IMPLEMENTION OF TOTAL PRODUCTIVE MAINTENANCE IN LARGE MANUFACTURING FIRMS IN KENYA

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A Management Research Project Submitted in Partial Fulfillment of the Requirements for Award of Master of Business Administration (MBA), School of Business, University of Nairobi.

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DECLARATION

This project is my original work and has not been submitted for an award of any degree in any other university.

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

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DEDICATION

To my spouse Josephine, Children (Rodney, Sheryl, Cynthia, Rachael and Michelle), Mother Jessica , brothers and sisters.

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ABSTRACT

The objective of this study was to establish the challenges, success factors and benefits of implementing Total Productive Maintenance (TPM) in large manufacturing firms in Kenya. The study employed cross-sectional survey design. The population of the study was 201 large manufacturing firms in Nairobi as per Kenya Association of Manufacturers & Exporters Directory: 2013. The study used primary data which was collected through questionnaires. Data was analyzed and presented using descriptive statistics. The study found out that large manufacturing firms in Kenya that implemented TPM, encountered several challenges such as employees considering TPM activities as additional work, insufficient understanding of the methodology and philosophy of TPM implementation, lack of rights skills, top management support, lack of commitment, insufficient resources esp. financial support, among others. The study was able to establish the success factors for the implementation of TPM in large manufacturing firms, and these were, top management commitment, effective communication before and during TPM implementation, support from the shop floor (union staff), training of operators in basic maintenance skills among others. The following were stated by the large manufacturing firms as benefits of implementing TPM: elimination of waste and losses, reduction of equipment breakdown, reduction of maintenance costs, optimization of equipment reliability, improvement of operator skills, boosting morale of employees, among others. This study provides useful insights for the implementation of TPM as a tool that enhances performances. In the current competitive market, large manufacturing firms stand to benefit greatly by adapting TPM as an performance improvement tool.

TABLE OF CONTENTS

LIST OF TABLE

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

The 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 attitude as well as competitive behaviour; this is according to Ahuja and Khamba (2006). The contemporary dynamic environment has become highly challenging and the manufacturing organizations are finding it extremely difficult to manage competition and consumer expectations. The global market place has witnessed an increased pressure from customers and competitors for greater value from their purchase whether based on quality, faster delivery, and lower cost in manufacturing as well as service sector (Bash, 2001).

Recent competitive trends have prompted top management of manufacturing enterprises to look at the performance of each and every business function, including manufacturing or maintenance for achieving competitive advantage (Pintelon, 2006). With increased global competition, attention has been shifted from increasing efficiency by means of economics of scale and internal specialization to meeting market conditions in terms of flexibility, delivery performance and quality (Karuppuswamy, 2007). In today's dynamic environment a reliable production system must be seen as a critical factor for competitiveness (Chong, 2004). Poor organizational competencies in managing the maintenance function effectively can severely affect competitiveness by reducing throughout, increasing inventory and leading to poor due-date performance (Ashayeri, 2007).

The contemporary business environment has become considerably complex and challenging, and as a result variety of factors influence the manufacturing organization's ability to compete effectively. Organizations today compete on several factors such as time, price, technology, innovation, quality, reliability and information management. Kumar, Anthony, Singh, Tiwari and Perry (2006) impress upon manufacturing organizations to adapt Lean and Sigma principles and business improvement strategies for achieving dramatic results in cost, quality and time by focusing on process performance.

The rapidly changing needs of modern manufacturing and the ever increasing global competition has emphasized upon the re-examination of the role of improved maintenance management towards enhancing organization's competitiveness (Riis, Luxhoj and Thortesinsson, 1997). It has been realized and well accepted by manufacturing organizations that the equipment maintenance and reliability are important strategies that can considerably influence the organization's ability to compete effectively (Madu, 2000). The maintenance processes can be streamlined to eliminate waste and produce breakthrough performance in areas valued by customers (Hammer, 1993). This has encouraged the manufacturing organizations to adopt TPM as a significant process improvement and problem solving approach for enhancing the organizations responsiveness for catering to customer needs and affecting cost optimization as part of management strategy to increase the market share and maximize profit. TPM has been accepted as the most promising strategy for improving maintenance performance in order to succeed in a highly demanding market arena (Nakajima, 1988). The TPM implementation methodology provides organizations with a guide to fundamentally transform their shop floor by integrating culture, process and technology (Moore, 1997).

1.1.1 Total Productive Maintenance

TPM is a production – drive improvement methodology that is designed to optimize equipment reliability and ensure efficient management of plant assets through the use of employee involvement and empowerment, by linking manufacturing, maintenance and engineering functions. Ahuja and Khamba (2006) report that TPM implementation can significantly contribute towards improvement in organizational behaviour in the manufacturing enterprises leading to world class competitiveness. TPM initiatives are focused upon addressing major losses, and wastes associated with the production systems by affecting continuous and systematic evaluations of production systems, thereby affecting significant improvements in performance (Ravishankar, 1992). The main goal of an effective TPM effort is to bring critical maintenance skilled trades and production workers together (Labib, 1999). There are three ultimate goals of TPM: zero defects, zero accident, and zero breakdowns (Noon, Jenkins and Lucio, 2000).

In the name TPM, Total signifies every aspect and the involvement of everybody right from top to bottom; Productive means that there's emphasis on trying to do it while production goes on and minimize problems for production. Maintenance means that the equipment is kept autonomously by production operators in good condition-repair, clean, grease and accept to spend necessary time on it.

In their pursuit of beating the competition in the demand driven environments, manufacturing firms are increasingly adapting proactive strategies like TPM and Total Quality Management (TQM) to achieve fast, focused and sustainable results. The TQM strategy focuses on employee empowerment for improving product quality and appropriately complements the TPM focus on employee empowerment for enhancing production system availability, reliability and capacity. TPM is an innovative approach to plant maintenance that is complementary to Total Quality Management (TQM), just-in-time (JIT), Total Employee Involvement (TEI), Continuous Performance Improvement (CPI), and other world class manufacturing strategies. TPM is a relatively new practical application of TQM and it aims to promote a culture in which operators develop ownership of their machines, learn much more about them, and in the process realize skilled trades to concentrate on problem diagnostic and equipment improvement projects.

TPM improves the competitiveness of an organization by providing enhanced equipment availability and utilization while optimizing the maintenance expenditures in the organizations. The evaluation of TPM efficiency can facilitate significantly enhanced organization capabilities across variety of dimensions (Wang, 2006). TPM enhances the competitive advantages of improved quality, improved delivery, and increased flexibility without excessive maintenance investments.

Ahuja and Khamba (2008) examined the long-term effects on TPM in an organization performance in the Indian Context. TPM implementation initiatives showed marked improvements in the equipment efficiency and effectiveness and also brought about appreciable improvements in other manufacturing functions in the organization. It was also observed that systematic interventions regarding TPM deployment significantly contributed towards the improvement of manufacturing system productivity, quality, safety, morale and besides ensuring the cost effectiveness of the manufacturing function within the organization. The holistic TPM implementation led

to establishment of strategic proactive maintenance practices in the organization for avoiding future system and equipment related losses and marshaled the organization toward capability building for sustained competitiveness in the global market place.

The traditional misconception about maintenance being viewed as an operational expense to be minimized and not as an investment in increased process reliability has to be done away with in realizing manufacturing performance excellence. Equipment and technology development capabilities have become major factors that demonstrate the strength of an organization and set it apart from others (Braglia, 2006). Maintenance has now become a strategic tool to increase competitiveness rather than simply an overhead expense that must be controlled. Investment in maintenance is one of the basic functions of a firm returns, improved quality, safety, dependability, flexibility and lead times (Teresko, 1992).

One approach to improve the performance of maintenance activities is to implement a TPM system. TPM represents a shift in the way progressive world class companies think about maintenance. It is a radical departure from the traditional view of breakdown maintenance. TPM is a methodology and philosophy of strategic equipment management focused on the goal of building product quality by minimizing equipment ineffectiveness.

1.1.2 Large Manufacturing Sector in Kenya

The manufacturing sector in Kenya in which the study is based on is one of the major contributors to the economic development of the country. According to the National development Plan 2002-2008 it contributes to employment of a large population of the country's workforce and also contributes about 13% of Gross Domestic Product (GDP).

According to the Kenya Economic Survey 2010, the manufacturing sector grew by 4.4% in 2010 when compared to prior year. This was mainly driven by; reliable power supplies arising from favourable weather conditions that bolstered electric power generation, favorable tax policies, including the removal of duty on capital equipments and some raw materials, increased credit to the manufacturing sector increased availability of raw agricultural materials, Growth in the regional market (EAC, COMESA)

The categorization of manufacturing firms is based on a 4- Digit United International Standard Industrial Classification (ISIC) of all economic activities, which Kenya adopted in 1972. According to ISIC, large firms are those with 50 persons and above. The industrial classification used in Kenya conforms with the 1973 United Nations International Standard of Industrial Classification (ISIC) which gives industrial products different codes, and divides the industry into the division as shown in the table below;

Table 1.1: Classification of manufacturing firms

Division	Title of Division	No. of coded industry types	Percentage
2	Mining and quarrying	5	6.8
3	Manufacturing	61	83.6
5	Building and construction	7	9.6
Total		73	100

Source: Adapted from Kenya standard industrial classification, (1973).

In the Kenyan context, the manufacturing sector is divided into 14 sub-sectors(Kenya Association of Manufacturers) which are: Food and Beverages, Tobacco, Building, Construction and Mining, Chemical and Allied, Energy, Electrical and Electronics, Leather Products and Footwear, metal and Allied, Paper and Paperboard, Motor Vehicle and Accessories, Pharmaceutical and Medical Equipment, Plastics and Rubber, Textiles and Apparels, Timber, woods Product and Furniture, Industrial Services(Manufacturing in Kenya: a Survey of Kenya's Manufacturing Sector 2006-KAM).

Although Kenya manufacturing sector is still small when compared to those of industrialized countries it is still the largest in East Africa (Aosa, 1992). Ownership of manufacturing firms is a major dimension because it has a strong bearing on the organization's performance and control. In terms of sector concentration, large companies in Kenya account for a large proportion of manufacturing sector's output and employment. From the above arguments, provides reason why the manufacturing sector is important to be studied.

1.2 Research Problem

TPM is an important aspect in the manufacturing sector of any economy as it leads to superior performance, effective service quality while ensuring that that customers expectations are not only met but also exceed. The manufacturing sector in the current and modern world is quite dynamic and therefore firms are faced with challenges such as how to manage stiff competition.

The manufacturing sector in Kenya is very important since it contributes to the country's GDP in a big way through not only in the production of goods and services but also in the creation of employment for a majority of Kenyans. The sector creates the flourishing of other upstream industries that provide materials that are processed for finished goods. By exporting some of the goods that are produced, the country is able to earn valuable foreign exchange.

Ahuja et al (2008) have reported that TPM implementation is not an easy task by any means. The failure of TPM implementation is due to lack of support system to facilitate learning and transform learning into effective diffusion of the practices of TPM. It has been observed that many of the organizations that attempt to implement TPM initiatives experience difficulties and are not able to achieve the anticipated benefits. The failure of an organization to successfully implement a TPM program has been attributed to various obstacles including lack of management support and understanding, lack of sufficient training, failure to allow sufficient time for the evolution (Bakerjan, 1994). Some of the prominent problems in TPM implementation include partial implementation of TPM, overly optimistic expectations, lack of well-defined routine for attaining the objectives of implementation (equipment effectiveness), cultural resistance to change, lack of training and education, lack of organizational communication and implementation of TPM to conform to societal norms rather for its instrumentality to achieve world class status (Becker, 1993).

Another significant contributor for failure of TPM implementation program is the organization's inability to obviate resistance to change. The resistance to change takes a number of forms that is reluctance of individuals to change roles (Cooke, 2000), inability to create dissatisfaction with the present situation (reason to change) (Maggand 1992) and inability to change organizational roles and culture (Lawrence,

1999). Bamber (1999) conducted a study of factors affecting successful implementation of TPM in the UK manufacturing small enterprises and found various reasons of TPM failure including lack of commitment of top management, deployment of inexperienced consults, lack of structure, failure to implement change on the shop floor, lack of education and training for employees, lack of employee involvement and poor structure to support the TPM initiatives. Mcadam (1996) describe that many issues arise when trying to implement TPM in a union environment. Workers fear that the only drive is to improve production efficiency, reduce labour and increase employee workload. Many operators don't want additional responsibility and are happy with the situation the way it is. In addition the skilled trades enjoy feeling indispensable and think that autonomous maintenance activity threatens their jobs.

Cooke (2000) has attributed the failure of TPM implementation program to the inability of management to holistically implement the TPM practices at the workplace and highlights that serious deviations have been observed between officially laid out TPM policies and actual practices employed at the workplace.

A number of studies have been conducted in Europe (Davis , 1997) and Asia (Ahuja and Khamba, 2008) on the challenges of implementing TPM as a performance improvement tool but none of the studies had focused attention on the context of the Kenyan manufacturing sector and therefore this research provided an ideal opportunity to fill this gap.

1.3 Research Objectives

i. To determine challenges faced in implementing TPM as a performance tool by large manufacturing firms in Kenya.

ii. To establish success factors in TPM implementation in large manufacturing firms.

iii. To establish benefits of TPM implementation in large manufacturing firms.

1.4 Value of the Study

The study will be important to researchers and scholars, policy makers in both manufacturing industry and government and also managers. To managers, the study will uncover the implementation challenges of TPM in an industrial set up.

It is hoped that this study will also provide insights that will assist managers in manufacturing organizations or firms to identify in advance the key challenges that are likely to impact their implementation of TPM as a performance improvement tool.

Based on the obvious benefits that come with TPM, this study will also provide an excellent opportunity to encourage more manufacturing firms in Kenya to adapt TPM as an improvement tool.

To the researchers, the results can be used to carry out comparative studies with companies or firms operating in different contexts.

To policy makers the study will be used to get insights in formulating policies that will create an enabling environment for performance excellence.

CHAPTER TWO: LITERATURE REVIEW

2.1 Total Productive Maintenance

TPM is a method which includes total participation on all levels and functions in an organization in order to raise overall effectiveness of equipment used in the production. This could be considered as a result of preventive maintenance and total quality management combination because major elements of TPM are employees, processes and equipment. According to Jerry Kilpatrick (2003), TPM capitalizes on pro-active and progressive maintenance methodologies and calls upon knowledge and co-operation of operators, equipments venders, engineering and support personnel to optimize machine performance. Results of this optimized performance include; elimination of breakdowns, reduction of unscheduled and scheduled down time, improved utilization, higher throughput and better product quality. Bottom line results include; lower operating costs, longer equipment life and lower overall maintenance costs.

According to Venkatesh (2009) TPM is a continuous improvement program, he continues to say that TPM is to increase production and raise the morale of the employees as well as increasing their job satisfaction.

2.2 Goals of TPM

Venkatesh (2007) has identified the most important goals of TPM are higher productivity of equipment and plant by obtaining minimum 90% overall equipment effectiveness (OEE), maintaining product quality, zero equipment breakdowns by maintaining equipments at optimal level, zero product defects, and making workers multi-skilled and flexible.

OEE is a combined measurement that shows the impact of equipment availability, equipment performance, and quality of output. The metric is calculated by multiplying Availability (A) X Performance Efficiency (PE) X Quality Rate (Q).

A - Availability of the machine is proportion of time machine is actually available out of time it should be available(A = (MTBF - MTTR) / MTBF): Where MTBF - Mean Time Between Failures = (Total Running Time) / Number of Failures.

MTTR is Mean Time To Repair while PE - Performance Efficiency is given by RE X SE where Rate efficiency (RE); the actual average cycle time is slower than design cycle time because of jams, etc. Speed efficiency (SE); actual cycle time is slower than design cycle time.(Note: machine output is reduced because it is running at reduced speed). Q – is the quality rate and it's the percentage of good parts out of total produced sometimes called "yield".

2.3 Principles of TPM

JIPM Solutions Company Limited (2000) has identified seven absolute pillars of TPM. They are represented by the following chart and discussed in further details.

Pillars of TPM						
TPM						
Autonomous Maintenance	**Focused Maintenance**	**Planned Maintenance**	**Quality Maintenance**	**Training**	**Office TPM**	**Safety Health and Environment**
Δ, ∏, ⌂	Δ, ∏	Δ, ∏	∏	Δ, ∏, ⌂	∏, ⌂	⌂

Key: Δ=Zero breakdown, ∏=Zero defects and ⌂= Zero accidents.

(Source: JIPM, 2009).

2.3.1 Autonomous Maintenance

This pillar stresses on performing simple maintenance tasks by operators, activities like lubrication tightening of loosened bolts, visual inspection cleaning. This will help more experienced maintenance staff to take care of more important maintenance tasks, which create more added values. The aim is keeping machines in good condition.

Autonomous maintenance fosters operator skills and ownership. But equally important the operator is able to carry out basic tasks such as cleaning, lubrication, tightening, adjustment, inspection and readjustment on production equipment.(JIPM, 2009).

2.3.2 Focused Improvement

This pillar states that, small improvements are more effective than just one big improvement if they are continuous. The pillar aims to reduce losses that can lower efficiency. Kaizen, a compound Japanese word meaning literally “change for the better” is applicable in both production and administrative areas. It refers to gradual approach to higher standards in quality enhancement and waste reduction, through small but continual improvements involving everyone from the chief executive to the lowest level worker.

Focused improvement emphasizes on finding ways of achieving zero loss in all activities, elimination of losses by means of using results of preventive maintenance analysis widely and being commitment towards cost reduction for resources. The improvement of overall equipment effectiveness (OEE) is achieved by defining preventive maintenance for each piece of equipment, creating standards for running condition based maintenance and responsibilities of maintenance staff centered around general breakdown activities while supporting operators by training them in problem diagnosis. (JIPM, 2009)

2.3.3 Planned Maintenance

In order to reach customer satisfaction the products must be defect free. Perfect free product requires machinery without trouble. Planned maintenance focuses on

reducing spares inventory, optimum maintenance cost, higher reliability and maintainability of machines, achieving and sustaining machine availability.

Planned maintenance is comprised of four parts: firstly, breakdown maintenance which is based on the philosophy of let it fail and fix it and is applicable where failure does not impose any significant effect on production and any cost except the cost of repair. Second part is preventive maintenance which comprises of actions like inspection, lubrication, cleaning, tightening to prevent machines from failures through periodic inspection and recognition of equipment condition. The third part is corrective maintenance which is done to increase the reliability, productivity and improving maintainability. At this point all the root causes of equipment failures should be removed. Root causes may originate from the design at manufacturing, installation or external factors. The fourth part is that of maintenance prevention and this is done by checking current equipments and data gathering about their weaknesses, failure records and safety while new equipments are re-designed and installed.(JIPM, 2009).

2.3.4 Quality Maintenance

Through defect-free manufacturing higher quality and customer satisfaction are accessible respectively. This pillar focuses on the equipment parts, which are critical for product quality.

Quality maintenance starts from elimination of current quality problems, which are reactive measures and in form of quality control. The trend is continued with consideration of potential quality problems, which results in productive measures and in form of quality assurance. Quality maintenance focuses on prevention of defects at source, in-line detection and segregation of defects (JIPM,2009).

2.3.5 Training

The aim of this pillar is making employees multi-skilled with high eagerness to work and fulfill their duties completely and independently. The knowledge and skills of the employees should be improved.

The training environment must be in such a way that employees want to learn by themselves based on their felt needs as well as making work more enjoyable. It is not sufficient that knowledge of the employees is limited to know how, they should also be aware of know how to recognize the root causes of problems. All employees should gain knowledge and skills relevant to their duties (JIPM, 2009).

2.3.6 Office TPM

Office TPM should be implemented in administrative and logistic functions in order to increase efficiency and productivity in addition to identification of losses and elimination. Logistics and support functions have significant impact on the production and manufacturing. The effectiveness and productivity of a production system can be increased by improving any activity that supports the production. Many administration losses are unmeasured and remain hidden. Some of the office losses include: administrative process losses, office equipment breakdowns, communication channel's cut-offs, accuracy loss, communication loss, customer complaints about logistics, expenses due to emergency dispatches and purchases and time spent on information retrieval.

Office TPM results to better plant performance by involvement of the employees in supportive activities. It also creates a clean and tidy work environment. Office TPM further ensures that staff are more creative and productive, there is reduced administrative costs e.g. non-production and non capital equipment, there is less inventory of documents and files thus resulting in higher efficiency through better utilization and organization of the office(JIPM, 2009).

2.3.7 Safety, Health and Environment

This pillar emphasizes that TPM program is not meaningful without focusing on health and environmental issues. This pillar is meant to achieve goals of zero accidents, zero injuries and zero environmental impact. Unreliable and fault equipment is a threat to the operator and the environment.(JIPM, 2009)

2.4 Factors for Successful Implementation of TPM

TPM is a result of corporate focus on making better use of available resources. In order to realize the true potential of TPM and ensure successful TPM implementation,

TPM goals and objectives need to be fully integrated into the strategic and business plans of the organization because TPM affects the entire organization and is not limited to production. For TPM to be successful, the improvement process must be recognized as benefiting both the organization and the worker.(Robinson, 1995).

Lycke (2000) has suggested that careful, thorough planning and preparation are keys to successful companywide implementation of TPM and so is senior managements understanding and belief in the concept. Boharis (1995) has emphasized upon affecting changes in the management structure focusing on continuous production system improvement, managing synergic cooperation of the production and maintenance, deployment of effective developed computerized maintenance system and gradual implementation of TPM on a handful of machines at a given time as key contributors towards successful TPM implementation. Hansson (2003) has emphasized upon effectively managing organizational change for enhancing organization's performance for strategic survival in the competitive environment.

Groate (1995) proposes a maintenance performance evaluation approach based on a quality audit and quantifiable maintenance performance indicators. He suggests that the maintenance function effectiveness must be defined through relative economic and technical ratios, to permit the maintenance manager to follow the evolution of maintenance performance and to make decisions necessary for improved maintenance management. Fredendall (1997) emphasizes that a TPM development program should typically emphasize among other things leadership role of top management in launching and implementing TPM, establishment of TPM policies, goals and master plan and communicating these to everyone in the organization, while building a system for training and employee involvement. Hutching 1998 has advocated for making considerable efforts for recognizing teams and enabling them to display their work for successful TPM implementation.

2.5 Steps of Implementing TPM

There is a recommended framework that organizations are encouraged to adapt when implementing TPM. The systematic, step by step guideline to be used by the staff and other stakeholders ensures that all the key elements are incorporated during the process. Management can in early stage be able to detect any deviation and thereafter

take corrective measures to ensure success and attainment of the objectives. The table below presents a summary of the eleven steps in the implementation of TPM.

Table 2.1: Steps of Implementing TPM

Action	Steps
Preparation	i. Announcement to Introduce TPM ii. Introductory Education Campaign iii. TPM Promotion (Special Committee) iv. Establish Basic TPM Policies and Goals
Kick-Off	i. Invite Customers, affiliated companies and sub-contractors ii. Develop Equipment Management Program iii. Develop a Planned Maintenance Program
Implementation	i. Develop an autonomous Maintenance Program ii. Increase skills of Production and Maintenance Personnel iii. Develop Early Equipment Management Program
Stabilization	i. Perfect TPM Implementation and raise TPM levels

Source: http/www.managementSupport.com

2.6 Benefits of TPM implementation

TPM implementation in an organization can ensure higher productivity, better quality, fewer breakdowns, lower costs, reliable deliveries, motivating working environments, enhanced safety and improved morale of the employees (Tripathi, 2005). The ultimate benefits that can be obtained by implementing TPM are enhanced productivity and profitability of the organizations.

TPM aims to increase the availability of existing equipment in a given situation, reducing in that way the need for further capital investment. Instrumental to its success is the investment in human resources, which further results in better hardware utilization, higher product quality and reduced labour costs (Bohoris et al., 1995).

Companies practicing TPM invariably achieve startling results, particularly in reducing equipment breakdowns, minimizing idling and minor stops (indispensable in unmanned plants), lessening quality defects and claims, boosting productivity, trimming labour and costs, shrinking inventory, cutting accidents, and promoting employee involvement (Suzuki, 1994). When the breakdowns and defects are eliminated, many benefits are presented: equipment productivity improvement, cost reduction, quality improvement, and inventory reduction, etc. The TPM approach helps increase uptime of equipment, reduce machinery set-up time, enhance quality, and lower costs. Through this approach, maintenance becomes an integral part of the team.

After successful TPM implementation, some cases show that companies achieved 15-30 per cent reduction in maintenance cost, while others revealed a 90 per cent reduction in process defects and 40-50 per cent increase in labour productivity (Nakajima, 1988). Also, some Japanese companies that have applied major TPM programs have seen a general increase in equipment productivity of 40-50 per cent (Willmott, 1994). Chowdhury (1995) reports that organizations with TPM culture have experienced benefits to the extent of 80 per cent reduction in defect rate, 90 per cent reduction in routine breakdowns and 50 per cent increase in production output.

Ahuja and Khamba (2007) have conducted a case study in the Indian Manufacturing Industry and revealed that there has been significant improvement in overall equipment effectiveness of all the production facilities as a result of TPM initiatives. The benefits realized through effective TPM implementation program included OEE improvement: 14-45 per cent, inventory reduction: 45-58 per cent, improvement in plant.

Total productive maintenance output: 22-41 per cent, reduction in customer rejections: 50-75 per cent, reduction in accidents: 90-98 per cent, reduction in maintenance cost: 18-45 per cent, reduction in defects and rework: 65-80 per cent, reduction in breakdowns: 65-78 per cent, reduction in energy costs: 8-27 per cent, increase in employee suggestions: 32-65 per cent and total savings resulting from effective implementation of kaizen themes as a result of significantly enhanced participation across the organization.

The outstanding results of TPM implementation have led many firms facing competitive pressures to adopt TPM (McKone K.E, Roger G.S and Cua K.O (1999). Several Japanese companies with rich experience in implementing TPM programs have realized significant improvements including: a 50 per cent rise in equipment availability and a 90 per cent decline in process defects, 75 per cent decline in customer complaints, 30 per cent decline in maintenance costs and 50 per cent reduction in maintenance inventories (Windle, 1993). Koelsch (1993) has reported that companies that adopt TPM are seeking 50 per cent reductions in breakdown labour rates, 70 per cent reductions in lost production, 50-90 per cent reductions in setups, 25-40 per cent increases in capacity, 50 per cent increases in labour productivity, and 60 per cent reductions in costs per maintenance unit.

Greater job satisfaction can translate into higher productivity and quality, and ultimately contributes to lower manufacturing costs (Hamrick, 1994). Companies need to consider the human aspect of TPM in combination with the technical and financial impacts.

2.7 Challenges of Implementing TPM

Many studies have been done on TPM implementation and its challenges, Rodrigues and Hatakeyama (2006) analysed the failure of the interaction between maintenance and production when implementing TPM in Brazilian companies and listed more than eleven factors that influence the outcome. They concluded that mainly the Managers of the process and the top administration of the companies were responsible for the failures. Alsyouf (2009) investigated the maintenance practices that were used in Swedish industry. The study was performed by conducting a cross-sectional survey within Swedish firms that had at least 100 employees. The main results achieved from the study showed that the role of maintenance was not highly recognised. There was a need for the wider adoption of maintenance concepts such as TPM and reliability centred maintenance (RCM).

Alsyouf (2009) asserted that the ineffectiveness of planning and scheduling could significantly limit the maintenance department in achieving its objectives and could thus prevent the company from maximising business profits and offering competitive advantages. Graisa and Al Habaibeh (2011) investigated maintenance and production

problems in the cement industry in Libya, with particular emphasis on the future implementation of TPM. The results of the study found that the four factories under investigation had low productivity when compared to design values. There was no clear TPM strategy, a lack of training and personal development being the main deficiencies. In addition, employees were found not to be motivated as a result of the lack of a management strategy and reward structure. Similarly, researchers such as Wang (2006), Bamber, Sharp and Hides (1999), Gupta, Tewari and Sharma (2006) and Lazim and Ramayah (2010) attempted to study the reasons behind the failure of TPM implementation. The reasons listed included: lack of proper understanding of the total effort required, lack of management support, lack of sufficient TPM staff, union resistance, not enough training carried out, change of priorities, lack of persistence, failure to develop a good implementation strategy, bad communication and simply choosing the wrong approach.

In summary, the review of literature reveals that challenges of TPM implementation in the case of Kenya's manufacturing firms has not been studied which creates a gap in knowledge to be filled.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the methodology of the study. It describes the procedure that was used in conducting the study. It comprises of the research design, population, sampling frame, and technique, data collection procedure, data processing and analysis.

3.2 Research Design

The study employed cross-sectional survey. According to Wilson (2010), cross-sectional survey involves the collection of data from a number of cases. It is also referred to as a survey design. This design, data is collected at a single point in time. The cross-sectional survey helped the researcher to do a summary of the findings on the challenges of implementing TPM in large manufacturing firms in Nairobi.

3.3 Population

The target population for this study was large manufacturing firms in Nairobi as listed in the Kenya Association of Manufacturers & Exporters Directory 2013. The directory lists a total of 647 firms of which 201 of them are located in Nairobi.

3.4 Sample Design

The study employed stratified sampling design. The sample consisted of 24 large manufacturing firms located within Nairobi city and its environs. All the manufacturing large firms will be stratified into classes or groups based on the Kenya Association of Manufacturers & Exporters Directory 2013. The directory lists a total of 14 groups/sectors. From each group a number will be picked to have data representative sample. A survey of 97 large manufacturing firms will be carried out using a stratified sampling technique. This is necessary to include at most all sectors within the large manufacturing firms in Nairobi.

At least 10% sample of the population is considered generally acceptable method of selecting samples from each category of the firms (Stanley and Gregory 2001).

The sample size is denoted by:

$N=(n_1+n_2+n_3……..)$

Where N=sample size,

n_1=group 1

n_2=group 2.....)

Table 3.1: Manufacturing firms in Nairobi and Sample size.

Manufacturing Firms			
	Industry Category	**Firms in Nairobi**	**Sample**
1	Food and Beverages	46	23
2	Tobacco	2	1
3	Building, Construction and Mining	16	7
4	Chemical and Allied	56	27
5	Energy, Electrical and Electronics	9	4
6	Leather Products and Footwear	3	1
7	Metal and Allied	20	10
8	Paper and Paperboard	19	10
9	Motor Vehicles and Accessories	12	6
10	Pharmaceutical and Medical equipment	7	3
11	Plastics and Rubber	11	5
	TOTAL	**201**	**97**

Source: Kenya Association of Manufacturers & Exporters. Directory 2013

3.5 Data Collection

Data was collected by use of questionnaires. The questionnaire was in four parts. Part A covered information on the respondent. Part B was on Challenges of TPM implementation and the respondent was asked to rate the challenges on a likert scale of 1 to 5. Part C was on the success factors on TPM implementation and the respondents rated the success factors on a likert scale of 1 to 5. Part D which was the last one, was on the benefits of TPM implementation in an organization and the

respondents enumerated these. The questionnaires were availed to the respondents by the researcher by dropping them at the offices and collected within a specified time. The data was collected from Plant/Factory Managers, Operations Managers or Maintenance Managers, of the sampled large manufacturing firms. Permission to disseminate questionnaires was sought through an introduction letter from the school of business.

3.6 Data Analysis

This was a cross sectional survey study the data was in qualitative and quantitative in nature. The raw data from the questionnaires were checked and cleaned for completeness by eliminating unusable data ,interpreting ambiguous answers and eliminating contradictory data from related questions. The statistical package for social sciences (SPSS) program was used to analyze cleaned data. Descriptive statistics was used to analyze quantitative data and qualitative data was analyzed using content analysis.

CHAPTER FOUR: DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

The research objective was to determine challenges faced in implementing TPM as a performance tool by large manufacturing firms in Kenya. This chapter presents the analysis and findings with regard to the objectives in this research and discussion of the same. The findings are presented in percentages and frequency distribution tables. A total of 44 questionnaires were issued out. The completed questionnaires were edited for completeness and consistency. Of the 44 questionnaires issued out only 34 were returned this represented a response rate of 77.3% .

4.2 Challenges faced in implementing TPM

Respondents were asked to indicate on a scale of 1 to 5 (where 1 was strongly agree and 5 was strongly disagree), the extent to which they faced various challenges when implementing TPM. A summary of the results is hereby given in the table below:

Table 4.1: Challenges faced when implementing TPM

CHALLENGES	SCALE					
	1	2	3	4	5	Mean
Many employees consider TPM activities as additional work	25	9				1.26
Insufficient understanding by employs of TPM methodology	23	10			1	1.32
Lack of right skills and educational background to implement TPM	21	12			1	1.44
TPM implementation requires financial commitment	21	12		1		1.56
Lack of strategies and overall objectives	19	14		1		1.68
Work environment supports TPM	16	16				1.76
Enough time to implement TPM	16	15	2		1	1.79
Culture Change	17	11	5		1	1.82
Top management support	16	17	1			1.82
Enough training to employees	14	19		1		1.97
Adequate technology	13	20	1			2.00
Organizational equipment	10	23	1			2.18

The findings on challenges faced in implementing TPM were (from highest to lowest mean): many employees consider TPM as additional work (mean-1.26), insufficient understanding by employees of the methodology and philosophy of TPM(mean-1.32), employees in the organization not having the right skills and education background to implement TPM (mean-1.44), requirement for resources esp. financial resources(mean-1.56), lack of strategies and overall objectives (mean-1.68), work environment (mean-1.76), enough time to implement TPM(mean-1.79), culture change(mean-1.82), top management team support (mean-1.82), training of staff(mean-1.97), adequate technology(2.00) and equipment ability to support TPM(mean-2.18).

Barkerjan(1994) attributes failure in the implementation of TPM as lack of management support, lack of training and lack of enough time by employees to participate in TPM activities. Bamber (1999) avers that TPM demands commitment especially from top management, structure and also a great deal of time, effort and resources to sustain ad with many change mgt philosophies.

4.3 Success Factors for TPM Implementation

Respondents were asked to indicate on a scale of 1 to 5 (where 1 was strongly agree and 5 was strongly disagree), the extent to which they consider as success factors for TPM implementation.

The findings on the success factor for the implementation of TPM in organization were as follows: top management commitment (mean-1.53), effective communication(mean-1.65), training of production staff on basic maintenance activities (mean-1.65), age of equipment(mean-1.74), operator ownership (mean-1.74), problem solving tools and techniques(1.76), time availability(1.79),Resources availability esp. financial resources(mean-1.85), group activities (mean-1.85), reward and recognition (mean-1.91), availability of reliable data(mean-1.94), union staff (shop-floor) support (mean-2.00), culture in the organization(mean-2.00), and conflicting process(mean-2.03).

4.2: Success factors for TPM Implementation

SUCCESS FACTORS	SCALE					
	1	**2**	**3**	**4**	**5**	**Mean**
Top Management commitment	16	18				1.53
Effective communication	13	20			1	1.63
Training of production staff on basic maintenance activities	14	20				1.64
Age of equipment	13	20	1			1.74
Operator ownership	13	20	1			1.74
Problem solving tools and techniques	12	22				1.76
Time availability	12	21	1			1.79
Resources availability esp. Financial support	11	22	1			1.85
Group activities	11	22	1			1.85
Reward and Recognition	10	23	1			1.91
Availability of reliable data	10	22	2			1.94
Union Staff (Shop floor) Support	8	23	2		1	2.00
Right culture in the organization	9	23	1			2.00
Conflicting process	7	25	1		1	2.03

The findings indicate top management commitment, effective communication and training to be strong factors for the successful implementation of TPM. Senior management must show commitment to TPM by devoting time, allocating resources to create and sustain the required cultural change, and educate employees to achieve autonomous maintenance, a major goal of TPM. It's important to achieve the required transformational work culture(Tsang, Chan, 2000).

4.4 Benefits of TPM Implementation

Respondents were asked to list what they consider as the benefits their organizations have realised as a result of implementing TPM. Optimization of equipment reliability scored highly at 46.9% as a benefit of implementation of TPM in organizations. TPM is essentially a philosophy that seeks to ensures production equipment is able to produce at the highest capacity with zero loses in terms of running time and quality. This results in lower maintenance and production costs. Literature confirms that one of the benefits for TPM is zero downtime.

44% of the respondents stated that TPM implementation boosts the morale of employees. Employees would feel empowered and therefore fully responsible for meeting production targets. Additionally, the machine operator would have a “feel good” sense as “owner“ of equipment and trusted to run it. In the process of implementing TPM, operators are trained on basic maintenance skills thus acquiring additional skills that boost their morale.

Table 4.3: Benefits of Implementing TPM

NO.	Benefits	No. of respondents	percentage
1.	Optimizes equipment reliability	16	46.9
2.	Boosts morale of employees	15	44
3.	Reduces wastages and production of poor quality	13	38
4.	Reduces maintenance cost	11	32.6
5.	Improves/increases the rate of production	11	32.6
6.	Improves basic maintenance skills of operators	9	26.4
7.	Ensures efficient management of plant assets	7	20.5
8.	Cost reduction by eliminating losses in PM	6	17.6
9.	Improves safety of workers	6	17.6
10.	Operators acquires good understanding of equipment performance	6	17.6
11.	Reduction in breakdown of equipment	5	14.7
12.	Makes supervision easy	1	2.9

Literature confirms that one of the key pillars of TPM is Quality Maintenance, which focuses on prevention of defects at source, in-line detection and segregation of defects. In this study, 44% of the respondents stated that by implementing TPM in an organization, there’s reduction of wastage/production of poor quality.

TPM reduces maintenance costs and 32.6% of the respondents stated so. Equipments are optimised and operators are trained on basics maintenance skills to carry out minor tasks rather than waiting for the maintenance teams. The operators are trained to detect the likelihood of equipment breakdown before it happens. With failure being anticipated and corrective action taken before it occurs, organizations are able to reduce maintenance costs.

32.6% of the respondents said that when TPM is implemented, there is an improvement or increases in the rate of production. This is achieved by continuous running of the machine as downtime is minimised to the bear minimum which there's also production of good quality.

25% of the respondents said that TPM implementation improves basic skills of operators. The operators are equipped with basic maintenance skills that enable them to clean, lubricate, inspect, tighten and even adjust and readjust production. Sharma, Kumar, Kumar(2006) states that implementation of TPM program had promoted more operator involvement by performing autonomous maintenance(oiling, lubrication, inspection and 5S housekeeping activities. This helped to generate a sense of importance for maintaining basic equipment among operators.

20.5% of the respondents said that TPM implementation ensures efficient management of plant assets. With improvement in equipment reliability as well as rates of production that results in minimum downtime, the organization's assets are put in good use.

17.6% of the respondents enumerated that there's cost reduction which can be attributed to the elimination of production maintenance loses. In a TPM environment, Planned Maintenance as well as Autonomous Maintenance create an enabling environment for addressing loses.

17.6% of the respondents enumerated that TPM implementation enhances good understanding of equipment performance. Employees and specifically operators are instilled with basic maintenance skills through autonomous maintenance. Consequently, the operators can be trusted to carry out minor equipment maintenance rather than relying on the services of the mainstream maintenance crew.

Safety, Health and Environment is one of the seven pillars of TPM implementation. In this study, 17.6% of the respondents stated that TPM improves safety at the workplace.

The results are in-line with Ahuja and Khamba(2008) statements that TPM implementations showed marked improvement in the equipment efficiency and also brought about appreciable improvement in other manufacturing functions in the organization.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter discusses the overall findings with the aim of answering the research questions. The chapter also presents conclusions and recommendations from the current study on the objectives of the study and recommends future possible studies.

5.2 Summary of the Findings

On whether many employees consider TPM activities as additional work the study found that majority of the respondents, 73.5%, strongly agreed and 26.5% agreed that many employees consider TPM activities as additional work. On whether there is insufficient understanding by the employees of the methodology and philosophy of TPM implementation the study found that the respondents were in agreement in a big way as 67.6% strongly agreed and 29.4% agreed for the same. On right skills and educational background , the study found that the respondents were in agreement as 61.8% strongly agreed and 35.3%.

50% of the respondents strongly agreed that culture change was a challenge in the implementation of TPM while 32.4% agreed as only 2.9% strongly disagreed. On TPM implementation requiring a significant financial commitment, the study found that this was true as 61.8% strongly agreed and 35.3% agreed for the same. On finding enough time to implement TPM initiatives, the study found that the respondents agreed to this as 47.1% strongly agreed and 44.1% agreed for the same.

On adequate technology, the study found that 58.8% of the respondents agreed that this was a challenge to TPM implementation initiatives. On enough training and importance of TPM implementation, the study found 41.2% and 55.9% of the respondents strongly agreed and agreed respectively. 67.6% of the respondent stated that organization equipment to support TPM initiatives was a challenge in the implementation while 29.4% just agreed to this.

On top management support, the study found that 47.1% of the respondents strongly agreed and 50% agreed to it as a challenge in the TPM implementation.

On whether work environment is conducive for TPM implementation, 47.1% of the respondents strongly agreed. Lack of a strategy and overall objectives were cited by 55.9% of the respondents to strongly agree as a challenge to TPM implementation initiatives.

The following were findings on the success factors for TPM implementation: On top management commitment the findings were that most of the respondents agreed that top management commitment is a determining success factor for TPM implementation where 47.1% strongly agreed and 52.9% agreed on the same. Effective communication before and after TPM implementation process, the findings were that this aspect determines the success of TPM implementation as 38.2% strongly agreed and 58.8% agreed for the same factor. On training of production staff, the findings were that this factor influences the success of TPM implementation as 41.2% strongly agreed on this and 58.8% agreed on the same factor. On union shop floor support the findings were that it has an influence on the success of TPM implementation as 23.5% strongly agreed and 67.6% agreed on the same. On resources availability especially financial support the findings were that this factor is a determinant of success factors of TPM implementation where 32.4% of the respondents strongly agreed and 64.7% agreed on the same. On age of equipment, the findings were that the age of the equipment is a success factor in TPM implementation as 38.2% strongly agreed and 58.8% agreed on the same. On problem solving tools and techniques, 35.3% of the respondents, strongly agreed and 64.7% agreed on the same factors for successful implementation of TPM implementation.

Operator ownership was identified as a determinant factor of successful implementation of TPM as 38.2% of the respondents strongly agreed and 58.8% agreed for the same factor. On availability of reliable data the findings were that the respondents agreed that this is success factor as 29.4% strongly agreed and 64.7% agreed for the same.

Reward and recognition is considered as an important factor for the successful implementation of TPM. In this study, 29.4% of the respondents strongly agreed while 67.6% agreed on the same. On conflicting processes, findings were that 20.6% of the respondents strong agreed that this would play a key role in ensuring the tool is successful implement. Organization culture was found to have an impact in the implementation of TPM when 26.5% of the respondents strongly agreed and 67.6% agreed to the same.

On group activities, this study established that it plays a role as a success factor in the implementation of TPM when 32.4% of the respondents strongly agreed to that and 64.7% agreed for the same.

35.3% of the respondents in this study strongly agreed that availability of time to attend to TPM activities was as a factor for the successful implementation of TPM while 61.8% agreed for the same.

5.3 Conclusions

TPM is a key competitive strategy for business organization in the global market place. This study concludes that implementation of TPM in organizations as performance improvement tool has various challenges that have been outlined. An effective TPM program can focus on addressing these challenges thus resulting in optimized equipment performance.

TPM concepts and philosophy can be effectively employed to realise fundamental improvements in the manufacturing performance in the organization, thereby leading organizations successfully in the highly competitive environment.

TPM can prove to be an effective global strategy for rendering firms consistent enhancement in performance in terms of achieving core competencies. Thus in the highly competitive scenario, TPM might prove to be amongst the best proactive strategic initiatives that can lead organizations to scale new levels of achievements and can make the difference between success and failure of organizations.

5.4 Recommendations

TPM should be an integral part of an organization's policy within its strategy to achieve significant productivity and competitiveness. In the current dynamic

market environmental, TPM is an ideal tool that organizations should adopt for performance improvement and attainment of world class status.

For successful implementation of TPM in an organization, there must be a very high level of awareness and commitment right from the top management to the shop-floor level. Proper understanding, commitment and active involvement of top management is needed for TPM implementation. Top Management needs to create an environment that will support the introduction of TPM since without it's support skepticism and resistance will kill the initiative.

The creation of an organizational support structure is recommended. This group will promote, and sustain TPM initiatives once they begin. The group will include members from every level of the organization from management to the shopfloor. This structure will definitely promote communication and also guarantee everyone is working towards the same goal.

The role of operators in the process of implementing TPM is very important and therefore, they should be equipped with the right skills at an early stage enabling them to familiarize with themselves with equipment and it's expected performance. With the right skills, the operators will be competent enough to be able to detect equipment abnormalities and take corrective actions prior to the involvement of the mainstream engineering teams thereby achieving optimum performance through elimination of breakdowns, reduction of unscheduled and scheduled downtime, improved utilization, higher throughput and better product quality, much in-line with TPM objectives.

5.5 Limitations of the Study

Citing work related pressure and lack of time, some of the targeted respondents in the organizations managerial level, delegated the responsibility of completing the questionnaire to low cadre staff. This has the potential of misunderstanding and mis-interpretation of the questionnaires.

The study was done in Kenya, thus the results are limited to Kenya and particularly confined to Nairobi. Therefore the findings cannot be generalized to

the rest of the world and Kenya at large, this is due to different business environments.

5.6 Suggestion for Further Research

The study results indicate some recommendations for further work to be done. The sample size in this study was small and therefore a follow-up study would be recommended.

The study also focused on the implementation of TPM in large manufacturing firms in Kenya, however, with competition among firms in the same industry becoming increasingly stiff, there's is need to establish whether there is direct relationship between TPM implementation in large manufacturing firms and their performance.

Firms that participated in the study were selected from those within and around Nairobi, yet we have other large firms outside Nairobi. Further research should be done to include other large manufacturing firms that are outside of Nairobi.

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APPENDICES

APPENDIX I:QUESTIONNAIRE

PART A: RESPONDENT INFORMATION

Name of firm/organization	
Name of respondent	
Position in the organization	

Definition of Total Productive Maintenance: TPM is a production – drive improvement methodology that is designed to optimize equipment reliability and ensure efficient management of plant assets through the use of employee involvement and empowerment, by linking manufacturing, maintenance and engineering functions.

PART B: CHALLENGES OF IMPLEMENTATING TPM.

Please tick as appropriate your opinion on challenges of TPM implementation in your organization.

1 = Strongly Agree, 2= Agree, 3= Neutral, 4=Disagree, 5=Strongly Disagree

	1	2	3	4	5
Many employees consider TPM activities as additional work.					
There is insufficient understanding by the employees of the methodology and philosophy of TPM implementation.					
Employees in the organization do not have the right skills and educational background to implement TPM initiatives.					
Culture change is hindering success of TPM implementation in our organization.					

TPM implementation requires a significant financial commitment from your organization.					
Finding enough time to implement TPM initiatives is a problem in your organization.					
Our organization has adequate technology to support implementation of TPM initiatives.					
All employees get enough training on and the importance of TPM implementation in your organization.					
Your organization's equipment are able to support TPM iniatives adequately					
In your organization does the top management team support TPM implementation?					
Your organization's work environment is conducive for the implementation of TPM.					
Lack of strategies and overall objectives					

PART C: SUCCESS FACTORS FOR TPM IMPLEMENTATION

In your own opinion, please rate the following factors for successful implementation of TPM in your organization.

1 = Strongly Agree, 2= Agree, 3= Neutral, 4=Disagree, 5=Strongly Disagree

	1	2	3	4	5
Top Management commitment					
Effective communication before and during the TPM implementation process.					
Training of production staff on basic maintenance activities.					
Union staff (shop-floor) support					
Resources availability esp. financial support.					
Age of equipment					
Problem solving tools and techniques					
Operator Ownership					
Availability of Reliable data					
Reward and Recognition					
Conflicting process					
Right culture in the organization					
Group activities					
Time availability to attend to TPM activities.					

PART C: SUCCESS FACTORS FOR TPM IMPLEMENTATION

In your own opinion, please rate the following factors for successful implementation of TPM in your organization.

1 = Strongly Agree, 2= Agree, 3= Neutral, 4=Disagree, 5=Strongly Disagree

PART D: BENEFITS OF TPM IMPLEMENTATION

List what you consider as the key benefits of implementing TPM in your organization.

(i)……

(ii)……..

(iii)……..

(iv)……..

(v)……

(vi)……

(vii)…….

Thank you for taking your time to complete this questionnaire