ADOPTION OF TOTAL PRODUCTIVE MAINTENANCE PRACTICES BY FOOD PROCESSING FIRMS IN KILIFI COUNTY, KENYA

BY

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DECLARATION

This research project report is my original work and has not been presented for examination to any other institution.

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Finally, I am greatly indebted to my family more so, my wife, my brother and my friend Abdulmajid Said for their constant support and encouragement that I would make it in life despite the odd challenges of the earth.

God bless you all.

DEDICATION

To the two who sowed the seed, watered it, helped it grow but never saw it ripen, my dearest the late father Yusuf Mohamed Masoud and my dearest the late uncleSalim Mohamed Masoud.

ABSTRACT

The purpose of the study was to establish the adoption of total productive maintenance in the food processing firms in Kilifi County as well as to determine the factors influencing implementation of total productive maintenance in the food processing firms in Kilifi County. A descriptive survey design was used for this study. The population of the study comprised all food processing firms in the county. According to county industrial officer register there are twenty firms. A census study was conducted, out of 20 firms only 17 firms responded amounting to 85%. The study used primary data which was collected using structured questionnaire. The data collected was analyzed through use of descriptive statistics. From the research it indicated that 29% of the firms maintenance philosophy is somewhat reactive while 24% is reactive and 18% is neither reactive nor proactive this sum up to 70% of the firms within the region maintenance philosophy being not proactive an aspect of TPM findings, from the study the following recommendation are made creation of awareness on modern cost effective ways on maintenance to the food processing firms in the region this will give mileage in further investment, a further study to be conducted on other manufacturing firms in the county to ascertain the level of adoption of total productive maintenance and its economic implication.

TABLE OF CONTENTS

ABREVIATIONS AND ACRONYMS

ERP	Enterprise Resource Planning
FDI	Foreign Directive Investment
IT	Information Technology
JIT	Just-In-Time
OVOP	One Village One Product
PM	Planned Maintenance
SCM	Supply Chain Management
SMQE	Strategic Maintenance Quality Engineering
SQM	Statistical Quality Management
TPM:	Total Productive Maintenance
TQM	Total Quality Management

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE: INTRODUCTION

1.1 Background of the study

Competition is worldwide, and markets are fast becoming more price sensitive. Achieving manufacturing excellence is seen as essential to survival and economic growth for any country inthis age of globalization (Singh and Khanduja, 2010). These global challenges are forcingcompanies to implement various productivity improvement efforts to meet the needs of ever changing market demand. Manufacturing industry has experienced an unprecedented degree of change in the last three decades; involving drastic changes in management approaches, product and process technologies, customer expectations, supplier attitudes as well as competitive behavior (Ahuja et al., 2006).

TPM is a resource-based maintenance management system which focuses on improving equipment effectiveness, productivity, workplace safety and environmental issues and eliminating production losses. Total participation from all employees including top management and operators is vital in TPM. More importantly, the role of top management stimulates the contribution of operators to achieve zero breakdowns, zero stoppages and a safer working environment (Ahuja, 2007). Moreover, TPM consolidates the preventive and predictive maintenance approaches with an emphasis on employee participation. The usage of technologies to detect any abnormality or deterioration of the equipment also supports the predictive maintenance principle. Additionally, TPM integrates preventive maintenance, condition-based maintenance and predictive maintenance activities as well (Halim and Ramayah, 2010).

The Kenyan food-processing sector, including food, beverages and tobacco, remains the largest component of the manufacturing industry. In 2008, the sector contracted by 3.9 percent from2007, but still generated over a third (33.4 percent) of the total manufacturing production, and provided 89,319 jobs (KNBS 2009). High production and ingredient costs were partially blamed. During 2009 the sector grew 2.1 percent (KNBS 2010).

1.1.1 Total Productive Maintenance

According to Nakajima (1988) Total productive maintenance (TPM) is productive maintenance carried out by all employees through small group activities. TPM in this definition covers three areas: equipment, people, and the workplace. The definition of TPM includes five major elements; overall equipment effectiveness maximization, A thorough system of preventive maintenance for the equipment's whole life span, implementation by various departments (engineering, production, maintenance, etc.), total employee involvement from top management to the workers on the floor andmotivation management through small group activities and teamwork.Seiichi Nakajima the father ofTPM, defined TPM as an innovative approach to maintenance that eliminatesbreakdowns and promotes autonomous maintenance by operators through day-to-dayactivities involving total workforce (Conway 1999; Bhadury, 2000). TPM has been defined as consisting of preventive and productivemaintenance activities implemented by production workers (Wireman, 2004).

TPM supports the other strategies most often associated with World ClassManufacturing: Just-in-Time manufacturing (JIT), Total Quality Management (TQM),and Employee

Involvement (El) (Schonberger, 1996; Ollila & Malmipuro, 1999, Cuaet al., 2001; Sharma et al., 2005). TPM is an important world class manufacturingprogram introduced during the quality revolution. TPM is a highly influentialtechnique that is in the core of "operations management" and deserves immediateattention by organizations across the globe (Voss, 2005).The entire edifice of TPM is built and stands, on eight pillars (Sangameshwran andJagannathan, 2002). TPM paves way for excellent planning, organizing, monitoringand controlling practices through its unique eight pillar methodology involvingautonomous maintenance, focused improvement, planned maintenance, qualitymaintenance, education and training, safety, health and environment, office TPMand development management (Ireland and Dale, 2001; Shamsuddin et al., 2005;Rodrigues and Hatakeyama, 2006).

To prosper in today's economic climate, any organization must be dedicated to never-ending improvement, and more efficient ways to obtain products or services that consistently meet customer's needs. Globalization has forced the engineers and managers of manufacturing organizations to manufacture their products with high quality at a lower cost.Cost reduction without compromising on quality' has become the motto of every manufacturingorganization, to survive in the global market. In manufacturing industry, product quality hasbecome a key factor in determining a firm's success or a failure in a global market place(Singh and Khanduja, 2010).

1.1.2 Food processing industry in Kenya

Major segments of the sector include grain milling, bakery, dairy, spirits, beer and tobacco, sugar, soft drinks and carbonated waters, animal feeds, and edible oils and fats; Total production amounted to $3,461 million, of which $2,706 million was exported; corn meal, wheat flour and other milled grain products led the market with production valued at $848.5 million, followed by canned vegetables, oil and fats at $794 million, and bakery products totaling $294 million; There were 1,070 registered food processing companies, mostly small companies; regarding the relative size of the domestic processors, 46 percent employed more than 49 people; 19 percent employed between 20 and 49 people, 35 percent employed fewer than 20 people; and Processing inputs were valued at $2,613 million (KNBS, 2009).

Table 1.1: The Kenya food processing sector

	2004	2005	2006	2007	2008
Total output ($ million)	2064	2420	2844	3550	3461
Total input ($ million)	1582	1847	2164	2695	2613
Total number of registered food processers	1124	1232	1038	1031	1070
Labour force in registered companies	83750	85297	86569	89356	89319
Total export of agriculture products($ million)	n/a	n/a	1746	2050	2706
Exchange rate (Kshs /$)	79.17	75.55	72.10	67.32	69.18

Source: (KNBS, 2009)

During 2009 the sector grew 2.1 percent, on the production side can be basically an issue of total productive maintenance.The production of food products registered a 0.3 per cent decline in 2012 after experiencing a 1.6 per cent decline in 2011. During the period 2011/12, production of meat and meat products rose by 12.3 per cent. Vegetablesoils and fats; and grainmilling products went up by 7.5 and 6.4 per cent respectively. Under grain milling production of wheat flour increased by 9.7 per cent while maize flour rose by 2.0 per cent. Sugar production grew marginally from 490.2 thousand tonnes in 2011 to 493.9 thousand tonnes in 2012. This marginal increase is mainly attributed to an increase in sugarcane production recorded. However, prepared and preserved fish, processed liquid milk, production of bakery products dropped by 10.4, 13.7, and 14.9 per cent, respectively (KNBS, 2013)

Singh and Ahuja (2012) find out thatthe adoption of flexible TPM by manufacturing organizations results in major competitive advantage.In theMinistry of Industrialization, Kilifi County industrial office there are twenty food processing in the county ranging from fruit processing, milk processing, bakery and confectioners, sweet processing and cashew nuts.

1.2 Research Problem

Maintenance has become more challenging in the current dynamic business environment. It is considered one of the important strategic decisions in operations management (Russell and Taylor, 2009; Heizer and Render, 2009, Krawjeski and Ritzman, 2002). The manufacturing sector has been experiencing tremendous challenges in ensuring all products are delivered to customers on time, the current business environment and

pressures from various parties such as customers, suppliers, governments and so forth have put manufacturing sectors operate under severe pressure. To operate efficiently and effectively, manufacturing sectors need to ensure no disruption due to equipment breakdown, stoppages and failure. More importantly, the rapid change in technologies and the marketplace requires the manufacturing sector to improve performance by emphasizing cost reduction, increasing quality and delivery levels, and improving equipment and human resources flexibility (Ahuja and Khamba, 2008).

According to Kutucuoglu et al. (2001), reliable equipment is regarded as the main contributor to the performance and profitability of manufacturing systems, especially in a dynamic and challenging environment.Companies that adopt TPM are overseeing 50 per cent reduction in breakdown labour rates, 70 per cent reduction in lost production, 50 – 90 per cent reduction in set up, and 60 per cent reduction in costs per maintenance unit (Koelsch, 1993).Cartel (1999) started the implementation of TPM in the US Shipbuilding industry achieved higher levels of quality and timeliness and eliminated costly delays in its shipbuilding operations.In 1996, MRC Bearing implemented a TPM program, and ten months later their breakdown losses fell to less than 30 hours, a decrease of over 540 per cent (Aerospace 1999).The popularity of trucks like the F – series meant that the Ford Windsor Engine plant needed to produce more engines. An increase of 100,000 engines, announced in April, brought the output for 2000 to 950,000 units(Vasilash, 1999).

In Africa a case study was taken at South Africa pulp and paper company in 2002 by Van der Wal & lynn, they found that TPM increases productivity, quality and reduction in cost of production. In Kenya, Mulwa (2000) studied various operation management

techniques used in maintenance management. Again Njihia in (1994) dwelt on resource allocation.From the above it is evident that there was little that had focused on adoption of TPM in food processing firms in Kenya. This research project intended to find out to what extent have firms in Kilifi county adopted TPM? What were the challenges of implementation of TPM?

1.3 Research Objectives

The research seeks to achieves the following specific objectives

i. To establish the adoption of total productive maintenance in the food processing firms in Kilifi.
ii. To determine thefactors influencingimplementation of total productive maintenance in the food processing firms in Kilifi County.

1.4 Value of the study

The survey will help the following people:Researchers will use the results of the survey to gain knowledge by understanding the concept of total productive maintenance(TPM) and as a source of reference material for future study in a related field.

Food processing firms will need valid information about the food processing performance after implementing TPM practices to guide their actions, hence this survey will be beneficial to them. They will be positioned to improve the performance efficiency since it can eliminate as much waste as possible.

The County Government will be able to identify any gaps on existing policies hence set new guidelines, policies and procedures on total productive maintenance issues. The government will realize their role in providing the necessary incentives to facilitate proper implementation of total productive maintenance in food security within the county.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter presented the literature on Total productive Maintenance (TPM), it gave the theories, the relationship with other concept like Total Quality Maintenance. It also highlightedaspects on TPM practices, benefits and challenges.

2.2 Total Productive Maintenance

In order to survive every industry has to improve productivity by utilizing resources like machinery, men, and material as optimally as possible. In an effort to increase organizational capabilities, companies have made investments in programs such as JIT and TQM. However, benefits from these programs have often been limited because of unreliable or inflexible equipment (Tajiri and Gotoh, 1992). Therefore, many companies have looked to TPM to augment their JIT and TQM programs in a drive for continual improvement. TPM brings maintenance into focus as a necessary and vitally important part of the business. TPM is an innovative approach to maintenance that optimizes equipment effectiveness, eliminates breakdowns and promotes autonomous operator maintenance through day-to-day activities involving the total workforce (Nakajima, 1989; Pophaley and Vyas, 2010).

Historically, there were three eras of maintenance in Japan, where TPM originated (Nakajima, 1988).The first era, known as the preventive maintenance era (1950s), emphasized establishing maintenance functions. The second era (1960s) was the

introduction of productive maintenance, where maintenance prevention, reliability, maintainability engineering took place. However, the third era, total productive maintenance in 1970s, put the emphasis on total employee participation and strong support from top management.

The era of Total Productive Maintenance (TPM) in the 1970s focused on preventive maintenance efficiency. The emphasis was on individuals and total employee involvement through a comprehensive system (Nakajima, 1989). TPM shows an important aspect of employee involvement from all levels, teamwork and continuous improvement activities. The history of TPM began back in 1969 when the pioneer in implementing TPM, Nippon Denso Company, was the first company to be awarded the Distinguished Plant Prize or PM Prize in 1971.

TPM, a resource-based approach, emphasizes the importance of total employee participation and cooperation among various departments in maintenance activities. However, the main focus is to allow operators to be actively involved in basic maintenance jobs.Recent competitive trends have been pushing manufacturing managers to reconsider the impact and importance of increasing equipment availability and utilization, increasing maintenance productivity, resource utilization, and increasing quality and responsiveness of maintenance services for meeting global competition (Singh et al., 2010). As maintenance departments enhance the organization's ability to provide their product or service (Kutucuoglu et al., 2002; Mishra et al., 2007), this has led many organizations to implement new manufacturing programmers' and organizational structures to enhance their competitive position.

An effective maintenance programme can make significant contributions to production efficiency, plant availability, reliability and organizational profitability and to support production, maintenance must ensure equipment availability to produce products at the requiredquantity and quality levels (Ahuja and Khamba, 2008a). Muthu et al. (2000) has proposed a model called 'Strategic Maintenance Quality Engineering' (SMQE) to make the theory of TPM exhaustive and suggest that scope of TPM could be enlarged and made more powerful by integrating it with the contemporary continuous quality improvement model called 'Statistical Quality Management' (SQM).

The study revealed that use of Information Technology (IT) for benchmarking SMQE can aid in improving strategic maintenance quality more effectively. It is evident that a well drawn TPM implementation plan not only improves equipment efficiency and effectiveness but also brings appreciable improvements in other areas such as reduction of manufacturing cycle time, size of inventory, customer complaints, and creates cohesive small group autonomous teams and increases the skill and confidence of individuals. The resulting system is found to be more productive in terms of both partial and total productivity measures.Over the years, Just-in-Time (JIT), Total Quality Management (TQM), Total Productive Maintenance (TPM), Supply Chain Management (SCM), and Enterprise Resource Planning (ERP) have emerged in response to the competitive pressures (Wakchaure et al., 2011).

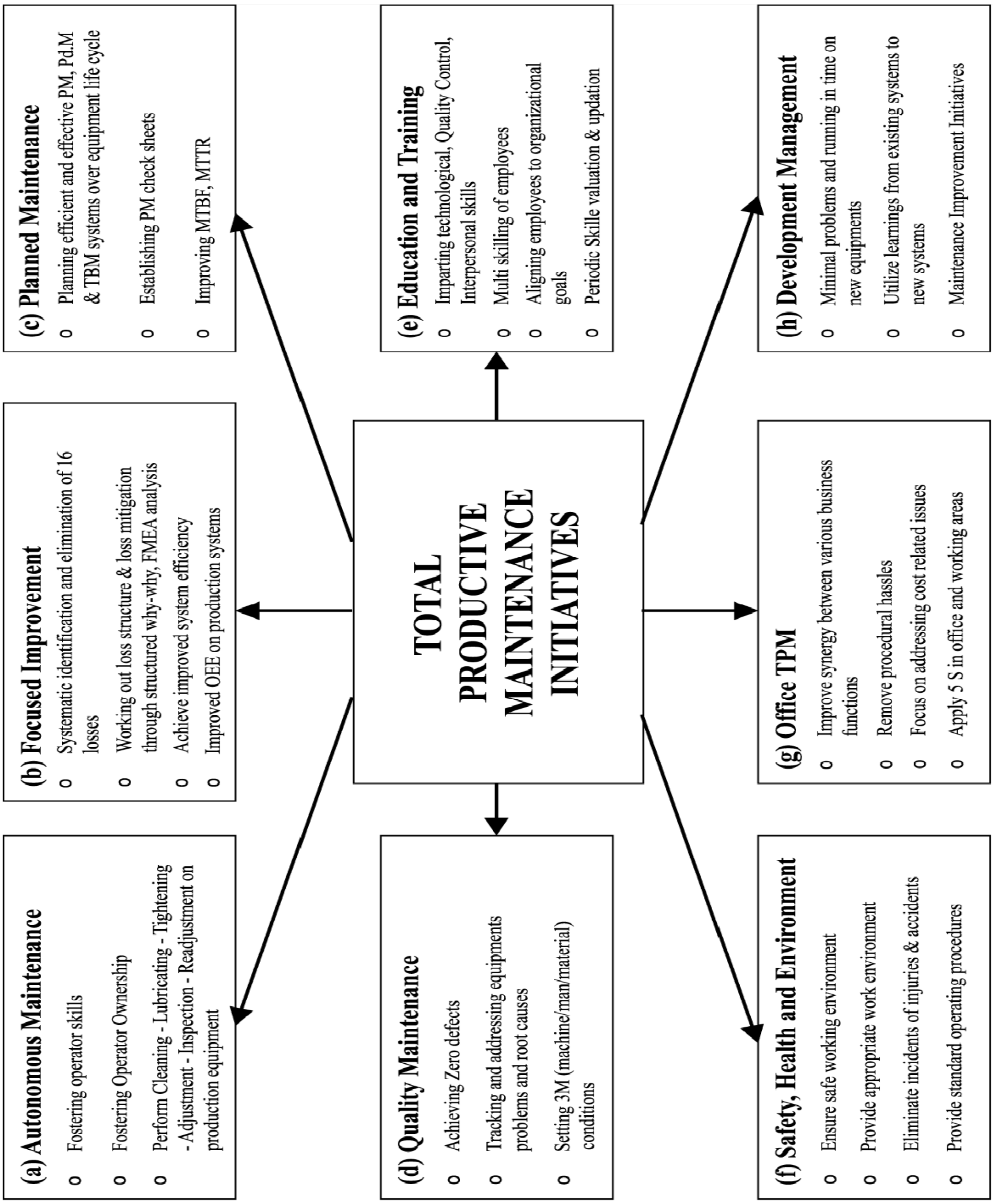
Konecny and Thun (2011) have pointed out that TQM and TPM, supported by HR practices, have a significant potential to improve plant performance. However, a simultaneous implementation of both concepts does not necessarily lead to superior

performance. As a potential reason for this, human resources are regarded as a limiting factor that both improvement programs draw on.Seth and Tripathi (2005) have identified two sets of factors which are critical for the effectiveness of TQM and TPM: universally significant factors for all the three approaches (TQM alone; TPM alone; both TQM and TPM together) like leadership, process management and strategic planning; and approach-specific factors like equipment management and focus on customer satisfaction.

Singh and Ahuja (2012) find out that the adoption of flexible TQM–TPM by manufacturing organizations results in major competitive advantage. The combined applications bring out significantly higher improvements than other individual drives to achieve synergy (Seth and Tripathi, 2006).

2.3 Framework of Total Productive Maintenance

The core TPM initiatives classified into eight TPM pillars or activities for accomplishing the manufacturing performance improvements include Autonomous Maintenance; Focused Maintenance; Planned Maintenance; Quality Maintenance; Education and Training; Office TPM;Development Management; and Safety, Health and Environment (Ireland & Dale, 2001; Shamsuddin et al., 2005; Rodrigues and Hatakeyama, 2006).



(Source; Ahuja and Khamba, 2007)

2.4 Benefit of Adopting Total Productive Maintenance

According to Khazraei and Deuse (2011), TPM is a maintenance strategy that focuses on process and people, and through deterioration prevention aspires to prevent any kind of slack before occurrence (Ahuja, 2012). TPM has achieved a great response from industrial organizations worldwide since its evolution and therefore a large number of industrial organizations have adopted TPM programs, especially in developed and industrialized nations (Muthu et al., 2000). TPM can be considered the science of machinery health.

One of the Central tenets of TPM is autonomous maintenance hence there is an implied loss of job demarcation. McAdam and McGeough(2000)implemented TPM in a heavily demarcated and unionized organization and reap the benefit (R.W.Evan der Wal and D.Lynn, 2002).The strategic outcome of TPM implementations is the reduced occurrence ofunexpected machine breakdowns that disrupt production and lead to losses which canexceed millions of dollars annually (Gosavi, 2006). TPM initiatives are focused uponaddressing major losses, and wastes associated with the production systems byaffecting continuous and systematic evaluations of production system, therebyaffecting significant improvements in production facilities (Ravishankar et al., 1992;Gupta et al., 2001, Juric et al., 2006). According to Coetzee(1999), an important success factor for implementation of TPM is the management“style”, values, principles and ideals (Shields, 2007).

One of the main aims of TPM is to increase productivity of plant and equipment in such a way as to achieve maximum productivity with only a modest investment in maintenance.

Maintenance jobs have been perceived as reactive tasks that require repairs and replacement of parts or just to fix malfunctioning equipment (Ahuja and Khamba, 2008).Maintenance supports the productiondepartment to achieve the desired quantity and quality of products produced throughensuring the availability of equipment. Hence, equipment relies not only on availability, butalso performance and quality (Nakajima, 1988)

Basically, there are many advantages that can be achieved through TPM implementation. For instance, TPM can lead to improvements in quality cost delivery and flexibility (Sharma et al., 2006; Cua et al., 2001; McKone et al., 1999, 2001; Seth and Tripathi, 2005; Seth and Tripathi, 2006). Meanwhile, Ahuja and Khamba (2008) critically analyzed and reviewed TPM related articles to show some importance directions in the TPM study. It can be clearly observed that TPM is a widely accepted approach to compete in the global competitive environment (Ahmed et al., 2005; Ahuja and Khamba, 2007, 2008; Brah and Chong, 2004; Seth and Tripathi, 2005, 2006).

TPM can bring in commendable reforms and improvement in terms of realization of manufacturing excellence in the manufacturing organizations (Ahuja and Singh, 2012). Another strategic outcome of TPM implementations is reduced occurrence of unexpected machine breakdowns that disrupt production and lead to losses which can exceed millions of dollars annually (Gosavi, 2006). The goal of TPM is to continually maintain, improve and maximize the condition and effectiveness of equipment through complete involvement of every employee, from top management to shop floor workers (Ireland and Dale, 2006). TPM addresses the entire production system over the entire life cycle and

builds a concrete, shop floor-based mechanism to prevent various losses and wastes (Sharma et al., 2006). TPM is considered to be an effectivestrategic improvement initiative for improving quality in maintenance engineering activities (Pramod et al., 2007).

2.5 Factors influencing adoption ofTotal Productive Maintenance practices

TPM adoption is a very challenging exercise to be undertaken by a firm. According to Rogers' (1995) model, organizations within anestablished social environment will not all adopt a specificinnovation at the same time (Beatty et al., 2001). Rogers(1995) suggests that it is possible to classify organizations intoone of five adopter categories determined by theirinnovativeness relative to other organizations in their socialsystem: innovators, early adopters, early majority, latemajority and laggards.In terms of organizational characteristics the mostfrequently measured is size – usually measured throughnumber of employees or revenues and relates positively toadoption (Nguyen et al., 2003).

For example, larger firmstend to adopt before smaller firms. Blili and Raymond (1993)recognized that small and medium-sized enterprises (SMEs)– enterprises which are not in the largest 10 to 20 percent ofindustry firms (OECD, 2000) – encounter unique problemsin comparison with larger firms: namely limited financialresources, low skills and minimal strategic management.Traditionally, maintenance has been considered as a support function, one that is non-productive and not a core function, thus adding little value to the business (Bamber et al., 1999). According to Al-Najjar and Alsyouf (2003),

the maintenance function has become more challenging in maintaining and improving product quality, safety requirements and plant cost effectiveness.

Teamwork among all employees in various departments in manufacturing companies canensure better TPM implementation. Indeed, the complexity of getting commitment andinvolvement from employees is one of the implementation difficulties of TPM (Arca and Prado, 2008).The employee involvement is nonetheless essential, particularly on the part of the personwho operates the equipment. Sufficient and effective training programs can help to detectabnormalities in the equipment condition as soon as possible. Moreover, it is very importantto follow up on any training and education programmes in order to ensure that operators'commitment, skills and knowledge are at exceptional level. Furthermore, through totalemployee involvement, skepticism about maintenance being a support function,non-productive and not a core function that adds little value to the business (Bamberet al., 1999) can be avoided.

Rodrigues and Hatakeyama(2006) analyzed the failure of the interaction between maintenance and production whenimplementing TPM in Brazilian companies and listed more than 11 factors thatinfluenced the outcome. They concluded that the managers of the process andthe top administration of the companies were responsible for the failures. Alsyouf (2009)investigated the maintenance practices that were used in Swedish industry. The studywas performed by conducting a cross-sectional survey within Swedish firms that had atleast 100 employees. The main results achieved from the study showed that the role ofmaintenance was not highly recognized. There was a need for the wider adoption ofmaintenance concepts such as TPM and reliability-centered maintenance

(RCM). Alsyoufasserted that the ineffectiveness of planning and scheduling could significantly limit themaintenance department in achieving its objectives and could thus prevent the companyfrom maximizing business profits and offering competitive advantages. Graisa andAl-Habaibeh (2011) investigated maintenance and production problems in the cementindustry in Libya, with particular emphasis on the future implementation of TPM. Theresults of the study found that the four factories under investigation had lowproductivitywhen compared to design values. There was no clearTPMstrategy, a lack of training andpersonal development being the main deficiencies. In addition, employees were found notto be motivated as a result of the lack of a management strategy and reward structure.

2.6 Summary of literature review

This review identified team work between diverse function as being an important driver of successful TPM implementation. The review looked at the success factors, adoption and challenges to TPM implementation. The review showed that more authors advocate TPM as a viable tool for companies aiming to achieve a sustainable competitive advantage. The review has noted the research gaps in that the TPM has not been thoroughly studied in this region. This study is therefore intended to address the gap.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

Thischapter examined the research design, the location of the study, population, data collection methods and procedures, data presentation and analysis techniques to be used. It described in detail what will be done and how it will be done.

3.2 Research design

Descriptive research design was adopted for this study. A descriptive survey is a present oriented methodology used to investigate population by selecting sample to analyze and discover occurrences (Oso and Onen, 2009). This method of investigation entails the collection and analysis of data in order to describe the problem in its actual status.The advantages of descriptive research is that it helps to look at the problem and issues in their current state and thus making it easier to make decisions on issues in their natural state.This method is also preferred as it also does not manipulate the events and behavior of the population under study as it is based on events in their original state.

3.3 Populationof the study

This study was carried out in all the food processing firms within Kilifi County. According to the County industrial office register, there are 20 firms. A census was done.The method wasadopted because the county has a small number of food processing firms and we want to incorporate input and views of all the firms.

3.4 Data Collection

The instrument used was aquestionnaire, which was covering the objectives of the study and answers the research question of the study. The questionnaire was going to give a standard form of information. The questionnaire was structured and it had closed ended questions.The questionnaire was comprise of section A that aimed to collect organizational data, section B was to collect data on Total Productive Maintenance practise, section C was to look onto TPM and processing performance, adoption of TPM will be in section D and finally section E was looking onto the factors to successful implementation.

3.5 Data Analysis

After data collection the questionnaires were coded and data input into SPSS for analysis.Descriptive statistic was used to analyze the collected data. Inferential statistic was used to analyze the relationship between TPM adoption and Cross tabulation were particularly used to put a meaning to the data.

CHAPTER FOUR: DATA ANALYSIS, RESULTS AND DISCUSSIONS

4.1. Introduction

This chapter contains the detailed data analysis and findings of the study. The data is summarized, presented and analyzed in the form of Tables and graphs.

4.2. Duration of operation

Most of the food processing firms within the region are barely less than 10years old, as indicated in table 2. 58% of the firms are less than ten years in operation.

Table 4.1: Duration of Operation

Duration in Operation	Frequency	Percent (%)	Cumulative Percent (%)
0 - 5 years	7	41.2	41.2
6 - 10 years	3	17.6	58.8
10 - 15 years	2	11.8	70.6
Over 15 years	5	29.4	100.0
Total	17	100.0	

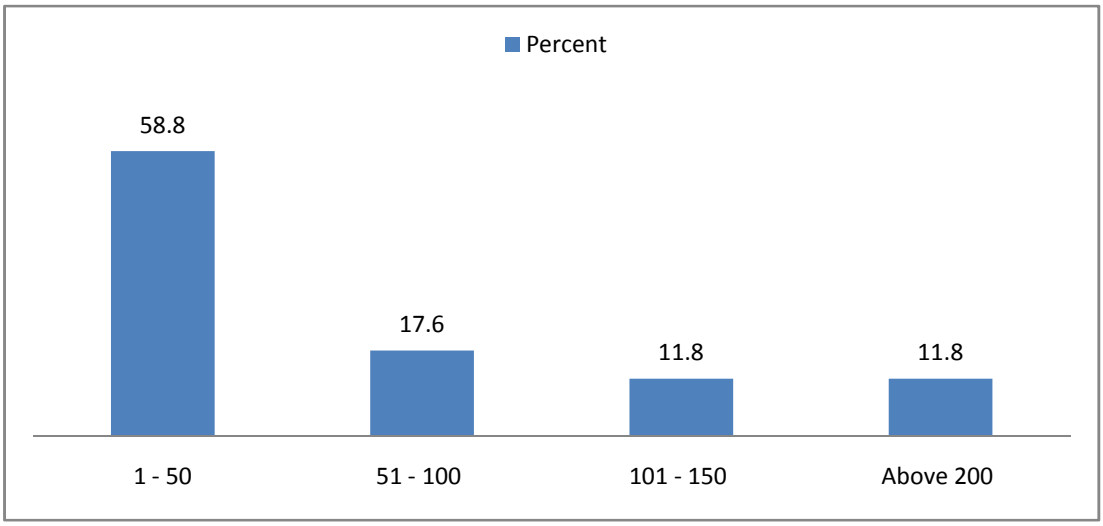
4.3.Total number of employees

The rate of employment is still very low as it can be seen 58% of the firms employ less than 50 employees and about 18% employ between 51 and 100 staff within the organizations. This means that three quarter of the firms within the region operate within small scale hence the engagement with massive and complicated machine is minimal as shown in Table 4.2.

Table 4.2: Total number of employees

Total Number of Employees	Frequency	Percent(%)	Cumulative Percent(%)
1 - 50	10	58.8	58.8
51 - 100	3	17.6	76.5
101 - 150	2	11.8	88.2
Above 200	2	11.8	100.0
Total	17	100.0	

Figure 4.1: Total number of employees



4.4. Food processing type

The researcher came across 6 bakery and confectioners firms, 5 dairy and milk processing firms, 3 fruit processing firms, animal feed processing firm, edible oil processing firm and one cashew nuts processing firm as shown in table 4.3.

Table 4.3: Food Processing Type

Food Processing Type	Frequency	Percent (%)	Cumulative Percent (%)
Bakery and confection	6	35.3	35.3
Dairy	5	29.4	64.7
Fruit processing	3	17.6	82.4
Animal feeds	1	5.9	88.2
Edible oil	1	5.9	94.1
Cashew Nuts	1	5.9	100.0
Total	17	100.0	

4.5 Appropriateness of maintenance techniques

Table 4.4: Appropriateness of maintenance techniques

Appropriateness of Maintenance Technique	Frequency	Percent (%)	Cumulative Percent (%)
Yes	17	100.0	100.0

Table 4.4 shows that the survey indicated all firms believe in the maintenance techniques currently used.

4.6. Maintenance philosophy

The research indicated that 29% of the firms maintenance philosophy is somewhat reactive while 24% is reactive and 18% is neither reactive nor proactive this sum up to 70% of the firms within the region maintenance philosophy being not proactive an aspect of TPM as illustrated in table 4.5.

Table 4.5: Maintenance philosophy

Maintenance Philosophy	Frequency	Percent (%)	Cumulative Percent (%)
Reactive	4	23.5	23.5
Somewhat reactive	5	29.4	52.9
Neither reactive nor proactive	3	17.6	70.6
Somewhat proactive	2	11.8	82.4
Proactive	3	17.6	100.0
Total	17	100	

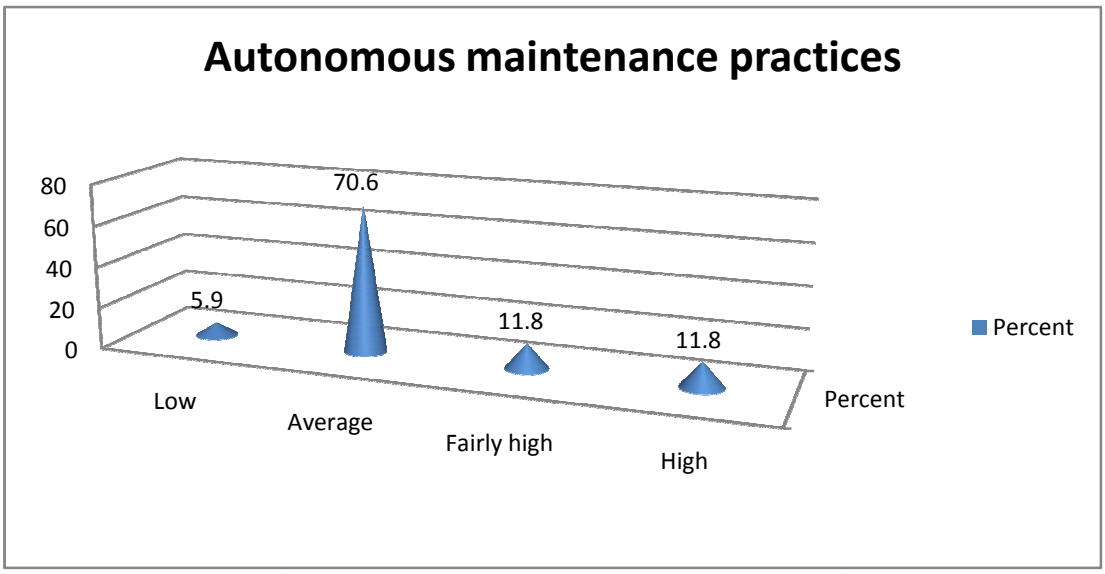
4.7. Autonomous maintenance practices

The survey indicated that 77% of the food processing firms within the Kilifi County do not undertake autonomous maintenance practices, See table 4.6. That is 3 quarters of the firms within the region have not embraced the second pillar of TPM which aimed at changing operator from being reactive to working in a more proactive way to achieve optimal conditions that eliminate minor equipment shops as well as reducing defects and breakdowns.

Table 4.6: **Autonomous maintenance practices**

Autonomous Maintenance Practices	Frequency	Percent(%)	Cumulative Percent(%)
Low	1	5.9	5.9
Average	12	70.6	76.5
Fairly high	2	11.8	88.2
High	2	11.8	100.0
Total	17	100.0	

Figure 4.2: Autonomous maintenance practices



4.8. Outsourcing maintenance

The outcome of 53% of the firms within the county outsource maintenance is a clear picture that the same percentage have not owned TPM as shown in Table 4.7.

Table 4.7: Outsourcing maintenance

Outsourcing Maintenance	Frequency	Percent(%)	Cumulative Percent(%)
Yes	9	52.9	52.9
No	4	23.5	76.5
Not sure	4	23.5	100.0
Total	17	100.0	

4.9. Degree of involvement of machine operator

Table 4.8: Degree of involvement of machine operator

	Mean	Std dev	Rank
Machine cleaning	3.7647	1.14725	2
Lubrication: oil checks, greasing etc.	3.5294	1.12459	4
Basic condition monitoring	3.8824	1.11144	1
Tightening of loose connections (spannering)	3.3529	1.16946	5
Machine inspection	3.7647	1.03256	2

Level of operator involvement in the Table 4.8 maintenance activities is between moderate to high. This means that operators undertake basic conditioning of their machines this had a mean score of 3.8824 and a standard deviation of 1.11144 while on the issue of tightening of loose connection had a mean score of 3.3529 and a standard deviation of 1.16946.

4.10. Health, safety and environment measures

Health, safety and environment is the 8^{th} pillar of TPM and implement a methodology to drive towards the achievement of zero accident. It is important to note that this is not just safety related but covers zero accidents, zero overburden (physical and mental stress and strain on employees) and zero pollution. Quite impressing fromtable 4.9which shows that this pillar is highly adopted 59% of the firms within the region have taken this pillar highly.

Table 4.9: Health, safety and environment measures

Health, Safety and Environment Measures	Frequency	Percent(%)	Cumulative Percent(%)
Fairly Low	2	11.8	11.8
Average	5	29.4	41.2
Fairly High	3	17.6	58.8
High	7	41.2	100.0
Total	17	100.0	

4.11. Employee involvement in maintenance activities

The research shows 53% of the employees are below average on the engagement on maintenance activities. Only 24% of the employees within firms within the county have a high involvement on maintenance activities.

Table 4.10: Employee involvement in maintenance activities

Employee Involvement in Maintenance Activities	Frequency	Percent (%)	Cumulative Percent (%)
Average	9	52.9	52.9
Fairly High	4	23.5	76.5
High	4	23.5	100.0
Total	17	100.0	

4.12. Manufacturing performance measure

Table 4.11 Manufacturing Performance Measure

	Mean	Std dev	Rank
What is the levels of product quality (higher levels of conformance to specifications)	4.2500	0.85635	1
What is the delivery performance (higher percentage of on-time deliveries and by faster speeds of delivery)	4.1333	0.83381	2
What is the Cost improvements e.g. materials, labour	3.2000	0.77460	13
What is the level in customer complaints	2.0000	1.19523	15
What is the manufacturing cycle time.	3.4286	1.08941	8
What is the level of inventory	3.2500	0.85635	12
What is the level of Improved environmental responsibility	3.5625	0.96393	6
What is the Improvement in overall productivity	3.6000	0.91026	5
What is the level of reduction in lead time	3.3571	0.84190	10
What is the Reduction in processing time	3.2000	0.67612	13
What is the level of Continuous flow production	3.3125	0.70415	11
What is the level of Improved equipment efficiency	3.7500	0.77460	4
What is the level of health and safety standards	3.8125	0.91059	3
What is the level of Elimination of waste	3.5625	1.15289	6
What is the level of Overall processing flexibility improvements	3.3750	1.02470	9

Table 4.11 showed that Continuous improvement initiatives in maintenance management had high influence in the level of product quality that is the level of the product quality conformance to specification with the mean score of 4.2500, the next most influenced manufacturing priorities by the continuous improvement initiatives was the delivery performance with mean score of 4.1333 followed by the level of health and safety

standard with mean score of 3.8125, the list item with a mean score of 2.0000 was the level of customer complaints.

4.13. Critical success factor for total productive maintenance

Table 4.12: Critical success factor for total productive maintenance

	Mean	**Std dev**	**Rank**
What is the management support and commitment	4.1765	0.80896	1
What is the sense of ownership and responsibility from the operators	3.7143	0.82542	7
What is the level of Co-operation and involvement of both the operators and the maintenance workers	3.9375	0.68007	2
What is the level of An attitude change by everybody from "that's not my job" to "this is what I can do to help"	3.3750	0.95743	12
What is the level of Alignment of management initiatives	3.6667	0.81650	8
What is the level of Financial support for maintenance activities	3.8125	0.91059	4
What is the level of Cultural change for the operators	3.1250	0.61914	14
What is the level of Operators' autonomy	3.4000	0.63246	11
What is the level of Greater communication and cooperation between operations and maintenance departments	3.7500	1.00000	6
What is the level of Training and education	3.4118	1.00367	10
What is the level of Introduction of major maintenance activities by use of committees/ task teams	3.3125	0.94648	13
What is the level of Open communication and creating a climate of trust	3.4706	0.94324	9
What is the level of Employee participation	3.7647	0.83137	5
What is the level of Teamwork	3.8235	0.88284	3

In determining the level of total productive maintenance adoption in the organization the survey score on table 4.12 critical factors indicated the management support and commitment with a mean of 4.1765 followed by the level of cooperation and involvement of both the operators and the maintenance workers with a mean of 3.9375, the third in the raw was the level of teamwork with a mean of 3.8235 and the list management maintenance practice with the mean of 3.1250 was the level of cultural change for the operator.

4.14. Factors to successful total productive maintenance implementation

Table 4.13: Factors to successful total productive maintenance implementation

	Mean	Std dev	Rank
What is the level of top management support and commitment	4.0000	0.93541	1
What is the level of maintenance activities – controlled by tight budget	3.1875	0.98107	2
What is the level on the Pressure of workload	3.0625	0.68007	4
What is the level of Union/ Worker resistance to new maintenance initiatives	2.4375	0.96393	10
What is the level of Senior management's tolerance of poor behavior	2.7143	1.38278	5
What is the level of Contradiction of management's initiatives	2.4667	0.99043	9
What is the level of Overly optimistic expectations	2.5385	0.77625	7
What is the level of Lack of a well-defined routine for attaining the objectives of implementation	2.3125	1.13835	12
What is the level of Cultural resistance to change towards new maintenance methodologies	2.4375	0.96393	10
What is the level of Lack of training and education	2.5000	1.09545	8
What is the level of Lack of organizational communication	2.2500	0.85635	13
What is the level of Skilled trades feeling indispensable (e.g. thinking that any new maintenance activity threatens their jobs)	2.6250	0.95743	6
What is the level of Organizational focus on results rather than on activities	3.1250	0.95743	3
What is the level of Inability to change organizational roles and culture	2.1875	0.65511	14
What is the level of Deployment of inexperienced consultants	2.6250	1.08781	6
What is the level of Deviations between officially laid out maintenance policies and actual practices deployed at workplace	2.3750	0.80623	11

In determining the successful total productive maintenance implementation as shown in table 4.13 that the factor that was clear was on the level of top management support and commitment followed by the level of maintenance activities controlled by tight budget and the level of organization focusing on result s rather than on activities with the means score of 4.000, 3.1875 and 3.1250 consequently. The level of inability to change organizational role and culture score the list mean of 2.1875.

4.15. Correlation

Table 4.14: Correlation

		Processing Performance	Level of TPM Adoption
Pearson Correlation	Processing Performance	1.000	0.781
	Level of TPM Adoption	0.781	1.000

According to the Pearson correlation coefficient the researcher observed that adoption of total productive maintenance was perceived to strongly result to improving process performance. Table 4.14 shows that 78.1% of process performance is as a result of adoption of total productive maintenance while 21.9% was as a result of factors outside the model. The 78.1% suits the manufacturing sector performance which meant a lot of emphasize on cost reduction, increasing quality and delivery levels and improving equipment and human resource flexibility. The same percentage could also be interpreted as a key factor in determining product quality.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter provided a summary, conclusion and recommendations drawn from the study. The conclusions are drawn from the objectives that the study sought to realize as well as the research findings. The chapter also covered the limitations of the study and made recommendations on areas that will require more research to enhance greater understanding of the subject area.

5.2 Summary

The study focused on establishing the adoption level of TPM in the food processing firms in Kilifi as well as determination of implementation of TPM factors by firms in Kilifi County. The firms which participated were drawn from the directory of the county ministry of industrialization office. The study was a census study of 20 firms, 17 firms responded which amounted to 85% response turn out.

It was found that most of the food processing firms in Kilifi County are less than 10years in service and have less than 50 employees. It is also apparent that the firms have maintenance activities but not specific TPM at large.The finding also shows the extent to which food processing firms in Kilifi have adopted TPM in most of the factors it showed the level of adoption as moderate to high, the correlation level of processing performance and TPMwas very positive with a 70% mark of influence.

5.3 Conclusions

The researcher drew conclusions based on the research finding (in chapter four) and in line with the study research objective which was to establish the adoption of total productive maintenance in food processing firms in Kilifi County and to determine the factors influencingimplementation of total productive maintenance in the food processing firms in Kilifi County.

Research finding indicated that the level of total productive maintenance adoption in Kilifi County food processing firms is moderate to high with critical success factors applied systematically as indicated in table 4.12, as well the correlation between processing performance and TPM adoption having a remarkable performance table 4.14. The researcher outcome conquers with the research conducted in South Africa pulp and Paper Company in 2002 by Van der Wal & Lynn where TPM increases productivity, quality & reduction in cost of production (Sharma et al., 2006). The results have indicated maintenance support the production department to achieve the desired quality and quantity of product produced (Nakajima 1988).

5.4 Recommendations

The study established that performance is seventy percent influenced by total productive maintenance practice. Therefore TPM adoption can enhance the operation performance of the processing firms in the region if fully adopted, the County government investment or marketing department should categorically mention the benefit of TPM to manufacturing investors inorder to lure them to the region.

5.5 Limitations of the Study

The study was carried out within a short period of time and some firms could not respond within time,others were reluctant to participate since they had little time to spare and most indicated that these were their working hours. The fear of firms thinking that an investigation is being carried against them drags the process. One of the cashewnut firms was closed down, kilifi plantation milk processing firm has given the work to buzeki which does part of the processing within the region and a big processing work is done upcountry. Accessibility of the firms was a challenge. This was because the firms were highly dispersed and the region is very vast.

5.6 Areas of Further Research

A further study needs to be taken to compare the impact of TPM on other manufacturing firms in the region and develop a comprehensive standard recommendation. A research can also be done on specific pillar of the eight pillars of TPM to ascertain TPM performance in other counties. A study can also be done on the impact of TPM on financial performance in different sectors such as mining, fishing. It is hoped that the information accrued from this article will trigger more studies to be conducted in lean manufacturing.

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APPENDICES

Appendix I: Questionnaire

Declaration

This research intends to examine the extent to which level the food processing firms have adopted Total Productive Maintenance (TPM) affects manufacturing performance in the Kenyan manufacturing sector. It aims to identify the key success factors, benefits and challenges of TPM in the food processing firms. The information obtained from this survey shall be kept confidential, and shall be used strictly for academic purposes only. Your participation in this survey shall be highly appreciated.

SECTION A: Company Profile

Name of Organization _____

Position held _____

Department/ Function _____

1. How long has the firm been in operation?

0-5 ( ) 6-10 ( ) 10-15( ) Over 15 years ( )

2. What is the total number of employees in your organization?

1-50 ( ) 51-100 ( ) 101-150 ( ) 151-200 ( ) Above 200 ( )

3. Which processing sector does your organization belong to? Indicate by ticking

Food processing type

Grain milling	( )
Bakery and confection	( )
Dairy	( )
Fruit processing	( )

Spirits	( )
Beer and tobacco	( )
Sugar	( )
Soft drinks and carbonated water	( )
Animal feeds	( )
Edible oil	( )
Others	( )

Section B: Total Productive Maintenance Practices

4. Do you think the maintenance techniques currently used by your organization are appropriate?

   Yes ( ) No ( ) Not Sure ( )

5. How would you describe your organization's maintenance philosophy?

   a) Reactive ( )

   b) Somewhat Reactive ( )

   c) Neither Reactive nor proactive ( )

   d) Somewhat proactive ( )

   e) Proactive ( )

6. To what extent is Autonomous Maintenance practiced in your organization?

   1. Low ( ) 2. Fairly low( ) 3. Average ( ) 4. Fairly high ( ) 5. High( )

7. Does your organization do outsourcing of maintenance activities?

   Yes ( ) No ( ) Not Sure ( )

8. What is the level of operator involvement in following maintenance activities?

Scale ranging from (1) Very Low (2) Low (3) Moderate (4) High (5) Very High

Level of operator Involvement in Maintenance	**SCALE**				
	1	**2**	**3**	**4**	**5**
Machine cleaning					
Lubrication: oil checks, greasing etc					
Basic condition monitoring					
Tightening of loose connections (spannering)					
Machine inspection					

9. What is the extent of Health, Safety and Environment measuresas incorporated in yourmaintenance activities?

    1. Low ( ) 2. Fairly low ( ) 3. Average ( ) 4. Fairly high ( ) 5. High ( )

10. To what extent is everyone involved in the maintenance activities inyour organization?

    1. Low ( ) 2. Fairly low( ) 3. Average ( ) 4. Fairly high ( ) 5. High ( )

Section C: TPM and Processing Performance

11. To what extent has continuous improvement initiatives in maintenance management helped in achieving the following organizational manufacturing priorities and goals?

Scale ranging from (1) Very Low (2) Low (3) Moderate (4) High (5)Very High

Manufacturing Performance Measure	**SCALE**				
	1	**2**	**3**	**4**	**5**
What is the levels of product quality (higher levels of conformance to specifications)					
What is the delivery performance(higher percentage of on-time deliveries and by faster speedsof delivery)					
What is the Cost improvements e.g. materials, labour					
What is the level in customer complaints					
What is the manufacturing cycle time.					
What is the level of inventory					
What is the level of Improved environmental responsibility					
What is the Improvement in overall productivity					
What is the level of reduction in lead time					
What is the Reduction in processing time					
What is the level of Continuous flow production					
What is the level of Improved equipment efficiency					
What is the level of health and safety standards					
What is the level of Elimination of waste					
What is the level of Overall processing flexibility improvements					

Section D: Level of TPM adoption

12. To what extent are the following maintenance management practices/ factorsimplemented in your organization?

Scale ranging from (1) Very Low (2) Low (3) Moderate (4) High (5) Very High

Critical success factors for TPM	**SCALE**				
	1	**2**	**3**	**4**	**5**
What is the management support and commitment					
What is the sense of ownership and responsibility from theoperators					
What is the level of Co-operation and involvement of both the operators and the maintenance workers, and importantly					
What is the level of An attitude change by everybody from “that's not my job” to “this is what I can do to help”					
What is the level of Alignment of management initiatives					
What is the level of Financial support for maintenance activities					
What is the level of Cultural change for the operators					
What is the level of Operators’ autonomy					
What is the level of Greater communication and cooperation between operations and maintenance departments					
What is the level of Training and education					
What is the level of Introduction of major maintenance activities by use ofcommittees/ task teams					
What is the level of Open communication and creating a climate of trust					
What is the level of Employee participation					
What is the level of Teamwork					

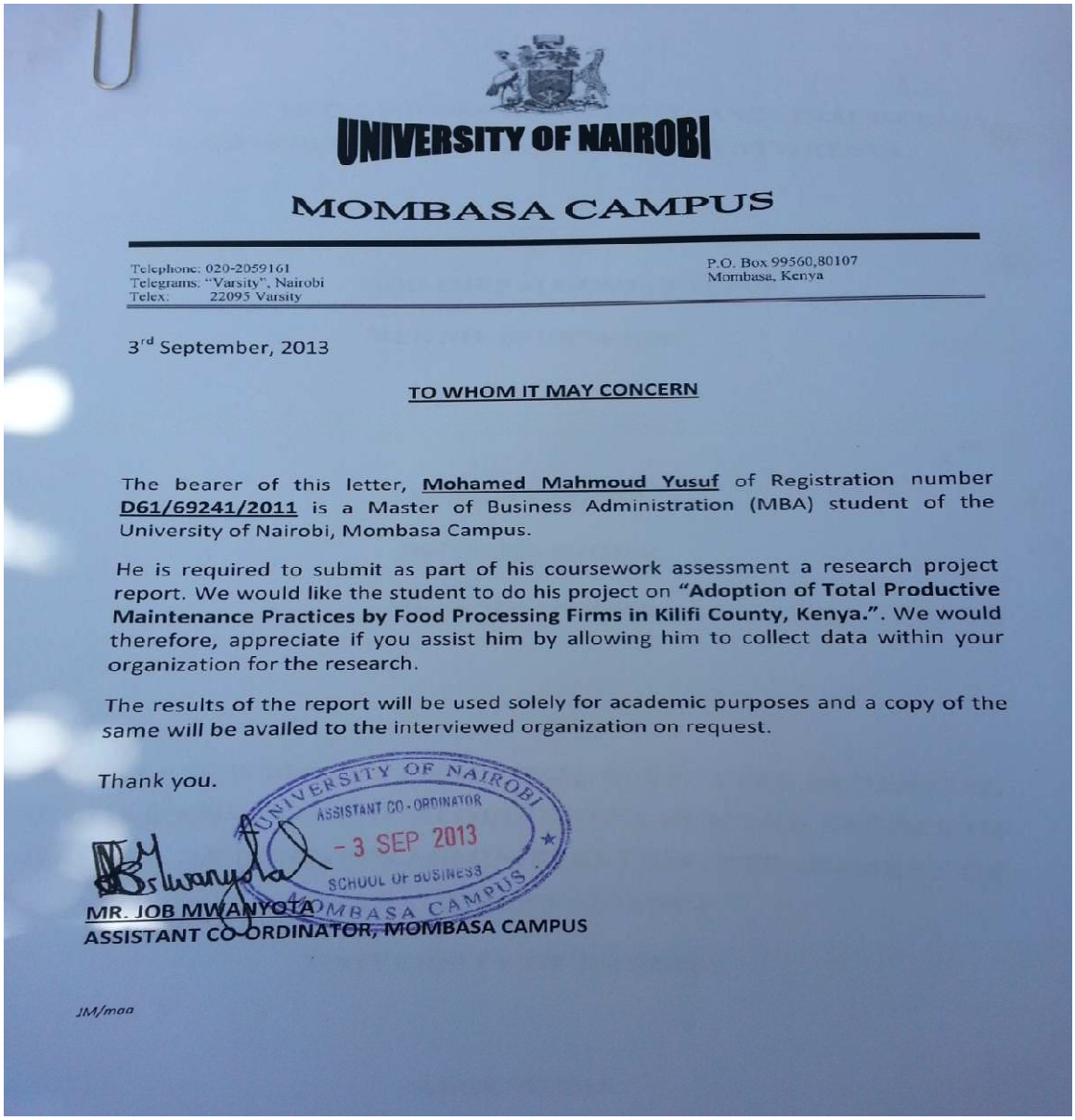
Section E: Factors to successful TPM implementation

13. To what extent have the following practices/ factors been witnessed in yourorganization's maintenance activities?

Scale ranging from (1) Very Low (2) Low (3) Moderate (4) High (5)Very High

Challenge	SCALE				
	1	2	3	4	5
What is the level of top management support and commitment					
What is the level of maintenanceactivities – controlled by tight budget					
What is the level on the Pressure of workload					
What is the level ofUnion/ Worker resistance to new maintenance initiatives					
What is the level of Senior management's tolerance of poor behavior					
What is the level of Contradiction of management's initiatives					
What is the level of Overly optimistic expectations					
What is the level of Lack of a well-defined routine for attaining theobjectives of implementation					
What is the level of Cultural resistance to change towards new maintenancemethodologies					
What is the level of Lack of training and education					
What is the level of Lack of organizational communication					
What is the level of Skilled trades feeling indispensable (e.g. thinking thatany new maintenance activity threatens their jobs)					
What is the level of Organizational focus on results rather than on activities					
What is the level of Inability to change organizational roles and culture					
What is the level of Deployment of inexperienced consultants					
What is the level of Deviations between officially laid out maintenancepolicies and actual practices deployed at workplace					

Appendix II: Letter of Introduction



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3rd September, 2013

TO WHOM IT MAY CONCERN

The bearer of this letter, **Mohamed Mahmoud Yusuf** of Registration number **D61/69241/2011** is a Master of Business Administration (MBA) student of the University of Nairobi, Mombasa Campus.

He is required to submit as part of his coursework assessment a research project report. We would like the student to do his project on **"Adoption of Total Productive Maintenance Practices by Food Processing Firms in Kilifi County, Kenya."**. We would therefore, appreciate if you assist him by allowing him to collect data within your organization for the research.

The results of the report will be used solely for academic purposes and a copy of the same will be availed to the interviewed organization on request.

Thank you.

UNIVERSITY OF NAIROBI
ASSISTANT CO-ORDINATOR
- 3 SEP 2013
SCHOOL OF BUSINESS
MOMBASA CAMPUS

MR. JOB MWANYOTA
ASSISTANT CO-ORDINATOR, MOMBASA CAMPUS

JM/moa