

**INVESTIGATING THE ROLE OF TECHNOLOGY IN THE
PERFORMANCE OF TEA MANUFACTURING INDUSTRY:
A CASE STUDY**

MASTERS IN BUSINESS ADMINISTRATION THESIS

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**UNIVERSITY OF MALAWI
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PERFORMANCE OF TEA MANUFACTURING INDUSTRY:
A CASE STUDY**

by

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A dissertation submitted to the Faculty of Commerce, The Malawi Polytechnic, in partial fulfilment of the requirements for the degree of Master of Business Administration.

OCTOBER 2006

DECLARATION

I declare that this research report is my own, unaided work, except where acknowledged in the text and references. It is being submitted in partial fulfilment of the requirements for the award of MBA in the University of Malawi, it has not been submitted before for any degree or examination in any other university.

Candidate _____
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Date _____

CERTIFICATE OF APPROVAL

We declare that this dissertation is from the student's own work and effort. Where he has used other sources of information, it has been acknowledged. This dissertation is submitted with our approval.

First Supervisor _____
Dr HARRY GOMBACHIKA

Second Supervisor _____
MR SIMON ITAYE

Date _____

DEDICATION

To my wife Caroline, and children Annette, Robert Jr. and Thumbiko for your love, patience and understanding during my late working hours in the two years that I have been studying.

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I wish to thank my supervisors, Dr Harry Gombachika, Head of Electrical Engineering – Malawi Polytechnic and Simon Itaye, Managing Director - Packaging Industries (MW) Limited for their guidance and advice during the dissertation exercise. Messrs F. P. Gundo, General Manager - Chitakali Tea Estate Limited, G. Chapota, General Manager – Smallholder Tea Company, V. G. Midaya, Production Manager – Esperanza Tea Factory and F. C. Chimpeni, Factory Manager – Sayama Tea Factory for sparing their valuable time to complete my research questionnaire. Finally I wish to thank J. Mwale of Tea and Commodity Brokers Limited for supplying tea auction prices.

ABSTRACT

Malawi aspires to be a middle income country by the year 2020. At a Gross Domestic Product (GDP) of US \$151.50 per capita, as of 2003, Malawi is far behind the World Bank's classification of a middle income country. The World Bank sets the GDP for a middle income country at US \$2,046. Malawi has lately witnessed closures of a number of manufacturing companies; a situation that puts to question the realization of its aspirations. A number of researchers have tried to explain the reasons behind the poor performance of the manufacturing industry that has led to company closures. In their explanations, however, the role of technology in the performance of the manufacturing industry has not been given prominence. In this report, the role of technology as it impacts on the performance of the manufacturing industry, using tea industry as a case study, has been investigated.

This research was designed to answer the research question "*What role does technology play in the performance of the tea manufacturing industry?*" where the tea industry was considered as a case study. To answer the question, four tea factories were selected for assessment. The selected companies were Chitakali, Smallholder Tea Company, Esperanza and Sayama.

In the research, technology was defined as constituting three dimensions, machinery/equipment, processes and knowledge. The approach was to assume that after working in the industry for more than seven years, management would have acquired enough knowledge to run the industry effectively. With this assumption, only the roles of machinery and production processes were assessed. The role of machinery was assessed based on maintenance programmes that the factories have in place. The role of production processes was assessed based on the use of either the Lawrie Tea Processing (LTP) technology or rotorvane/cut-tear-curl (CTC) tea processing technology. Thus the selection of the four companies for assessment considered their maintenance programmes and processing methods.

The analyses showed that companies that ignore the condition of their machinery, giving preference to production at the expense of preventive maintenance, struggle and eventually close shop. The research also revealed that use of LTP technology produces better quality tea than rotorvane/CTC technology. Finally the analyses showed that using rotorvane/CTC technology results in higher labour productivity than LTP technology.

In conclusion, the research has demonstrated that technology plays an important role in performance of the tea manufacturing industry. Ignoring technology would lead to companies struggling or eventually closing. In addition, the choice of processing technology also helps in giving a company competitive edge over others. It was, therefore recommended that technology be given prominence when considering turnaround strategies for struggling companies in Malawi.

TABLE OF CONTENTS

Declaration.....	i
Certificate of approval	ii
Dedication	iii
Acknowledgements.....	iv
Abstract	v
Table of contents.....	vii
List of abbreviations	x
List of tables and boxes.....	xi
List of figures.....	xii
Chapter 1 INTRODUCTION.....	13
1.1 Background	13
1.2 Statement of Problem.....	15
1.3 Project Rationale	16
1.4 Research Question	16
1.5 Objectives	5
1.6 Scope of Study	17
1.6.1 Assumptions	17
1.6.2 Limitations	17
1.6.3 Study Significance	17
1.6.4 Related Study Areas.....	18
1.7 Report Outline.....	18
CHAPTER 2 LITERATURE REVIEW	20
2.1 Introduction.....	20
2.2 Works by Other Researchers	20
2.3 The Role of Technology in Performance of Manufacturing Industries	22
2.3.1 Reasons for Acquiring Technology	23
2.3.2 Maintaining Production Capability of a Firm.....	24
2.3.3 Technology as a Competitive Tool.....	28
2.4 Technology and Performance of the Tea Industry.....	31
2.4.1 Factors Influencing Tea Quality	31
2.4.1.1 Geographic/Climatic Factors	19
2.4.1.2 Technological Factors	33
2.5 Tea Production Outturn.....	43
2.6 Summary	43
CHAPTER 3 METHODOLOGY	45
3.1 Introduction.....	45
3.2 Research Design.....	45
3.3 Sample Selection.....	48
3.3.1 Sample Size	48
3.3.2 Company selection	48
3.4 Data Collection	49
3.4.1 Primary Data.....	50
3.4.2 Secondary Data.....	50
3.5 Data Presentation and Analysis	50
3.5.1 Data Presentation	50
3.5.2 Data Analysis	51
3.6 Summary	54

CHAPTER 4 DESCRIPTION OF SAMPLED COMPANIES	55
4.1 Introduction.....	55
4.2 Sampled Companies.....	55
4.2.1 Chitakali Tea Estate Limited	56
4.2.1.1 Background.....	56
4.2.1.2 Tea Production Technology.....	56
4.2.1.3 Maintenance programmes.....	57
4.2.1.4 Current Status.....	58
4.2.1.5 Tea Production.....	59
4.2.2 Smallholder Tea Company.....	59
4.2.2.1 Background.....	59
4.2.2.2 Tea Production Technology.....	60
4.2.2.3 Maintenance programmes.....	60
4.2.2.4 Current Status.....	61
4.2.2.5 Tea Production.....	62
4.2.3 Sayama Tea Factory.....	62
4.2.3.1 Background.....	62
4.2.3.2 Tea Production Technology.....	62
4.2.3.3 Maintenance Programmes.....	63
4.2.3.4 Current Status.....	66
4.2.3.5 Tea Production.....	66
4.2.4 Esperanza Tea Factory.....	66
4.2.4.1 Background.....	66
4.2.4.2 Tea Production Technology.....	67
4.2.4.3 Maintenance programmes.....	67
4.2.4.4 Current Status.....	68
4.2.4.5 Tea Production.....	68
4.3 A synopsis of Tea Auctioning at Limbe Tea Auction	69
4.2 Summary	70
CHAPTER 5 RESULTS AND DISCUSSION OF RESULTS	71
5.1 Introduction.....	71
5.2 Tea Production.....	71
5.2.1 Tea Production Patterns	71
5.2.2 Impact of Maintenance Methods on Production.....	74
5.2.3 Impact of Processing Methods on Production.....	76
5.2.4 Discussions.....	77
5.3 Tea Prices.....	80
5.3.1 Average Monthly Tea Prices, 2003-2005	80
5.3.2 Impact of Maintenance Methods on Prices	82
5.3.3 Impact of Processing Methods on Prices	83
5.3.4 Discussions.....	84
5.4 Labour Productivity	85
5.4.1 Impact of Maintenance Methods on Labour Productivity.....	87
5.4.2 Impact of Processing Methods on Labour Productivity.....	88
5.4.3 Discussions.....	89
5.5 Summary	90

CHAPTER 6 CONCLUSIONS AND RECOMMENDATIONS	91
6.1 Introduction.....	91
6.2 Conclusions.....	92
6.3 Recommendations.....	94
6.4 Summary	94
REFERENCES	96
APPENDICES.....	102
Appendix 1 Research Qustionnaire	100
Appendix 2 Monthly Production	110
Appendix 3 Average Monthly Tea Prices.....	112
Appendix 4 Labour Productivity	114
Appendix 5 Tea Testing Terminology.....	116
Appendix 6 Regular Tea Buyers, Limbe Tea Auction	118
Appendix 7 Malawi Tea On The International Market	119
Appendix 8 Liquidation Of Mbozi Tea Factory	120

LIST OF ABBREVIATIONS

ADMARC.....	Agricultural Development and Marketing Corporation
BATE	British African Tea Estates
BM	Breakdown Maintenance
CFM	Continuous Fermentation Machine
CFU.....	Continuous Fermentation Unit
CTC.....	Cut Tear and Curl
DTRDC.....	Darjeeling Tea Research and Development Centre
FBD	Fluid Bed Dryer
GDP	Gross Domestic Product
GNP	Gross National Product
JIT	Just-in-Time
LDC	Low Income Country
LTP.....	Lawrie Tea Processor
MATECO.....	Malawi Tea Company
MBA	Master of Business Administration
MDG	Millennium Development Goals
MEPD	Ministry of Economic Planning and Development
MSCE.....	Malawi School Certificate of Education
NLPTS	National Long-Term Perspective Studies
PLC	Product Life Cycle
PM	Preventive Maintenance
PVC	Poly-Vinyl Chloride
R&D	Research and Development
SBU.....	Strategic Business Unit
SC.....	Superior Cultivars
STECO.....	Smallholder Tea Company
TPM	Total Productive Maintenance
TQM	Total Quality Management
UNDP	United Nations Development Programme
USA	United States of America

LIST OF TABLES AND BOXES

Table 1.1	Prospective medium-term sectoral annual economic growth	5
Table 4.1	Tea production machinery, Chitakali	64
Table 4.2	Tea production machinery, STECO	69
Table 4.3	Annual production, STECO	72
Table 4.4	Tea production machinery, Sayama	74
Table 4.5	Annual production, Sayama	78
Table 4.6	Tea production machinery, Esperanza	80
Table 4.7	Annual production, Esperanza	83
Table 4.8	Tea auctioning pricing	85
Box 3.1	Test hypotheses	58
Box 5.1	Labour productivity formula	108

LIST OF FIGURES

Figure 2.1	Bath-tub curve	19
Figure 2.2	Tea production flow chart	32
Figure 2.3	Two leaves and a bud	33
Figure 2.4	Withering tea	36
Figure 2.5	Rolling tea using rotorvane/CTC method	38
Figure 2.6	Fermenting tea, green leaf at the start of fermentation process (CFM)	40
Figure 2.7	Fermenting tea, green colour changing to copper (CFM)	41
Figure 2.8	Extracting fibres and dust	43
Figure 2.9	Sorting tea, High Speed Sorter	44
Figure 2.10	Sorting tea, Vibro-Screen Sorter	45
Figure 4.1	Tea estates and factories in Mulanje	62
Figure 4.2a	Repairing CTC roller.....	75
Figure 4.2b	Standby CTC rollers	75
Figure 4.2c	CTC rollers in use	75
Figure 5.1	Annual tea production	89
Figure 5.2	Monthly production	90
Figure 5.3	Monthly production, Esperanza/STECO	94
Figure 5.4	Monthly production, Esperanza/Sayama	94
Figure 5.5	Tea prices	102
Figure 5.6	Average monthly prices, Esperanza/STECO	104
Figure 5.7	Average monthly prices, Esperanza/Sayama	106
Figure 5.8	Monthly labour productivity	109
Figure 5.9	Labour productivity, Esperanza/STECO	111
Figure 5.10	Labour productivity, Esperanza/Sayama	113

CHAPTER 1

INTRODUCTION

1.1 Background

The National Economic Council (1998) summarizes Malawi's long-term development aspirations expressed in a Vision that states:

By the year 2020, Malawi as a God-fearing nation will be secure, democratically mature, environmentally sustainable, self reliant with equal opportunities for and active participation by all, having social services, vibrant cultural and religious values and being a technologically driven middle-income country. (p. v)

The Vision was developed based on the application of the National Long-Term Perspective Studies (NLPTS) approach that, according to the National Economic Council (1998) was formulated by the African Futures Group in Abidjan.

Reading through the Vision, Malawi aspires to achieve sustainable growth and development and become a middle income country by the year 2020. Sawyer & Sprinkle (2004) quoting the World Bank (2002) put the Gross Domestic Product (GDP) per capita of middle-income economies at US\$2,046. Keegan (2004) categorizes the middle income countries into two, the Upper Middle-Income representing countries with a Gross National Product (GNP) of between US\$3,126 and US\$9,655; and Lower Middle-Income where countries with GNP ranging from US\$785 to US\$3,125 are categorized. The United Nations Development Programme (UNDP)(2005b) indicates that Malawi's GNP per capita has actually been declining in recent years; dropping from US\$210 in 1998, when the Vision was formulated, to US\$113.40 in 2001; rising slightly to US\$ 151.50 in 2003. With this type of performance, Malawi is destined to miss its aspirations by a wide margin. This situation is exacerbated by the recent closures of companies that would otherwise have helped the economy become more productive. According to the Management Development Centre (MDC) (2002) by the year 2000, 21 companies had shut down while another 26 were struggling.

Globally, the United Nations General Assembly in 2000 set eight development goals, christened Millennium Development Goals (MGD), that countries of the world are expected to achieve by year 2015. The first goal, according to UNDP (2005a), is to “Eradicate extreme hunger and poverty; halving the proportion of people living on less than one dollar a day and halving malnutrition” (p 39). This goal is less ambitious than the Vision 2020 that Malawi has set for herself. However, going by the actual performance as observed above, Malawi is bound to miss both the Vision 2020 and the Millennium Development Goals by wide margins.

It, therefore, becomes imperative that ways of turning around the Malawi economy be identified. This task can be achieved, among other means, through industrial development. The development, however, should not just concentrate on attracting new investment but also on sustaining the existing industries. Realizing this noble cause, a number of scholars and other stakeholders have studied the causes of poor performance of the manufacturing industry in Malawi with the aim of identifying its root causes and subsequently making suggestions and recommendations for improvement. Among those that have written on the causes of poor performance of companies in Malawi are the Ministry of Economic Planning and Development (MEPD), the Management Development Centre of the University of Malawi (MDC), Moloko, H.B., Chunda, J. and Changaya, F S. This paper adds onto the knowledge generated by the earlier works by looking at the role of technology on the performance of the manufacturing industry, using tea industry as a case study.

The MEPD (2004) lists tea as the second largest export earner for Malawi, after tobacco, accounting for nearly 10 percent of the total export earnings. In fact, the Ministry claims that Malawi is the second largest producer of tea in Africa, after Kenya; accounting for four percent of the world annual tea exports. This gives tea an important role in helping Malawi fulfill both the Millennium Development Goals and the Vision 2020. Despite this important position that tea holds in the Malawi economy, tea-producing companies have not been spared from poor performance. I Comforzi Tea Estates Limited went under receivership in 2000 while Chagwamjira & Company (Legal Practitioners) gave notice of the appointment of a liquidator for Mbozi Tea Factory Limited in May 2006, attached as APPENDIX 8. In addition, the MEPD

(2005) reported that Chitakali Tea Estate Limited and Smallholder Tea Company (STECO) were struggling to survive.

This dissertation investigates the role of technology on performance of tea manufacturing industry by looking at four tea companies. The analysis looked at the way technology is managed and the processing methods adopted in the sampled companies. Performance of the companies was then assessed by analyzing the relationship that technology management styles and the processing methods have on production volumes, quality of tea produced as manifested through the prices the tea fetches at the tea auction and labour productivity. The differences in production volumes, tea prices and labour productivity were then used to draw conclusions on the role that technology has on the general performance of the companies.

1.2 Statement of Problem

The National Economic Council (1998) states that Malawi aspires to become a middle income country by the year 2020; this implies improving its GNP that the UNDP (2005 b) reported was at US\$151.50 in 2003 to at least US\$785.00; the GNP considered as the minimum production for lower middle income countries as classified by Keegan (2004). In order for the aspiration to become middle income to be met, MEPD (2004) states that the Malawi Government prospects medium-term (2004-2008) sectoral annual economic growth to be as given in Table 1.1.

However, this optimism is overshadowed by poor performance of some of the sectors where the prospective growth is expected to come from.

Table 1.1 Prospective Medium -Term Sectoral Annual Economic Growth

Sector	Annual Growth
Agriculture	7.8%
Manufacturing	5%
Agro-processing	6.8%
Textile and Garments	13.8%
Mining	9.4%
Tourism	9.6

Source: MEPD (2004)

The table above indicates that the Government of Malawi expects the Manufacturing sector to annually grow by 5%. The prospect of achieving growth, however, is threatened by closing companies.

1.3 Project Rationale

Closure of companies is putting the economic development of Malawi at a disadvantage. Any effort working towards averting the company closures will help arrest or even turnaround the fortunes of the country. This dissertation attempts to explain the closures by looking at the technology dimension in the performance of tea manufacturing industry with the aim of helping managers make informed decisions regarding upgrading or replacing machinery and equipment in their factories. This has been achieved by showing the impact of having a functioning preventive maintenance programme and selecting better processing technologies in a competitive business environment.

1.4 Research Question

This research is designed to answer the research question:

What role does technology play in the performance of tea manufacturing industry?

The research question is answered by considering the main objective and three specific objectives given hereunder:

1.5 Objectives

The main objective of this research is to investigate the role of technology on the performance of tea manufacturing industry.

This objective is met by studying four tea producing companies as a case study in the tea producing district of Mulanje through addressing the following specific objectives:

- 1) To assess the role of technology on production volumes (quantity).
- 2) To assess the role of technology on quality of tea.
- 3) To assess the role of technology on productivity of the tea industry.

1.6 Scope of Study

1.6.1 Assumptions

The following two assumptions were made in the execution of this research. The first assumption was that tea manufacturing knowledge among management and personnel of the companies under review is adequate to run the factories efficiently. This assumption was made on the basis that management in all the companies has been in the industry for more than seven years. In addition, most of the knowledge was gained on the job. With such an assumption, production problems, where they existed, were assumed to be purely a result of deficiencies in the technologies in use. Secondly, it was assumed that prices offered at the auction were purely a reflection of the quality of the tea on offer.

1.6.2 Limitations

In order for the results of the study to qualify for generalization, a probabilistic sample was required; however, this study settled for judgemental sampling in a case study as the objective was to study both struggling and thriving companies hence a deliberate move to have representation from both categories.

The tea bushes in Malawi were grown with human plucking in mind, thus despite the availability of tea plucking machinery on the market, the research was unable to establish the impact the use of such machinery would have on tea quality as well as productivity.

1.6.3 Study Significance

In line with the aspirations of Malawians, that is, to become middle income by the year 2020 and to achieving the Millennium Development Goals as propagated by the United Nations, Malawi needs to grow economically. Since the tea industry is the second most important foreign exchange earner, accounting for nearly 10 percent of export earnings, it is significant that ways of improving the industry are identified. Results of this research are expected to help managers in the manufacturing industry, in general, and tea manufacturing industry, in particular, to develop technology programmes that will help curb company closures. In essence, the research shows

how technology can be manipulated to improve product quality, quantity and labour productivity.

1.6.4 Related Study Areas

In the course of this work, it was observed that both Eastern Produce (Malawi) Limited and Lujeri Tea Estates Limited have a number of estates scattered in the tea growing districts of Thyolo and Mulanje. The factories are actually spread in a fifty-kilometer radius; this factor generates interest for an investigation on whether the laws of synergy would not apply in the tea manufacturing industry.

1.7 Report Outline

This dissertation comprises seven chapters. Chapter 1 gives the background against which this research has been conducted. Within the chapter, problem statement and the rationale of the research have been discussed; the research question and research objectives have also been outlined in detail. The rest of the chapters are as follows:

Chapter 2, Literature Review

The chapter critiques work of similar theme that was done by other researchers; in addition, the chapter analyses work by other researchers and practitioners who have looked at the impact of technology on the tea industry. The chapter also provides information on preventive maintenance and tea processing; two variables that are pivotal to this research.

Chapter 3, Research Methodology

The chapter on Research Methodology outlines the methods that were used in conducting this research. The chapter states how the sample was selected, how data was gathered, analyzed and interpreted.

Chapter 4, Description of Sampled Companies and Tea Auctioning

Chapter 4 gives brief descriptions of the sampled companies, how they care for their technologies and the type of processes they follow. The chapter also gives a synopsis of the tea auctioning at Limbe Tea Auction.

Chapter 5, Results and Discussion of Results

This chapter provides research results and analysis of the results. The chapter also interprets the results.

Chapter 6, Conclusions and Recommendations

The Conclusions chapter outlines conclusions that were drawn from the research and makes recommendations on how the research results can be used to improve performance of companies in the sector of study. Finally the chapter reflects on whether the results of the research have answered the research question.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The previous chapter provided the aspirations of Malawians through Vision 2020. The chapter also outlined the challenges Malawians face in their quest to realize their aspirations. In addition, the chapter provided the problem that this research intends to address through the research question and corresponding objectives. The chapter concluded by giving a brief outline of this document.

This chapter gives a background to work done by other researchers who have helped decipher what Malawians need to do in order to make their Vision a reality. In addition, technology has been defined. The role of technology in performance of the manufacturing industries has been outlined, giving special interest to the tea industry. The chapter also explains how machinery and processes can impact on the survival of a firm. The impact of machinery is explained through maintenance programmes that a firm can put in place; whereas impact of processes is explained through how various methods can map the competitiveness of an organisation.

The chapter concludes by introducing the tea making process and reviewing how each process can impact on productivity of a tea producing firm.

2.2 Works by Other Researchers

Following closure and struggling of a number of Malawian companies, a number of scholars have shown interest in work that was designed to explain reasons why Malawian companies are struggling, some even closing down. Among the researchers that have worked on topics aimed at explaining causes of poor performance of Malawian companies are Moloko, Changaya and Chunda. Moloko (2004) in a research entitled *Causes of Company Failure in Malawi: the Case of David Whitehead & Sons Ltd*, looked at financial, marketing and investment policies of David Whitehead and Sons Limited. The researcher's interest was to establish if management of the three areas could have caused the demise of the company. The research intended to infer that Malawian companies perform poorly due to the way the management handles financial,

marketing and investment issues. Changaya (2005), on the other hand, focused on shortfalls of marketing as causes for company failure in Malawi. This was done through a research entitled *Lack of Sound Marketing is the Opium for Companies' Closures in Malawi*. Changaya looked at marketing deficiencies and gaps between good marketing principles and marketing practices. Chunda (2005), on his part, looked at the reliability of electricity supply to manufacturing industry through a research entitled *The Impact of Electricity Supply on Manufacturing Industries in Malawi*. Chunda's work assessed the impact of electricity supply interruptions and tariffs on the performance of the manufacturing industry in Malawi. In addition to the three researchers, the Management Development Centre (MDC) of the University of Malawi and the Ministry of Economic Planning and Development (MEPD) also worked on the subject of companies struggling and closing in Malawi.

The MDC (2002) in a paper entitled *From Early Warnings to a Total Business Crisis: Formulating and Implementing Turnaround Strategies*, analyzed causes of poor performance of Malawian companies and proposed turnaround strategies. In the research, the MDC identified three main causes of poor performance; namely: wrong products, poor management and unfavourable Government policies. According to the MDC, poor performance is a result of wrong products that do not meet the needs of customers in type, quality and price either individually or a combination thereof. Secondly, management style is not conducive to doing business in the modern competitive environment. Lastly, the MDC associates poor performance of Malawian companies to Government policies and regulations. The MDC argues that Government policies and regulations erode the local companies' competitiveness. On its part, the MEPD (2005) conducted business interviews of 65 companies operating in various sectors of the economy. Twenty-six of the interviewed companies were in the manufacturing sector. Among the issues captured in the survey were those that affect smooth operations of the surveyed companies. In their responses on factors that negatively affected their operations, the manufacturing sector isolated economic, political, social and technological factors. The technological factors, however, were not rated significantly as only two out of a list of 21 factors were technological.

This research was designed to complement work such as the ones listed above so that the causes of poor performance of Malawian companies can be better explained. It is expected that future considerations of turnaround strategies for Malawian companies will consider the findings of this research.

2.3 The Role of Technology in Performance of Manufacturing Industries

Technology, according to Krajewski & Ritzman (2000), consists of three dimensions; these are know-how, physical things and procedures used in production of goods and services. They explain that know-how is the knowledge and judgement of how, when, and why equipment and procedures are employed. Physical things are the equipment and tools used in the processes while procedures are the rules and techniques used in operating the equipment and performing work. Thus according to the comprehensive definition of technology, the knowledge to plan, produce and market products most competitively is technology; the machinery and equipment used in the production of goods and services is technology and finally the procedures used in the production of goods and services are also technology.

Chartergee (2004) like Krajewski & Ritzman above also defines technology in the three dimensions. He defines technology as the transformation process through which machinery and knowledge skills are used to produce goods and services. In Chartergee's definition, equipment and knowledge are explicit whereas procedures are embedded in what he calls the transformation process.

This paper recognizes all the three dimensions of technology; however, the research concentrates on the role of technology as it pertains to machinery/equipment and processes. During the research it was observed that knowledge and skills in tea processing for the surveyed factories was largely obtained through on the job experience with few specialized courses for managers; consequently it was assumed that the acquisition of knowledge and skills levels off after working in the tea industry for seven or more years. With this assumption in mind, knowledge and skills in the sampled companies were also assumed not to be significantly different. The research, therefore, assessed the impact of machinery and the processing methods on the performance of the sampled companies.

2.3.1 Reasons for Acquiring Technology

The role of technology on performance of manufacturing industries, where technology is defined as machinery and equipment that is used in the production of goods and services, starts with acquisition decisions. Muhlemann et al. (1992) list four reasons that propel organisations to acquire technologies, namely:

1. for the production of new products or services;
2. for the expansion of the available capacity;
3. for the replacement of equipment that has become obsolete and/or changes that would help the organisation maintain competitiveness; and
4. for the replacement of equipment that has entered the wear-out phase of its life and must be replaced.

The first reason for acquiring technology, acquiring technology for the production of new products or services, is adopted where a company is being newly launched. The acquired technologies give it capacity to produce goods or services it wishes to offer. In case of an existing company, newly acquired technologies give it capacity to respond to market needs in products it may hitherto have had no capacity to produce. In this context, the firm undertakes to acquire technology as a response to changes in the external environment, which is the market. Thus the role of technology is to offer firms capacity to produce goods or services in response to market needs. In cases where the firm has pioneered the development of the technology, the firm gets a competitive edge over competitors.

The second reason for technology acquisition, which is to expand the available capacity, is usually undertaken in response to increased demand for existing products or services to levels that the organisation fails to cope with the existing capacity. In this case, the firm is able to meet the increased demand for its products, in the process achieving firm growth. Technology that is acquired in this way plays a role of providing growth to a firm. In addition to providing growth, the fact that the new technology would enable the firm meet market demand makes technology a tool for barrier to entry.

The third reason for acquiring technology as given by Muhlemann et al. (1992) is for replacing technologies that are limited to producing products that have become obsolete. Products go through a product life cycle (PLC). Kotler & Keller (2005) state that a product goes through four stages from its inception to death, namely: emergence, growth, maturity and decline. They state that demand for a product that is in the decline stage of its life cycle decreases. Thus a technology that was specialized to producing a product whose life cycle has reached the decline stage needs to be replaced by one whose products are in demand, most especially where the demand is rising. In these circumstances, replacement needs to take place even if the technology is still in usable condition. Clinging to the old technology would lead to, as observed by Kotler & Keller, business decline and eventual firm closure. Thus the role of technology, in this case, is to help firms sustain their businesses.

Lastly, technology is acquired to replace worn-out equipment. When technology has been acquired, Stevenson (2002) states, there would be need for maintenance in order to maintain the production capability of an organization. However, there reaches a time when breakdowns become frequent and/or costly such that replacement becomes the viable option. In this case, technology plays a role of maintaining the production capability of a firm.

2.3.2 Maintaining Production Capability of a Firm

Once the machinery and equipment has been acquired to play the various roles in a manufacturing industry as listed above, the production capability of the machinery needs to be sustained. The capability can be sustained through maintenance programmes accorded to the machinery. Wild (1998) gives a comprehensive purpose of maintenance, stating that it is meant to maximize the performance of equipment by ensuring the equipment's reliability and efficiency. Reliability, according to Wild, is achieved through minimization of breakdowns or failures while efficiency is achieved through cost minimization and high quality products.

SPM Instruments (2005) and Muhlemann et al. (1992) allude to three lives of technology, infant, adult and aged period, as stages a machine goes through after acquisition. The machine performance in terms of cost of operation and failure frequencies follow a bath-tub curve. SPM Instruments and Muhlemann et al. state that in the infant stage failure rate is high due to learning

challenges and, sometimes, factory errors. The adult stage that follows has the least operating cost and the best performance resulting from familiarity with the technology. Lastly comes the aged stage; at this stage the machine has lived through its economic life and most of its parts are worn-out. Running a machine in its aged stage, according to Stevenson (2002), is expensive and its products are unreliable both in quality and quantity. The bath-tub curve is as is given in Figure 2.1:

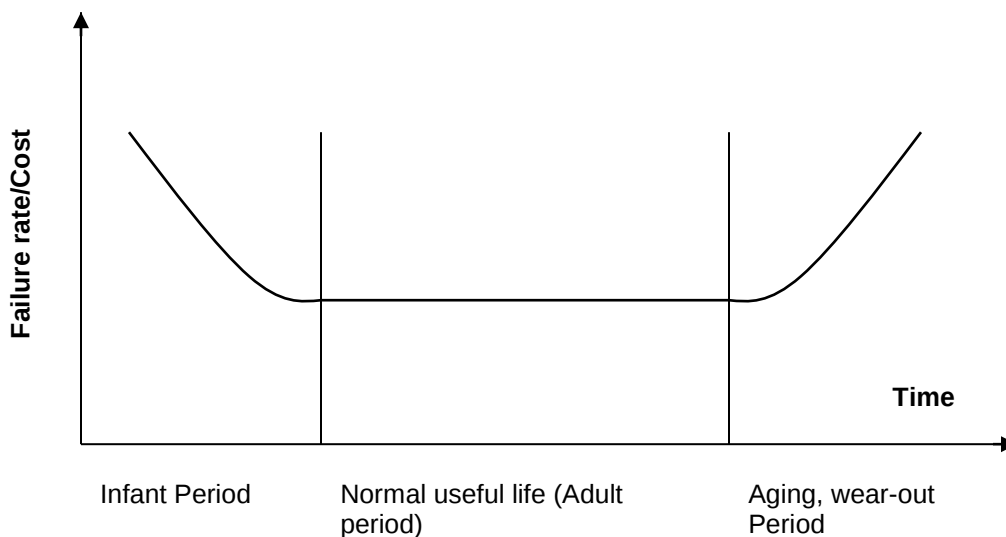


Figure 2.1 Bath-tub Curve (SPM Instrument, 2005)

In Figure 2.1, the infant stage failure rate is high; however, its cost is usually shared with the manufacturers who offer warranties. Costs due to learning curve are usually taken care of in the purchasing plans. The aging period, like the infant period, also has high failure rate. In addition, the aging period has high operational costs as there are no warranties to help absorb the operational costs. At this stage, the machinery needs replacement. Delays in replacing machinery yield inefficiencies as resources are spent on fixing the machines instead of production. In addition, Peterson (2002) observes, products from companies that operate machinery that is in the aged phase are of poor quality hence uncompetitive. The adult stage, with minimum failures, offers the most competitive operating conditions. In addition, familiarity with the equipment

offers best quality and quantity, hence minimum operating costs. In an effort to extend the adult life of machinery, hence sustain the organization's production capability, Peterson (2002) recommends the institution of maintenance programmes. He states that there are two generic maintenance programmes that firms can adopt; these are breakdown maintenance (BM) and preventive maintenance (PM).

Stevenson (2002) defines BM as the reactive approach to maintenance; that is dealing with breakdowns or problems when they occur. Wild (1998) on his part defines breakdown repair as fixing of a machine or operating system when it has stopped functioning. Wild adds that equipment of whatever type is liable to breakdown. Hence breakdown maintenance is inevitable, no matter what other programmes a plant might have. Stevenson, however, adds that repair costs in breakdown maintenance, when undertaken as a sole maintenance initiative, are very high. He cites hidden costs of lost production and cost of wages whilst equipment is out of service as additional costs to normal maintenance costs in BM systems. Muhlemann et al. (1992) adds poor staff morale and bad relations with customers as additional non-financial costs of breakdowns.

Preventive maintenance, on the other hand, is precautionary; it is undertaken to prevent or delay breakdowns, consequently the need for repairs, according to Wild (1998). Peterson (2002) on his part defines preventive maintenance as the undertaking of scheduled tasks aimed at correcting specific defect or failure causes. Wild argues that preventive maintenance (PM) can be undertaken under two circumstances. Firstly, PM can be undertaken according to a predetermined regular schedule. The schedule is established for items with a fairly predictable reliability or breakdown characteristics. Secondly, PM can be conducted as required when there is evidence of deteriorating efficiency or impending breakdown. Wild lists six main objectives of a PM programme, these are:

1. To enable product or service quality and customer satisfaction to be achieved through correctly adjusted, serviced and operated equipment.
2. To maximize the useful life of the equipment.
3. To keep the equipment safe and prevent the development of safety hazards.
4. To minimize the total production or operating costs directly attributable to equipment service or repair.

5. To minimize the frequency and severity of interruptions to operating processes.
6. To maximize production/operation capacity from the given equipment resources.

The six objectives clearly show how important PM is to sustaining productive capacity of a firm if they are all met. The product or service quality for the satisfaction of a customer is the heart of any manufacturing operation. As stated earlier, acquisition of equipment costs money; it is therefore only prudent to ensure that the useful life of equipment is extended to its maximum. The bath-tub theory relates the useful life of machinery to operating it in its adult stage. The theory indicates that production or operating costs directly attributable to equipment service or repair are minimized. Peterson (2002) likens machine maintenance, especially preventive maintenance, to a healthcare programme. He states that just as a healthcare programme is meant to sustain the function or condition of the body to perform certain activities, a maintenance programme is established to assure the likelihood of machinery or equipment to perform tasks for which it is meant when required to do so. Further to that, the performance of machinery should be able to impart into the product features and characteristics that Kotler & Keller (2005) state satisfy “stated or implied needs” (p. 146). Finally, equipment comes with its capacity. Realizing the production/operation capacity requires use of the equipment to its prescribed limits. This can only happen if the equipment is available for use. Maintenance enables the equipment to be available.

Operationalizing preventive maintenance programmes incorporates a number of strategies. Some of the strategies are predictive maintenance, total productive maintenance (TPM) and just-in-time (JIT). Stevenson (2002) defines predictive maintenance as a programme that determines when to perform preventive maintenance activities. This is done after establishing the period within which equipment would lose its reliability or breakdown. Stevenson goes on to define TPM as a Japanese concept where workers perform maintenance on machines they operate. Thus instead of having a separate maintenance personnel, the same machine operators conduct routine checks and perform preventive maintenance. Stevenson (2002) defines JIT is a production system in which movement of goods during production and deliveries from suppliers are carefully synchronized such that at each step of the process the next batch arrives for processing just as the preceding batch is completed. Krajewski & Ritzman (2000) put it more bluntly by

defining JIT as a waste elimination system where unnecessary inventory is cut and delays in operations removed. Thus in a preventive maintenance system, JIT is applied in resource mobilization. Spare parts and specialized technical personnel are assembled at the time they are required; consequently, financial resources are freed at times when maintenance needs are not required. For smooth operations, JIT is implemented together with TPM so that maintenance is conducted on continuous basis. In recent times, state Krajewski & Ritzman, JIT II has evolved; conceived and first implemented by Bose Corporation. JIT II refers to the practice of allowing vendors to manage some aspects of the supply chain on behalf of the buyer.

The fact that TPM and JIT advocate elimination of other functions or departments within an organization, the systems are synonymous to lean production systems. Lean production systems, according to Stevenson (2002), operate with optimal inventory and workers; consequently eliminating space wastage.

2.3.3 Technology as a Competitive Tool

Stevenson (2002) defines competitiveness as a measure of how effectively an organisation meets its customers' needs relative to other organisations offering similar or alternative goods and/or services. He alludes to the need for companies to be competitive if they are to sell goods or services and in order for them to prosper; other wise, he states that they will barely get-by or even fail. Faulkner & Bowman (2002) contend that competitive strategy is about meeting the needs of customers more effectively than competitors are able to meet them. In case of tea, which is sold on auction where customers determine the price at which they are willing to buy the product it becomes crucial that their expectations are met or even surpassed if higher prices are to be offered.

While commenting on what technology can do to companies that refuse to adopt new technologies as they appear on the market, Kotler & Keller (2005) best summarize the need to move with the times by stating "instead of moving into the new technologies, many old industries fought or ignored them, and their businesses declined" (p.92). Thus those companies that felt they did not need to replace their old technologies with modern ones found themselves being less and less competitive, hence struggling or closing. They conclude by stating that the

single most important source of economic growth in the United States has been technological change. This view is echoed by Krajewski & Ritzman (2000) who state that technology is probably the most important force driving the increase in global competition. According to them, companies that invest and apply new technologies tend to have stronger financial positions than those that don't. This implies that technology, where technology is defined as processes, is very important to companies intending to strengthen their competitiveness.

Porter (2004) suggests three generic competitive strategies that enterprises can adopt to fend off competition; these are overall cost leadership, product differentiation and market focus. Porter describes cost leadership as the optimization of economies of scale, cost reduction from experience, overhead cost control and cost minimization in complementary work such as R&D, service, sales force and advertising. Here Porter is considering technology as a process. Thus despite products having similar features and fetching the same price, the firm that is using more efficient processing methods gains a competitive edge, cost leadership. Underlying Porter's cost leadership strategy is the aspect of productivity. Robins (2004) defines productivity as the achievement of goals through transferring of inputs into outputs at the lowest cost. While Statistics Canada (2005) defines productivity as the amount of output (what is produced) per unit of input used. This implies that high productivity is achieved where the cost of production is lowest. Stevenson (2002), on the other hand, defines productivity as an index that measures output of goods and services relative to inputs. The inputs are listed as labour, materials, energy and other resources. Wells et al. (1999), as quoted by Statistics Canada (2005), say productivity can be input specific, such as labour productivity or multifactor productivity where more than one input is considered. Thus whereas all the definitions give productivity as a ratio of output upon input, Stevenson and Wells et al. distinguish input specific productivity from multifactor productivity. They explain that in multifactor productivity a combination of inputs are considered when solving for productivity. Thus a firm that is practicing cost leadership thrives on high levels of productivity.

Porter (2004) regards product differentiation as the offering of a product or service, within an industry, that is perceived to be unique. The uniqueness can come about through any of the following means; design or brand image, technology, customer service or dealer network. The

factors that bring in uniqueness are a result of processing decisions taken by the manufacturer or service provider.

The last Porter's generic competitive strategy, the strategy of market focus, is about focusing on a particular buyer or segment of a product or focusing on a particular geographic market. This strategy, looked at from a technology perspective, also fits the process strategy. A firm can choose to be processing for a specific market by embedding in its production system features that would enable it meet the needs of that particular market.

Stevenson (2002) suggests seven competitive strategies, namely; price, quality, product or service differentiation, flexibility, time to perform certain activities, service and management and workers. A closer look at Stevenson's strategies reveals that they fall within two of Porter's strategies; the strategy of cost leadership and that of product differentiation. Price and workers fall within cost leadership as the workers competencies and motivation are likely to be used to lower the production cost hence giving the firm a cost advantage. The rest of Stevenson's strategies can easily fall within product differentiation as they are basically helping the firm offer a product or service that is unique to the firm, consequently giving the firm a competitive edge.

According to Stevenson (2002), "Technological changes in products and processes can have major implications for production systems; affecting competitiveness and quality" (p. 25). This statement summarizes the role of technology as a competitive tool. In the summary, technological changes in products would mean changes in the quality of products resulting from changes in state of machinery through normal wear and tear. This change can be delayed through maintenance programmes that firms can put in place. Changes in product can also come about by changing tastes of consumers such that products that can be made by existing technologies become obsolete. This change can be countered by replacing the existing machinery with new machinery that is able to produce products whose demand has substituted the obsolete products. Technological changes in processes are those changes that make certain processes offer cost leadership or product differentiation. In cost leadership, a firm is competitive as its overall costs are lower than those of competitors. In product differentiation, a firm is competitive as it offers products in a form that customers are willing to pay more than they would pay competitors.

2.4 Technology and Performance of the Tea Industry

2.4.1 *Factors Influencing Tea Quality*

The Lanka Ceylon Teas Limited (2000) lists six factors that influence tea quality; these are: the strain of the tea plant, the soil composition, the extent of sunshine and air temperature, the extent of humidity in the air, altitude at which it is grown and produced and type of manufacturing (processing and grading). The six factors can be classified into two general areas; the first being geographic/climatic factors, the other technological factors. The factors of soil composition, the extent of sunshine and air temperature, the extent of humidity in the air and the altitude at which tea is grown can be classified as geographic/climatic factors while the strain of the tea plant and the type of manufacturing are technological factors. These factors influence the tea quality on the way the tea plant thrives and on attributes that are expected from the finished product, the processed tea.

2.4.1.1 Geographic/Climatic Factors

The geographic/climatic factors generally influence the well being of the tea plant, in the process, the plant acquires characteristics that are favourable to the quality of the tea. Following are the factors considered individually.

1. *Soil Composition*

The Tea Association of Malawi (1991) states that tea bushes thrive well in acid soils. The Association adds that tea was introduced to Mulanje, despite the first plants being planted in Blantyre because local tea pioneer, Henry Brown, found Mulanje soils to be acidic, just like those of Ceylon, now Sri Lanka, where he had come from. However, as the Darjeeling Tea Research and Development Centre (DTRDC) (2003) asserts, maintenance of good soil structure and fertility as achieved through soil husbandry practices are vital management considerations for tea soils.

2. *Sunshine and air temperature*

The Tea Fountain (2004) gives climatic conditions under which tea flourishes as having a minimum temperature of 18°C, with no or infrequent frosts and a good balance of sunshine. Under such conditions and good rainfall, the Tea Fountain believes that a tea plant can remain

productive for up to 100 years. The DTRDC (2003) explains that tea grows in temperatures of between 8°C and 35°C. Its experience was that the extension growth stops when monthly mean maximum and minimum air temperatures are within 19.4°C and 12.4°C. The plants start flushing when mean maximum and minimum temperatures exceed 21°C and 14°C respectively. DTRDC observed highest yields when mean maximum and minimum temperatures were 23.5°C and 18.3°C. The DTRDC also recommends minimum and maximum soil temperatures suitable for growing tea as 20°C and 29°C when observed at 0.3 metres under short surface overgrowth or 16°C and 25°C when temperature readings are taken beneath a tea canopy.

3. *Humidity (Rainfall)*

Rainfall for tea growing areas is required to be high and well distributed throughout the year, this being the case since tea is a perennial crop. The Tea Fountain (2004) recommends annual precipitation of 1600 mm. The DTRDC (2003) and Café Direct (2006), on the other hand, give the minimum annual rainfall for cultivation of tea as 1150 mm. They advise that tea should not be grown in areas where annual rainfall is below that level, unless irrigation is available. In addition, DTRDC emphasizes the need for the distribution of the rainfall over the year, stating that it is as vital that the rainfall be evenly distributed throughout the year.

4. *Altitude*

The Lanka Ceylon Teas (2000) and Café Direct (2006) state that tea thrives at altitudes of near sea level to just above 2000 metres above sea level. They claim that the altitude affects flavour, taste, and colour of the brewed beverage. From their experience, teas grown at lower altitudes brew darker coloured beverages, whereas those grown at higher altitudes, above 1500 metres, brew a bright, lighter coloured beverage with sought after flavours and taste. Chiu (2006) agrees with the two by explaining that high elevations are most favourable for the production of quality tea. In fact, the highly rated Darjeeling teas, according to the Tea Fountain (2004), are grown at altitudes of 2000 metres on the Himalayan slopes while the lower prized Assam teas grow on either side of the Brahmaputra River. The DTRDC (2003) confirms this by stating that Darjeeling teas grow at altitudes of over 1100 metres.

2.4.1.2 *Technological Factors*

Technology as was defined earlier by Krajewski & Ritzman (2000) and Chartergee (2004) is about know-how, physical things and procedures used in production of goods and services. Thus the development of special tea strains resulting into superior tea plant is considered technology, the procedures used in producing tea that is ready for the consumer is technology and the machinery that is used in the production process is also technology. Hence in classifying the factors that influence tea quality, plant strain factors and manufacturing processes and machinery have been taken as technological factors.

1. *Strain of Tea Plant*

The Tea Man (1996) reveals that tea plants that are grown today are an embodiment of a number of changes that have been done in an effort to improve the characteristics that consumers look for in tea. Thus technological changes have given growers a plant that exhibits superior qualities to the natural plant discovered centuries ago. Chiu (2006) supports this position by stating that cultivars exhibit different fermentation ability, chemical components and agronomic characters. Hence time has provided mankind a tea plant that has inherent characteristics that meet customer expectations, consequently giving it an edge over competition. In Malawi, the Tea Research Foundation (TRF) is responsible for coming up with better quality tea. As a consequence, Malawi tea is gaining reputation on the international market (APPENDIX 6).

2. *Manufacturing Process and Grading*

Tea is manufactured using a continuous manufacturing process. Stash Tea Company (2006) and Turkish Tea (2004) give a summary of black tea production that they claim is a generic process followed the world over. The process has six production stages as given in Figure 2.2:

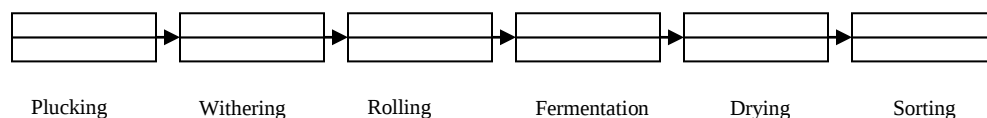


Figure 2.2 Tea Production Flow Chart (Stash Tea Company, 2006)

When tea is made and ready for the market, it is tested to ascertain its quality by the manufacturer, the tea broker and the buyer. Special terminology is used to describe specific tea characteristics. APPENDIX 5 gives tea testing terminology and its meaning. The APPENDIX has only covered terminology that describes characteristics that are affected by the production methods and conditions, as referred to in this section. The APPENDIX was adopted from Tea Brokers Central African Limited.

Details of the tea manufacturing processes and their effect on product quality are as follows:

i. Plucking

The first stage in tea manufacturing is that of plucking. Since tea is a perennial crop, plucking takes place throughout the year. Owing to the seasonal rainfall patterns in Malawi, the Tea Association of Malawi (1991) states that tea plucking is also seasonal. According to the Association, tea plucking starts peaking in November at the onset of the rainy season. Harvesting increases through December where it peaks and remains high up to April. Harvesting starts dropping towards the end of April and reaches minimum levels in June-July. The Tea Association claims that the cycle starts again in October-November.

Stash Tea Company (2006) explains that black tea is made from the vegetative part of the tea bush. In this way, pluckers are advised to pluck the topmost two leaves and a bud as in Figure 2.3. This is so, as Tea Auction (2006) asserts, because it is in the young leaves and a bud where enzymatic action necessary for the production of tea is most active.



Figure 2.3 Two leaves and a bud (Stash Tea Company, 2006).

Tea Auction (2006) and Lanka Ceylon Teas (2000) elaborate that it is only the young shoots, of two leaves and a bud that produce tea of the highest quality.

Mechanical tea harvesters are available. However, in Malawi, as well as other parts of the tea growing world, so states the Tea Association of Malawi (1991), plucking is done by hand using both skilled and unskilled workers. The use of workers of varying skills means that, besides the targeted young leaves, some mature leaves and stems are also plucked. The mixing of mature leaf with the young leaves of two leaves and a bud, as stated by Lanka Ceylon Teas (2000), leads to production of different tea grades that reflect the leaf quality. *Tip* as explained in APPENDIX 5 is a term that refers to tea made from well plucked leaves of two leaves and a bud. Thus high quality production would be assured if quality control systems that would ensure only good quality leaf is forwarded are put in place.

ii. Withering

Freshly plucked tea leaves, explains the Tea Auction (2006), contain 70-80% water. This moisture is reduced to 60-65% through the withering process, technically referred to as flat bed withering. In withering, the leaf that has been approved for processing is spread over the drying troughs in layers not exceeding 15 centimeters. Warm air of approximately 32°C is then blown through the leaves. The leaves are regularly tumbled to even out the withering. The process, according to Tea Auction (2006) and Tea Man (1996) takes between eight and twenty hours, depending on the condition of the leaves. Thus withering is the longest process in tea production. The Tea Fountain (2004) explains that withering makes the leaves soft and pliable, characteristics that are suitable for the subsequent rolling process. The Tea Fountain continues to state that withering is best achieved in tender leaf, arguing that mature leaf is difficult to wither hence would affect the efficiency of the subsequent processes.

During withering, it is important that temperature is maintained around 32°C in order to achieve the desired leaf pliability. Higher temperatures, as would be achieved in sun-drying, would provide quick drying but would at the same time inhibit the enzymatic activity that is key to tea production. Lower temperatures would make the drying too slow, consequently extending the already long process. The temperature is obtained through a steam heated heat exchanger. The drying air is generated by drying fans that continuously blow through the heat exchanger at the

stacked leaf on the drying racks. Thus, in order to get effective withering, both the fans and the steam boiler need to be maintained regularly.

Tumbling is done by hand, experience is necessary to ensure that all the leaf is exposed to the drying air equally. Figure 2.4 shows withering in progress; green leaf on withering racks and leaf tumbling personnel.



Figure 2.4 Withering tea (Esperanza Tea Factory, 2006)

iii. Rolling

Rolling, according to the Tea Fountain (2004), is a process during which withered tea is mechanically cut, ground and rolled through a succession of machinery until tea cells are broken and exposed to air. The exposure to air initiates an oxidation process. Thus critical in the rolling process is the ability of the equipment to break the tea leaves including the cells such that oxidation is enhanced. Due to this critical function, Lanka Ceylon Teas (2000) declares that rolling, to a large extent, determines the quantity and quality of tea a firm can produce. The Tea Fountain states that there are four rolling methods that are used in commercial tea production, the orthodox method, the crushing, tearing and curling (CTC) method, the rotorvane method and the Lawrie Tea Processor (LTP) method. In the orthodox method, rollers crush the withered leaf against a table in a circular motion. The use of the rollers in the orthodox method, according the Tea Fountain (2004), is what led to the process being called a rolling process. Critical in the method is the clearance between the rollers and the table. As wear and tear sets in, the clearance

increases, consequently reducing the crushing efficiency. The orthodox process is a batch process; implying that it is a slow process. The Tea Association of Malawi (1991) states that the orthodox tea processing method has been phased out in Malawi. In the CTC method, two stainless steel rollers are meshed closely; however, one roller rotates at a speed ten times the other. Tea leaves are crushed as they pass in between the rollers. Just like in the orthodox method, the clearance between the two rollers is critical for effective maceration of the leaf. In the rotorvane method, the crushing action is achieved through the action of an Archimedes screw (formed from a rotor-shaft and vanes) and a blade. In this method, withered leaf is fed through a hopper fitted at one end of a barrel. The leaf is crushed as it is conveyed through the barrel. The crushing and cutting is finalized by a rotary blade fitted at the other end of the barrel. In a rotorvane method, it is the vanes and the blades that wear in use since the barrel is made of stronger material. If production continues when the vanes and blade require replacing, the produced tea ends up being *choppy* (APPENDIX 5) requiring further cutting at sorting stage. The secondary cutting reduces the appeal of such tea.

In some establishments, crushed leaf from the rotorvane is further crushed through the CTC method in a rotorvane/CTC combination method. Figure 2.5 shows crushed tea leaves coming out of a rotorvane, falling onto a conveyor feeding the CTC in a rotorvane/ CTC combination method.



Figure 2.5 Rolling tea using rotorvane/CTC method (Sayama Tea Factory, 2006)

The last rolling method, the LTP technology, was borrowed from the cereal hammer-mill. In fact, the Tea Association of Malawi (1991) reveals that the LTP method was developed in Malawi by the British African Tea Estates Group of Companies under the tutelage of Mr Lawrie. The LTP method took its name after Mr Lawrie. In the LTP, beaters/knives spin at high speed in a crushing chamber. Withered leaf is fed from the top and through the effect of gravity it enters the crushing chamber. In the chamber, the leaves are pulverized in the same way cereals are milled. Continuous use in the LTP method leads to beaters wearing out. Thus effective rolling requires regular maintenance or replacement of the beaters. Owing to its origins, the Tea Association of Malawi claims, the LTP method is more popular in Malawi than the CTC method. Tea Fountain (2004) states that the CTC method is popular in India.

iv. Oxidation/Fermentation

The third stage in tea production is fermentation, also called oxidation. In the oxidation process the macerated tea is allowed to react with oxygen from the air. During the reaction, the Tea Auction (2006) asserts, polyphenols and enzymes of cell sap that are most active in a growing leaf react with oxygen causing fermentation (oxidation); as a result of this process, *theaflavins* and *thearubigins* levels in the tea leaves rise turning the green leaf colour to copper (as shown in Figures 2.5 and 2.6) and developing a distinct aroma.

In orthodox tea production as provided by Tea Fountain (2004) and Tea Man (1996), the crushed tea from the rolling process is spread out in layers of approximately ten centimeters high and left to react for one to three hours in a cool, damp atmosphere. When the colour turns copper and the aroma develops the person supervising the process knows how far the fermentation has progressed. The chemical reactions during oxidation cause the leaf temperature to rise. It is critical for the quality of the tea that the fermentation process be stopped at its peak, when the temperature has reached its maximum. This, the Tea Fountain declares, is achieved through drying.

On the other hand, modern fermentation occurs through a continuous process on conveyors, the Continuous Fermenting Machines (CFMs) as shown in Figures 2.5 and 2.6. In this method, macerated tea is spread on a conveyor to an even thickness that, according to the Tea Auction

(2006), is approximately five to eight centimetres. The conveyor is driven by a variable speed motor whose speed is adjusted to a level that allows the leaf to ferment to its optimum levels by the time it reaches the end of the conveyor, just before entry into the drying oven. On CFMs fermentation takes between 45 minutes to three hours. Recognizing that the oxidation process emits heat, an exothermic process, cooling fans are placed along the length of the conveyor such that the temperature is maintained between 28 and 30 degrees Celsius.



Figure 2.6 Fermenting tea, green leaf at the start of fermentation process (Sayama Tea Factory, 2006).



Figure 2.7 Fermenting Tea, leaf changing colour to copper (Sayama Tea Factory, 2006).

Figures 2.6 and 2.7 show the change in leaf colour during the fermentation process. The macerated green tea leaves turn coppery as fermentation takes place.

Malawi has phased out the orthodox process of tea fermentation; The Tea Association of Malawi (1991) attests that all tea factories have converted to continuous fermentation. In the continuous fermentation processing, it is important that the effective fermentation period remains constant after optimization. For this to be achieved, the conveyor drives need to be reliable in maintaining constant speed. The other critical factor is the maintenance of a warm temperature of between 28 and 30 degrees Celsius. The warm temperature ensures that fermentation takes place; it is neither too cold nor too hot to inhibit fermentation.

v. Drying

The fermentation process needs to be stopped when optimum levels of *theaflavins* and *thearubigins* are reached, otherwise the tea quality will also degenerate. Drying is the process that arrests oxidation by reducing moisture content of the tea leaves. The Tea Auction (2006) explains that the fermented leaves have a moisture content of between 45 to 50 percent; this moisture is reduced to between three and four percent through drying. Drying is achieved through blowing of hot air through the fermented leaves as they are conveyed through the drying chamber. The drying process, according to the Tea Auction, takes about 20 minutes. Dry tea is then ready for sorting.

Effective drying, according to Tea Auction (2006), is achieved at temperatures ranging from 80 to 130 degrees Celsius. The heat is supplied by blowing air through steam heated heat exchangers. The hot air passes through wet tea that is conveyed on a vibrating perforated bed. The drying oven is required to maintain the necessary temperature profile as well as the conveyance of tea such that the drying is through within 20 minutes. If the temperature is not properly controlled, tea might come out of the oven with too much moisture; a situation that would lead to the tea becoming *mushy* (APPENDIX 5). The Tea Auction advises that if the temperature is too high or the dwell-time too long, the tea becomes scorched and its taste becomes *bakey* (APPENDIX 5)

vi. Sorting and Packaging

The sorting process starts with the removal of leafstalks from the tea then grading it according to grain size using sieves of different mesh sizes. Stalk extraction, according to Aarkay Group (2005) is achieved through the use of stalk/fibre extractors. The stalk/fibre extractors are fitted with polyvinyl chloride (PVC) rollers that are charged with static electricity. The electricity attracts fibres and dust from tea as it passes underneath the rollers. The attracted fibres and dust are then scraped off the roller and conveyed into a receiving bin. Figure 2.8 shows the stalk extractor in action. If extractors are faulty and fail to extract the fibres and dust, a common occurrence in worn-out rollers, the produced tea is said not to be *clean* or is *coarse* (APPENDIX 5).



Figure 2.8 Extracting fibres and dust (Esperanza Tea Factory, 2006).

The clean tea is then sorted into different sizes using different mesh sizes. The Tea Association of Malawi (1991) states that there are two types of tea sorting machines that are in use in Malawi; the high speed sorters and the vibro-screen sorters. The high speed sorters are a collection of screens fitted on rectangular frames, positioned in a zigzag format one above the other. The topmost screen has the biggest mesh size; the subsequent screens underneath it are in reducing mesh sizes with the bottommost being a collection tray. Figure 2.9 shows two high

speed sorters that are in use at Esperanza Tea Factory. The mesh assembly vibrates at high speed, sifting the tea into various sizes according to the required grades.

Unlike the high-speed sorters where the screens are in the open, in the vibro-screen sorters, meshes are fitted on round trays that are enclosed. The mesh arrangement, like in the high speed sorters, also starts with the biggest mesh size at the top, the size reducing in the subsequent meshes. Operationally, the vibro-screen sorters also vibrate at high speed. Figure 2.10 shows a vibro-screen sorter in use at Sayama Tea Factory.



Figure 2.9 **Sorting tea - High Speed Sorter (Esperanza Tea Factory, 2006)**



Figure 2.10 **Sorting tea - Vibro-Screen Sorter; (Sayama Tea Factory, 2006)**

Tea Fountain (2004) and Tea Man (1996) state that there are four basic groups in which tea is sorted; these are leaf, broken, fannings and dust. They go on to add that the leaf grades do not necessarily indicate quality of the tea but rather refer to the leaf size. They inform that smaller grained tea is preferred for tea bags whereas larger grained is preferred as loose tea. If the sorting is properly done, where leaf sizes are the same, the tea is said be *even*. The sorted black tea is then packaged in multiwall paper sacks with an aluminium foil liner ready for auctioning. The aluminium foil is used as a moisture and aroma barrier. If tea gains moisture from the atmosphere it may gain an *earthy* flavour that is indicative of poor quality. The aroma barrier properties of the aluminium foil also retain the factory aroma of the tea.

2.5 Tea Production Outturn

Typically, according to the Tea Association of Malawi (1991), using the tea production processes explained above, four kilograms of green leaf is required for production of one kilogram of made tea. The Lanka Ceylon Teas (2000) on the other hand, state that it takes five kilograms of harvested leaf to produce one kilogram of black tea. Implying that Malawi tea has a higher made tea to green leaf outturn than Sri Lanka.

2.6 Summary

In the Chapter work done by other researchers who studied the performance of Malawian manufacturing industries with the hope of explaining the causes of poor performance has been cited. In the work done so far, technology took a backseat. Consequently, technology was not considered as playing a major role in determining the fate of manufacturing companies. As a result, no recommendation was made on how technology can help in turning around the struggling companies.

In the chapter, the role of technology, both as machinery/equipment and process, as obtained from literature has been reviewed. While emphasizing tea production, the role of technology in performance of manufacturing firms has been reviewed.

The oncoming chapter, Methodology, has presented methods that were followed in conducting this research. The methods were geared at identifying companies that once studied would demonstrate how technology would impact on performance of the tea industry.

CHAPTER 3

METHODOLOGY

3.1 Introduction

The previous chapter, Literature Review, gives a background to work done by other researchers who have helped explain poor performance of Malawian companies. In the review, it was observed that earlier works had their emphasis elsewhere other than technology. The chapter, on the basis of available literature, argued that technology plays an important role in the survival of manufacturing firms in general and the tea industry in particular. The chapter explained how machinery and processes can impact on the survival of a firm. In conclusion, the tea making process was introduced and a review of how each process impacts on productivity of a tea producing firm was made.

This chapter outlines the methodology that was used in conducting the research in order to answer the research question *'What role does technology play in the performance of tea manufacturing industry?'* It builds on the previous chapter by showing how technology, where it is considered as machinery/equipment and processes, can impact on performance of the tea manufacturing industry. In its structure, the chapter gives the research design, how the sampled companies were selected and data were gathered. The chapter concludes by presenting research hypotheses that would be used in testing the research data.

3.2 Research Design

This research was designed as a case study where four tea manufacturing companies were selected for analysis. De Vaus (2001) states that a case is the object of study or a unit of analysis about which information is collected. He goes on to state that there are three types of case studies, namely; theory testing case studies, theory building case studies and clinical case studies. De Vaus distinguishes the three by explaining that the theory building case study is a process where research begins with observations and uses inductive reasoning to derive a theory. On the other hand, a theory testing case study begins with a theory and uses observations to test the worth of the theory, deductive reasoning. Saunders et al. (2003) argue that case studies can be a

worthwhile way of testing existing theory. They state that research is designed in case studies to answer questions ‘why?’, ‘what?’ and ‘how?’ In clinical case studies, de Vaus (2001) elaborates, theories are used to understand a case. In this research a theory testing case study approach was adopted.

Saunders et al. (2003) suggest five steps that deductive research follows, namely:

- 1) Deduce the hypothesis;
- 2) Express the hypothesis in operative terms;
- 3) Test the hypothesis;
- 4) Examine the specific outcome of enquiry;
- 5) If necessary modify the theory in light of the findings.

In answering the research question ‘*What role does technology play in the performance of tea manufacturing industry?*’ and to meet the research objectives, ‘*To demonstrate the role of technology on production volumes (quantity).*’; ‘*To demonstrate the role of technology on quality of tea.*’ and ‘*To demonstrate the role of technology on productivity of the tea industry.*’, the following null hypotheses (H_0) with there corresponding alternative hypotheses (H_1) were deduced:

- 1) H_0 . There is **no** difference in mean monthly production from companies that have adopted breakdown maintenance and those that have adopted preventive maintenance programmes.
 H_1 . There is a difference in mean monthly production from companies that have adopted breakdown maintenance and those that have adopted preventive maintenance programmes.
- 2) H_0 . There is **no** difference in mean monthly production from companies that are using the LTP tea processing technology and those using the rotorvane/CTC tea processing technology.

- H₁. There is a difference in mean monthly production from companies that are using the LTP tea processing technology and those using the rotorvane/CTC tea processing technology.
- 3) H₀. There is **no** difference in mean tea prices for companies that have adopted breakdown maintenance and those that have adopted preventive maintenance programmes.
- H₁. There is a difference in mean tea prices for companies that have adopted breakdown maintenance and those that have adopted preventive maintenance programmes.
- 4) H₀. There is **no** significant difference in mean tea prices for companies that are using the LTP tea processing technology and those using the rotorvane/CTC tea processing technology.
- H₁. There is a significant difference in mean tea prices for companies that are using the LTP tea processing technology and those using the rotorvane/CTC tea processing technology.
- 5) H₀. There is **no** significant difference in mean productivity of companies that have adopted breakdown maintenance and those that have adopted preventive maintenance programmes.
- H₁. There is a significant difference in mean productivity of companies that have adopted breakdown maintenance and those that have adopted preventive maintenance programmes.
- 6) H₀. There is **no** significant difference in mean productivity of companies that are using the LTP tea processing technology and those using the rotorvane/CTC tea processing technology.

- H₁. There is a significant difference in mean productivity of companies that have adopted breakdown maintenance and those that have adopted preventive maintenance programmes.

Four tea manufacturing companies were then selected in order to provide data for the testing of the hypotheses.

3.3 Sample Selection

3.3.1 Sample Size

This research is based on a case study of four companies. De Vaus (2001) argues that a case study is a unit of analysis; as such, even one person can be a case. However, in this case study companies from two categories were required for analysis; hence the unit of analysis comprised more than one player. De Vaus recognizes this type of case study; he gives, as examples, communities and a block of houses as cases where more than one player is considered as a unit of analysis in a case study. For purposes of manageability, four companies were selected to form a case. In addition to manageability, the four offer an opportunity to have participants that have the required characteristics to fit the desired analyses.

3.3.2 Company selection

Tea producing companies have been selected for study because tea, according to the Ministry of Economic Planning and Development (2004), is the second largest export crop for Malawi after tobacco. This position gives tea an important role to play in the fulfillment of the country's development goals and aspirations. Another reason for selecting tea is that it is processed in factories concentrated within Mulanje and Thyolo districts; the two districts are within 100 kilometres of Blantyre. This factor makes it easy to identify companies with contrasting technology characteristics in close proximity. In addition, the closeness to Blantyre makes the research cost effective.

The research, being a theory testing case study, requires a sample that comprises companies possessing characteristics that would facilitate the testing of the theory; consequently, judgemental sampling was adopted. Saunders et al. (2003) describe judgemental or purposive

sampling as a technique where cases are purposefully selected to enable the researcher answer research questions and meet research objectives. Saunders et al. recommend this technique when working with small samples as what happens in case studies. This research investigates the role of technology in performance of a firm, hence there was need to stratify companies on the basis of differences in technologies that are in use. Thus from the definition of technology, where knowledge has been assumed to be equal, differences in state of machinery (that comes about due to maintenance programmes that are in practice) and processing methods were used to classify the companies. Based on this classification, companies that are practicing breakdown maintenance programmes were grouped together and two samples were selected from that category. Another category comprised companies that practice preventive maintenance; two samples were also drawn from this category. In selecting companies that follow preventive maintenance, efforts were made to select companies that have different processing methods, one using LTP tea processing method and the other using rotorvane/CTC processing method. Performance of the selected companies was then compared on the basis of production quantity, quality and labour productivity.

Earlier in Chapter 2 section 2.4.1.1, it was argued that climatic factors affect the tea quality. In order to eliminate influences of the climatic factors in the analysis of results, the selected companies were those that are in close proximity geographically.

3.4 Data Collection

In order to analyze the performance of the selected companies, quantitative primary and secondary data were collected. Pawar (2004) defines primary data as data that is collected through observations, questionnaires, interviews and focus group discussions. Pawar further quotes Stewart and Kamins' (1993) definition of secondary data where they state that secondary data consist of information by others that have been archived in some form. In the research, primary data about the sampled companies were collected through a questionnaire, attached as APPENDIX 1, and interviews. Secondary data, on the other hand, were collected from records kept at tea brokers and the sampled factories.

3.4.1 Primary Data

Data on the sampled companies were gathered through a prepared questionnaire (APPENDIX 1) that was administered through structured interviews. The questionnaire contained both closed and open questions. Key data gathered through the questionnaire were on monthly production volumes, tea processing procedures, maintenance programmes and factory labour figures. In addition, the history of the participating companies was also gathered through the questionnaire. Observations were used to gather data on how the production was carried out, noting areas of strengths and weaknesses in the production processes.

Data on the auction process was gathered through attendance at the tea auction. Through observations, the tea auction process was recorded. Additional information on the auction process was obtained through unstructured interviews that were conducted with some buyers at the auction.

3.4.2 Secondary Data

Data on tea auction prices were collected from auction records kept at Tea and Commodity Brokers Limited, one of the two brokers at the Limbe Tea Auction. In cases where the auction data were not available at the Broker, prices data were collected from files kept at the sampled companies. In this way, weekly sales data for three years, 2003, 2004 and 2005 were gathered.

3.5 Data Presentation and Analysis

3.5.1 Data Presentation

Data have been presented in prose, tables and graphs. Prose has been used to describe the participating companies, their history and current status; tables have been used to display production figures, sales prices and labour productivity. Graphs have been used to show patterns in production, prices and productivity.

3.5.2 Data Analysis

Data has been analyzed using statistical techniques. Both descriptive and inferential analyses have been used. De Vaus (2001) states that descriptive statistics summarize patterns while inferential statistics help in establishing whether findings from a sample can be extrapolated to a wider population. In this research, descriptive analysis has been used to indicate tea price distribution from the sampled companies. On the other hand, inferential analysis has been used to explain the cause-effect relationships between having a preventive maintenance programme and having higher prices, vis-à-vis better quality and high productivity. Inferential analysis has also been used to analyze the cause-effect relationship between use of a particular process and better prices and higher productivity. Dewberry (2004) and Field (2005) recommend use of independent samples *t*-test when testing mean differences where there is one independent variable and one dependent variable. As such, independent samples *t*-test was adopted in establishing statistical significance of mean differences. In the analyses, having a breakdown maintenance programme or having a preventive maintenance programme was used to assess the impact of machinery/equipment; while using LTP or rotorvane/CTC technology was used to assess the impact of different processing technologies. 95% confidence intervals, as recommended by Dewberry and Field, were used for statistical significance.

Box 3.1 gives the mathematical presentation of the six null hypotheses (together with their corresponding alternative hypotheses) that were tested in order to draw conclusions in an effort to answer the research question.

Box 3.1 Test Hypotheses

Impact of Machinery on Production (maintenance)

$$\begin{array}{ll} H_0 & : \quad \mu_{pm} = \mu_{bd} \\ H_1 & : \quad \mu_{pm} \neq \mu_{bd} \end{array}$$

Where H_0 = null hypothesis;
 H_1 = alternative hypothesis;
 μ_{pm} = mean production for companies with preventive maintenance programmes; and
 μ_{bd} = mean production for companies with breakdown maintenance programmes.

Impact of Production Process on Production.

$$\begin{array}{ll} H_0 & : \quad \mu_{ctc} = \mu_{ltp} \\ H_1 & : \quad \mu_{ctc} \neq \mu_{ltp} \end{array}$$

Where H_0 = null hypothesis;
 H_1 = alternative hypothesis;
 μ_{ctc} = mean production for companies with rotorvane/CTC processing technology; and
 μ_{ltp} = mean production for companies with LTP processing technology.

Impact of Machinery on Quality (Prices)

$$\begin{array}{ll} H_0 & : \quad \mu_{pm} = \mu_{bd} \\ H_1 & : \quad \mu_{pm} \neq \mu_{bd} \end{array}$$

Where H_0 = null hypothesis;
 H_1 = alternative hypothesis;
 μ_{pm} = mean prices for companies with preventive maintenance programmes; and
 μ_{bd} = mean prices for companies with breakdown maintenance programmes.

Box 3.1 Test Hypotheses (Continued)

Impact of Processing Methods On Quality (Prices)

$$\begin{array}{lll} H_0 & : & \mu_{ctc} = \mu_{ltp} \\ H_1 & : & \mu_{ctc} \neq \mu_{ltp} \end{array}$$

Where H_0 = null hypothesis;
 H_1 = alternative hypothesis;
 μ_{ctc} = mean prices for companies with rotorvane/CTC processing technology; and
 μ_{ltp} = mean prices for companies with LTP processing technology.

Impact of Machinery on Labour Productivity

$$\begin{array}{lll} H_0 & : & \mu_{pm} = \mu_{bd} \\ H_1 & : & \mu_{pm} \neq \mu_{bd} \end{array}$$

Where H_0 = null hypothesis;
 H_1 = alternative hypothesis;
 μ_{pm} = mean labour productivity for companies with preventive maintenance programmes; and
 μ_{bd} = mean labour productivity for companies with breakdown maintenance programmes.

Impact of Processing Methods on Labour productivity

$$\begin{array}{lll} H_0 & : & \mu_{ctc} = \mu_{ltp} \\ H_1 & : & \mu_{ctc} \neq \mu_{ltp} \end{array}$$

Where H_0 = null hypothesis;
 H_1 = alternative hypothesis;
 μ_{ctc} = mean labour productivity for companies with rotorvane/CTC processing technology; and
 μ_{ltp} = mean labour productivity for companies with LTP processing technology.

3.6 Summary

This research was designed as a case study. The Research Methodology depended on gathering and analyzing primary and secondary quantitative data. An independent samples *t*-test was adopted for analyzing the data. For purposes of inference, companies belonging to different categories were selected through judgemental sampling. The purpose for doing so was to select companies that have desired characteristics for analysis.

Two main assessments were conducted in establishing the role of technology on performance of the tea manufacturing industry, the role of machinery and the role of processes. In the role of machinery, maintenance programmes that were in practice at a firm were used to determine the status of machinery in that firm. The rolling process was used as the determinant of different processing method. In the research, LTP tea processing method was compared to a combination of rotorvane/CTC tea processing method.

The next chapter, Description of Selected Companies and Tea Auction gives briefings of the selected companies. The types of maintenance and processing methods followed in the companies have been given. In addition, a synopsis of tea auctioning as it happens at the Limbe Tea Auction has been included.

CHAPTER 4

DESCRIPTION OF SAMPLED COMPANIES AND TEA AUCTIONING PROCESS

4.1 Introduction

The previous chapter provided the methodology in which this research was conducted. In the methodology chapter it was stated that four companies would be selected for analysis. This chapter gives briefings of the selected companies. In addition, the chapter also explains the tea auctioning process as it takes place at the Limbe Tea Auction.

4.2 Sampled Companies

Chitakali Tea Estate Limited, Smallholder Tea Company Limited, Esperanza Tea Factory and Sayama Tea Factory were selected for analysis. Recognizing the impact climatic conditions have on tea quality, efforts were made to select factories that are located within a ten kilometre radius. Figure 4.1 gives relative positions of the selected factories. The locations of the selected factories have been marked by a star.

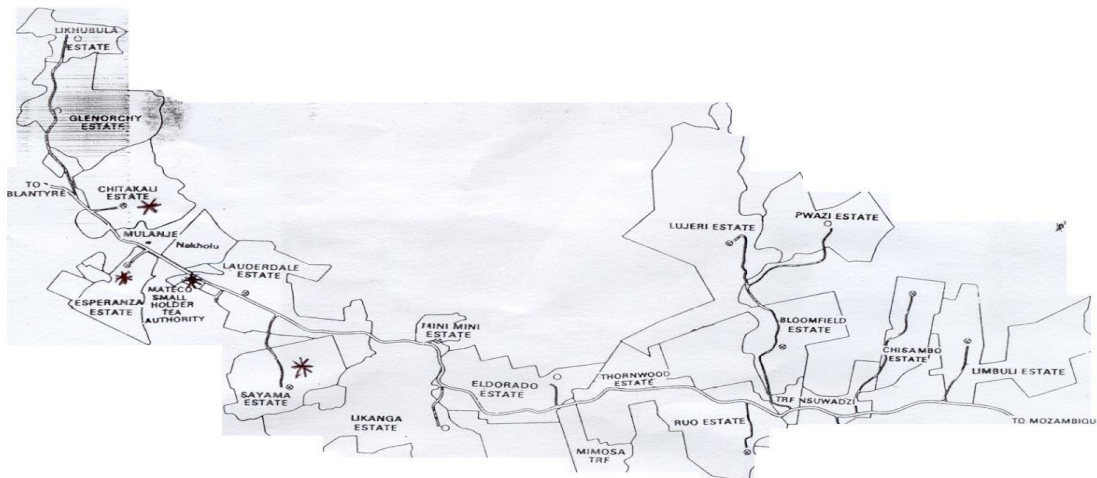


Figure 4.1 Tea Estates and Factories in Mulanje, the selected factories are marked by a star- (Tea Association of Malawi, 1991)

In the figure above, Chitakali is furthest to the left, followed by Esperanza, then MATECO (now STECO) and finally Sayama. Though the map in Figure 4.1 has no scale, using MATECO as a focal point, all the factories are within the ten kilometre radius.

4.2.1 *Chitakali Tea Estate Limited*

4.2.1.1 Background

Chitakali Tea Estate Limited, according to the General Manager of the company, was established in early 1950s by the African Lakes Corporation who later changed to Mandala Limited. In 1999 the Malawi Government took over operations of the Company when Mandala Limited wanted to close it. The change in ownership, however, did not come with the expected recapitalization of the factory. Chitakali Tea Estate factory continued to operate with equipment left behind by Mandala Limited who had conducted a major factory recapitalization in 1975.

The tea estate has 392 hectares of tea bushes comprising 50 percent traditional Indo/Chinese seedling tea varieties and the remaining 50 percent is improved superior cultivars (SCs) also called clonal varieties. Chitakali realizes the need of replanting all its land with the improved clonal varieties whose teas fetch better prices; however, the Tea Association of Malawi (1991) estimates that it costs about US \$5,000.00 to replant one hectare of tea and bring it to maturity, a sum Chitakali finds as a barrier to the change.

4.2.1.2 Tea Production Technology.

Chitakali Factory closed shop in 2004, however when it was in operation, the company was employing 250 factory workers. The factory had two production lines, installed with the Lawrie Tea Processing (LTP) technology on both lines. Fermentation (oxidation) was achieved by use of Continuous Fermentation Units (CFU). Drying was by a fluid bed dryer while sorting was done by a Triton high speed sorter.

The table below gives a comprehensive list of the equipment that was in the factory and the years in which that equipment was made and installed.

Table 4.1 Tea Production Machinery, Chitakali Tea Factory.

Machine Name	Year of Make	Year of Installation
Withering trough mesh	2002	2002
Withering fans	1974	1975
LTP	1975	1975
LTP Cooling conveyor	2001	2002
Continuous Fermenting Unit (CFU)	1975	1975
Fluid Bed Dryer	1974	1975
Boiler	1974	1975
Triton Sorter	1980	1980
Fibre extractor	1996	1996
Packaging Vibrator	1980	1980

From Table 4.1 it can be observed that 45% of the machinery were bought and installed in 1975, implying that they were about 30 years old when the factory closed down in 2004. In addition, over 80 % of the machinery was over ten years at the time the factory closed down. In chapter two section 2.3.2, reasons for acquiring technology were presented. In the presentation, Muhlemann et al. (1992) stated that new equipment is acquired to replace worn-out ones. However, in the same chapter, section 2.3.2, argued that maintenance helps companies maintain their productive capacity. Hence it was important for Chitakali to either replace its old equipment or have in place a rigorous maintenance programme.

4.2.1.3 Maintenance programmes

It was stated earlier that tea is a perennial crop; as such, it is harvested all year round. Chitakali Tea Estate Limited had only one tea factory that had two production lines (the factory caught fire and got burned down in March 2006). When operational, Chitakali Tea Factory was running 24 hours a day. Unlike other factories that close for annual maintenance when tea flush is low, a period the Tea Association of Malawi (1991) state is between April and November, Chitakali

factory remained open throughout the year. Instead of closing, it could stop one line for maintenance while keeping the other running. The running line would then be stopped for maintenance after the first line has been maintained. Unfortunately, this plan was not strictly adhered to in some years, especially when the supply of leaf became too high for one line to cope. Consequently, machines would be kept running throughout the year, stopping only when there was a breakdown. This situation meant that machines were kept running when they should have been overhauled or replaced altogether under the preventive maintenance system. Preventive maintenance was defined earlier as a programme of regular inspection and/or replacement of critical parts before the system is rendered impotent. Thus, overly Chitakali Tea Estate practiced breakdown maintenance despite on paper having a preventive maintenance programme, a practice that is common in the tea industry.

4.2.1.4 Current Status

Chitakali Tea Estate, upon transferring ownership from Mandala to Malawi Government in 1999 continued producing tea using the machinery that was handed over. The General Manager states that some of the machines were in need of replacing while others required frequent attention. However, no serious recapitalization was undertaken and demand for machinery meant preventive maintenance programmes could not be implemented. The General Manager for Chitakali claims that in the whole five years that Government operated the tea factory, it only replaced the withering troughs' mesh and the LTP cooling conveyor, this was done in 2002; Table 4.1 above gives details of the Chitakali Tea Factory machinery. Eventually, the poor state of machinery affected production in volumes and quality; consequently Chitakali tea prices on the Limbe Tea Auction were not competitive. The company eventually found the going so tough that the Board of Directors decided to cease factory operations in 2004. Since then, the company has been left with the farming side only. The green leaf that is grown is sold to other factories whose operations are sustainable. The green leaf is selling at K12.00 per kilogram for superior cultivars (SCs) and K11.00 per kilogram for traditional grades (Indian and Chinese grades).

4.2.1.5 Tea Production

Chitakali Tea Factory is headed by a General Manager who has been in the tea industry for 15 years. Tea Production figures for Chitakali Tea Factory were lost in the fire that burnt the factory in 2006. However, all the tea that was produced was sold through the Limbe Auction and the auction figures for the last three years of operation are available. The production figures for 2003 and 2004 were as presented in APPENDIX 2. The production figures show a gradual decline, decreasing from a total of 455,925 kilograms in 2003 to a meagre 26,940 kilograms in 2004, the year in which the factory closed.

4.2.2 *Smallholder Tea Company (STECO)*

4.2.2.1 Background

Small Holder Tea Company (STECO) was commissioned in 1975 by the Malawi Government through Agricultural Development and Marketing Corporation (ADMARC) to promote participation of indigenous smallholder farmers in tea growing. Tea growing had hitherto been exclusively a white-man's crop. STECO started as Malawi Tea Company (MATECO). To ensure that it fulfils its mandate, STECO does not have tea gardens of her own, relying on smallholder farmers for the supply of green leaf. This setup, claims the General Manager of the company, is expensive for the company as it is required to send its trucks to far away places where smallholder farmers have their crop. The long distances are a direct contrast to the general practice in the industry. In the industry, factories are within their plantations, with some players owning a number of factories within reach of each other, just to reduce leaf transportation distances. The small size of the farmers' gardens has not helped matters either; there are a total of 8000 tea farmers owning a total of 3618 hectares spread in the tea growing districts of Thyolo and Mulanje. The spread of farmers mean that a seven ton truck can travel distances of over 50 kilometres only to collect less than half a ton of green leaf.

Farmers under the smallholder programme grow poly-clonal teas and superior cultivars (SC). The poly-clonal teas cover over 93% of the hectareage farmed by smallholder farmers, superior cultivars cover the rest. Poly-clonal teas, according to STECO General Manager, are superior to traditional Indo/Chinese tea varieties.

In 2002 the Company was restructured, moving the controlling stakes of the company from ADMARC to the Smallholder Tea Growers Trust. The Trust is controlled by smallholder farmers themselves.

4.2.2.2 Tea Production Technology

Smallholder Tea Company has one factory that has 240 employees of whom 14 are administrative staff, the rest are factory workers. The factory has two production lines using the Lawrie Tea Processor (LTP) technology on both lines. Fermentation is achieved through a continuous fermentation unit (CFU). Drying is done by a fluid bed dryer (FBD) while sorting is done by fibre extracting rollers and a linear high speed sifter. Table 4.2 below gives machine details and the year the machines were made and installed.

Table 4.2 Tea Production Machinery, STECO Factory.

Machine Name	Year of Make	Year of Installation
Withering trough mesh	1974	1974
Withering fans	1973	1974
LTP	1984	1986
LTP Cooling conveyor	1985	1986
Continuous Fermenting Unit (CFU)	1982	1984
Fluid Bed Dryer	1998	1998
Boiler	1974	1975
Triton Sorter	1997	1997
Fibre extractor	1994	1994
Packaging Vibrator	1999	1999

Table 4.2 shows that STECO, like Chitakali, has machinery that is mostly over ten years old. Actually, by 2006 all but one machine were over ten years old. The fact that machinery is old does not mean poor performance, Wild (1998), Stevenson (2002) and Peterson (2002) stated earlier in Section 2.3.2 that production capacity can be sustained if preventive maintenance programmes are put in place.

4.2.2.3 Maintenance programmes

The tea factory was operating for 24 hours a day with two shifts until May 2006 when it closed down. Just like Chitakali, STECO was also facing preventive maintenance problems; being the only factory owned by the Smallholder Tea Growers Trust. Even though weekly scheduled maintenance was being conducted, the factory could not close for a thorough machine overhaul

as is practiced by other factories in the industry. In addition, the economic hardships facing the company meant failure to replace worn-out parts. Attempts were being made to stop one line for maintenance while keeping the other line in production; however, this option was also disturbed in favour of production whenever the supply of leaf was too much for one line. The need to produce and sell was compounded by the need to pay growers who supply the leaf. This situation resulted into machines, or part thereof, being operated well beyond their service time and sometimes beyond their replacement stage. Thus, gradually, STECO moved from what the Tea Association of Malawi (1991) referred to as being one of the most modern factories in Malawi whose tea fetched prices that were well in excess of the Malawi average to an antiquated factory whose tea could no longer compete on the auction. By 2002/2003 season, STECO's tea prices at the Limbe Auction had become so low that the company started avoiding the auction selling system, preferring negotiating prices directly with buyers. By 2003/2004 season, the factory completely abandoned the auction system and wholly sold its tea through direct contracts; a practice it maintained up to 2006 when it closed down.

4.2.2.4 Current Status

STECO is headed by a General Manager who has been in the tea Industry for more than 12 years. The General Manager is assisted by a Production Manager who has been in the industry for 20 years. STECO has been selling its tea directly to buyers without going through the auction since 2003/2004 tea season. By selling directly to buyers, STECO avoids paying a tea cess to the Tea Association of Malawi. The Tea Association of Malawi levies a cess of US\$0.03 to a kilogram of tea sold through the Limbe Tea Auction. By abrogating on the cess, STECO also lost membership of the Tea Association of Malawi.

4.2.2.5 Tea Production

Monthly tea production for STECO for 2003 to 2005 is given in APPENDIX 2. Production figures followed the same pattern like those of Esperanza and Sayama, rising in 2004 and dropping in 2005. Table 4.3 shows annual tea production for STECO in the years under review.

Table 4.3 Annual Tea Production, STECO

Year	Production
2003	1,269,207
2004	1,313,802
2005	1,068,707

4.2.3 *Sayama Tea Factory*

4.2.3.1 Background

Sayama Tea Factory is one of four tea factories belonging to Lujeri Tea Estates. The factory happens to be the smallest among the four, operating only one production line. The Factory was incorporated in 1958 by the Miller family. Besides the Millers, Sayama Tea Factory has also been owned by three other investors at different times before Lujeri took over. After the Miller family, the factory has also been owned by Brooke Bond, Unilever and PGI at different times.

Sayama Tea Factory is serviced mainly by Sayama Tea Estate. The Estate has 491 hectares of which 293 are of superior cultivars and the remaining 198 hectares are of traditional varieties, the Indo/Chinese varieties.

4.2.3.2 Tea Production Technology

Sayama Tea Factory employs 105 workers of whom three are senior managers, five middle managers and 97 shift factory workers. Among the senior managers, the General Manager and the Factory Manager have more than 48 years of experience in the tea industry between them. The tea factory has one production line using the rotorvane/cut-tear-curl (CTC) combination tea processing technology for rolling. Fermentation is achieved through a continuous fermentation

machine (CFM). Drying is done by a fluid bed dryer (FBD) while sorting is done by fibre extracting rollers and a vibro-screen sorter.

Table 4.4 gives details of the acquisition and installation of Sayama Tea Factory machinery.

Table 4.4 Tea Production Machinery, Sayama Tea Factory

Machine Name	Year of Make	Year of Installation
Withering trough mesh	2005	2005
Withering fans (three groups)	1958/1999/2005	1960/2000/2005
Rotorvane	2001	2004
CTC	2003	2004
Continuous Fermenting Unit (CFU)	2002	2005
Fluid Bed Dryer	1998	1999
Boiler	1965/1983	1967/1984
Fibre Extractor	2004	2004
Vibro-sorter	2004	2004
Packaging Vibrator	2004	2004

It can be noted from Table 4.4 that Sayama Tea Factory has a combination of new and old machinery. However, unlike Chitakali and STECO, Over 60% of its machinery is less than three years old. Apart from the boilers and two sets of withering fans, the machinery is less than ten years old. The age of the machinery is a reflection of a meticulous maintenance programme that Sayama follows. At Sayama once a machine has served its economic life it is retired and replaced by a new one. A result of this policy saw a major factory recapitalization in 2004 where all but a few machines were replaced.

4.2.3.3 Maintenance Programmes

Sayama Tea Factory practices preventive maintenance, that is, regular inspection and/or replacement of critical parts that is conducted weekly. The use of the rotorvane/CTC production process requires that the vanes and the blades in the rotorvane and the rollers in the CTC are repaired weekly. This fits what Stevenson (2002) calls predictive maintenance. In order to ensure that production is not unnecessarily disturbed, Sayama has three sets of the rollers and vanes. Every week one set is on the machine while the second set is kept on standby and the third set is undergoing repairs. Figures 4.2a to 4.2c show the three sets of rollers as they are handled at

Sayama. Figure 4.2a shows a worker sharpening a CTC roller; 4.2b shows sets of rollers on stand by while 4.2c shows CTC rollers in use on the production line.



Figure 4.2a Repairing CTC Roller (Sayama Tea Factory, May 2006)

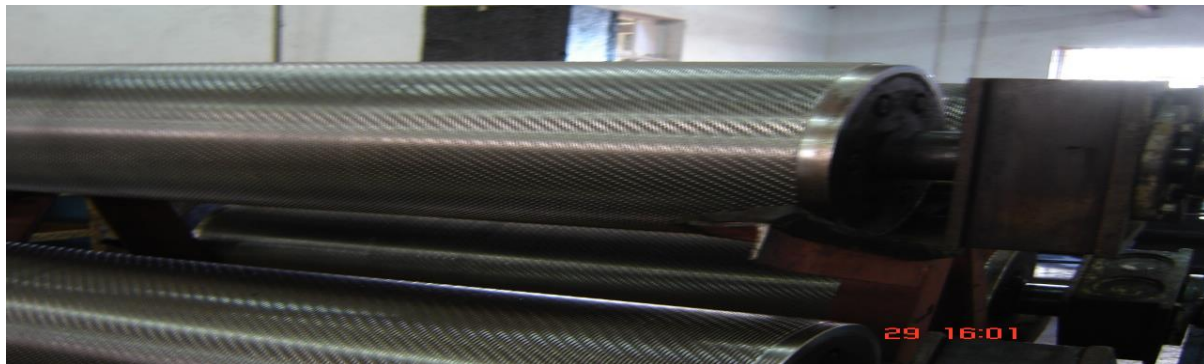


Figure 4.2b Standby CTC Rollers (Sayama Tea Factory, May 2006)



Figure 4.2c CTC Rollers in use (Sayama Tea Factory, May 2006)

Figures 4.2a through to 4.2c show different stages at which CTC rollers are kept at Sayama. Every Mondays the rollers that were on the production line, like in 4.2c are removed from the line and replaced by stand-by rollers as shown in 4.2b. Once the rollers move from stand-by, their place is taken over by the freshly sharpened rollers from 4.2a who are themselves replaced by the rollers removed from 4.2c.

In addition to weekly scheduled maintenance, every year Sayama Factory is closed for a month or two for thorough machine overhaul. During this time, all parts or components that show wearing are replaced or repaired, oils are changed, the factory building and machines are repainted. On reopening, the factory wears a new face and its machines operate as new. The annual shutdown and other maintenance that require replacement at Sayama operate along JIT II principles. The Tea Association of Malawi, through its members set up a spare parts stocking company, the Planters Tea Agency (Mw) Limited. The Planters Tea Agency stocks fast moving tea machinery spares in place of the tea factories. Once the factories are in need of the spares, they can quickly have them supplied locally through the Agency. This arrangement saves the tea factories idle time as lead time for the acquisition of spares is reduced. In addition, the factories do not need to keep too many spares as that responsibility is shifted to the Agency.

Weekly and annual maintenance is done by technical personnel from the engineering departments. However, on daily basis machine operators are trained to monitor performance of critical parts as production is in progress. The operators are trained to take some corrective action if they observe unusual behaviour on their equipment, a form of TPM. If the problem is beyond their competence, they report the problem to their supervisors who advise on the way forward. The way forward may lead to inviting technicians trained in repair of the machinery.

Membership to Lujeri Estates Limited enables Sayama Estates to continue harvesting from the tea estate, albeit at reduced levels, during the off-season period. At the time, when the factory is closed for maintenance, tea from the estate is sent to other sister factories for processing; this ensures that nothing is lost. During the time the factory is closed, workers are sent on leave so that when they come back from rest, they are ready for the arduous twelve hour a day and seven days a week shifts.

4.2.3.4 Current Status

Sayama Tea Factory continues to command some of the best tea prices at the Limbe Tea Auction (APPENDIX 3). Through the programme of replacing traditional tea varieties with the improved superior cultivars that have proved to fetch higher prices than traditional seedling varieties Sayama Tea Factory looks set to continue producing high tea volumes (APPENDIX 2) that fetch good prices at the tea auction.

4.2.3.5 Tea Production

Annual tea production for 2003 to 2005 is given in Table 4.5. The production figures show annual variation, increasing by 26.6% in 2004 over the 2003 production and falling again by 19.5% the following year.

Table 4.5 Annual Production, Sayama

Year	Production
2003	1,839,337
2004	2,328,851
2005	1,875,391

4.2.4 *Esperanza Tea Factory*

4.2.4.1 Background

Esperanza Tea Factory is one of the 11 tea factories owned by Eastern Produce (MW) Limited in the tea growing districts of Thyolo and Mulanje. The factory was incorporated by the British African Tea Estates (BATE) but was acquired by the present owners, Eastern Produce (MW) Limited in 1994.

Esperanza Tea Factory employs 276 personnel, three senior managers, two middle managers and 271 factory workers. The General Manager for Esperanza has been in the tea industry for over 40 years while its Production Manager has been in the industry for 18 years. The factory runs two 12 hour shifts per day for seven days a week except when the supply of green leaf is low or the factory is closed. It operates two production lines.

Esperanza Tea Factory receives green leaf from a 304.3 hectares estate. 78.7% of the estate comprises superior cultivars, the rest comprising the original Indo/Chinese seedling tea varieties.

4.2.4.2 Tea Production Technology

Esperanza uses the LTP tea processing technology on both its production lines. Fermentation is achieved through a continuous fermentation unit (CFU). Drying is done by a fluid bed dryer (FBD) while sorting is done by fibre extracting rollers and Mackintosh high speed sorter.

Table 4.6 gives the major machinery in the Esperanza tea factory and the years in which the machines were made and installed.

Table 4.6 Tea Production machinery, Esperanza Tea Factory.

Machine Name	Year of Make	Year of Installation
Withering trough mesh	1999	1999
Withering fans	1983/2000	1984/2000
LTP	1969	1971
Cooling Conveyor	1971	1971
Continuous Fermenting Unit (CFU)	2000	2000
Fluid Bed Dryer	2000	2000
Boiler	1999	1999
Fibre Extractor	2006	2006
High Speed Sorter	1971	1971
Packaging Vibrator	1990	1990

Table 4.6 shows that the factory at Esperanza, though not as new as Sayama, has over 50% of its machinery below ten years old. Esperanza also offers an insight in showing that old machinery, once properly looked after, can still be reliable and get involved in producing quality products. The factory has been using about 30% of its machinery since 1971.

4.2.4.3 Maintenance programmes

Esperanza, as a member of the Tea Association of Malawi, enjoys support from the Planters Tea Agency (Mw) Limited. Like Sayama, Esperanza Tea Factory operates a preventive maintenance programme. In its maintenance programme, on weekly basis, cutters for the LTP machines are replaced. Like what Sayama does with its CTC rollers and rotorvane cutters, there are three sets

of cutters for each production line. As one set is in the LTP machine, another set is on standby while a third set is being repaired. Standby LTP cutters, also called beaters, are kept on a rack within the factory premises for emergency replacement. Should there be no emergency requiring early replacement of beaters, a set of standby beaters is fitted into the LTP machine every Monday. On the same day the beaters that were in the machine are transferred to the workshop for repairs while those that were at the workshop are transferred to the standby racks in the factory. Thus with this type of circulating, the LTP machine remains a reliable rolling machine for a long time.

Besides regular weekly checks and repair, Esperanza also operates an annual machine overhaul programme where the factory is closed for a month or two to allow for a thorough inspection and repair exercise. Like Sayama, the time is also used to offer the factory workers a rest period.

Like Sayama, Esperanza has also trained its machine operators to do simple inspection and monitoring of the machines that they operate. The operators are able to do simple maintenance of their machinery in a TPM programme. Technicians are only called when the problem that might have occurred is complicated requiring specialised skills.

4.2.4.4 Current Status

Esperanza Tea Factory is one of the leading tea factories in Malawi. Esperanza Tea Factory produces tea of high quality such that it continues to attract very good prices of over one US dollar per kilogram (APPENDIX 3) at the Limbe Tea Auction. Membership to Eastern Produce (MW) Limited enables Esperanza to benefit from competitive benchmarking that is in practice within the group.

4.2.4.5 Tea Production

Esperanza has the highest annual production among the sampled companies (APPENDIX 2). However, like STECO and Sayama, its production was also variable; increasing by 15.6% in 2004 and dropping by 20.0% the following year.

The production figures for Esperanza in the years under review have been presented in Table 4.7.

Table 4.7 Annual Production, Esperanza

Year	Production
2003	2,092,207
2004	2,418,903
2005	1,934,597

4.3 A synopsis of Tea Auctioning at Limbe Tea Auction

Most of the manufactured tea in Malawi is sold through Limbe Tea Auction. The Limbe Tea Auction has two brokers, Tea and Commodity Brokers Limited and Tea Brokers Central Africa Limited, who auction tea on behalf of growers. It has 13 regular buyers (APPENDIX 6) of whom four major ones are Lipton Tea, Stansand (C A) Limited, Global Tea Limited and Van Rees Limited. The auction happens every Tuesdays, except when the tea flows are low; which, according to Tea and Commodity Brokers Limited, occurs in June to August. During the low period tea is auctioned every fortnight. However tea is auctioned throughout the year, its trading calendar starts in July in one year running to June the following year.

Before auctioning takes place, samples of tea from the manufacturers are sent to all buyers and a broker of their choice for assessment two weeks before the auction. A week later, brokers send their valuation prices of the samples together with forms that contain details of all the tea that is on offer. Before coming to the auction, buyers make their own assessment of the tea and set prices within which they will participate in the bidding.

At the auction, brokers take turns at selling the tea starting with one broker. The broker announces the tea identification number, the factory from which the tea is coming, its grade and the broker valuation price. He then requests the buyers to give a bidding price. If the bidding price is too low, the auctioneer asks for a higher starting price. Should there be no agreement on the starting price the tea is withdrawn. In the event that there is an agreement, other bidders are invited to join in the bidding. The bidders can bid any higher price in increments of not less than one cent. At the end, the highest bidder is offered the commodity. Table 4.8 below gives a

sample of some of the broker valuation prices, first bidding prices and the selling prices of tea from the sampled companies at the first auction of the 2006/07 season that took place on 11th July 2006. The researcher witnessed this auction.

Table 4.8 Tea Auction Pricing

Factory	Tea Grade	Broker valuation price(US cents/kg)	First bidding price (US cents/kg)	Selling price (US cents/kg)
Sayama	Pecko Fannings 1	175	160	173
	Pecko Dust	180	160	173
Esperanza	Pecko Fannings 1	175	166	172
	Pecko Dust	180	165	173

In Table 4.8, Sayama's Pecko Fannings grade1 (PF1) was valued by the broker at 175 US cents; however, the first bidder was willing to buy it at 160 US cents. After competing, the tea was sold at 173 US cents per kilogram.

4.4 Summary

Four tea factories were selected for analysis. Two of the selected factories, Chitakali and STECO follow breakdown maintenance while Sayama and Esperanza follow preventive maintenance. Three of the selected companies Chitakali, STECO and Esperanza use LTP tea processing technology while Sayama used a combination of rotorvane/CTC tea processing technology. Most of the manufactured tea is sold through the Limbe Tea Auction, however, sometimes the tea is sold under contract arrangements where the auction is bypassed.

In the next chapter, results of the research have been presented and analyzed. The analysis was based on production, quality and labour productivity.

CHAPTER 5

RESULTS AND DISCUSSION OF RESULTS

5.1 Introduction

In the previous chapter briefings of the selected companies were presented. In the presentation it was established that amongst the selected companies there were companies that follow different maintenance programmes and processing methods. This offered an opportunity for an analysis of the impact of the parameters on quality and productivity. A brief on the tea auction process was also given.

This chapter presents results of the tea production and sales of the sampled companies for years 2003, 2004 and 2005. The data are then analyzed using the independent samples *t*-test and interpreted.

5.2 Tea Production

Tea production figures that were assessed in this research were those of 2003 to 2005. Production figures for Esperanza, Sayama and STECO were sourced from records kept at the factories while those of Chitakali were obtained from Commodity and Tea Brokers Limited. Commodity and Tea Brokers Limited is the broker that handled all the tea that was produced by Chitakali Tea Estate Limited. The General Manager for Chitakali confirmed that all the tea that was produced at the factory was sold through the Broker. Figures were collected from the Broker since production records kept at the factory were destroyed in a fire that burnt the factory in March, 2006. Production figures for the sampled companies in the years under review were as given in APPENDIX 2.

5.2.1 Tea Production Patterns

Tea production in the four sampled companies in the years 2003 to 2005 were as presented in Figure 5.1. In the figure it can be observed that production in the years under review varied. There were years of poor production, 2003 and 2005 and a year of relatively good production, 2004. It is further observed that production pattern was the same in all the three companies that

were operational throughout the period of assessment. It was not the scope of this research to investigate the unassignable causes of fluctuations in production, hence an explanation for the higher production in 2004 than those of 2003 and 2005 has not been provided.

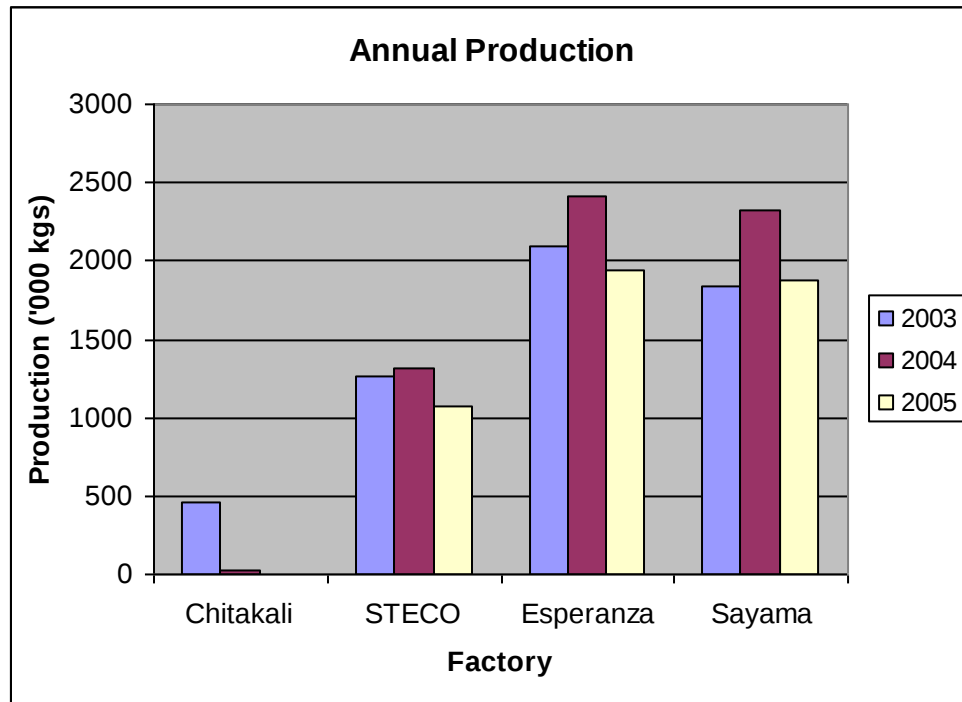


Figure 5.1 Annual Tea Production

Figure 5.1 shows the annual production figures for the test companies from 2003 to 2005. Since Chitakali closed down in 2004, it has no production data for most part of that year and 2005. From the graphs above it can be seen that STECO had a much lower production when compared to the other two, Esperanza and Sayama. On the other hand, despite Sayama having only one production line, its production compares well to that of Esperanza.

It was earlier presented in section 2.4.1.2 that tea harvesting, though takes place throughout the year, is seasonal in nature.

The seasonality in the annual production is reflected in the monthly production volumes as given in APPENDIX 2, graphically presented in Figure 5.2.

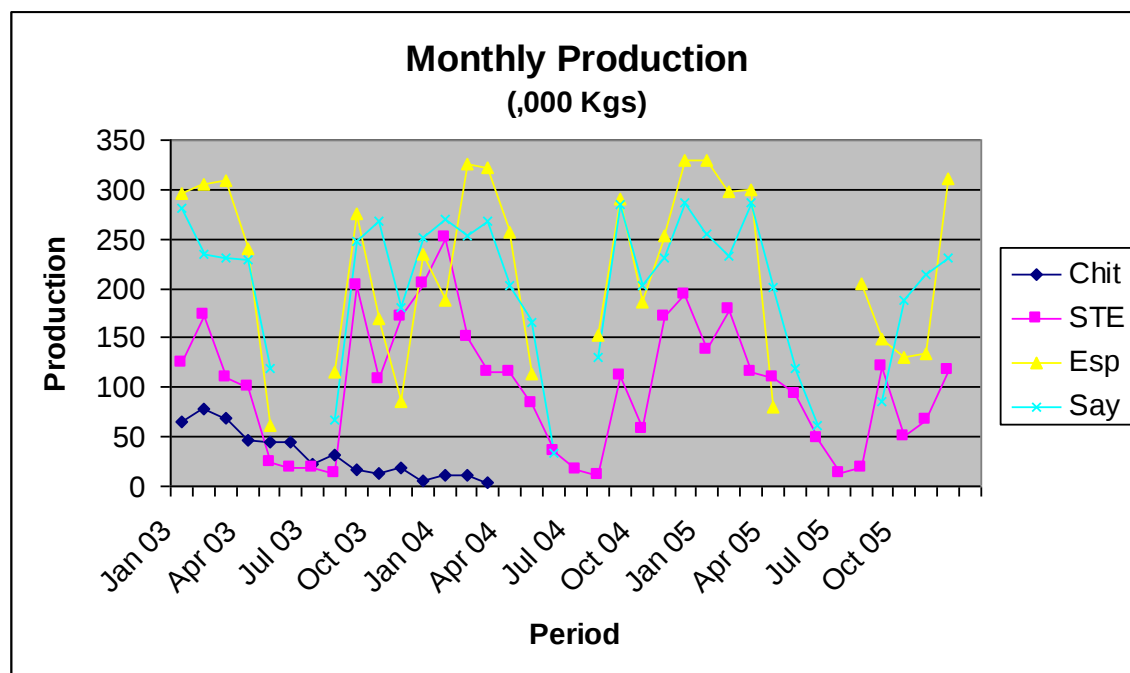


Figure 5.2 Monthly Production

In Figure 5.2 the tea seasonal production pattern as was stated by the Tea Association of Malawi (1991) is confirmed. Production is lowest between June and August and maximum between December and March. The seasonal cycle repeated in all the three years under review.

From the same Figure 5.2 it can be observed that Sayama and Esperanza factories were shutting down during months of poor production whereas Chitakali and STECO were in production throughout the year. However, despite the closures Sayama and Esperanza still produced higher volumes than either Chitakali or STECO as was seen in Figure 5.1. Another observation that can be noted is the gradual drop in production for Chitakali in the months under review. It is certain that it was easy to forecast closure for the company well before the actual closure happened.

5.2.2 *Impact of Maintenance Methods on Production.*

Analyses in this research were conducted at 95% confidence interval. The 95% along with 99% are the confidence intervals that Field (2005) recommends for social scientific research. Dewberry (2004), Lucey (2002) and Sanders et al. (2003) recommend use of 30 or more sample means for statistical power. Since Chitakali closed down in 2004, there were only 15 months production data that could be analyzed. This implies that the data for Chitakali were well below the recommended 30. The data are, therefore, not adequate to form a basis for comparative analyses. The factory, therefore, did not form part of further analyses. Unlike Chitakali, STECO has data for 36 months, Esperanza 29 and Sayama 31 months. Thus the three factories are the ones that were used in the analyses.

The factory briefs in the previous chapter revealed that Esperanza and STECO have equal installed capacity, both having two LTP production lines. Ordinarily, it would be expected that production from the two factories would be equal. However, the factories follow different maintenance programmes; STECO following breakdown maintenance while Esperanza following preventive maintenance. It was earlier argued that machines in factories that follow breakdown maintenance are usually in poor state as they are kept running until they breakdown. On the other hand, machines in factories that follow preventive maintenance are kept in fairly good condition. The machines are subjected to regular inspection, repair and/or replacement of faulty parts at the earliest sign or anticipated sign of malfunction. Thus the two factories were used for assessment of the impact of machinery on production.

The monthly production data from the two factories were analyzed for mean difference using an independent samples *t*-test. In the analysis the null hypothesis '*There is no difference in the average monthly production for STECO and Esperanza tea factories*' was tested. The results of the analysis showed that the mean production for 36 months for STECO ($M = 101.4$ tons, $SD = 65.3$) and 29 months for Esperanza ($M = 222.3$ tons, $SD = 87.3$) were significantly different ($t [63] = 6.19$, $p = 0.00$); equal variance not assumed. As expected, the analysis confirms that preventive maintenance programmes are superior to breakdown maintenance programmes. The p value of 0.00 indicates that it can be said with certainty that monthly mean production from

Esperanza would be different from that of STECO. Thus the null hypothesis is rejected in favour of the alternative hypothesis ‘*There is a difference in the average monthly production for STECO and Esperanza*’.

Dewberry (2005) and Field (2005) recommend the inclusion of the *effect size* when reporting *t*-test results where the ‘*t*’ value is significant. Since in the above analysis the ‘*t*’ value is significant, the Cohen’s effect size ‘*d*’ needs to be included. In the above analysis the effect size ($d = 1.58$). Dewberry goes on to explain that an effect size of ($d \approx 0.2$) represents a small effect, that of ($d \approx 0.5$) is a medium effect and that of ($d \geq 0.8$) is a large effect. In the case of average production of STECO and Esperanza, the effect size ($d = 1.58$) is a large effect. This implies that the mean differences are indeed large.

Presenting the results in a box and whiskers graphs clarifies the above explanation. Figure 5.3 presents the box and whiskers graphs of the mean difference analysis.

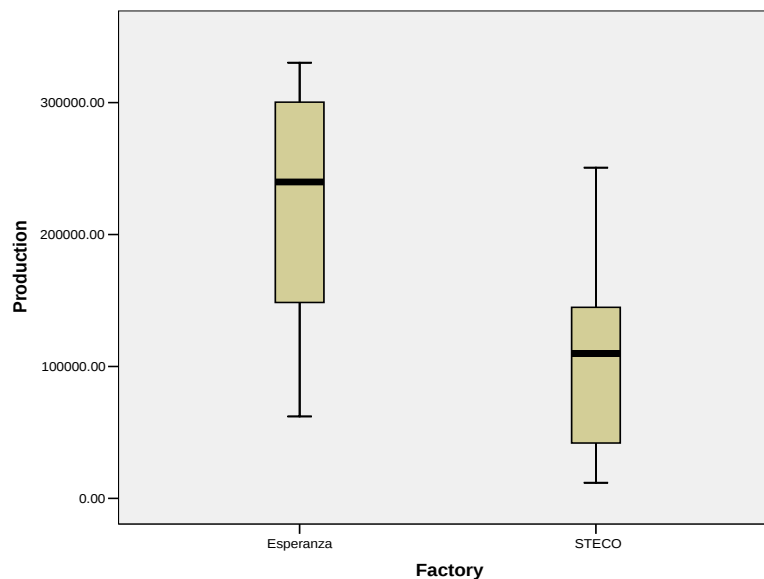


Figure 5.3 Monthly Production, Esperanza/STECO.

The box and whiskers graphs of Figure 5.3 clearly show that there is a difference between the mean production volumes for Esperanza and STECO. Esperanza monthly production volumes are way above those of STECO. The box and whiskers graphs, therefore, confirm the results that were presented statistically earlier.

5.2.3 *Impact of Processing Methods on Production*

Section 5.2.2 above gives the impact of machinery on production. From the analysis, it has been demonstrated that the maintenance methods have an impact on performance of a firm. The section has shown that Esperanza with a good machine care programme was able to outperform STECO despite the two factories having the same installed production capacity. In this section, the impact of the production process will be assessed. Both Sayama and Esperanza have functional preventive maintenance programmes. On the basis of the programmes, it can be said that their machinery is in comparative state. However, the two use different processing technologies; Esperanza uses LTP technology while Sayama uses rotorvane/CTC processing technology.

In analyzing for mean differences on monthly production data from the two factories, the null hypothesis, '*There is no difference in mean monthly production from Esperanza and Sayama*' was tested using independent samples *t*-test. The results show that 31 months production for Sayama ($M = 203.6$ tons, $SD = 72.2$) and the 29 months production for Esperanza ($M = 222.3$ tons, $SD = 87.3$) were not significantly different ($t [58] = 0.899$, $p = 0.373$, $d = 0.23$). Thus despite using different processing technologies, the two factories production is likely to be similar. In this case, the null hypothesis is adopted. The adoption of the null hypothesis is made in light of the small to medium effect size of the results. In addition, it was earlier stated that Sayama has one production line, while Esperanza has two production lines. Thus the results obtained so far are not conclusive in assessing the impact of the processing methods on production volumes.

Figure 5.4 of the box and whiskers graphs below confirm the conclusions reached above. In the figure, the graphs show a complete overlap. Since Esperanza has a wider range, ignoring the outlier for Sayama, all Sayama data would fit into Esperanza data.

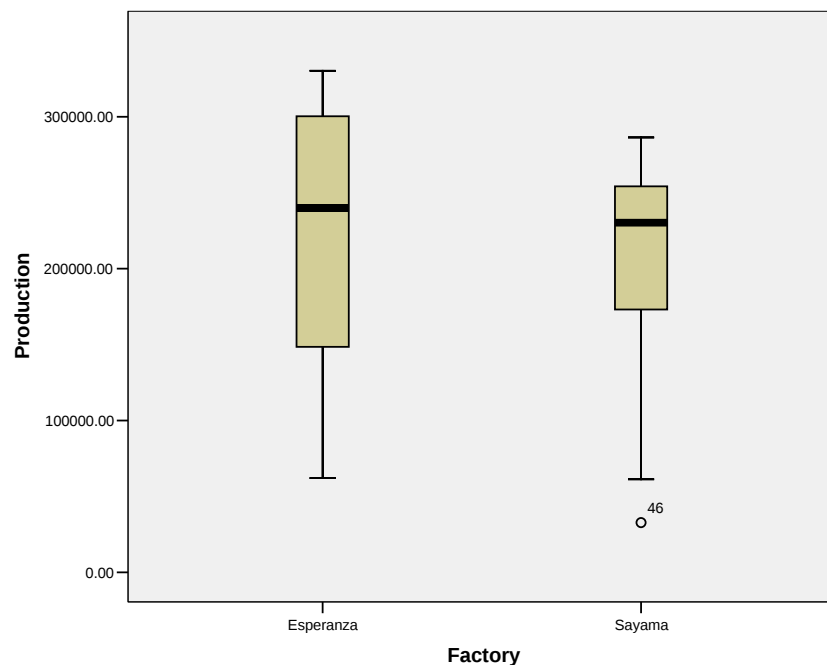


Figure 5.4 Monthly Production, Esperanza/Sayama.

In Figure 5.4 production for Sayama had one outlier, that of 35,788 kilograms that occurred in June 2004. The outlier has been left in the data as it does not affect the results. In addition, the outlier helps to emphasize the seasonal variation in production.

5.2.4 Discussions

Monthly tea production volumes from all the sampled companies (Figure 5.2) showed great variations in volumes. In addition, the factories show a distinct seasonal pattern that coincided with factory closure for Esperanza and Sayama factories and lowest production for STECO. The fluctuations in production figures are an indication of lack of control in production in all the three factories. The situation was the same even at the time when production was supposed to be at its pick, from December to March. Esperanza with a standard deviation of 87.3 happens to be the worst. At Esperanza, there were months that registered production of over 300,000 kilograms

and others that registered production of less than 100,000 kilograms, giving a range of over 200,000 kilograms. Such variation is a clear testimony of capacity underutilization. The capacity underutilization is against a background of keeping staff levels constant throughout the year. Such a situation implies that staff is paid for doing very little; in addition, electricity that is charged on maximum demand (maximum demand is charged based on the maximum energy demanded in the previous 12 months) is paid for based on demand that is hardly reached. The two factors affect the multifactor productivity of the factories. It is, therefore, recommended that factories that have sister factories, like Esperanza and Sayama, find ways of harmonizing their production so that the installed capacity is optimally utilized. In harmonizing production, it may be necessary that other workers be put under seasonal employment contracts.

In discussions with management of STECO, it transpired that the factory was unable to close for maintenance because it is the only factory where smallholder farmers take their tea for processing. Closure of the factory would, therefore lead to loss of income to farmers as the tea harvested during that time would be wasted. This situation could be averted if STECO had come into agreement with other tea factories to process the tea on its behalf. There is high likelihood of such an arrangement succeeding because the research results show that all factories produce under capacity during the off season period. Thus additional raw materials from smallholder farmers would help factories achieve higher outputs. This arrangement is working for Chitakali who after closing their factory are selling all their tea to other factories. STECO may introduce a barrier to farmers from selling the green leaf directly to other processing factories by selling pre-withered leaf. Withering requires use of equipment that farmers do not have, such that by insisting on selling withered leaf farmers would continue selling their green leaf to STECO. Withered leaf would fetch a better price than fresh leaf; thus STECO would benefit from price differentials.

A closer look at production graphs of Figure 5.2 shows that production drops a month after the onset of a new season. This could be an indication of early reopening of the factories; that is, reopening before the tea bushes are in full flush. This means the available leaf is inadequate to ensure full capacity operations. It is, therefore, recommended that the factory reopening month be reviewed. Should a decision to extend the maintenance period be made, green leaf should be

sent to sister factories that would use such leave to optimize use of their production capacity. During the closure period, staff may be sent on leave or reassigned other duties or even sent to the factories that would be kept operational. Alternatively, a no contract month can be included in their employment terms; such a system is practiced in tobacco and sugar industries.

Figure 5.2 also gives the impression that with a little more effort, STECO could have easily caught up with Esperanza in production, especially in 2003/2004 season. This was expected as the two factories use similar technology and have equal installed capacity. It is, therefore, recommended that companies within the tea industry adopt competitive benchmarking. Stephenson (2002) defines competitive benchmarking as the identification of an organization that is best at doing desired tasks and studying how it does them in order to learn from it. Had STECO identified Esperanza as its benchmark, it would have learnt that running the factory continuously without giving workers enough break and machines time for maintenance does not translate into improved production. Thus competitive benchmarking can offer STECO and other like factories an opportunity to improve their operations.

Besides the fluctuations in production that apply to all factories, production from STECO and Esperanza showed significant differences. Esperanza's production was significantly higher than that of STECO; a situation that is assigned to the differences in the maintenance programmes that were followed by the two factories. Despite Esperanza operating for only 29 months against 36 for STECO in the three years under review, Esperanza's production of 6,445,707 kilograms was 27.68% higher than that of STECO. Thus the seven months used in maintenance paid off through machine reliability when the factory was operational. On the other hand, production for Esperanza and Sayama, though from different processes and Sayama having only one production line, are not significantly different, only 3.22% apart.

Based on the production results and analysis presented earlier, it can be concluded that preventive maintenance programmes help companies produce higher volumes than companies that use breakdown maintenance. It is, therefore, recommended that companies in the manufacturing industry in general and tea industry in particular, should adopt preventive

maintenance programmes. Results from use of different processing technologies could not be concluded at this stage.

5.3 Tea Prices

Tea prices were considered as a measure of the quality of the tea on offer. It was explained earlier in Chapter 4 that in tea auction, buyers determine the price at which they would buy the tea. The price they set is largely determined by the value the buyers attach to the tea, hence quality attached to the tea.

The average tea prices presented in APPENDIX 3 were worked out from the prices offered at the Limbe Tea Auction, except those for STECO. Prices for STECO were obtained from records kept at their factory. STECO did not sell tea through the Auction, preferring one-to-one agreements with buyers. In addition, sales figures for Esperanza Tea Factory for 2003 and part of 2004 were also obtained from factory records as they too were not available at the Tea and Commodity Brokers Limited, the broker who provided the auction figures.

5.3.1 Average Monthly Tea Prices, 2003-2005

Average tea prices for the sampled companies have been presented in APPENDIX 3. The prices presented are average prices of the weekly auction sales. The auction prices and quantity of tea sold were obtained from Tea and Commodity Brokers Limited. In cases where data were not available at the Broker, the data were obtained from the respective factories. The prices in the table are prices per kilogram of tea in US cents.

Figure 5.5 graphically presents average monthly prices from all the four sampled companies during the period under review.

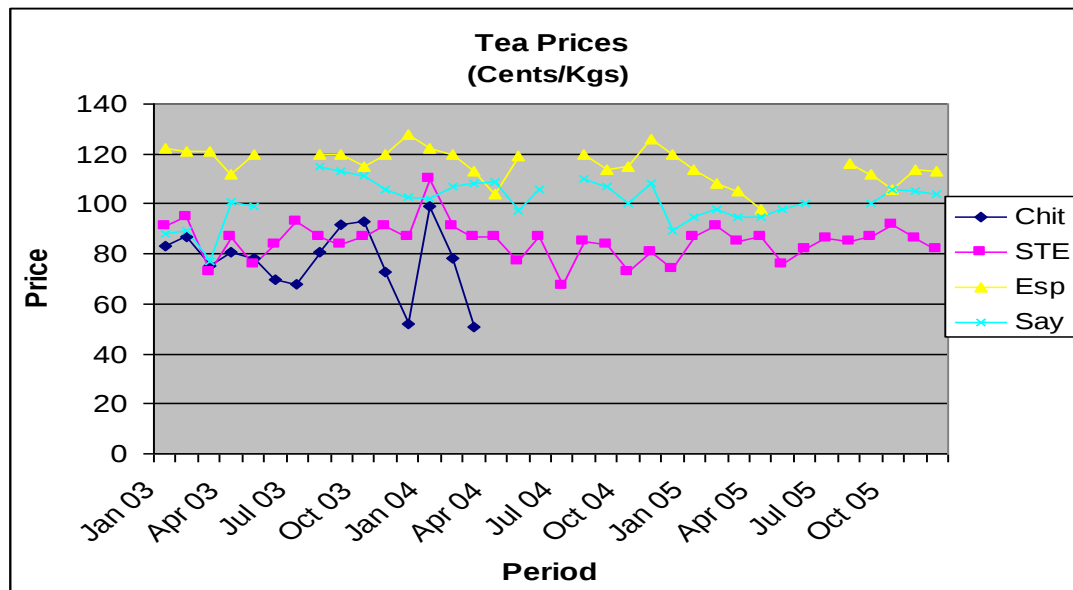


Figure 5.5 Tea Prices, 2003 - 2005

The average monthly prices for the sampled companies as shown in Figure 5.5 indicate that prices for companies with preventive maintenance programmes (Esperanza and Sayama) are higher than those of companies following breakdown maintenance programmes (Chitakali and STECO). Whereas prices for Esperanza and Sayama are largely above 100 cents per kilogram, those of Chitakali and STECO are generally below 100 cents per kilogram. However, between companies that follow breakdown maintenance programmes, prices for Chitakali Tea Company Limited are noticeably lower than those of STECO. Similarly, between companies following preventive maintenance, prices for Esperanza Tea Factory are higher than those of Sayama Tea Factory.

Another observation is that, except for Chitakali, tea prices were fairly stable during the period under review.

5.3.2 Impact of Maintenance Methods on Prices

It was earlier stated that Chitakali Factory closed in 2004 hence data collected from its operations is not adequate to form part of the analysis. Consequently, impact of maintenance methods on prices was based on analyzing the mean differences for data sets from STECO and Esperanza. The null hypothesis '*There is no difference in the mean tea prices for STECO and Esperanza teas*' was tested. The independent *t*-test results of 36 months prices for STECO ($M = 85.1$ US cents per kilogram, $SD = 7.6$) and the 29 months prices for Esperanza ($M = 115.8$ US cents per kilogram, $SD = 6.8$) were significantly different ($t [63] = 16.933$, $p = 0.00$, $d = 4.26$). Following the results the null hypothesis was rejected, instead the alternative hypothesis '*There is a difference in the mean tea prices for STECO and Esperanza teas*' was adopted. The box and whiskers graphs of Figure 5.6 clearly show that there is a difference between average prices of the two factories.

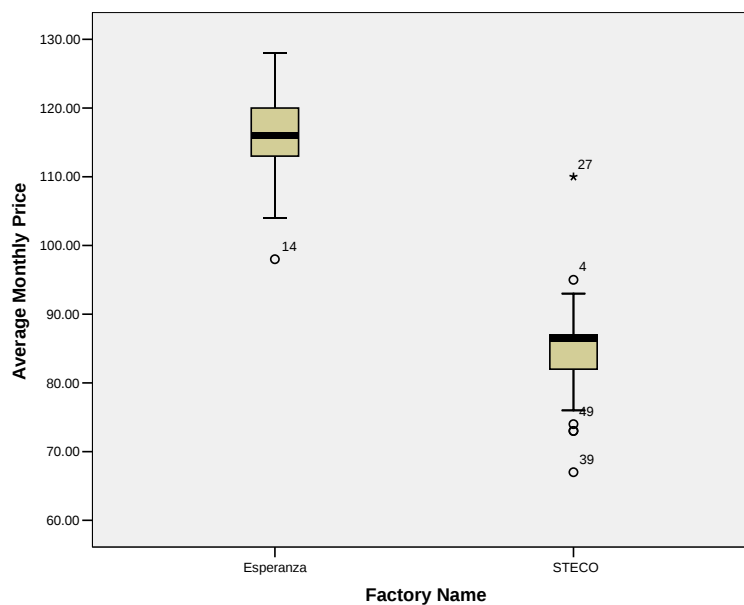


Figure 5.6 Average monthly prices, Esperanza/STECO.

The box and whiskers of Figure 5.6 shows one outlier price for Esperanza and four outlier prices for STECO. In case of Esperanza, the outlier price was of 98 cents per kilogram against a mean price of 115.8 cents per kilogram. In case of STECO the four outliers were 110 cents, 94 cents

74 cents and 67 cents against a mean price of 85.1 cents per kilogram. The outliers were left in the data as they did not affect the interpretation of the results; instead they added credence to the results. It will be observed that a price of 98 cents per kilogram that was considered to be too low among the Esperanza prices was itself above a price of 94 cents per kilogram, a price considered as too high amongst STECO prices.

The standard deviation of 7.6 cents for STECO and 6.8 cents for Esperanza confirm the stability of the prices during the test period.

5.3.3 Impact of Processing Methods on Prices

The impact of processing methods on prices, hence quality, was obtained from analyzing monthly average prices for Esperanza and Sayama tea factories. It was stated earlier that the two have functional PM programmes but use different processing technologies. The null hypothesis, *‘There is no difference in average monthly prices for tea from Esperanza and Sayama’* was tested. The analysis of 29 average prices ($M = 115.8$ US cents, $SD\ 6.8$) for Esperanza and 31 average prices ($M = 101.3$ US cents, $SD\ 8.2$) for Sayama reveals that the prices are significantly different, ($t\ [58] = 7.38, p = 0.00, d = 1.93$). Therefore, the null hypothesis was rejected in favour of the alternative hypothesis *‘There is a difference in average monthly prices for tea from Esperanza and Sayama’*.

The Box and whiskers graphs for the average prices, Figure 5.7, confirm the difference in prices but also give a picture of some overlap in the prices especially in the upper quartile for Sayama and lower quartile for Esperanza. The overlap is reflected in the effect size of the analysis. Whereas the effect size for price differences between Esperanza and STECO was 4.26, the one for price differences for Esperanza and Sayama was 1.93.

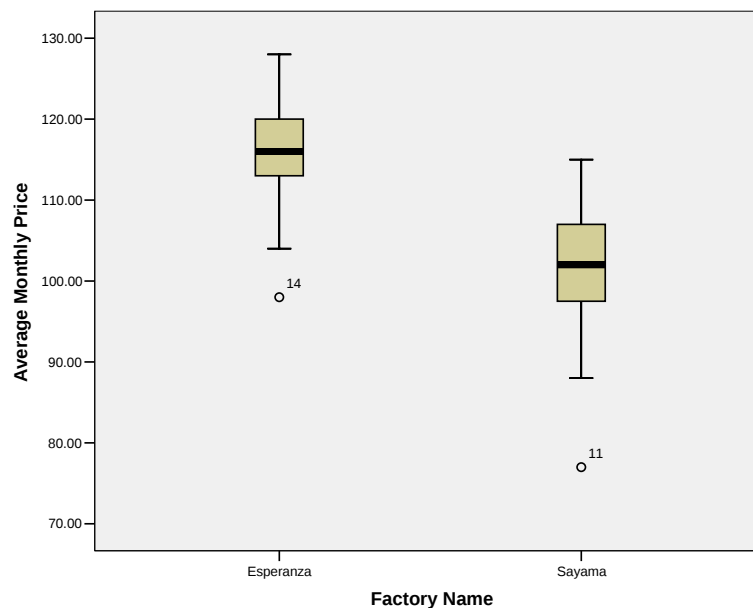


Figure 5.7 Average monthly prices, Esperanza/Sayama

5.3.4 Discussions

Tea prices were used to assess the quality of tea from the sampled companies. Since tea prices are set by buyers at the auction, good quality tea fetches higher prices than poor quality tea. Unlike the production quantities that showed month to month variations, tea prices are fairly stable (Figure 5.5); implying that all companies were able to control quality. The control, however, was within each company's ability. Consequently, the mean prices for STECO, Esperanza and Sayama of 85.1(SD 7.6), 115.8 (SD 6.8) and 101.3 (SD 8.2) US cents per kilogram respectively were significantly different. It can, therefore be concluded, like before, that preventive maintenance programmes like those of Esperanza and Sayama result in products of higher quality than breakdown maintenance programmes as adopted by STECO. Comparing prices for

Esperanza and Sayama indicates that Esperanza's prices are significantly higher than those of Sayama despite the fact that both have adopted preventive maintenance programmes. Since price is a reflection of quality, it can be concluded that the LTP tea processing technology as adopted by Esperanza produces superior quality tea to the rotorvane/CTC tea processing method as adopted by Sayama. As such, where the market requires higher quality, it is advisable to adopt the LTP tea processing technology.

Dean (2004) advises that the main objective of a price is ensuring company's survival. This was to mean that if a company is to achieve higher prices for a good produced at the same cost as a competitor, then that company has higher chances of survival. By Dean's observation, it was not surprising that Chitakali and STECO failed to compete against other players in the industry leading to eventual closure for Chitakali in 2004 and struggling for STECO. STECO started by withdrawing from the auction market in 2004 and finally stopped production in 2006. It is, therefore recommended that production units adopt preventive maintenance programmes as lifeline programmes.

5.4 Labour Productivity

In the analysis that follows, labour productivity has been considered, over multifactor productivity. The input in the analysis is the number of employees engaged in the production whereas the output is the monthly revenue generated from sales of the manufactured tea (a combination of production volumes and prices/quality). It was earlier reported that STECO employs 240 factory workers, Esperanza 276 and Sayama 105. APPENDIXes 2 and 3 give monthly tea production and average tea prices respectively. Using these data and applying the formula given in Box 5.1, labour productivity was worked out.

Stevenson (2002) advises that labour productivity be presented in units of output per labour hour or per shift, value-added per labour hour or dollar value of output per labour hour.

Based on information available, labour productivity has been presented in dollar value of output per labour month. Labour month has been preferred over labour hour for purposes of convenience.

Box 5.1 Labour Productivity Formula

	P_L	=	t p/L (US cents per labour month)
Where	P_L	=	labour productivity
	t	=	monthly tea production in kilograms
	p	=	monthly average tea prices
and	L	=	labour employed

APPENDIX 4 gives monthly labour productivity in US cents per labour month of the sampled factories in the three years under analysis. Figure 5.8 presents the labour productivity graphically. In the figure, it can be observed that Sayama, with its different processing method, has the highest labour productivity followed by Esperanza then STECO; Chitakali had the least labour productivity. From the Figure, it can also be observed that none of the sampled companies was able to control labour productivity. The graphs for labour productivity in Figure 5.8 below mirror those of production in Figure 5.2 above, with labour productivity fluctuating from month to month throughout the year in all the sampled companies.

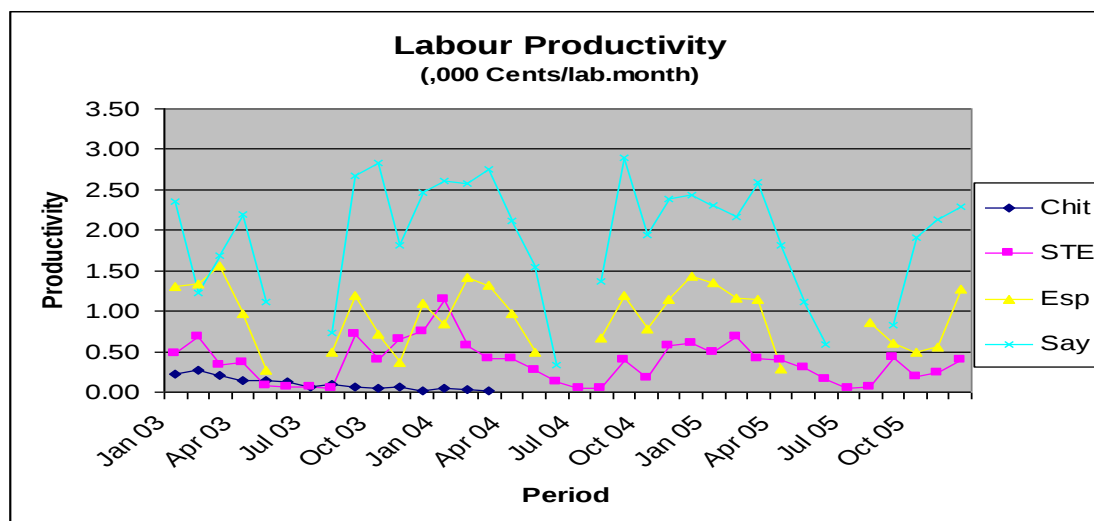


Figure 5.8 Monthly Labour Productivity

For the same reasons given earlier, Chitakali data is inadequate for further analysis, thus leaving STECO, Esperanza and Sayama for further analysis. Just as above, STECO and Esperanza's data

were used to compare and contrast impact of state of machinery on labour productivity while Esperanza and Sayama's data were used to analyze the impact of processing technology on labour productivity.

5.4.1 Impact of Maintenance Methods on Labour Productivity

The impact of maintenance methods on labour productivity was assessed using data from STECO and Esperanza. The null hypothesis '*There is no difference in labour productivity for STECO and Esperanza*' was tested. The average monthly labour productivity for the 36 months ($M = 366.9$ US cents/labour month, $SD = 256.1$) for STECO and for 29 months ($M = 941.5$ US cents/labour month, $SD = 383.0$) for Esperanza were significantly different ($t [63] = 7.224$, $p = 0.00$, $d = 1.80$). The null hypothesis was, therefore rejected. The box and whiskers graphs of Figure 5.9 confirm this observation.

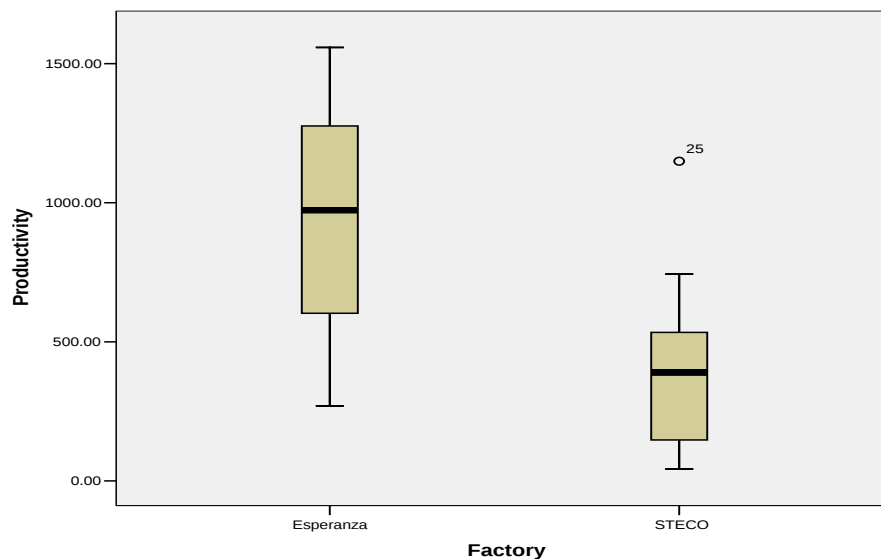


Figure 5.9 Labour Productivity, Esperanza/STECO

The labour productivity from the two factories as shown in Figure 5.9 is indeed different. The mean labour productivity for STECO has one outlier of 1149.04 cents per labour month that occurred in January 2004. The outlier was left as it does not affect the results. The outlier also gives an insight in the level of capacity underutilization at STECO. It shows that STECO was capable of achieving much higher productivity than its mean productivity of 366.9 cents per labour month.

5.4.2 Impact of Processing Methods on Labour Productivity

The impact of processing methods on labour productivity was assessed using data from Sayama and Esperanza. The data are presented in APPENDIX 4. To test the impact of processing technologies, the null hypothesis ‘*There is no difference in labour productivity between Esperanza and Sayama factories*’ was tested. The results of the analysis are that the 29 months productivity for Esperanza (M = 941.5 US cents/labour month, SD = 383.0) and the 31 months productivity for Sayama (M = 1915 US cents/labour month, SD = 698.9) are significantly different ($t[58] = 6.626, p = 0.00, d = 1.80$). The null hypothesis, therefore, was rejected and the alternative hypothesis adopted.

Figure 5.10 supports the rejection of the null hypothesis. From the figure, labour productivity for Sayama is way above that of Esperanza. This result confirms the earlier observation when it was established that production for Sayama was not significantly different from that of Esperanza; yet Sayama has only one production line employing 106 people against Esperanza’s two production lines and 276 employees. It, therefore, follows as no surprise that Sayama’s labour productivity is higher than that of Esperanza.

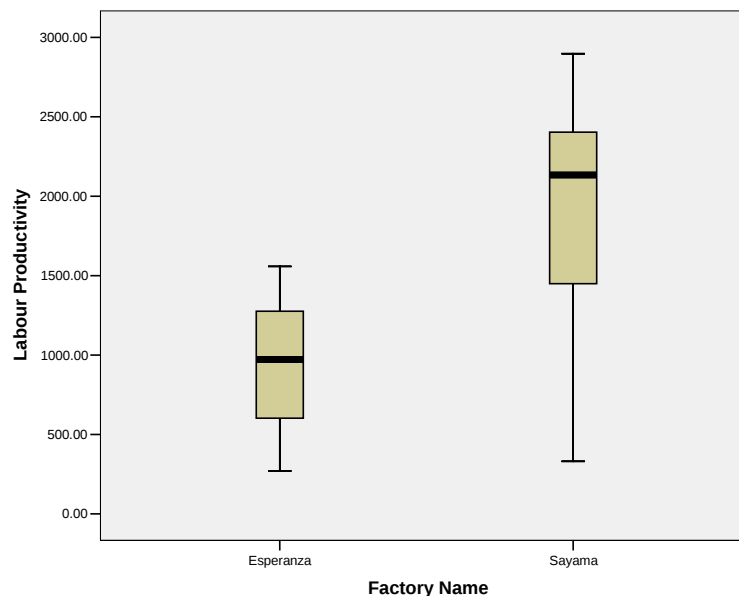


Figure 5.10 Labour productivity, Esperanza/Sayama

5.4.3 Discussions

Labour productivity was worked out using volumes produced, prices commanded and personnel involved. The results indicated that Sayama at a mean labour productivity of 1915.0 US cents per labour-month (SD 698.9) has the highest labour productivity followed by Esperanza at 941.5 US cents per labour-month (SD 383.0); while STECO at 366.9 US Cents per labour-month (SD 256.1) has the lowest. With such disparities in labour productivity it was obvious that STECO would struggle in the industry. It is also worthwhile to note that Esperanza that hitherto seemed a star performer is torpedoed by Sayama at labour productivity. This was expected since production volumes from the two factories were not significantly different and their prices, though significantly different, were only 6.68% apart. Esperanza, with a labour force of 276, employs approximately three times more labour than Sayama. With such results, it can be concluded that rotorvane/CTC tea processing technology is more productive than the LTP tea processing technology. Thus Esperanza should not consider itself a better performer on the basis of slightly higher production figures and prices because overall it costs Sayama much less to produce a kilogram of tea than it does Esperanza. This, therefore, is a wake-up call for Esperanza to start working towards improving labour productivity in particular and multifactor productivity in general. Should the status-quo remain unchanged, Sayama would be able to attract all the good labour force on the market as it can afford to offer better packages to its personnel without endangering its profitability. In the event that such a change occurs, Sayama would be able to improve its quality, get better prices and invest in growth. On the other hand, Esperanza stands to be affected negatively by any major changes in tea prices.

It was earlier concluded that Esperanza's LTP technology produces tea of higher quality as manifested by the higher prices tea from the factory is commanding on the market while Sayama's rotorvane/CTC technology produces higher tea volumes per production line such that a single line is able to compare to two lines of LTP. When overall performance is taken into consideration, Sayama turns out to have labour productivity that is more than twice that of Esperanza. It is, therefore, recommended that for sustainability, rotorvane/CTC tea processing technology should be a preferred technology to LTP technology. This recommendation should be confirmed with an investment appraisal. The investment appraisal is beyond the scope of this

research. Having made this statement, it is worth noting that Malawi, despite its aspiration of becoming a middle income country by the year 2020, remains a low income country (LDC). Sawyer & Sprinkle (2004) while discussing factor endowment theory, allude to the fact that LDCs are by nature labour abundant countries. It follows, therefore, that despite showing low productivity LTP technology is more labour intensive than rotorvane/CTC technology. Hence it may be socially prudent to stick to LTP technology and work towards improving the quality of the tea further so that better prices than so far achieved are offered. In this way, improved prices together with optimized production levels will translate into improved labour productivity without necessarily changing the type of technology.

5.5 Summary

The results of the analyses above were meant to demonstrate how technology impacts on performance of the tea manufacturing industry. Based on the definition of technology given earlier, the role of technology has been assessed based on the state of machinery, where technology is defined as machinery and equipment; and processes followed in production, where technology is defined as processes. In the assessment, tea production, its quality (as reflected from the prices) and labour productivity have been used to analyze the impact of technology on performance. The results have shown that there are statistically different performance indicators between the sampled companies. The analysis showed that companies that follow preventive maintenance have higher production, higher quality and higher productivity. On the other hand, comparing LTP processing technology and rotorvane/CTC processing technology shows that LTP technology gives higher quality while rotorvane technology gives higher productivity.

The next chapter, Conclusions and Recommendations reflects on the lessons that can be drawn from the results. Conclusions and recommendations have been made based on the results found in the research.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This research was designed to answer the research question ‘*What role does technology play in the performance of tea manufacturing industry?*’ The research question was against a background of Malawian companies struggling and others closing shop in the face of global competition. Recognition was made of works by other researchers and the fact that previous work was conducted on the premise of factors other than technology. It was, therefore, acknowledged that this research would emphasize the role of technology on the competitiveness of the manufacturing industry, using tea as a case study.

In the research, technology was defined as constituting three dimensions, namely; knowledge, processes and machinery. When management has been in the industry for more than seven years, it was assumed to have acquired enough knowledge to run the industry efficiently and effectively. It was, thence, assumed that the knowledge aspect of technology was uniform in all the sampled companies. The research, therefore, looked at the role of machinery and processing methods on performance of the tea industry.

The performance of the industry was assessed on the basis of production quantity and quality as well as productivity. Production quantity was assessed to reflect the output the companies were able to produce within a specific period, a month in case of this research. Quality was defined as having characteristics that meet the buyers’ “expressed and perceived needs” (Porter & Keller, 2005). Since tea is sold on the auction, it was assumed that the tea with good quality was offered higher prices. The role of technology was then assessed on how it influences the quality, hence price.

Productivity was assessed to demonstrate the efficiency of technology on using the resources when subjected to a different maintenance programme while keeping the processing methods constant as well as when using different processing methods while keeping the maintenance programmes constant. Thus STECO’s production was compared to that of Esperanza on the basis

of their different maintenance programmes. Esperanza's production was also compared to that of Sayama on the basis of the different processing methods the two have in place.

The research findings indicated that there is a difference between production quantity, quality and productivity from companies using technologies that receive different care as well as companies using different processing methods. This chapter will draw conclusions from the findings and make recommendations that would help in manipulating technology to avert struggling or closing down of Malawian companies.

6.2 Conclusions

After conducting this research, the research question '*What role does technology play in the performance of tea manufacturing industry?*' can now be answered. The answer can be given as '*technology influences the survival of manufacturing industries in general, and tea manufacturing companies in particular*'. This answer emanates from three key areas where technology was highlighted as influencing the performance of tea manufacturing firms.

Firstly, technology influence was highlighted through its impact on production volumes. In the research, production from a factory whose technology is kept in good shape through preventive maintenance programmes, hence sustaining the productive capacity of the firm, was compared to production from a factory of similar installed capacity but follows breakdown maintenance. Statistical analysis of the production data revealed that when technology is taken care of, like in a healthcare programme, production capacity is sustained and volumes are much higher than when technology is used until it breaks down. Another test on production volumes was conducted on use of different processing technologies. This test was inconclusive since the labour factors in the selected factories were different; Esperanza employing about three times the labour for Sayama.

Secondly, technology influence was assessed through product quality. The test used the same factories that were used above. The research has shown that if technology is ignored, the product quality deteriorates to levels that customers either stop buying the product as it fails to meet their expressed or perceived needs or buy it at such a low price that survival becomes impossible. In

addition, the research has shown that different technologies can produce goods of different quality. LTP tea processing technology turned out to be superior in achieving high tea quality when compared to rotorvane/CTC technology.

Lastly, the research has shown how technology influences productivity of a manufacturing company. It is clear from the research that a good maintenance programme enhances labour productivity. The research has also shown that some technologies are more productive than others such that they require fewer inputs for the same or higher outputs. In a competitive environment, companies that have high productivity are bound to thrive while those with poor productivity will struggle and eventually crumble. The research has demonstrated that preventive maintenance programmes help firms achieve higher productivity than breakdown maintenance programmes. The research has also shown that rotorvane/CTC technology is more productive than the LTP tea processing technology.

The above observations that emanate from the research results lead to the conclusion that some companies that have closed shop in Malawi have done so because they became less competitive as a result of ignoring their technological needs. The research has demonstrated that technology can make or break a firm. If technology is ignored, production quantity, quality and productivity would be affected in such a way that the firm will eventually lose its competitiveness. When this occurs, the firm would struggle and, sometimes, collapse. In fact, the Ministry of Economic Planning and Development (2005) reports Chitakali Tea Estate Limited and STECO as struggling firms. In addition, the research has also shown that different technologies impact on production quantity, quality and productivity differently. Some technologies are good at productivity while others are good at producing high quality while others are good or useless at both. It can, therefore, be concluded that the choice of appropriate technology would help to determine the competitiveness of a firm.

In addition to observations on the impact of technology on performance of the sampled companies, it was also observed that the companies that had adopted the breakdown maintenance were government owned. The ownership was either direct through the company being a statutory corporation, as is the case with Chitakali, or indirect through the company being a business unit

of a government owned corporation, as in the case of STECO. In the research, the two government owned companies struggled while the privately owned, Esperanza, a subsidiary of Eastern Produce (MW) Limited and Sayama a subsidiary of Lujeri Tea Estates Limited, thrived. It was beyond the scope of this research to investigate whether the government connection played a part in the poor performance of the two government owned companies. Further research can be designed to examine the relationship between government ownership and performance of the tea industry.

6.3 Recommendations

From the above conclusions, a number of recommendations can be made. Based on the result that use of preventive maintenance programmes improves production volumes, quality and productivity; it is recommended that the programmes be the preferred maintenance programmes to breakdown maintenance programmes in the manufacturing industries in general and tea manufacturing companies in particular.

In addition, the result that LTP technology produces higher tea quality than rotorvane/CTC technology, it is recommended that the LTP technology be the preferred technology when producing tea destined for markets that prefer tea of the highest quality. At the same time, the rotorvane/CTC technology is recommended for use where productivity is of paramount importance. In general, firms are advised to conduct a thorough market study before selecting appropriate technologies.

Following the conclusion that technology can make or break a firm, it is, recommended that technology be given prominence when considering turnaround strategies for struggling companies in Malawi.

6.4 Summary

The research has answered the research question, “*What role does technology play in the performance of tea manufacturing industry?*” In answering the question, the research has demonstrated how technology can impact on production quantity, quality and productivity. In conclusion, the report recommends serious consideration in selection and maintenance of

technology in order for firms to acquire and sustain productive capacity in the survival of the fittest competitive world.

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APPENDIX 1 Research Questionnaire

INVESTIGATING THE ROLE OF TECHNOLOGY IN PERFORMANCE OF TEA

MANUFACTURING INDUSTRY: A CASE STUDY

RESEARCH QUESTIONNAIRE

Part 1. General Information

1.1 Name of Respondent:

1.2 Title:

1.3 Company Name:

1.4 Year of Incorporation:

1.5 First Owners:

1.6 Subsequent Owners:

.....

.....

.....

1.7 How many people are employed in your factory?

Senior Mgt Middle Mgt Workers

1.8 What are the highest qualifications and experience for senior staff?

Title	Qualification	Experience in Tea Industry
General Manager		
Production Manager		
Engineering Manager		

1.9 What other courses have been offered to senior and middle managers?

Management Position	Course Title	Duration	Where it is offered

1.10 What other training do you offer to your staff and how many have had access to that training?

Type of Training	Grade of staff offered the training	No of staff trained

Part Two: Tea Production Process

2.1 How big is your Tea Estate?

2.2 What type of tea do you grow?

Tea Variety	Hectarage
Seedling varieties (Indian and Chinese)	
Poly Clonal	
Superior Cultivars	
Others	

2.3 Are there any special reasons for growing the varieties that you grow?

.....
.....
.....

2.4 What methods do you follow in your tea processing?

Process	Machines used	Conditions for best results
Plucking		
Withering		
Rolling		
Fermentation		
Drying		
Sorting		
Packaging		

2.5 What other methods do you know that are used for the same processes?

Process	Machines used	Reasons for not using the process
Plucking		
Withering		
Rolling		
Fermentation		
Drying		
Sorting		
Packaging		

Part 3 Maintenance

3.1 What type of maintenance programme do you follow?

Breakdown ☐ Preventive ☐ Other

3.2 How often do you service your machines?

Weekly ☐ Monthly ☐ Biannually ☐ Annually ☐

3.3 Who conducts your maintenance?

Machine operators ☐ Maintenance Technicians ☐

Consultants ☐ Others

3.4 What machines on your production line require:

Daily maintenance

Weekly maintenance

Biannual maintenance

Annual maintenance

3.5 Do you conduct annual shutdown for maintenance? Yes/No (tick)

3.6 How old are your Machinery?

Process	Machine	Year of Make	Year Installed
Plucking			
Withering			
Rolling			
Fermentation			
Drying			
Sorting			
Packaging			

Part 4 Production

4.1 What has been your monthly production in kilograms for the last three years?

Month	2003	2004	2005
Jan			
Feb			
Mar			
Apr			
May			
Jun			
Jul			
Aug			
Sep			
Oct			
Nov			
Dec			

Part 5 Prices

5.1 Where do you sell your tea?

Limbe Auction Mombasa Auction London Auction
Johannesburg Others

5.2 What have been your monthly average tea prices for the past three years?

Month	2003	2004	2005
Jan			
Feb			
Mar			
Apr			
May			
Jun			
Jul			
Aug			
Sep			
Oct			
Nov			
Dec			

APPENDIX 2 Monthly Production

Year	Month	Monthly Production (Kilograms)			
		Chitakali	STECO	Esperanza	Sayama
2003	Jan	65,400	125,070	295,153	281,648
	Feb	78,025	173,009	305,455	235,193
	Mar	69,520	109,770	309,072	230,331
	Apr	45,800	100,717	239,858	228,244
	May	43,760	24,717	62,142	118,887
	Jun	44,480	18,474		
	Jul	21,840	18,470		
	Aug	32,360	12,770	115,308	66,728
	Sep	16,880	202,770	275,717	247,886
	Oct	13,740	107,440	169,811	267,865
	Nov	18,920	171,000	85,687	180,000
	Dec	5,200	205,000	234,004	250,441
	Totals	455,925	1,269,207	2,092,207	1,839,337
2004	Jan	11,580	250,700	188,911	269,110
	Feb	10,920	151,000	326,556	252,646
	Mar	4,440	114,700	321,486	268,542
	Apr		114,500	256,193	203,614
	May		84,000	113,265	166,241
	Jun		36,000		32,788
	Jul		16,162		
	Aug		11,920	153,280	130,128

2004	Sep		111,740	290,617	284,343
	Oct		57,700	185,698	203,737
	Nov		171,480	252,615	231,305
	Dec		193,900	330,282	286,397
	Totals	26,940	1,313,802	2,418,903	2,328,851
2005	Jan		138,660	328,833	255,744
	Feb		178,840	297,708	232,202
	Mar		114,700	300,311	285,968
	Apr		110,000	79,350	201,202
	May		93,000		120,033
	Jun		48,000		61,298
	Jul		12,470		
	Aug		18,007	204,167	
	Set		120,110	148,520	86,473
	Oct		50,700	130,390	188,397
	Nov		67,110	133,669	213,376
	Dec		117,110	311,649	230,698
	Totals		1,068,707	1,934,597	1,875,391

APPENDIX 3 Average Monthly Tea Prices

Year	Month	Tea Prices (US Cents)			
		Chitakali	STECO	Esperanza	Sayama
2003	Jan	83	91	122	88
	Feb	87	95	121	89
	Mar	75	73	121	77
	Apr	81	87	112	101
	May	78	76	120	99
	Jun	70	84		
	Jul	68	93		
	Aug	81	87	120	115
	Sep	92	84	120	113
	Oct	93	87	115	111
	Nov	73	91	120	106
	Dec	52	87	128	103
2004	Jan	0.99	110	122	102
	Feb	0.78	91	120	107
	Mar	0.51	87	113	108
	Apr		87	104	109
	May		77	119	97
	Jun		87		106
	Jul		67		
	Aug		85	120	110
	Sep		84	114	107

2004	Oct		73	115	100
	Nov		81	126	108
	Dec		74	120	89
2005	Jan		87	114	95
	Feb		91	108	98
	Mar		85	105	95
	Apr		87	98	95
	May		76		98
	Jun		82		100
	Jul		86		
	Aug		85	116	
	Set		87	112	100
	Oct		92	106	106
	Nov		86	114	105
	Dec		82	113	104

APPENDIX 4 Labour Productivity

Year	Month	Labour Productivity			
		Chitakali	STECO	Esperanza	Sayama
2003	Jan	217.13	474.22	1304.66	2360.48
	Feb	271.53	684.83	1339.13	1223.54
	Mar	208.56	333.88	1558.24	1689.09
	Apr	148.39	365.10	973.33	2195.49
	May	136.53	78.27	270.18	1120.93
	Jun	124.54	64.66		
	Jul	59.40	71.57		
	Aug	104.84	46.29	501.34	730.83
	Sep	62.12	709.70	1198.77	2667.73
	Oct	51.11	389.47	707.55	2831.72
	Nov	55.25	648.38	372.55	1817.14
	Dec	10.82	743.13	1085.24	2456.71
2004	Jan	45.86	1149.04	835.04	2614.21
	Feb	34.07	572.54	1419.81	2574.58
	Mar	9.06	415.79	1316.23	2762.15
	Apr		415.06	965.36	2113.71
	May		269.50	488.35	1535.75
	Jun		130.50		331.00
	Jul		45.12		
	Aug		42.22	666.43	1363.25
	Sep		391.09	1200.37	2897.59

2004	Oct		175.50	773.74	1936.89
	Nov		578.75	1153.24	2379.14
	Dec		597.86	1436.01	2427.56
2005	Jan		495.39	1358.22	2313.87
	Feb		678.10	1164.94	2167.22
	Mar		406.23	1142.49	2587.33
	Apr		398.75	281.75	1820.40
	May		294.50		1120.31
	Jun		164.00		583.79
	Jul		44.68		
	Aug		63.77	858.09	
	Set		435.40	602.69	823.55
	Oct		194.35	500.77	1901.91
	Nov		240.48	552.11	2133.76
	Dec		400.13	1275.95	2285.01

APPENDIX 5 TEA TESTING TERMINOLOGY

(TEA BROKERS CENTRAL AFRICAN LIMITED, 2006)

Tea Term	Type of score	Meaning
Choppy	negative	Orthodox or rotorvane manufactured leaf which has to be cut by a breaker during sorting- typical in worn-out cutting blades.
Bold	negative	Particles of leaf which are too large for the particular grade- signifying spillovers at sorting or worn-out sorting mesh.
Even	positive	True to the grade and consisting of pieces of leaf of even size – a sign of efficient sorting.
Bloom	positive	A sign of good manufacture and sorting (where the reduction of leaf has mainly taken place before firing) A sheen that has not been removed by over-handling or over-sorting- signaling use of worn-out fibre extraction rollers.
Clean	positive	Leaf which is free from fibre, dust or any extraneous matter – a sign of efficient fibre extractors on the production line.

Grey	negative	Leaf colour caused by too much abrasion during sorting – a sign of problems in sorting, either too aggressive vibration or too much tea being fed into the sorter resulting into longer shaking before being ejected or passing through the screen.
Ragged	negative	An uneven badly manufactured and graded tea
Tip	positive	A sign of fine plucking and apparent in the top grades of orthodox manufacture
Well twisted	positive	Applicable to Orthodox manufacture. Often referred as “well made” or “rolled” and used for describing whole leaf grades
Green	negative	Caused by under-fermentation which itself could be a result of poor rolling or too short a fermentation period
Fruity	negative	An over-ripe taste. Can be due to over-fermentation and/or bacterial infection before firing.
Bakey	negative	An over-fired tea. Tea in which too much moisture has been removed.
Mushy	negative	A tea which has been packed or stored with high moisture content.
Earthy	negative	A taste normally caused by dump storage.

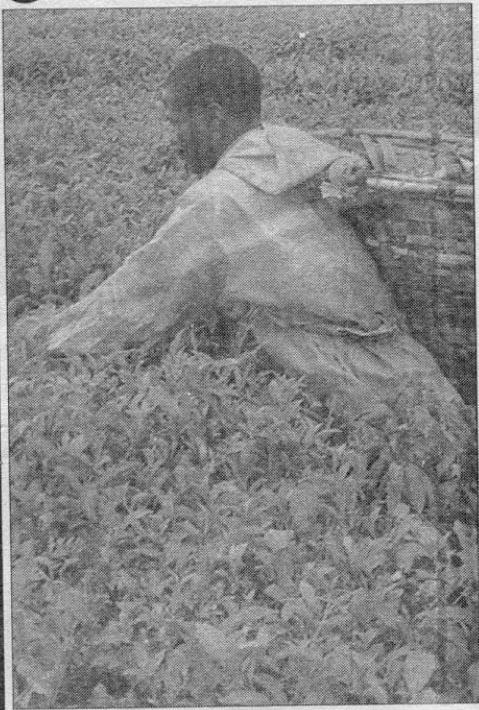
APPENDIX 6 REGULAR TEA BUYERS, LIMBE TEA AUCTION

No	Buyer Name
1	Target Brand
2	Stansand (C A) Limited
3	Lipton Tea
4	Global Tea
5	Chombe Tea
6	I & M Smith
7	Van Rees Limited
8	Planters Tea
9	James Finlay (Blantyre) Limited
10	ITS Limited
11	Rab Processors
12	Bharat Trading
13	Unicorn Limited

The Nation 16 August, 2006

Malawi tea gaining ground internationally

by Chikumbutso Ndaferankhande



Malawi's tea—which accounts for between 20 and 25 percent of foreign exchange earning—is gaining ground on the international market, shaking off its tag as a filler commodity, Lujeri Tea Estate Managing Director Jim Melrose has indicated.

Melrose said in an interview last week that international blenders have always regarded Malawi tea as a filler, filling the gaps on the international market and to provide consistency and maintain cheap prices when it is mixed with other tea producers from countries producing better blends like Kenya.

"Our tea has four unique qualities making it sell, which is very good colour, good strength, brightness and briskness. The problem is that 90 percent is seedling tea that produces low quality leaf.

"But the good news is that we, through the Tea Research Foundation, are coming up with better quality tea because we are using the method of cultivars. The new cultivars are high-yielding and drought-resistant, and these cultivars will spread across the field with pollination over time," he said.

The bulk of the tea produced in Malawi is derived from old seedling tea which is low-yielding and of only average quality, not fetching very good prices on the world market.

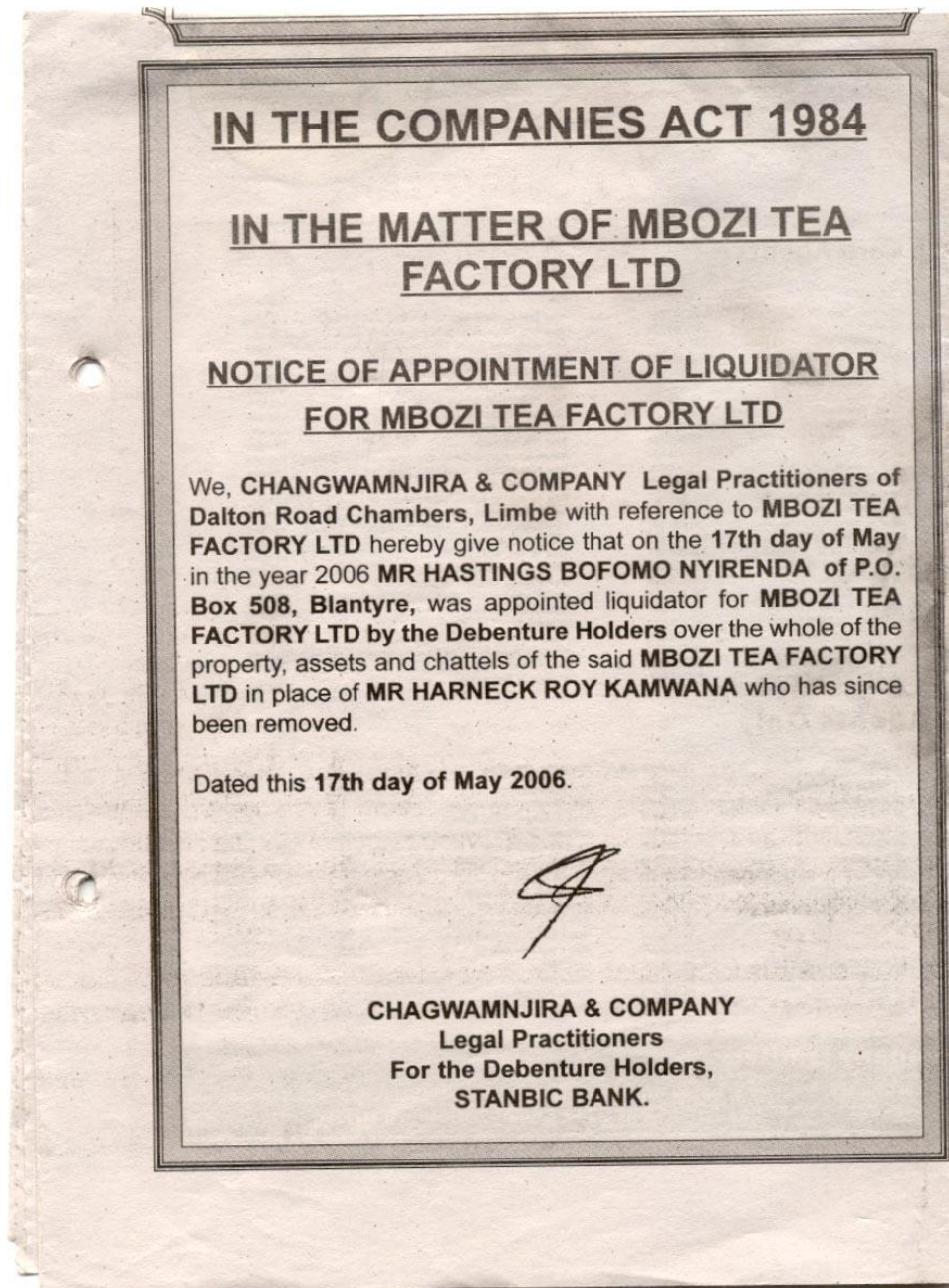
The Tea Research Foundation—a body totally financed by the industry—has since the 1960s been mainly engaged in the selection and propagation of "superior cultivars".

The fruits of these cultivars are now showing up and will increase the tea's market share on the international front, according to Melrose.

He said the other hopeful news is that the small-holder private sector has potential for growth and expansion, adding that tea is sustainable, a good conservational bush and a long-term perennial crop.

No longer a filler: A tea-plucker picking Malawi leaf in Mulanje.— Pic: Nation Library

Source: The Nation, 16th August, 2006



Source: The Daily Times, 19th May 2006

