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Effects of Lean Manufacturing technology strategy implementation on Factory Time Efficiency, a case study of Mumias Sugar Company Limited in Kakamega County, Kenya

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ABSTRACT: *The case study examined the effects of lean manufacturing techniques implementation on factory time efficiency in Mumias Sugar Company limited in Kenya. The study was a case study of Mumias Sugar Company Limited, in Western Kenya. Purposive sampling was used to select a sample of 95 employees from Human Resources, Engineering, Production, Quality Assurance, Sales and Distribution sections. Data was collected using a structured questionnaire consisting mainly with closed ended questions and was analyzed using descriptive and inferential statistics. Study was motivated by the financial losses made by Mumias Sugar Company limited and the contribution of sugar in the Kenyan economy. The study revealed that Mumias Sugar Company Limited has not adopted and implemented holistically lean technology. Mumias Sugar Company has only adopted practices relating to lean manufacturing and there is little impact of these practices to factory time efficiency. It was concluded that lean manufacturing technology has significant impact on Factory Time Efficiency depending on the manner of implementation of the practice. Piece meal implementation impacts insignificantly on factory time efficiency and has no resultant benefits. It was also concluded that Mumias Sugar Company needs training on lean technology to have a workforce that understands the aspects of lean technology and then embark on a full implementation program in order to reap the full benefits. The case study also demonstrated the current situation on lean manufacturing technology in the Kenyan sugar industry. Lean tool and techniques examined were total productive maintenance, Just in time, kanban, Production smoothing, Total Quality management, Standardization of work, Visual systems and 5S.There has been no research done on lean manufacturing tools and techniques in Mumias Sugar company. It is recommended that implementation of lean manufacturing practices should support the overall company business strategy and should be in line with cooperate vision, mission, and values .This will ensure that performance is linked to expectations.*

KEYWORDS: *Mumias Sugar Company, Lean manufacturing Technology, waste, Factory Time Efficiency, Production costs.*

I. INTRODUCTION

1.1 background of the Study

Kenya sugar sector is a major employer and contributor to the national economy; this is as per Kenya sugar industry strategic plan 2009-2014, Kenya Sugar Board. (2009) [1].The industry directly supports approximately 300,000 small-scale farmers who supply over 90% of the cane milled by the sugar industries. Self-sufficiency in sugar has remained elusive over the years as consumption continues to outstrip supply, Kenya sugar research foundation, KESREF (2013) [2]. The performance of the Sugar industry continues to face several challenges some of which include; high cost of production characterized by poor operational efficiencies with average sugar recoveries being 85%, which is less than the world average of 92%. Costs of local sugar production estimated at 74,000 Kenya Shillings per metric ton are almost double the 24,000 Kenya Shillings that countries like Swaziland in Southern Africa register, KESREF (2013) [2]. The Kenyan sugar industry is protected by COMESA safeguard measures. The safeguards were first granted in 2004 and were to expire in February 2008. Despite the remarkable progress made during the safeguard period, the industry was not ready for an open trade regime in sugar. Kenya therefore sought and was granted an additional four years of protection from March 2008 to February 2015, with a declining tariff and an increasing quota. Since its inception in 1973, Mumias Sugar Company (MSC) limited has progressively expanded to become the largest sugar company in Kenya in respect of industry revenue and profits. The Company carries out various activities including sugar milling, sugar cane production, ethanol and power generation. In November 2001, the company was privatized and listed on the Nairobi Stock Exchange.

It has become a complex entity performing its economic activities as well as providing service to the surrounding communities. It supports about 1.6 million people directly and indirectly. Currently, the Company has a market capitalization of 9 billion Kenya Shillings making it one of the largest listed companies in Kenya, MSC strategic plan (2013) [3].

Following the success of lean manufacturing in Japan, other companies and industries in the world copied this system. The term 'lean' as defined by Womack and Jones (2009) [4] denotes a system that utilises less in terms of all inputs, to create the same output as those created by a traditional mass production system while contributing increased varieties for the end customer. Lean is to manufacture only what is needed by the customer, when it is needed and in the quantities ordered. The manufacture of goods is done in a way that minimises the time taken to deliver the finished goods, the amount of labour required, and the shop floor size required and it is done with the highest quality raw materials, and usually at the lowest cost possible. A variety of specific lean tools techniques exist: total productive maintenance (TPM), just-in-time (JIT), Kanban, production smoothing, total quality management (TQM), standardization of work, 5S and visual systems ,Womack and Jones (2009) [4]. Implementation of lean practices is associated with improvements in operational performance measures. The most commonly cited benefits related to lean practices are improvement in labour productivity and quality, along with reduction in customer lead time, cycle time and manufacturing cost, Shah and Ward (2007) [5].

1.2 Statement of the Problem

Plant Capacity utilization for Mumias sugar company stands at less than 70% and coupled with factory time inefficiencies translates into high production costs according to Centre for Governance and Development (CGD). Factory time efficiencies (FTE) stands at 91.7% globally while MSC is 88% .Lost time has been cited as the largest operating problem of the sugar industries in Kenya as concluded in CGD Bills Digest (2005) [6]. Through put of Mumias Sugar Company was below the expected industry rate and below the installed capacities, Wawire, Shiundu, and Mulama (2008) . Mumias Sugar Company will begin operating under a liberalized trade regime after the COMESA safeguard measures lapse in February 2015. Without the COMESA safeguards, the miller will have to enhance its competitiveness along the entire value chain and reduce production costs by at least 39% to be in line with competing millers in East African Community (EAC) partner states and Common Market for Eastern and Southern Africa (COMESA). This research was driven by the gap that exists between Mumias Sugar Company limited industry operations and implementation of lean manufacturing practices in improving factory time efficiency through efficient modern style management, adoption of new technology and carry out regular condition maintenance. In order to compete in today`s global competitive market, Mumias sugar company which is the leading miller in Kenya needs to implement lean manufacturing tools to increase profit. The introduction of the paper should explain the nature of the problem, previous work, purpose, and the contribution of the paper. The contents of each section may be provided to understand easily about the paper.

Objective
The impact of lean manufacturing on factory time efficiency

Research question
What is the impact of lean manufacturing tool and techniques on factory time efficiency?

Justification

According to mumias Sugar Company limited annual report and financial statements 30 June 2013 mumias Sugar Company limited (2014) [7], the company made a loss after tax of Kshs 1,670 million. This was a decrease of 183% over the previous year's profit after tax of Kshs 2,013 million. There was a Loss per Share (LPS) of (Kshs 1.09) which was worse than the Earnings per Share (EPS) of Kshs 1.32 in the year 2012. The company processed 1,719,920 tonnes of sugar cane, which is 10.3 % lower than the 1,917,340 tonnes processed in 2012. This was due to a decline in cane availability. In the period, the company produced 147,320 tonnes of sugar which is 15% below 174,005 tonnes produced in 2012. The factory efficiency was lower due to lower capacity utilisation and hence less sugar was recovered thus compounding the problem of declining cane supply in comparison to the previous financial year.Gross turnover in the year 2013 was Shs 14,936 million compared to Shs 18,703 million in 2012 representing a 20% drop.

II. LITERATURE REVIEW

2.1 Introduction

Womack and Jones (1996) [8] notes that Customer driven and competetive market for sugar has rendered old managerial style inadequate to cope with the challenges present in the sugar sector. The coming of regional trade blocks and free trade areas has made matters complex for sugar manufactureres in the Kenyan economy. These factors compel millers to look for new tools to continue moving up the ladder in a global competetive and growing market.Lean manufacturing tools and techniques is turning out to be the new style for many manufacturers to improve performamce of their firms.

2.2 Theoretical Literature on lean manufacturing tools and techniques

The term "lean" as Womack and his colleagues define it denotes a system that utilizes less, in term of all inputs, to create the same outputs as those created by a traditional mass production system, while contributing increased varieties for the end customer. Companies that have adopted lean manufacturing have typically cut inventories and cycle time by 50% in each wave of their lean program. According to Shah and Ward (2007) [5], many concepts of lean manufacturing such as Just in Time (JIT), Kanban, Production smoothing, Total Productive Maintenance (TPM) and Total Quality Management (TQM) have been implemented in more than one process industry and resulted in huge benefits. For example, JIT concepts were successfully applied in a DuPont textile plant to decrease work in progress (WIP) inventory by 96% and reduced working capital by $2 million according to Billesbach (1994) [9]. According to Abdulmalek, Rajgopal, and Needy (2006) [10], a series of simulation experiments in a steel mill suggested that Value Stream Mapping (VSM), Kanban, JIT, Production smoothing, TPM, Setup reduction, 5S and Visual Control resulted in a decrease of production lead time from 48 days to 15 days and a reduction of WIP inventory from 96 to 10 coils for a particular portion of the process.

Just-In-Time (JIT)

Just-in-time is a management idea that attempts to eliminate sources of manufacturing waste by producing the right part in the right place at the right time. This addresses waste such as work-in-process material, defects, and poor scheduling of parts delivered (Nahmias, 1997) [11]. Inventory and material flow systems are typically classified as either push (traditional) or pull (just-in-time)systems. Moreover, just-in-time is a critical tool to manage the external activities of a company such as purchasing anddistribution. It can be thought of as consisting of three elements: JIT production, JIT distribution,and JIT purchasing.

Kanban

A kanban is used to manage shipments. Kanban is an information system that is used to control the number of parts to beproduced in every process (Monden, 1998) [12]. The most common types of kanbans are the withdrawal kanban, which specify the quantity that the succeeding process should pull from the preceding process, and the production kanban, which specifies the quantity to be produced by the preceding process (Monden, 1998)[12].

Production Smoothing

In a lean manufacturing system it is important to move to a higher degree of process control in order to strive to reduce waste. Another tool to accomplish this is production smoothing. Heijunka, the Japanese word for production smoothing, is where the manufacturers try to keep the production level as constant as possible from day to day (Womack et al., 1990)[13].If the production level is not constant this leads to waste (such as work-in-process inventory) at the workplace.

Standardization of Work

A very important principle of waste elimination is the standardization of worker actions.Standardized work basically ensures that each job is organized and is carried out in the most effective manner. No matter who is doing the job the same level of quality should be achieved.

Total Productive Maintenance

Machine breakdown is one of the most important issues that concerns the people on the shop floor. The reliability of the equipment on the shop floor is very important since if one machine breaks down the entire production line could go down. An important tool that is necessary to account for sudden machine breakdowns is total productive maintenance. In almostany lean environment setting a total productive maintenance program is very important.There are three main components of a total productive maintenance program: preventivemaintenance, corrective maintenance, and maintenance prevention. Preventive maintenance hasto do with regular planned maintenance on all equipment rather than random check ups. Corrective maintenance deals with decisions such as whether to fix or buy newequipment. Maintenance prevention has to do with buying the right machine. If amachine is hard to maintain (e.g., hard to lubricate or bolts are hard to tighten) then workers willbe reluctant to maintain the machine on a regular basis, which will result in a huge amount oflost money invested in that machine. Researchers including Nicholls (1994) [14], Taylor (1996) [15] have reported good results implementing TPM.

Visual display and control systems

This is a lean technique employed in many places where information is communicated by using visual signals instead of texts or other written instructions. The design is deliberate in allowing quick recognition of the information being communicated, in order to increase efficiency and clarity. These signals can be of many forms, from different coloured clothing for different teams, to focusing measures upon the size of the problem and not the size of the activity. In The Toyota Way, it is also known as *mieruka*. (Monden, 1998) [12].

5s

Sort: Sort, the first S, focuses on eliminating unnecessary items from the workplace that are not needed for current production operations. An effective visual method to identify these unneeded items is called "red tagging", which involves evaluating the necessity of each item in a work area and dealing with it appropriately. A red tag is placed on all items that are not important for operations or that are not in the proper location or quantity. Once the red tag items are identified, these items are then moved to a central holding area for subsequent disposal, recycling, or reassignment, (Peterson, 1998) [16].

Set In Order. Set In Order focuses on creating efficient and effective storage methods to arrange items so that they are easy to use and to label them so that they are easy to find and put away. Set in Order can only be implemented once the first pillar, Sort, has cleared the work area of unneeded items.

Shine. Once the clutter that has been clogging the work areas is eliminated and remaining items are organized, the next step is to thoroughly clean the work area. (Peterson, 1998) [16].

Standardize. Once the first three 5S's have been implemented, the next pillar is to standardize the best practices in the work area. Standardize, the method to maintain the first three pillars creates a consistent approach with which tasks and procedures are done. (Peterson, 1998)[16].

Sustain. Sustain, making a habit of properly maintaining correct procedures, is often the most difficult S to implement and achieve. Changing entrenched behaviors can be difficult, and the tendency is often to return to the status quo and the comfort zone of the "old way" of doing things. Peterson, 1998)[16].

2.3 Critical elements to lean manufacture technology

The critical elements on sugar sector commitment to lean manufacture technology are management leadership and commitment, financial capability, employee empowerment & involvement, continuous improvement, building multifunctional teams, adoption of new technology, effective communication and organizational & culture change. These elements are considered as prerequisites for lean manufacturing as depicted by Ferdousi (2009)[17] and Achanga et al (2006) [18]. The transition from traditional to lean manufacturing implementation should be driven by the top management team concludes Boyer & Sovilla (2003)[19]. According to Achanga, Shehab, Roy, and Nelder (2006)[18], organizational culture is an essential element in lean implementation process and high performing companies are those with a culture of sustainable and proactive improvement efforts. It is highly desirable to have a certain degree of communication skills throughout the company, long-term focus of management and strategic team while implementing a new initiative concludes Achanga et al (2006)[18]. Financial resources are needed for employee training, external consultants and many other inputs to the programs. Sometimes even production of firms may be interrupted as a result of the employees training in the new techniques, (Crute et al. 2003) [20].

Factory Time Efficiency

Factory time efficiency is a percentage that measures the availability of the factory for production operations throughout the year without interruptions and is an important indicator to operational performance of a manufacturing industry, Factory time efficiency is an important indicator to operational performance of a manufacturing industry, Bills Digest (2005)[6].

Conceptual framework

In the conceptual frame work the independent variables are lean manufacturing tools and techniques. The researcher focused on Total productive maintenance; Just In time ; Kanban; Production smoothing; Total Quality Management; Standardization of work;5s;Visual Systems. The dependent variable is Factory Time efficiency which is an important indicator to operational performance of manufacturing industry and a fair return on investment. The intervening variables are management leadership and commitment, employee empowerment and involvement, continuous improvement, Adoption of new technology, and organization culture change

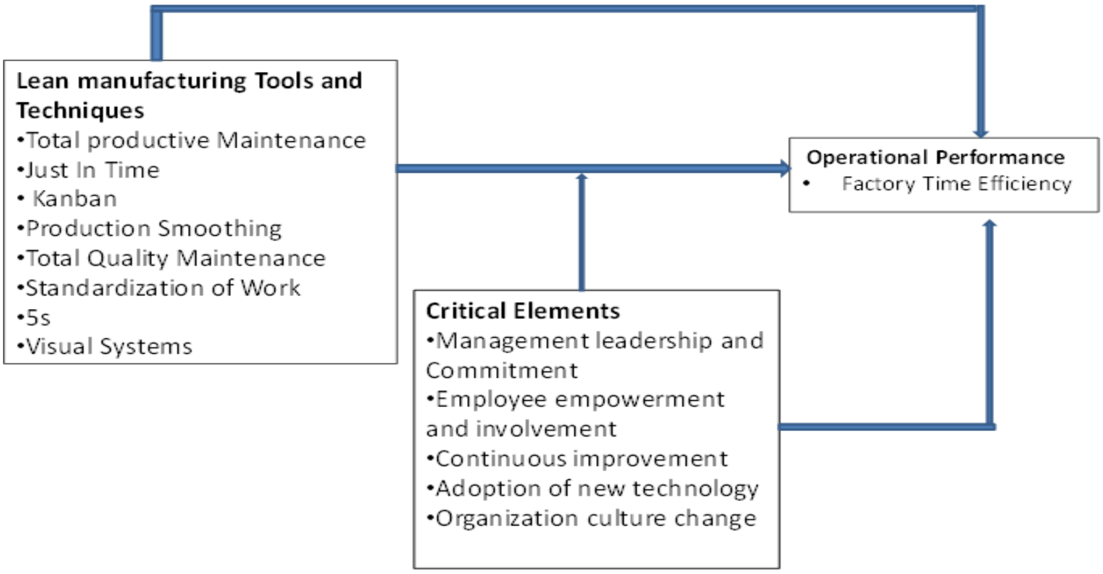

Figure 1: Conceptual Framework

III. RESEARCH METHODOLOGY

3.1 Research Design

The purpose of this study was to investigate the implementations of lean manufacturing tools and technology by Mumias Sugar Company Limited, Kenya. Methodology will also include the analyses of the results thereafter using appropriate tools. Operational framework within which the facts are placed so that meaning may be seen more clearly (Leedy, 1989)[21]. Furthermore, it can be defined as the description of the procedures that would be followed in conducting a study (Mugenda and Mugenda, 2003)[22].The study adopted a descriptive case study. This is aimed at structuring the variables in a manner that enables their relationship to be determined. Nixon, M. (2010)[23], defines descriptive studies as studies undertaken in order to ascertain and be able to describe the characteristics of the variables of interest.

3.2 The target population and sample size

The study targeted 910 employees of Mumias Sugar Company Limited, Kenya who are attached to the five departments; Human Resources, Engineering, Production, Quality Assurance, Sales and Distribution. The sampling unit was one single employee which is an acceptable in sampling design for social sciences, Kothari (2004). The study also targeted twenty (20) suppliers and twenty (20) distributers of Mumias Sugar Company Products; sugar, mineral water and alcohol. The total target population was 950.

The sample size of employees was determined by use of Kombo and Tromp (2006) [24] recommendation that a sample size of 10% to 30 % is representative enough for the study population. Therefore the sample size of employees was determined on the basis of 10% recommended by Kombo and Tromp (2006) [24]: Number of employees: 10/100 X 950=95

3.3 Sampling Techniques

Stratified sampling technique was used to categories employees in their strata (According to their department). The study employed stratified sampling which was used to draw 95 respondents according to the different departments. This was to ensure that respondents ranging from department directors to Union sable staff were equally considered. The stratified sampling strategy ensures an equal probability sample and avoid misrepresentation of any strata that might occur by chance if a simple non-stratified sample would be drawn.

3.4 Data Collection Instruments

Primary data was obtained from the questionnaires and interview schedules as research instruments. Questionnaires were used to capture data from employees and departmental heads. This instrument was used in the study because it is convenient to administer when handling a large group of respondents and the type of questions to be administered are to be standard, they are confidential, save on time, not biased and cover wide area. Mugenda and Mugenda, (2003)[22].A total of 95 questionnaires were distributed to Human Resources, Engineering, Production, Quality Assurance, Sales and Distribution departments and 63 were filled. This gave a returning rate of 63%. Employees in Human Resources, Engineering, Production, Quality Assurance, Sales and Distribution were targeted because these are the people with the most knowledge of the subject under study.

3.5 Data Collection Procedures

The researcher got permission from the relevant authorities, the Ministry of Education, Mumias Sugar Departmental Heads, before starting to collect data. The researcher notified Mumias Sugar Management of the intention to conduct the research and the proposed dates. This was done through a letter in which the researcher asked for permission and assistance. Administration of questionnaires was done on the same day in each of the targeted departments.

3.6Data Processing and Analysis

Data processing is the process of bringing orderly structure and meaning to the mass of information collected. It entails examining what has been collected and making deductions and inferences (Kombo and Tromp, 2006[24]; Mugenda and Mugenda, 2003)[22]. The completed copies of questionnaires were coded and fed into the computer using Statistical Package for Social Sciences (SPSS 17.0).

IV. RESEARCH FINDINGS AND DISCUSSIONS

4.1 Impact of lean manufacturing tools and techniques on factory time efficiency (FTE).

TABLE 1 show that 60% of respondents agreed that implementation of lean manufacturing practices and activities had actually improved factory time efficiency while 40% could not say with certainty whether lean practices had improved factory time efficiency.

Table 1

Results of impact of lean manufacturing tools and techniques on factory time efficiency (FTE).

Response	Percentage responses					Total
	Not at all	Not always	Neutral	To some extent	To a great extent	
Impact of Lean Manufacturing on FTE	0.0	0.0	40.0	60.0	0.0	100.0

Source: Research data

4.2 Multiple Regression Model for Lean Manufacturing Practices in Relation to Factory Time Efficiency

Multiple Regression analysis was conducted using data collected from the five sections in Mumias Sugar Company limited selected for the study; Human Resources, Engineering, Production, Quality Assurance, Sales and Distribution.

The adjusted R square value (0.574) in table 3 which is the proportion of variation accounted for by the regression model above and beyond the mean model indicates that Lean manufacturing techniques explain 57.4% of the variability of Factory time efficiency. Therefore, there is a positive relationship between lean manufacturing practices and factory time efficiency. The results of ANOVA show that this relationship was significant (TABLE 2)

Table 2

Model summary table for relationship between lean manufacturing practices and factory time efficiency

R	R Square	Adjusted R square	STD error of the estimate
0.591	0.541	0.574	0.46667

a. Predictors: (constant), JIT, kanban,5s,Production smoothing, standardization of works, TPM, visual display, TQM,

b. Dependent Variable: Factory Time Efficiency (FTE)

4.3 Regression model tests

The *F*-ratio in the ANOVA table 3 below tests whether the overall regression model was a good fit for the data. The table shows that the independent variables statistically significantly predict the dependent variable, $F(4, 95) = 30.580$, $p < .0005$ (i.e., the regression model is a good fit of the data).

Table 3
ANOVA table for F- ration

Model	Sum of squares	df	Mean squares	F	Sig
Regression	9.356	4	0.780	30.580	0.000
Residual	29.400	95	0.218		
Total	38.757	96			

a. Predictors: (constant), JIT, kanban,5s,Production smoothing, standardization of works, TPM, visual display, TQM,
b. Dependent Variable: Factory Time Efficiency (FTE)

4.4 Estimated Model coefficients

The general form of the equation to predict Factory Time efficiency (FTE) from JIT, kanban,5s, Production smoothing, standardization of works, TPM, visual display and TQM is;

Predicted FTE = 2.830 +(0.910 x TPM) +(0.62 x Production smoothing) + (0.32 x Visual Display) + (0.31 x Standardization of works)+ (0.106 x TQM)+ (0.083 xJIT) - (0.218 x Kanban) –(0.569 x 5S)

This is obtained from the Coefficients table, as shown below in table 4.

Unstandardized coefficients indicate how much the Factory time efficiency varies with individual lean manufacturing tool, when all lean manufacturing tools are held constant.

Table 4
Estimated regression model coefficients

Variables	Unstandardized Coefficients		Standardized coefficients			% confidence interval for B	
	B	Standard error	Betta	t	Significance	Lower Limit	Upper Limit
(Constant)	2.830	1.05		1.593	0.124	-.727	5.638
Total Productive Maintenance	0.910	0.155	0.255	1.36	0.179	-0.098	0.519
Just In Time	0.083	0.13	-0.004	0.026	0.979	-0.263	0.256
Kanban	-0.218	0.132	-0.368	2.969	0.004	-0.653	-1.28
Production Smoothing	0.620	0.217	-0.086	0.629	0.532	-0.57	0.297
Total Quality Management	0.106	0.134	0.066	0.45	0.654	-0.208	0.329
Standardization of work	0.310	0.144	0.158	1.001	0.320	-0.143	0.431
Visual Systems	0.320	0.182	0.164	1.013	0.315	-0.18	0.549
5S Practices	-0.569	0.105	-0.040	-0.21	0.833	-0.233	0.188

A multiple regression was run to predict Factory Time efficiency (FTE) from JIT, kanban, 5s, Production smoothing, standardization of works, TPM, visual display and TQM. These variables statistically significantly predicted Factory time efficiency (FTE) F (4, 95) = 30.850, p < .05, R^2 = .574. All four variables added statistically significantly to the prediction, p < .05.

Discussion

Factory time efficiency is a percentage that measures the availability of the factory for production operations throughout the year without interruptions and is an important indicator to operational performance of a manufacturing industry.

The unstandardized coefficients corresponding to Total productive maintenance (TPM) was 0.910. This indicates that total productive maintenance contributes highest to Factory time efficiency. This is because Total productive maintenance increases the productivity of plant and equipment with a modest investment in maintenance. Production smoothing had an unstandardized coefficient 0.62 since its goal is to produce intermediate goods at a constant rate so that further processing may also be carried out at a constant and predictable rate. This improves factory time efficiency by ensuring the factory is available for production. Visual display had a predicted unstandardized coefficient of 0.32 ranked after production smoothing.

Standardisation of works had a predicted unstandardized coefficient of 0.31, Total Quality Management (TQM) had 0.106, and Just in Time had 0.083. Kanban and 5S practices had negative coefficients and thus they affect negatively to factory time efficiency.

4.4 Lean tools and techniques best suitable for Mumias Sugar Company Limited

The lean tools best suitable for Mumias Sugar Company Limited were scored as Production smoothing 30%, visual systems 27%, Kanban 19%, 5S standardization of work 24%.

4.5 Critical elements for Lean manufacturing technology

65 % of the respondents agreed that Mumias Sugar Company had the financial capability to implement lean manufacturing tools. 40 % of the respondents indicated that there was Management Leadership and commitment. Continuous improvement and adoption of new technology scored 39 % of the respondents, thus indicating that there was continuous improvement and new technology had been acquired. Organization culture change was also effected and 45 % of the respondents agreed that the culture had changed. Employee empowerment and involvement, Building multifunctional teams, effective communication had 0% response.

Discussion

Elements of commitment to Lean manufacturing technology practiced by Mumias Sugar Company include, Management Leadership and commitment, Continuous improvement, Adoption of new technology and organisation culture change. Critical elements like employee empowerment and involvement, building multifunctional teams, and effective communication are not enforced. The company has the financial capability and has used it to acquire some of the latest and efficient technologies like the diffuser technology, Vertical crystalliser, Digital Control Systems for automation and instrument controls, supervisory control and data acquisition (SCADA) and Stock keeping Unit (SKU) packaging machines. These elements implementation is incomplete and cannot yield to full lean benefits. The top management leadership and commitment which is a key pre-requisite to lean manufacturing lacks the lateral support of employee and involvement.

V. SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary

Mumias Sugar Company implements lean manufacturing tools and techniques to a small extent. Only five lean manufacturing tools and techniques are practiced. This is not a holistic approach to lean technology and as result, there has not been good benefits realized of Factory Time Efficiency and as a result on the profitability of the business.

Lean manufacturing tools and techniques have a positive effect on Factory time efficiency if the lean technology is holistically embraced. Total Productive maintenance contributes highest to factory time efficiency. Kanban use creates the need for Just- in- time since the kanbans (stock cards) contains dates, and the quantities. All tools are to be implemented and therefore are best suitable for Mumias Sugar Company. There is no full realization of high factory time efficiency when there is piece meal implementation of Lean manufacturing tools and techniques.

5.2Conclusion

It was concluded that lean manufacturing technology has significant impact on Factory Time Efficiency depending on the manner of implementation of the practice. Mumias Sugar Company has not implemented Lean manufacturing tools and technology holistically. Piece meal implementation of lean techniques has had insignificant effects on factory time efficiency and no resultant benefits.
The results of the study shows that Mumias Sugar Company in Kenya has not implemented very important tools and techniques in their operations like total productive maintenance (mean 2.91) , Just In Time (mean 2.91) and total Quality management (mean 2.91) . Despite being IS0 certified, Mumias Sugar Company has not implemented practices and activities associated with total quality management. Total quality management practices and activities have a mean of 2.91 as given in table 1. It is also interesting to also note that just in time practices (mean 2.91) are practices that have been adopted by the company to a lesser extent.
Mumias Sugar Company has implemented lean manufacturing practices for different reasons. It has concentrated more on visual display and control and 5S practices as a way of addressing safety and ergonomic issues. These practices to a larger extent improve ergonomics and employee safety.

There is lack of a general understanding of lean manufacturing practices and the company has not employed a systematic approach in their implementation. Lean tools have been implemented in isolation and the company has therefore not reaped the full benefits of lean. According to Bhasin and Burcher (2006)[25], lean tools should not be implemented in isolation; and should be developed for a reason, which was to support an overall strategy. They have also suggested that it was better to embrace more lean tools rather than practicing one or two isolated ones. Overall, it is shown that Mumias Sugar Company is a "moderate" adopter of lean manufacturing.

5.3 Recommendations

Recommendations for Mumias Sugar Company and to a larger extent the Kenya sugar sector based on the analysis and conclusions of this research paper are as follows;

1. Mumias Sugar Company and the sugar sector in Kenya need to give attention to the implementation of all the key areas of lean manufacturing practices from a holistic perspective in order to reap the full benefits of lean and significantly improve their operational performance; more specifically factory time efficiency.
2. Mumias Sugar Company and the sugar sector in Kenya are advised to consider implementing basic practices like 5S, visual display and control, employee involvement and standardization of work practices before implementing advanced practices like value stream mapping and production smoothing. Production smoothing cannot be Industrial implemented for example in an environment of poor quality, unstable machine conditions and poor housekeeping.
3. Implementation of lean manufacturing practices should support the company business strategy. The implementation should be in line with the corporate vision, mission, values and plans including communication and evaluation plans to build employee buy-in and communicate results. This will ensure that performance is measured to track actual performance against expectations, new initiatives, budgets including resources needed for new initiatives and current operations for lean projects.
4. Effectiveness of lean practices needs to be evaluated. Effectiveness should be measured through performance measurements such as inventory, cycle time, product quality and delivery time.

VI. FIGURES AND TABLES

6.1 List of Tables

6.2 LIST OF FIGURES

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