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TECHNOLOGY INNOVATION STRATEGY AND FIRM COMPETITIVENESS: A CASE OF AUTOMATED WEIGHT BASED SOLUTION ADOPTION IN TEA PROCESSING FIRMS IN KENYA

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Abstract

Innovation plays a very important role in the success of a firm as well as the economy of a country at large. Firms that invest in innovation are better placed to compete in the global markets. Despite its importance the relationship between innovation and competition is widely misunderstood. There is little empirical evidence on the role of adopting innovation on firm competitiveness especially in the local context such as the tea industry in Kenya. Therefore, the purpose of this study is to establish the role of technology innovation strategy on the competitiveness of KTDA tea firms in Kenya. It specifically sought to establish the role of Automated Weight Based Solution (AWBS), on competitiveness of KTDA tea firms in Kenya. The study adopted descriptive survey targeting 12 tea firms in the Region 5 under the management of KTDA. The study population comprised 12 factory unit managers, 24 production managers, 36 supervisors, 36 store clerks and 96 leaf collection clerks. Stratified random sampling technique was used to select 130 respondents to participate in the study. Data was collected using questionnaires and was analyzed using both descriptive and inferential statistical methods with the aid of SPSS. The findings revealed that use of the established that

use of AWBS significantly influenced the competitiveness of the KTDA tea firms (β = 0.383, p < 0.05) and could explain up to 20.8 % of the variations in the competitiveness of KTDA tea firms in Kenya. The study, therefore, concluded that the use of the AWBS was important to the competitiveness of the KTDA tea firms. It was recommended that the tea processing firms carry out more sensitization among farmers on the use of the automated weighing based solution so as to increase farmer confidence in our organization. It is also recommended that the government provide incentives to increase the usage of the AWBS so to improve competitiveness of the tea sector

Keywords: Technology innovation, Competitiveness, Automated Weight Based Solution

INTRODUCTION

Background

Firm competitiveness is a capability of a firm to sustainably fulfil its double purpose: meeting customer requirements at profit. This capability is realized through offering on the market goods and services which customers value higher than those offered by competitors. A condition to this competitiveness is for the company, to be able to detect and adapt to changes in the environment and within the company by way of meeting competitive market criteria permanently more favorable than those rivals (Chikan, 2008). Buckley (2016) consider competitiveness to be synonymous with a firm's long-run profit performance, its ability to compensate employees and generate superior returns for shareholders. Firms that invest in innovation and research are better placed to compete in the global markets. Strategically focused innovation is found to be the most important characteristic associated with success and firms that innovate achieve high growth, gain market share and increased profits than those that do not innovate (Asli et al, 2013). Rajnoba and Lorincova (2015) in their study explained that innovation is an engine to development, economic growth and solely relies on the operations core of a firm. The scholars further argue that innovation increases business process efficiency and thus guarantees strategic growth of a firm. It is therefore important for any firm that wants to remain relevant in the market to identify innovations that drive their business as tool to maintaining their competitiveness (Rajnoba & Lorincova, 2015).

The ability of high-growth firms to outperform others derives in large part from their greater levels of successful innovation. For example, a study by Mason, Bishop and Robinso (2009) found that innovative firms in the UK grew twice as fast - both in employment and sales - than firms that failed to innovate. For instance, firms that had introduced a product innovation in

2002 and 2004 experienced a 4.4 per cent average employment growth rate within a period of three years, in contrast to the 2 per cent average growth displayed by non-innovators in the market. The figures rose to 10 per cent when sales growth was considered. Therefore, the links between innovation and growth suggest that supporting innovation is a crucial channel to foster business growth. However, not all technological innovation adoption can lead to growth and as such; technological innovation must be clearly supported by strategic choices if they are to yield the desired results.

According to Fernando, Chang and Tripathy (2015), unless a company has a genuine scientific or technological advantage, preferably one that can be protected by patent, competitors can more often than not match any incremental change in an ever-shortening time-scale. Cost reduction in an operation, may be by use of new tools and techniques in operational management, relocating production to areas of lower labour cost. A combination of both likewise creates advantage that can be sustained only over a relatively short time. As changes in technology occur, the firm's technology and production levels must be adapted to respond to new requirements. Should this not happen, the company could lose its cost advantage if a rival incorporates these changes instead (Coelli et al., 2005). Neither should the firm's leaders disregard their products' possible obsolescence nor clients' new expectations as clients' needs are always diverse and evolving (Ahmed et al., 2014). In addition, the strategy's drawbacks also include the limited validity of the experience curve when a big change occurs in technology or when new entrants are able to learn more swiftly.

In Kenya, tea processing firms affiliated to the Kenya Tea Development Authority (KTDA) have adopted Continuous Fermentation Units, Automated Weight Based Solutions and Inventory Control Systems to increase their competitiveness. However, up until the present study was undertaken, the influence of the adoption of this innovation on competitiveness of the KTDA tea firms was largely unknown.

Adoption of Technological Innovation by the Kenya Tea Development Agency

Tea was commercialized in Kenya in 1924 by the European settlers in central Kenya and was restricted to large scale production only in order to maintain the quality of tea. After independence, tea growing was made open to natives under the control of Kenya Tea Development Authority. However, it was in the year 2000 that the Kenya Tea Development Agency (KTDA) was incorporated as a private company to take over the role and functions of the erstwhile Kenya Tea Development Authority and was mandated to manage the independent tea firms in Kenya. The agency is responsible for management of tea factories, collection, processing and selling of the processed tea leaf and currently manages 65 tea firms across the

tea growing regions in the country (KTDA, 2007). Over the years KTDA has been able to transform itself into a smallholder-owned company serving as a case study for the region due to its growth and performance (Deloitte, 2014).

Demand by customers and suppliers have forced KTDA tea firms to improve their operations by adopting international standards in all its operations. Some of the standards attained by the tea firms include the Rainforest Alliance, ISO 22000 and Fair trade certifications which require firms to adapt to new technology and innovation in production as well as aiming at improving the welfare of farmers (Stathers, 2013). The international markets also stipulated that they were to buying tea by the year 2015 from firms that have attained above certifications, hence, forcing KTDA to rethink their strategies (Namu, Kaimba, Muriithi & Nkari, 2014).

The demand for a technology innovation led approach in tea production in the country also stems from local research. For instance, according to the Tea Research Foundation of Kenya, current research efforts are on-going in order to enhance the quality of tea and focus on cost effective and efficient manufacturing methodologies covering leaf withering, maceration, fermentation, and drying (Tea Research Foundation of Kenya strategic plan, 2011).The research carried out by the foundation revealed that more flavour and anti-oxidant rich teas could be produced by varying process conditions and type of raw leaf used. Technologies and innovation for enhanced throughput in tea factories will be of importance for deployment during peak crop season when a lot of farmers' produce goes to waste (Tea Research Foundation of Kenya Strategic Plan, 2011).

In August 2007, task force report by the ministry of agriculture on the tea industry in Kenya recommended introduction of new technology to curb weight falsification at the collection centres. The report proposed the introduction of automated weighing solution and low weight bags as one of the ways to address challenges faced in the tea industry especially by the small-scale farmers (Task Force, 2007). KTDA tea firms now have the CFU's and the digital weighing machines in their factories. The digital weighing solution is fitted with a weigh scale, a personal digital assistant (PDA), a portable printer and server software. The solution is expected to assure accuracy of data through automation of factory weights and buying centre weights. (Namu et al, 2014). The new facility also links all the KTDA's tea firms to the head office in Nairobi, thereby enabling farmers to electronically access information about payments due to them each month. It therefore takes under three days up from six months to register a new grower, thanks to a more-efficient recording system of the number of growers (Sambu, 2009). Nevertheless, the effect of the automatic weight based solutions on competitiveness of the KTDA tea firms has not been previously examined.

Statement of the Problem

Innovation is one of the principal drivers of competition. Of all the things that can change the rules of competition, innovation is among the most prominent (Porter et al, 2006). Despite its importance, the relationship between innovation and competition is widely misunderstood. Innovation tends to be viewed as valuable for its own sake and any technological innovation a firm can pioneer is believed to be good. In "high-technology" industries, innovation is widely perceived as being a ticket to profitability, while other industries that are considered "low-technology" innovation is viewed with disdain (Walsh & Linton, 2011). The recent success of foreign competition, much of it based on technological innovation, has encouraged companies even more to invest in innovation. However, there is little empirical evidence on the role of adopting innovation on firm competitiveness especially in the local context such as the tea industry in Kenya. For instance, since the introduction of the Automated Weight Based Solution (AWBS), its effect on competitiveness of tea processing firms is yet to be established. Therefore, the present study sought to determine the relationship between technology innovation strategy and firm competitiveness specifically focusing on the adoption of the Automated Weight Based Solution on competitive advantage to firms in the tea industry in Kenya.

Objectives of the Study

To assess the role of Automated Weight Based Solution adoption on competitiveness of the KTDA tea firms.

Hypothesis

HO_1: There is no significant relationship between adoption of automated weight based solutions and competitiveness of KTDA tea firms.

LITERATURE REVIEW

Theory of Diffusion of Innovation

Diffusion of innovations is a theory that seeks to explain how, why, and at what rate new ideas and technology spread through cultures. Everett Rogers, a professor of communication studies, popularized the theory in his book Diffusion of Innovations. Rogers (2003), argues that diffusion is the process by which an innovation is communicated through certain channels over time among the participants in a social system. The origins of the diffusion of innovations theory are varied and span multiple disciplines. Rogers (2003), further proposes that four main elements influence the spread of a new idea: the innovation itself, communication channels, time, and a

social system. This process relies heavily on human capital. Jenssen and Randoy (2006), explain that innovation must be widely adopted in order to self-sustain. The scholars further argue that within the rate of adoption, there is a point at which an innovation reaches critical mass and manifests itself in different ways in various cultures and fields and is highly subject to the type of adopters and innovation-decision process.

Rogers (2003), point out categories of adopters as follows: early adopters, early majority, late majority, and laggards. Robinson (2009), agrees with Professor Everett that communication is important during diffusion of innovation and further explains that an innovation spreads from early adopters to majority audiences hence face-to face communication therefore becomes more essential for the decision to be adopted. According to Boston (2013), the stages by which a person adopts an innovation and where diffusion is accomplished include awareness of the need for an innovation, decision to adopt or reject the innovation, initial use of the innovation to test it, and continued use of the innovation. In the current study, this theory was used to examine the appreciation of technology by the users in the tea producing firms and areas.

Technological Innovation

Technological innovations according to Burge Smani et al (2012), comprises of new products and processes and significant technological changes of products and processes. Innovation generally speaking includes both technological innovation (new technologies, products, and services) and administrative innovations (new procedures, policies and organizational forms). The goal of using technological innovation in the factory automation process is to simplify the production process, product designs and factory organization in order to provide vital foundation for automation and integration. According to (Zook, 1997), Marxist theory placed technological innovation as one of the prime movers of capitalist development and therefore a necessity for any firm that wants to be ahead in competition and also as a way of changing systems of production in order to cut on costs and increase efficiency. Burge Smani et al (2012), further points out that introduction of service and process technological innovations involves a series of scientific, technological, organizational, financial and commercial activities. Technological innovation process consists of four broad stages of problem recognition or idea generation, technology Selection, solution development and implementation (Narayanan, 2007). Technological innovation not only serves as an important competitive tool but also plays an important role in improving the firm's performance (Tidd, 2009) and may involve the use of radically new technologies, a combination of pre-existing technologies or new knowledge.

Technological innovation in firms comprises of two approaches; process innovation and product innovation.

Technology Innovation Strategy

Innovation strategy facilitates the attainment of a company's vision through alignment of its information technology strategy with its business strategy (Hill & Jones, 2009). Innovation refers to the act of creating new products or services and is classified into two; product and process innovation. Product innovation is the development of products that are new to the world or have superior attributes to those of existing products while process innovation is the development of a new process for producing and delivering them to customers. It is also the application of better solutions that meet new requirements, unarticulated needs, or existing market needs and is accomplished through more effective products, processes, services, technologies, or ideas that are readily available to markets, governments and society (Wong, 2012). All these definitions share a number of key elements that innovation concerns new ideas, exploitation of new possibilities or new processes. As innovation become increasingly a priority for established firms, managers are seeking to emulate the flexibility, creativity and entrepreneurial spirit of technology based startup firms that are consistently successful in innovation and have the ability to design organization processes that capture, direct and exploit individual's drive for achievement and success and commitment to innovations this is aimed at making their firms competitive in the market (Grant, 2010).

In order to avoid obsolesce and promote innovation, a firm must be aware of technological changes that might influence its industry. Creative technological innovations can suggest possibilities for new products, for improvements in manufacturing or marketing techniques. (Pearce, 2005), argue that a company can use innovation create a competitive advantage by creating barriers that deter entry of rivals, introducing novel products or technology processes that attract new customers, or changing the rules of competition in the industry and that high performing firms match investments in technology with strong managerial and technical skills (Meeta, 2009). Salge (2012) explains that innovation in an organization context may be linked to positive changes in efficiency, productivity, quality, competitiveness, and market share. However, recent research findings highlight the complementary role of organizational culture in enabling organizations to translate innovative activity into tangible performance improvements.

According Tidd (2009), innovation strategy must cope with the external environment which is complex and ever changing. This is because there is considerable amount of uncertainties about current or future developments in terms of technology, competitive threats

and market demands. Dehoff and Jaruzelki (2008), observed that there is only best innovative strategy for a particular firm and that success of a given innovative strategy will depend on the effort extended to align innovation with strategy and management of the entire process with discipline and transparency. This means therefore that management play a key role in ensuring the success of a given innovation strategy and without their support there is limited chances of success.

Innovation can also help business owners keep costs to a minimum. According to Thomson, Strickland and Gamble (2010), use of automation can assist a small manufacturer reduce its dependence on human beings to perform some of the necessary production processes. As a result, the business can reduce employee expenses such as salary, benefits and turnover and also help to streamline the production process. Pearce (2005), outlines that in order to avoid obsolesce and promote innovation, a firm must be aware of technological changes that might influence its industry. This is because creative technological innovations can suggest possibilities for new products, improvements in manufacturing or marketing techniques. Schacht (2006), argues that innovation has become a double-edged sword because it has enabled opportunities but has also introduced risks. Uses of innovation and technology enable firms to connect and engage with their stakeholders in new and significantly faster and cheaper ways. Meeta (2009), explains that innovation enables firms to have access to important resources without necessarily having to own them through business processes outsourcing However in the process of connecting and engaging the stakeholders, uses of innovation has introduce new interdependencies that if improperly managed can lead to costly and inefficient operations and can ultimately reduce agility and hurt performance of a firm (Priem, 2001).

Automated Weighing Based Solution

The automated weighing based solution (AWBS) is a wireless device that employs the use of blue tooth technology in facilitating communication between the tea buying center and the tea firm. It was introduced by KTDA in its tea firms in 2009 as a way of curbing cheating and corruption by unscrupulous tea clerks. The system was piloted for one year in the selected tea firms before it was rolled out to the rest of the country (Namu,et al ,2014). Manual weighing scale was what was in use before the introduction of AWBS which had many limitations and loopholes to exploit. Key among these has been the manipulation manual weighing scales to defraud farmers. So rampant had been the practice that a number of growers abandoned tea farming. The manual weighing machines required clerks at the buying centers to carry out the record keeping, which was cumbersome and often saw records lost in the high volume of paper work (CPDA, 2008).

The automated weighing based solution comprises of three devices which include a handle held computer commonly known as portable device assistant (PDA), an electronic scale and a small printer (Muruiki & Kimanthi, 2013). When a farmer places tea leaves on the electronic scale, it records weight after stabilizing and then automatically reflects on the PDA. The clerk then presses the "ACCEPT" button in order for the printer to produce a receipt which reflects on farmer's daily and cumulative eight of the tea deliveries. The transactions are the transmitted automatically to the factory database and also replicated at the KTDA headquarters. While the manual machines only recorded the whole figure and omitted the figure after the decimal, the AWBS records the precise weight, restoring to farmers substantial losses that were being incurred. This ensures that only valid growers can deliver green leaf at buying centers. Growers' information is stored on the PDA and is loaded every morning to ensure that newly registered or transferred growers are included (TBK, 2012).

A study by Kagjobola (2004), revealed that firms that adopt the use of information communication technology (ICT)has contributed significantly to closing communication gaps as users and suppliers can now communicate more easily and faster. Placing orders or sourcing for raw materials becomes an easy task as well as effective use of time. This argument emphasizes the need for firms to invest in innovation so as to remain competitive in the market and that innovation in an organization context may be linked to positive changes in efficiency, productivity, quality, competitiveness and market share (Salge, 2012).

Conceptual Framework

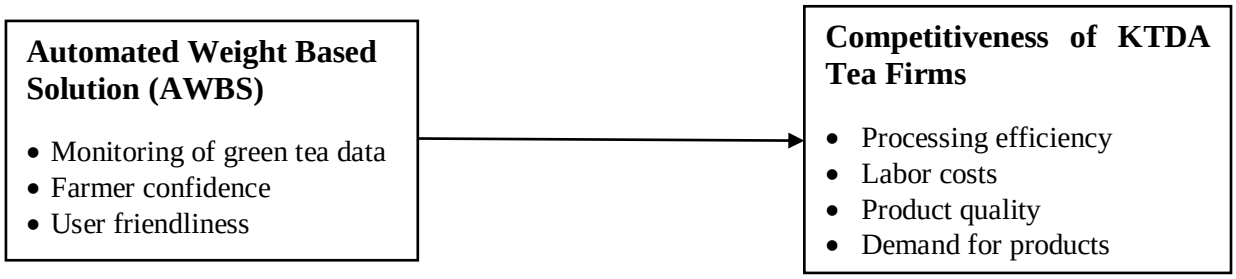

Figure 1: Conceptual Framework

RESEARCH METHODOLOGY

Research Design

This study adopted descriptive survey which determines and reports the way things are and commonly involves assessing attitudes and opinions towards individuals, organization and procedures (Orodho, 2003). The design was suitable for this study because there was need to collect large amount of data over a wide area and that could be generalized.

Target Population

This study was carried out in Region 5 of KTDA management area with particular focus on firms located in Bomet and Kericho counties, Kenya. There are 12 tea firms in the Region 5 under the management of KTDA. Cumulatively, the firms have 12 factory unit managers, 24 production managers, 36 supervisors, 36 store clerks and 96 leaf collection clerks. The study, therefore, targeted the factory unit managers, production managers, supervisors, store clerks and the leaf collection clerks since they were handling the technologies and reports on a day to day basis and were, therefore, in a position to supply the study with the information being sought. The distribution of the target population is shown in Table 1.

Table 1: Target Population

Population	Total Population	Percentage of population
Factory Unit Managers	12	6
Production Managers	12	6
Supervisors	36	19
Leaf collection clerks	96	50
Store clerk	36	19
Total	**192**	**100**

Sampling Design

Sample Size Determination

The overall population under consideration in this study comprised of 192 respondents from KTDA tea firms. This population was large enough to warrant the use of probability sampling techniques. For such sample sizes, the formula below by Yamane (1967) was used in determining the sample size from a definite population suffices under;

$$n = \frac{N}{1 + Ne^2}$$

Where,

n = sample size, N= population size e = error of sampling. Substituting into the formula;

$$n = \frac{192}{1 + 192 * 0.05^2}$$

n = 129.7297

Hence the sample size,

***n*≈ 130**

Sampling Technique

Stratified random sampling technique was used to select respondents by placing them into 4 strata in order to maximize survey precision given the sample size. The employees were categorized into five strata according to their levels: Factory Unit Manager (FUM), Production Manager (PM), Supervisor, stores clerks and leaf collection Clerk out of which 130 respondents were selected to participate in the study.

Instrumentation

The study used copies of questionnaires designed by the researcher to gather relevant data for the study. The questionnaire was the structured type containing only closed ended items. The selection of this tool was guided by the nature of data to be collected, time available and the objectives of the study. This enabled the researcher to reduce both researcher and respondent biases.

The study adopted content validity approach to determine whether the test items represented the content that the test was designed to measure (Mugenda & Mugenda, 2003). In order to ensure that all the items used in the questionnaires are consistent and valid, the instruments were subjected to scrutiny and review by the researcher's supervisors at Kabarak University. The items were rephrased and modified where necessary to avoid ambiguity before being used for data collection.

Pilot Test

This study used questionnaires after pilot testing them for correctness and accuracy on 15 non-participatory respondent samples. Piloting of the questionnaires was done in two tea processing firms in Kisii County which had similar demographic patterns. The purpose of the pilot test was to test face validity of the instrument (Mugenda & Mugenda, 2003). The results of the pilot test were used to assess the usability of the questionnaires for the study purposed.

The researcher used the internal consistency method to check the reliability of the research instruments. This was done by computing the Cronbach's alpha coefficient for the questionnaire from the results of the pilot study. The study established an instrument Cronbach Reliability Coefficient of 0.8801 which was high enough and acceptable for the study. According to Cronbach and Azuma (1962), a value of 0.7 or above of the Cronbach's alpha coefficient shows high internal consistency and is, therefore, acceptable for most studies. Subsequently, modifications, additional questions and any shortcomings that were found in the questionnaire items were duly corrected at this stage.

Data Analysis and Presentation

Data was analyzed using both descriptive and inferential statistical methods. According to Freund (2001), the major objective of any statistical investigation is to establish relationship which makes it possible to predict one or more variables in terms of the other variables. Descriptive data allows the researcher to meaningful describe many scores using a small number of indices using frequency, mode and percentages. Inferential statistics involved the use of bivariate regression to determine the nature of the relationship between the variables. The bivariate regression model was estimated to hold under the relation;

$$y_{ij} = b_0 + b_1 x_1 + e$$

Where;

y = Competitiveness of KTDA Tea Firms

b_0 = Regression Constant

X_1 = Automated Weight Based Solution

b_1 is the coefficient of the variable determined by the model

e = the estimated error of the regression model

The results were then presented in APA tables for ease of understanding of the results

RESULTS AND DISCUSSION

Response Rate

The study administered 130 questionnaires and was able to retrieve 105 completed questionnaires representing a 81% instrument response rate. This was acceptable according to the recommendations of Mugenda and Mugenda (2003). The questionnaire response rate resulted from the self-administered method of administration of the instrument. The other questionnaires were either not returned or found to be unusable for the study; hence, they were excluded for data analysis.

Use of Automated Weight Based Solution and Competitiveness of KTDA Tea Firms

The study also sought to examine the influence of automated weight based solution (AWBS) on the competitiveness of the KTDA tea firms. The empirical findings are presented in the Table 2.

Table 2: Automated Weight Based Solution and Competitiveness of KTDA Tea Firms

Statement	SA Freq(%)	A Freq(%)	N Freq(%)	D Freq(%)	SD Freq(%)	χ2	P-value
Since the introduction of the automated weighing based solution our firm has been able to precisely monitor the procurement of raw tea	7(25)	12(43)	0	7(24)	2(8)	26.82	0.001
The automated weighing based solution has considerably reduced fraudulent practices in tea procurement from farmers	19(32)	14(49)	0	3(12)	2(7)	19.29	0.001
The use of the automated weighing based solution has virtually eliminated brokers	8(29)	11(40)	3(13)	3(12)	2(7)	101.1	0.001
The use of the automated weighing based solution has increased farmer confidence in our organization	3(10)	10(37)	5(17)	8(29)	2(7)	75.03	0.001
Through the automated weighing based solution, farmers can estimate their harvest leading to fewer post-harvest losses	5(18)	10(34)	4(16)	6(20)	3(12)	94.18	0.001
The automated weighing based solution has enabled our firm to accurately forecast volumes of raw tea from the farmers	12(9)	59(48)	10(8)	26(21)	15(12)	53.73	0.001
Automated weighing based solution is user friendly	11(9)	53(43)	18(15)	22(18)	18(15)	46.36	0.0001
Regular training is required to use automated weighing based solution.	9(7)	46(38)	16(13)	36(30)	15(12)	72.23	0.0001
There was no resistance in adopting the use of automated weighing based solution	23(19)	23(19)	8(7)	47(39)	21(17)	99.24	0.001

The findings in Table 2 suggest that most respondents agreed $(43\%, \chi^2 = 26.8, P \leq 0.001)$ that the introduction of the automated weighing based solution had enabled the firms to precisely monitor the procurement of raw tea. Most of the respondents also agreed

$(49\%, \chi^2 = 19.3, \leq 0.001)$ that the introduction of the automated weighing based solution had considerably reduced fraudulent practices in tea procurement from farmers. Majority of the respondents also agreed $(40\%, \chi^2 = 101.1, P \leq 0.001)$ that the use of the automated weighing based solution has virtually eliminated brokers. As a result, the use of the automated weighing based solution has increased farmer confidence in most firms as indicated by majority of the respondents who agreed $(37\%, \chi^2 = 75.03, P \leq 0.001)$ with this statement. Further, most respondents agreed $(34\%, \chi^2 = 94.18, P \leq 0.001)$ that through the system, farmers could reliably estimate their harvest leading to fewer post-harvest losses. The respondents also agreed $(48\%, \chi^2 = 53.7, \leq 0.001)$ that tea processing firms could also accurately forecast volumes of raw tea from the farmers using the system. Most of the respondents were also of the agreement $(43\%, \chi^2 = 46.36, \leq 0.001)$ that automated weighing based solution was user friendly though it still required regular training $(38\%, \chi^2 = 72.23, P \leq 0.001)$. However, it emerged that there was considerable resistance in adopting the use of automated weighing based solution as indicated by most respondents who agreed $(39\%, \chi^2 = 99.24, P \leq 0.001)$ probably owing to the disruption of the broker networks and instead creating a vertical integration in the sourcing of the raw material.

Looking at these findings, it is evident that despite the perceived benefits of using the AWBS, there was considerable resistance to the innovation. This suggests that the AWBS could have considerable impact on the competitiveness on the firms as it could give the farmers more confidence to trade with them. This will ensure that there will be constant supply of the raw materials. This finding is in line with the Tidd (2009) who explained that innovation strategy must cope with the external environment which is complex and ever changing. This is because there is considerable amount of uncertainties about current or future developments in terms of technology, competitive threats and market demands.

Competitiveness of KTDA Tea Firms

It was also necessary to establish the status of Competitiveness of KTDA Tea Firms. This was the dependent variable and was determined by posing several statements related to the levels of competitiveness of the tea firms. The findings are presented in Table 3.

Table 3: Competitiveness of KTDA Tea Firms

Statement	SA Freq(%)	A Freq(%)	N Freq(%)	D Freq(%)	SD Freq(%)	χ2	P-value
Spillage of green leaf has reduced	14(16)	27(31)	13(15)	23(26)	11(13)	38.45	0.000
Capacity for tea handling has increased	18(21)	29(33)	11(13)	18(21)	12(14)	48.71	0.000
Processing time of green leaf has reduced	22(25)	25(28)	10(11)	20(23)	11(13)	48.12	0.000
Labour cost has reduced	16(18)	28(32)	12(14)	23(26)	9(10)	64.67	0.000
Hygiene has improved during fermentation process	25(28)	29(33)	11(13)	13(15)	10(11)	84.15	0.000
Tea of high quality is being produced	21(24)	32(36)	5(6)	17(19)	13(15)	56.24	0.000
Consistency during fermentation has been enhanced	12(14)	28(32)	15(17)	21(24)	12(14)	111.75	0.000
Loss of green leaf (kgs) has reduced	17(19)	26(30)	9(10)	20(23)	16(18)	78.77	0.000
We are able to satisfy market demands in a timely manner	14(16)	30(34)	13(18)	16(18)	15(17)	85.21	0.000
Our firm has been able to cut procurement losses	19(22)	37(42)	4(5)	19(22)	9(10)	86.36	0.000
Our supply chains are stable due to increased confidence with our partners	16(18)	27(31)	11(13)	20(23)	14(16)	95.38	0.000
Our tea fetches good prices both domestically and internationally	18(21)	26(30)	10(11)	22(25)	12(14)	108.42	0.000
Some of the importers have switched to our tea due to our increased quality and ability to meet demands on short notice	23(19)	47(39)	8(7)	23(19)	21(17)	91.56	0.000
We have also been able to improve our internal efficiencies due to automation	13(12)	52(48)	10(10)	32(30)	0	46.36	0.000

The results in Table 3 indicate that as a result of adopting the technological innovations in the firms, the spillage of green leaf had reduced as indicated by most respondents who agreed $(31\%, \chi^2 = 38.45, \leq 0.001)$ and, similarly most respondents agreed $(33\%, \chi^2 = 48.71, \leq 0.001)$

that the capacity for tea handling has increased. At the same time the processing time of green leaf had reduced as indicate by most respondents $(28\%, \chi^2 = 48.12, \leq 0.001)$ and, similarly, the labor costs has reduced in most of the firms as suggested by most respondents who agreed $(32\%, \chi^2 = 64.67, \leq 0.001)$. The findings also suggest that most of the respondents agreed $(33\%, \chi^2 = 84.15, \leq 0.001)$ that hygiene has improved and consistency enhanced during fermentation process $(32\%, \chi^2 = 111.75, \leq 0.001)$ leading to the production of high quality tea as indicated by most respondents $(36\%, \chi^2 = 56.24, \leq 0.001)$. Further, the firms were able to satisfy the market demand in a timely manner $(34\%, \chi^2 = 78.77, \leq 0.001)$. The firms were also able to cut procurement losses as indicated by most respondents $(42\%, \chi^2 = 85.21, \leq 0.001)$ and stabilize their supply chains according to majority of the respondents $(31\%, \chi^2 = 95.38, \leq 0.001)$. According to most respondents $(30\%, \chi^2 = 108.42, \leq 0.001)$, the tea was also able to fetch competitive prices both in the domestic and international market. A growing number of importers had also switched to Kenyan tea produced in the KTDA firms owing to their quality and ability to meet the market demands as indicated by majority of the respondents $(39\%, \chi^2 = 91.56, \leq 0.001)$. Majority of the respondents also agreed $(48\%, \chi^2 = 46.36, \leq 0.001)$ that the firms had also been able to improve their internal efficiencies.

These findings suggest that despite the challenges of adopting the innovative technologies, there was some improvement in terms of competitiveness of the tea processing firms. The findings, further, agree with Ochieng and Ongonga, (2013) who found that innovative strategies adopted by multinational tea firms in Kericho resulted into increased revenues, high productivity levels and reduced costs. According to Riley (2012), constant threat from foreign competition, it is important for firms to strive to improve their competitiveness by incorporating latest technology and innovation into their operations in order to increase their international competitiveness.

Regression Analysis

Correlation analysis was carried out to determine both the significance and degree of association of the variables. The results of the correlation analysis are summarized in the Table 4.

Table 4: Bivariate linear regression analysis model summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.478	0.22848	0.20792	3.5101

a. Predictors: (Constant), Automated weight based solution

Looking at the results in Table 4 show that the model correlation coefficient r = 0.478 was higher than any zero order value in the table. This suggested that the model could improve when more variables were incorporated into it when analyzing the role of the adoption of innovation on the competitiveness of KTDA tea firms in Kenya. The coefficient of determination, that is, the adjusted r square = 0.2079, also indicates that the all the independent variables combined in the model could explain for approximately 20.8% of the variations in the competitiveness of KTDA tea firms in Kenya when technology innovation strategies are considered.

Table 5: Summary of ANOVA results

	Sum of Squares	Df	Mean Square	F	Sig.
Regression	110.327	1	110.327	20.4681	.000[b]
Residual	544.41	101	5.3902		
Total	654.737	104			

a. Dependent Variable: Competitiveness of KTDA Tea Firms
b. Predictors: (Constant), Automated Weight Based Solution

The results of ANOVA performed on the independent and dependent variables (Table 5) indicate that there was a significant difference between means of the Automated Weight Based Solution and the competitiveness of KTDA tea firms in Kenya (F_o = 20.4681> F_c = 3.94; α < 0.05; df = 1, 101; $p < 0.05$). This finding confirms the finding suggested by regression model in Table 4. In order to find out which was the most significant innovation on the competitiveness of KTDA tea firms in Kenya, the beta value was used. The results are given in Table 6.

Table 6: Summary of Multiple Regression Analysis

	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	VIF
	B	Std. Error	Beta			
(Constant)	20.239	4.482		4.516	0.001	
Automated Weight Based Solution	0.478	0.199	0.383	2.402	0.001	2.016

a. Dependent Variable: Competitiveness of KTDA Tea Firms

Looking at the results in Table 6, it is evident that the Automated Weight Based Solution (β = 0.383, p < 0.05)suggesting that the dependent variable would change by a corresponding number of standard deviations when the independent variable changed by one standard deviation. Therefore, the resulting linear regression model is:

Competitiveness of KTDA Tea Firms = 20.239 +.478Automated Weight Based Solution

The finding shows that there was a moderate relationship between the two variables implying that the competitiveness of the tea processing firms could be further enhanced when more emphasis was put on the adoption of the AWBS. This finding concurs with Salge (2012) who found that innovations such as the AWBS contributed significantly to the firm's competitive advantage. Specifically, placing orders or sourcing for raw materials becomes an easy task as well as effective use of time.

Hypothesis Testing

Based on these findings the hypotheses of the study can be tested. The hypothesis of the study was:

HO_1: there is no significant relationship between the use of Automated Weight Based Solutions on the Competitiveness of KTDA Tea Firms

According to the results in the multiple regression model in Table 5, Automated Weight Based Solutions significantly influenced the Competitiveness of KTDA Tea Firms ($\beta_2 =$ 0.127, p < 0.05). Consequently, the null hypothesis H02 was rejected. These findings indicate that the use of the AWBS machines resulted in firm competitiveness. These findings are consistent with those of Namu et al., (2014) who observed that the use of the previous manual weighing scale had many limitations and loopholes to exploit and resulted in the manipulation manual weighing scales to defraud farmers. As such, the farmers' confidence was lowered and this affected their consistency in production. According to CPDA (2008), so rampant had been the practice that a number of growers abandoned tea farming.

CONCLUSIONS

The preceding findings have revealed very important aspects of the introduction of the automated weighing based solution on the competitiveness of the tea processing firms. First, the introduction of the automated weighing based solution had enabled the firms to precisely monitor the procurement of raw tea. Second, the introduction of the automated weighing based solution had significantly reduced fraudulent practices in tea procurement from farmers by virtually eliminated brokers leading to increased farmer confidence in the firms. Understandably,

the farmers could now reliably estimate their harvest leading to fewer post-harvest losses. Third, the AWBS had considerably improved the internal processes of the tea processing firms. The firms could now accurately forecast volumes of raw tea from the farmers using the system. However, it emerged that there was considerable resistance in adopting the use of automated weighing based solution probably owing to the disruption of the broker networks and instead creating a vertical integration in the sourcing of the raw material. Additional findings suggested that the use of AWBS significantly influenced the competitiveness of the KTDA tea firms. The study, further, shows how technologies like AWBS can influence the social system - in this case the farmers whose role in the value chain and eventual competitiveness in the tea industry is important and needs to be safeguarded - in line with the Diffusion of Innovations Theory advanced by Rogers (2003). Therefore, the study concludes that the use of the Automated Weight Based Solution was important to the competitiveness of the KTDA tea firms and could not be overlooked.

RECOMMENDATIONS

i. The study, therefore, recommends that there is need for tea processing firms to invest in the Automated Weight Based Solution so as to remain competitive in the market. Other agro-processing firms in the country could also invest in this technology to make them competitive.
ii. The study also recommends that the tea processing firms need to sensitize farmers more on the use of the automated weighing based solution so as to increase farmer confidence in our organization.
iii. The government should also provide incentives to increase the usage of the AWBS so to improve competitiveness of the tea sector which is an important forex earner to the country. The farmers at the lower end of the value chain will also find more incentive to produce tea.

SCOPE FOR FURTHER RESEARCH

The study covered the areas in the main objective which were not exhaustive in assessing the adoption of innovation on the competitiveness of KTDA tea firms in Kenya. Therefore, more studies could be instrumental in augmenting the outcome of this study and expanding its scope. Hence, it is recommended that future studies be done on the adoption of other innovations such as the effects of e-human resource information systems on the competitiveness of KTDA tea firms in Kenya.

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