ROOT CAUSE ANALYSIS IN HORTICULTURE EXPORTING FIRMS IN KENYA

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DECLARATION

This management research project is my original work and has not been presented for a degree in any other university.

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This project has been submitted for examination with my approval as university supervisor.

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Thanks be to God for his gift of life, knowledge and all he has given.

Secondly, I acknowledge my family for being beside me all the way and giving me priceless support and encouragement.

I also acknowledge my supervisor, Dr. XN Iraki, who guided me throughout the research process and the panel of lecturers that guided my report during proposal defence stage. Thank you very much, sincere gratitude to all.

DEDICATION

To my family, academic and work colleagues who have been instrumental in shaping my life and destiny

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ABSTRACT

The purpose of this research was to investigate the application of root cause analysis in the horticulture export industry in Kenya and explore the problem solving techniques used in the industry and hence give recommendations on the areas that were found to have gaps. Also to investigate the extent of awareness levels of and the use of problem solving techniques in the industry .Based on the literature, the paper sought to confirm the variables identified in the theoretical framework; that is the dependent, independent and the moderating variables. A survey comprising of 42 horticultural firms dealing with fresh produce processing was conducted targeting the Operations Managers of those companies. Semi structured questionnaire was used to collect date where questions were asked on a five-point Likert scale. Overall, the study found that brainstorming as the most widely used approach employed by the horticultural firms in solving the identified day-to-day problems being faced in the production process. The findings also show that the other problem solving techniques popularly used by the horticultural firms such as the hypothesis testing, means-ends analysis, lateral thinking, morphological analysis and trial and error methods.

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study- Root cause analysis practices

In the normal production environment, including many different assets, a large number of problems arise everyday and this raises the question of which problems need to be addressed first. However, since organizations do not have unlimited resources, it is imperative to focus on those problems which once solved will bring the most benefits. The continuous process of identifying and eliminating the causes of inefficiency and ineffectiveness in business and production process has, along with technological improvements, driven much of the increased standard of living of the world (Miguel & Adrieta, 2009). Consequently, most organizations consider problem solving as an important skill and desire their employees to have the same. Different specialists and consultants tend to advocate different problem solving techniques at the expense of other available techniques. However, according to Bates and Bates (2010), the combination of the "seven simple tools", RCA and K-T provides unequalled framework for tackling any problematic situation. A problem is a deviation between what should be happening and what is actually happening. Problem solving is the activity associated with changing the state of what is actually happening to what should be happening (Arora, 2007).

The process of solving a problem in any organization must first recognize and understand what is causing the problem since one cannot prescribe a remedy if in the first place the organization has not identified what is facing it in terms of quality or productivity. According to Wilson et al. (1993), a root cause is the most basic reason for an undesirable

condition or problem. Hence if the real cause of the problem is not identified, then one is merely addressing the symptoms and the problem will continue to exist and thus affect the firm's operational objectives. For this reason, identifying and eliminating root causes of problems is of utmost importance (Sproull, 2001). Root cause analysis is the process of identifying causal factors using a structured approach with techniques designed to provide a focus for identifying and resolving problems. Tools that assist groups and individuals in identifying the root causes of problems are known as root cause analysis tools.

Root cause analysis is a management and a problem solving method aimed at identifying the root causes of problems and events. The development of the problem solving technique is based on believe that a successful adoption of total quality management (TQM) in any organization depends on its ability to solve any emerging problems in the course of its production process (Liu et al., 2009). Problem solving lies at the heart of every quality management process especially in the present day operating environment characterized by a consumer pool that want high-quality; durable products and that too at a reasonable price. Further, according to Dangayach and Deshmukh (2006), agriculture and manufacturing based firms work under constant challenges such as new entrants in the global market, adoption of more sophisticated technology and availability of high quality alternatives to the customer. This type of competitive business environment calls for improvement in the industries' present production and management systems as well as adoption of new management tools.

1.1.1 Root Cause Analysis

The Root-cause-Analysis (RCA) is common terminology found in the reliability literature to avoid future occurrence of failures by pinpointing the causes of problems (Madu, 2005). According to Sharma et al. (2005), the method provides comprehensive classification of causes related to 4 M's i.e. man, machine, materials and methods which helps in establishing a knowledge base to deal with problems related to process/product reliability, availability and maintainability. In the horticultural business, the human factor plays an important role in the growing of the plants and the eventual processing. For example with respect to man, defects may arise due to inadequate training; operator's errors and attitude which can lead to unreliability while problems that might arise due to machine may include, poor calibrations or misalignments that might result in loss in operational efficiency (Sharma & Sharma, 2010)

The primary aim of RCA is to identify the factors that resulted in the nature, the magnitude, the location, and the timing of the harmful outcomes of one or more past events in order to identify what behaviours, actions, inactions, or conditions need to be changed to prevent recurrence of similar harmful outcomes and to identify the lessons to be learned to promote the achievement of better consequences (Gupta et al., 2012). To be effective, RCA must be performed systematically, usually as part of investigation, with conclusion and root causes identified that are identified backed up by documented evidence. There may be more than one root cause for an event or a problem, the difficult part is demonstrating the persistence and sustaining the effort required to determine them. To be effective, the analysis should establish a sequence of events or timeline to

understand the relationship between contributory root cause and the defined problem or event to prevent in the future. Root cause analysis can help to transform a reactive culture into a forward looking culture that solves problems before they occur or escalate. The RCA process involves defining the problem, isolating issues that caused the problem, identifying the root cause, developing actions to address the root cause, implementing the actions and conducting follow up assessment of the actions to ensure their effectiveness (Gano, 2008).

Several root cause analysis tools have emerged from the literature as generic standards for identifying root causes. According to Dogget (2011), the common tools are the cause-and-effect diagram (CED), the interrelationship diagram (ID), and the current reality tree (CRT). Ishikawa (1982) advocated the CED as a tool for breaking down potential causes into more detailed categories so they can be organized and related into factors that help identify the root cause. In contrast, Mizuno (1988) supported the ID as a tool to quantify the relationships between factors and thereby classify potential causal issues or drivers. Finally, Goldratt (1994) championed the CRT as a tool to find logical interdependent chains of relationships between undesirable effects leading to the identification of the core cause.

1.1.2 Horticultural Industry in Kenya

The Kenyan horticulture sub-sector of agriculture has grown in the last decade to become a major foreign exchange earner, employer and contributor to food needs in the country. Currently the horticulture industry is the fastest growing agricultural subsector in the country and is ranked third in terms of foreign exchange earnings from exports after

tourism and tea (FPEAK, 2014). Fruits, vegetable and cut flower production are the main aspects of horticultural production in Kenya. The industry continues to contribute to the Kenyan economy through generation of income, creation of employment opportunities for rural people and foreign exchange earnings, in addition to providing raw materials to the agro processing industry. The sub sector employs approximately 4.5 million people countrywide directly in production, processing, and marketing, while another 3.5 million people benefit indirectly through trade and other activities (FPEAK, 2014).

Kenya has a long history of growing horticultural crops for both domestic and export markets. Kenya's ideal tropical and temperate climatic condition makes it favourable for horticulture production and development. The climate is highly varied supporting the growth of a wide range of horticultural crops. Horticulture in Kenya is mainly rain fed though a number of farms, especially the ones growing horticultural crops for export, also use irrigation. The sub-sector is characterised by a tremendous diversity in terms of farm sizes, variety of produce, and geographical area of production. Farm sizes range from large-scale estates with substantial investments in irrigation and high level use of inputs, hired labour and skilled management to small-scale farms, usually under one acre. The sub-sector generates over US$ 300 million in foreign exchange earnings. The Horticultural sub sector is the fastest growing industry within the agricultural sector, recording an average growth of 15% to 20% per annum. It contributes positively to wealth creation, poverty alleviation, and gender equity especially in the rural areas. The industry continues to contribute to the Kenyan economy through generation of income, creation of employment opportunities for rural people and foreign exchange earnings, in

addition to providing raw materials to the agro processing industry. The total horticultural production is close to 3 million tonnes making Kenya one of the major producers and exporters of horticultural products in the world. Europe is the main market for Kenyan fresh horticultural produce with the main importing countries being United Kingdom, Germany, France, Switzerland, Belgium, Holland and Italy. Other importing countries include Saudi Arabia and South Africa.

1.2 Research Problem

Problem solving lies at the heart of quality management. The continuous process of identifying and eliminating the causes of inefficiency and ineffectiveness in business and production processes has, along with technological improvements, driven much of the increased standard of living presently being enjoyed (Bates and Bates, 2011). When faced with operational problems, organizations have to establish the reasons why the product or process is non-conforming in the first place and how it can be avoided in the future.

The fresh produce and vegetables sector in the Kenyan horticultural industry has been registering dwindling profit margins over the years due to an increase in the cost base attributed to inflationary effects, increased demands from the customers and regulators. One other cause of the increased costs is the failure by the industry to use cost identification and management tools to solve their problems. Even those firms that have applied such tools, as pointed out by Dogget (2011), still face challenges relating to managerial skills, limited resources and knowledge relating to the use of root-cause-

analysis. Consequently, as a result of these changes, the production cost has increased and yet the prices of the horticultural products have tended to remain steady over time. The recession experienced in Europe lately has not made the situation in the Kenyan horticulture industry any better since the generally purchasing power of the traditional consumers in Western Europe has been eroded and consequently they have tended to direct their purchases to the more essential goods and services. There is need therefore to reevaluate the cause of the steady decline in the in the quality as well as the quantity of the fresh produce and horticulture sectors in the Kenyan market. This study will seek therefore to realise this objective.

Several studies have been implemented to seek to establish applicability of several problem solving tools in firms. Alsmadi, Lehaney and Khan (2012) carried out a research on the implementation of six sigma Saudi Arabia fortune 100 firms and found that the firms sampled were not implementing six sigma due to increased bureaucratization resulting from the demand for everything to be thoroughly documented and controlled, the resulting loss time and a lack of knowledge of the benefits resulting from its implementation. Cheng & Chang (2012) researched also on the implementation of Lean Six Sigma framework in non-profit organizations and found that the cause and effect diagram is the frequently used method for identifying potential causes out of a host of methods available for such identification. However, the researcher is not aware of any research locally done that relates to the usage of any problem solving tool and it is the intention of this research to fill in the gap.

The study will aim to evaluate the extent of application of root cause analysis and resolution of problems in organizations by seeking answers to the following questions; to establish the problem solving tools/techniques used in the horticulture industry, to establish the use of root cause analysis practices employed by horticulture export firms and extent of their use, establish the relationship between root cause analysis and performance among horticulture export firms in Kenya.

1.3 Objectives of the Research

The study objectives were to:

i) To establish common problems facing horticultural firms in the export industry in Kenya.
ii) To establish the common problem solving techniques applied by horticultural export firms in Kenya.
iii) To establish application of root cause analysis as a problem solving technique in the export horticultural firms.

1.4 Value of the Study

The study will be beneficial to various stakeholders; it will be a source of information to the Kenyan horticulture industry in the sense that that they will be able to understand various root cause analysis techniques that can be employed in solving various problems and in the process be able to identify the appropriate approach that will be able to solve its problems. The management of these firms will also benefit in the sense that by adopting an appropriate problem solving technique, they will be able to be proactive rather than reactive in their problem solving approach which will at the same time create more time to strategize for the future rather than addressing past bottlenecks.

The study will enable policy makers obtain knowledge of the horticultural industry dynamics, such as the dominant challenges facing the industry and the variation of the same across the firms, which at the same time assist in the development of appropriate strategies to be applied to enhance performance and in the process obtain guidance from this study in designing appropriate policies that will regulate the industry.

To the academicians the study will contribute to the existing literature in the field of problem solving techniques and adaptation of the same in the horticulture industry. It should also act as a stimulus for further research to refine and extend the present study especially in Kenya.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The chapter provides information from publications on topics related to the research problem. It examines what various scholars and authors have said about problem solving management and problem solving tools. The chapter also covers the root cause analysis, horticulture in Kenya and how the root cause analysis is applied in the sector.

2.2 Problem Solving in Management

In order to improve their operations and enhance their competitive advantage, firms across the globe have embraced different tools and techniques that they hope will keep them profitable and keep them competitive within the market place. Latino & Latino (2009) considers that causes of problems can be divided into three categories; the physical causes, human causes and latent causes. They further argued that the most effective, sustainable solutions are those that address the latent or organizational systems that people use to make their decisions.

Birren (2006) observes that the most effective way in problem solving using either of the systems developed within the organization is by empowering the workforce to solve problems within their area of operations and encouraging the use of team-based problem solving approaches for more complex problems. Team-based problem solving process are generally the most effective way of solving most problems, especially those that are more complex and requires application of root cause analysis (Latino & Latino, 2009).

Currently, the Six Sigma is the most widely recognized and spreads the continuous improvement strategy accessible by most organization (Alsmadi & Khan, 2010). The Six Sigma philosophy entails the tools and methods used to seek, find and eliminate the

causes of defects or mistakes in business processes by focusing on outputs that are important to the customers (Kumar & Buer, 2010).

Sigma can be understood at three levels (Anthony & Fergusson, 2008). These levels include the feature that Six Sigma is a metric measure that allows organizations to implement a measurement-based strategy that focuses on process improvement and variation reduction. Its implementation follows a well-defined problem solving tools such as DMAIC (define, measure, analyze, improve and control). The benefits that have been highlighted to accrue from Six Sigma include improve product quality and reduce production costs by lowering costs related to poor quality (De Mast, 2007). Further, Arnheiter & Maleyef (2010) argued that the Six Sigma adoption can result in continuous quality and process improvement, increased productivity, production capacity and reliability. Pulakanan & Voges (2010) point that some of these factors include senior management commitment, linking six sigma to business strategy and customers, organizational readiness and project management skills as well as integration of the system with financial accountability.

2.3 Problem Solving Approaches

In an organization, everyone has the same objective – maximum production, on specification, at the lowest cost over the entire product life cycle. The general objective will be for the production and technical departments to work together in order to maximise asset availability and limit costs over the lifetime of that asset. The potential problem analysis approach by Kepner and Tregoe (K-T) provides ideal framework of

constructing total productive system. It provides a set of questions and steps whereby one can create an accurate description of the problem (Bates and Bates, 2010).

In their research in 1965, Charles Kepner et al found that when two managers are faced with identical information, they often make different decision of dramatically different quality. Deeper examination revealed that successful managers, however, followed similar and often counters - intuitive strategies when faced by with difficult situations (Alsaler, 2007). K-T captured and refined these strategies and termed them K-T strategies. The strategies are composed of four thinking tools which begin with a situation analysis (SA). The elements of the situation causing concern are identified so that priorities can be decided and which of the other three models is appropriate for handling the situation. In addition, the K-T tool looks back in time by looking at something that operated well in the past and that presently seems to be failing and the cause is not known yet. The cause of the deviation is established by examining in detail the specification of the operation and what might be causing the problem. This specification consists of a list of what is specifically suffering the problem and the deviation being experienced in the firm. It continues to ask where, when and the magnitude of the deviation. It then records what could be exhibiting the problem but *is not* (Bates and Bates (2010),

The is not, is then extended to where not (during the normal operations), when not and the magnitude it is not (e.g 100% over the allowable limit). By looking at the difference between the *is* and the *is not* data, one can generate a range of possible causes and select the most likely i.e. the one that can best explain the specification (Kumar & Bauer, 2010).

Most customers' orders come with specification on the tolerance or the upper and lower specification norms. This is in recognition of the fact that, it is impossible to produce everything exactly on the norm (Voelkel, 2002). The final product is a function of dozens of such causes, deeply embedded in the process. The failure mode and effect analysis (FMEA) is yet another problem solving technique (De Mast, 2006). Its objective is to prioritize the potential failure modes, which pose a detrimental effect on the system and its performance. The approach involves statistical data collection of the component failure and their chances of non-detect ability and severity it imposes on the system performance. The other disadvantage of the FMEA ranking method is that it neglects the relative importance among the occurrence and severity (De Mast, 2006). The two factors are assumed to have the same importance but in real practical application, the relative importance among the factors exists.

2.4 Root Cause Analysis

Root cause analysis (RCA), a process used to identify the root causes of problems or events, is arguable one of the most powerful tools available in the proactive maintenance 'toolbox' (Bakalu, 2012). RCA is designed to discover not only what or how something happened, but why it happened, but why it happened, and also determines the underlying causes of an event so proper corrective measures can be implemented to prevent any recurrences. Bakalu (2012) further noted that the RCA process involves defining a problem, isolating the issues that caused the problem, identifying the root cause, implementing the actions and conducting follow up assessment of the actions to ensure their effectiveness. RCA employs different tools in the identification and corrections of problems in an organization.

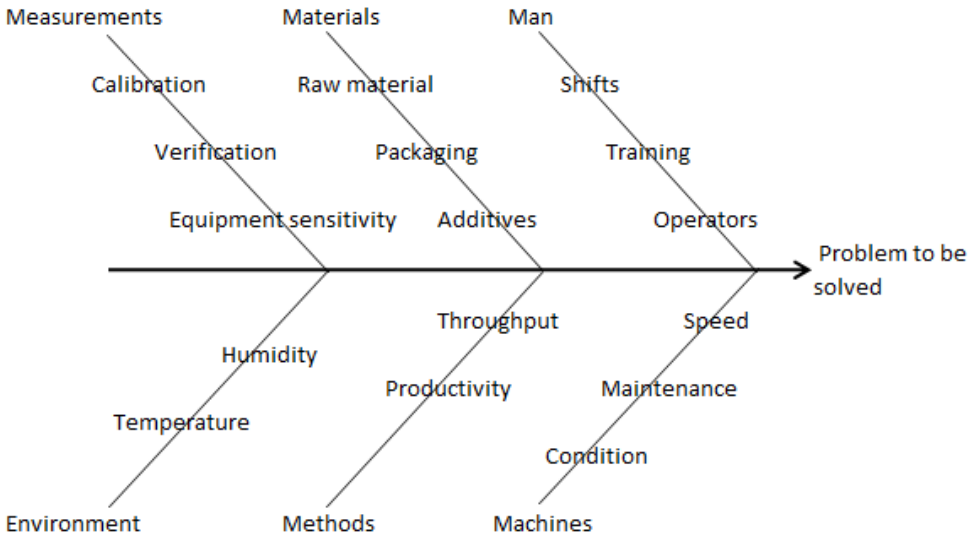
Some of the commonly used tools in RCA include the 5 whys, Pareto analysis, Ishikawa diagram, and fault tree analysis. The ‘5 whys’ tool involves asking why at least 5 times which will then normally lead to the root cause of the a given problem (Muir, 2006). The steps involve asking what happened through description of the effect, why did it happen, and the process is repeated until the root cause is found. The Pareto analysis allows the selection of a limited number of causes that produces a significant effect. This tool is based on the 80/20 rule which states that a large number of problems are produced by a few key issues (20 percent). In this case, a simple use of Pareto analysis is to list all the problems along with their frequency, sort the list by their frequency, and then focus on the problems that occur more frequently (Mahto and Kumar, 2008).

The Ishikawa or the fishbone diagram (figure 2 below) is a graphic tool used to explore and display the causes behind a problem (Eckert and Huges, 2008). Possible causes are categorized and shown as the main ‘bones’ in the diagram. The team involved in this exercise assists by making suggestions until the entire cause and effect diagram is complete. With the entire fishbone diagram complete, team discussion take place to decide on the most likely root cause of the problem and whereby upon the causes are circled to indicate items that will be acted upon. The other component of RCA is the fault tree analysis which is performed using a top-down approach. Starting with a top level event, fault tree analysis is performed by working down to determine all the contributing events that may ultimately lead to the occurrence of the top-level event. The resulting fault tree is a graphical representation of the chain of events in the system or process. The

probability of the top-level event can be determined using mathematical techniques (Eckert and Huges, 2008).

Figure 2. 1: The Ishikawa or Fish bone diagram

Source: The Quality Toolbox; *Seven Basic Quality Tools*; by Nancy R. Tague, 2004. (Adapted to suit the Horticulture sector by Francis T Murumbi).



The Fish bone diagram has been adapted to suit the horticulture sector. Calibration, verification, equipment sensitivity, temperature, humidity, packaging, training are some of the key inputs that can be used as elements of the fish bone diagram in order to arrive at a solution to a problem.

2.5 Global Horticulture

The value of horticulture products in 2013 was $1.5 billion (Source: http://www.trademap.org). The fresh fruit and vegetable market has been influenced by globalization and competitiveness concerning the high safety and quality requirements of

the products. The great increase in this trade has been made possible mainly due to the many technological innovations that had been made in the storage, transport, and postharvest technology fields. The demand for fruit and vegetable produce is rising, both in domestic and international markets (Lumpkin et al., 2005).

In developed countries, a desire for year-round availability and increased diversity of food, as well as a growing awareness of the relationship between diet and health, all contribute to the increased consumption of these commodities (Lumpkin et al., 2005). An acceleration in the nutrition transition has been driven by a radical change in the food marketing and distribution system (Schmidhuber, 2003). The fresh fruit and vegetable market is changing rapidly not only because of the development of new technologies, which allow better and longer preservation of these perishable products, but also because of an increasing consumer demand for food quality and diversified diets (Nicola et al, 2006).

2.6 Horticulture and Root Cause Analysis

Unlike most other industries where packaging goes a long way in satisfying the customer's visual appeal of the product, in horticulture, the appearance of the product itself (be it a vegetable or a flower or a fruit), has to be visually appealing to the customer for the purchase decision to be made. This then means the industry is naturally labor intensive. In most cases, solutions are borrowed from other industries/sectors e.g. bottling, canning, which in most cases do not work well in horticulture industry. Most solutions are aimed at reducing labor. Most senior managers and executives prescribe solutions that mostly tackle the symptoms of the problem. This then means that since the underlying issues are not addressed, expensive solutions are implemented; unfortunately,

these solutions do not result in the desired effect of solving the problem and end up increasing the cost of production and hence reduced profitability. This may be attributable to the fact that horticulture in Kenya is relatively young and there is not enough research and study in this sector. (Source: http://www.epzakenya.com).

Root cause analysis is therefore an important tool that would address the underlying root causes of problems therefore resolving problems once and for all. RCA study will therefore form a very important tool in this industry. The sector has increasingly been faced by many challenges even as the global economic fortunes seem to be getting better. Higher power costs, rising fuel prices, high costs of inputs, foreign currency exchange rates, high transportation cost and poor infrastructure such as roads and water unpredictable weather, obsolete technology and stringent international standards are some of the challenges the sector continues to face. Competition from Ethiopia's fledging cut flower industry has also threatened Kenya's dominance in Africa. (Source: http://www.africanfarming.net).

2.7 Empirical studies

Tools are used to derive information from data and convert information to knowledge (McQuater and Dale, 1995; Scurr and Hillman, 1995). They are used for identification and solving of problems as well as analysis of data. Oakland, (1993) noted that Teams helps tackle a variety of problems, exposes problems to a diversity of knowledge, skills, experience, and solve problems more efficiently. It also provides an environment in which people can grow and use all the resources effectively and efficiently to make continuous improvements.

Oakland, (1993) argues that organisational culture is formed by the beliefs, behaviours, norms, dominant values, rules and climate in the organisation. This results from an organisation's vision framework which comprise of its guiding philosophy, core values and beliefs, purpose and mission. Communication in Oakland's soft elements is concerned with ensuring efficient flow of information as well as eliminating barriers and fears between departments.

Citing ISO Lewis, Pun and Lalla, (2006) argue that identifying, understanding, and managing a system of interrelated process for a given objectives improves the operational effectiveness and efficiency of a firm. Oakland, (1993) reckons that within an organization, a system consists of an integrated collection of personnel, knowledge, abilities, motivations, equipment, machinery, methods, measures, processes and task activities. They are aimed at improving efficiency and effectiveness of organisational processes.

Problem solving tools and techniques are practical methods, skills, means or mechanisms that can be applied to particular tasks. Among other things, they are used to facilitate positive changes and improvements (McQuater and Dale, 1995; Scurr and Hillman, 1995). They stated that a single tool may be described as a device which has a clear role. It is narrow in focus and usually used on its own. They include: flow charts; check sheets; brainstorming; nominal group techniques; Pareto charts; cause-and-effect diagrams; run charts; stratification; histograms; scatter diagrams; control charts; process capability indices; and forces field analysis.

Dale et al, (1995) explained that a technique, on the other hand, has a wider application than a tool. This often results in a need for more thought, skill and training to use them effectively. They can be thought of as a collection of tools. For example, statistical process control (SPC), employs a variety of tools such as charts, graphs and histograms, as well as other statistical methods, all of which are necessary for the effective use of this technique. Techniques include: SPC, benchmarking, quality function deployment, failure mode and effect analysis and design of experiments (McQuater et al, 1995).

McQuater et al, (1995) noted that tools and techniques require attention in terms of a number of critical success factors, such as management support and commitment, effective, timely and planned training, genuine need to use of tools or techniques, defined aims and objectives for use, co-operative environment and backup. Bunney and Dale (1997) suggested the following key points which organisations need to consider to make effective use of tools and techniques: training be undertaken just-in-time, a planned approach should be used for application of the tools and techniques, management understanding needs to be ensured, and that a simple tool or technique should not be expected to be a solution to all issues.

2.8 Conceptual frame work

The primary aim of RCA is to identify the factors that resulted in the nature, the magnitude, the location, and the timing of the harmful outcomes (consequences) of one or more past events in order to identify what behaviours, actions, inactions, or conditions need to be changed to prevent recurrence of similar harmful outcomes and to identify the lessons to be learned to promote the achievement of better consequences. ("Success" is

defined as the near-certain prevention of recurrence.) To be effective, RCA must be performed systematically, usually as part of an investigation, with conclusions and root causes that are identified backed up by documented evidence. Usually a team effort is required. There may be more than one root cause for an event or a problem, the difficult part is demonstrating the persistence and sustaining the effort required to determine them. The purpose of identifying all solutions to a problem is to prevent recurrence at lowest cost in the simplest way. If there are alternatives that are equally effective, then the simplest or lowest cost approach is preferred.

Root causes identified depend on the way in which the problem or event is defined. Effective problem statements and event descriptions (as failures, for example) are helpful, or even required. To be effective, the analysis should establish a sequence of events or timeline to understand the relationships between contributory (causal) factors, root cause(s) and the defined problem or event to prevent in the future (Baines, 2002).

The theoretical framework is a logically developed, described, and elaborated network of associations among variables that have been identified through such processes as interviews, observations, and literature survey. These variables are; dependent, independent and moderating variable and they are deemed relevant to the problem situation. In this research the dependent variable is to achieve effective problem resolution and maximize firm profitability and shareholder value, which is in essence the variable of primary interest. The variance in which is explained by the following independent variables; high cost of inputs, high labour requirements per unit processed, lack of skilled labour, high cost of credit/finance, high freight/shipping costs, wastage in the supply chain, unpredictable freight schedules, equipment breakdown/obsolete

equipment, security challenges, unreliable raw material supply, unpredictable weather patterns.

The moderating variables have a contingent effect on the relationship between the dependent and the independent variables. That is, the moderating variable has an interaction effect with the independent variable in explaining the variance of the dependent variable. In this context, such variables include: the choice of the problem solving tool to be applied to resolve the problems identified, top management commitment, availability of resources.

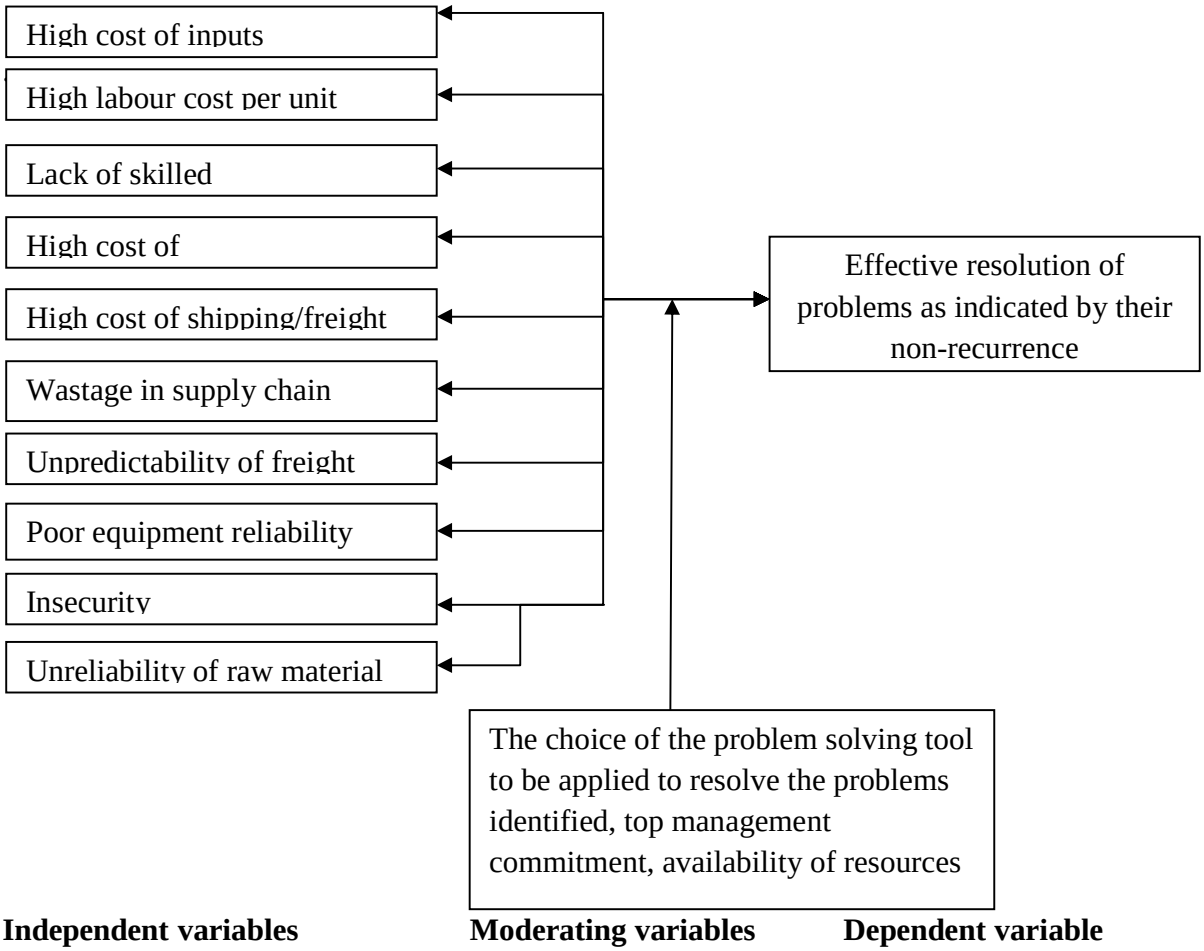


Figure 2. 2: A schematic diagram of the theoretical framework

2.9 Chapter Summary

The different problem solving tools used in the firms operations has been expounded in detail both in the literature as well as from the empirical studies done on the subject area. The current development in globalization and commerce have indicated an interest in developing a global market that is open to fair competition based on quality and price. It is imperative therefore that in order to achieve a quality product the management of an organization need to inculcate proactive use of problem solving tools and that these activities are given sufficient priority. In addition, senior management must support the implementation of recommendations dealing with organizational causes. From the literature, it can also be deduced that Root cause analysis as a process used to identify the root causes of a problem or events has come out as one of the powerful pieces of equipment available in the proactive maintenance 'toolbox'. RCA is designed to discover not only what, or how something happened but why it happened, and also determines the underlying causes of an event so that proper corrective measures can be implemented. However, it was noted that at present there lacks a comprehensive framework on the problem solving management and as a result different organization adopts different practices that they deem is suitable to their business context. Thus, there is no problem solving techniques that is more as a result, there is no single problem identification and solving framework that can be said to be universally accepted.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

The chapter describes the proposed research design that was used and includes the research design, the target population, sampling design, data collection instruments and procedures, and the techniques for data analysis.

3.2 Research Design

This study adopted a cross sectional research design. The design was deemed appropriate because the main interest will be to explore the viable relationship and describe how the factors support matters under investigation. A cross sectional study was also used to determine the interrelationship between the variables under consideration among the different horticultural firms in Kenya in the study at the same time period.

3.3 Population of study

The targeted population in the study were all the horticultural export firms operating in Kenya. As at 31st July 2014, there were 61 horticultural exporters (42 fruits & vegetables and 19 flower exporters) and it is assumed the number still prevailed. (www.fpeak.org, accessed 31.07.2014) (Appendix III).

3.4 Sample

This study was a census survey hence all the 61 horticultural exporters will be included in the survey.

3.5 Data collection

The study used both primary and secondary data. The primary data was collected by use of the structured questionnaire (Appendix I) while secondary data was collected from the financial reports of the firms. A questioner was deemed appropriate in this study because new explanation of the observed practices may be found and assumptions underlying any of the practices can be examined in more detail. Further a questionnaire provided disaggregated data that can be used to examine the practices of firms on an individual basis rather than on an aggregated basis (Graham and Harvey, 2001). The questionnaires were hand delivered to the respondents' offices with a request to fill in the questionnaire in one week time where upon it was collected. The questionnaire involved both closed and open-ended questions. The open-ended questionnaire sought to encourage respondents to share as much information as possible in an unconstrained manner while the closed-ended questionnaire involved "questions" that could be answered by simply checking a box. The target respondents were Operations managers or their equivalent in the horticulture industry.

3.6 Data Analysis

The data collected was analyzed using descriptive statistics. The data was classified, tabulated and summarized using descriptive measures, percentages and frequency distribution tables while tables and graphs was used for presentation of findings. Factor analysis was used to establish the loading strength of the root-cause-analysis variables and for the validity and reliability test cronbach α was applied. In accomplishing all analysis details with efficiency and effectiveness, the researcher will utilize the Statistical Package for Social Sciences (SPSS) software.

CHAPTER FOUR: DATA ANALYSIS, FINDINGS AND DISCUSSIONS

4.1 Introduction

The research objective was to study the application of root cause analysis in horticulture exporting firms in Kenya. This chapter presents the analysis, findings and the discussion with regard to the objective. The analysis is presented in mean and standard deviations while the findings are presented in frequency distributions and tables.

4.2 Background Information

The demographic information considered in this study included the firm's characteristics such as the number of years the firm had been in operation, the products the firm deals with, weekly turnover of the key products in tonnage, and the major export market for the cut flowers. A total of 60 questionnaires were issued out. The completed questionnaires were edited for completeness and consistency. Of the 60 questionnaires distributed, 49 were returned. The remaining 11 were not returned. The returned questionnaires' represented a response rate of 82% and this response rate was deemed to be adequate in the realization of the research objectives.

4.2.1 Operation Period of the Horticulture Firms

The results indicates that 75% of the respondents had been in operation for a period of more than 10 years while the remaining firms had been in operation for less than 10 years with 14.3% having been in operation for less than5 years. The period under consideration

refers to the year that the business unit started operating and not necessarily when it was registered.

Table 4. 1: The company operation period

Years	Frequency	Percent	Cumulative percent
Under 5	6	14.3	14.3
6 – 10 years	4	9.5	23.8
11-15 years	17	40.5	64.3
Over 16 years	15	35.7	100
Total	42	100	

The types of problems that a horticultural firm faces depend on the size of the firm and the diversification level of firms operation, in terms of the operation as well as export market. In the same vein, it is expected that firms that will have been in operation for long will have employed different problem solving techniques and also developed diverse problem solving techniques. Consequently, it is expected that with 75% of the firms having been in operation for more than 10 years, they formed an invaluable source of information to the research.

4.2.2 Horticultural firm's Local operation

This section sort to establish the type of products, weekly turnover and export market of the horticultural firms. The findings show a diverse range of horticultural products that the firms produce and the major ones include French beans, runner beans, mangoes, avocadoes, karalla, snow beans, Asian vegetables and roses. The production and

processing process of the horticultural products varies and consequently, the type of problems they face will also be diverse. The tonnage of the weekly output from the firms varied majorly from firm to another based on the period of operation that firm had been in existence. In this regard, it was found that for the firms that had been in operation for less than 5 years, the output tonnage per week was found to be less than 50 tonnes. On the other hand, majority of the firms that had been in operation for more than 10 years, it was found that their weekly tonnage ranged between 100 – 200kg.

The export markets for most of these firms were found to be in Western Europe in countries such as Germany, UK, Netherlands and France. At the same time, some firms indicated that USA was their major export market and also in southern Africa. More recently, China was also found to be another market that the horticultural firms exported their horticultural products. Based on the diverse regions that the export products are destined, the form of challenges that they face also varied and will be able to be identified in the research.

4.3 Common Problems Facing Horticultural Firms

This section of the questionnaire sought to establish from the common problems facing horticultural firms in the export industry in Kenya. The results are presented in table 4.2 below.

Table 4. 2: Common Problems facing Horticultural firms

	Mean	Std. Deviation
High cost of inputs	4.7381	.54368
High labour requirements per unit processed	3.6905	1.35229
Lack of skilled labour	2.2143	1.20032
High cost of credit/finance	4.6190	.58236
High freight/shipping costs	4.5714	.66783
Wastage in the supply chain	1.9286	1.02154
Barriers to trade in destination countries	3.9524	1.01097
Unpredictable weather patterns	3.0000	1.30664
Unpredictable demand patterns in destination countries	4.0238	1.23936
Equipment breakdown/obsolete equipment	2.2143	1.24029
Unreliable raw material supply	3.0238	1.09295
Unpredictable freight schedules	3.1905	1.41831
Overall Mean	3.43	

The range was 'not at all (1)' to 'most frequently' (5). The scores of not at all/less frequent have been taken to present a variable which had a mean score of 0 to 2.5 on the continuous Likert scale; ($0 \leq$ L.F <2.4). On the other hand scores of 3.5 to 4.8 on the continuous Likert was taken to be frequent and most frequent. The findings from the results varied such that the common problem that the horticultural firms faced with high

unanimity was existence of high input cost (Mean = 4.74) high freight/shipping cost (Mean = 4.57) and high cost of credit (Mean = 4.62). The variation as evidenced by the low standard deviation shows that the problems identified cut across all the horticultural firms researched on. On the other hand, the absence of skilled labour (Mean = 2.21), presence of wastage in the supply chain (Mean = 1,93) and equipment breakdown was found to be least problems that are experience by the horticultural firms in their operation. Unreliable raw material supply was only limited to fewer firms especially the firms that had been in operation for less than 5 years. The other problem that was not uniformly shared by the firms was the unpredictable weather patterns that was found to have high variation (SD= 1.4 2) and this could be attributed to the position that most of the horticultural firms produced the products under a controlled environment. The overall mean of the results (3.43) shows that the identified problems are common to most of the horticultural firms and they frequently experience the problems.

4.4 Common Problem Solving Techniques applied by Horticultural Firms

The second objective of the study was to establish the common problem solving techniques applied by the horticultural firms to deal with their operational problems. The results of the findings are presented in table 4.3 below. The range was 'very low extent (1)' to 'very great extent' (5). The scores of not at all/little extent have been taken to present a variable which had a mean score of 0 to 2.5 on the continuous Likert scale; ($0 \leq$ L.E <2.4).

Table 4. 3: Problem Solving Techniques

	Mean	Std. Deviation
The use of abstraction techniques where a model is used before applying the same in a real life situation	2.8810	1.31042
Brainstorming whereby a large pool of solution is floated and then	3.6190	.98655
Divide and conquer whereby a large and complex problem is broken down to smaller and management problems	2.2619	1.41524
Hypothesis testing where a possible explanation to the problem is assumed and the assumption is proved	2.6190	1.30575
Means-ends analysis which involves choosing an action at every step and to move towards the goal of problem solving	2.9762	1.29705
Lateral thinking which involves approaching the problem indirectly and creatively	2.9524	1.24846
Method of focal objects that involves synthesizing seemingly non-matching characteristics of different objects into something new that will solve the problem in hand.	2.6190	1.12515
Morphological analysis that involves assessing the output and interaction of the entire system to identify the problem	3.0000	1.36149
Root cause analysis which involves identifying the root cause of the problem	3.2857	1.27424
Trial-and-error that involves testing possible solution until the problem is solved	2.8810	1.34713
Research process which involves applying existing ideas or adapting existing solutions to similar problems	3.4524	1.31042
Overall Mean	**2.9621**	

Different horticultural firms employ varying problem solving techniques in their day-to-day operations. The findings above shows that the most common problem solving technique is through brainstorming (Mean = 3.619) where staff from different backgrounds and experience come together to deliberate on a problem at hand, identifying the origin of the problem and how best to deal with the problem. Different

firms have also set-up a research sections that continually research on the evolving problems and how best to eliminate them (Mean = 3.42). The research departments however are managed by a few staff and their research capacity might be a challenge. However, the findings also show that the other problem solving techniques were not popularly used by the horticultural firms such as the hypothesis testing, means-ends analysis, lateral thinking, morphological analysis and trial and error methods.

4.5 Application of the Root cause Analysis in the Horticultural Firms

The third objective of the research was to determine the application of root cause analysis as a problem solving technique in the export horticultural firms. Towards the determination of the same measurement scales were developed, tested, and applied. The measurement scales consist of items representing Dunn (2001) root cause analysis process in a solving a problem in a firm. The problem definition scale contained items that are followed in an organization in identifying the problems that face the horticulture firm and include description of the problem, data collection and compilation of evidence. Based on this, the content validity of the scale was checked and improved. The scale was tested for both construct loadings and reliability, and the scale and its subscale items proved to have high loadings (> 0.5) and high reliability Cronbach's α (> 0.7).

The instrument constructs, corresponding items, their factor loadings, and construct reliability are presented in Table 4.4.

Table 4. 4: Root cause analysis process item and factor loading

Factor	Item	Cronbach's α	Factor Loading
Problem definition	Problem description	0.757	0.790
	Data collection and evidence		0.735
	Involvement of all players		0.832
Problem Identification	Classification of causal factors	0.813	0.754
	Identification of corrective action		0.784
Action Development	Identification of solution	0.828	0.536
	Implementation of correction plan		0.749
	Identification of other solution		0.780
	Identification of other harmful outcomes		0.769

Source: Constructed from the Research Data

From the findings in table 4.5 problem solving in the horticultural firms involved more involvement of players in the firms (factor loading 0.832) while the lowest factor loading was registered on identification of problems facing the firms (factor loading 0.536). If every problem that is to be solved requires the involvement of a few, highly skilled specialists, then these specialists quickly become the bottleneck in the problem solving process. This might be the reason for the low concurrence in the involvement of many staff in the problem identification process.

4.6 Discussion of the Findings

The horticultural sector is one of the capital intensive business lines and considering that start up firms lack enough finances to support the business in setting up the infrastructure and purchase of the inputs in terms of chemicals, and seedlings, most of the firms will source from the banks the extra funding required. However, the current average lending rate for the Kenya commercial banks is 14.5% (CBK, half year report, 2014). With such a rate, the interest rate to these firms will be high and might disadvantage them in comparison to other firms from other countries. The high cost of freight experienced by the horticultural firms can be attributed to the special conditions of transporting the produce in which most of them are perishable within a short period and consequently require refrigeration throughout the distance to the customer. The other reason for the high freight cost is due to the long distance between the farms and the airport (JKIA) which acts as the dispatch airport for majority of the fresh produce from the firms. Currently, there exists a threat of the Kenyan horticultural products to be subjected to taxes ranging from 10.5% to 20.4% in the EU countries unless an agreement is reached with the East African countries before then.

Different horticultural firms were found to adopt different approaches to problem solving. The varying approaches can be attributed to different sizes of the firms, type of horticultural products they deal with, mode of transporting the produce, distance from the dispatch center, manpower capacity as well as top management support provided to the team. There has been an increased demand from the traditional Kenyan horticultural

market in the EU on factors such as carbon emission, amount of carbon per kilometer covered.

As Latino and Latino (2009) pointed out, the problems facing firms can be divided into three categories that can be categorized as physical causes, human causes and latent causes. This position supports the current study findings that tangible causes of failures were being faced by the firms as well as errors of commission and omission and these forms of errors were being analyzed using various techniques. The findings were also that the horticultural firms employed different problem solving techniques and root cause analysis though one of the methods, did not come out as a popular technique. This finding supports that position found by Fukuda (2001) when a similar study was undertaken in Japanese manufacturing firms whereby, it was found that application of the "five whys" and the cause-and–effect diagram was popular amongst the firms. The high content validity and reliability of the data is exhibited by the high levels of the factor loadings as well as the cronbach's α respectively. This shows that the data used to analyse the results can be relied upon to give a finding that supports the position on the ground.

In conclusion, root cause analysis can be said to be a clear process utilized for determining what happened, how it happened and why it happened and that most root causes can be categorized in three areas: people, equipment and processes. The people category can be improved through training and leadership, the equipment through better operation and maintenance practices, and the processes through optimization and continuous improvement. Though the application of root cause analysis as a problem solving techniques has not been adopted by majority of the horticultural firms in Kenya,

there is a potential of the same having a practical use in the industry and create the much needed source of competitiveness. For the minority of the firms that use the technique, it has reduced the incidences of problems and hastened the identification and solving the problem at hand.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of the key findings of the study as well as the conclusions, limitations of the study, and recommendations for further research.

5.2 Summary of Findings

The findings show a diverse range of horticultural products that the horticultural firms export from Kenya. The major produce for export includes French beans, runner beans, mangoes, avocadoes, karalla, snow beans, Asian vegetables and roses. Due to the difference in the horticultural products being produced locally and exported, the production and processing process of the horticultural products varied and this led to a difference in the types of challenges being faced by the export firms. The major export markets for the products include EU countries such as Germany, UK, Netherlands and France. At the same time, some firms indicated that USA was their major export market and also in southern Africa. The horticultural firms experience varying levels of day-to-day problems and this therefore lead to different approaches of solving the problems being adopted by the horticultural firms. Different firms have also set-up a research sections that continually research on the evolving problems and how best to eliminate them. Brainstorming came out as the popular approach being employed by the horticultural firms in solving the identified day-to-day problems being faced in the production process. However, the findings also show that the other problem solving

techniques popularly used by the horticultural firms such as the hypothesis testing, means-ends analysis, lateral thinking, morphological analysis and trial and error methods.

Different firms have also set-up a research sections that continually research on the evolving problems and how best to eliminate them. On the same, the findings found out that the research departments are however managed by a few staff and their research capacity not up to the standard. Other problem solving techniques were not commonly used by the horticultural firms. These methods include hypothesis testing, means-ends analysis, lateral thinking, morphological analysis and trial and error methods. In order to successfully identify and address the underlying organisational causes of failures, it is necessary, usually, to identify the errors of omission or commission that were committed by individuals, which led to the ensuing failure. This can be a daunting, and event terrifying experience for those who committed the errors. Team-based problem solving processes are generally the most effective way of solving most problems – especially those that are more complex (in other words, those problems that you are most likely to want to subject to some form of Root Cause Analysis in the first place).

5.3 Conclusion

Problem solving lies at the heart of quality management. The continuous process of identifying and eliminating the causes of inefficiency and ineffectiveness in business and production processes can be attributed to the increased standard of living presently being enjoyed. When faced with operational problems, organizations have to establish the reasons why the product or process is non-conforming in the first place and how it can be avoided in the future. In order to successfully identify and address the underlying organisational causes of failures, it is necessary, usually, to identify the errors of omission

or commission that were committed by individuals and the system, which led to the ensuing failure.

The need to strive and eliminate the problems facing an organization, there is need to find a skilled facilitator who will ensure that sufficient depth of analysis is conducted. In particular, the facilitator needs to encourage the development of causes and recommendations back to the leadership of the organization. A strong organization leadership support is necessary for the application of Root-cause-analysis, just like other problem solving techniques, for effective identification and solving of the problems. Finding root causes is related to how effectively groups can work together to test assumptions. Generally, root cause analysis may be valuable because it has the potential of developing new ways of thinking. However, the preoccupation with error, and the continual focus on refining processes and systems in order to eliminate error, is something that needs to be promoted and encouraged at all levels in the organisation, starting from the very top, if the full potential of Root Cause Analysis processes are to be realized.

5.4 Recommendations

The study found that a high cost of finances is one of the major problem facing horticultural firms and the recommendation for the same is that the government should put in place adequate mechanism of reducing the cost of capital in the local commercial banks. It is also recommended that the horticultural firms should explore other sources of funding such as listing in the securities exchange. In addition, the government should consider setting up newer international airports closer to the regions where the fresh produce products are farmed.

The study also found that the horticultural products have faced both tariff and non-tariff barriers in the traditional export markets such as the EU. It is therefore recommended that the firms in support from the government develop both defensive and offensive strategies for not only survival in the EU market, but also venturing in non-traditional horticultural export markets. Such strategies would include; education of producers to understand the EU import requirements which encompass both tariff and non-tariff measures, penetration of new markets in Asia, USA, and Africa, encouragement of organic farming where necessary, and creating an enabling environment for small scale farmers to access credit. Thus, the study recommends that the horticultural firms should look beyond competitive forces in the environment, by scanning the external and internal environment in search of other opportunities for revenue generation and competitive advantage.

The research also found that top management support is critical for effective realization of Root cause analysis benefits. However, many organisations have many recommendations from the problem solving processes that are never implemented, simply because there is not the top management will, or the management processes to deal with these. There is a tendency on the part of senior managers to assume that, when dealing with isolated events, the organisational causes that led to that event occurring are unusual or exceptional . Consequently, it is recommended that Management of the organisation needs to create a culture that encourages proactive use of RCA techniques, and ensures that these activities are given sufficient priority. The fundamental tool that is most effective in achieving this is by modifying the organisational reward system.

5.5 Limitations of the Study

This study has several limitations that should be considered in the interpretation and implication of its findings. First, although the organizational problem solving techniques was multidimensional, a true effect of root cause analysis on the problem solving capacity should be assessed by examining multiple effect it has on the performance representing different firms. Non-linear effects were not tested because the data span covered only a single period.

Further, there are several aspects beyond the scope of this research which reveal considerable scope for further research studies. First, it would be interesting to study the industry effect deeply that relate to problem solving techniques, and to keep an eye on the evolution of the problem solving techniques. The findings should also be considered in light of a single-industry case sample. It would be useful to analyse organization from an expanded sample of entities with characteristics other than those investigated in this research. Future studies might also address other moderating variables related to these different performance settings.

5.6 Suggestions for Further Research

In light of these limitations, future research is recommended to use mixed methods research in order to validate the results of this research, and apply a longitudinal study to better capture the relationships between the uses of root-cause analysis on performance of a firm. Conducting a replication study with random sample selection can enhance the methodological rigor of the study and increase the possibility of having a better and a

supported external validity. Also, another possible source of data could be the customers whose opinions, along with those of executives, can give a better insight of the relationship. Furthermore, taking into consideration certain factors that may have a moderating role in these relationships, such as the organizational culture, could enrich the research results.

REFERENCES

Alsmadi, G.M & Khan, P,. (2010), *Introduction to Statistics Quality Control*, Wiley India, Pvt Ltd, New Delhi

Anthony, J & Fergusson, G. (2008), " Six Sigma v Lean: Some perspectives from Leading academics and practitioners", *International Journal of Productivity and Performance Manag*ement, 60(2)

Arora, K.C. (2007), *"Total quality management"* S.K. Kataria and Sons, Darya Ganj, New Delhi, pg 931.

Arnheiter, E. & Maleyef, J., (2010), "The Integration of Lean Management and Six Sigma", *The TQM magazine*, 17(1)

Baines, R.N. (2002), *Quality Assurance and Food Trade; A critical comparison of Systems*, Royal Agricultural college, Cirencester

Bates, T.F & Bates, C.F (2011), An Integrated Approach to Problem Solving: Linking K-T, TQM and RCA to TPM, *International Journal of Quality and Reliability Management*, 12 (3): 229-38

Birren, J (2006), *Lean Six Sigma Statistics*, McGraw-Hill, New York, NY

Burney, H.S. and Dale, B.G. (1997), The implementation of quality management tools and techniques, *the TQM magazine*, 9 (3):183-189.

Dangayach , G. & Deshmuhk, S. (2006), "An exploratory study of Manufacturing Strategy practices of machinery manufacturing companies in India," *Omega* 34,(3): 254-73

Dogget, A.M (2011), " Root Cause Analysis:- A framework for tool selection," *Quality Management Journal*, 12 (4):35-45

Export Promotion Council, *Horticultural Industry in Kenya*, available at www.epckenya.org, accessed 10.01.2014

Fobes, R (1993), *The Creative Problem Solver's Toolbox: A Complete Course in the Art of Creating Solutions to Problems of Any Kind* , McGraw-Hill, New York, NY

Gano, D.L (2008), *Apollo Root Cause Analysis,* Apollian Publication, Yakima, Washington, DC

Gupta, V., Acharya, P. & Patwardhan, M. (2012), "Monitoring quality goals through lean six sigma insures competitiveness", International Journal of Productivity and Performance Management, 61 (2)

Goldratt, E.M (1994), It's Not Luck, Great Barrington MA: North River Press

Kumar , S & Buer, M. (2010), " Managing Recalls in a Consumer supply chain – root cause analysis and measures to mitigate risk" *International Journal of Production Research*, 49, (1)

Latino, G.M & Latino, J.K (2009); "Barriers to realizing sustainable process improvement: a root cause analysis of paradigms for manufacturing system improvement" *International Journal of Computer Integrated Manufacturing*, 31. (1)

Lewis, W.G. Pun, K.F. and Lalla, T.R.M. (2006), *Exploring "soft versus "hard factors of TQM implementation in small and medium-sized enterprises,* International Journal of productivity and performance management, 55 (7): 539-554.

Liu, X., Ma, L. & Mathews, J. (2009), "Machinery fault diagnosis based on fussy measure and fussy integral techniques," *Mechanical systems and Signal Processing,* 23 (33):690 – 720

Lumpkin, T.A., Weinberger, K. and Moore, S. 2005. Increasing income through fruit and vegetable production opportunities and challenges. Consultative Group on International Agricultural Research Science Forum. December 6, 2005, Marrakech, Morocco. p.1-10

Magu, C.N (2005), “Strategic value of reliability and Maintainability management,” *International Journal of Quality and Reliability Management*, 22 (3):317-28

McQuater, R.E. Scurr, C.H. Dale, B.G. and Hillman, P.G. (1995), *Using quality tools and techniques successfully*, the TQM magazine, 7 (6):37-42.

Miguel,K. & Adrieta, M. (2009), “ Systems failure behaviour and maintenance decision making use of RCA, FMEA and FM” *Journal of Quality in Maintenance Engineering*, 16 (1)

Nicola, S., Fontana, E., Hoeberechts, J. and Torassa, C. 2006c. Fresh-cut produce: critical issues. *Acta Hort*. 712:223-230.

Oakland, J.S. (1993), Total Quality management, the route the improving performance, 1993.

Pulakanan, D.C & Voges, D. (2010), “Lean and Six Sigma – a one-two punch”, *Quality Progress*, 5 (23)

Russell, S. (2000**),** *ISO 9000: 2000 and the EFQM Excellence model: competition or cooperation,* Total quality management, 11 (4/6):657-65

Sharma, R., Kumar, D & Kumar, P. (2005), “ FML to Select suitable maintenance strategy in industries using MISO model”, *Journal of Quality in Maintenance Engineering*, 11 (4):359 -67

Sharma, R., & Sharma., G (2010), Systematic Failure Mode and effect analysis using fussy linguistic modeling, *International Journal of Quality and Reliability Management*, 22 (9): 225-38

Sproull, B (2001), *Process problem solving: A guide for Process and Maintenance teams*; Portland, Productivity Press

Schmidhuber, J. 2003. The outlook for long-term changes in food consumption patterns: concerns and policy options. FAO Scientific Workshop on Globalization of the Food System: Impact on food security and nutrition, FAO, October 8-10, 2003, Rome, Italy. www.fao.org/es/ESD/Schmidhuberdiets.pdf. Up-to-date 28/12/2006.

Tom Huston, *What is root cause analysis?*, available at www.alertsite.com, accessed July 27, 2014

Wilson, P.F., Dell, L.D., & Anderson, G.F., (1993), *Root Cause Analysis; A Total for Total Quality Management*, Milwaukee. ASQS Press

APPENDICES

Appendix I: The Questionnaire

Organisation name .....

Location .....

Section A: Open-ended Questions

1. What products does your organisation sell?

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.....
.....

2. What is the weekly turnover of each of your key products in terms of tonnage?

.....
.....
.....

3. Where are the markets for your products?

.....
.....
.....

Section B: Management problems

The following are potential problems that may occur in any horticultural company.

Please rate them in terms of frequency of occurrence in your organisation. Use a 5-point scale rating with;
1= not at all, 2 = less frequent 3= sometimes 4= Frequently and 5= Most frequently.

		Frequency of occurrence				
	Problem/challenge	1	2	3	4	5
1	High cost of inputs					
2	High labour requirements per unit processed					
3	Lack of skilled labour					

4	High cost of credit/finance					
5	High freight/shipping costs					
6	Wastage in the supply chain					
7	Barriers to trade in destination countries					
8	Unpredictable weather patterns					
9	Unpredictable demand patterns in destination countries					
10	Equipment breakdown/obsolete equipment					
11	Security challenges					
12	Unreliable raw material supply					
13	Unpredictable freight schedules					

Others (specify please)

.....
.....
.....

Section C:
Problem solving steps

1. For each statement, rate your answer according to how best each statement describes the steps your organization takes when addressing problems. (Please answer questions as you actually are, rather than how you think you should be).

1= not at all, 2= rarely, 3= sometimes 4= frequently, 5= most frequently

	Statement	**Problem solving steps used**				
		1	2	3	4	5
1	Definition of problem and description of event to prevent in future.					
2	Collection of data and evidence, classifying it along a timeline of events to the final failure or crisis.					
3	Involvement of all players in the process however inconsequential they may seem.					
4	Classification of causes into causal factors that relate to an event in the sequence that if eliminated, can be agreed to have interrupted that step of the sequence chain.					
5	Identification of corrective action(s) that will with certainty prevent recurrence of each harmful effect, including outcomes and					

	factors					
6	Identification of solutions that, when effective, and with consensus agreement of the group, prevent recurrence with reasonable certainty, are within the institution's control, meet its goals and objectives and do not cause or introduce other new, unforeseen problems.					
7	Implementation of the recommended root cause correction(s).					
8	Identification of other methodologies for problem solving and problem avoidance that may be useful.					
9	Identifying and addressing the other instances of each harmful outcome and harmful factor.					

2. The following are problem tools/strategies that a company may use in solving problems.

Please rate them in terms of awareness levels with;
1= not aware at all, 2= not aware, 3= basic awareness, 4= good awareness, 5 = complete awareness

	Problem solving tools/ strategies	Rate of use				
		1	2	3	4	5
1	Abstraction					
2	Analogy					
3	Brainstorming					
4	Divide and conquer					
5	Hypothesis testing					
6	Lateral thinking					
7	Means-ends analysis					
8	Method of focal objects					
9	Morphological analysis					
10	Proof					
11	Reduction					
12	Research					
13	Root cause analysis					
14	Trial-and-error					

Source: Fobes (1993)

3. The following are problem solving tools/strategies? Please rate them according to the rate of use in your organization.

Please rate them in a 5-point scale with;

1= not used at all, 2= rarely, 3= sometimes 4= frequently, 5= most frequently

	Problem solving tools/ strategies	Rate of use				
		1	2	3	4	5
1	Abstraction					
2	Analogy					
3	Brainstorming					
4	Divide and conquer					
5	Hypothesis testing					
6	Lateral thinking					
7	Means-ends analysis					
8	Method of focal objects					
9	Morphological analysis					

10	Proof					
11	Reduction					
12	Research					
13	Root cause analysis					
14	Trial-and-error					

4. How often do problems identified in section A above recur in your organization

Please rate them in a 5-point scale with;

1= most frequently, 2= frequently, 3= sometimes 4= rarely, 5= not at all

	Problems encountered in your organization	**Rate of use**				
		1	2	3	4	5
1	High cost of inputs					
2	High labour requirements per unit processed					
3	Lack of skilled labour					
4	High cost of credit/finance					
5	High freight/shipping costs					
6	Wastage in the supply chain					
7	Barriers to trade in destination countries					
8	Unpredictable weather patterns					
9	Unpredictable demand patterns in destination countries					
10	Equipment breakdown/obsolete equipment					
11	Security challenges					

12	Unpredictable freight schedules					
13	Unreliable raw material supply					

Appendix II: Problem solving approaches, definitions

Problem solving approaches;

1. **Abstraction:** solving the problem in a model of the system before applying it to the real system
2. **Analogy:** using a solution that solves an analogous problem
3. **Brainstorming:** (especially among groups of people) suggesting a large number of solutions or ideas and combining and developing them until an optimum solution is found
4. **Divide and conquer:** breaking down a large, complex problem into smaller, solvable problems
5. **Hypothesis testing:** assuming a possible explanation to the problem and trying to prove (or, in some contexts, disprove) the assumption
6. **Lateral thinking:** approaching solutions indirectly and creatively
7. **Means-ends analysis:** choosing an action at each step to move closer to the goal
8. **Method of focal objects:** synthesizing seemingly non-matching characteristics of different objects into something new
9. **Morphological analysis:** assessing the output and interactions of an entire system
10. **Proof:** try to prove that the problem cannot be solved. The point where the proof fails will be the starting point for solving it
11. **Reduction:** transforming the problem into another problem for which solutions exist
12. **Research:** employing existing ideas or adapting existing solutions to similar problems
13. **Root cause analysis:** identifying the cause of a problem
14. **Trial-and-error:** testing possible solutions until the right one is found

Appendix III: Fruits, veg and flower export firms

Fruits and Vegetables export firms

No.	Company Name	Location	Contacts
1	AAA Growers Ltd	Nairobi	Mr. Neville Ratemo P.O. Box 32201 - 00600 Nairobi Tel: 020-4453970 - 4 Fax: 020-4453975 neville@aaagrowers.co.ke, admin@aaagrowers.co.ke
2	African Fruits and Veg Ltd	Nairobi	Godwin Kiplagat P.O. Box 2873-00200 Nairobi Tel: +254736 907034 africanfruitandveg@live.com
3	Avenue Fresh Produce Ltd	Nairobi	Mr. C. Muchiri P.O. Box 3865-00506 Nairobi Tel: 020-825342/820015 Fax: 020-825288 info@avenuefresh.co.ke, avenue@avenue.co.ke
4	Avo-Health (EPZ) Ltd	Nairobi	Jeanie Molly, P.O. Box 19515-00200 Nairobi Tel: +254 728 278 814 molly@avohealth.co.ke
5	Batian Horticultural Agencies	Meru	Mr. James Kaaria P.O. Box 35-60200, Meru, Kenya Tel: +254 723 340 819 arimbajames@hotmail.com
6	Benvar Estates Ltd	Thika	Mr. Robert Muchoki, P.O. Box 53-00661, Village Market, Nairobi Tel: 020 2337095 farm@bcf.co.ke
7	Best Grown Produce (K) Ltd	Nairobi	Mr. Paul Muigai P.O. Box 73463, Nairobi Tel: 020222755 Fax: bestgproduce@yahoo.com
8	Deluxe Fruits Ltd	Nairobi	Mr. Arvin N. Gurjar P.O. Box 18726 - 00500, Nairobi Tel: 020-3673822 info@deluxefruits.co.ke arvind@deluxefruits.co.ke
9	Dominion Vegfruits Ltd	Nairobi	Mr. John Mairura P.O. Box 55078 - 00200, Nairobi Tel: 020-823002/3 Fax: 020-823005 vegfruits@wananchi.com

10	East African Growers Ltd	Nairobi	Mr. P. Mahajan P.O Box 49125 Nairobi Tel: 020-822017/25 Fax: 020-822155 peeush@eaga.co.ke
11	Everest Enterprises Ltd	Nairobi	Mr. J. Karuga P.O. Box 52448, Nairobi Tel: 020-824141/823333 Fax: 020-824195 jkaruga@everest.co.ke, 1smuhoho@everest.co.ke
12	Ever Green Crops Ltd	Nairobi	Mr. Arun Singh P.O. Box 46826, Nairobi Tel: 0202014606 evergreencrops@gmail.com
13	Exotic Farm East Africa Ltd	Nairobi	Mr. Kinoti S. Bundi P.O. Box 64459 - 00620, Nairobi Tel: 0722521581 Fax: 020-823005 exoticfea@gmail.com
14	Fian Green Kenya Ltd	Nairobi	Mr. Francis Thuita, P.O. Box 60455, Nairobi Tel: 020-826157/3542471 info@fiangreens.co.ke
15	Finlays Horticulture Kenya Ltd	Nairobi	Mr. R. Fox P.O. Box 10222, Nairobi Tel: 020-3873800/3874193 Fax: 020-3873800/3874940 Richard.Fox@finlays.net
16	Fresh An Juici Ltd	Nairobi	Ms. Maleka Akaberali P.O. Box 39833 - 00623, Nairobi Tel: 020-826090/3 Fax: 020-826092 maleka@freshanjuici.co.ke
17	Frigoken Ltd	Nairobi	Mr. D. Karim. P.O Box 30500, Nairobi Tel: 020-8560096/8560449 Fax: 020-8560098 frigoken@frigoken.com

18	From Eden ltd	Nairobi	Mr. Zulfikar Jessa P.O. Box 11880, Nairobi Tel: 020-8562203 Fax: roy@from-eden.com
19	Greenpoint Exporters Ltd	Nairobi	Justus Oyallo P.O. Box 44496, Nairobi Tel: +254722698870 info@greenpoint.co.ke
20	Greenlands Agro Producers Ltd	Nairobi	Mr. G. Murungi P.O. Box 78025, Nairobi Tel: 020-827080/1/2 Fax: 020-827078 murungim@greenlands.co.ke
21	Hillside Green Growers & Exporters Co. Ltd	Nairobi	Ms. Eunice Mwongera P.O. Box 73585 -00200, Nairobi Tel: 020- 3878134/74 Fax: 020 - 3872127/6623 infoland@nbnet.co.ke
22	Indu farm EPZ Ltd	Nairobi	Mr. C. Bernard P.O. Box 42564, Nairobi Tel: 020-550215/6/7 Fax: 020-550220 info@indu-farm.com/christian. benard@indu-farm.com
23	Kakuzi Ltd	Thika	Mr. R. Collins P.O. Box 24, Thika Tel: (060)33012/31393 Fax: 067-64433 rcollins@kakuzi.co.ke/ mail@kakuzi.co.ke
24	Kandia Fresh Produce Suppliers Ltd	Nairobi	Ms. Lucy Mundia P.o. Box 42806 - 00100, Nairobi Tel: 020 - 3500866 Fax: 020 - 821152 kandia@swiftkenya.com
25	Keitt Ltd	Nairobi	Mr. Asif Aman P.o. Box 6390- 00200, Nairobi Tel: 020 - 822829 Fax: 020 - 827842 asif@keitt.co.ke

26	Kenya Horticultural Exporters (1977) Ltd	Nairobi	Mr. Manu Dhanani P.O. Box 11097, Nairobi Tel: 020-650300/1/2 Fax: 020-559115 khe@khekenya.com, manu@ khekenya.com
27	Key Export Co. ltd	Nairobi	Mouz Husnan P.O. Box 22200, Nairobi Tel: 020823024 info@keyexporters.co.ke
28	Makindu Growers & Packers Ltd	Nairobi	Mr. O.P. Bij P.O. Box 45308, Nairobi Tel: 020- 822812 Fax: 020-822813 info@makindugrowers.co.ke
29	Mboga Tuu Ltd	Nairobi	Mr. J. Kent P.O. Box 47070, Nairobi Tel: 020-3877988/3561196 Fax: 020-3878071 mtl@wananchi.com
30	Namelok Exotics (K) Ltd	Kajiado	Mr. D. T. Sinkeet P.O. Box 44- 0242, Kitengela Tel: 0724743258 Info@namelokexotic.com
31	Nicola Farms Ltd	Murang'a	Ms. Grace Wanjiku P.O. Box 64-10205, Maragua Tel: 020-2048874/76 Fax: 020-2048874 marketing@nicola.co.ke
32	Sacco Fresh Ltd	Nairobi	Mr. J. M. Muia P.O. Box 26211-00100, Nairobi Tel: 020-824687/8 Fax: 020-824689 info@sacco-fh.com
33	Shree Ganesh Fruits & Vegetables Ltd	Mombasa	Mr. Kanji Kalyan Patel P.O. Box 83745 - ,Mombasa Tel: 020-80243645 meleka@freshanjuici.co.ke
34	Sian Exports Kenya Ltd	Nairobi	Mr. S.S. Mangat P.O. Box 43042-00100, Nairobi Tel: 020-822220 Fax: 020-890287 rano@sianexports.com

35	Sunmango Ltd	Ruiru	Mr. Kushal Patel P.O. Box 62-00232, Ruiru Tel: 067-5854406/0203542151 sumango@dmblgroup.com
36	Sunripe (1976) Ltd	Nairobi	Mr. Hasit Shah P.O. Box 41852, Nairobi Tel: 020-822518/822879 Fax: 020-352266/822709 info@sunripe.co.ke
37	The African Herb Co. Ltd	Nanyuki	Nelson Osano P.O. Box 149-10400, Nanyuki Tel: +254720412279 nick.emson@african-herb.com
38	Value Pak Foods Ltd	Nairobi	Mrs. J. R. Patel P.O. Box 42828, Nairobi Tel: 020-823438/823439 Fax: 020-823347 valuepak@wananchi.com
39	Vegpro Kenya Ltd	Nairobi	Mr. B. Patel P.O. Box 32931, Nairobi Tel: 020-82283-4 Fax: 020-822753 bharat@vegpro-group.com, ddevraj@vegpro-group.com
40	Wamu Investments Ltd	Nairobi	Mrs. P. Muriuki P.O. Box 26026, Nairobi Tel: 020-822441/824990 Fax: 020-824991 wamu@swiftkenya.com, peris@wamu-investments.com
41	Woni Veg-Fru Importers and Exporters Ltd	Nairobi	Mr. T. K. Mutiso P.O. Box 52115, Nairobi Tel: 020-532805/650350 Fax: 020-650350 woni@swiftkenya.com
42	Wilham Kenya Ltd	Nairobi	Mr. P. Mahajan P.O. Box 52494, Nairobi Tel: 020-822030/827486 Fax: 020-822823 peeush@eaga.co.ke

Flowers export firms

No.	Company Name	Location	Contacts
1	Carnation Plants Ltd	Nairobi	Mr. E. Fieldman P.O. Box 54274, Nairobi Tel: 020 - 2045162 - 3438066 Fax: 020-4348066 evi@exoticfields.com
2	Everflora Ltd	Thika	Mr. Khilan Patel P.O. Box 62-00232, Ruiru Tel: 067-54624/50624/0733637090 Fax: 067-54413 everflora@dmblgroup.com, khilan@dmblgroup.com
3	Fides Kenya Ltd	Embu	Mr. F. Mwangi P.O. Box 1175, Embu Tel: 020-3570182/068-30776 Fax: 068-30776 info@fideskenya.com
4	Finlays Horticulture Kenya Ltd	Nairobi	Mr. R. Fox P.O. Box 10222, Nairobi Tel: 020-3873800/3874193 Fax: 020-3873800/3874940 Richard.Fox@finlays.net
5	Fontana Ltd	Nakuru	Mr. A. C. Achaia, P.O. Box 15688 - 20100, Nakuru Tel: 0051 - 343156 Fax: 051 - 343322 sarju@fontana.co.ke
6	Gatoka Ltd	Thika	Mr. Martin Gacheru P.O. Box 404, Thika Tel: 020-20110254/0733619505 gatoka@swiftkenya.com
7	Karen Roses Ltd	Nairobi	Mrs. R. Kotut P.O. Box 68010, Nairobi Tel: 020- 2020846 Fax: 020-2020846 karen@karenroses.com
8	Karuturi Ltd		Ms. Christabel Thanji P.O. Box 729, Naivasha Tel: 050-50001/2/3 Fax:020-2021058 shernaiv@sherkaruturi.co.ke, shernaiv@karuturi.com
9	K-Net Flowers Ltd	Nairobi	Mr. Mike King'ori P.O. Box 44334-00100, Nairobi Tel: 020-3875662/3 Fax: 020-3875080 info@k-netflowers.com

10	Lauren International Flowers Ltd		Mr. Joseph Tawk P.O. Box 10373, Nairobi Tel: 020-2358119/0722525683 laurenflowers@accesskenya.co.ke
11	Millenium Management Consultants	Nairobi	Dr. George Ogoti
12	Panocal International Ltd	Kitale	Dr. P. Wekesa P.O. Box 982, Kitale Tel: 054-30916/31655, 020-2029614 Fax: 054-30917 pwekesa@africaonline.co.ke, panocalinter@swiftkenya.come
13	PJ Flowers Ltd	Nairobi	Mrs. E. Thande P.O. Box 14725, Nairobi Tel: 020-3870302 Fax: 020-3870302 elizabeth@wetfarm.co.ke
14	Subati Flowers Ltd	Nairobi	Mr. Ravi Patel P.O. Box 25130 - 00100, Nairobi Tel: 020 - 650511, 0736 347777 Fax: 020 - 650494 info@subatiflowers.com
15	Tropiflora Ltd	Nairobi	Mr. N. Krasensky P.O. Box 622, Village Market Tel: 020 -2013960, 0720 - 205246 Fax:066-73138/73278 tropiflora@tropiflora.net
16	Wilfay Investments Ltd	Nairobi	Mr. Sammy Kiboro P.O. Box 28241-0020, Nairobi Tel: 020 -3874477 Fax:020-3870096 wilfayflowers@gmail.com zedgee@swiftkenya.com
17	Wilmar Ltd	Nairobi	Mr. P. Mahajan P.O. Box 52494, Nairobi Tel: 020-822030/827486 Fax: 020-822823 peeush@eaga.co.ke
18	Wilmar Agro Ltd	Thika	Mr. W. Kamami P.O. Box 1682, Thika Tel: 020-2096452, 067-30176 Fax: 067-30176/22324 info@wilmar.co.ke
19	Zedgee Ltd	Nairobi	Mr. Paul Mwangi P.O. Box 16480 - 00100, Nairobi Cell: +254-722679400 Cell: +254-722852546 zedgee@swiftkenya.com