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Testing the relationship between constraints management and capacity utilization of tea processing firms: Evidence from Kenya

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Abstract

Despite having one of the many studies in constraints management and capacity utilization, there is dearth of the same in the tea processing firms. The purpose of this study was to link constraints management to capacity utilization of tea processing firms by focusing on a Kenyan developing economy. Specifically the study determines the relationship between constraints management and capacity utilization of tea processing firms in Kenya. A multiple linear regression and correlation models were performed on a sample that included 84 firms operating in the Kenyan tea industry for the period 2008–2012. The study established that the relationship between constraints management and the firm's capacity utilization is significant and positive.

Keywords: Constraints management; Capacity utilization; Tea processing; Kenya

1. Introduction

The business environment in which most of the firms operate in is characterized by the cut-throat competition due to globalization. The management of these organizations is working round the clock to make sure that they improve the stakeholders' welfare now and in the future. The managers are faced with a myriad of challenges in their effort of trying to achieve the set goals. According to Goldratt and Cox (1992), a constraint is any element or factor that blocks the system from achieving more of what it was designed to accomplish (achieving its goal). Bhardwaj, Gupta, and Kanda (2010) in their study on fundamentals of Theory of Constraints (TOC) argued that inconsistencies between goals, measurement systems, and policies are the major problems organizations face. Goldratt (1990) argued that the TOC guides the user through the decision-making process of problem structuring, problem identification, solution building, identification of constraints to be overcome, and implementation of the solution. The TOC thinking

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processes are crucial in establishing what should be changed, what to change to, and how to carry out the change when an organization wants to introduce changes in their production system. It is also called as problem-solving methodologies. Goldratt (1990) states that it is the weakest link that limits the overall performance of an organization, and for an organization to improve its performance, it must identify the system's constraints or bottleneck.

According to Mabin and Balderstone (2003), the constraints may be equipment constraints, such as a machine with limited capacity, raw material, policy or behavioral constraints. Policy constraints arise when the environment in which the company operates in changes while the policies of the business remain unchanged. Most significantly, policy constraints are within the control of the management of the organization. Behavioral constraints are as a result of performance measures or policies that lead to that, even after policies or rules are changed, they are firmly embedded and constrain the system's performance. Gupta and Boyd (2008) argued that TOC provides a framework to assist organizations to avoid pitfalls of local optimization by ensuring that everybody and every part of the organization is involved.

According to Larson and Halldorsson (2002), supply chain management is a set of approaches that are used by organizations to efficiently integrate suppliers, warehouses, manufacturers, and stores, so that products are produced and distributed to the right locations in the right quantities, and when they are required, so as to minimize system-wide costs while satisfying service level requirements. This definition was used to guide this study given that it recognizes a supply chain management as a network that takes into consideration every facility's role and impact on cost when making the product that conform to customer requirements with a single objective of being efficient and cost-effective across the entire system which should be well integrated.

According to KNBS (2012), since 2004, the strategy for increasing processing capacity for the tea processing firms has changed from construction of new limited liability companies to processing plants, satellites factories developed by a mother plant. To date, 11 such tea processing firms have been put up and commissioned bringing the total number of processing units to 107.

The tea processing firms face many challenges in their efforts to meet their customers' expectations and make money. Most of these constraints are similar to those outlined by Abeysinghe (2013) ranging from high-cost component to workers as a result of higher wages and other social costs; high input costs like agrochemicals, machinery and fuel; low productivity in all tea growing belts; ageing of tea and expansion of uneconomical tea lands as a result of reduced replanting rate; shortage of workers; climate change; meeting energy requirements; food safety; mandatory certifications and hygiene protocols for tea production and processing to satisfy International food, worker safety requirements and environment; and to increase their share in the international market.

Many studies have been done on constraints management and capacity utilization and initiatives have been implemented in various industries from both developed and developing nations, for example, in USA (Anderson, Morrice, & Lundeen, 2005; Morin & Stevens, 2004, 2005), in UK (Evans & Naim, 1994), in Nigeria (Mojekwu & Iwuji, 2012) and in India (Tulasi & Rao, 2012); yet, none have been completed in the Kenya tea processing chains context. The Kenyan tea industry is ranked as one of the Africa's and world top producers of black tea (**KNBS, 2012**) and contributes significantly to the economy of the nation ("www.teaboard.or.ke," n.d.). This, therefore, makes Kenya's tea farming not just important to the Kenyan economy but also to the world's tea production. Kenya's tea industry is among the country's leading foreign exchange earner and contributes to about 20% of the Kenya's total export earnings, about 4% of the Gross Domestic Product (GDP) and 8% of the total employment. This significant production and export contributes greatly to Kenya's economy. To gain higher economic benefits from the tea industry, there is the need to understand the relationship between constraints management and capacity. To do this, one of the most promising approaches will be to investigate the relationship between constraints management and capacity utilization in relation to sustainability development in the Kenyan tea industry. For this reason, the primary motivation behind this study is to satisfy the need for the investigation of the relationship between constraints management and capacity utilization in relation to sustainability development in the Kenyan tea industry. This investigation will set the foundation for future constraints management and capacity utilization research in the tea industry and provide managers and researchers with a better understanding of the different sustainable operational factors and specific management interventions that will enhance the value chain performance of Kenyan tea industry in particular and general tea industry.

The rest of the paper will be organized as follows: Section 2 will be theoretical background and literature review, Section 3 will be conceptual model and hypothesis, Section 4 will be on research methodology, Section 5 will be

research results, Section 6 will be discussion of the findings and Section 7 will be on conclusion, implications and future research.

2. Theoretical background and literature review

Many managers have tried to address the various challenges that affect their organizations' operations. Some of the problems are the unavailability of skilled personnel, the high cost of production, low capacity utilization, and epileptic electricity supply. It is better to identify a bottleneck by interviewing operators than higher level managers because the senior managers will not have an understanding of the real challenges their organizations are undergoing. Constraints are easy to locate when they are physical, but when they are invisible such as training, policies, and measurement, it becomes harder to identify them. These constraints can cause a person to undertake an action that may end up being costly to the organization (Kendall, 1997).

In managing a bottleneck, management can use both the short-term and long-term capacity expansions. The short-term capacity options during the peak periods include temporary employment, temporarily outsourcing, part-time employees, seasonal employees, and many more. The managers are supposed to find alternatives for improving the effective capacity utilization at the bottlenecks, without incurring higher expenses and inferior customer service. When fully implemented, TOC is an effective management philosophy that results in positive, observable outcomes like increased throughput, reduced inventory levels and reduced operation expenses, which in turn are related to improved performance of the organization. Firms considering TOC implementation can feel some degree of confidence that worthwhile improvements can and should be realized as a result of implementation (Inman, Sale, & Green, 2009; Tulasi & Rao, 2012). TOC views bottlenecks as positive because they determine the level of performance of the entire system hence the sequential elevation of the system's constraints will improve its performance (Frazier & Reyes, 2000).

Sanjika (2010) posits that in an attempt to improve overall performance in an organization, the approach of TOC should be employed to deal with complex issues that make it difficult to do the implementation. Capacity is the volume of output per unit of time that the stock of plant and equipment can produce (Corrado & Mattey, 1997; Kirkley, Paul & Squires, 2002; Leeuw, 1962). Leeuw (1962) argued that capacity is used as an indicator of short-run cost conditions and affects economic developments at points where short-run costs influence decisions. According to Leeuw (1962) capacity utilization determines the level of prices and contributes to returns to and efficiencies of various outputs. Capacity measures a point at which the cost of producing an additional unit of output is well above the average value in the most efficient output range. Smith-Daniels and Schweikhart (1988) argued that the management of capacity involves decisions concerning the acquisition and allocation of workforce, equipment, and facilities. These decisions place equipment constraints on the quantity of services that can be delivered and the flexibility of the delivery system to significantly change the service mix in response to shifts in demand. According to Gupta and Boyd (2008), managing the organizations constraints will lead to better utilization of the available capacity in the organization and hence result in improvement in the overall performance.

According to Christiano (1981) capacity utilization is a measure of the intensity with which the national economy i.e. sector or firm makes use of its resources. Christiano (1981) argued that capacity utilization falls into two categories: those that are concerned with a degree of utilization of capital only (capital utilization) and those that are concerned with the extent of utilization of all resources including capital. Christiano (1981) continued to argue that there are two approaches to measuring capacity utilization: to infer from available data and to ask businesses what their capacity is.

The need for value addition in tea production has become important than before to provide the consumers globally with pure Kenyan branded teas, blended at the source. Kenya exports value-added teas as tea in small packets and bags; and also herbal tea, green tea and flavored tea instead of black tea. Although the volume of Kenya's value added tea sales has been on the rise, there is need to increase sales through product diversification, improving the profitability, and providing employment opportunities for Kenyans doing value addition and lastly attain the goal of industrialization as envisioned in the Vision 2030 (KNBS, 2010). This study focused on the internal supply chain value-added production about constraints management and capacity utilization. As a result, the primary knowledge contributions from this research stem from the concurrent treatment, in the same study, of an expanded range of constraints management and capacity utilization within a crucial sector in Kenya's economy.

Constraints force management to think differently and be more innovative and achieve more with fewer resources. Managing constraints requires inter-functional co-operation in organizations as it requires making appropriate capacity decisions at both the individual process level and the organizational level. Elevating a bottleneck in one section of an organization might not have a substantial effect unless bottlenecks in other parts of the organization are also addressed. The constraints determine the level of output of the system whether acknowledged and managed or not; so management should be so conscious of such bottlenecks in the organization if they are to achieve the objective of making money now and in the future. Once an obstacle has been eliminated, the system needs to be reassessed to confirm that the constraint has not relocated to another link in the system (Cyplik, Hadaś, & Domański, 2009).

Consequently, the study sought to determine the relationship between constraints management and capacity utilization of tea processing firms in Kenya by inferring available data and asking the practitioners. The study addressed the following research question: does constraints management affect capacity utilization of tea processing firms in Kenya?

3. Conceptual model and hypothesis

From the literature review, Fig. 1 is emphasizing the interconnection between constraints management and capacity utilization in one comprehensive framework that aided the researchers in developing an understanding of the linkages between the two variables. It is hypothesized that constraints such as equipment constraints, People Constraints, and policy constraints influence capacity utilization in the tea processing firms. If bottlenecks in an organization are properly managed, the capacity utilization rate will increase. Capacity utilization was measured in terms of the design capacity and actual output that is an economic measure of the capacity utilization. The policy of the government regarding capacity utilization can hinder or enhance the level of capacity utilized in any organization.

Based on the study objective and literature review, the following hypothesis was tested:

H_1. There is a relationship between constraints management and capacity utilization of tea processing firms in Kenya.

4. Methodology of research

4.1. Research design

This study was guided by a positivistic philosophical approach that assumes that the reality is objectively given and is measurable (Buttery & Buttery, 1991; Stiles, 2003). This study adopted a cross-sectional survey design.

Random stratified sampling was used to obtain respondents from the tea processing firms who were conversant with the study variables. In each stratum, proportionate sampling was applied to select respondents who were the firm Accountants, Production Managers, and Environmental representatives. The unit of analysis was the individual tea processing firm. The sampling frame represents all the tea processing firms in Kenya, which was obtained from the Tea Board of Kenya (see Appendix B). This source provided a sampling frame of one hundred and seven (107) registered tea processing firms in Kenya by May 2013 ("www.teaboard.or.ke," n.d.). The sample size was obtained

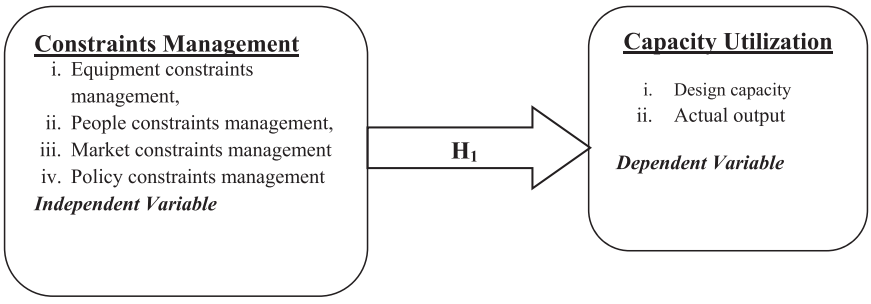

Fig. 1. : Conceptual framework.

using Cochran's (1963) formula that gave a sample of 84 respondents.

$$n = \frac{t^{2*}p(1-p)}{m^2} \tag{1}$$

where n is the required sample size, t is the confidence level of 95% (standard value of 1.96), p is the estimated percentage prevalence of the population of interest – 50% was preferred and m is the margin of error at 5%.

4.2. Data collection

Data was collected from both primary and secondary sources. Primary data entailed responses on all the study variables: constraints management and capacity utilization. Secondary data for five-year on firm performance was sourced from annual company reports, policy papers, pamphlets, circulars, office manuals, corporate and survey reports from Kenya Central Bureau of Statistics and Kenya Tea Board for the years 2008–2012. This was because the normal planning cycle at a strategic level is five years and in 2008, Kenya adopted the vision 2030 as a new blue blueprint for Kenya's economic development. A self-administered questionnaire and data forms were the primary tools for collecting primary data and secondary data respectively (see Appendix A). Prior to data collection, a pilot study was done to ensure that the items in the questionnaire were clear and had the same meaning to all the respondents. During piloting, a total of ten (10) questionnaires were administered to those tea processing firms that were not included in the sample to avoid data contamination. All the ten questionnaires were received, and only eight were found to be usable.

The questionnaires were distributed using the drop and pick method. A research permit and letter of introduction accompanied the questionnaires explaining the purpose of the study and assuring of confidentiality among the respondents. The response rate in this study was improved by sending reminders to the respondents through short messages or making phone calls. Data was collected between January 2014 and May 2014.

4.3. Data analysis

Information required for testing the study hypotheses was generated using quantitative data analytical techniques. Data analysis followed four-step process for data analysis that is "getting data ready for analysis, getting a feel for the data, testing the goodness for the data, and testing the hypotheses" (Umma, 2006).

The Descriptive statistics and measures of dispersion especially variance, standard deviation and range were used to explore the underlying features of the data. A multiple linear regression model was used to study the relationships among the study variables. Multiple regression analysis was conducted on the data. The multiple regression model was tested for multicollinearity.

To establish the relationship between constraints management and capacity utilization of tea processing firms in Kenya, Eq. (2) was modeled as follows:

$$CPPF_{Index} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \epsilon_i \tag{2}$$

where $\boldsymbol{CPPF}_{Index}$ is the capacity utilization index in processing (firm) constrained and is a linear function of x_1, x_2, x_3, and x_4 plus ε_i; β_0 is the regression constant or intercept; x_{1-p} are independent variables (four constraints); β_{1-p} are the regression coefficients/ change induced in $CPPF$ by each x; and ε_i is the error term.

The capacity utilization for each firm was computed from the actual capacity used and design capacity for each of the five years using the following equation:

$$CPMF_t = \frac{Actual\ \ Output}{Design\ \ Capacity} \tag{3}$$

where ***CPMF*** is the capacity utilization for each firm, ***Actual output*** is the rate of production achieved which cannot exceed the effective capacity, ***Design capacity*** is the maximum output rate or service capacity an operation, process, or facility is intended for and ***t*** *is* the year: five-year (2008–2012) planning period that is a common characteristic of organizations.

Design capacity is the maximum output the technical designers had in mind when the operation was commissioned. In real life situation, it is not easy to achieve design capacity due to planned and unplanned

stoppages. The planned stoppages include setup, no work scheduled, preventive maintenance, shift change times, quality sampling checks, etc. The unplanned stoppages include quality failure investigation, equipment breakdown, labor shortages, material stock outs and waiting for materials (Mojekwu & Iwuji, 2012).

Capacity utilization is one of the most strategic variables in the Wharton model and shows up in several places. In the fundamental equation for the price formation – the manufacturing deflator, a non-linear transformation of capacity is one of the most significant variables:

$$CPPF_t = \log \frac{1}{1\ CPMF} \tag{4}$$

where t is the year, and the five-year planning period is a common characteristic of organizations. The focus here is the years 2008–2012; ***CPPF*** is the capacity utilization in processing (firm) estimated to lie between 0.87 and 0.99. In this non-linear transformation, stronger upward pressure on prices develops as CPPF comes closer to its limiting value, 0.99.

The capacity utilization constrained index (*CPPF*) for each firm for five years based on *CPPF* from Eq. (4) is shown in Eq. (5) below.

$$CPPF_{Index} = CPPF_{Year\ 1} + CPPF_{Year\ 2} + CPPF_{Year\ 3} + CPPF_{Year\ 4} + CPPF_{Year\ 5} \tag{5}$$

where $\boldsymbol{CPPF}_{Index}$ is the capacity utilization index in processing (firm) constrained; $\boldsymbol{CPPF}_{\boldsymbol{Year\ t}}$ is the composite capacity utilization index for each firm determined for each of the five years.

Correlation analysis was carried out to determine the extent to which constraints management influences capacity utilization in the tea processing firms. Although the study had set out a confidence level at 95% (standard value of 1.96) in the determination of its sample size, based on the guidelines of Kerlinger (1999) the reporting of all results was done at 0.05, 0.01 and 0.001.

5. Research results

Capacity utilization is a measure of the firm's productive capacity that determines the amount of output that could be produced in a given period. The tea processing companies provided the level of design capacity at factory level and the actual output for a five-year period and it was used to compute capacity utilization as the percentage of the firm's total likely production capacity that is actually utilized as shown in Table 1 .

The design capacity and actual output provided in Table 1 are a composite of the design capacities and actual output from all the firms from the sample. Then as per the model Eq. (3) in the research methodology, the capacity utilization for each year was computed as *Composite Capacity Utilization=Actual output/Design capacity.* Fig. 2 shows the trend in capacity utilization for the five-year period (2008–2012).

From the trend in Fig. 2, the capacity utilization level was equal to the level of actual output. This was expected given that the level of output depends on the level of capacity utilization for any manufacturing entity. It therefore, follows that a firm should be most efficient if its level of the output matches the capacity utilization level without waste although there might be some constraints. Also from the research data, there was no firm that operated at capacity level at or greater than 100%, hence there was no need of using the log function (in Section 4 Eqs. (4) and (5)) in reducing the capacity utilization back to less than 100%. Also from the trend above, there was a steady growth in capacity utilization from 2008 to 2011, but there was a decline in the year 2011/2012.

Table 1
Composite capacity utilization.
Source: Research Data, 2014.

Year	2008	2009	2010	2011	2012
Composite factory design capacity available	537,077,695	559,195,695	568,011,795	503,008,896	542,528,898
Composite factory actual level of output	247,896,471	313,137,423	380,665,655	341,202,670	343,682,614
Composite capacity utilization	46.156538	55.997824	67.01721	67.832333	63.348259

5.1. Correlation analysis on the relationship between constraints management and capacity utilization

The results of the correlation analysis between constraints management and capacity utilization of tea processing firms in Kenya are presented in Table 2. The significance values of the variables at the $p < 0.01$ level (**) and $p < 0.05$ level (*) level of correlation significance were extracted and presented in Table 2. There is a positive significant relationship observed between constraints management ($r = 0.322$, $p < 0.05$) and capacity utilization.

Since the four measures of operations constraint management (the independent variable) are not highly correlated with each other (two tail inter-item correlation coefficient is $1 \leq$), there is no problem of Multicollinearity. Hence, all the four indicators of the independent variable (operations constraint management) can be used to estimate the relationship between Operations Constraint Management and Capacity Utilization.

The two constraints that are correlated with firm capacity utilization are equipment constraints and market constraints. This means the shortage in working tools and equipment to support operations, and another external marketplace can constrain the throughput that affects the capacity utilization level.

People constraints and policy constraints are not correlated to firm capacity utilization. This means allowing the firm's equipment running to lower the manufacturing cost per piece alongside strict adherence to required or recommended ways of working are not significantly correlated to firm capacity utilization. The details are shown in Table 2. These results in Table 2 indicate that both equipment constraints and market constraints are highly related to the capacity utilization of tea processing firms in Kenya.

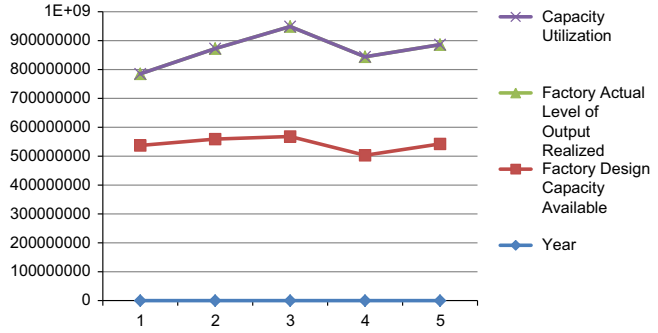

Fig. 2. Composite Capacity Utilization.
Source: Research Data, 2014

Table 2
Correlation between Constraints Management and Capacity Utilization.
Source: Research Data, 2014.

Variables	**Pearson Correlation Coefficient**				
	Capacity Utilization	Market Constraints	People Constraints	Policy Constraints	Equipment Constraints
Capacity utilization	1				
The external marketplace is constraining the throughput (Market Constraints)	0.308*	1			
Allowing the firm's equipment running to lower the manufacturing cost per piece (People Constraints)	0.280	0.733**	1		
Strict adherence to required or recommended ways of working (Policy Constraints)	0.108	0.716**	0.540**	1	
The firms face shortage in working tools and equipment to support its operations (equipment constraints)	0.322*	0.676**	0.586**	0.581**	1

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

5.2. Hypothesis testing on the relationship between constraints management and capacity utilization

The study aimed at determining the relationship between constraints management and capacity utilization of tea processing firms in Kenya. The literature review and theoretical reasoning led to the belief that market constraints, people constraints, policy constraints and equipment constraints as forms of constraints are associated with capacity utilization. Hence, the hypothesis that there is a relationship between constraints management and capacity utilization of tea processing firms in Kenya was tested.

The types of constraints consisted of market constraints, people constraints, policy constraints and equipment constraints. Pearson's correlation showed significant relationship between constraints management ($r=0.322$, $p<0.05$) with capacity utilization. Further analysis using multiple regression analysis generated the following regression models as presented in Table 3.

From the regression results in Table 3, multiple regression model on the relationship between constraints management and capacity utilization is significant at the set confidence interval of 95% (sign.=0.00). This model is a good predictor of the relationship between constraints management and capacity utilization. This regression model shows a very strong significant association between constraints management and capacity utilization, implying that constraints management explains 75.4% of the variance in the firm's capacity utilization level.

The coefficients of this predictive model on the relationship between constraints management and capacity utilization rate are given as in Table 4.

Multicollinearity test was conducted to determine the correlation of the explanatory variables. Multicollinearity occurs when two or more predictors in the model are correlated and provide redundant information about the response. The diagnostics variance inflation factor (VIF) and tolerance were used to test multicollinearity of the independent variables. However, there is no universal criterion for determining the minimum level of the tolerance value or VIF. Pallant (2007) and Hocking (2003) argue that a tolerance value less than 0.1 or VIF greater than ten (10) roughly indicates significant multicollinearity. Others (Midia, Sarkara & Ranaa, 2010) insist that a magnitude of model's R^2 is to be considered determining the significance of multicollinearity. While others argue that if the correlation is between two or more independent variables is higher that is R^2 is greater than 0.80, then multicollinearity problem is present (Belsley, 1991). The results of this study indicate that VIF values were much lower than the recommended cut-off of 10 (Midia et al., 2010), thus suggesting the absence of multicollinearity in the data (respective VIF values were market constraints=3.421, people constraints=2.204, policy constraints=2.100 and equipment constraints=1.943).

From the specific β coefficients for the various constraints management in Table 4, all the four constraints (equipment constraints, policy constraints, people constraints and market constraints) make contributions to the firm's level of capacity utilization. With standardized coefficients, the three types of constraints when well managed that have a significant ($p \leq 0.00$) positive effect on the firm's level of capacity utilization are market constraints management ($\beta=0.281$), people constraints management ($\beta=0.080$) and equipment constraints ($\beta=0.245$). This implies that for every unit level of capacity utilization improvements, the management of market constraints contribute to 28% while people constraints contribute to 8%. Thus, firms should invest more in controlling the marketing constraints to control the flow of their product offers to the marketplace while coordinating the people constraints.

The only constraints that have a significant ($p \leq 0.00$) negative effect on the firm's level of capacity utilization are policy constraints ($\beta=-0.275$). To establish the relationship between constraints management and capacity

Table 3
Model summary on the relationship between constraints management and capacity utilization.
Source: Research Data, 2014.

Model summary					ANOVA (*f*)		
Model	*R*	R^2	Adjusted R square	Std. error of the estimate	Mean square	*F*	Sig.
1	0.873(a)	0.762	0.754	31.24	91883.36	94.15	0.000[a]

[a]Predictors: (Constant), (Equipments Constraints), Strict adherence to required or recommended ways of working (Policy Constraints), Allowing the firm's equipment running to lower the manufacturing cost per piece (People Constraints), The external marketplace is constraining throughput (Market Constraints)

Table 4
Regression coefficients (a) for the relationship between constraints management and capacity utilization.[a]
Source: Research Data, 2014.

Regression coefficients		Unstandardized coefficients		Standardized coefficients	t	Sig.	Collinearity statistics	
		B	Std. error	β			Tolerance	VIF
1	(Constant)	−0.714	11.613		−0.061	0.951		
	The external marketplace is constraining throughput (market constraints)	4.235	4.156	0.281	1.019	0.315	0.292	3.421
	Allowing the firm's equipment running to lower the manufacturing cost per piece (people constraints)	1.171	3.232	0.080	0.362	0.719	.454	2.203
	Strict adherence to required or recommended ways of working (policy constraints)	−4.062	3.191	−0.275	−1.273	0.211	0.476	2.100
	The firms faces shortage in working tools and equipment to support its operations (equipment constraints)	3.602	3.049	0.245	1.181	0.245	0.515	1.943

[a]Dependent variable: capacity utilization.

utilization of tea processing firms in Kenya, the general Eq. (2) was modeled as follows:

$$CPPF_{Index} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \epsilon_i \quad (2)$$

The predictive model on the relationship between constraints management and capacity utilization of tea processing firms in Kenya, therefore, takes the form of

$$\begin{aligned} \textit{Capacity utilization} = {} & 0.281 \times \textit{market constraints} + 0.080 \times \textit{people constraints} - 0.275 \\ & \times \textit{policy constraints} + 0.245 \times \textit{equipment constraints} \end{aligned}$$

As shown in Tables 3 and 4, only three types of constraints (market constraints, people constraints and equipment constraints) have a strong positive effect on firm's capacity utilization level with a correlation coefficient of $R = 0.762$ (a) and adjusted $R^2 = 75.4\%$, $F = 94.15$; Sig. $= 0.000$(a). This is a clear indication that constraints management significantly predicts the firm's capacity utilization. Hence, the H_1 is accepted.

This implies that the constraints management explains 75.4% of the variance in the firm's capacity utilization. The relationship between constraints management and the company's capacity utilization is positive.

6. Discussion of the findings

This study aimed at determining the relationship between constraints management and capacity utilization of tea processing firms in Kenya. This study focused on the constraints management and further tested whether constraints management could lead to improved capacity utilization of the tea processing firms in Kenya. This is supported by Goldratt's (1992, 1990) observation that currently, the TOC is a management philosophy that has been applied to manufacturing organizations to improve organizational effectiveness.

It was hypothesized that there is a relationship between constraints management and capacity utilization of tea processing firms in Kenya, the research findings confirm the hypothesis that there is a relationship between constraints management and capacity utilization. The results pointed out that the firms should invest more in controlling the marketing constraints to monitor the flow of the products they offer to the marketplace while coordinating the people constraints. The findings concur with Gupta and Boyd (2008) that managing the organizations constraints will lead to better utilization of the available capacity in the organization and improve the overall performance. This empirical evidence gave a clear indication that constraints management is a significant predictor of the firm's capacity utilization. This empirical evidence is supported by Inman et al. (2009) that there are many beneficial effects of constraints management in improving the organizational performance that have been reported in both manufacturing and services.

The research findings point out that the three types of constraints that have a strong positive effect on the tea processing firms' capacity utilization level are market constraints, people constraints, and equipment constraints management. Cyplik et al. (2009) argued that contrary to conventional thinking, TOC views constraints as positive, not negative, something that should force management to think smarter and be more innovative and they get challenged to achieve more with fewer resources in improving their level of capacity utilization.

Lastly, since capacity utilization requires proper coordination in the various transformation processes, effective capacity utilization requires inter-functional coordination to eliminate constraints that commonly affect capacity utilization. The findings from this study are in support of the conclusion by Cyplik et al. (2009) that managing constraints requires inter-functional co-operation in any organization since constraints management determines whether an organization succeeds or fails as a whole.

7. Conclusions, implications and suggestions for future research

With the level of competition that has moved from the local markets to the global markets, organizations have to be smart on how to manage their constraints to be better than their competitors. Firstly, the present study adds to the academic knowledge by confirming the applicability of the Theory of Constraints to a developing country Kenya in particular. Secondly, this study confirms that most of the challenges that affect most organizations in their effort of achieving their set goals as they maximize the stakeholders' welfare are similar whether in the developed or developing the world. Finally, the study contributes to the body of knowledge by examining the effects of various constraints (people, market, equipment, and policy) on capacity utilization among the tea processing firms in Kenya. This study, to the best of our knowledge, is the first one to offer empirical evidence regarding the relationship between constraints management and capacity utilization of tea processing firms. Moreover, the study adds to the constraint management and capacity utilization literature by providing empirical evidence from Kenya as a developing economy, given that much of the existing evidence comes from developed countries. By relating constraints management and capacity utilization, we contribute to the growing number of research that investigates the relationship between constraints management, capacity utilization, and capacity management.

By applying TOC philosophy based on this study, managers will be able to take the correct decisions that will enable their organizations to create competitive advantage and improve their profitability. Specifically, they will be able to study the effects of people constraints, policy constraints and equipment constraints on the overall utilization of capacity in their organizations. Based on this study, managers will understand that instead of overworking the entire system, they should shift their focus to resources at the bottleneck as argued by Tulasi and Rao (2012). Once the Kenyan managers are able to manage the constraints that affect their production systems, they will be in a position to utilize their capacities well and be in a position to contribute to the general economic growth as a result of increased foreign exchange and creation of employment.

This study suffers from some limitations. Firstly, this study used a cross-sectional research design Kenya only. Secondly, the study did not consider the moderating or mediating variables like the size of the firm to link it with the study variables. These limitations and the findings of this study open some directions for future research in constraints management and capacity utilization literature. First, future research should be conducted to cover a developing and a developed economy for comparison and generalization purposes. Secondly, the longitudinal study should be carried out to establish the causality between constraints management and capacity utilization. Thirdly, future research should focus on other sectors and industries to understand the heterogeneity of the various sectors and industries and the level of constraints management and capacity utilization. Lastly, future research should focus on the relationship between constraints management and capacity efficiency rather than on capacity utilization.

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Appendix A. Research questionnaire

Section A: constraints management

1. How successful do you think is your company in managing its operations constraints in general?

Not successful at all [ ]	Successful [ ]
Somewhat successful [ ]	Very successful [ ]

2. To what extent has your firm experienced the following situations in the management of its operations? Use the following scale: 1 = very small extent; 2 = small extent; 3 = average; 4 = great extent; 5 = very great extent

Situations experienced	Very Small Extent	Small Extent	Average	Great Extent	Very Great Extent
The external marketplace is constraining throughput (market constraints)	(1)	(2)	(3)	(4)	(5)
Allowing the firm's equipment running to lower the manufacturing cost per piece (People Constraints)	(1)	(2)	(3)	(4)	(5)
Strict adherence to required or recommended ways of working (policy constraints)	(1)	(2)	(3)	(4)	(5)
The firms faces shortage in working tools and equipment to support its operations (equipment constraints)	(1)	(2)	(3)	(4)	(5)

3. To what extent has your firm experienced the following situations in the management of its operations? Use the following scale: 1 = Very Small Extent; 2 = Small Extent; 3 = Average; 4 = Great Extent; 5 = Very Great Extent

Situations Experienced	Very Small Extent	Small Extent	Average	Great Extent	Very Great Extent
The external marketplace is constraining throughput (Market Constraints)	(1)	(2)	(3)	(4)	(5)
Allowing the firm's equipment running to lower the manufacturing cost per piece (People Constraints)	(1)	(2)	(3)	(4)	(5)
Strict adherence to required or recommended ways of working (Policy Constraints)	(1)	(2)	(3)	(4)	(5)
The firms faces shortage in working tools and equipment to support its operations (Equipment Constraints)	(1)	(2)	(3)	(4)	(5)

4. To what extent has your firm experienced the following equipment constraints situations in the management of its operations? Use the following scale: 1 = Very Small Extent; 2 = Small Extent; 3 = Average; 4 = Great Extent; 5 = Very Great Extent

Equipment Constraints Situations	Very Small Extent	Small Extent	Average	Great Extent	Very Great Extent
Equipment shortages	(1)	(2)	(3)	(4)	(5)

Raw material shortages	(1)	(2)	(3)	(4)	(5)
Lack of people or labour shortage	(1)	(2)	(3)	(4)	(5)
Lack of space or warehousing shortage.	(1)	(2)	(3)	(4)	(5)

5. To what extent has your firm experienced the following policy constraints situations in the management of its operations? Use the following scale: 1= Very Small Extent; 2=Small Extent; 3=Average; 4=Great Extent; 5=Very Great Extent

Policy Constraints Situations	Very Small Extent	Small Extent	Average	Great Extent	Very Great Extent
The "how" lot sizes are calculated is a constraints to the firm's operations	(1)	(2)	(3)	(4)	(5)
Bonus plans are a constraints to the firm's operations	(1)	(2)	(3)	(4)	(5)
Overtime policy is a constraints to the firm's operations	(1)	(2)	(3)	(4)	(5)
Union contracts are a constraints to the firm's operations	(1)	(2)	(3)	(4)	(5)
Government regulations especially mandated breaks are a constraints to the firm's operations	(1)	(2)	(3)	(4)	(5)

Others:_____

6. To what extent has your firm experienced the following People Constraints situations in the management of its operations? Use the following scale: 1= Very Small Extent; 2=Small Extent; 3=Average; 4=Great Extent; 5=Very Great Extent

People Constraints Situations	Very Small Extent	Small Extent	Average	Great Extent	Very Great Extent
The firm being deeply engrained to certain operational beliefs or habits is a constraints to the firm's operations	(1)	(2)	(3)	(4)	(5)
Keeping equipment running to lower the manufacturing cost per piece is a constraints to the firm's operations	(1)	(2)	(3)	(4)	(5)

Others:_____

7. To what extent has your firm experienced the following Market constraints situations in the management of its operations? Use the following scale: 1= Very Small Extent; 2=Small Extent; 3=Average; 4=Great Extent; 5=Very Great Extent

Market Constraints Situations	Very Small Extent	Small Extent	Average	Great Extent	Very Great Extent
Situations where production capacity exceeds sales is a constraints to the firm's operations	(1)	(2)	(3)	(4)	(5)
The external marketplace is constraining throughput for the firm	(1)	(2)	(3)	(4)	(5)

Others:_____

8. To what extent has your firm actually benefited from the management of its operational constraints? Use the following scale: 1= Very Small Extent; 2=Small Extent; 3=Average; 4=Great Extent; 5=Very Great Extent

Factors Motivating Management of Operational Constraints	Very Small Extent	Small Extent	Average	Great Extent	Very Great Extent
The management of the firm's operational constraints has led to increased growth of the firm	(1)	(2)	(3)	(4)	(5)
Supply chain strategies implementation have led to greater profits	(1)	(2)	(3)	(4)	(5)
The management of the firm's operational constraints has enabled the firm to overcome competition in the local market	(1)	(2)	(3)	(4)	(5)
The management of the firm's operational constraints has enabled the firm to accommodate periods of poor supplier performance	(1)	(2)	(3)	(4)	(5)
The management of the firm's operational constraints has enabled the firm to enhance customer response time	(1)	(2)	(3)	(4)	(5)
The management of the firm's operational constraints has enabled the firm to enhance on-time deliveries	(1)	(2)	(3)	(4)	(5)
The management of the firm's operational constraints has enabled the firm to enhance product quality.	(1)	(2)	(3)	(4)	(5)
The management of the firm's operational constraints has enabled the firm to reduce costs associated with held finished goods inventories.	(1)	(2)	(3)	(4)	(5)
The management of the firm's operational constraints has enabled the firm to reduce costs associated with obsolete inventory	(1)	(2)	(3)	(4)	(5)
The management of the firm's operational constraints has enabled the firm to reduce costs associated with work-in-process inventories.	(1)	(2)	(3)	(4)	(5)
The management of the firm's operational constraints has enabled the firm to need to reduce the number of backorders	(1)	(2)	(3)	(4)	(5)
The management of the firm's operational constraints has enabled the firm to reduce the number of late orders	(1)	(2)	(3)	(4)	(5)
The management of the firm's operational constraints has enabled the firm to reduce the total cost of distribution, including transportation and handling costs.	(1)	(2)	(3)	(4)	(5)

Section B: capacity utilization

9. Kindly provide us with the following information to enable us compute the firm capacity utilization.

Criteria/domain	**Unit of measure**	**5 Years Achievements**				
		2008	**2009**	**2010**	**2011**	**2012**
Factory Design Capacity Available	Units					
Factory Actual Level of Output Realized	Units					

10. How much did you actually benefit from utilizing the design capacity for its desired output levels? Use the following scale: 1= Very Small Extent; 2=Small Extent; 3=Average; 4=Great Extent; 5=Very Great Extent

Benefits from utilizing the design capacity	Very Small Extent	Small Extent	Average	Great Extent	Very Great Extent
Better operational efficiency	(1)	(2)	(3)	(4)	(5)
Increased profit as it is the primary goal of constraints management for most companies	(1)	(2)	(3)	(4)	(5)
Fast improvement a result of focusing all attention on one critical area – the system constraints	(1)	(2)	(3)	(4)	(5)
Improved capacity as optimizing the constraints enables more product to be manufactured	(1)	(2)	(3)	(4)	(5)
Reduced lead times as optimizing the constraints results in smoother and faster product flow	(1)	(2)	(3)	(4)	(5)
Reduced inventory as eliminating bottlenecks means there will be less work-in-process	(1)	(2)	(3)	(4)	(5)
Better quality of information	(1)	(2)	(3)	(4)	(5)
Cost saving	(1)	(2)	(3)	(4)	(5)
Increased coordination between departments	(1)	(2)	(3)	(4)	(5)
Increased coordination with customers	(1)	(2)	(3)	(4)	(5)
Increased coordination with suppliers	(1)	(2)	(3)	(4)	(5)
Increased sales	(1)	(2)	(3)	(4)	(5)
More accurate costing	(1)	(2)	(3)	(4)	(5)
Proper Resource planning	(1)	(2)	(3)	(4)	(5)

Others:_____

Appendix B. Sampling frame and sample size

Source: www.teaboard.or.ke

Name of the County	Strata (N)	P_n=*N/Total Popn (107) *Sample (84)*
Kisii County	7	6
Nyamira County	5	4
Kericho County	13	11
Kisumu County	1	1
Bomet County	2	1
Nakuru County	2	1
Migori County	1	1
Nandi	16	13
Trans Nzoia	1	1
Marsabit	–	–
Homa Bay County	–	–
Siaya County	–	–
Kakamega County	–	–
Busia County	–	–
Bungoma County	–	–
Elgeyo Markwet	5	4

Baringo County	5	4
West Pokot	2	1
Uasin Gishu	2	1
Kajiado County	–	–
Samburu County	–	–
Narok County	–	–
Kilifi County	–	–
Lamu County	–	–
Kwale County	–	–
Mombasa County	–	–
Kitui County	–	–
Machakos County	–	–
Makueni County	–	–
Mandera County	–	–
Wajir County	–	–
Garissa County	–	–
Nairobi County	–	–
Isiolo County	–	–
Meru County	5	4
Embu County	3	2
Kirinyaga County	3	2
Muranga County	6	5
Nyeri County	9	7
Kiambu County	13	11
Laikipia County	–	–
Vihiga County	2	1
Turkana County	–	–
Kitui County	–	–
Tharaka Nithi	4	3
Taita Taveta	–	–
Tana River County	–	–
Total	**107**	**84**

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