2018

Cloud based prototype for electronic tea auctioning: case of Momul Tea Factory

Irene C. Chepkwony
Faculty of Information Technology (FIT)
Strathmore University

Cloud Based Prototype for Electronic Tea Auctioning

Case of Momul Tea Factory

Irine Cherotich Chepkwony - 067832

Submitted in partial fulfilment of the requirements for the Degree of

Masters of Science in Information Technology at Strathmore University

Faculty of Information Technology

Strathmore University

Nairobi, Kenya

June, 2018

Declaration

I declare that this work has not been previously submitted for an approved of the award of a degree by this or any other University. To the best of my knowledge and belief, the proposal contains no material previously published or written by another person except where due reference is made.

Irine Cherotich Chepkwony

Reg. No. 067832

Signature_____

Date _____

Approval

The research has been submitted with my prior approval as University Supervisor.

Signature _____

Date _____

Professor: Ismail Ateya Lukandu

Faculty of Information Technology

Strathmore University

Dedication

I dedicate this work to the Committee of the Catholic Sponsorship Program of East Africa (CSPK) for the financial and moral support they gave me throughout my study. I also dedicate this work to the memory of my loving mother, Eleanor Chepkwony who loved me unconditionally. Lastly, this work is also dedicated to my loving son, Ian Kimutai for whom despite his tender age of four years old, he demonstrated understanding, care and love when I had to leave him behind in order to carry out my studies; I draw much of my inspirations from that, and for that I am eternally grateful.

Abstract

Kenya is among the global leaders in tea exports. Tea sub-sector is among the largest foreign exchange earners in the county. Processed tea is sold through the Mombasa tea auction; each tea factory is represented by a broker. The method of auction is “open cry “; all buyers and sellers meet and compete for tea sales and purchases publicly; the prices and awards are also public. The auction processes are currently done manually and the auction model is broker centric. There have been serious challenges affecting the Mombasa auction house; inefficiency in the manual processes, lack of transparency to all stakeholders and concerns of unfair auctions practices of collusions and price manipulation. The aim of this research was to remodel tea auction using information technology innovation as an agent of that change. The remodelling involves devolving tea auctions so that the tea processing factories can auction their own tea directly to the buyers. This is achieved through the use of a cloud-based e-auctioning prototype. By enabling factories auction their own processed tea, it resolves the issues of transparently, collusions and price manipulations and it indirectly reduces the cost of production through minimal dependence on brokers for tea auctions thus positive impact on raising the overall income. The research design used is a mixed method research design; qualitative and quantitative, information was collected from written literature; raw data were collected from the population of the case study: Momul tea factory limited by means of interviews and questionnaires and were analysed using SPSS. The analysis results were presented in form graphs of which over 80% of the respondents felt that brokers controlling the auction process were the main challenge ailing tea auction in Kenya. The tools used to develop the prototype are: MySQL, PHP, HTML and JavaScript, these are open source programming tools. Usability tests were carried out among the selected users. The overall reception of the concept was positive with recommendations to include more factories and tea trade regulatory bodies.

Acknowledgements

This study would not have come to a successful conclusion without the help and contributions of many individuals. A profound gratitude goes to my supervisor; Professor Ismail Ateya Lukandu, of the Faculty of Information Technology at Strathmore university. Professor Ateya offered consistent support and his office was always open whenever I needed his guidance. He guided me through all the thesis phases with patience, encouragement and the needed toughness. He steered me in the right direction through his recommendations however, he constantly allowed this study to be my own work.

I would also like to appreciate and acknowledge the experts who were involved at various levels. The Board of Directors Momul Tea factory, they provided helpful insights into Tea trade. The Strathmore University thesis examining body for concept validation and constructive critique of which I was able to more accurately align my concept with the industry.

I thank my fellow classmates and my friends: Caroline Cheruiyot, Fredrick Omondi, Ali Mirza, Angela Lungaho, Alphonse Ombogo, Betty Mutua, Gilbert Mutai, Irene Misoi, Diana Musa, Emma Muindi, Ciliaca Njeri, Gertrude Chepkirui , Clara Cheptoo ,Dennis Ondieki, and Leonard Kipngetich for the moral and academic support they gave me which made my years of study manageable and enjoyable.

I remain indebted to my family members: my loving father; William Chepkwony, my loving grandmother; Magdalene Kosgei, my loving aunt Pricila Kosgei, My loving siblings Robert Langat, Victor Biegon, Josephine Chepkemoi, Caren Chelangat , Patricia Chepkoech and Josphat Kipkorir , All my nieces and nephews especially Judith Cherono. Thank you for giving me your unfailing support and encouragement throughout the years of my study.

Above all, I wish to thank the almighty God to whom I awe my being for the abundant provision of wisdom, knowledge, good health and resilience to withstand challenges. Due to his sufficient grace, I was able to bring this work to fruition.

Table of Contents

List of Tables

List of Figures

Abbreviations/ Acronyms

B2B	-	Business to Business
B2C	-	Business to Consumer
C2C	-	Consumer to Consumer
DFD	_	Data Flow Diagram
E-	_	Electronic
EATTA	_	East African Tea Trade Association
ERD	_	Entity Relationship Diagram
KTDA	_	Kenya Tea Development Agency
KTGA	_	Kenya Tea Growers Association
NTDC	_	Nyayo Tea Zones Development Corporation
TBK	_	The Tea Board of Kenya
TRFK	_	Tea Research Foundation of Kenya

Definition of Terms

Auctioning	Refers to a process of sale where the price is neither set nor arrived at by negotiation but is discovered through the process of competitive and open bidding (Choi and Whinston ,2000).
E-Auctioning	Electronic auctioning refers to open bidding through an automated trading system which utilizes various IT including the internet (Choi and Whinston, 2000).
Catalogues	A process of labeling of tea using pre-defined parameters (East African Tea Trade Association, 2015).
Grades	Sorting of tea according to various leaf sizes (East African Tea Trade Association, 2015).
Pallet.	20 packages of graded tea (East African Tea Trade Association, 2015).
Lot Number	A unique number allocated to each factory invoice. And is the main auction reference in the auction. Main grades auction and secondary grades (East African Tea Trade Association, 2015).

Chapter 1 : Introduction

1.1 Background of the Study

Tea farming was first introduced to Kenya in 1903 by a European settler GWL Caine who had come from India (Tea Board of Kenya, 2010). The British Colonial Administration started exporting it to London by 1933. The cultivation of tea in the colonial period was basically the preserve of the British settlers. After independence in 1963, the cultivation of tea was desegregated to African farmers both small scale and large-scale farmers who had bought land from British settlers (Kenya Human Rights Commission, 2008).

The planting and production of tea has rapidly increased since independence. Over the years Kenya has grown into a formidable world tea producer, with an annual production of about 300 million kilograms and is rated as the fourth largest tea producer and the second biggest exporter in the world. This formidable growth has seen the tea industry grow into the most important agricultural sub-sector and the leading foreign exchange earner in Kenya. Tea has put Kenya squarely on the world map with over fifty countries importing Kenyan tea (Kenya Human Rights Commission, 2008).

The country contributes 10% of the total global tea production and commands a remarkable 21% of the global tea exports outside producing countries. Over three million Kenyans, an approximate of 10% of the population are directly or indirectly employed by the tea industry. Tea plays an important role as the economy's main anchor and is among the largest foreign exchange earner (International Research Network ,2005).

Historically, the tea industry is one of the greatest successes in Kenyan agriculture. Tea planting and production have expanded rapidly since independence in 1963, from 18,000 tonnes and 24,448 hectares in 1963 to 294,000 tonnes and 131,000 hectares in 2003. The nation grew record 473,000 tonnes in 2016, which earned the country 120-billion shillings ($1.16bn) of export revenue ("Black tea production in kenya to rise 20% by 2020," 2017).

1.1.1 Organization Structure for Tea Industry in Kenya

Tea sub-sector in Kenya is governed by various institutions. According to (Tea Board of Kenya, 2011) , the various institutions and their roles are: Ministry of Agriculture promotes agricultural production among tea production, TBK is responsible for the overall function of regulating tea production, TRFK carries out research on pest and disease control, improvement of planting materials, KTDA is responsible for managing small scale tea producers , NTDC manages the tea belts around the forest zones, KTGA manages large-scale tea producers, EATTA regulate tea auction at Mombasa Tea auction house, Packers add value to the finished tea through blending and packaging. Fig 1-1 provides a summary representation of each institution and its roles.

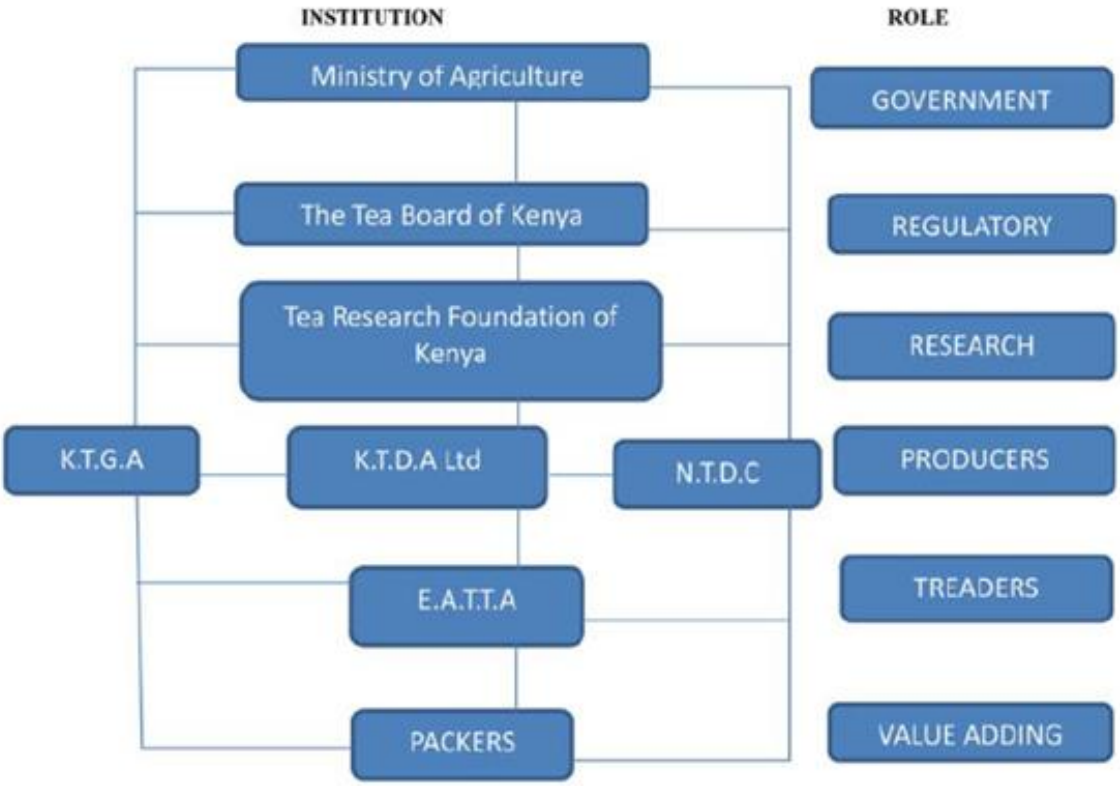


Figure 1-1 organization structure for tea industry in Kenya (Tea Board of Kenya, 2011)

1.1.2 Tea Trading in Kenya

About 10% of global tea production comes from Kenya. 5% of Kenya's overall production is sold in the domestic market, and the rest is traded in the international markets (Monroy, Mulinge & Witwer, 2012). Kenya commands over 20% of world tea export (Andrianna, 2015). Tea export is majorly done through auction. Monroy et al, (2012) demonstrates that; Mombasa auction is the centre of the tea trade in Kenya, and an important reference point for the global tea industry. It serves Kenya, Tanzania, Uganda and Rwanda. The world tea export according to international tea committee 2015 report is shown below:

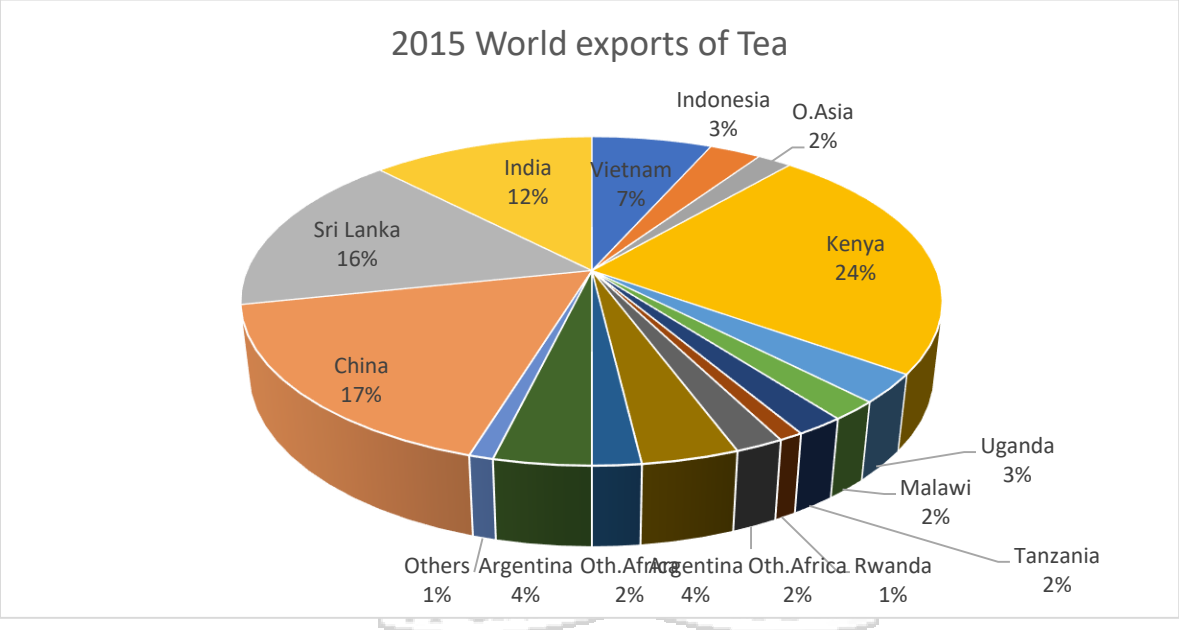


Figure 1-2 Worlds tea export 2015 (International tea committee, 2015)

1.1.3 Challenges Facing Tea Trade in Kenya

There are a number of challenges facing tea trade in Kenya. Tea production, unpredictable exchange rates, decreasing farm sizes, high production costs, weather-related issues among other factors (Farmers trend, 2016). The report further indicates that production costs rose by 15% in the year 2015. The increase in cost of production, has a negative effect on the overall income, this negative effect greatly affects the tea farmers especially small-scale farmers (Farmers trend, 2016).

1.1.4 Volume and Average Price Comparisons

There has been fluctuation of tea prices. Prices are affected by many factors including the quantity of tea produced, the quality of tea and cost of production among others (East African Tea Trade Association, 2015). It can be inferred from Figure 1-3 that the higher the volume produced, the lower the prices and vice versa.

Figure 1-3 Figure 1.2 Volume Average price comparison (East Africa Tea Trade Association, 2016)

1.2 Problem Statement

Tea subsector is among the largest foreign exchange earners in Kenya. Despite its extensive growth over the years, cost of production has been steadily rising (Farmers trend, 2016). Tea auction have had challenges with the reports of unfair practices, price manipulation and collusions with major brokers, warehouses and traders to sell high grade tea at exact same prices as low-grade tea (Gerald, 2015). The recent industry report indicated the gradual fall in tea prices (Gerald, 2018).

There is a need to relook into tea trade with the aim of optimizing processes in the tea supply chain. This research looked into auction process. The aim is to enable factories directly auction their freshly processed tea to buyers without necessarily having to go through brokers. This is achieved using electronic tea auctioning prototype. The implementation of the prototype will see significant reduction of over-dependence on brokers, elimination of unfair practices like collusions and price manipulations. It also has the potential to reduce costs of production, because tea will be

exported directly to buyers thus reducing warehouse overhead costs and consequently raising the profit margins to the benefit of all the stake holders.

1.3 Research Objectives

i. To review the current methods of auction used in tea auction.

ii. To identify factors affecting tea auction.

iii. To review the current tea auctioning systems.

iv. To develop factory-based electronic tea auction prototype.

v. To test the prototype on the case study.

1.4 Research Questions

i. What are the methods of auction currently in use for tea auction?

ii. What are the factors affecting the tea trade?

iii. What are the system(s) currently used in tea action?

iv. How can electronic tea auction prototype be implemented?

vi. How can the effectiveness of the prototype be demonstrated?

1.5 Justification

There have been price fluctuations for tea, 2013 through 2014 registered 40% price reduction (Cheruiyot, 2014). The cost of production in the other hand has increased significantly (Farmers trend, 2016). The latest industry statistics on the price fall is alarming with the lowest price per kilogram registered on March 2018 (Gerald, 2018). There is need to rethink on the current design of tea export. The focus should be a reduction on the costs of production, to ensure that maximum income is enjoyed by the stakeholders. The reduction on cost of production can be achieved through optimization of supply chain operations. This research aimed to optimize auction processes by addressing the current operational inefficiencies on the auction model. Cloud-based prototype was used as a process remodelling agent to enable processing factories auction their own tea. The implementation of the concept will see the reduction on brokers involvement

on tea auction and thus potential overall income goes directory to the factories and subsequently to the farmers.

1.6 Scope and Limitations

The research is focused on remodelling auction process in the tea supply chain with a case of one tea factory: Momul Tea Factory. Elements of brokers and warehouse effect on cost of production was considered. Elements of tea farming and tea processing was not considered. The research limitation is on the aspect of tea testing. The current model enables buyers test their tea before auction. Since factories will be auctioning their own tea directly from the factory, it will not be possible for buyers to test tea before auction. Buyers will therefore depend largely on information provided by the factory regarding the tea on auction; which will be provided prior to auction.

Chapter 2 : Literature Review

2.1 Background of Online Auction

The earliest internet auctions appeared in the year 1993, with auctions based on internet news groups (Reiley, 1999). In 1995, the first internet auction websites opened, with On-Sale (www.onsale.com) and eBay (www.ebay.com) starting operations. Since that time, electronic markets based on the internet, in particular, online auctions have become popular venues for conducting business transactions (Grenier,2001). In fact, it can be argued that the auction-based electronic markets best represent the changes to business inherent in E-commerce.

Following Vanheck and Vervest (1998), E-markets are characterized by the number of buyers and sellers and whether the participants are consumers or businesses. Auctions are found when a single seller is selling to multiple buyers, or when multiple sellers are selling to single or multiple buyers. There are various auction categories according to buyer consumer logic. Business to Consumer (B2C) case in point, On-Sale, Consumer to Consumer (C2C) case in point eBay and many sellers and a single buyer, these auctions are known as reverse auctions or procurement auctions.

There are many examples of firms using procurement auctions in which sellers compete for a contract in the Business to Business (B2B) market; Sorcity (www.sorcity.com) is an example of a third party that specializes in hosting such auctions. In the reverse B2C auctions (C2B auctions), firms vie to make a sale to a particular consumer, e.g., Priceline.com. There are also several B2B exchanges in which forward and reverse auctions, negotiations, and electronic catalogue sales are all conducted between buyers and sellers for specific industries. Examples include Covisint for the auto industry, Exostar (www.exostar.com) in the aerospace industry, e-Steel (www.exchange.e-steel.com) for the steel industry, and Chemconnect (www.chemconnect.com) for the chemical industry.

2.2 Auction processes

Kumar and Feldman (1998) described a complete auction-based trading process comprises six basic activities as below.

Step one: Initial buyer and seller registration: Kumar and Feldman (1998) indicated that this step deals with the issues relating to authentication of trading parties, exchange of cryptography

keys, and perhaps creation of a profile for each trader that reflects his interest in products of different kinds and possibly his authorized spending limits (Kumar & Feldman 1998).

Step Two: Setting up a particular auction event: This step deals with describing the item being sold or acquired and setting up the rules of the auction. The auction rules explain the type of auction being conducted (open cry, sealed bid, Dutch), parameters negotiated (price, delivery dates, terms of payment, among others.), starting date and time of the auction, auction closing rules (Kumar & Feldman 1998).

Step Three: Scheduling and advertising: To attract potential buyers, items of the same category should be auctioned together at a regular schedule. Items to be auctioned in upcoming auctions are advertised, and potential buyers are notified in this step (Kumar & Feldman 1998).

Step Four: Bidding: The bidding step handles the collection of bids from the buyers and implements the bid control rules of the auction (minimum bid, bid increment, deposits required with bids) and for open cry auctions notifies the participants when new high bids are submitted (Kumar & Feldman 1998).

Step Five: Evaluation of bids and closing the auction: This step implements the auction closing rules and notifies the winners and losers of the auction (Kumar & Feldman 1998).

Step Six: Trade settlement: This final step handles the payment to the seller, the transfer of goods to the buyer, and if the seller is not the auctioneer, payment of fees to the auctioneer and other agents i.e. appraisers, consignment agents among others (Kumar & Feldman 1998).

2.3 Methods of Auction

According to Kumar and Feldman (1998), the commonly used auction models are the open-cry auctions, single and multiple round sealed bid auctions, and Dutch auctions.

Open-cry auction, also called an 'English auction', the buyers gather at a common location, physical or virtual, at the pre-specified time (Kumar & Feldman 1998), each buyer can hear the bid submitted by a rival buyer and has a limited time to respond to it with a higher counter-bid (Kumar & Feldman 1998).

In physical auctions the responses must be received within seconds, while in cyber auctions it is conceivable that several minutes or hours will be allowed for the response. Auctions may end

at a posted closing time. Alternatively, the auctions could be kept open so long as new bids continue to arrive within some time interval of the preceding bid (Kumar & Feldman 1998).

Pros and Cons of an open-cry auction

Table 2-1 Pros and cons of open-cry auction (Kumar and Feldman 1998).

Pros	**Cons**
Fairness is one of the biggest advantages of public bidding, open cry is public which means all the bidders are seen and everything is done public which is relatively fair.	The process takes long to gather all the necessities and to submit a responsible bid
There is no discrimination, all qualified bidders have access to all bids	There is no guarantee of award for the contractors despite taking long to prepare for the bid
Open cry is simple thus familiar to general population.	The number of bidders can be so high since it is public, it is therefore, difficult to negotiate fair or lower prices
It is preferred for the internet auction due of its transparency.	It can potentially encourage the formation of rings
There is bidding frenzy due to its nature of being public and this encourages competition which potentially raises the average cost of products on auction.	

Sealed bid auction, there are two types of sealed bid: single round and multi-round. The overall characteristics of sealed bid is that the buyers are required to submit their bids by a specified deadline (Kumar & Feldman 1998). The auctioneer then keeps the bid information secret until the deadline; the bids are evaluated based on particular set criteria and the winners are declared (Kumar & Feldman 1998). Single round sealed bid; of which a single submission is considered

final lacks the competitive atmosphere that is experienced in open cry auctions due to the bidding frenzy each bidder working to outbid their rivals (Kumar & Feldman 1998). Multiple round sealed bid auctions however, tries to rectify this situation in that there is a deadline for each round of bids, and at that deadline, a decision is made to either the auction is closed is satisfactory, if not satisfactory, the bids from the current round are publicized. A fresh round of bids is then solicited with new deadline provided (Kumar and Feldman 1998).

Pros and Cons of a sealed bid auction

Table 2-2 Pros and Cons of a sealed bid auction (Kumar and Feldman 1998).

Pros	**Cons**
Attracts small crowds could be good for unit prices.	Tough multiple seal bid tries to bring competitiveness, it still lacks the instant bidding frenzy which is enjoyed in open cry auctions. Time is also consumed running multiple bids
It works best when the product is exceptional	Buyer bids blindly, thus have no control

Dutch auctions, this model users reverse auction engineering approach. The auctioneer starts with a very high asking price as the upper price limit. Then actioner then gradually decreases the asking price until potential buyers come out to bid by specifying the number of items they will purchase at the current asking price at that particular time. The auctioneer then continues lowering the bid, this is an effort to maintain a stream of potential buyers while the inventory lasts (Kumar and Feldman 1998). Furthermore, the pace of the bidding process can be controlled by fluctuating the rate of lowering the prices. The faster the process are lowered, the faster the inventory is depleted (Kumar and Feldman 1998). The auctions can be closed; at a pre-specified time, or when the entire inventory has been sold out or when the price has reached to a pre-specified which cannot be lowered further, or at any combination of the aforementioned conditions (Kumar and Feldman 1998). When the bidding period is over, the bidders with the highest number of bids get the item on auction, however, the price they eventually pay could either be the same as what they bided or lower (Kumar & Feldman 1998).

Pros and Cons of a Dutch bid auction

Table 2-3 Pros and Cons of a Dutch bid auction (Kumar and Feldman 1998).

Pros	**Cons**
This model is best suited for perishable items such as vegetables or airplane seats	The buyer pays their maximum internal price
Revenue-Equivalence, each bidder evaluates against the same valuation information	The auction cannot be done if all bidders do not have instant access to information.
This model provides a seller a better control on liquidating inventory because a seller has control giving over download price to revision	The model only works when one product is being sold.
Discourage the formation of rings	
The descending nature of prices encourages and ensures that bidders bids promptly when their internal price is reached	
The model guarantees transparency to everyone involved because every aspect of auction is done out in the open.	

There are a number of factors which informs the choice of auction. The overall aim is to get the commodity with fair prices. Figure 2-1 demonstrates the overall bidding nature of the three auction methods in relation to prices.

Figure 2.1 Auction Pricing Model (Kumar and Feldman 1998).

2.4 Architecture

Ezhchivelen and Morgan (2001), described three architectural auctions based on server design: centralized server, interconnected server and distributed server.

2.4.1 Centralized Server Approach

According to (Ezhchivelen & Morgan 2001) a central server displays the item on auction, a deadline for placing bids is attached to the item. The bidders then access the server in order to place their bids. The bidders' responsibility is to ensure that their bids reaches the server before the deadline. Once the deadline elapse, the item is sold to the winning bidder.

Some well-known central server systems are eBay and AuctionBot (Ezhchivelen & Morgan 2001). The bidders can access the server through various means: via internet, or by mobile systems, or by agents executing on the server itself. The server authorization and is done through brokers whose main role is to ensure the authentication of the bidders such that the server is able

to trust the authenticated bidders. The mail role of the brokers is to verify the bidders' ability to settle the payments, after the verifications, the authentication keys are then distributed (Ezhchivelen & Morgan 2001).

From (Ezhchivelen & Morgan 2001), the mail server functionalities can be deduced as below:

(i) The server verifies the authenticity of the bids and the timeliness of incoming bids.

(ii) The server displays all the information about the auction details, for example, the bidding deadline, the highest bid placed among others.

(iii) The server executes the bids as per the set policies.

Challenges of the centralized server

There are few challenges affecting the centralize architecture as below stated:

(i) The challenges with scalability; there is an increasing popularity and usage of internet auctions, the centralized approach cannot effectively scale to meet the demand (Ezhchivelen & Morgan 2001).

(ii) Due to its centrality, it cannot therefore, effectively handle the autonomy of various local markets with varied auction policies (Ezhchivelen & Morgan 2001).

2.4.2 Interconnected Servers

This design is that there is a server for a given local market, each local market is autonomous and exercises policies which are best suited to local conditions and market mechanisms (Ezhchivelen & Morgan 2001). Among other examples of the conditions which could be set locally are: bidding deadlines, this takes into consideration the reliability and the availability of the bandwidth, formation of payment rules which are feasible and acceptable with the local traders.

The local market servers are connected to each other by the internet or by private network with a communication infrastructure that enables the connected servers to carry out B2B transactions. The interconnected local markets collectively form the global market (Ezhchivelen

& Morgan 2001).

2.4.3 Distributed Auction System

Distributed auction system is made up of many bid servers connected to each other through the internet or a privately-owned network of which each server serves a local market (Ezhchivelen & Morgan 2001). The process starts when a seller places a request to the local bid server to auction an item. Once the request has been accepted based on the set acceptance criteria, by default; the local server informs all other servers in the system to initiate an auction on the item. Every server in the system then displays the details of the item to be sold and announces the start of a new auction to its respective local market. Once the potential buyers start bidding, the server accepts the bids (Ezhchivelen & Morgan 2001).

The server periodically multicasts the received bids to every other server in the system. The multicast messages are called the episode messages. The content on the episode messages are aggregated by each server to form the history of bids accepted in the global system. The episode messages follow that: Every local bid accepted is referred to in one of the episode messages, and no two-episode messages refer to the same bid; This is necessary to ensure that there is no duplication on the global history (Ezhchivelen & Morgan 2001).

Active out-bidding is encouraged in this architecture with the aim of seeking better offers for the seller. Outbidding is achieved through each server displaying the global bid history it computes, to the local bidders. The local bidders are continuously updated on the global bidding trend. The bidding frenzy is further enhanced by extending the deadline for the local market if a remote bid is known to be the same as or higher than the highest local bid. When the locally-set deadline is reached and no new higher bid is placed in any of the servers, the auction terminates and the highest bidder wins the item (Ezhchivelen & Morgan 2001).

2.5 Current Auction Systems

2.5.1 Mombasa auction house processes and systems in use

Mombasa tea auction house auctions tea via manual system based on open cry model of trade (East Africa Tea Trade Association, n.d.). The auction consists of a main grades auction and secondary grades auction. According to (East Africa Tea Trade Association, 2016). brochures, the

auction is held weekly on Mondays for main grade and Wednesdays for secondary grades. EATTA organizes all the schedule. Brokers are the main sellers; each factory has a representing broker.

2.5.1.1 Auction Catalogues

Tea is sold under as per the producing factories, each tea has factory marks to uniquely identify the packages. The tea is sorted into various leaf sizes, known as grades, each grade has standard abbreviations such as PF1(East Africa Tea Trade Association, n.d.). Every batch production of a single leaf grade is given a unique invoice number, before being packed into standard paper sacks, which in turn are put onto pallets. The standard unit of tea is a single pallet of twenty packages, and a single invoice will therefore be made up of a number of pallets of twenty packages. The number of pallets per invoice will depend on the total amount of leaf processed in the day, and the percentage of each grade (East Africa Tea Trade Association, n.d.).

2.5.1.2 Before tea auction

Tea factory companies does not auction their own tea, they are represented by a selling broker. The responsibility of the selling broker is to catalogue the tea for sale. The mail reference for each tea in the auction is a lot number which is assigned to each factory invoice. The buyers are provided with samples before the auction date such that they can measure and taste the tea. Each lot of tea is give a valuation by the broker. Tea valuation is based on factors such as: the previous week's price for similar grade of tea, and any changes in quality (East Africa Tea Trade Association, n.d.). The standard format for the catalogue follows: lot, factory mark, grade, invoice, number of packages, package type, net weight, and weight per package. The standard unit used is a pallet of twenty sacks, and a lot comprises multiple pallets (East Africa Tea Trade Association, n.d.).

2.5.1.3 Auctioning

Auctions are held in public using the open cry model of auction. The buyers publicly compete for lots of tea by bidding against each other in auction room. Every lot is sold or ("knocked") to the highest bidder once the minimum price level set by the broker is reached. The buyers are given a grace period of ten days within which they must pay for their purchases. The payments are automatically transferred to producers via an electronic payment system (East Africa Tea Trade Association, n.d.).

Table 2.4 Pros and Cons of the current Mombasa auction model (East Africa Tea Trade Association, 2016).

Pros	**Cons**
Transparency; the system is public auction information can be accessed by the public.	The model is broker centric
Certainty and speed, it is relatively faster	Less time for surveyors and solicitors
Fairness: It offers a 'level playing field'.	Being ready with your financials
The process is straightforward	It's easy to go over budget due to "Auction Frenzy"
Greater choice of grades	

2.5.2 Free Markets BidWare Auction system

Free Markets started by conducting auctions online in 1995 (Brian ,2003). The main focus was on the industrial market, this was informed by the fact that industrial market was a big market and had many potential opportunities for development (Brian ,2003). Free market faced a number of competitions. However, it gained a leadership role in creating business-to-business online auctions for buyers of industrial parts, raw material, commodities and services around the globe (Brian ,2003). Its technology and services have is modelled around five main areas, which are: automotive, consumer, energy, high technology, manufacturing and the public sector. There has been a success in auctioning in more than seventy product categories including injection moulded plastic parts, commercial machining, metal fabrications, chemicals, printed circuit boards, corrugated packaging and coal among other (Brian ,2003).

The success of BidWare was majorly due to team collaboration. Dedicated team worked closely with potential; customers and suppliers. The aim on the customer was to establish their purchasing needs and expectations so as to connect with potential suppliers that will help them to

meet those needs (Anderson & Frohlich 2003). There are advantages Free Markets promotes: cost savings, speed when completing negotiations, faster return on investment, supplier consolidation, global sourcing and better market information. The BidWare software has superior design which provides near-instantaneous response. It displays bids to both buyers and competing suppliers within seconds of their submission (Anderson & Frohlich 2003).

2.5.3 Promena E-Auction

Promena electronic auction system was founded in the year 2001 by Koç Holding, Turkey and Carlyle Group, United States of America ("Promena," n.d). The main aim of Promena e-auction was to provide high efficiency, and effective control of time, labor and cost savings to its customers in their purchasing activities. To achieve its main agenda, it combined both global and regional market know-how, and high technology system ("Promena," n.d). The system solution is called e-Auction, and it provides on demand electronic auction event management service and integrations with ERP. e-Auction handles wide variety of goods and services ("Promena," n.d).

2.5.4 Xpert Auction software

Xpert is a single-seller auction system which can handle varied business lines for instance "commercial auctioneers, collectibles dealers, charity events, advertising and promotional auctions and auctions for media outlets like radio, television or newspaper" ("Xpert Auction Software,"n.d).

2.5.5 A pan-India electronic auction system

India is the second largest tea producing country. It has several auction centres. The auction centres use a centralized electronic auction system for tea auctioning (Andrianna, 2015). The system connects all auction centres, its implementation has increased efficiency, brought uniformity and has improved tea prices. The tea board of India has continually improved the system to meet the standard required and has expanded to include all tea previously left out for manual auction ("Tea Board launches e-auction to bring uniformity in rules," 2016).

2.5.6 Electronic Auction system in Sri-Lanka

Colombo auction house in Srin-lnka is the largest auction house in the world (Andrianna, 2015). It utilizes innovative business solutions to enhance their product and service offering. eGravel application, conceptualized and initiated by John Keels PLC, the tea and rubber broking

arm of John Keels Holdings, is a tablet-based application capturing tea auction information in real-time.

2.6 The Research Gap

Based on the research done and in line with most of the articles and journal reviews, there have been advancements in automating the manual auction processes. However, in as much as there have been advancements, auction processes have not been optimized and there is a need to remodel the e-auction by decentralizing the auction process to the processing factories. Most systems reviewed do not have the ability to integrate with existing ERP systems and there was no mention of a cloud-based solution to facilitate Software as a service. Comparison in relation to scope and the objective of each system has been tabulated on table 2.6 and the gap in each system has been identified.

Table 2.5 Review results of the auction systems which were studied

System	**Scope**	**Objectives**	**Gap**
FreeMarket Bidware	Industrial parts, raw material, commodities and services around the globe.	Business-to-Business online auctions	Business – Consumer not factored. Not flexible to accommodate
Promena E-Auction	Management of : "Auction, Bid, Catalog, Contract, Inventory, Invoice Processing, Punch-out, Purchase Order , Receiving Requisitions & Approvals Sourcing, Spend , Supplier "	Efficiency in e-commerce. Is in SaaS platform	

India E-Auction	Auction of Tea	Auction tea in all Indian tea auction houses	Broker-centric, No integration to the ERP system.
Xpert Auction software	Wide Variety of Commodities	single-seller auction	Lacks specialized model
Sri-Lanka eGravel	Tea Auction information	Real time e-auction information	No integrations with existing systems eg the ERP

2.7 Conceptual Model

The conceptual model is cloud based E-auction prototype which enables tea factories to auction their tea directly to the registered buyers. The models address the gaps in the current broker-centric model of auction by reducing the overdependence on brokers through decentralizing auction to the tea processing factories. Tea will be transported to the port once it is sold thus reducing the overhead cost on warehouses. There is a potential for good quality exports since tea is exported directly without having to spend long time in the warehouses awaiting auction. Consequently, it has potential of raising tea overall profit margins.

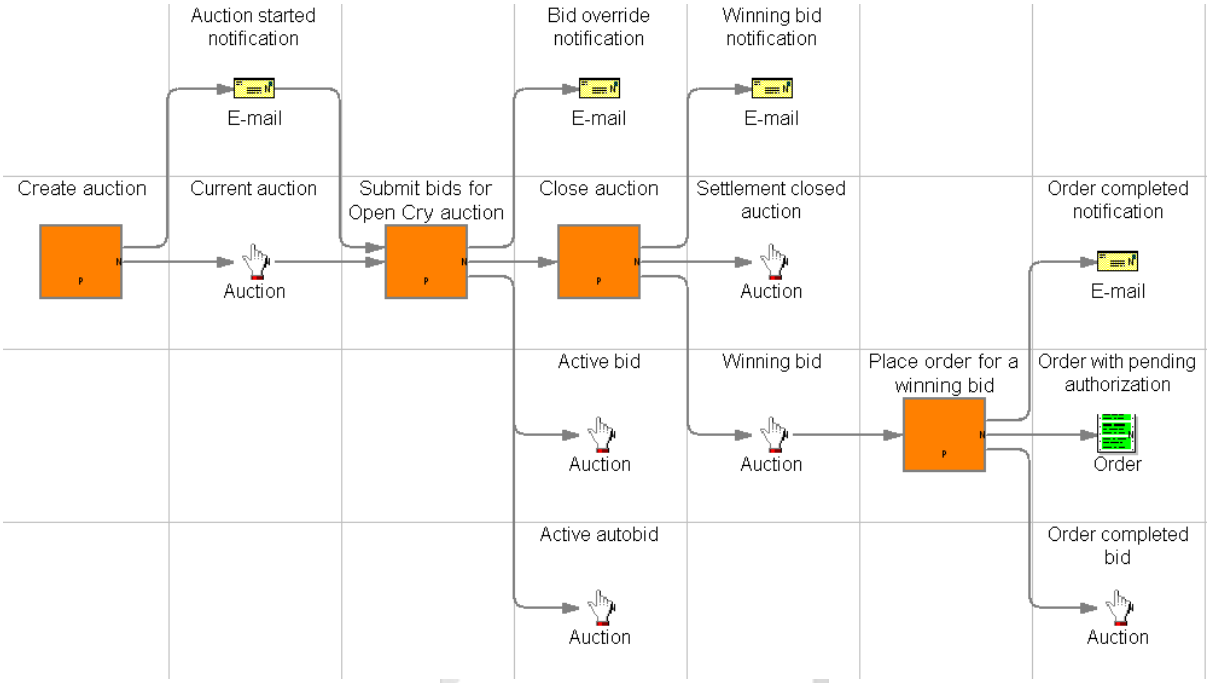


Figure 2-2 Conceptual model of the electronic tea auctioning system

Chapter 3 : Research Methodology

3.1 Research Design

Burns and Grove (2007) define a research design as "a blueprint for conducting a study with maximum control over factors that may interfere with the validity of the findings". Parahoo (1997) describes a research design as "a plan that describes how, when and where data are to be collected and analysed". Polit and Hungler (2004) define a research design as "the researcher's overall for answering the research question or testing the research hypothesis". According to (Mugenda & Mugenda, 1999), "the research design is the overall strategy that a researcher selects to integrate different components of the study in a logical manner to ensure that the research questions and objectives are clearly addressed".

The research design used in this research is a mixed method research design. A mixed research combines both the qualitative of which the interviews to probe the respondent for further answers to provide clarity and better understanding to the researcher, and quantitative approach of which questionnaires were used. "The term mixed methods refers to an emergent methodology of research that advances the systematic integration, or "mixing," of quantitative and qualitative data within a single investigation or sustained program of inquiry" (Creswell & Plano, 2011). It incorporates both the use of primary and secondary data collection methods as a way to provide complete, detailed description of the research focus.

Primary data was obtained from Kenya Tea Development Authority (KTDA), Tea Board of Kenya and the Momul factory management. Secondary data was obtained from previous studies.

3.2 Population and sampling

According to (Polit & Hungler, 2004)," a research population refers to an aggregate or an entire group of people, events or matter that conform to a set of specifications". "Target population refers to the entire group of individuals or objects from which the study seeks to generalize its findings" (Cooper & Schindler, 2008). "A sample is a group of people, events or matter which is selected to represent the target population "(Cooper & Schindler, 2008). The research population in this study includes Members of Kenya Tea Development Authority (KTDA), Tea Board of Kenya and Momul tea factory Management and board of directors.

The following Slovin sampling formula was used:

$n=N/1+N\ (e)^2$

n=sample size;

N=population

e=allowed error<=5%(0.05)

Equation 3-1 Slovin sampling formula (Stephanie, 2013)

From the Equation 3-1, Table 3.1 was generated:

Table 3.1 Target population and sample population

Population Category	**Target Population**	**Sample Size**
Tea Board of Kenya	16	8
Kenya Tea Development Agency	6	4
Momul Tea Factory	25	10
Total	47	22

3.3 Data Collection method

Polit and Hungler (2004) defined data as information obtained in a course of a study. "There are several methods of data collection easily categorized as primary and secondary. In primary data collection, the raw data is collected. Primary data are facts that is not interpreted or analysed while secondary data is information which have already been processed, analysed and documented just ready to be used as it is" (Polit & Hungler,2004).

In this study, the primary methods used to collect data are questionnaires and interviews.

3.4 Data analysis

"Data analysis involves using several interpretations to find linkage between the research objectives and the outcome with reference to the original research question"(Ngau & Kumssa ,2004) explains methods of analysing data which are interpretational, structural and reflective analysis. Interpretational and structural analysis were used in this research study and were based on the variables identified. "Both qualitative and quantitative approach of data analysis were used ; the quantitative was used to analyse the questioners and some of the interview questions , the qualitative approach was used to gather views of the e-auction system users on a particular e-auction system" ((Ngau et al., 2004).

3.5 Prototype Devolvement Methodology

The prototype development followed agile development framework. "Agile software development is an umbrella term for a set of methods and practices based on the values and principles of software iterations" (Tore & Torgeir, 2007). Solutions evolve through collaboration between self-organizing, cross-functional teams utilizing the appropriate practices for their context. Working software is the primary measure of progress; each iteration is to deliver working software, so the measure of progress is the number of software modules that were tested, achieved release standards and are seen to work.

3.6 Development Tools

The software is web system which is accessed via a browser. It was built using tools: PHP, MySQL, jQuery, HTML5 programming tools., it was temporarily hosted on cloud for one month as a prove of concept.

3.7 The Research Quality

The research design standard was followed in this research thus ensuring that the research is of high quality. "One of the quality parameters used to rate the quality is reliability of the data collection instruments"(Mugenda & Muenda, 1999). Mugenda and Muenda(1999) defines data reliability as "a measure of the degree to which research instruments yield consistent results". In this study, the data reliability was provided by carrying out pre-testing of the questionnaires with a selected staff member with proficient knowledge in tea auctioning.

3.8 Ethics in Research

This research complied with the standard research ethic guidelines (National Advisory Board on Research Ethic, 2002). The guideline provides ethical principles of research in the humanities, social and behavioural sciences. These principles are divided into three areas: Respecting the autonomy of research subjects, voluntary participation based on the informed consent, avoidance of harm and the appreciation of the sensitivity of a subject matter and the limits of privacy. Finally, privacy and data protection were also observed.

Chapter 4 : Presentation of Research Findings

4.1 Introduction

This chapter describes data analysis and system design of the electronic auction prototype. The data collected, sets up the basis for research implementation of the E-Auction system. Overally, this chapter gives the description of the data analysis, presentation of the research findings and graphical design representation of the functional flows and database engine of the electronic auction prototype.

4.2 Analysis and presentation of the of the findings

Presentations of the findings aim to show data interpretation from the field. The primary data was from the questionnaire and the interviews done on the Momul Tea Factory and Kenya Tea Development Authority stakeholders, while the secondary data were from recorded literature: research books, articles, journals and electronic documents.

Twenty-one responses out of the sample size of twenty-two questionnaires were collected and analysed. The research performance response was good with a percentage of over 90%, the research covered almost half of the target population.

The findings have a direct relation with the research questions, the research questions guided the study and were formulated according to the research objectives. The collected data were analysed to explore the relationship between cost of production specifically with warehousing and brokers' parameters, and the overall income and profit margins.

4.2.1 Stakeholder Levels

Figure 4.1 illustrates the employee distribution of momul factory. The largest number as can be implied from the findings are the junior officers, this could be so because the it is a processing firm and the most human resource required are for manual labour.

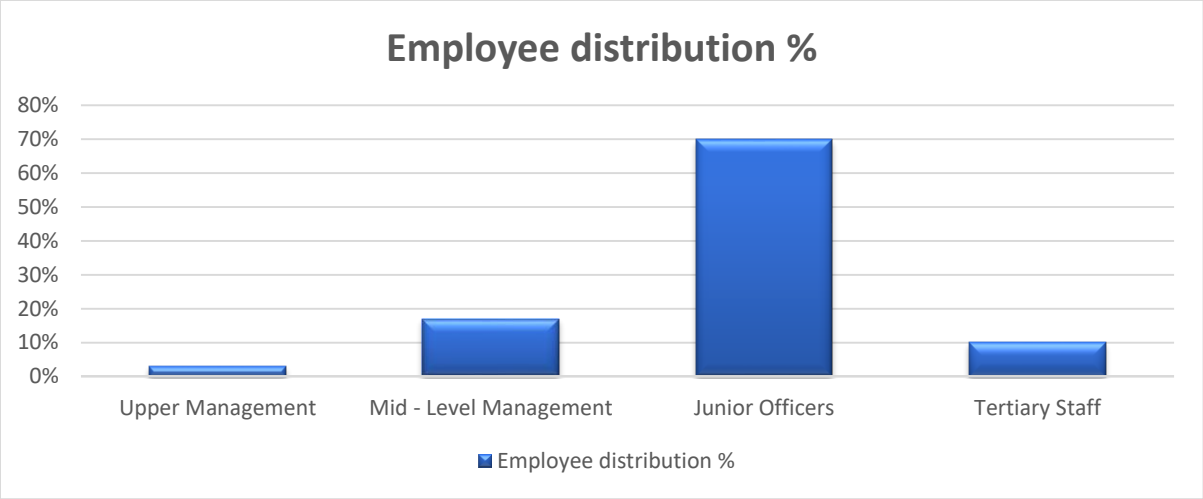


Figure 4-1 Employee distribution at Momul Tea Factory

4.2.2 Stakeholder Years of Experience

The experience in years of working was one of the aspects on the questionnaire to find out the level of experience of the employees to appreciate their depth of skills in the industry. Figure 4.2 illustrates the findings in regard to experience distribution of the human resource.

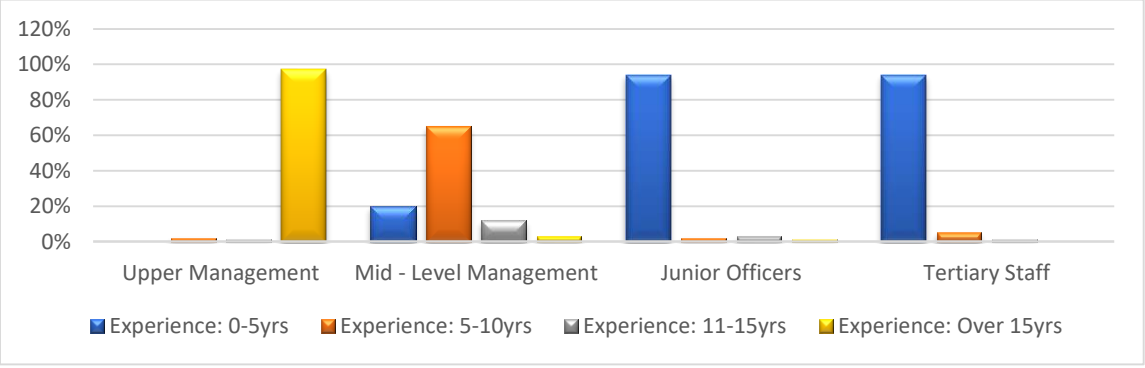


Figure 4-2 Employee experience distribution at Momul Tea Factory in years

4.2.3 Stakeholder Participation in Tea Trade

Employee tea trade participation was another area of interest; the aim was to find out the employment direct involvement with tea trade. Fig 4.3 illustrates that.

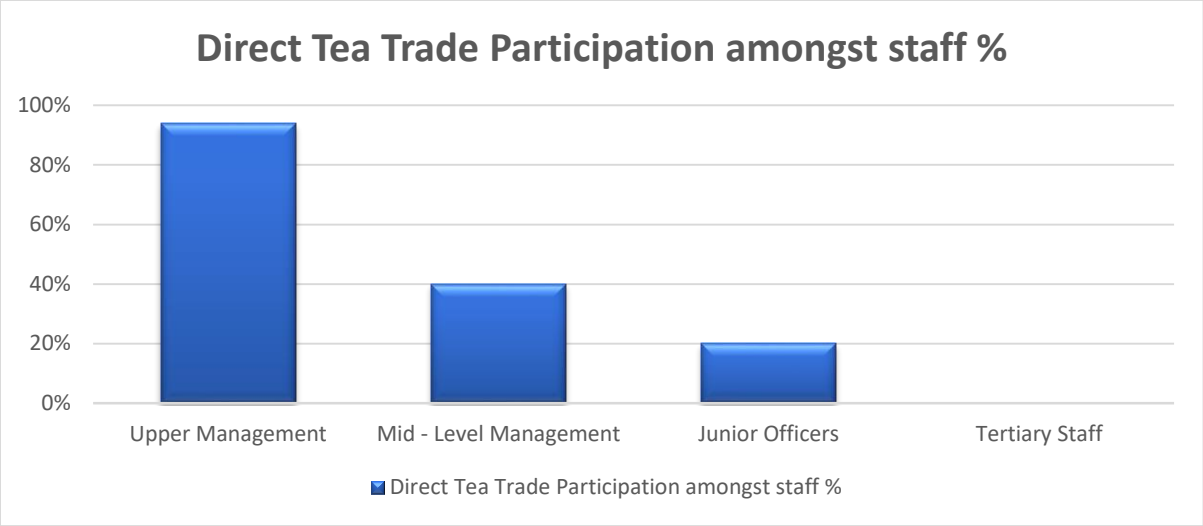


Figure 4-3 Employee participation in direct tea trade at Momul Tea Factory

4.2.4 Stakeholder Change management programs

Fig 4.4 shows the employee participation on change management programs. These are programs occasionally organized by the factory management to discuss on various changes affecting tea trade and how to manage such changes.

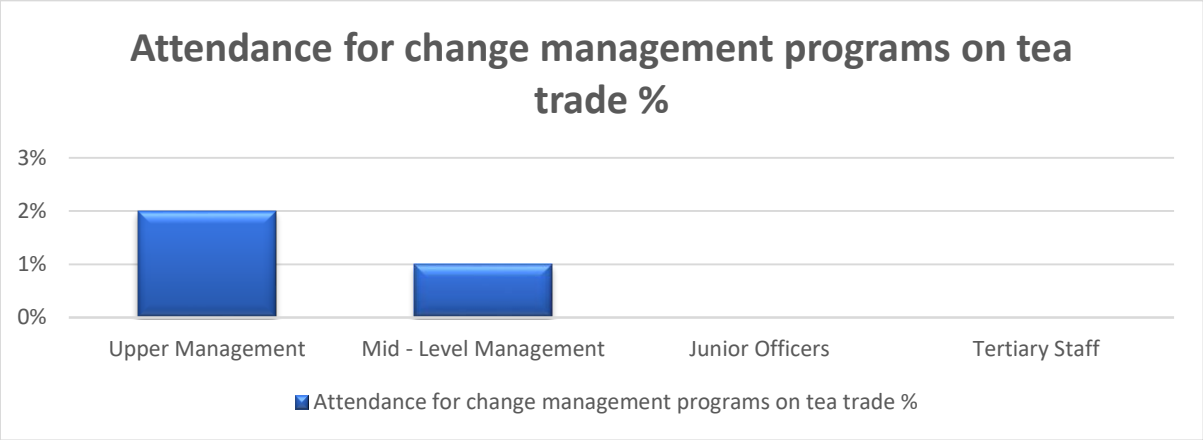


Figure 4-4 Employee attendance for change management forums on tea trade at Momul Tea Factory.

4.2.5 Tea Distribution Channels

Fig 4.5 shows the tea distribution channels through which tea is sold. According to the findings, export through auction/broker is the highest percentage through which tea is sold.

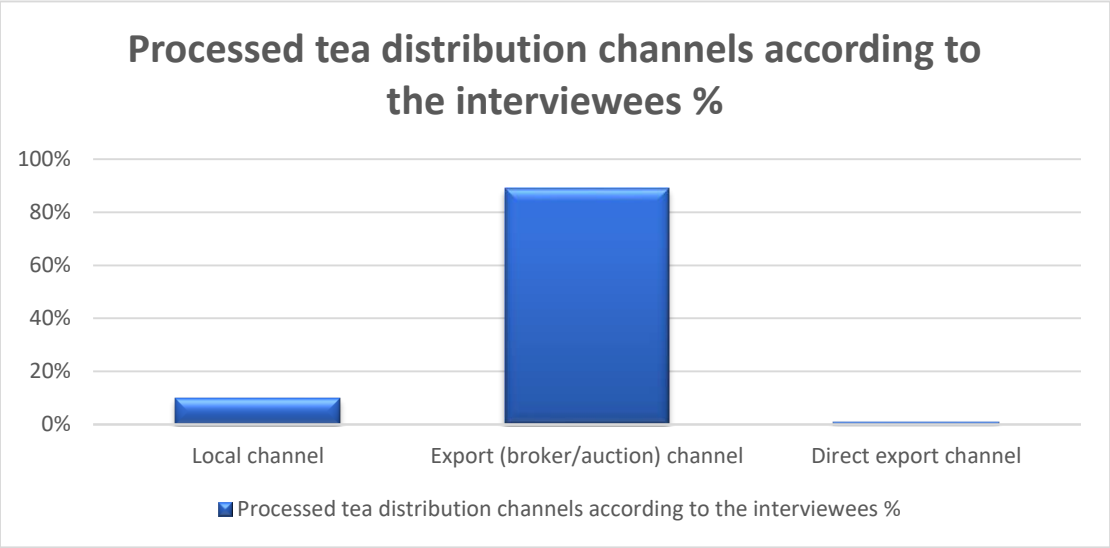


Figure 4-5 Tea Distribution channels used by Momul Tea Factory.

4.2.6 Challenges of Tea Export Trade

Figure 4.6 gives insights on the challenges faced specifically on the exportation. Brokers controlling the process were the major challenge reported.

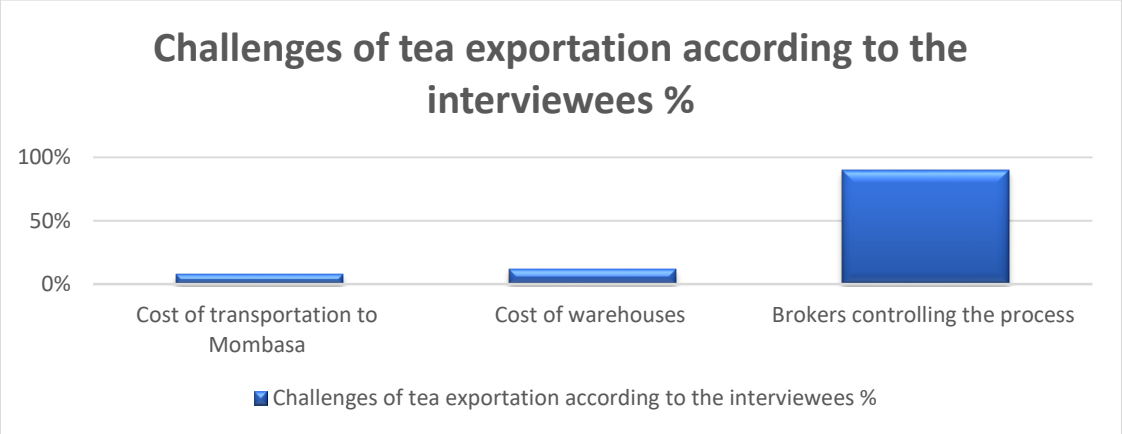


Figure 4-6 Challenges of tea export faced by Momul Tea Factory

4.2.7 Effects of Brokers in the Tea Trade

Fig 4.7 demonstrates the effects of brokers on the supply chain regarding process, volumes of sales and overall effect on cost of production

Figure 4-7 Effects of middlemen in tea distribution experienced by Momul Tea Factory.

4.2.8 Anticipated effect on implementing online tea trade

Figure 4.8 illustrates the predicted effects of direct tea auctions. More 80% agreed on reduction in cost of production, reduction in cost of warehousing and overall income increase in the event direct auctioning is rolled out full-fledged.

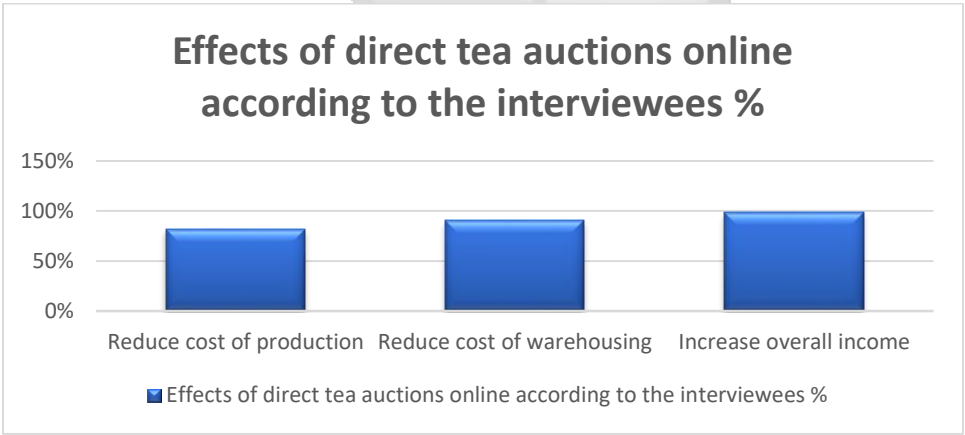


Figure 4-8 Predicted effects of direct tea auctions online without middlemen at Momul Tea Factory

4.2.9 ICT Infrastructure at Momul Tea factory

Figure 4.9 illustrates ICT infrastructure assessment. According to the findings, Momul factory has good ICT infrastructure.

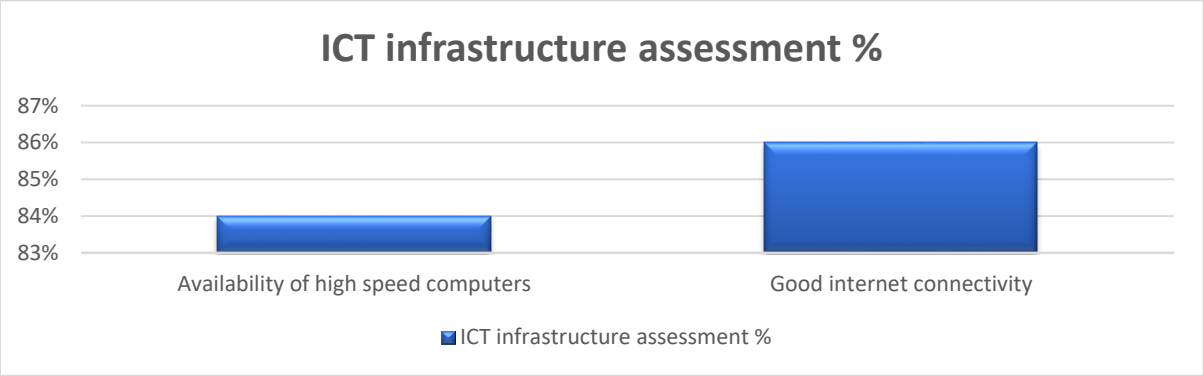


Figure 4-9 ICT infrastructure readiness for online auctioning at Momul Tea Factory

4.2.10 Stakeholder Readiness for Change in Tea Trade Model

Readiness to change was the aspect enquired on the research. Figure 4.10 shows the readiness for change Momul factory are. More than 75% across all levels are ready for change.

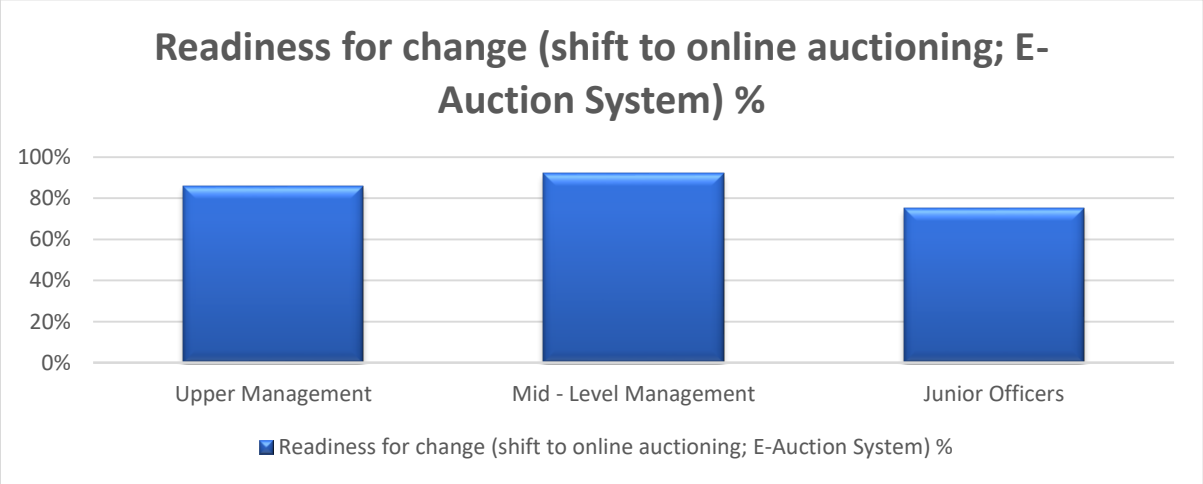


Figure 4-10 General readiness for direct online auctioning at Momul Tea Factory

4.3 System Design and Architecture

In this section, the literature review and the research findings guided the development of the application. The various expert systems techniques reviewed assisted in selecting the appropriate platform for the application and the research findings enabled the collection of data and design of the application. Use Case, Interaction, Class, Context and level 0 were used. It also shows the system architecture design.

4.3.1 Use Case Diagram

The following figures detail each user's basic interaction with the system. According to Gemino and Parker, (2009), "use case diagram represents the different types of users of a system and the various ways that they interact with the system".

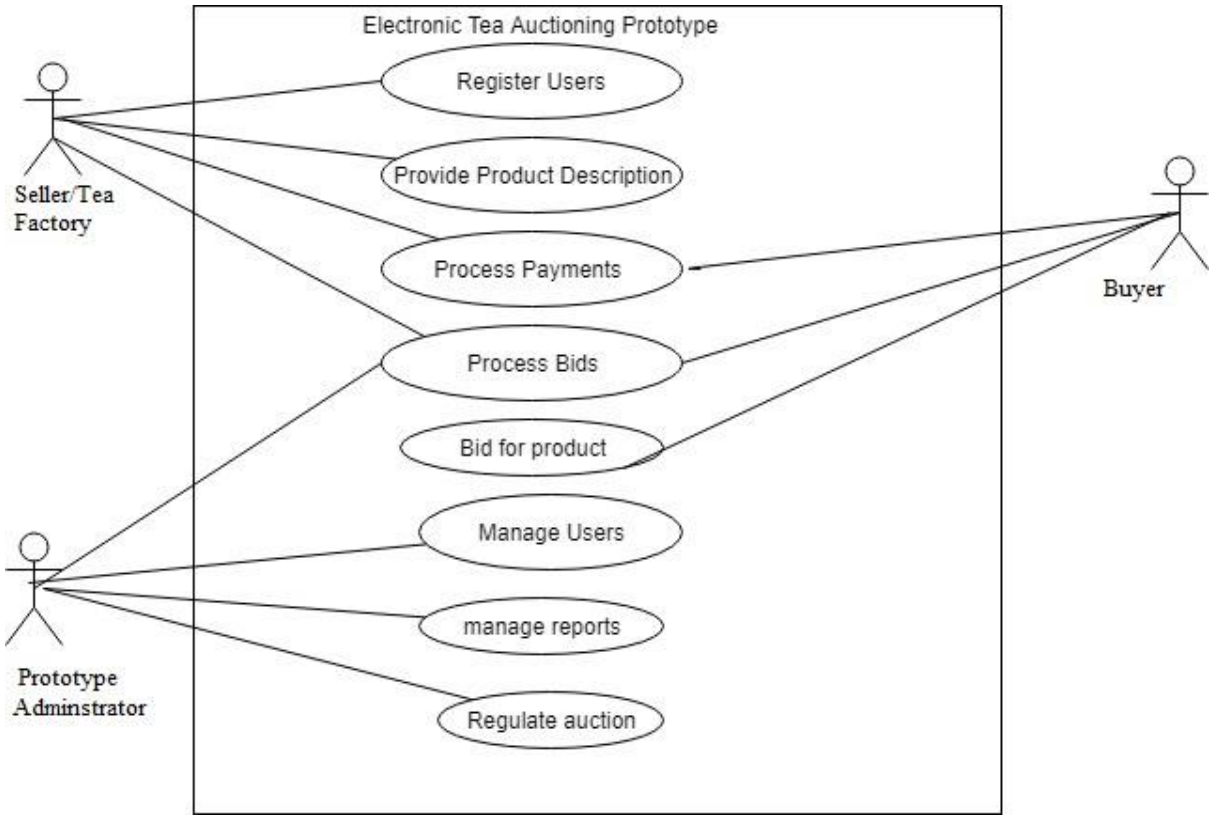


Figure 4-11 Use Case Diagram of the E-Tea Auction prototype

Table 4-1 Description of Seller Use Case

E-Auction System: Primary roles	
Actors	Seller
Description	The seller carries some of the basic roles of the entire system. They are first of all tasked with registering themselves as sellers onto the system. They then proceed to upload products they wish to sell for which they receive bids from potential buyers. They then proceed to either accept or reject the bids after which they receive payment for products from the highest bidder.
Data	Products, bid acceptance / rejection and payment confirmation.
Stimulus	User command issued by Seller.
Response	That all updates to the system are recorded successfully and notification of the same reverted.
Comments	The seller must have appropriate authentication to transact within the system.

Table 4-2 Description of Buyer Use Case

E-Auction System: Primary roles	
Actors	Buyer
Description	Buyers are first of all tasked with registering themselves as buyers onto the system. They then proceed to view products they wish to buy for which they raise bids to the specific sellers. They then proceed to make payments for the products if their bids are accepted.
Data	Purchase bids and payment information.
Stimulus	User command issued by Buyer.
Response	That all updates to the system are recorded successfully and notification of the same reverted.
Comments	The buyer must have appropriate authentication to transact within the system.

Table 4-3 Description of Administrator Use Case

E-Auction System: Primary roles	
Actors	Administrator
Description	Administrator are tasked with activating bid requests for products and deactivating the bid process once payment confirmation is received from seller. They are also in charge of user management.
Data	Bid activation / deactivation information.
Stimulus	User command issued by Administrator.

Response	That all updates to the system are recorded successfully and notification of the same reverted.
Comments	The administrator must have appropriate authentication to transact within the system.

4.3.2 Sequence Diagram

A sequence diagram envisages the interactive behaviour among actors in the system. It demonstrates the overall workflows of the prototype, the flow of the messages in the prototype, the object structure, object organization and the interaction of objects among each other as shown in figure 4-12.

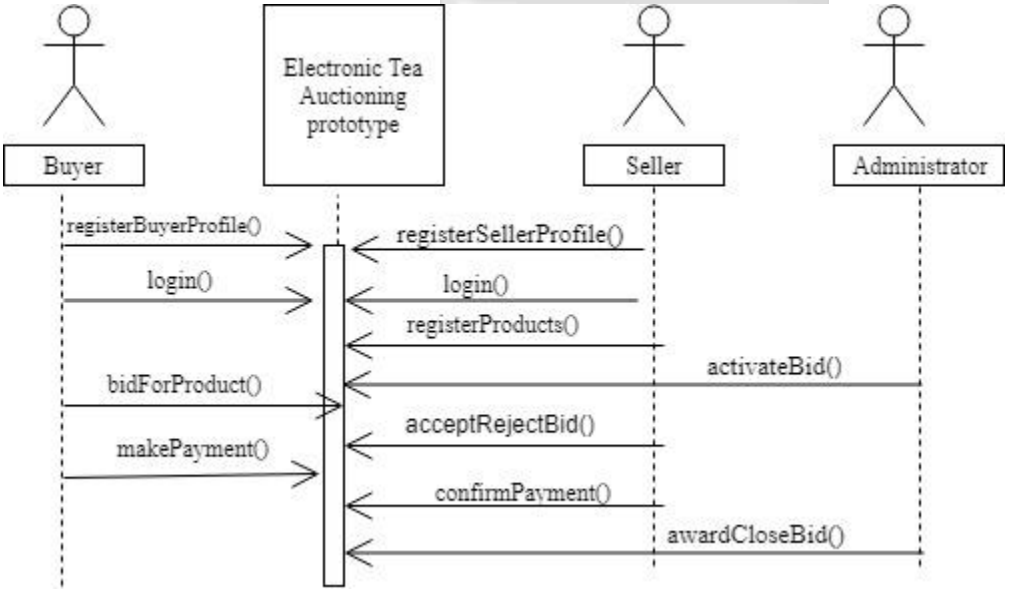


Figure 4-12 Interaction Diagram of the E-Tea Auction prototype

4.3.3 Class Diagram

Class diagrams demonstrates the view of the application prototype in a static form hence clarifying the responsibility of a prototype. This is as shown in figure 4-13.

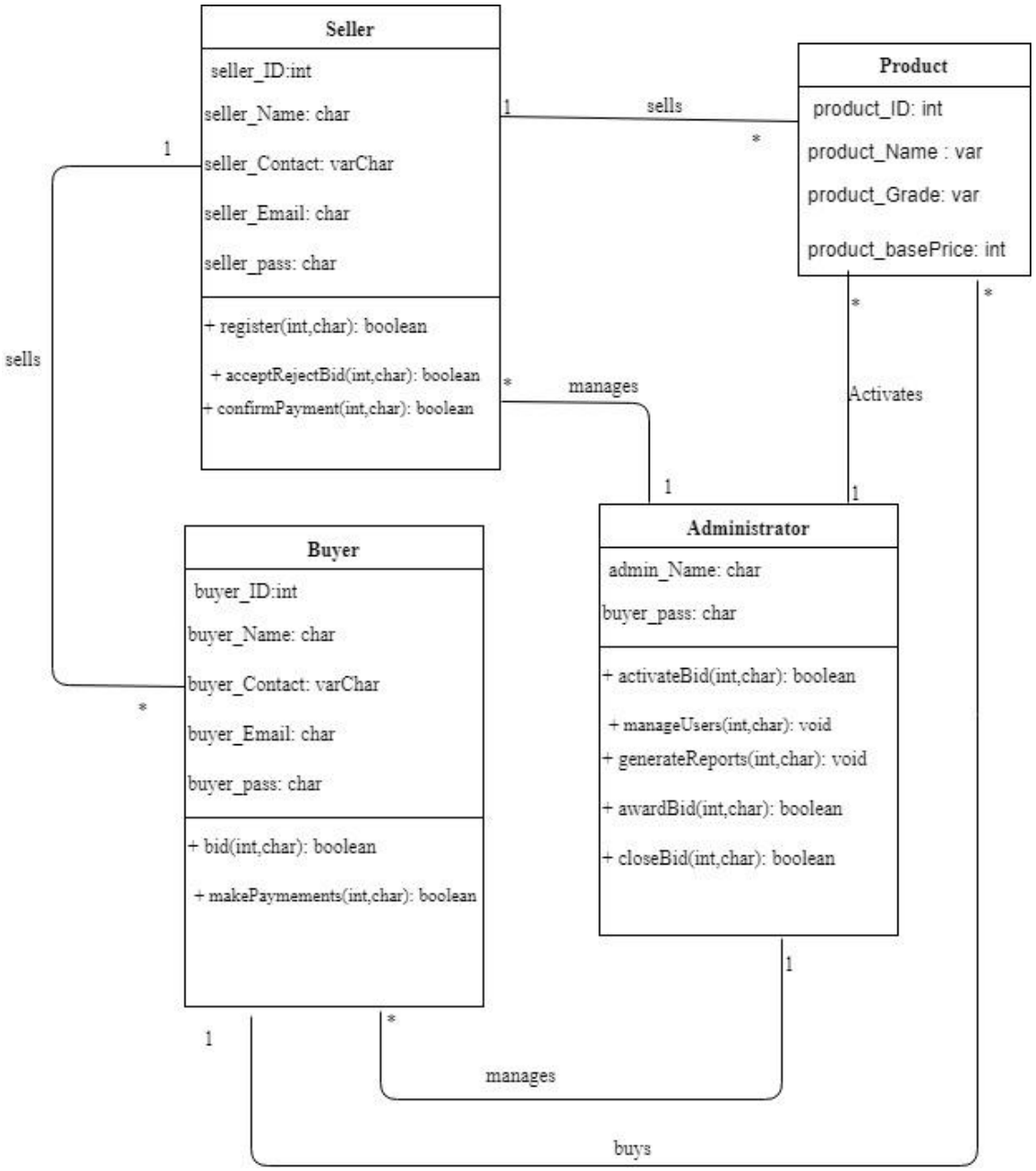


Figure 4-13 Class Diagram of the E-Tea Auction prototype

Table 4-4 Description of class diagram

Actor	Description of roles
Seller	They introduce new products they wish to sell to the system for which they receive bids from potential buyers. They then proceed to either accept or reject the bids after which they receive payment for products from the highest bidder. One seller may upload numerous products and receive bids for them from numerous potential buyers.
Buyer	They view products they wish to buy for which they raise bids to the specific sellers. They then proceed to make payments to the specific sellers for the products if their bids are accepted by the seller. One buyer may make numerous bids for different products.
Administrator	Administrator are tasked with activating bid requests for products and deactivating the bid process once payment confirmation is received from seller. They are also in charge of user management.
Product	They are uploaded by the sellers, viewed by potential buyers and form the basis of the bidding process (substantiate). Many products can substantiate many bidding processes if they are sold individually.
Bid	Is activated by the Administrator once a product is scheduled for auction and potential buyers notified. Bid is momentarily closed when a seller accepts the highest bid from a potential buyer. Once seller confirms payment by highest bidder, bid is deactivated.

4.3.4 Data Flow Diagram(DFD)

The following diagrams shows all the major processes, data stores and interrelated data flows that comprise the overall web-based application prototype. They consist of process nodes that generalize the function of the entire system in relation to relevant external entities.

This DFD Level 0 diagram basically shows the data flow relevant to each user and corresponding process in the prototype.

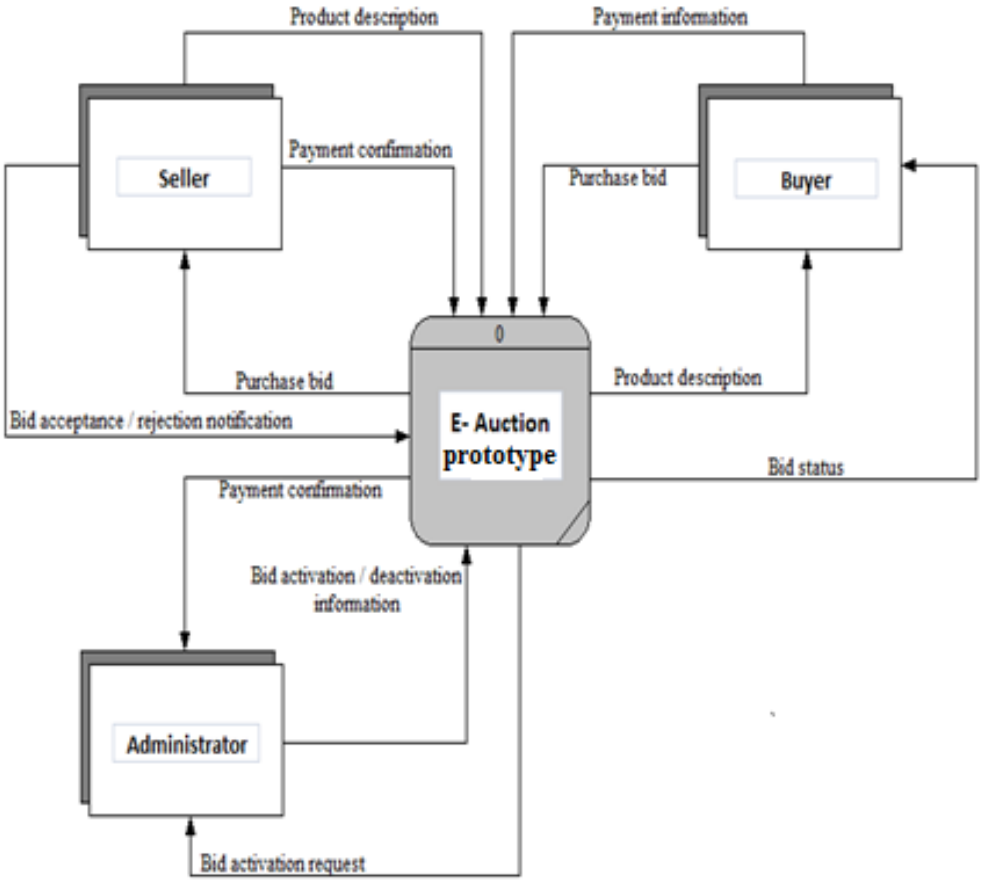


Figure 4-14 DFD Level 0 Diagram for e-auction prototype

This DFD Level 1 diagram basically shows how various data moves through the system i.e. from source to store and finally to sink. Further, it shows how the same data is interpreted differently for the different players.

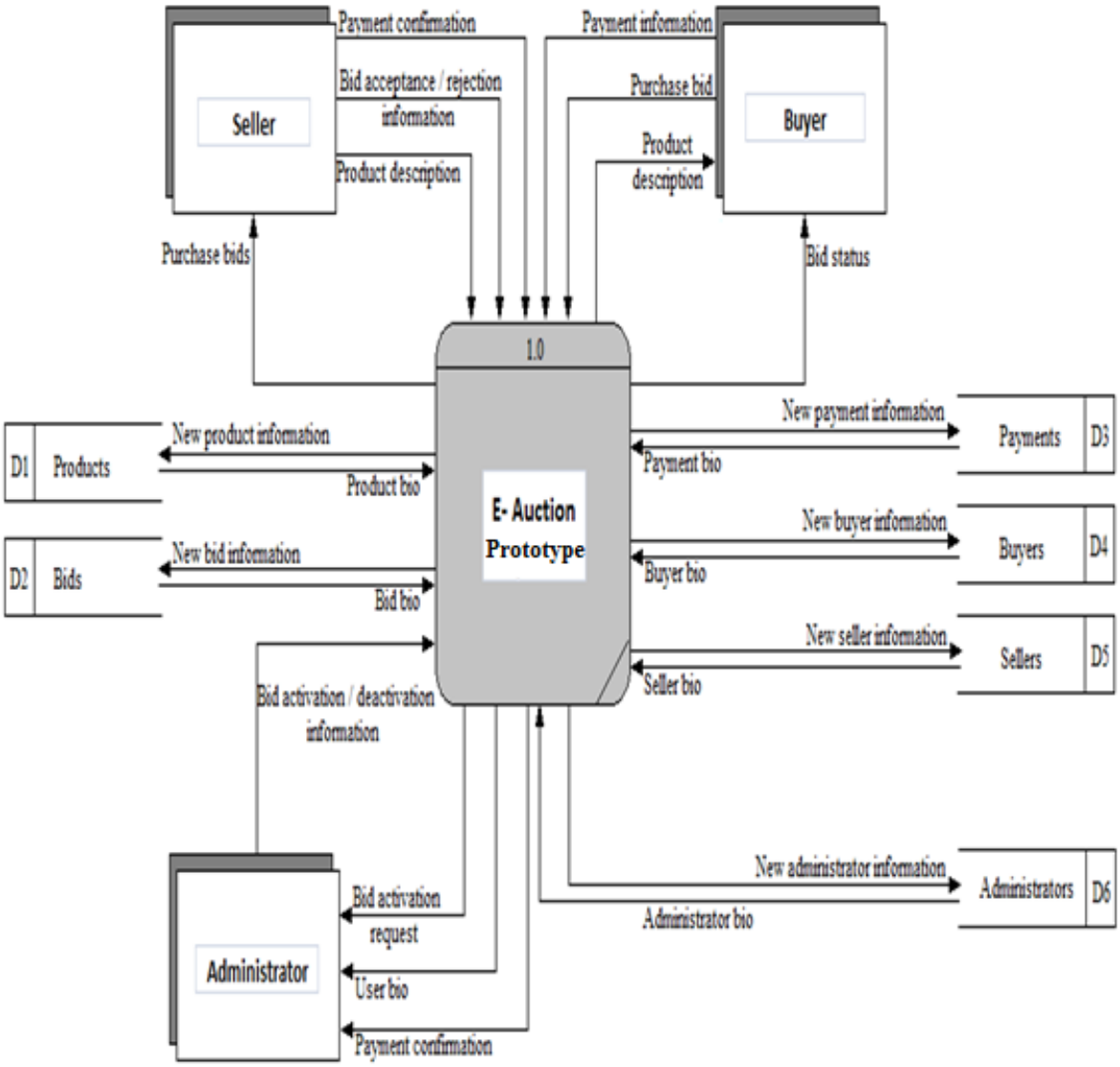


Figure 4-15 Level 1 Diagram for e-auction prototype

This DFD Level 2 diagram, specific to the seller, shows how all the data they interact with is stored and processed through various sub-systems.

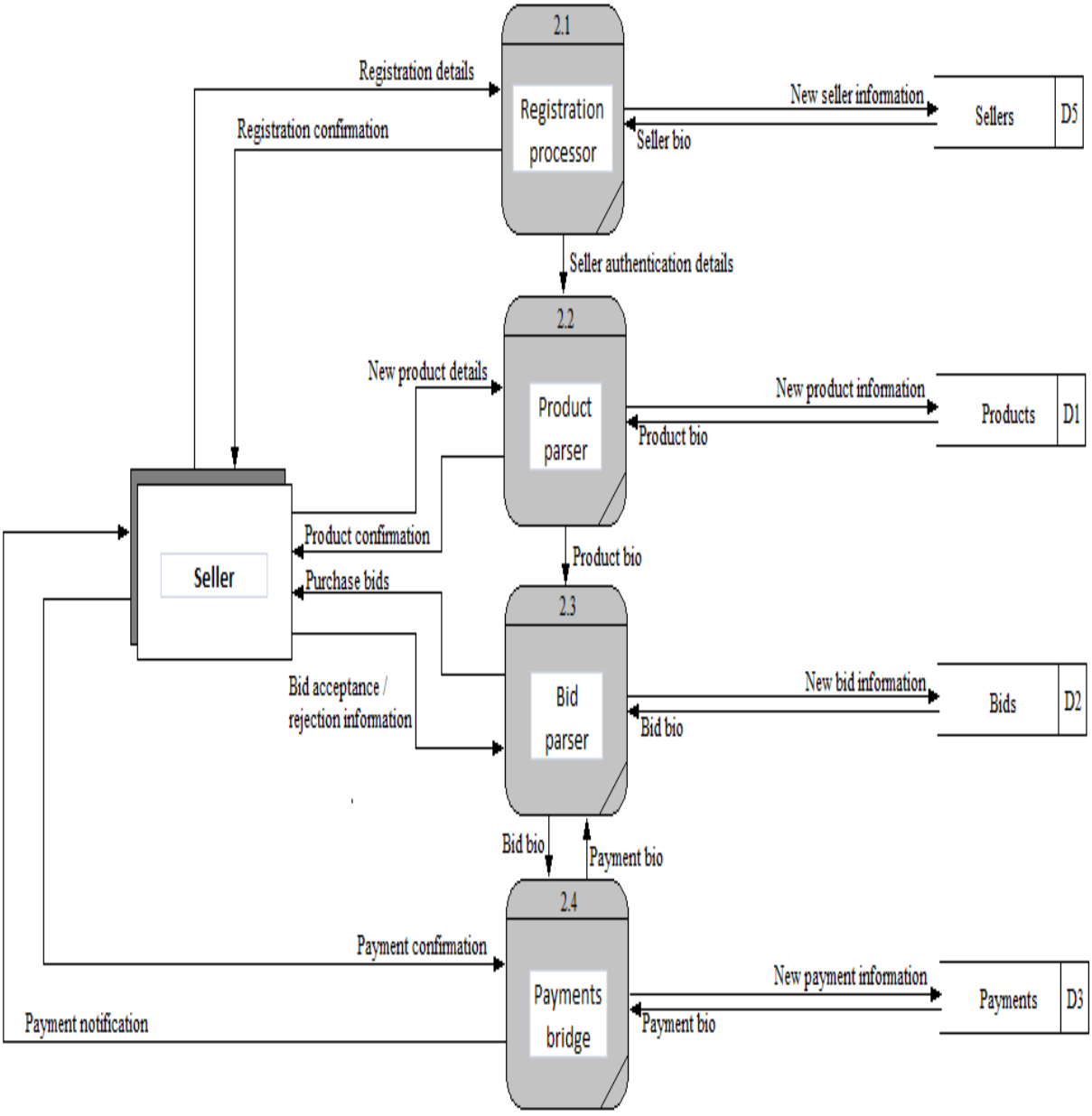


Figure 4-16 DFD Level 2 Diagram: Seller Operations

This DFD Level 2 diagram, specific to the buyer, shows how all the data they interact with is stored and processed through various sub-systems.

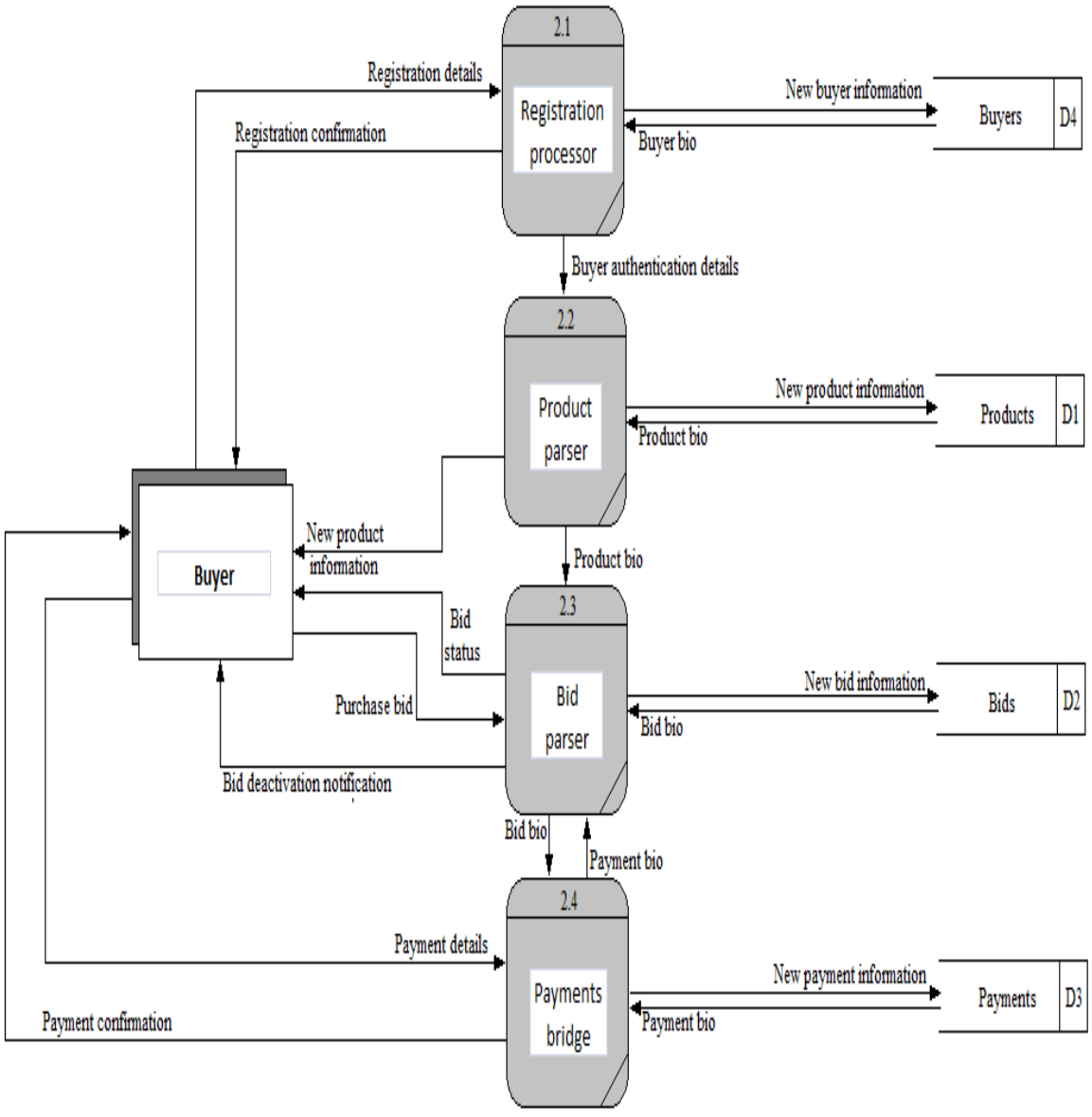


Figure 4-17 DFD Level 2 Diagram: Buyer operations

This DFD Level 2 diagram, specific to the administrator, shows how all the data they interact with is stored and processed through various sub-systems.

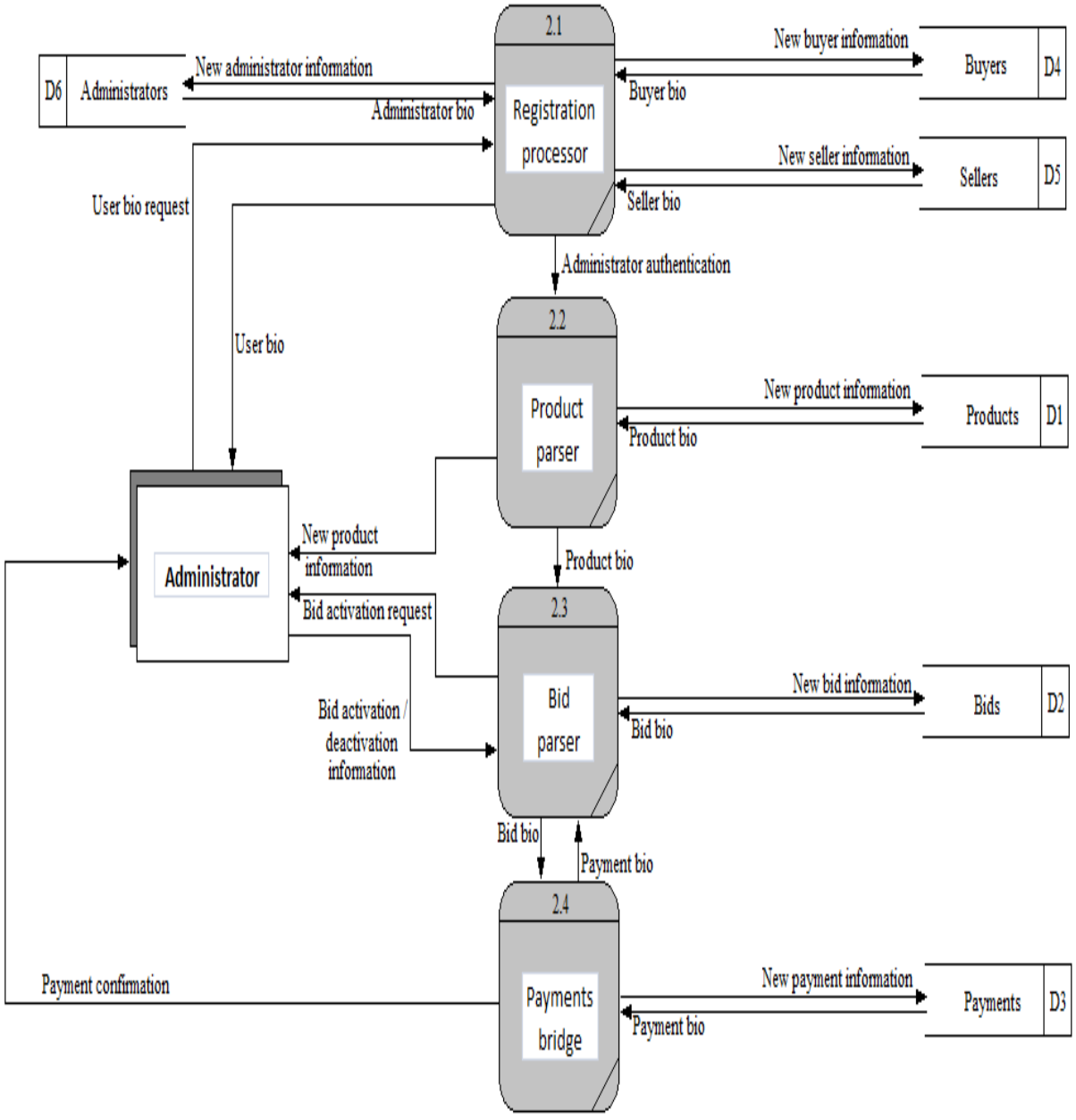


Figure 4-18 DFD Level 2 Diagram: Administrator operations

4.3.5 Database design

This ERD diagram shows how all the data specific to each user and or entity are classified as well as the relationships amongst those entities; it is the logical structure of a database. Figure 4-19 illustrates the logical structure of the E-Auction database.

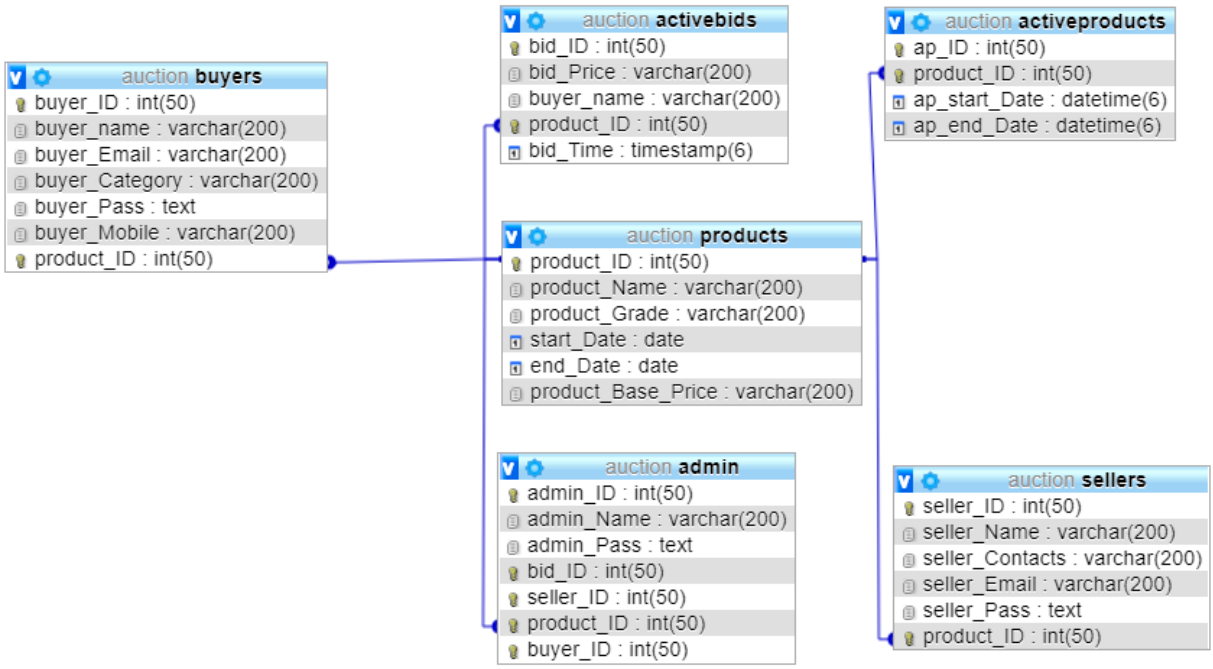


Figure 4-19 Entity Relationship Diagram for the electronic-auction database

Chapter 5 : Implementation and Testing

5.1 Introduction

This chapter documents the implementation and testing guidelines of the prototype; outlook design of the Graphical User Interface (GUI). This is with regards to understand ability, reusability and ease of use of the system by the end-users.

5.2 Graphical User Interface (GUI)

The colour scheme of the entire GUI incorporated as much as possible the standard colour of tea representation.

Standard API representation images were used within the GUI to boost ease of use especially comprehension of system by users.

5.2.1 Graphical User Interface (GUI) Consistency

The following were observed in development to ensure a standard GUI layout was achieved

Table 5-1 GUI Consistency Plan

Aspect	**Measure to achieve consistency**
Grid	Both vertical and horizontal in all possible interfaces
Navigational Links	Accurately similar in position, size and colour, in all similar interfaces
Font size and Face	Standard font size and spacing of 12 pixels and a Professional looking font face.

5.3 Data Validation

This is a measure to guard against 'garbage in, garbage out'.

Table 5-2 Data Validation Plan

Validation Aspect	**Validation Measure**
Empty Fields	Include an (*) sign before all fields required to be filled. **Reminder:** Remind user to fill in empty fields when they attempt to save or submit data.
Correct Data Entry Format	Include controlled option selection where possible to limit unwanted data entry format i.e. dates and pupil classes. **Reminder:** Remind users to enter correct data format whenever they get it wrong.
Correct Length	Include controlled option selection for the specific length - dependant fields. **Reminder:** Remind the users to enter correct data length whenever they enter data that is shorter than the required length.
Feedback	Include mechanism to provide user with a confirmatory message of system acceptance of data entered.

5.4 System Requirements

i. **Output**: the system should always display content in a clear and correct manner understandable by its users. Also, the system should provide notifications to users through short messages on its interface after process executions.

ii. **Input**: Users' registration forms should be clear, concise and always include name, password, and e-mail fields.

iii. **Process:** There should always be a clear defined path of process execution. The system should also perform auto save and recovery in the event of such situations as power interruptions.

iv. **Performance:** Response time should not exceed twenty seconds

v. **Control:** the system must maintain separate levels of security for users and system administrator

vi. **Usability:** Users must be able to use the system at most possible comfort level

5.5 Testing Plan

Testing in this context can be termed as requirement-based testing. All possible test cases were designed to test the prototype requirement. For each requirement, a suitable test case was identified to demonstrate that the prototype meets the requirement. The testing plan for the system mainly observed the following strategy:

Unit testing- which involves testing individual modules.

Table 5-3 Prototype Testing Plan

MODULE	INPUT DATA	EXPECTED RESULTS	SUCCESS/ FAILURE
Seller Registration	Registration Details	Successful recognition by the database	
Buyer Registration	Registration Details	Successful recognition by the database	

Product upload	New product information	Submission into database	
Bidding	Bids by potential buyers and responses from sellers	Successful exchange between buyer and seller	
Momentary bid closure	Payment claim	Bid halt	
Bid deactivation	Deactivation stimulus	Successful bid deactivation	
Creation, Updating and Deletion of data. (CRUD)	System relevant data	Successful CRUD.	
Auto save	Automatic Interruption mitigation command	To auto save bid data	

5.6 Technologies Used

5.6.1 Hosting

The hosting used and recommendation for the prototype is in cloud. The choice of cloud hosting was informed by the benefits which comes with it.

i. Improved connectivity due to dedicated managed service platform and thus reliability.
ii. Flexibility in both cost and capacity, one can increase or reduce capacity based on demand, this also affects cost.
iii. Disaster recovery, in case of a system failure, cloud hosting provides back-up services.
iv. Ease of management, the management of the platform is transferred to the cloud vendor thus the team concentrates on the auctioning activities.

5.6.2 Programming languages

I. HTML

HTML stands for Hyper Text Markup Language. Hyper means active. It represents textual and image content. It is platform independent. This means that the text and the content are encoded in a way that they can be displayed on a wide range of web browsers.

- Relevance

The prototype is web based, thus the choice of HTML which is advantageous in creating web pages because it can be written in any editor, it is universal and simple to implement and it gives an opportunity to further explore and add more features.

II. MySQL

This is a multithread, multi-user, SQL relational database server. Programming languages that can access a MySQL database include C, C++, Java, PHP and Perl. MySQL runs on many different operating systems including Linux and Windows. MySQL offers a lot of improvement over previous versions including transactions, SSL support, nested SELECT, ACID compliance and Query Catching.

- Relevance:

The prototype relies heavily on database activities especially when bidding processes are initiated as well as adding other relevant data into the system. Therefore, the choice of MySQL which offers improved query catching.

III. PHP

This acronym stands for Hypertext Pre-processor. It is mainly used as a general-purpose scripting language used to develop dynamic web content and can be embedded in HTML. PHP can be used as an alternative to Macromedia ColdFusion, ASP.NET/C#/VB.NET and the JSP/Java system. PHP is a fully defined language and can be used to develop Graphic User Interface Applications.

- Relevance

The prototype relies heavily on input from both the sellers (product information) and buyers (purchase bids). Therefore, the choice to embed PHP into html so as to enable dynamic input into the prototype by the users.

IV. *JavaScript*

JavaScript is a dynamic programming language. It is mostly used as part of web browsers whose implementations allow client-side scripts to interact with the user (Validation).

- Relevance

Owing to the fact that the prototype heavily relies on user input, a mechanism needed to be employed to ensure that only valid data is keyed in. Therefore, JavaScript was chosen to aid in validation as well as timers for bids.

5.6.3 Programming Development Tools Used

i. NetBeans 9.6 IDE for PHP, which is an integration development environment
ii. Adobe Dreamweaver CS4 and IDE

5.6.4 Software platforms used

i. Browser: Mozilla or Microsoft internet explorer
ii. Operating System: Windows 10
iii. Database: MySQL and PHPMyAdmin
iv. Web Server: Apache Web Server

5.6 E- Auction Prototype Screen Shots

Home Page

Home page is the page or a landing page for a user. It has navigational links to other pages. It also has a login form where a user can directly log onto the system.

Figure 5-1 Home page layout of the prototype

Register Seller/Factory

The registration page provides a form where a user registers as either a seller of a bidder. Once a user enters the details onto the form and click register, a digital provide is created where they can log onto the system and transact.

Figure 5-2 Factory/Seller registration form

Seller Login

A seller login page, is a login window where a registered seller log onto the system. A username and a password is required.

Figure 5-3 seller login page

Seller Profile

Seller profile is a digital provide for sellers. This provide opens ones the registered seller has successfully log onto to the system with the correct username and password. A seller can then perform seller specific transactions of updating the kind of tea available for sale and stating the base price.

Figure 5-4 seller digital profile

Register Buyer/Bidder

Buyer or bidder registration page is where buyers register to bid for the tea on auction. The bidder is required to enter their details and click register button. A registration success message will be shown and simultaneously a digital bidder profile is created.

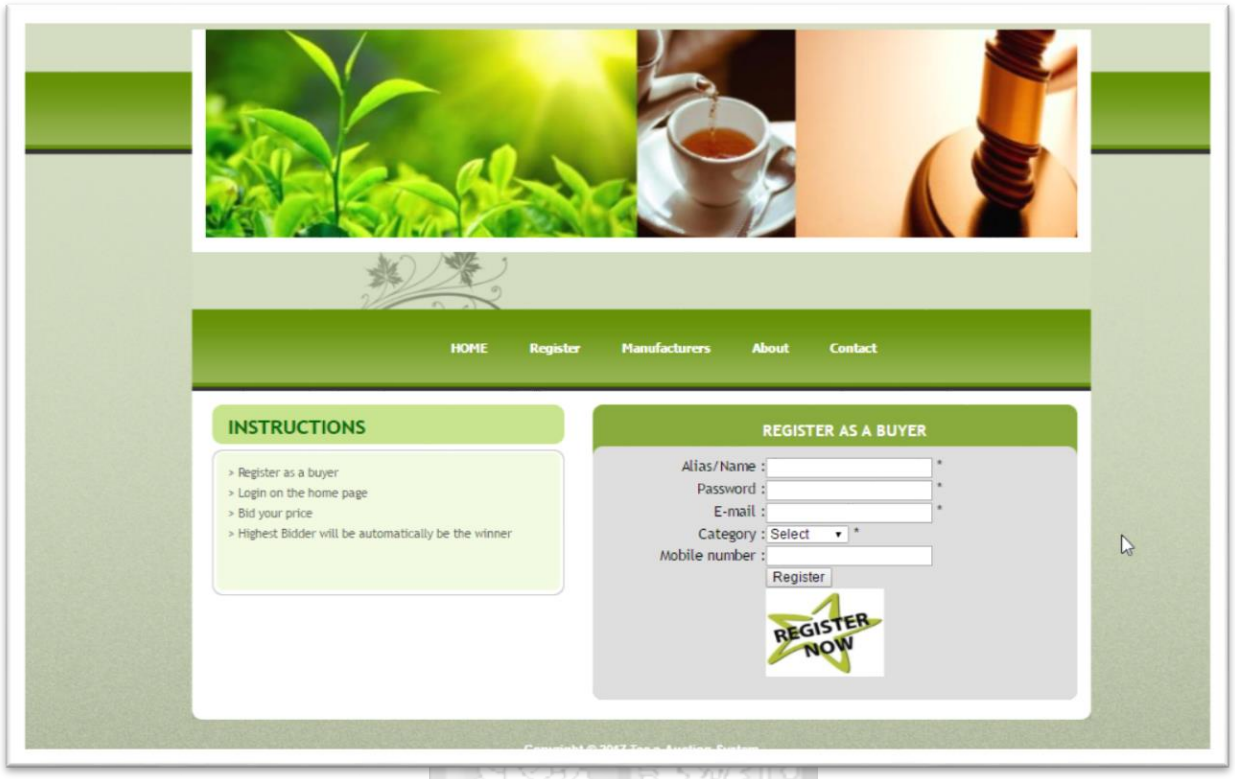


Figure 5-5 Buyer registration form

Buyer Login

Once successfully registered, a bidder can logo on to the system through bidder login form using the registered username and password.

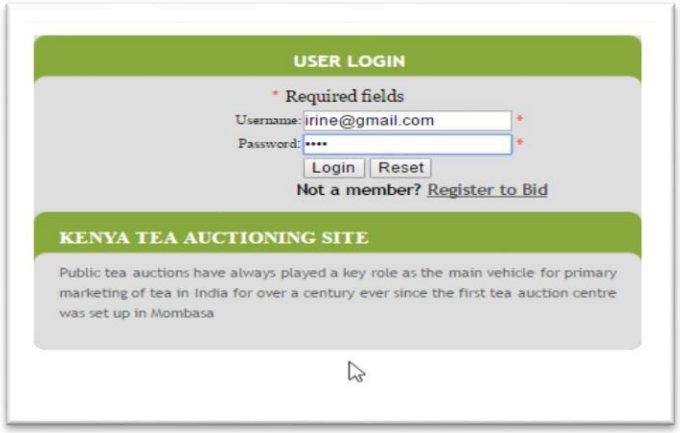


Figure 5-6 Buyer login page

Buyer Profile

On successful system login, a buyer is able to view tea on action and can bid. Th bidder is also able to view other bidders and the prices they have bided for.

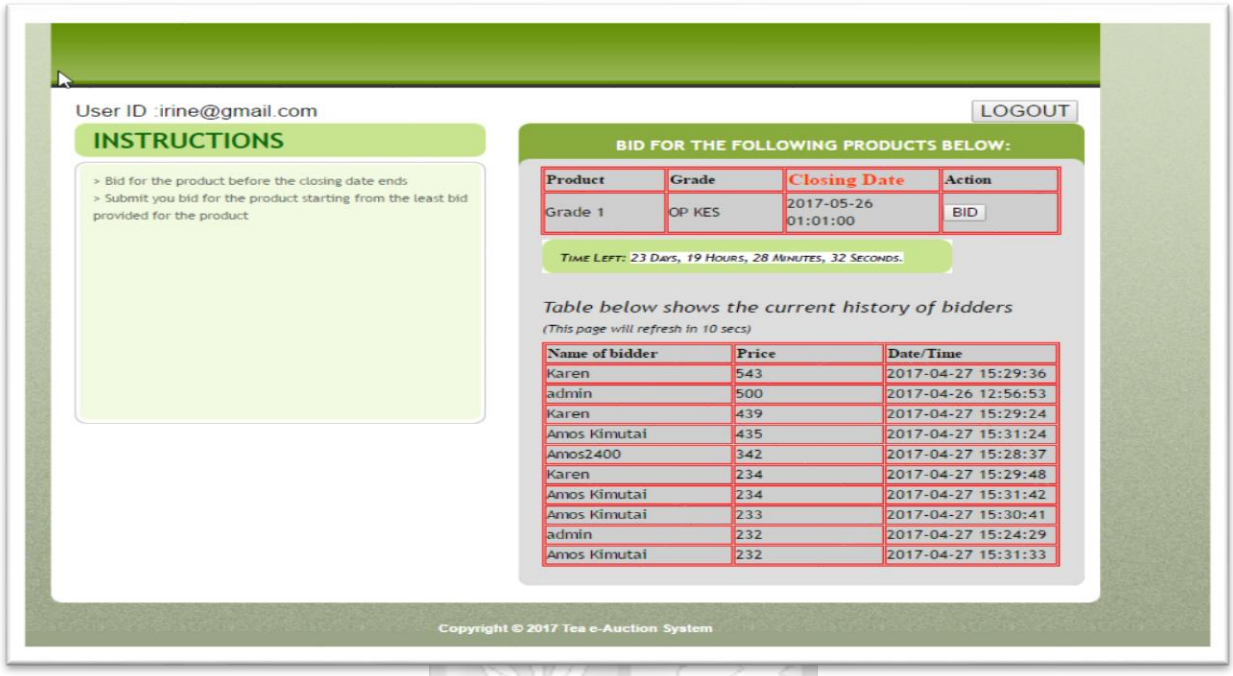


Figure 5-7 Buyer digital profile

Bid Form

A bid form is a bidder prefilled form in which a bidder is required to state the bid price .

Figure 5-8 Bid form

System Administration

System administration is the back-end management of the system. It can be configured to handle any custom management the factory requires to manage. The prototype has list of factories, list of available products for bid, list of products on bids, user administration and basic reports.

List of Tea Factories

List the number of factories subscribed to the system.

Figure 5-9 List of tea factories/sellers

List of Available products for bid

List the tea available for auction.

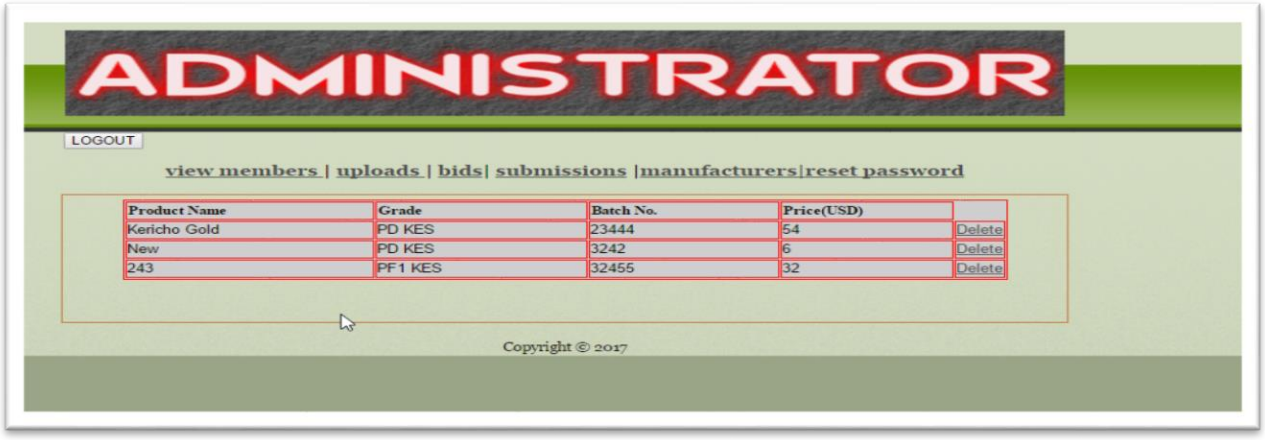


Figure 5-10 List of available products for bidding

Active product on Bids

List the tea on live on auction

Figure 5-11 Product bid activation form

Reports

Bidding reports

This report shows the general overview of the past biddings.

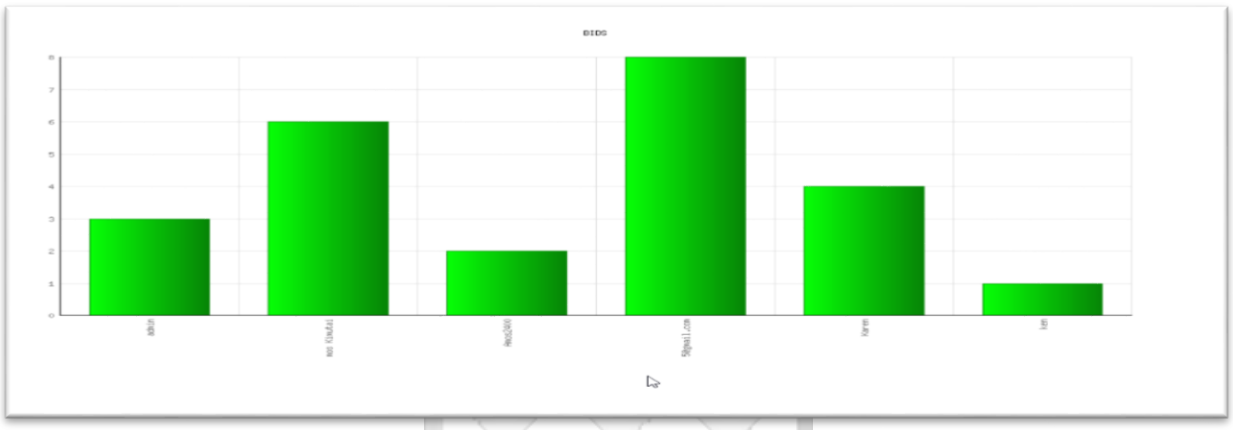


Figure 5-12 Bidding Reports

Member analysis

This report shows members or users subscribe to the system.

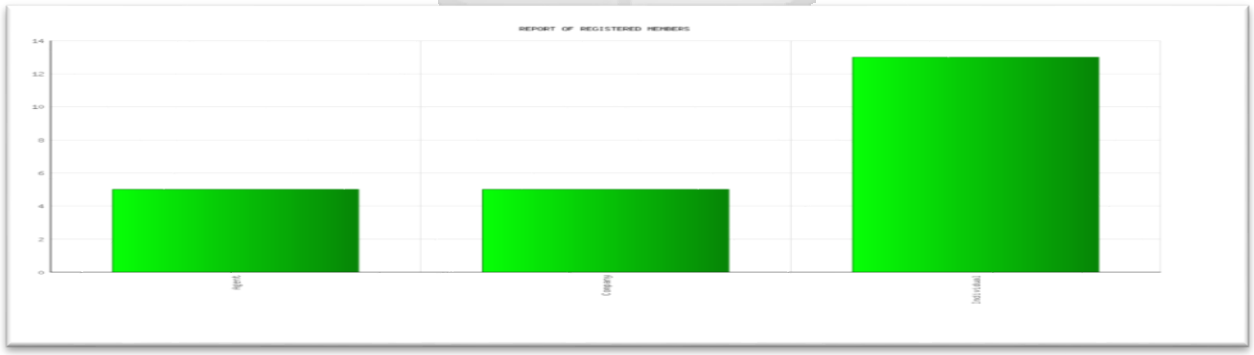


Figure 5-13 Registered members report

Chapter 6 : Discussion

6.1 Introduction

The outlined discussions are correlated with the research objectives and are based on both primary data collected, analysed and presented, and the secondary data gathered from recorded literature. The conclusions are drawn from the overall critical analysis of the research findings.

6.1.1 Existing methods used in tea auction.

According to chapter 2 section 2.3. There are 3 mothods used in auctioning: Open cry, sealed bid and Dutch auction. Each is chosen according to the business model. Mombasa tea auction uses open cry method. Each bidder is able to see the prices of the other bidder and the highest bidder gets the commodity. The tea auction automation prototype was modelled around the open cry model of auction. Chapter 2 section 2.5 demonstrates auction systems based on open cry model: A pan-India electronic auction system, xpert auction, Promena auction and Free market bidware. Open cry model is popular due to its openness which enhances fair competitiveness and thus high prices outcome, due to each bidder working to outprice the other.

6.1.2 Factors affecting tea trade.

In chapter 1 section 1.1.3 There are a number of challenges facing tea production industry: unpredictable exchange rates, decreasing farm sizes, high production costs, weather-related issues among other factors. The questionnaire and interview focused on cost of production. Three areas were identified for discussion: cost of transportation, cost of warehouses and brokers. Chapter 4 Figure 4.6 illustrates the outcome of the interview. Under 10% of the stake holders felt the cost of transportation from the factory to Mombasa for auctioning was a factor. Just over 11% of the stake holders felt that the warehousing cost was a challenge. Over 90% of the stakeholder response felt the brokers controlling the sale process was a major challenge to tea export.

Mombasa tea auction is broker centric business model where brokers are the ones solely selling tea on behalf of producing factories and thus on behalf of farmers. The outcome of the in-depth interviews and questionnaires demonstrates that, the heavily reliance on brokers have a direct effect on low prices and overall low income in small scale tea farming. The outcome of data collected regarding brokers agrees with the concerns of price manipulation and brokers colliding with buyers to sell high grade tea at the exact same price as low-grade tea as outline in chapter 1 section 1.2.

6.1.3 Current system used in tea action

The current system of auctioning used in Mombasa tea auction is largely manual. The model is open cry; brokers meet weekly to auction tea. There has been tea auction automation around the world. Chapter 2 section 2.5.5 demonstrates an electronic tea auction system: A pan-India electronic auction system. India is the second largest tea producing country. It has several auction centres. The auction centres use electronic trading systems for tea auctioning (Adrianna, 2015). The challenge with the existing model is, it automates the manual system, meaning brokers are part of the tea trading chain. The current automation solves the issues arising from the manual auctioning process. It however, doesn't provide remodelling of the auction process to optimize on the benefits of having an electronic system. The variables on cost of production and broker controlling the prices remains. Figure 4.8, illustrates the stakeholder's perspective, they felt that the implementation of direct sales will greatly reduce cost of production related to warehouses and elimination or minimizing the middlemen effect will potentially see the rise in the profit margins and thus the overall increase of income to the factories and to the farmers.

6.1.4 Factory based e-auction prototype

A factory-based auction prototype was developed and tested as a prove of concept for factories auctioning their tea directly to customers. It complements the existing systems by utilizing the same concept of centralized auctioning. However, it remodels it by decentralizing the auction to the factory level. The main variation this system brings if adopted, is the elimination of the middle man which is beneficial to both the sellers and the buyers. It is also the underlying challenge this entire project aims to map out the solution for, not to mention mitigating the ethical question as to whether brokers are supposed to earn more than the producers and farmers.

The prototype also eliminates the cost of warehousing since on successful auctioning, the tea moves from factory to the new owner. This further implies that the transportation cost could also be significantly reduced. This is because the factory no longer has to transport the tea to the warehouse and from the warehouse to the new owner; the cost of transportation is now from factory to owner and can be done on shared basis. The figure 6.1 and figure 6.2 below further supports the point:

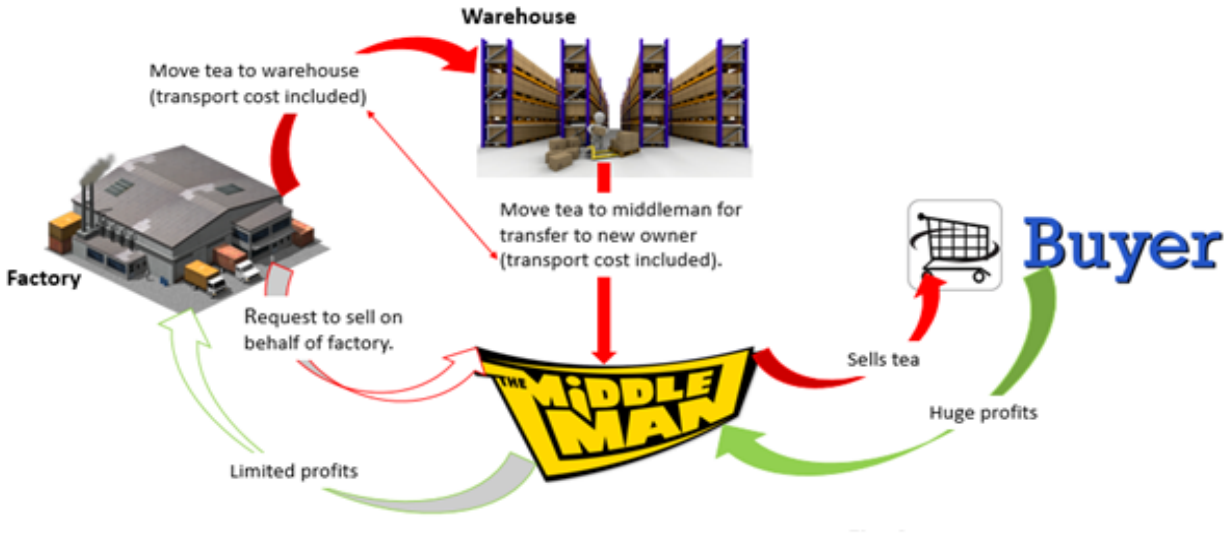


Figure 6-1 Current tea auction model

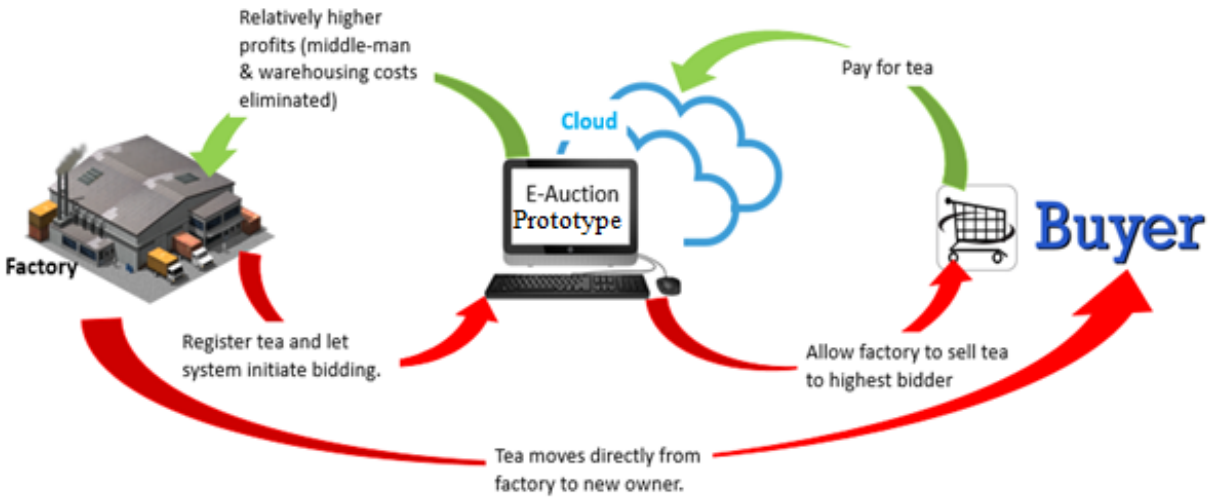


Figure 6-2 Factory based electronic tea auctioning prototype

6.1.5 Research performance evaluation

The overall research can be evaluated as a success. Over 90% of the respondents positively provided their feedback which were incorporated into the data analysis. There was no misappropriation of data collected and the research followed the given researcher standard guidelines. There were a few challenges which were effectively managed.

i. Scheduling a convenient time to conduct the interviews and subsequent prototype demo was a challenge. Most targeted respondents were management and their schedule were quite tied up. Phone calls interviews and prototype demo guide assisted in getting the response of those they could not be found physically.

ii. One respondent failed to submit the questionnaire form hence the results were analysed without that data.

Chapter 7 : Conclusion and Recommendations

7.1 Conclusion.

Following completion of the research and the analysis of data collected, it is evident that tea export is a significant source of revenue to the Kenyan economy as per (Andrianna, 2015) report, Kenya commands over 20% of world tea export. Tea international sales are done through auction at Mombasa auction house. The tea factories transport the processed tea to Mombasa, to be stored at the warehouses waiting auctioning. Mombasa tea auction schedule for auctions and brokers sell on behalf of tea factories. Once tea is sold, it is dispatched from the warehouse for shipment ("A step-by-step guide on foreign trade procedures," n.d.).

From the interviews contacted, it was revealed that Tea can stay in the warehouses for as short as days and as long as months before a successful auction; all warehouse costs directly adding to the cost of production. Concerns of brokers colluding with warehouses and traders at the expense of the farmers were raised as reported on (Tea Industry Status Report, 2014). More concerning issue was revealed on the Tea Board of Kenya industry status report (Gerald, 2015) that accused various players of manipulating the price of high-grade tea to sell at the exact same price as lower grade tea at the auction.

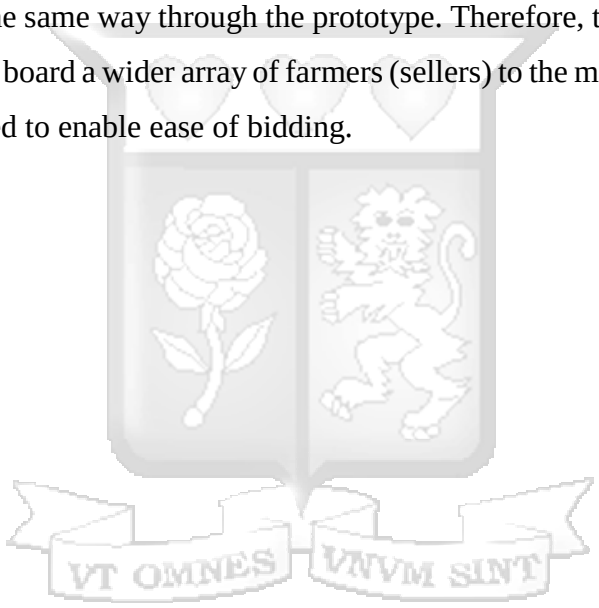
The main objective of this research was to provide prototype as a prove of concept in remodelling the tea trade to solve the issues currently being experienced. The prototype concept put forward, utilizes an electronic auctioning system where factories actioned their processed tea directly to potential registered buyers. Based on the research outcome which encompassed assorted variables ranging from stakeholders and their pressure points to solution engineering, it can be concluded that the proposed prototype could go a long way if implemented, with regards to enabling factories directly auction their freshly processed tea to buyers without necessarily having to go through brokers. This will significantly reduce the over-dependence on brokers and will have the potential to reduce costs of production, because tea will be exported directly to buyers thus reducing warehouse overhead costs and consequently raising the profit margins to the benefit of all the stake holders.

7.2 Recommendation.

The prototype will be sufficient in resolving some of the current systemic issues ailing the tea export industry in Kenya. Full scale implementation is recommended with the following to be observed in order to achieve optimum results.

i. Ensure the presence of high connectivity and good ICT infrastructure.
ii. All potential buyers are properly vetted and registered into the system.
iii. The system to be hosted on cloud to ensure uninterrupted service provision; Cloud services gives advantage of minimal down time due to distributed shared resources.
iv. Ensure the users of the system are properly trained.

Further recommendation is for more factories to register for the service. Other farm produce could also be auctioned the same way through the prototype. Therefore, the prototype could be up scaled in order to bring on board a wider array of farmers (sellers) to the market. Mobile application can be further incorporated to enable ease of bidding.



References

Amde, C., & Mihretu, T. (2009). Microeconomics of competitiveness: Country: *Kenya, Cluster:tea*. Student . Retrieved from http://www.isc.hbs.edu/pdf/Student_Projects/Kenya_Tea_2009.pdf

Andrianna,S.(2015) The world top 10 tea producing nations Retrieved from(http://www.surveysystem.com/sample-size-formula.htm.)

A step-by-step guide on foreign trade procedures. (n.d). Retrieved from http://infotradekenya.go.ke/menu/4?l=en

Brian D. (2013). The World's Largest Black Tea Exporter

Black tea production in kenya to rise 20% by 2020. (2017) Retrieved from https://www.trademarkea.com/news/black-tea-production-in-kenya-to-rise-20-by-2020/

Brusaw, C. T., Alred, G. J., &Oliu, W. E. (1997). *Handbook of technical writing* (5th ed.). New York: St. Martin's Press.

Burns, N. & Grove, S.K. (2007).Understanding nursing research. 4th ed. Philadelphia: Saunders Company.

Creative Research Systems (2010). http://www.surveysystem.com/sample-size-formula.htm

Creswell, J. W., & Plano, C. V. L. (2011). Designing and Conducting Mixed Methods Research (2nd ed.). London: Sage Publications Ltd.

Cheruiyot Collins, (2014, July 12). *Mombasa tea auction is systematically shortchanging region's tea farmers.* The East African.

Cooper, D., & Schindler, P. (2008). Business research methods (10th ed.). New York, McGraw-Hill/Irwin.

David , C. (1996). *Writing your dissertation: A guide. Macquarie University.* Faculty of human Sciences, department of linguistics.

De Vaus, D. A. (2001) *Research design in social research*. London: SAGE.

Gavey, N., & Braun, V. (1997). *Ethics and the publication of clinical case material. Professional* Psychology: Research and Practice. 1997;28:399–404. doi: 10.1037/0735-7028.28.4.399.

Gerald, A. (2018, March 15). Tea prices at Mombasa auction hit lowest level this year. The business Daily. Retrieved from https://www.businessdailyafrica.com/markets/commodities/Tea-prices-at-Mombasa-auction-hit-lowest-level-this-year/3815530-4343236-p3mic9z/index.html

Gerald, D. (2015, August 23) . *Tea prices fall to a ten-week low at the Mombasa auction*

Business Daily.

Grenier, M. P. (2001). The curiosity shop: Online auctions aren't just about office supplies and semiconductors; There's also the Spock ears and ox gallstones. Wall Street J. (May 21) R16.

Kenya Human Rights Commission. (2008), *A Comparative Study of the Tea Sector in Kenya A Case Study of Large Scale Tea Estates:* Author

Kumar, M., & Feldman,S.I.(1998) . Internet auctions. IBM T.J. Watson Research Centre

Monroy L., Mulinge W., & Witwer M., (2012). *Analysis of incentives and disincentives for tea in Kenya*. Technical notes series, MAFAP, FAO, Rom

Mugenda, O.M. & Mugenda, A.G. (1999) Research Methods: Quantitative and Qualitative Approaches. Acts Press, Nairobi.

Mwangi, C.M. (2013). The Causes of High Cost of Tea Production and Sustainability of the Tea Subsector in Kenya.

Mwaura, F., & Muku, O. (2007). Tea farming enterprise contribution tpo small holders' wellbeing in Kenya. (pp. 307-313). Nairobi: Tea Research Foundation of Kenya.

National Advisory Board on Research Ethics. (2002) "Good scientific practice and procedures for handling misconduct and fraud in science": Author

Ngau, P., & Kumssa, A.(2004). **Research Design, Data Collection and Analysis: A Training Manual.** United Nations Centre for Regional Development, Africa.

Parahoo, K. (1997). Nursing research: Principles, process and issues. London: MacMillan Press.

Paul .E &Graham.M (2001) "A Dependable Distributed Auction System: Architecture and an Implementation Framework"

Polit, D.F. & Hungler B.P. 2004, Nursing research: principles and methods. Philadelphia: Lippincott, William & Wilkins.

Promena. (N.d) Retrieved from https://www.promena.net/e-sourcing-solutions

Reiley, D.L. (1 999). Auctions on the internet: What's being auctioned and How? Department of Economics: Vanderbilt University, Nashville.

Stephanie, E. (2003). Slovin's Formula Sampling Techniques. Houghton-Mifflin, New York, USA

Tea Board launches e-auction to bring uniformity in rules. (2016). Retrieved from https://www.business-standard.com/article/markets/tea-board-launches-e-auction-to-bring-uniformity-in-rules-116051000934_1.html.

Tea trade issues for the ACP. (2010). Retrieved from http://agritrade.cta.int/ .

Tore D &Torgeir D (2007) "*Empirical studies of agile software development: A systematic review"*

VanHeck, E., P. & Vervest. 1998. How should CIOs deal with web-based auctions? Comm. ACM 41(7) 99–100

Xpert Auction Software. (n.d) Retrieved from https://www.xpertauctionsoftware.com.

APPENDICES

APPEDIX A: Questionnaire

RESEARCH QUESTIONNAIRE

Cloud Based Prototype for Tea E-Auctioning (Case of Momul Tea Factory)

I am Irine Cherotich Chepkwony, a master's student at Strathmore University. I am carrying out a research on electronic auctioning.

Research Objectives

The study seeks to find out the impact of devolving auctioning function of tea trade from Mombasa Tea auction house and allowing Tea factories auction their tea directly through a cloud-based e-auction system.

Guidelines in responding to the Questionnaire:

This questionnaire has **FOUR** Sections, kindly provide as much information as you can.

Confidentiality/Non-Disclosure Assurance

The information you provide will be treated with utmost confidentiality and shall be used only for the purpose and objectives of this study.

E-auction system for tea is an online auction that take place in real time, it gives buyers the opportunity to bid against each other electronically, can be on the same room, building or from diverse geographical locations.

Correspondence/Inquiries:

Irine Cherotich Chepkwony (irinecherotich@gmail.com)

Masters in Information Technology, Strathmore University

Mobile Number(s): +254 (0)728 143 675

SECTION ONE: GENERAL INFORMATION

Instruction: Please Tick (√) where appropriate

1. Name
   Optional)……
2. What is your position in the organization?
   ……
3. How long have you worked with this organization?
   Less than 5 years [ ] 5-10 years [ ] 11-15 years [ ] more than 15 years specify [ ]
4. How many employees work in your section?
   Less than 5 [ ] Between 5 and 10 [ ] More than 10 [ ] Specify [ ]
5. How many employees in your section participates directly or indirectly with tea trade?
   Less than 5 [ ] Between 5 and 10 [ ] More than 10 [ ] specify [ ]
6. Have you ever attended any change management program regarding tea trade?
   Yes [ ] No [ ]

SECTION TWO: TEA AUCTIONING/SALE IN KENYA

Below is a list of general enquiries of tea auctioning and sales. Please: Tick (√) the appropriate column (You can tick multiple columns), give a brief explanation/reason/figures or % where appropriate.

1. What are your channels of selling your processed tea?
   Local [ ] Export(broker/auction) [ ] Direct Export[ ]
2. What is the average percentage of tea annual sales? Locally [ ] Exported[ ]
3. What are the challenges of exporting tea?
   i. Cost of transportation to Mombasa for auction [ ]
   ii. Cost of warehouses [ ]
   iii. Brokers controlling the process [ ]
   iv. Other, ……... please specify

How can you rate trade balance at Mombasa auction house? (1)- No balanced (2)- somehow balanced (3) -balanced (4) -very balanced.

i. Regional [ ]

ii. Factory [ ]
iii. Auction space [ ]
iv. Broker [ ]
v. Direct Sales [ ]
vi. Other, …… please specify.

4. What is the average cost of the warehouse per kilo [ ] per tones [ ]?
   Hourly rates [ ] weekly rates [ ] Monthly Rates [ ] Annual Rates [ ]
5. For how long does tea stay in the warehouse before auction/sale?
   Hours [ ] Weeks [ ] Months [ ]
6. What is the volume (Tones/Kilos) of tea for sale is transported to Mombasa?
   Daily [ ] Weekly [ ] Monthly [ ] Annually [ ]

7. How does Momul factory manage the logistics of transporting tea to Mombasa for auction?
   i. Factory have tracks and drivers specifically for transportation [ ]
   ii. Outsourced transport facilities [ ]
   iii. Others……please specify
   iv. How much is the cost of transportation?
8. How much is the overall cost of transportation, if outsourced, kindly give the average monthly cost as per the contract, if factory tracks, please include the cost of drivers, track maintenance, fuel among other cost?
   i. Factory tracks/drivers KES: Monthly [ ] Annually [ ]
   ii. Outsourced KES: Monthly [ ] Annually [ ]
9. What are some of the effects of having a broker in the sales chain?
   i. High-prices of tea [ ]
   ii. Low prices of tea [ ]
   iii. High sales volume [ ]
   iv. Low sales volume [ ]
   v. Increase cost of production [ ]

vi. Other, ……please specify

10. What is your take on the concept of factories selling tea directly through online auction?
    i. Reduce cost of production? [ ]
    ii. Reduce cost of warehousing? [ ]
    iii. Increase overall income? [ ]
    iv. Other, ……please specify
11. What are the challenges of auctioning tea at a factory level ie; factories auctioning tea direct from the factory?
    i. Buyer not able to taste tea? [ ]
    ii. Lack of open cry frenzy? [ ]
    iii. Lack of technology Knowledge [ ]
    iv. Others……please specify

12. If the answer for number 10 above is i, can the traceability information ie grade, color, factory taste results among other descriptive tea parameters, provided during electronic pre-auction sufficient for the buyer to place an order?
    i. YES [ ]
    ii. NO [ ]

    kindly give a brief reason……...……
13. How well equipped is Momul in reference to ICT infrastructure?
    i. Availability of high speed computers fully? Fully equipped [ ] not equipped [ ]
    ii. Good internet connectivity Fully equipped [ ] not equipped [ ]
14. Does Momul Factory have an ERP system? YES [ ] NO [ ]
15. How ready for change in the model of tea trade are Momul board of directors?
    Very Ready [ ] Ready [ ] Not Ready [ ]
16. What are some of the challenges facing tea auction at Mombasa Auction house?
    i. Broker-Buyer Price collusions [ ]
    ii. Auction Congestions [ ]

iii. Warehouse Charges [ ]

iv. Lack of ICT based auction system [ ]

v. Others…….. please specify

17. How easy or difficult is it for a factory to get a warehouse?

Very difficult [ ] Difficult [ ] easily available [ ]

18. What is the average cost of warehouses?

Hourly per kilo KES: ……..weekly per kilo KES: …….

Daily per kilo KES: ……. Monthly per kilo KES: …….

19. What is the average unit cost of production for tea?

i. Cost of factory operations KES: …….

ii. Cost of transport KES: ……

iii. Cost of ware housing KES: ……..

iv. Other costs KES: …… please specify

20. What is the average unit cost of tea sold (please specify)?

Black Tea

i. BP1 KES: 2015 …… 2016 ……. 2017 ……

ii. PF1 KES: 2015 ……2016 ……2017 ……

iii. PD KES: 2015 …….2016 …… ….2017 ……

iv. D1 KES: 2015 …….2016 …….2017 ……..

Black Orthodox Teas

i. FOP KES: 2015 ……2016 ……. 2017 ……

ii. OP KES: 2015 ……2016 ……. 2017 …….

iii. PEKOE KES: 2015 ……2016 ……. 2017 …….

iv. BOPF KES: 2015 ……2016 ……. 2017 …….

v. OF KES: 2015 ……2016 ……. 2017 ……...

21. What are some of the measures that could be taken to reduce the cost of production?
    i. Reduce cost of transportation [ ]
    ii. Reduce cost of warehousing [ ]
    iii. Shorten the supply chain i.e. direct sales from the factory to the buyer [ ]
    iv. Others ……. please specify.
22. What will you wished to be changed in the tea trading process at Mombasa Auction house?
    ……..……
23. How ready are the organizations governing tea sector for change on tea trading model ie to embracing ICT as a tool and means for trade?
    Very Ready [ ] Ready[ ] Not Ready[ ]
24. With the probability of cost reduction and overall increase in profit margins, will the board consider the adoption of factory based electronic auction system?
    YES [ ] NO [ ]
25. What are some of the concerns in allowing factories auction their tea directly to the buyers?
    i. Challenge in tasting tea before auction [ ]
    ii. Reduction in competitiveness [ ]
    iii. Information Technology fear of unknown [ ]
    iv. Change resistance [ ]
    v. Others…….……please specify.

26. In your experience, will the removal of a broker in the sales chain have adverse impact on tea sales in relation to prices and volumes?

    Give a brief reason:

    ……

27. Does enabling factories sale their tea directly to the buyer have any impact, eg on sales volume and prices? Yes [ ] NO[ ]

    Give a brief reason:

    ……

28. In your experience, does displaying full information regarding tea under auction have any impact on the buyers?

    Give a brief reason:

    ……

29. Does linking the auction system with the ERP system and display traceable tea properties on an e-format where the buyer is able to access anywhere before auction have any impact on the buyer?

    Give a brief reason:

    ……

    What are some of the common recommendations/complains from the buyers?

    Give a brief list:

    ……

30. What are some of the common recommendations/complains from the tea processing factories?

    Give a brief list:

    ……

31. What are some of the common recommendations/complains from the tea farmers?

    Give a brief list:

    ……

32. Others (Please specify)

    ……

SECTION THREE: FACTORS NECESSARY FOR IMPLEMENTATION E- AUCTION SYSTEM

Below is a list of factors that needs to be in place before implementing an e-auction system. Please indicate the extent to which you agree with each of them.

{Tick (√) the appropriate column} (1)- No extent (2)- Little extent (3) -Moderate extent (4) -Large extent (5) Very large extent.

1. Change management program for the tea board of Kenya, EATTA, Factory board of Directors and end users (auction agents) on adoption of e-auction through expert consultations.

No extent [ ] Little extent [ ] Moderate extent [ ] Large extent [ ] Very large extent [ ]

2. Training of staff on auction practices/processes and the use of e-auction system tools.

No extent [ ] Little extent [ ] Moderate extent [ ]Large extent [ ] Very large extent [ ]

3. Electronic auction policy/manual within the organization to guide the process.

No extent [ ] Little extent [ ]Moderate extent [ ]Large extent [ ] Very large extent [ ]

4. An established information and communication technology Department to support the e-auction system.

No extent [ ] Little extent [ ]Moderate extent [ ]Large extent [ ] Very large extent [ ]

5. A high-speed internet connected computers with a reliable Internet Service Provider (ISP)

No extent [ ] Little extent [ ]Moderate extent [ ]Large extent [ ] Very large extent [ ]

6. A project management team to spearhead implementation of the electronic auction system

No extent [ ] Little extent [ ]Moderate extent [ ]Large extent [ ] Very large extent [ ]

7. Re-engineering the e-auction process to accommodate factory based concept

No extent [ ] Little extent [ ]Moderate extent [ ]Large extent [ ] Very large extent [ ]

8. Communication standards on e-auction that requires various buyer-seller exchange information and electronic documents:

No extent [ ] Little extent [ ]Moderate extent [ ]Large extent [ ] Very large extent [ ]

9. Management leadership and support for the e-auction project implementation from Organizations governing tea:

No extent [ ] Little extent [ ]Moderate extent [ ]Large extent [ ] Very large extent [ ]

10. Proficient knowledge of information and communication technology by auction agents:

No extent [ ] Little extent [ ]Moderate extent [ ]Large extent [ ] Very large extent [ ]

11. System integration to link the e-auction system to the Factory ERP system s

No extent [ ] Little extent [ ]Moderate extent [ ]Large extent [ ] Very large extent [ ]

12. Security and authentication in e-auction systems due to widespread hacking into information systems:

No extent [ ] Little extent [ ]Moderate extent [ ]Large extent [ ] Very large extent [ ]

13. Others……(Please specify)

SECTION FOUR: PERCEIVED VALUE ADDITION

The following are some of the benefits that could accrue from the use of factory based e-auction over automating the manual auction process. Indicate the extent to which you agree/disagree with them.

{Tick (√) the appropriate column} (1) Strongly disagree (2) Disagree (3) Moderately agree (4) Agree (5) Strongly agree.

1. E-auction reduces corruption and fraud on price collusion:
   Strongly disagree [ ] Disagree [ ] Moderately agree [ ] Agree [ ] Strongly agree[ ]
2. Reduced overhead cost on warehousing and transportation:
   Strongly disagree [ ] Disagree [ ] Moderately agree [ ] Agree [ ] Strongly agree[ ]
3. Improved transparency and accountability:
   Strongly disagree [ ] Disagree [ ] Moderately agree [ ] Agree [ ] Strongly agree[ ]
4. Improved quality of tea exports, because freshly manufactured tea is auctioned and exported direct to the buyer:
   Strongly disagree [ ] Disagree [ ] Moderately agree [ ] Agree [ ] Strongly agree[ ]
5. Improve speed on tea exports turn around time:
   Strongly disagree [ ] Disagree [ ] Moderately agree [ ] Agree [ ] Strongly agree[ ]
6. Provides quicker reference and audit trail :
   Strongly disagree [ ] Disagree [ ] Moderately agree [ ] Agree [ ] Strongly agree[ ]
7. Enhances inter-factory, intercountry competition, which can lead to improved quality:
   Strongly disagree [ ] Disagree [ ] Moderately agree [ ] Agree [ ] Strongly agree[ ]
8. Improved transparency and accountability can lead to reduced disputes among the stakeholders
   Strongly disagree [ ] Disagree [ ] Moderately agree [ ] Agree [ ] Strongly agree[ ]
9. Improves standardization and streamlining of auction processes.
   Strongly disagree [ ] Disagree [ ] Moderately agree [ ] Agree [ ] Strongly agree[ ]
10. Increase on the information of tea being auctioned, tea prices, real time state of the market
    Strongly disagree [ ] Disagree [ ] Moderately agree [ ] Agree [ ] Strongly agree[ ]
11. Others (Please specify).
    ……
12. From your experience in tea sector, what is your personal view regarding devolving tea auction from Mombasa main auction to the tea processing factories?
    ……

Any other comment?

APPEDIX B: Turnitin Report

Cloud Based Prototype for Electronic Tea Auctioning

ORIGINALITY REPORT

23%	22%	9%	13%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	ece.ut.ac.ir Internet Source	2%
2	www.cs.newcastle.ac.uk Internet Source	2%
3	www.epzakenya.com Internet Source	1%
4	www.eatta.com Internet Source	1%
5	www.theeastafrican.co.ke Internet Source	1%
6	Submitted to University of Nairobi Student Paper	1%
7	www.gerv.org Internet Source	1%