capabilities gap. No unneeded words in the structure of the system. “A sentence should contain no unnecessary words, a paragraph no unnecessary sentence”(Krug, 2006). It should be obvious, what is clickable is

clickable so that users can easily interact with the system. The design needs to be self-explanatory easy to find information, simple design to achieve clean presentation, plain language, and universal usability which require the understanding of user and their goals, this mean that the site be simple and easy even if the task is complex. Going beyond technical accessibility and basic requirements will create a nice experience for everyone. Putting the emotions to the design always provide greater level of experience.

3.2.1 Design Thinking Approach

It is a way for innovative problem resolving. It is a process of solving different kinds of design problem that understands the human needs, rather than beginning from a technology (Horton *et al.*, 2013). Design thinking is, way of prioritizing end users desires, needs and challenges by fully understanding a problem and finding an effective solution (Roberts *et al.*, 2016).

Tim Brown, CEO of IDEO defined design thinking as a human-cantered way to improvement that comes from the designer's toolkit to fit in the requirements of people, the opportunities of technology, and the necessities for the success of the business (IDEO, 2018). Among of the advantages of Design thinking are prioritizing comprehensive understanding of underlying problems, it aims to disclose the important issues to users in their day to day lives and empathy study concentrates on what users feel to tell new as mentioned by Camacho (2016), Chou (2018) and Roberts *et al.* (2016). Design thinking is a methodology that has been used in product design and other areas such as information systems design and “it can be used to integrate technologies, innovative thinking, design process and available resources into human desire to build up a new and innovative product” (Chou, 2018). It relies on our ability to be create, to brainstorm and get new ideas and how to enforce the ideas into new product so as to achieve user satisfaction. Based on this studies it shows Design thinking can be used to generate an innovative web based platform for reliable market linkage.

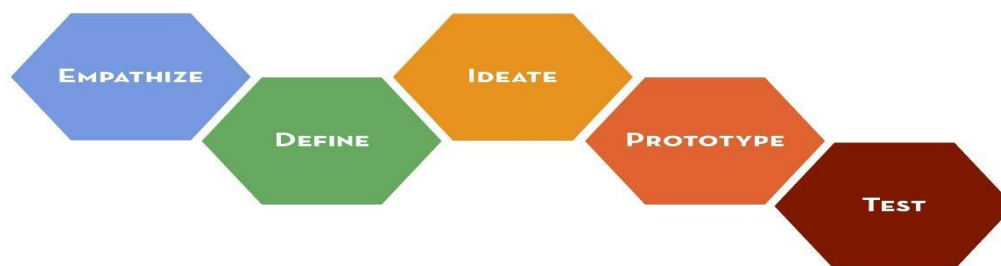


Figure 3: Phases of Design thinking (image by creativiteach.me 2012)

(i) Empathy

Empathy can be defined as a capacity to realise and recognise with someone context, goals, emotions and motivations (“Interaction Design Foundation”, 2018). According to Roberts *et al.* (2016), empathy the process of doing research to the people who are affected or knowledgeable about a product and discover the needs. Empathy is gathering of specific information and on the other hand is precisely analysing it.

Structured questionnaire and observation together was used to get required data. Interview was conducted to farmers and buyers to find out market information needs through a structured questionnaire. Coding was done to open data kit. Random sampling is as sampling strategy used to select poultry keepers and buyers from the list which will be obtained from the government officials. Observation is a way of data gathering where by investigator observe within a specific area of study. Observation of how poultry farmer sell their poultry and poultry farmers was done for fourteen days, two hours each day within a period of February and March 2018 at Magandini and Muheza markets located within Tanga Region.

Analysis was done using Radar Chart Visualization together with the support of descriptive statistics. Radar Charts relates two or more objects or groups on different characteristics or features (Media Educational, 2012). Radar chart gives a very clear visualisation of the groups and factors to make decision according to the various features. It is a useful tool to simplify comparisons between results obtained in further studies (Chaumillon *et al.*, 2017). Radar chart is not good method if you have more than three groups and more than ten factors (Media Educational, 2012). In Poultry market information requirements radar chart was used so as to get a straight forward clear picture and to get a good understanding of data. Among of the result obtained was poultry farmer’s market requirements need.

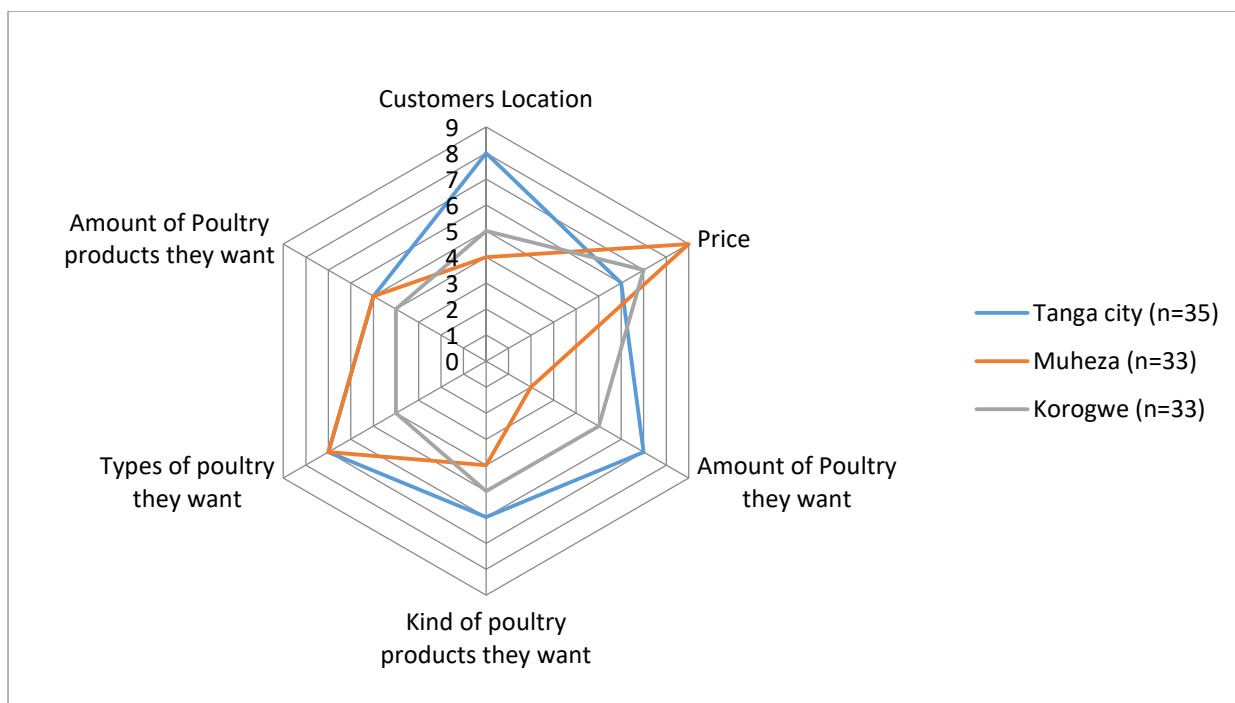


Figure 4: Market information requirements by poultry Farmer, 2018

The Chart above shows that, there are six market requirements needed by poultry farmers. These requirements were the only requirements mentioned by poultry farmers. Poultry farmers in Muheza needs more information about price while poultry farmer in Tanga city wants more information about customer location. One of the poultry farmer in Tanga city say “I don’t have any information about price, and when I want to sell my chicken I just decide the price based on my own experience”. Also poultry farmers in Tanga city wants more information about amount of poultry customer wants and types of poultry customer wants than Korogwe. This market information is very important to both poultry farmers and buyers. This information will help them to make an informed decision, and give them right direction onto where they can go.

Personas is a technique of linking research data from users, which are coming from numerous sources into imaginary but truthful character (Horton *et al.*, 2013). Personas assist developers and designers to concentrate on main users of the system and their needs (Huh *et al.*, 2016). Persona is an explanation of typical user who signifies a group of other typical users. Personal can be created form user research data but sometime can be created from designer’s assumption and experience. Designers in the field of design use personas to focus on target people and it normally help them to establish the user group they are designing for (Vosbergen *et al.*, 2015). Based on this studies personas can be a useful method to understand poultry farmers and

buyers, their behaviour, the needs and combine them into realistic characters and to help remember to put people first during design.

In this study two different personas was created, into imaginary but truthful character from user research data such as interview and observation. From the qualitative data gathered during data collection, we have managed to categorize with different characteristics to life in the stories of the personas. These stories are based on the many people we have met with during user research sessions. They have the skills, desire, education, and resources to use technology.

(ii) Define

Define is a second phase of design thinking where you need to generate design ideas using simple language to be shared by designers and users. In this phase you need to put together all data from research and observe where the problems are, while recognizing users' needs, and start to highlight innovation chances (Gibbons, 2016). Best way to do this is by using scenarios. Scenario can be defined as a story of someone in a specific situation, uses a system with a specific aim. Scenario also is inventive thing to discover good design ideas. It is structured like a story inside a core character that is interested to use a system in precise situation with exact intentions and goals. It is normally established around a main persona (Nielsen, 2004). Here scenarios has been used to illustrate how these personas will use the web and how can we design for them.

Scenarios has been used to illustrate how these personas will use the web and how we can design for them. See sample Scenario



(Tumwebaze, 2015)

A site with so many decision, I can't stay.

I always wants things to be straight, so I can accomplish my tasks quickly and gets into another schedule. I need sites that are so straight. I can read it so quickly and make decisions. Honestly I don't stay on a site long if it has a lot of text and so many decision to do. On many sites, there is so much crowded in that I can't find anything at all. It just makes my head hurt to even try.

I like the sites that are simple and don't have so many decisions I have to make. Sometimes I find sites which are so straight. And there I will stick and just search.

Figure 5: Poultry farmers Scenario, 2018

(iii) Ideate

Ideate is the third phase of design thinking which means making a wider range of ideas on a chosen topic. The ideas are generated without any attempt to assess or to judge them. This can be done in group or alone (Harley, 2017). Brainstorming is one type of ideation. According to Osborn's (1957), the following are rules for brainstorming: no bad idea, go for quality and crazy is allowed. Brainstorming encourages building of ideas. In this research brainstorming method has been used to avoid obvious solution.

The following things was among the ideas generated during brainstorming session. How Products will be shipped (contract between seller and buyer), Nice chicken recipes will be included (Hotels and restaurants will be given free chance to advertise (recommend) nice chicken recipes, Buying guide will be used to compare and contrast between products and then advice buyers, Daily deals showing Discounts and nearby shops, hotels and restaurants. (Permanent not pop up), Jokes (Memes), A calendar will be includes to help farmers not to forget orders, Industry News will be included such as feeds and medication. Twitter feeds will be used (#tags). Poultry farmers and buyers will be rating each other.

(iv) Prototype

Prototype is a draft that represent a subset of your ideas. We can also define prototype as a draft used to show intentions behind a future. Prototype is general design idea to users before spending a lot of time and money into development (Gibbons, 2016). In this study wireframes has been prepared by using pencil software also use case was created using online lucid chart software.

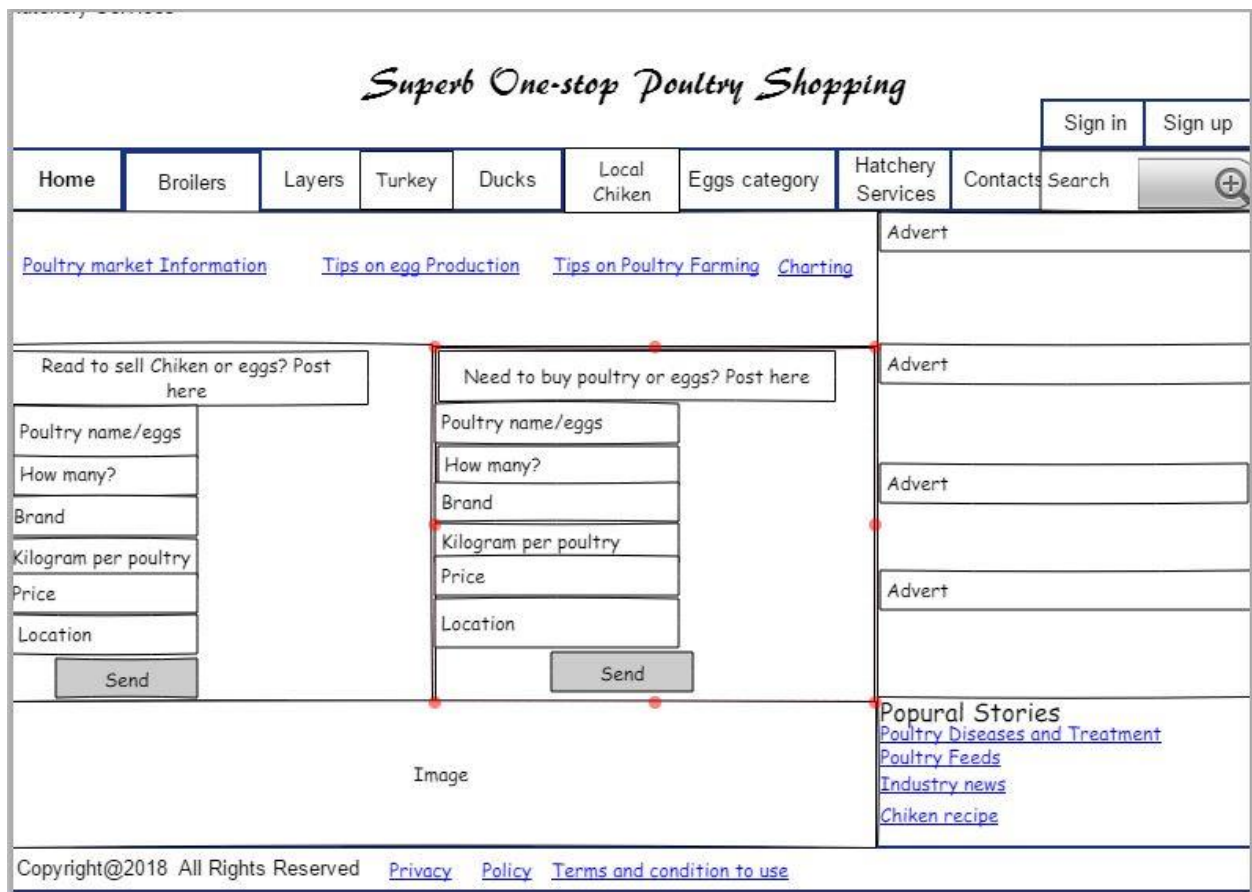


Figure 6: One of the home page wireframes created as a prototype, 2018

3.3 Research Framework

This framework was derived from data analysis, that poultry farmers and buyers will use the web based platform to access the required market information and overcome the mentioned challenges caused by lack of market information. Poultry farmers and buyers will use smartphone, tablets or computers to access the web based platform, and it will depend since nowadays the advancement of technology has brought low cost smartphone which are affordable to majority of poultry farmers in Tanzania (Mussa *et al.*, 2016).

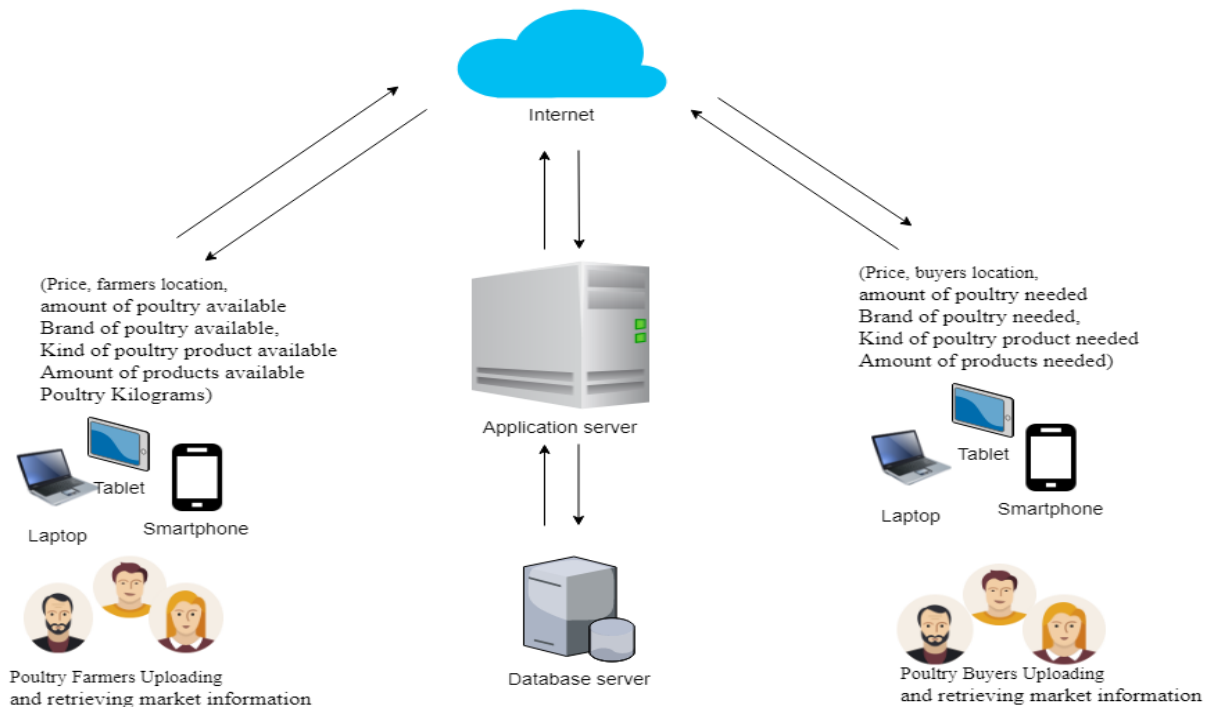


Figure 7: Framework the proposed web based platform

3.4 Requirements Engineering

The process of determining and examining the purpose of the software. It also involves stakeholder's identification and their needs. Also documenting them in a form that is open to communication, analysis and implementation (Al-salem, 2007; Schneider *et al.*, 2010). Requirements for a system are the explanations of the services that the system should offers and the limitations on its operation (Schneider *et al.*, 2010). Requirement is a term for explaining a set of statements for identification of a system features, tasks or limitations. Generally, requirements are required to connect the problem and the solution. Design of a solution relies on the completeness and correctness of the problem. It is important to determine the scope of the system so as to be attention on planning the tasks in the right direction as early phase as possible (Dey and Lee, 2017). The aim of requirement engineering is to find out information on what features the system should have (Carrizo *et al.*, 2014). Requirement engineering phase is a very important phase because it answers the very vital question "what was the system aimed for?" (Al-salem, 2007).

Requirement engineering phase may include four activities which are feasibility study, discovery requirement (elicitation and analysis), specification and validation (Schneider *et al.*, 2010). In this area we will be more attentive on requirement discovery and requirement

specification. In this study more than one elicitation methods was used to find the requirements for web based platform for reliable market linkage, which are interview, questionnaire, observation and literature review. Also there was active participation of stockholders to be sure that all the requirements required has been gathered. Despite of using interview, questionnaire, observation and literature review active involvement of the stakeholders were also important (Sadiq, 2010).

3.4.1 Requirement Specification

Requirements specification is the procedure of putting down in writings all user and system requirements. These requirements should be easy to understand, clear, complete, unambiguous and consistent (Schneider *et al.*, 2010). System requirements are classified as functional requirements and non-functional requirements. Functional requirements are what services the system should offer and how the system should react to certain inputs. Also what the system should not do. While non-functional requirements are limitations on the functions the system should offered (Schneider *et al.*, 2010).

Table 1: Functional Requirements

Actor	Requirements	Description
Administrator	Monitor system activities	System Administrator shall monitor the whole system
	Update system	System Administrator shall update the system
	Create account	Poultry farmer Shall be able to create account
	Sign in	Poultry farmer Shall be able to sign in
Poultry Farmer	Post the Advertisement	Poultry farmer shall be able to post the advertisement
	View the poultry and poultry products needs	Poultry buyer shall be able to view the poultry and poultry products needs
	View her orders form buyers	Poultry farmer shall be able to view her orders
	Real time charting	Poultry farmer shall be able to chart with buyer
	Provide Payments details	Poultry farmer shall be able to provide payments details
Poultry Buyer	Create account	Poultry buyer Shall be able to create account
	Sign in	Poultry buyer Shall be able to sign in
	View the Advertisement	Poultry buyer shall be able to view the advertisement
	Post the poultry and poultry products needs	Poultry buyer shall be able to post the poultry and poultry products needs
	Press orders	Poultry buyer shall be able to press orders
	Real time charting	Poultry buyer shall be able to chart with farmer
	Access the payment details	Poultry buyer shall be able to access payments details
Visitor	Provide industry information	Visitor shall provide poultry feeds information
		Visitor shall provide poultry vet care information

Table 2: Non Functional Requirements

S/N	Requirement	Description
1	Usability(ease of use, effectiveness, efficiency and satisfaction,)	Development was user centered
2	Reliability	When the user enters invalid username or password he cannot buy or sell.
3	Performance	The system is available when the internet is available
4	Security	Users cannot buy or sell through the system until administrator approves them.

3.5 Development of the Web Based Platform for Poultry Market Linkages

In this study Word press was used to develop web base platform for reliable market linkage between farmers and potential buyers. Word press is a website creation tool which is online and open source. It is based in Hypertext Preprocessor (PHP) and My Structured Query Language (MySQL).

Word press has been chosen to develop this platform because of the power of plugin, which allow easy customization and modification. It have APIs that make it possible for users to create own plugins and extend functionality. Word press has a very powerful, vibrant and supportive community. In addition word press support more than 60 languages. Also it has very easy way for users to manage contents, drafts, private or public posts, the widgets are designed to provide simple and easy way of structuring, designing and creating pages without using the technical platform of Hypertext Markup Language (HTML). It is easy to create look and feel and keep the website fresh by changing the site layout by clicking single button. It has very responsive theme that automatically adjust to fit into mobile screen, no need to create a separate website for mobile phones. Furthermore Word press code are very easy to index via Google (Fernandes 2017; Hisar, 2015).

Developing from scratch always is so costly in terms of money and time, perhaps it will be very difficult to have all the functionalities together with good user experience. To reuse the software to build customized solution for users, makes it able to seize key benefit such as better output and customer production. Also traditionally businesses in developing countries,

similarly in developed countries are hindered by a small budget and limited technical expertise (Valter and Josir, 2012). In order to save time and money cost while achieving good quality and user experience, Open source software was used in this study to implement the web based system for market linkage between farmers and buyers. The statistics below shows the usage of content management software by 2017.

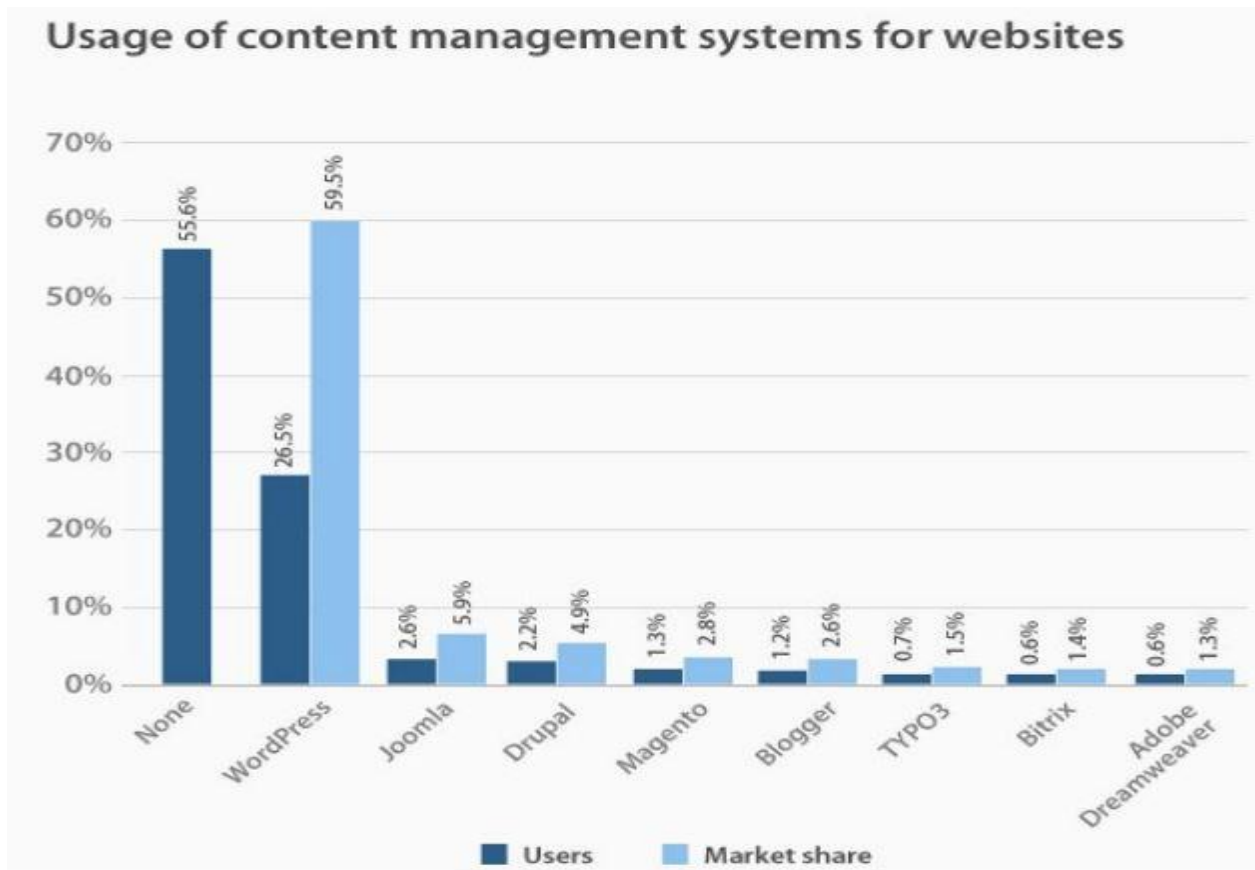


Figure 8: Usage of content management systems for website creation (Gina Smith 2017)

3.6 Assumptions

The following assumptions were made

- (i) All poultry farmers and buyers know how to read and write
- (ii) All poultry farmers and buyers have or will afford to have smartphone or computer or tablet
- (iii) All poultry farmers and buyers have internet access
- (iv) All poultry farmers and buyers have knowledge on using smartphone and website

3.7 System Actors

The system is comprised of several actors and their underlying roles. Actors are direct and important users of the system because they represent of various groups of stakeholders of this website. The following list are the main system actors;

- (i) Administrator
- (ii) Poultry farmers
- (iii) Poultry buyers
- (iv) Visitor

3.8 Technologies Used

- (i) Word press website creation tool based in PHP and MySQL
- (ii) Hypertext Markup Language was used to format Interface
- (iii) Scrip language; Java script language

3.9 Use Case Diagrams

Use case are representation of system main functionalities and actors involved form users point of view. Use case provides a valuable and simple platform with a common language for both end users and technical people to collaboratively understand system requirements and functions.

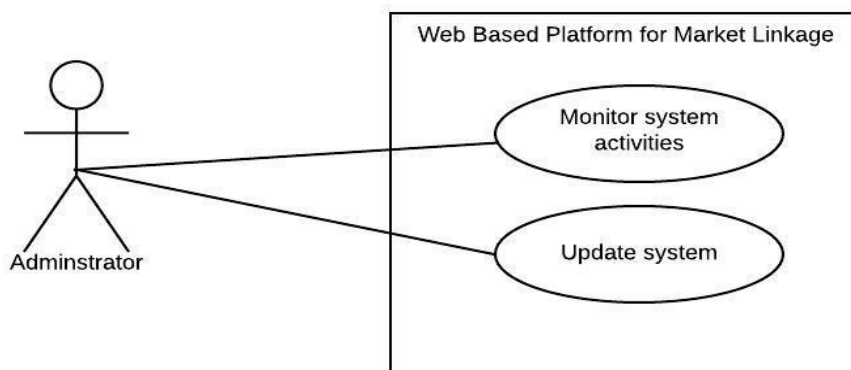


Figure 9: Administrator use case, 2018

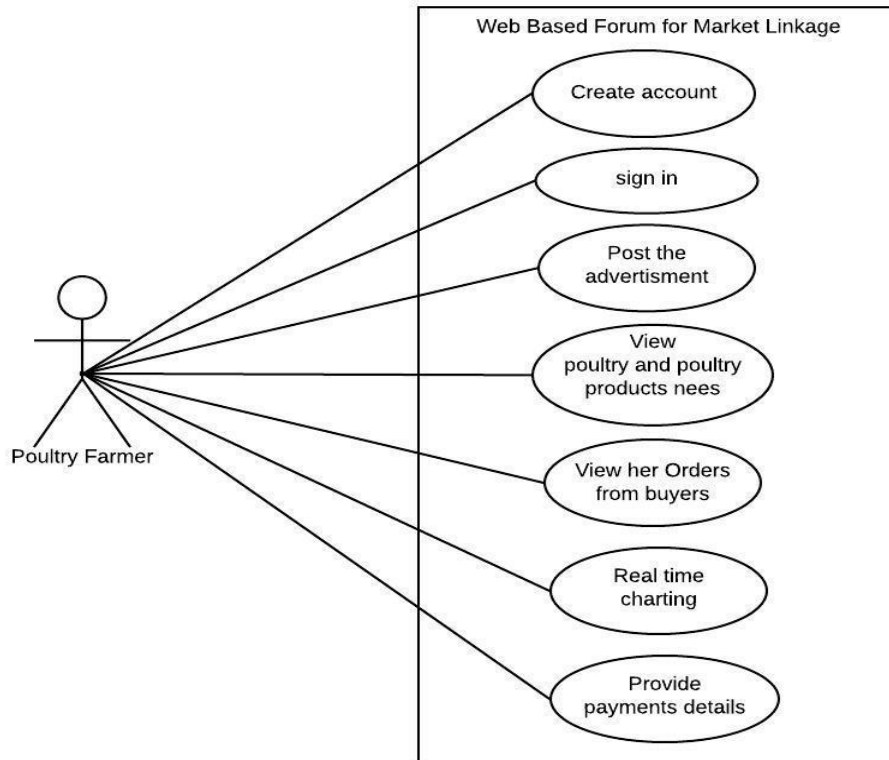


Figure 10: Poultry farmers use case, 2018

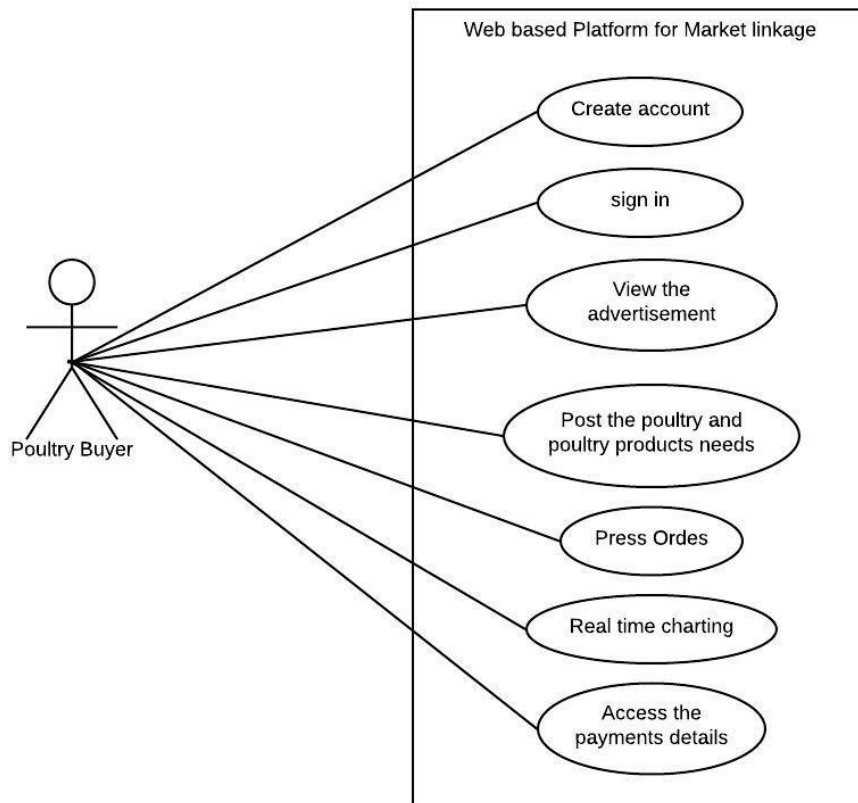


Figure 11: Poultry buyer use case, 2018

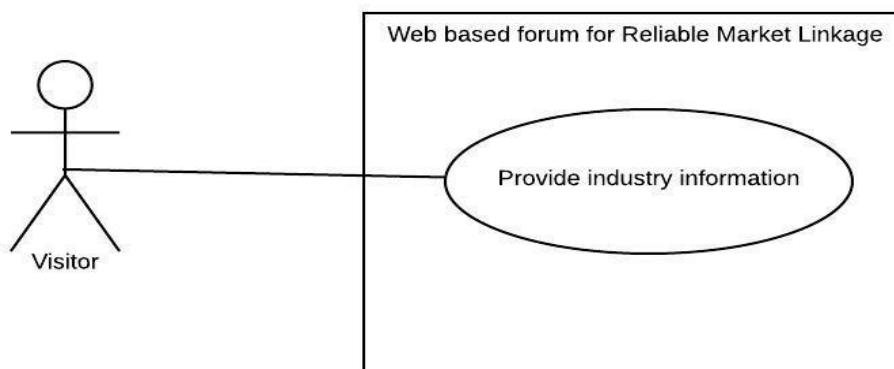


Figure 12: Visitor use case, 2018

3.10 Other Requirement for Operating Environment

- (i) Internet connection
- (ii) A web browser: Mozilla Firefox, internet explorer, Opera etc
- (iii) Operating system: windows, Linux, Ubuntu, Mac OX and Android

- (iv) XAMPP server
- (v) Java JDK

3.11 Usability and User Experience Testing Of the Developed Web Based Platform

Real user uses were given a software to evaluate. In this study usability testing was used to assess usability and eye tracking was used to evaluate user experience. Eye tracking was combined with usability testing as another method to measure the user experience (Bergstrom and Schall, 2014).

Usability testing method was selected because first we want to watch people actually use things and get stuck so that we can solve the problem. Krug (2006) argues that usability test is about observing someone at a time performing typical tasks in a system so you can detect and fix problems. Second the nature of this research it is easy and cost effective to get the poultry farmer and buyer participants rather than usability testing experts. Participants form targeted group was selected and was asked to complete a set of tasks within a web based forum for reliable market linkage between poultry farmers and buyers. Their performance was assessed through think aloud technique and questionnaires to identify any concerns.

Eye tracking method was combined with retrospective think aloud to test effectiveness (accuracy) of the developed home page interface of Web Based Platform for reliable market linkage between poultry farmers and buyers. Medium fidelity prototype was tested. It was so important to test the home page interface because if the homepage can not to clearly say what the website is for and what users can perform on the website, people will leave (Nielsen, 2012). Users will never spend a lot of time to trying understand an interface.

3.11.1 Testing Model

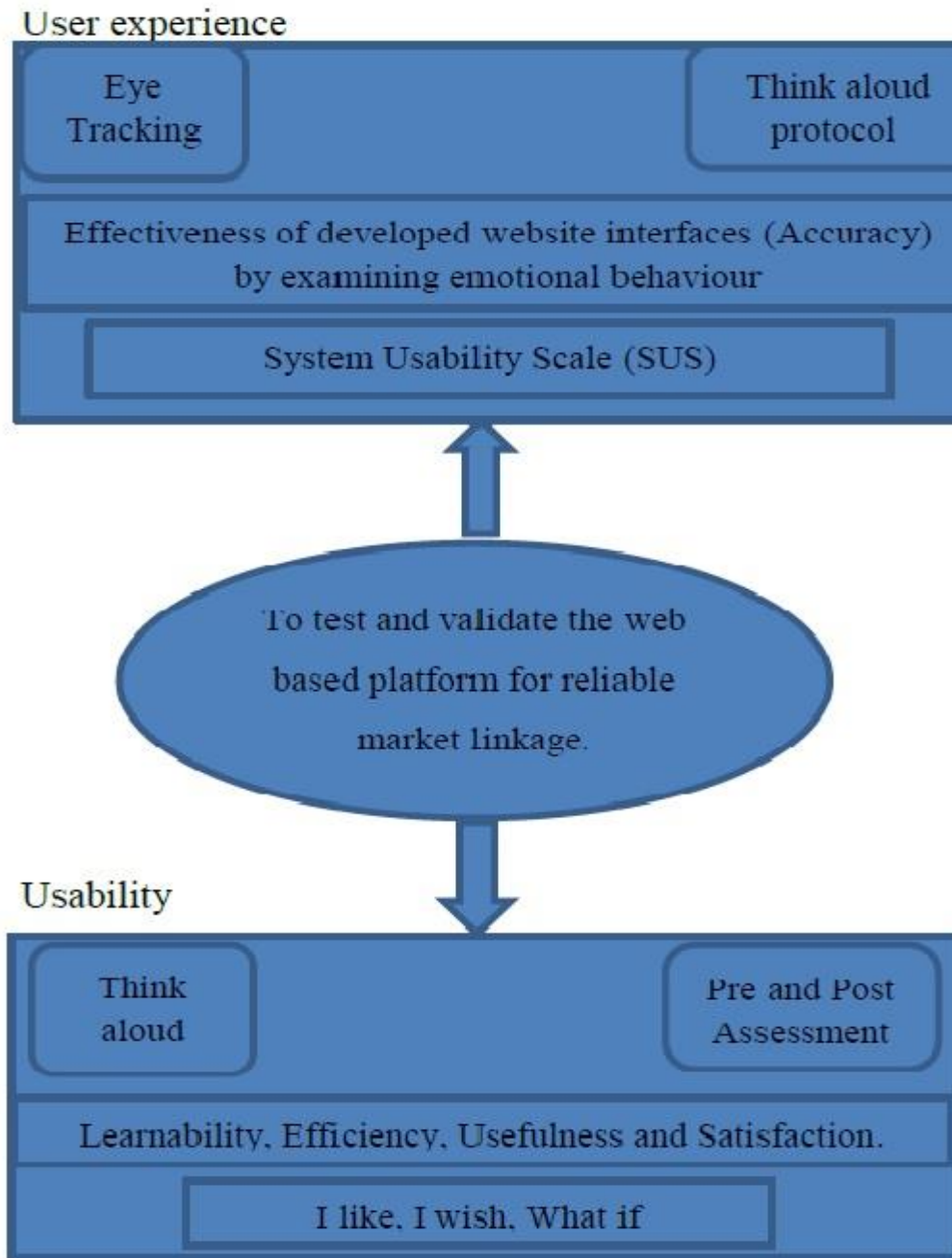


Figure 13: Usability Testing Model, 2018

3.11.2 Usability Testing of the Developed Web Based Platform

An onsite and laboratory usability testing was conducted to poultry farmers using high fidelity prototype of web based platform located on the test administrator laptop. During the testing session's moderator were present in the room to capture and record each participant navigation

choices, number of task completed correctly, number of incomplete tasks, comments, overall satisfaction rate, questions and feedback.

Usability testing sessions was conducted to poultry farmers on 18th June 2018 at Nelson Mandela CoCSE lab and 25th June 2018 at farmer's normal places (home). The purpose of doing this study was to make this system usable, by accessing the web interface design and information flow. Also ensuring the absence of frustrations when using it (Rubin and Chisnel, 2014). Usability is an essential situation for survival of website. When a website is not clear "what the web site is for" and it is difficult to use, people leave (Jacob Nielsen, 2012).

(i) Methodology

In this study within subject design was used where by each individual user perform all the tasks, summative tests was done with the aim of examining and evaluating how effectively the concept has been implemented. One laptop with internet connection was the equipment's used. The goals of this study were to assess user ability to operate the system (Learnability), the quickness the user can accomplish the goals (Efficiency), user's readiness to use the system (Usefulness) and users' perception of the system (Satisfaction)

The standard data about system usability was gathered. Both qualitative and quantitative data about the effectiveness of Web Based Forum for reliable market linkage was gathered. Quantitative data such as number of users able to complete all tasks, number of attempts required to complete task time to complete task and pre-test and Post-test questionnaires was gathered. Qualitative data (think aloud protocol) such as I like it, Wow! Was also gathered. Performance measures were also collected such as Number of tasks completed collect, number of uncompleted task. Preference Measures were also collected such as product usefulness, product matched expectations and suitability of product purposes to user's tasks.

The test administrator recruited the participants using poultry farmers screening questionnaire. The test administrator went physically to see poultry farmers and inform them about the testing logistics and inviting to participate. Each single session took around 50 minutes. In the testing sessions the administrator gives short introduction about the session and requested participants to fill out a brief pre-test questionnaire. Participants reads the task list and starts to perform the tasks on the website. After completion of all the tasks, the administrator requested the participants to rate the system on a 4 point System Usability Scale with measures ranging from

1 strong agree to 4 strong disagree for seven subjective measures. Post-test debriefing followed to find out more information about the overall website. The following questions were asked

- a) What the participants liked most
- b) What the is their wish about the system
- c) Recommendations for improvement (What if)

(ii) Participants

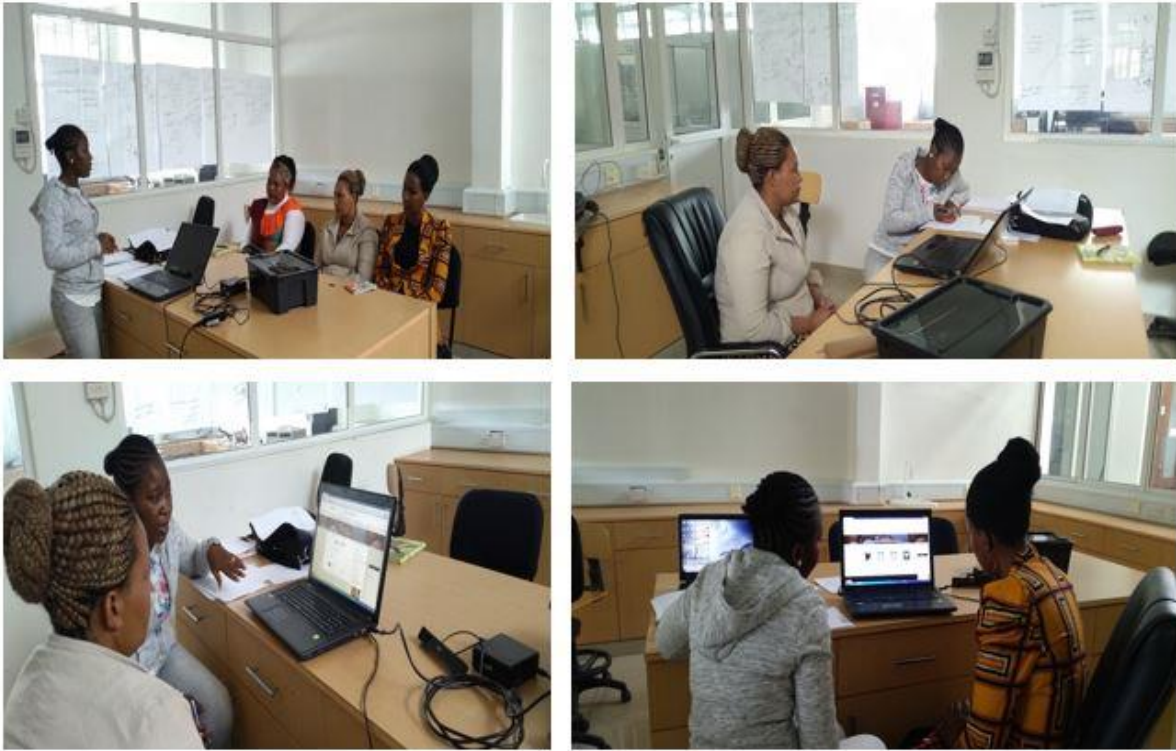
Five poultry farmers aged 18 and above were test participants. Three of the participants where female and two were male. Five poultry buyers where scheduled over two testing dates. Three participants were involved in testing on 18th June 2018 and two on 25th June 2018. All five participants completed the test. According to Nielsen (2012), only 5 participants are enough to let you discover nearly as many usability problems as you could discover using many more test members. Each individual session lasted approximately 50 minutes.

(iii) Task/Scenario

Test participants attempted completion of the following tasks

Table 3: Poultry farmers task scenario

Tasks	Estimated Time (min) / baseline
Identify what the website is for	5 / 3
Create account	5 / 3
Try selling 10 chicken	7 / 5
Find if someone has posted (advertisement) information about poultry and poultry products to find out more about your fellow farmers	5 / 3



CoCSE Lab – NM-AIST

Figure 14: Photos taken during usability testing session with poultry farmers, 2018

3.11.3 User Experience Testing of the Developed Web Based Platform

An onsite user experience testing was conducted to poultry farmers using high fidelity prototype of web based platform located on the test administrator laptop. During the testing session's moderator were present in the room to capture and record each participant navigation choices, number of task completed correctly, number of stopping points, Think aloud quotes, number of incomplete tasks, comments, overall satisfaction rate, questions and feedback.

User experience testing sessions was conducted in Moshi to poultry buyers (Uhuru hotel, Hostel Hoff and Mimoso Cafe on 22th June 2018 and 2nd July 2018 in Tanga, respectively to poultry buyers (Tanga Hotel and Mkonge Hotel). The aim of doing user experience testing is to ensure the home page interface is clear and will exactly help farmers and buyers to accomplish their goals as expected. If homepage could not clearly say what a website is for people will leave (Nielsen, 2012). This study is necessary for the survival of the website. Accomplishment of task without error (accuracy) and how early will the user accomplish a given task (completeness) is the effectiveness (Rösler, 2012).

(i) Methodology

In this study within subject design was used where by each individual user perform all the tasks, summative tests was done with the aim of examining and assessing how effectively the concept has been implemented. One laptop with internet connection, connected to the eye tracker was the equipment's used. The goals of this study is to make the use of web based platform for market linkage less stressful and easy to use. We examine emotional behavior when a user is interacting with the system. Eye tracking combined with think aloud protocol together with facial expression will be used to answer a variety of questions when a user is performing tasks in website.

The standard data about system usability was gathered. Qualitative data (think aloud protocol) such as I like it, Wow! Was gathered. Also qualitative data about the effectiveness of Web Based Forum for reliable market linkage was gathered.

The test administrator recruited the participants using poultry buyers screening questionnaire. Poultry buyers where contacted through email and some of them through mobile phone and inform them about the testing logistics and asking their presence and participation. Each separate session took around 50 minutes. During the sessions the testing administrator gives short introduction about the session and requested participants to answer brief pre-test questionnaire. Participants reads the task list and starts to perform the tasks on the website. After completion of all the tasks, the administrator requested the participants to rate the system on a 4 point System Usability Scale with measures ranging from 1 strong agree to 2 strong disagree for seven subjective measures.

(ii) Participants

Five poultry buyers aged 18 and above were test participants. Three of the participants where female and two were male. Five poultry buyers where scheduled over two testing dates. Three participants were involved in testing on 22th June 2018 and two on 02th June 2018. All five participants completed the test. According to Jakob Nielsen (2012), only 5 participants are enough to let discover nearly as many usability problems as you could discover using many more test members. Each individual session lasted approximately 50 minutes.

(iii) Task/Scenario

Test participants attempted completion of the following tasks

Table 4: Poultry buyer's task scenario

Tasks	Estimated Time (min) / baseline
Create account	5 / 3
Find if someone has posted (advertisement) information about poultry and poultry products before you decide to buy.	5 / 3
Find out where you can find more information about the advertised products	5 / 3
Try buying 20 eggs from this website	7 / 5



Mimosa Café-Moshi

Uhuru Hotel-Moshi

Figure 15: Photos taken during user experience testing session with poultry buyers, 2018

CHAPTER FOUR

RESULTS AND DISCUSSION

4.2 Findings from Interviews and Questionnaires

The analysis of the collected data was done using Radar Chart Visualization together with the support of descriptive statistics. Radar Charts normally compares two or more different objects on different characteristics (Media, 2012). Using Radar chart we have been able to understand, compare and get a clear meaning of all the collected data from two groups (farmers and buyers), furthermore it has been a useful tool to simplify comparisons between results obtained (Chaumillon *et al.*, 2017). Radar chart is good method if you have less than three groups and less than ten factors (Media, 2012).

4.2.1 Profile of the Respondent

A total of two hundred and four respondents were surveyed. One hundred and one (101) were Poultry farmers and one hundred and three (103) were Poultry buyers. One hundred and ten (110) were women and ninety four (94) were men. Respondents were aged between 20 and 66 years and their mean age was 39 years. Seventy two (72%) of all poultry farmers and eighty six (86%) of all poultry buyers have access to the internet. Most of them access internet by using smartphone.

Table 5: Selected Poultry Farmers and Buyers Tanga Region

S/N	District	No of Poultry Farmers	No of Poultry Buyers
1	Tanga city	35	35
2	Muheza	33	34
3	Korogwe	33	34
4	Total	101 (50%)	103(50%)
5	Grand Total	204 (100%)	

4.2.2 Poultry Farmer Market Information Requirement

It was discovered that poultry farmers cannot attain greater sells, not for the reason that there is a lack of demand for their produce. But it is because they do not have market information in the aspects of their business, this has also been established by previously studies (Abate *et al.*, 2003; International, 2010; Msoffe and Ngulube, 2016). Poultry Farmers they need constant flow of information about the market (El-obeid, 2012). The Chart below shows that, there are

six market requirements needed by poultry farmers. These were the only requirements mentioned by poultry farmer. Poultry farmer in Muheza needs more information about price while poultry farmer in Tanga city wants more information about customer location. One of the poultry farmer in Tanga city say “I don’t have any information about price, and when I want to sell my chicken I just decide the price based on my own experience”. Also poultry farmers in Tanga city wants more information about amount of poultry customer wants and types of poultry customer wants than Korogwe. This market information is very important to both poultry farmers and buyers. This information will help them to make an informed decision, and give them right direction onto where they can go. Hence reliable market information system is essential that will bridge the poultry market information and allow users to get required information on timely manner (Hurrissa and Eshetu, 2003).

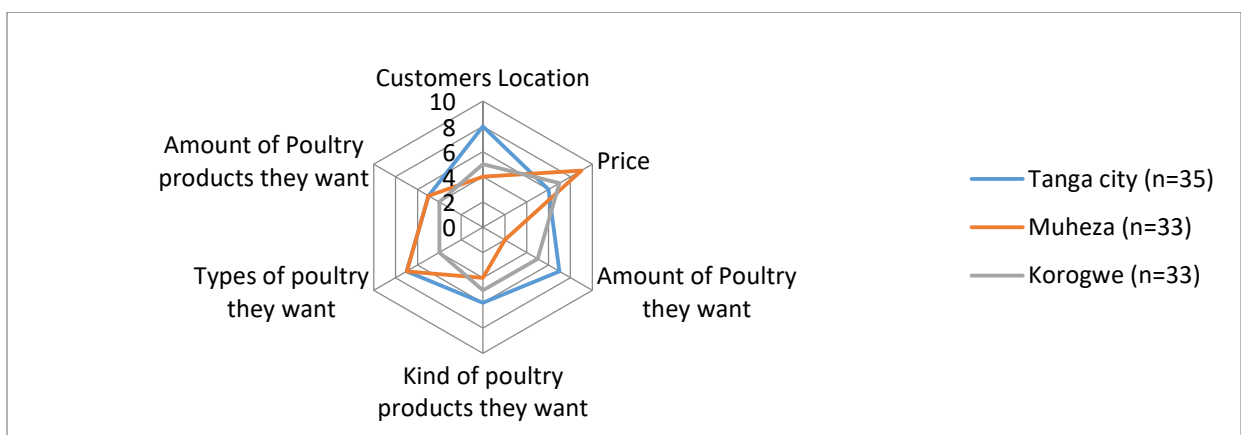


Figure 16: Description of poultry farmer’s market information requirements, 2018

4.2.3 Poultry Farmer’s Current Way of Advertising and Getting Market Information

It was discovered that current markets are not well integrated because of absence of market information (Hurrissa and Eshetu, 2003). From data analysis we discovered that the medium used mostly by farmers to advertise and to get market information of their poultry and poultry products is friends (neighbors) followed by internet. Although they also use other medium such as radio, Television (TV), and brochures but this were least mentioned. This means that Poultry farmers mostly advertise their products through a word of mouth to friends. Poultry marketing situation analysis was done so that to discover the current situation, 69% of farmers advertise their poultry and poultry products, while 31% do not advertise their products. However these farmers who advertise their products they just do it in local ways for example many of them

they just tell a friend by a word of mouth. In order for this poultry farmers to build more strong business and to have a large customer base they need to change the way of marketing their products. Up-to-date marketing needs effective advertising activities to familiarize products to potential buyers (Hurrissa and Eshetu, 2003).

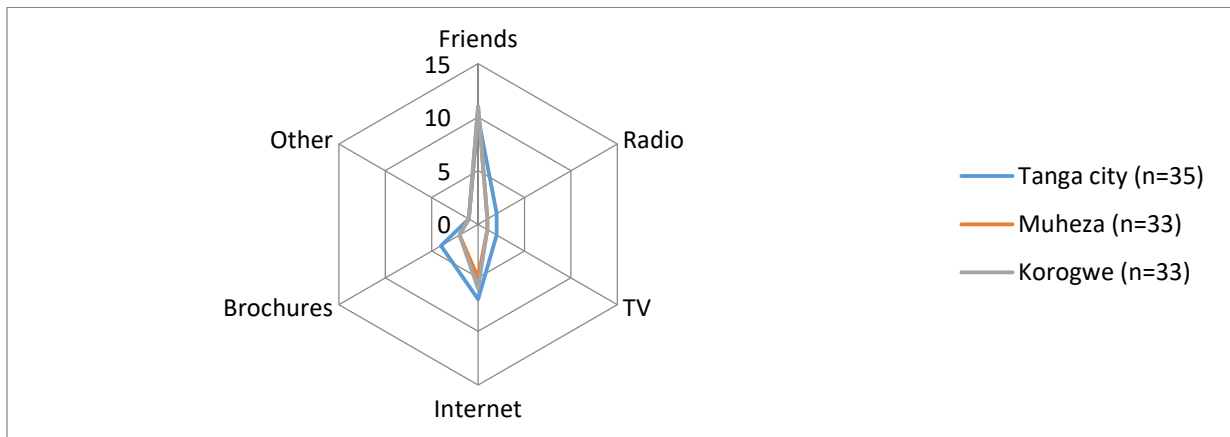


Figure 17: Description of current way of advertising and getting market information, 2018

4.2.4 Challenges Faced by Poultry Buyer Due to Lack of Market Information

It was discovered that due to lack of market information poultry buyers are facing a lot of challenges including making uninformed decision, “buyers are not able to communicate more proactively” (Tiago and Veríssimo, 2014). One of the buyers at Muheza district said this “many times I decide to buy any kind of chicken appeared in front of me, at any price just because there is no any other choice”. If poultry buyers will have online access to marketing information then they will avoid the challenge of buying low quality products at higher price, since they will have a variety of choice and they can seek others opinion about a specific product and its price (Stephen, 2016; Tiago and Veríssimo, 2014). And thus failure to achieve customer satisfaction will be avoided since the buyer has get the value which is more than promotion.

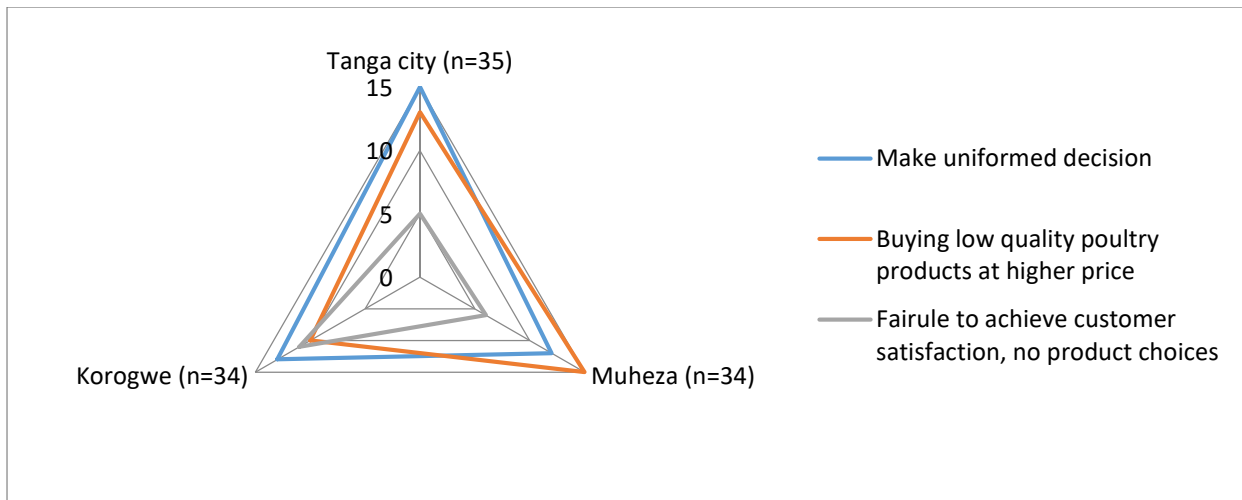


Figure 18: Challenges faced by poultry buyer due to lack of market information, 2018

4.2.5 Challenges Faced by Poultry Farmer Due to Lack of Market Information

Most of the poultry farmers are selling at a cheaper price only because of the absence of market information. Also it was discovered that poultry farmers fail to grow into their business because they only focus to the friends around them. They also get loss, if the eggs stay longer without being sold they will get spoiled. Poultry farmers fail to decide on how much chicken to keep and this is uninformed decision. Failure to get market information leads to arise of middleman which buy the poultry at cheaper price and sell them at higher price. Poultry farmer spend more time to find the customers and fail to perform other activities.

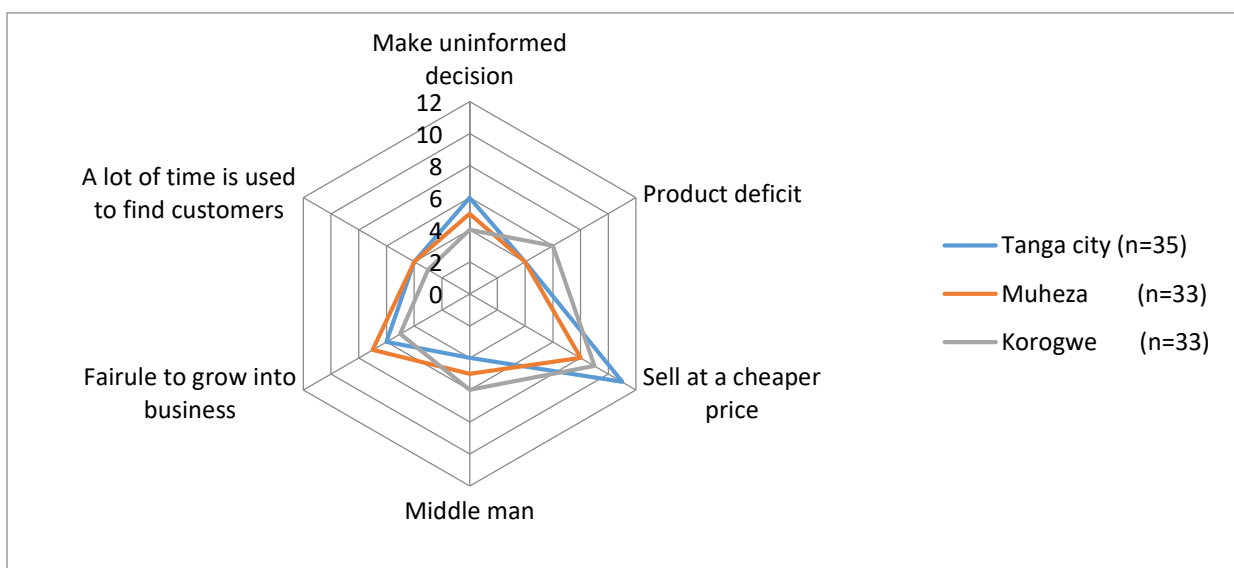


Figure 19: Challenges faced by poultry farmer due to lack of market information, 2018

4.2.6 Observation

Observation involves watching a certain group with an intention of gathering specific information about different settings of their daily activities. Normally the objective is to understand well their situation (Fry *et al.*, 2017; Walshe *et al.*, 2012). Observation involve the investigator visiting a particular place and watching the real performance of the processes without any interference. Data collected during observation are of grater use and can answer different questions that generates new facts about the problem. The findings from observation can be used to improve the overall system performance (Fry *et al.*, 2017; Walshe *et al.*, 2012).

During the study enough time was used visiting the farmers and buyers of the selected district and observe the whole process of selling or buying poultry or poultry products, the process was done for fourteen days, two hours each day within a period of February and March 2018, at Magandini and Muheza markets located within Tanga Region. This approach provide the opportunity to discover how they sell their products and how do them get market information. It was observed that poultry farmers get market information through friends, family and other customers and the information where not reliable which leads to poultry of the same type and kilogram be sold at different price. Also it was discovered that poultry farmers use a lot of time and energy to shout when a person pass nearby their poultry thinking that the person is a customer. They only focus to the people who pass there or who come to the market. Failure to reach more customer leads to deficit of some of the products such as eggs.

4.3 Usability Testing Results

4.3.1 Task Completion Success Rate

All participants successful completed Task 1 (Identify what the website is for). Four of the five (80%) completed Task 2 (Create account). Three of the five (60%) completed Task 3(Try selling 10 chicken). Also three of the five (60%) completed Task 4 (Find if someone has posted (advertisement) information about poultry and poultry products to find out more about your fellow farmers).

Table 6: Task accomplishment success rate

Participants	Task 1	Task 2	Task 3	Task 4
Participant 1	✓	✓	-	-
Participant 2	✓	-	-	-
Participant 3	✓	✓	✓	✓
Participant 4	✓	✓	✓	✓
Participant 5	✓	✓	✓	✓
Success	5	4	3	3
Task Accomplishment Success rates	100%	80%	60%	60%

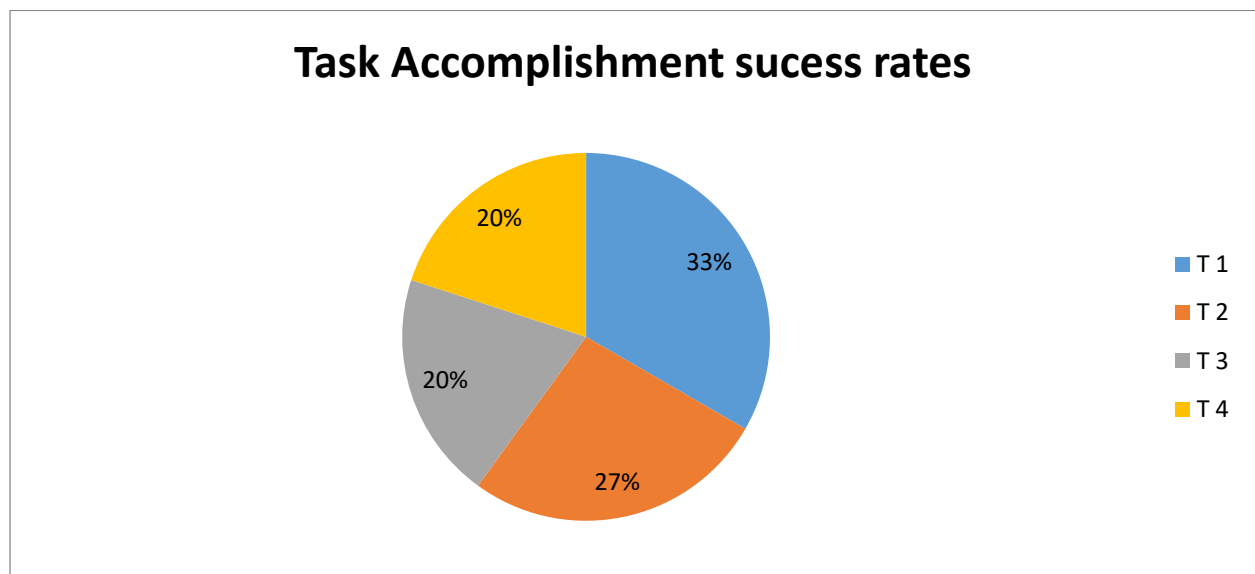


Figure 20: Graph for task completion success rate, 2018

4.3.2 Task Rating

After completion of all tasks, the participants were asked if was easy finding the information within the website, capability to retain track of their location within the website and if the system functions were well integrated. The number of participants who said yes it was easy to find information, easy to track their location and the system was well integrated was recorded and the mean was calculated.

Table 7: Task rating results, 2018

Tasks	Easy Finding Info	Location in site	System Integration	Overall
Identify what the website is for	4 (80%)	5 (100%)	4 (80%)	4.4
Create account	4 (80%)	5 (100%)	3 (60%)	3.8
Try selling 10 chicken	3 (60%)	2 (40%)	3(60%)	3.4
Find posted info about poultry and products	3 (60%)	5(100%)	2(40%)	3.2
All tasks	3.5	4.25	3	

4.3.3 Time Used on Each Task

Administrator noted down time on each task of every participant. Other tasks were simple compared to others.

Table 8: Time on task results

Tasks	Baseline	P 1	P 2	P 3	P 4	P 5	Average
T 1	5 / 3 min	1 min	30 sec	30 sec	20 sec	1 min	0.47 min
T 2	5 / 3 min	5 min	5 min	5 min	3 min	3 min	3.2 min
T 3	7 / 5 min	10 min	7 min	5 min	3 min	5 min	6.0 min
T 4	5 / 3 min	10 min	7 min	1 min	1 min	5 min	4.8 min

Task 3 required the participants to try selling 10 chicken and took the longest time to complete (mean average = 6.0 minutes). However completion time ranges from 20 sec to 10 minutes with mostly time less than 5 minutes.

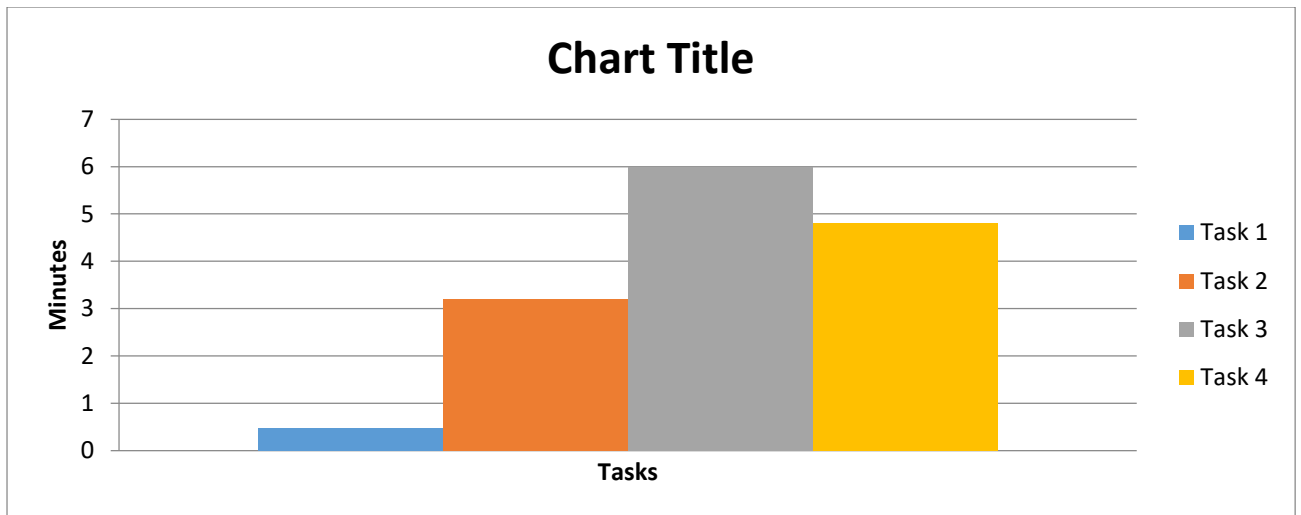


Figure 21: Graph for time on Task results, 2018

4.3.4 User Errors

Errors (5 users, 7 errors opportunities)

Error rate = Multiple error opportunities per task, average error occurrence rate, Total number of errors / Total number of task attempts

$$\text{Error rate} = (1+2+3+2+2) / (7*5) = 0.29*100 = 29\%$$

Table 9: User errors

Participants	Errors
1	1
2	2
3	3
4	2
5	2

4.3.5 Summary of the Data

Satisfaction = combined mean of three post task (task rating) which are easy of looking (finding) information, capability to retain track of their location within the website and if the system functions were well integrated.

Table 10: Summary of data

Task	Task completion	Errors	Time on Task	Satisfaction
1	5	1	0.47	4.4
2	4	2	3.2	3.8
3	3	3	6.0	3.4
4	3	2	4.8	3.2

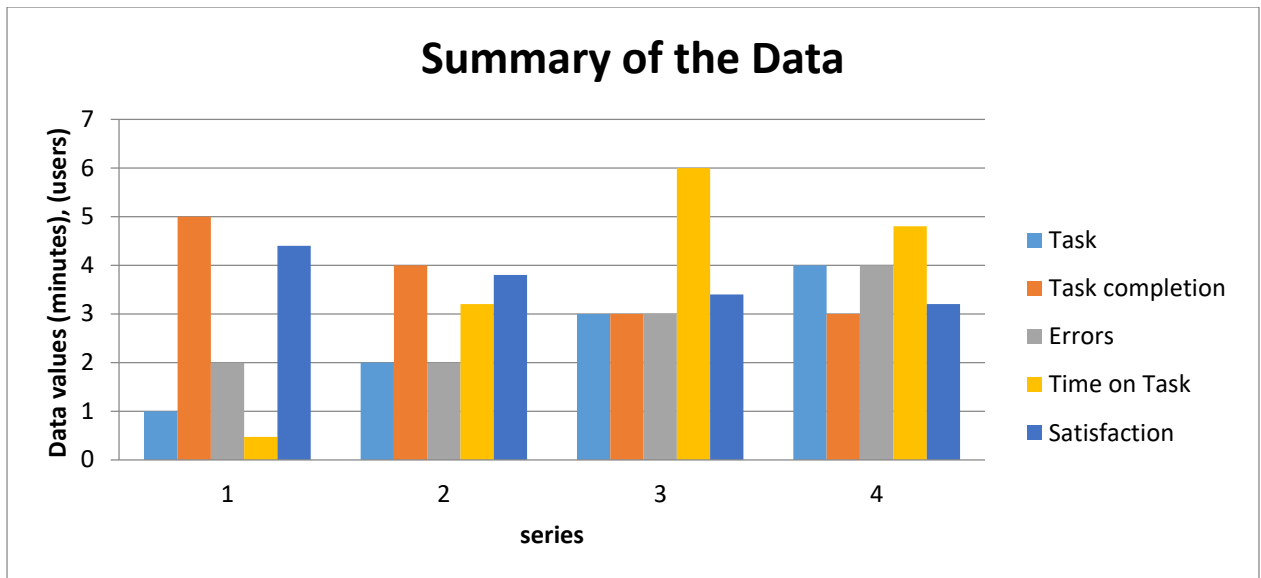


Figure 22: Graph of summary of data, 2018

4.3.6 General Metrics

Once task session was completed, participants were asked to rate the website for general measures. The measures were:

- (i) Like to use the system
- (ii) Ease of use
- (iii) System learnability
- (iv) Help of technical person to use the system
- (v) Becoming productive quickly using the system
- (vi) Integrations of the functions within the system
- (vii) Recommendation a system to a friend

Large number of participants (80%) agreed (agree or strong agree) the site was very easy to use. Also large number participants (80%) agreed they will like to use the website often. Sixty percent 60% of the participants think that most users will learn how to use the website very fast and could become productive using this system. All participants (100%) would like to recommend this website to a friend. Only 20% of the participants think they will need help of technical person to use the website.

Table 11: Usability System Scale results (USS)

Post Study usability questionnaire (System Usability Scale)	Strong agree	Agree	Disagree	Strong disagree	Percentage Agree
I would like to use this system often	3	1	1	0	80%
I saw the system is easy to use	2	2	1	0	80%
I think most people would learn to use this system very fast	0	3	2	0	60%
I will need the help of a technical person to be able to use the website	0	1	3	1	20%
I think I will become productive quickly using this website.	2	1	1	1	60%
I found different tasks on the website were well integrated.	0	3	2	0	60%
I would recommend the system to a friend	3	2	0	0	100%

4.4 User Experience Testing Results

The data was analyzed using gaze plots and heat maps for user’s entire visit to web based platform for market linkage together with think aloud data and facial expression and draw conclusion from these data.

4.4.1 Heat Map Image

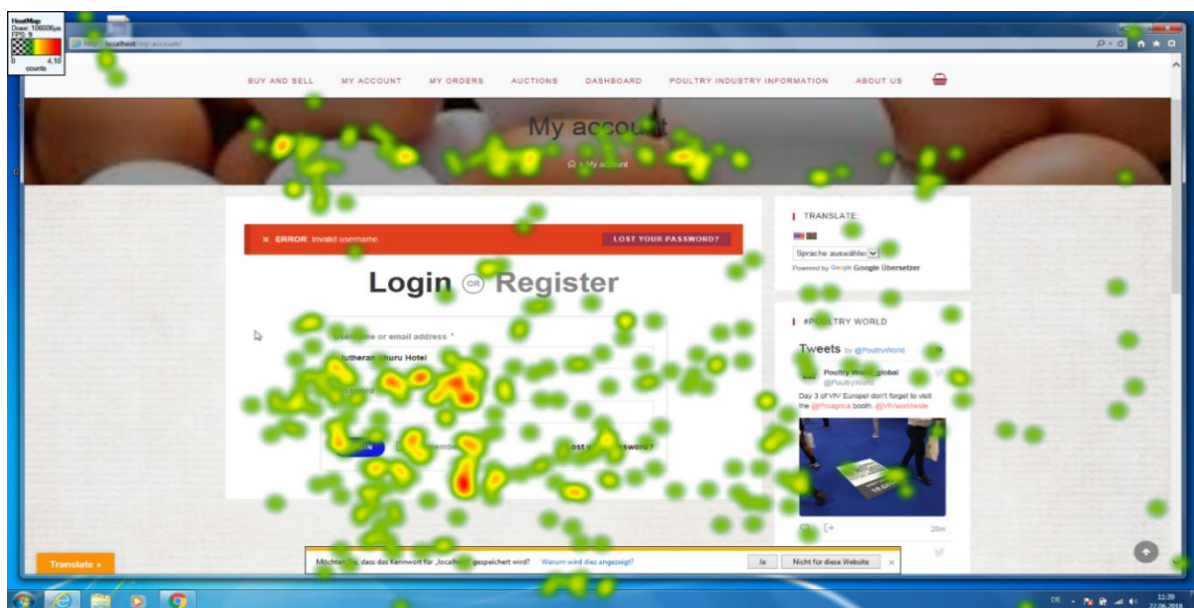


Figure 23: The heat map image of a first poultry farmer when interacting with web based platform for market linkage, 2018

4.4.2 Gaze Plot Image

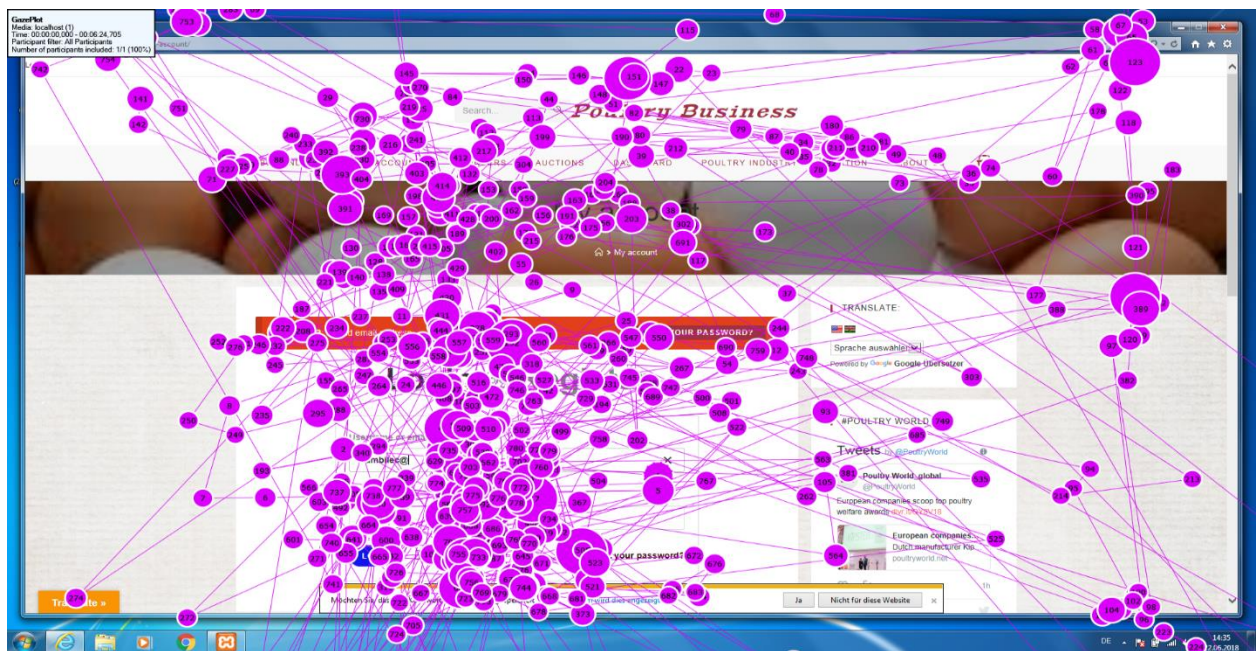


Figure 24: The gaze plot image of a last poultry buyer when performing the tasks, 2018

Gaze plots and heat maps for all 5 users were analyzed and the results shows that a larger amount of attention was paid to the login page and checkout page of the website. People also look a little bit to menu items. There is a smaller amount of attention to the right side of the website and there are almost no fixation (attention) to the right side of the website. These results shows that user spend a lot of time during creating account and during the checkout process, while spend little time on other parts of the website. During the testing sessions users were requested to think out loudly. And the results were as follows

4.4.3 Think Aloud Protocol Results


















Table 12: Think aloud results

Users	T 1	T 2	T 3	T 4
1	Mh!What is this!	I love it!	Very impressed!	Duh!
2	Daah!	Wow!	Good!	Duh!
3	-	Easy!	-	Good!
4	Uwiii!	Easy!	Wow!	What!
5	I don't understand!	-	I like this!	I am confused!

Testing administrator was taking detailed notes and record participant’s behavior including the facial expression of each participants during testing sessions. The results were as follows

4.4.4 Facial Expression

Table 13: Facial expression results, Emoji by super sad emoticon, 2018.

Users	T 1	T 2	T 3	T 4
1				
2				
3	-		-	
4				
5		-		

The data from eye tracking, think aloud protocol and facial expression was combined together. The result shows that users were emotionally happy when performing the second and the third tasks. But when performing the first task and the last task users were emotionally anxiety and disappointed. The eye tracking data (gaze plots and heat maps) shows that, users use long time when performing first and last tasks. Most of the think aloud data shows that, the users was wondering what to do when performing the first task and the last task. Also facial expression data shows the participants were not happy when performing the first and the last tasks.

4.4.5 General Metrics

Once task session completed, users where asked to rate the website for general measures. The measures were:

- (i) Like to use the system
- (ii) Ease of use
- (iii) System learnability
- (iv) Help of technical person to use the system

- (v) Becoming productive quickly using the system
- (vi) Integrations of the functions within the system
- (vii) Recommendation a system to a friend

The majority of participants (80%) agreed (agree or strong agree) they would use the website frequently. More participants (60%) agreed that the site was very easy to use. Sixty percent 60% of the participants think majority of people will learn to use the system very fast and could become productive using this system. All participants (100%) would like to recommend this website to a friend. Only 40% of the participants think they will need help of technical person to use the website.

Table 14: Usability System Scale (USS)

Post Study usability questionnaire (System Usability Scale)	Strong agree	Agree	Disagree	Strong disagree	Percentage Agree
I would like to use this system often	3	1	1	0	80%
I saw the system is easy to use	2	1	1	1	60%
I think most people would learn to use this system very fast	0	3	2	0	60%
I will need the help of a technical person to be able to use the website	1	1	2	1	40%
I think I will become productive quickly using this website.	2	1	1	1	60%
I found different tasks on the website were well integrated.	0	3	2	0	60%
I would recommend the system to a friend	3	2	0	0	100%

4.4.6 Problems Identified

From this data it was identified that

- (i) Register word was confusing most of the user think of the word “Create account” instead of “Register”. Also Login and register was not clear differentiated
- (ii) Checkout word was confusing most of the user expected something like “payment” instead of checkout
- (iii) The Website did not show up the shipping price when someone mentioned the destination place.
- (iv) Mpesa and tigo pesa was not working.

4.5 Developed Web Based Platform

The developed web based platform for market linkage is simple and not overloaded by information. Poultry farmer and buyers before advertising products and needs will be required to register first.

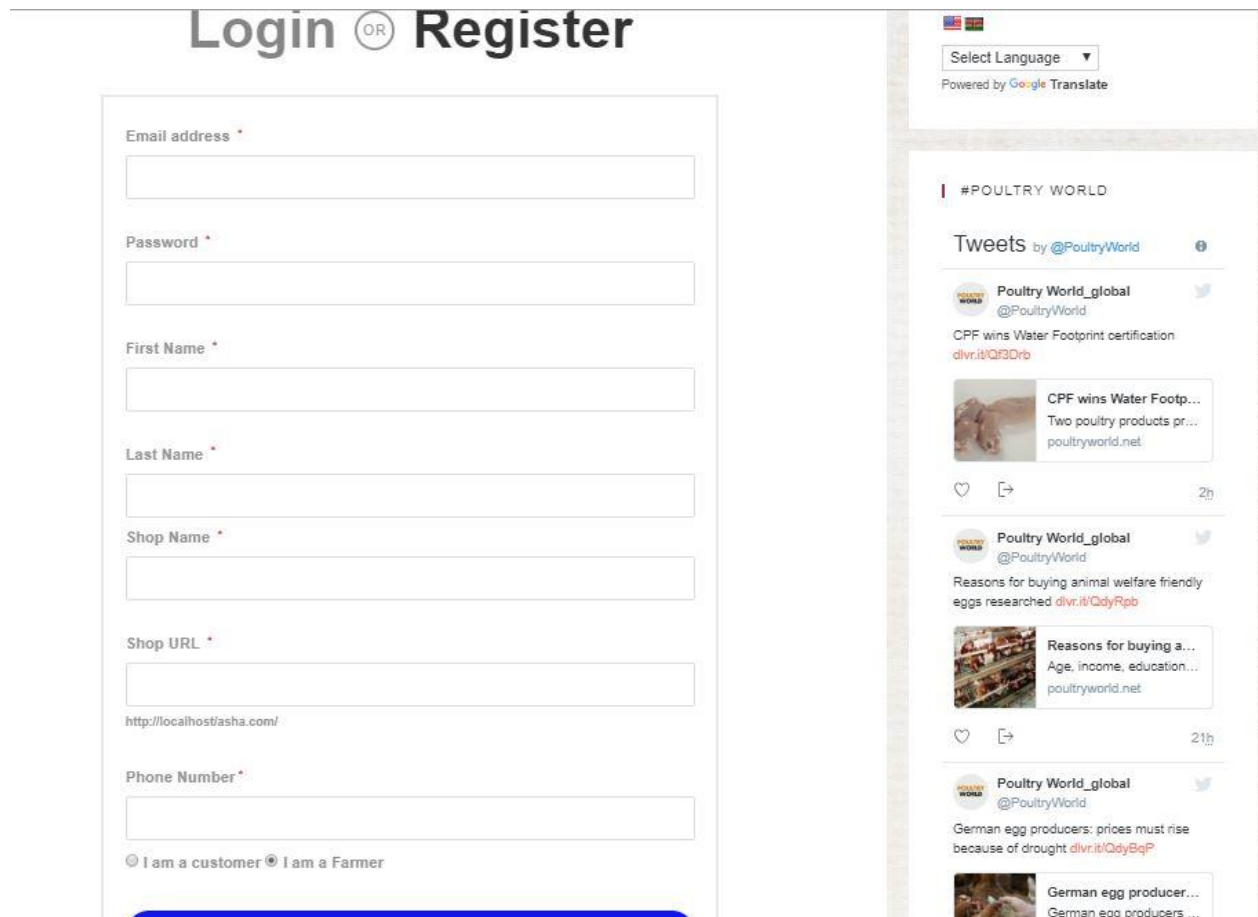


Figure 25: Web based platform for market linkage farmers/buyers login page, 2018

The web based platform provide all the required market information such as price, seller location, amount of poultry, type of poultry, brand etc. Farmers are able to advertise their products using the website by providing details of the product together with image or video of the product. Buyers (farmers, individual person, shops, catering services, supermarkets, hotels, industries, butchers and other farmers) can make orders and purchase poultry and poultry products form the platform. Buyers upon selecting a particular product all the details regarding that product will be shown. The web based platform available in English and Swahili.

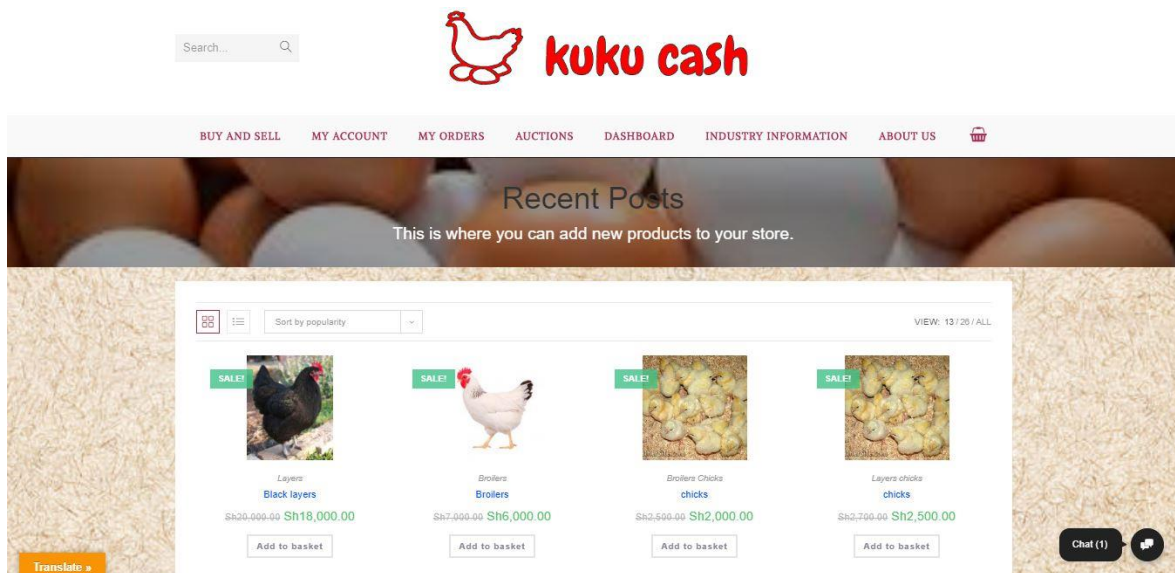


Figure 26: Home page interface of the web based platform for market linkage between poultry farmers and potential buyers in Tanzania, 2018

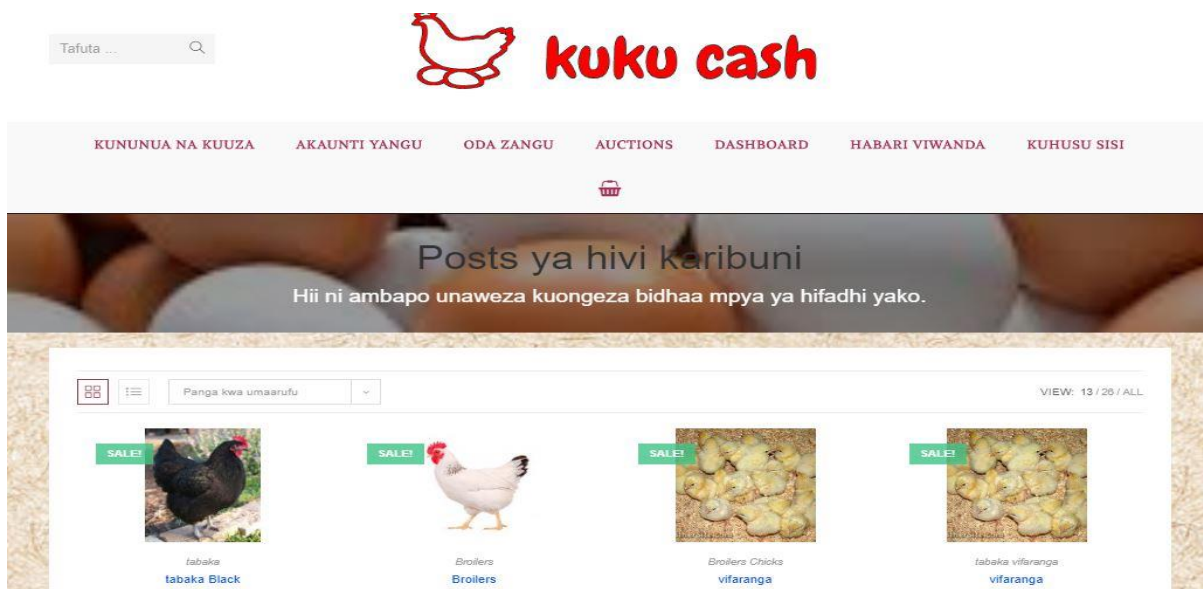


Figure 27: Swahili interface of the web based platform for poultry market linkages, 2018.

Each poultry farmer and buyer will be able to view and manage his/her orders. Through administrator farmers can do auctions. This web based platform also provides Poultry industry information such as poultry diseases and feeds. The application provides poultry industry information from other websites and twitter feeds (#tags). The information changes automatically after every two hours. Also through the website buyers can rate farmers. Payment methods used in this web based platform are cash on delivery and normal bank transfer. Furthermore the developed web based platform supports real time charting (group charting or one to one).

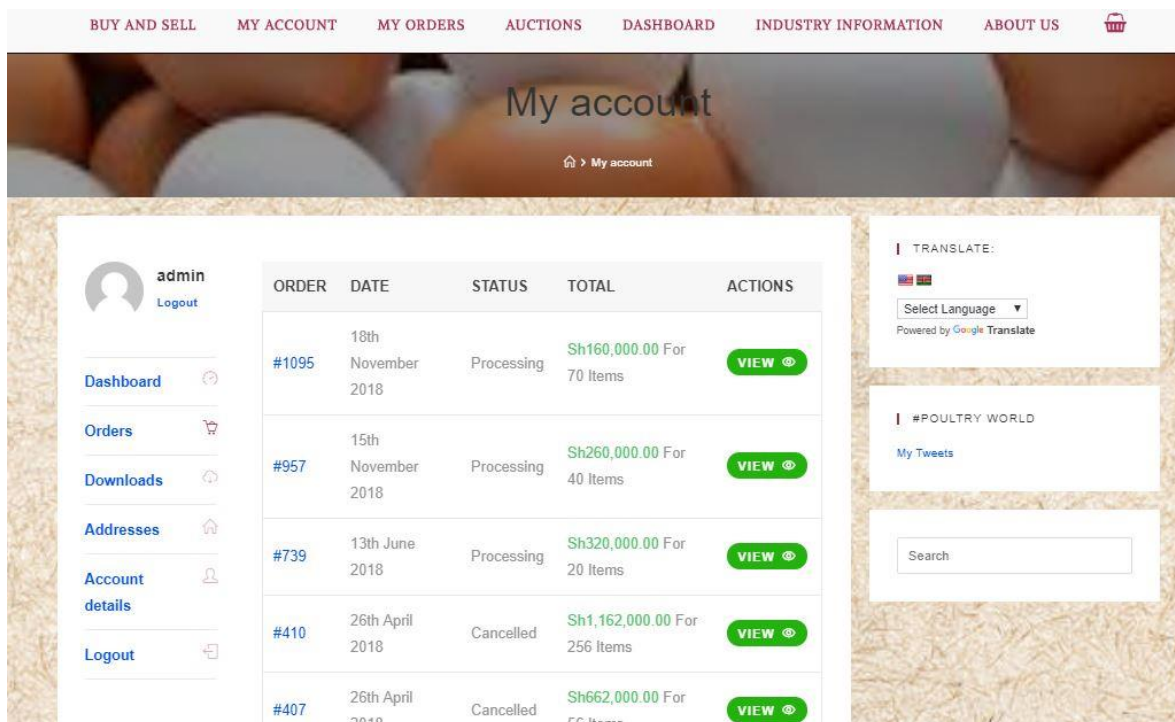


Figure 28: Web based platform order management page, 2018

4.6 Discussion

The chapter presented the dialogue of the obtained results from the study, interviews and questionnaire such that a total of two hundred and four respondents were surveyed and the profile of the respondent was presented in this chapter. Also poultry farmer marketing information requirements was discovered as well as poultry farmers and buyers current way of advertising and getting market information. And challenges faced by poultry farmers and buyers were also presented. In addition, results from observation was also presented in this chapter, where by it was discovered that poultry farmers use a lot of time and energy to shout when a person pass nearby their poultry thinking that the person is a customer. They only focus

to the people who pass there or who come to the market. Failure to reach more customer leads to deficit of some of the products such as eggs.

Furthermore results from usability testing and user experience testing were discussed in this chapter such as success rate of task accomplishment, task rating, and time on task, errors as well as usability system scale results. Moreover the chapter has presented the development of Web Based Platform for reliable market linkage between poultry farmers and potential buyers.

During testing users liked most the ability of the website to host auctions, the ability of the website to be in English as well as Swahili Language. The ability of the system to provide information about poultry sector also to manage orders. Furthermore during testing the following problems were identified; Register word was confusing, they expected login word instead of register. Also coupon was confusing. In addition during testing users discovered that when you go back you get lost also login and register was not clear differentiated. Checkout word was confusing most of the user expected something like “payment” instead of checkout. The Website did not show up the shipping price when someone mentioned the destination place. All of these shortcoming were incorporated in the platform

Moreover the following challenges were uncounted during testing; most of the poultry farmers were scared to accept invitation to be test participants. Some of the participants were scared during the testing session because of the eye tracker device. Also during testing session at the CoCSE lab the internet connection was not good, also the administrator laptop hosted the website failed to connect to the internet. During day one testing, it was raining as a result most of the participants delayed to show up, one of them didn't show up completely. Hotels were located far away from each other hence it was not so easy to move from one hotel to another with all the equipment's.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Information is key to any business and is a major input to boost sales (Lwoga, 2010; Temba *et al.*, 2016). Poultry farmers need to obtain correct and appropriate market information because it is an important aspect to them in maximizing productivity and sales. To transform farmers will not be possible until we secure reliable market for them and this is not something luxury. (Mammo, 2015). Normally people do not like to buy things they do not know, do you? In order for people to buy things they need to see or hear about them and decide to buy. Poultry farmer need to publicize and promote their products, this will increase awareness and then demand of these products.

In solving the poultry market information challenge, so many options could be taken to increase access to this information (Msoffe and Ngulube, 2016; Temba *et al.*, 2016) but web application has so many advantages. The web technology gives suitability and a rapidity way of communication in today's world of computer. Also the web offers worldwide market coverage as well compared to other marketing channels furthermore it offers collaboration, cross-platform capabilities, Integration and interoperability, Versioning, customization and maintenance, controlled access and ease of use. Web application needs no installation costs, and always have instant upgrade for new future to everyone. In addition it is free from type of browser in the user machine (Byrne *et al.*, 2010; Panthi and Mohapatra, 2017). In the agricultural era, companies and individuals bring their produce near to customer location and let them adapted to their needs (Sharma and Sheth, 2004), and the good way of achieving this is through Web systems. Websites enables companies and individuals to place promotion material on web server. The promotional materials can be simple advertisement or complex brochures (O'Keefe and McEachern, 1998).

The study reported in this Dissertation aimed at improving the market information gathering and feedback through the development of Web Based Platform. This study aimed to remove farmers and buyers locational dependence and, instead of depending on a certain physical locational sales, they will focus faraway since the World Wide Web makes the world as a single village. The study aimed to help farmers and buyers to more readily engage in the poultry network and other important stakeholders like poultry feeds companies. This study aimed to

solve the problem of fixed time, the time has been central to both poultry farmers and buyers. Buyers' needs access to information 24 hours a day without any limitation. Studies show that majority of customer want a 24 hours access to basic customer service including information, communications and transactions (Sharma and Sheth, 2004). Furthermore the study intended to increase knowledge to both poultry farmers and buyers, it will promote internal and external relationship, and supports decision making process. In addition the study aims to increase productivity and there after better outcome measure and business branding (Lim, 2017; Stephen, 2016; Tiago and Veríssimo, 2014).

Specifically, the study reviewed the currently poultry marketing situation using a case study of Tanga, Tanzania as well as existing marketing applications. It was discovered that this application do not provide market linkage between poultry farmers and potential buyers. Marketing system was not developed in such a way to enhance well organized marketing activities as well as flow of poultry market information. In addition it does not also support promotional activities and planned marketing which are also necessary attributes of effective marketing. The market structure does not support continuous flow of livestock information from production areas to the markets. Hence innovative Web Based Platform for reliable market linkage was developed. And the developed Web Based Platform is able to; provide all the required market information such as price, seller location, amount of poultry, type of poultry, brand etc. It supports selling and buying, Farmers are able to manage their orders. The platform supports auctions. Also the platform provides poultry industry information from other websites and twitter feeds (#tags) and the information changes automatically after every two hours. The application is also available in Swahili and English. Buyers can rate farmers through the platform. Currently available payment methods are cash on delivery and normal bank transfer. The developed platform also supports real time charting (group charting or one to one)

Majority of the users found the website was easy to use, well organized and very useful. Having a website to link poultry farmers and poultry buyers is a key to both of them. Fulfilling the recommendations and going on to work with real users would guarantee more a sustained website.

This research provides both hypothetical and practical contribution for coming work particular on implementation of any other projects towards attaining availability of livestock market information.

5.2 Recommendations

There are some areas for extension for adaptation of the work to the society. Extension such as local payment methods M-PESA and Tigopesa should be added to the platform for easy and reliable payments. The platform was developed in Swahili and English languages since most of small holder poultry farmers like to use Swahili language, so Swahili Language translator need to be improved. A map capable for showing poultry farmers location will help poultry buyers to select where to easily buy, this will save shipping cost. I addition buying guide is also recommended be incorporated in a platform since it will help poultry buyers to compare and contrast the products before buying as well as addition of help page.

Furthermore the study recommends the actual implementation and use of the developed Web Based Platform for reliable market linkage between poultry farmers and potential buyers in Tanzania for bridging poultry market information gap.

As we are solving the problem of poultry market information, this study also recommends the following factors to be taken into consideration because they also hinder farmers and buyers to have access to market information, factors such as “lack of knowledge, lack of awareness, ignorance and poverty. Also personal and economic aspects might also prevent farmers form accessing market information” (Lwoga, 2010; Msoffe and Ngulube, 2016).

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APPENDICES

Appendix 1: Usability Testing Plan

This plan is the root for complete testing and it speaks in details on where, who, how, when, why, and what of this usability testing. It is a main communication vehicle, serves as a blue print, define the required resources, provide a focal point and landmark(Rubin & Chisnel, 2014). In this study we want to understand if the user will use the system so well.

Purpose Goals and Objectives for Usability testing

In this study summative tests will be conducted with the objective of examining and evaluating how effectively the concept has been implemented. The purpose of doing this study is to make this system usable, by ensuring the absence of frustrations when using it(Rubin & Chisnel, 2014). The standard data about system usability will be gathered. The goals of this study are to assess user ability to operate the system (Learnability), the quickness the user can accomplish the goals (Efficiency), user's readiness to use the system (Usefulness) and users' perception of the system (Satisfaction)

Research questions

The research questions should be clear and observable. The following are the research questions are

- Is the system easy to learn?
- How fast is the system to accomplish the task?
- How fast are the users to accomplish the task?
- Is the system useful?
- Is the system satisfactory to users?

Participant's characteristics

Selecting participants who are real representative of system users is very important thing in testing process. The test results will only be of greater meaning if the testing process will involve typical users of the product. If you test with the "wrong" people, the testing results will be doubtful and of limited worth (Rubin & Chisnel, 2014). When selecting participants is very vital to find their attitude towards the system, their IT skills and knowledge. In this study the screening questionnaire will be used to select participants

Poultry Buyer Participants screening questionnaire

1. Do you buy poultry and poultry products?
 No [Terminate]
 Yes [Continue]
2. How many poultry (chicken) do you usually buy per week?
 Less than 10 [Terminate]
 10 to 20 [Continue]
 21 to 40 [Continue]
 40 and above [Continue]
3. How many poultry eggs do you usually buy per week?
 Less than 10 [Terminate]
 10 to 40 [Continue]
 40 to 100 [Continue]
 100 and above [Continue]
4. How frequently do you use internet?
 I don't use internet [Terminate]
 Once per month [Terminate]
 once per week [Continue]
 Everyday [Continue]

In this study 5 (five) poultry buyers participants will be recruited.

Table 1: Poultry Buyer participant's characteristics and desired mix

Characteristics	Desired no of participants
Regular Poultry Buyer	5
Total number of participants	5
Involvement into business	
3 – 6 months	1
6 –12 months	1
1–2 years	1
2-3 years	1
3 years and above	1
Buying quantity (chicken)	
10 to 20	3
21 and above	2
Internet usage	
two to three times per week	2
everyday	3
Age	
18–27	1
28–40	2
41–55	1
55 and above	1
Gender	
Female	3
Male	2

Method (test design)

Within-subjects design is a type of experiment where by each individual user perform all the tasks. In this study within subject design will be used. Data about the effectiveness of Web Based Forum for reliable market linkage will be gathered. Participants will fall into two groups (Poultry Farmers and Poultry Buyers) and they will perform all the main tasks.

Length of Session

The typical user test is 50–90 minutes (Jakob Nielsen, 2005). In this study each session will be 50 minutes long. 10 minutes of each session will be used for pre-testing, post-testing and other 10 minutes for debriefing interviews.

Each session will be (50 minutes). Test will include

- 8 minutes for introduction to the session
- 5 minutes for Pre-test Questionnaire
- 22 minutes for Tasks
- 5 minutes for Post-test Questionnaire
- 10 minutes for Post-test debriefing

Task List

Table 2: Poultry Farmer task Scenario

Tasks	Estimated Time (min)
Identify what the website is for	5
Create account	5
Try selling 10 chicken	7
Find if someone has posted (advertisement) information about poultry and poultry products to find out more about your fellow farmers.	5

Test Environment, Equipment, and Logistics

The sessions will take place at poultry buyer's normal places (field) rather than in laboratory. Field testing was selected because additional information can be discovered. Information such as user behavior is easy to be discovered in a natural environment. These information helps researchers to recognize how users will use the service (Rösler, 2012). Although sometimes laboratory testing can be more appropriate. There will be a room prepared nearby poultry rooms and cages and that place will be used as a testing room. Participants will use their smartphone, tablet or PC with an Internet bundle with a high-speed.

Roles and responsibilities of moderator

Moderator will sit in the room with participants, introduce the session, Conduct the Pre-test and Post Questionnaire, Introduce task as appropriate, Conduct Post Debriefing, Take detailed notice and record the participant's behaviour.

List of data to be collected

Quantitative

- Time used to finish a particular task
- How many users able to finish all tasks
- How many trails to complete a task
- Before and after test questionnaire (Pre-test and Post-test questionnaires)

Performance Measures

- Total number and percentage of tasks which was completed correctly.
- Stopping points
- Total number and percentage of tasks which was completed incorrectly.

Qualitative Data about Users Experience

- Data form think aloud protocol (for example)
 - ✓ Good!
 - ✓ Wow!
 - ✓ Duh!

Preference Measures

- How the product is useful

- Product meet expectations
- product functions

Description of how results will be reported

Short background summary. Methodology on how the test was carried out, test results and finally. Findings and recommendations based on the observations.

Pre-test Questionnaire

1. How do you usually purchase poultry or poultry products?

2. Have you ever sold or bought something online?

3. How much poultry or poultry products have you bought last month?

4. What are the top three sites you consult when using internet?

5. What do you like about them?

Table 3: Post-test Questionnaire (System Usability Scale)

S/N	Post Study usability questionnaire	Strong agree	Agree	Disagree	Strong disagree
		1	2	3	4
1	I would like to use this system often				
2	I saw the system is easy to use				
3	I think most people would learn to use this system very fast				
4	I will need the help of a technical person to be able to use the website				
5	I think I will become productive quickly using this website.				
6	I found different tasks on the website were well integrated.				
7	I would recommend the system to a friend				

Table 4: Project Timeline

Pilot testing Date:-----	
5am-6pm (may change)	Pilot user
Day One Testing Date: 18/06/2018	
9:00am-10:00am	Participant No 1
Tea Break	
11:00 am-12:00pm	Participant No 2
Lunch Break	
1:00pm-2:00pm	Participant No 3
Day Two Testing Date: 19/06/2018	
9:00 am-10:00 am	Participant No 4
Tea Break	
11:00 am-12:00pm	Participant No 2
Lunch Break	

Appendix 2: User Experience Test Plan (Eye tracking)

Nowadays eye tracking method is combined with other usability testing method and become another method to measure the user experience (Bergstrom & Schall, 2014). In this study we want to understand if the developed home page interface is operative for users to accomplish their goals.

Purpose Goals and Objectives for User Experience testing

This study will also be summative, conducted midway to product development cycle with the objective of examining the effectiveness of the home page interface. The aim of doing this study is to ensure the home page interface is clear and will exactly help farmers and buyers to accomplish their goals as expected. This study is necessary for the survival of the website. Accomplishment of task without error (accuracy) and how early will the user accomplish a given task (completeness) is the effectiveness (Rösler, 2012).

Testing questions

The research questions should be clear and observable. The following are research questions

- How quickly will the user understand what this web site is for?
- How fast will the user learn the interface?
- How easy will the interface help user to accomplish the task?

Participant's characteristics

Since the test results will only be of greater meaning only if the testing process will involve typical users of the product. If you test with the “wrong” people, testing results will be doubtful and of limited worth (Rubin & Chisnel, 2014). Then in this study the following screening questionnaire will be used to select participants based on their current eye situation, behaviour, skills and knowledge.

Poultry Farmer Participants Screening Questionnaire

1. Do you sell poultry or poultry products?

Yes [Continue]

No [Terminate]

2. How many poultry do usually sell?

Less than 15 [Terminate]

Above 15 [Continue]

3. Do you use the computer/smartphone and the web?

Yes [Continue]

No [Terminate]

4. Do you wear eyeglasses in order to read the computer screen?

Yes [Continue]

No [Skip to 3]

5. What are your glasses for?

Reading only [Continue]

Seeing distant objects [Continue]

Both [Continue]

6. Can you read a computer screen and the Web without difficulty?

Yes [Continue]

No [Terminate]

In this study 6 poultry farmers will be recruited as tests participants.

Table 1: Poultry Farmer participant's characteristics and desired mix

Characteristics	Desired no of participants
Regular Poultry buyer	5
Total number of participants	5
Involvement into business	
6–12 months	1
1–2 years	1
2-3 years	1
3 years and above	2
Number of poultry	
20 to 150	2
150 and above	3
Internet usage	
two to three times per week	2
everyday	3
Age	
18–27	1
28–40	2
41–55	1
55 and above	1
Gender	
Female	3
Male	2

Method (test design)

In this study we will focus on two main elements available on home page interface which are Market information's and advertisement posting procedure. In this website this two elements are very important because are the ones which carries the whole meaning of this website.

Length of Session

The typical user test is 50–90 minutes(Jakob Nielsen, 2005). In this study each session is 50 minutes. Each 10 minutes of the session will be used for pre-test, post-test and other 10 minutes for debriefing interviews.

Each session will be one hour (50 minutes). Test will include

- 8 minutes for introduction to the session
- 5 minutes for Pre-test Questionnaire
- 22 minutes for Tasks
- 5 minutes for Post-test Questionnaire
- 10 minutes for Post-test debriefing

Task List

Table 2: Poultry buyer task Scenario

Tasks	Estimated Time (min) / baseline
Create account	5 / 3
Find if someone has posted (advertisement) information about poultry and poultry products before you decide to buy.	5 / 3
Find out where you can find more information about the advertised products	5 / 3
Try buying 20 eggs from this website	7 / 5

Test Environment, Equipment, and Logistics

The participants will be brought to the CoCSE lab, one by one and be given a list of task to perform. Laboratory is more appropriate place for conducting this test because of the availability of Ethernet ports and cables which are necessary in Tobii system, and are not available to the farmers place.

Roles and responsibilities of moderator

Moderator will sit in the room with participants, introduce the session, Conduct the Pre-test and Post Questionnaire, Introduce task as appropriate, Conduct Post Debriefing, Take detailed notice and record the participant's behaviour.

List of data to be collected

Quantitative

- How many wrong attempts when participants posting the advertisement?
- How long the market information was examined?
- How long before participants actually click to view the market information?

Qualitative Data about Users Experience

- ✓ Think aloud verbal protocol
- ✓ How long it takes to perform the tasks
- ✓ Quotable quotes: (for example)
- ✓ Data form think aloud protocol (for example)
 - Good!
 - Wow!
 - Duh!

Preference Measures

- How the product is useful
- Product meet expectations
- product functions

Description of how results will be reported

Short background summary. Methodology on how the test was carried out, test results and finally

Findings and recommendations based on the observations.

Pre-test Questionnaire

1. Do you market your Poultry and poultry products?

Yes

No

2. If No. 1 above is yes, then what is your primary reason marketing your products.

3. How important is it to you that you are able to get market information over a marketing system?

4. What are the top three sites you consult when using the internet?

5. What do you like about them?

Table 3: Post-test Questionnaire (System Usability Scale)

S/ N	Post Study usability questionnaire	Strong agree	Agree	Disagree	Strong disagree
		1	2	3	4
1	I would like to use this system often				
2	I saw the system is easy to use				
3	I think most people would learn to use this system very fast				
4	I will need the help of a technical person to be able to use the website				
5	I think I will become productive quickly using this website.				
6	I found different tasks on the website were well integrated.				
7	I would recommend the system to a friend				

Table 4: Project Timeline

Pilot testing Date:-----	
5am-6pm (may change)	Pilot user
Day One Testing Date: 22/06/2018	
9:00am-10:00am	Participant No 1
10:15 am-11:15am	Participant No 2
11:30am-12:30pm	Participant No 3
Lunch Break	
1:30pm-2:30pm	Participant No 4
2:45pm-3:45pm	Participant No 5

Appendix 3: Poultry farmer Persona

Persona of Janet Frank – Poultry farmer



Figure 1: Image by Pixabay, 2018

Name: Janet Frank

Demographic Information: 49 years old, married and have four children.

Characteristics of person: Poor in keeping memory, she is so friendly person and hard worker

Job: Full time job as a poultry farmer for manager for seven (7) years now. She is in

charge of managing all the poultry farming activities in her farm located at Muheza, Tanga.

Goals: To become a leading supplier of poultry and poultry products.

Environment: Middle class family making \$500 per month.

Experience: Janet has a certificate in nutrition. She uses internet in other activities but not for poultry activities. Janet don't have experience on buying and selling on internet. She hope to get a good advertisement means one day so that she can reach more customers at the same time.

Preferences & Dislikes when he is online: Janet said that "I like websites with very few links at the top. It is helpfully to see them clearly. It is easy to find out things. I don't like interfaces with a lot of colors. She likes easy to use interfaces which still offer lots of features

Fact sheet Janet Frank Poultry farmer	
Age	49
Job situation	Not employed
Status of employment	permanent in poultry activities
Change receiving	Follower
Motivation level	Best Practice
Languages	English and swahili
Formal education	Certificate
Impairments	Vision (medium), Hearing(medium), Mobility (medium), Dexterity (medium), Cognition (medium)
Assistive technology	None
Type of device	Smartphone
User environment	Public transport, public places, home
Main activities	Poultry farming activities
Availability environment	Learning None

Appendix 4: Poultry buyer persona

Persona of Paul Peterson – Poultry buyer

Figure 1: Image by Pixabay, 2018

Name: Paul Peterson

Demographic Information: 27 years old, married and have two children.

Characteristics of person: Paul is a very sharp person, He is responsible for his work. He is well connected within his office and among colleagues in other places. But has poor reading skills
Job: Full time job a hotel manager for three (3) years now. He is in charge of managing Extra Pub Hotel located in Korogwe Tanga

Goals: To become more efficient in hotel activities which he believe will make him even more liked and further his career goals. Improve Hotel services to everybody. Support people in healthy eating

Environment: Middle class family making \$420 per month.

Experience: Paul has a Bachelor degree in Hotel management. He uses internet in poultry activities. Paul has experience on buying and selling on internet. He usually don't advertise his poultry product's needs. Paul is wondering if there can be online means of advertising his needs directly to poultry farmers

Preferences & Dislikes when he is online: Paul doesn't stay long if the site is confusing. On many sites, there is so much crammed in that he can't find anything at all. He like the sites that are simple and don't have so many decisions he has to make. He dislikes systems that are unstable or need a seer to operate correctly.

Fact sheet Paul Peterson, Hotel Manager	
Age	27
Job situation	Hotel manager
Status of employment	Permanent, contract.
Receiving of Change	Follower
Motivation level	Best Practice
Languages	English and Swahili
Formal education	university degree
Impairments	Vision (medium), Hearing(medium), Mobility (medium), Dexterity (medium), Cognition (medium),
Assistive technology	None
Type of device	Laptop, Smartphone
User environment	Office, vehicle, home, outdoors, public transport, public places
Main activities	Food management and guest's management.
Availability Marketing environment	Electricity, Awareness, Internet access
Marketing roles in WBP	Poultry Buyer

Appendix 5: Poultry farmers Questionnaire

1. What is your name?

2. How old are you?

3. Phone number

4. Gender
 - i. Male
 - ii. Female
5. What is the name of this District?
 - i. Tanga
 - ii. Muheza
 - iii. Korogwe
 - iv. Lushoto
6. What is the name of this Ward?

7. What is the name of this street or village?

8. What kind of poultry do you keep?
 - i. Chicken
 - ii. Ducks
 - iii. Geese
 - iv. Turkey
 - v. Guinea fowl
9. What kind of poultry products do you sell?
 - i. Chicks
 - ii. Eggs
 - iii. Poultry meat
 - iv. Manure
 - v. Poultry
10. Do you sell other service?
 - i. Yes

- ii. No
11. What type of other service do you offer?
- i. Hatchery services
 - ii. Manure
12. How many poultry do you keep?
-
13. Do you know how to read and write?
- i. Yes
 - ii. No
14. Do you access internet?
- i. Yes
 - ii. No
15. Device used to access the internet is?
- i. Mobile phone
 - ii. Computer
 - iii. Tablet
16. Bundles used to access the internet is?
- i. Vodacom
 - ii. Tigo
 - iii. Airtel
 - iv. Halotel
 - v. TTCL
17. How frequently do you use the internet?
- i. Once per month
 - ii. Once per week
 - iii. Overy day
18. What applications do you usually access through the internet?
- i. Facebook
 - ii. Watsup
 - iii. Email
 - iv. YouTube
 - v. Games
 - vi. Instagram

- vii. Other Application
19. Do you use internet for poultry farming activities?
- i. Yes
 - ii. No
20. How do you use internet in poultry farming?
- i. Advertisements
 - ii. Learning
 - iii. Consultation
 - iv. Communication
21. Have you ever buy or sell something through internet?
- i. Yes
 - ii. No
22. How did you pay the money?
- i. Mpesa
 - ii. Tigo pesa
 - iii. Airtel money
 - iv. Bank
23. Do you advertise your products?
- i. Yes
 - ii. No
24. How do you advertise your products?
- i. Friends
 - ii. Radio
 - iii. TV
 - iv. Internet
 - v. Brochures
25. How do you do the advertisement?
- i. Upload photos to the internet
 - ii. Upload videos to the internet
 - iii. Upload posters to the internet
 - iv. Sending sound clips via internet
 - v. A word of mouth to friends
 - vi. Pinning the brochures around different places

- vii. Distributing brochures to different peoples
 - viii. Pay for a radio announcement
 - ix. Pay for a TV announcement
26. Are you satisfied by the methods you have mentioned?
- i. Yes
 - ii. No
27. If No, What do you think?
-
28. How do you get customers?
- i. Taking the products to the market
 - ii. Customers come to look for products
 - iii. Middle man
29. Are you selling your poultry and poultry products in time?
- i. Yes
 - ii. No
30. Do you get loss in buying more feeds when you didn't sell poultry in time?
- i. Yes
 - ii. No
31. Did the poultry products get rotten when you didn't sell them in time?
- i. Yes
 - ii. No
32. Do you get exactly profit you wished to get from poultry keeping?
- i. Yes
 - ii. No
33. If you don't get exactly profit you wished what do you think is the reason?
- i. No customers
 - ii. Diseases
 - iii. Lack of education
 - iv. No market information
34. Do use middle man for your marketing strategy?
- i. Yes
 - ii. No
35. Do you consider middle man as a problem?

- i. Yes
 - ii. No
36. Are you facing any marketing challenges?
- i. Yes
 - ii. No
37. If yes, what are those challenges do you face during marketing your products?
- i. Middle man
 - ii. Price
 - iii. Poultry market Information
 - iv. Customer location
38. If internet is to be used to advertise your poultry and poultry products, how do you find that?
- i. Good
 - ii. Somehow good
 - iii. Bad
 - iv. I don't know
39. Where do you sell your products?
- i. Around Neighborhoods
 - ii. Around District
 - iii. Around Region
 - iv. Around Country
 - v. Outside the Country
40. Who are you potential buyers?
- i. Individual person
 - ii. Shops
 - iii. Catering services
 - iv. Supermarkets
 - v. Hotels
 - vi. Industries
 - vii. Butchers
 - viii. Other farmers
41. How do you get the market information?
- i. TV

- ii. Radio
- iii. Social media
- iv. Friends

42. Do you know any kind of marketing system?

- i. Yes
- ii. No

43. Do you need a marketing system?

- i. Yes
- ii. No

44. What kind of a system?

- i. Where I can get only the price
- ii. Where I can also advertise
- iii. Where I can only get the location

45. What kind of market information do you need in order to reach more customers?

- i. Customers Location
- ii. Price
- iii. Amount of Poultry they want
- iv. Kind of poultry products they want
- v. Types of poultry they want
- vi. Amount of Poultry products they want

46. If a new marketing system is introduced are you willing to pay?

- i. Yes
- ii. No

47. How much per year?

48. Collect the GPS coordinates of this place

Appendix 6: Poultry Buyers Questionnaire

1. What is your name?

2. How old are you?

3. Phone number

4. Gender

i. Male

ii. Female

5. What is the name of this District?

i. Tanga

ii. Muheza

iii. Korogwe

iv. Lushoto

6. What is the name of this Ward?

7. What is the name of this street or village?

8. What kind of poultry and poultry products do you buy usually?

i. Eggs

ii. Poultry

iii. Chicks

iv. Manure

v. Hatchery services

9. Do you know how to read and write?

i. Yes

ii. No

10. Do you access internet?

i. Yes

ii. No

11. Device used to access the internet is?

i. Mobile phone

- ii. Computer
 - iii. Tablet
12. Bundles used to access the internet is?
- i. Vodacom
 - ii. Tigo
 - iii. Airtel
 - iv. Halotel
 - v. TTCL
13. How frequently do you use the internet?
- i. Once per month
 - ii. Once per week
 - iii. Every day
14. What applications do you usually access through the internet?
- i. Facebook
 - ii. Watsup
 - iii. Email
 - iv. YouTube
 - v. Games
 - vi. Instagram
 - vii. Other Application
15. Do you use internet in getting poultry and poultry products?
- i. Yes
 - ii. No
16. How do you use internet in getting poultry and their products?
- i. Broadcasting my needs in social media
 - ii. Google
 - iii. Charting with friends
 - iv. Advertisements through different websites
17. Which information and/or tips about poultry market you have been able to acquire through internet?
- i. Price
 - ii. Location of products
 - iii. Types of poultry

- iv. Kind of products
 - v. Poultry kilograms
18. Have you ever buy or sell something through internet?
- i. Yes
 - ii. No
19. How did you pay the money?
- i. Mpesa
 - ii. Tigo pesa
 - iii. Airtel money
 - iv. Bank
20. If internet is to be used to place orders of poultry and poultry products, how do you find that?
- i. Good
 - ii. Somehow good
 - iii. Bad
 - iv. I don't know
21. Do you advertise your poultry and poultry product's needs?
- i. Yes
 - ii. No
22. If yes, how do you advertise your needs?
- i. Upload photos of what I need to the internet
 - ii. Upload videos of what I need to the internet
 - iii. Upload posters of what I need to the internet
 - iv. Sending sound clips of what I need via internet
 - v. A word of mouth of what I need to friends
 - vi. Pinning the brochures of what I need around different places
 - vii. Distributing brochures of what I need to different peoples
 - viii. Pay for a radio announcement
 - ix. Pay for a TV announcement
23. Will you like to advertise your needs?
- i. Yes
 - ii. No
24. How do you get poultry and poultry products?

- i. Visiting the farmer
 - ii. Going to different shops
 - iii. Through advertisement
 - iv. Going to the market place
 - v. Through a word of mouth from friend
 - vi. A farmer comes to tell you about the products
25. Where do you buy your poultry products?
- i. Around Neighbourhoods
 - ii. Around District
 - iii. Around Region
 - iv. Around Country
 - v. Outside the Country
26. Where do you get the poultry market information?
- i. TV
 - ii. Radio
 - iii. Social media
 - iv. Friends
27. Do you know any kind of marketing system?
- i. Yes
 - ii. No
28. Do you need a system which will give you market information about poultry and poultry products?
- i. Yes
 - ii. No
29. What kind of a system?
- i. Where I can get only the price
 - ii. Where I can also advertise
 - iii. Where I can only get the location
30. What kind of market information do you need in order to buy or get products easily and at cheaper price?
- i. Products Location
 - ii. Price
 - iii. Amount of Poultry they have

- iv. Kind of poultry products they have
 - v. Types of poultry they have
 - vi. Amount of Poultry products they have
31. What challenges do you face during buying your products?
- i. Middle man
 - ii. Price
 - iii. Poultry Information
 - iv. Poultry products information
32. Collect the GPS coordinates of this place
-

RESEARCH OUTPUTS