

**THE IMPACT OF AUTOMATION ON OPERATIONAL
PERFORMANCE: A STUDY OF KENYA TEA DEVELOPMENT
AGENCY MANAGED FACTORIES**

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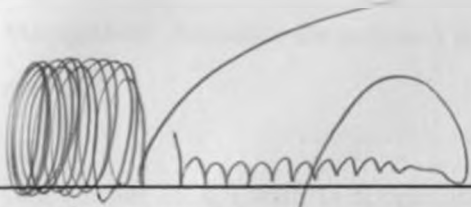
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DECLARATION

This Research Project is my original work and has not been presented for a degree in any other university.



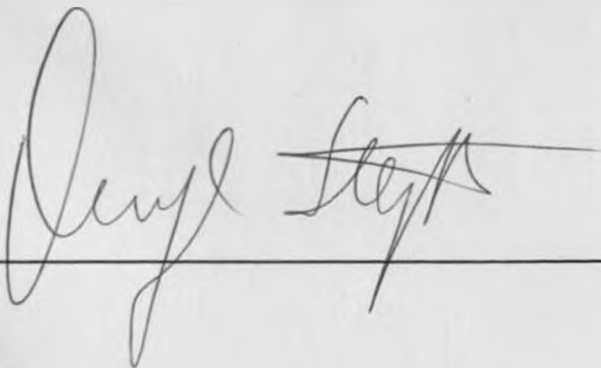
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Last but not least I wish to appreciate the role played by my parents, Mary Wanjuki and Njagi Muruana who over the years have never tired of encouraging pursuit of higher education.

DEDICATION

This study is dedicated to my family, Muthanje, Murugi and Njagi, who offered invaluable support and encouragement during the course of its duration.

ABSTRACT

Technology can be the basis of realizing the operational performance objectives of quality, customer-focus, dependability, flexibility, and cost-reduction. Automation is often chosen over manual methods because it has the advantage of providing consistency and control over the final product. Automation also provides an organization with the ability to collect data about the performance of its process and to analyze the variables that contribute to achievement of performance objectives (Beckman and Rosenfield, 2008).

This study investigated the impact of automation on the operational performance of the KTDA managed factories. A total of sixty three factories out of the sixty five managed participated in this study. Primary data was collected from production managers inquiring into the impact on automation on operations as well as on strategy.

The results of the study show that although fully automated factories have higher operational performance compared to partially automated ones, the overall performance is not significantly different. Further, the study did not find any significant difference between labour costs incurred by fully automated and partially automated factories. This seems to imply that replacement of workers by machines does not significantly change the cost composition of the factories under study. The study, however, found that factories which report full automation considered that they had achieved a higher competitive advantage over their competitors in comparison with those less automated.

The study concludes that the critical cost factor (s) in KTDA managed factories be identified through further investigation. It also recommends that KTDA management align its automation strategy with a customer-centric perspective, rather than pursuing automation independent of customers as the results of this study indicate.

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CHAPTER ONE: INTRODUCTION

1.1 Background

Organizational competitiveness is one of the most critical issues modern firms have to consider in the management of their operations. Achieving competitiveness has become a major imperative in the face of the rapid pace of the globalized marketplace. With this competition, companies which cannot or will not structure their operations in such a way as to be competitive will not be able survive in the marketplace. Indeed, competitiveness has become an important factor determining whether a company prospers, barely gets by, or fails (Stevenson, 2007).

Waters (2002) categorizes processes by the level of technology into manual, mechanical and automated processes. In manual processes, people have full control over operations that need their constant attention. Manual systems have the benefits of flexibility, low capital costs and low risk. Their disadvantages include high unit cost, the need for a skilled workforce, variable quality and low output.

In mechanical processes, an operator loads a piece of equipment which can work without further intervention. Mechanized systems have the advantages of producing high volumes of uniform products at low unit cost, but have the disadvantages of high capital cost and inflexibility. They still need operators to do some of the aspects of the work operations and deal with problems. Unfortunately, humans slow down a process, add variability to the quality and increase unit costs and this is the major reason why automated processes have been adopted. Automation overcomes the problems of a mechanized process because automated equipment performs series of operations without any operator involvement.

Operations performance is judged primarily in terms of five performance objectives, namely: quality, speed, dependability, flexibility, and cost. Unfortunately, assessing performance is not a straightforward matter. This is because perceived performance means different things to different people. The five performance objectives have been arrived at from the perspectives of organizational stakeholders who include: customers, shareholders, employees, suppliers, and the society. Understanding the broad stakeholder objectives is

important because different priorities between stakeholder groups often provide the backdrop to operations strategy decision-making (Slack and Lewis, 2008).

Quality is the first of the performance objectives. Quality usually means that the product is fit for purpose, that is, it does what it is supposed to do. According to Garvin (1984), most definitions of quality are transcendent, product-based, user-based, manufacturing-based, or value-based. Transcendent means that quality is something that is intuitively understood but nearly impossible to communicate, such as beauty or love. That quality is product-based means that quality is found in the components and attributes of a product. When quality is defined as being user-based, it means that if the customer is satisfied, the product has good quality. Manufacturing-based quality means that if the product conforms to design specifications, it has good quality. Value-based quality means that the product is perceived as providing good value for the price.

Beckman and Rosenfield (2008) make a distinction between quality as a means of competition and quality management as a capability. They observe that a quality capability, and the quality tools associated with developing that capability, can be the basis for competing on the quality dimension. A company that chooses to gain competitive advantage through quality may choose a particular focus from among the various tangible and intangible characteristics, or it may choose to develop quality as a company wide capability. If the company chooses to develop quality as a capability, Beckman and Rosenfield (2008) observe, the major reason for this would be position itself competitively to take advantage of that capability. Shiba and Walden's (2001) definition of quality focus more directly on how well the product or service meets different types of specifications and customer needs, include fitness to standard, fitness to use, fitness to cost, fitness to latent requirements, fitness of corporate culture, and fitness for society and the global environment.

Speed is the second operational performance objective. At its most basic, speed indicates the time between the beginning of an operations process and its end. It is an elapsed time. This may relate to externally obvious events; for example, from the time when the customer requests a product or service, to the time when the customer receives it. Speed may also be

considered as the time it takes for material to go through the operations process; that is, from the moment of entry to the time it exits the system as a finished product. From the customers' view, the total process starts when they become aware that they may need the product or service and ends when they are completely satisfied with its installation.

Dependability is the third performance objective. It means keeping delivery promises. It means honouring the delivery time given to the customer. It is the other half of total delivery performance along with delivery speed. Good dependability can often be helped by fast throughput. The focus on reducing stocks of inventory to lower costs has placed increasing emphasis on delivery reliability as a criterion for evaluating alternative vendors (Chase *et al*, 2004).

Flexibility can be defined as the ability to adopt different states. An operation that moves quickly, smoothly and cheaply from doing one thing to doing another would be considered more flexible than one that can only achieve the same change at greater cost and or organizational disruption. Both the cost and time of making a change are elements of flexibility. According to Beckman and Rosenfield (2008), flexibility is viewed as a strategic output of an organization whose usefulness is in its being a source of superior performance. It is an internal capability that helps fulfill strategic goals.

Cost is the fifth performance objective. In many cases, it is the most important objective because it has a direct impact on the customer. Products sold strictly on the basis of cost are typically commodity like (Chase *et al*, 2004). Operations costs are a major input in the overall cost of the products destined for the market. If it happens that such products become too expensive and, therefore, beyond the reach of customers, they would not be competitive in the marketplace. This means that sales would not be sufficient for the company to realize an acceptable return on its investment. Because of this, companies are continually exploring ways in which they can reduce the cost component of their final products. This requires that such organizations adopt an operations strategy based on achieving competitiveness.

Slack and Lewis (2008) have observed that many enduringly remarkable enterprises manage their operations in such a way as to achieve a real strategic impact. They contend that such firms have found that it is the way they manage their operations that sets them apart from their competitors. Adoption of an operations strategy ensures that strategic decisions are not frustrated by poor operational implementation. The focus of operations strategy is, therefore, to ensure that all operating capabilities provide competitive advantage.

Cost is perhaps the most important of the performance objectives and is especially important to those companies that compete directly on price. A company competing along the cost dimension might choose to compete on the basis of purchase cost to the customer, or it might worry more broadly about the full cost of ownership for the customer (Beckman and Rosenfield, 2008). Automation has been used to cut costs and make the organization competitive. Technology allows the firm to deliver on consistency and control. Consistency is achieved because machines behave more or less predictably over time while control is realized in the sense that machines can be instructed more easily than human beings. Automation also allows the company to collect data about performance of its process and to analyze the variables that contribute to competitiveness metrics. Thus, a company interested in obtaining high-quality performance might choose to invest in automation and to standardize technologies within and across its facilities. The overall aim is to pass to the customer the benefits of lower prices in the process achieving market competitiveness on the basis of cost.

Managing costs is an important aspect of the overall operations strategy. By definition, operations refer to the activity of managing resources and processes that produce and deliver goods and services. Every organization, no matter the sector it is in, has an operations function because every organization produces some mix of goods and services. Management of costs can contribute to the success of an organization by providing what the business needs to survive and prosper through obtaining higher margins, innovation of new products, achieving unique competencies and ultimately by satisfying its customers. Management of costs reduces the costs of producing products through bringing efficiency in the way the organization transforms inputs into outputs, increases revenue by promoting outstanding customer satisfaction, reduces the amount of capital employed that is necessary to produce the required type and quantity of

products and services, and provides the basis for future innovation by building a solid base of operations-based capabilities, skills and knowledge within the business (Slack and Lewis, 2008). Organizations perform poorly when they fail to realize that their input costs have a major contribution to the final pricing decisions and consequently to profits.

Slack and Lewis (2008) have defined cost as any financial input to the operation that enables it to produce its products and services. Conventionally, these financial inputs can be divided into three categories, namely: operating expenditure, capital expenditure, and working capital. Operating expenditure refers to the financial inputs to the operation needed to fund the ongoing production of products and services. It includes expenditure on labour, materials, rent, and energy. Usually the sum of all these expenditures is divided by the output from the operation to give the operation's unit cost. Capital expenditure is the financial inputs to the operation that funds the acquisition of the facilities which produce its products and services. It includes the money invested in land, buildings, and machinery. Working capital is the financial inputs needed to fund the time difference between regular outflows and inflows of cash.

This study sought to determine the impact of automating the fermentation process on the cost and quality aspects of operational performance in KTDA managed factories. Fermentation, one of the six processes in tea manufacturing, accounts for about 30% of the total labour complement in a typical tea factory. Thus, automating this function is expected to significantly reduce the overall costs and contribute to organizational competitiveness and achieve operations strategy objectives. The other processes that are associated with tea manufacture are withering, cutting/rolling, drying, sorting and packing.

1.2 The Kenya Tea Development Agency Limited

The Kenya Tea Development Agency Ltd (KTDA) is a Kenyan small-scale tea farmer's organization incorporated in the year 2000. Its precursor, the Kenya Tea Development Authority, KTDA, was a government parastatal incorporated in 1964 whose mandate was to foster small scale tea growing in Kenyan (KTDA, 2011). The Kenya Tea Development Agency has been grappling with issues of operational performance and general competitiveness of its final products-the Kenyan tea-in the global market place.

Run by a board comprising twelve (12) farmer-elected directors and three (3) executive directors, KTDA Ltd currently provides management and secretarial services to 54 small-scale tea factory companies. From only 19,975 farmers producing 2,800 metric tons of tea at the time of inception in 1964, the tea business managed by the KTDA has grown and currently serves over 550,000 farmers with an average farm size of 0.2 hectares producing over 200,000 metric tons of tea annually (KTDA, 2011). The development of the factories is as shown here below:

Table1. 1: Distribution of KTDA factories in Kenya

Year	Number of factories
1957 – 1963	2
1964 – 1970	4
1971 – 1975	10
1976 – 1980	9
1981 – 1985	14
1986 – 1990	0
1991 – 1995	5
1996 – 2000	1
2000 – 2003	6
2003 – 2004	3
Limited Companies	54
Satellites 2004 – 2011	11
Total Processing Plants	65

Source: KT DA Ltd Strategic Plan 2009 -1014

Since 2004, the strategy for increasing processing capacity has changed from construction of new limited liability companies to processing plants, satellites, developed by a mother factory. To date eleven (11) such plants have been put up and commissioned bringing the total number of processing units to sixty five (65).

In the year 2010, Kenya produced 399,006 metric tons of black tea and was ranked the third largest producer of black tea in the world after China and India. Of this crop, KTDA Ltd

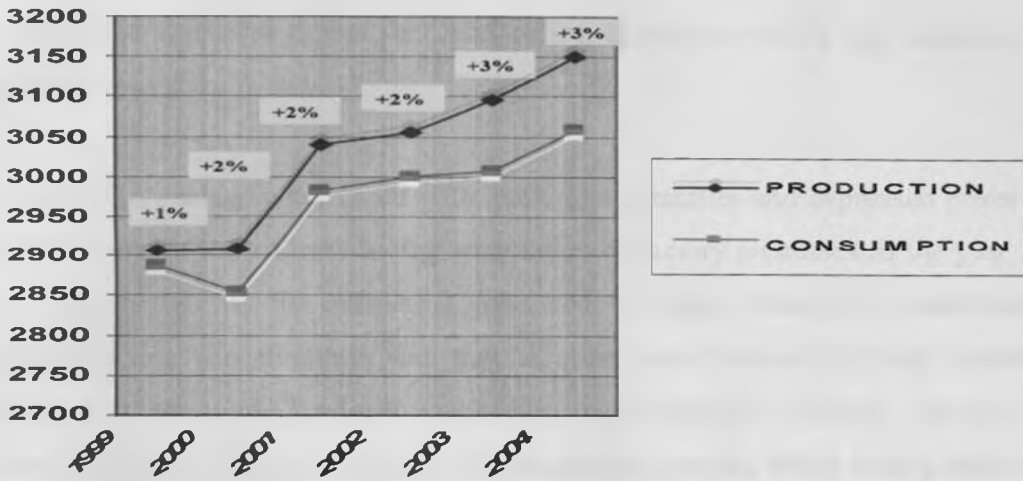
produced 224,980 metric tons representing 56% of the total Kenyan tea crop that year while the balance was produced mainly by multinational companies, with the main ones being: Unilever Tea Kenya Ltd (9%), James Finlay Kenya Ltd (7%), Eastern Produce Kenya Ltd (7%) and Williamson Tea Kenya Ltd (5%). Other tea processing companies produced the balance 16%. (The Tea Board of Kenya Fact Sheet: 2010). Despite the relatively high tea production in Kenya, only a mere 18.7 Million Kgs was consumed locally which was 3% higher compared to 18.1 Million Kgs recorded in 2009.

During the year 2010, a total of 441 Million Kgs were exported. This was 99 Million Kgs higher than 342 Million Kgs exported in 2009. Consequently, the export earnings rose by KSh 28 Billion from KSh 69 Billion (USD 899 Million) to KSh 97 Billion (USD 1.23 Billion) to register the highest export performance recorded by the industry. Improved export earnings were attributed to a combination of higher export volume, improved prices as well as depreciation of the Kenya Shillings against the USD. During the year, the Kenya Shilling exchanged at an average rate of 79.23 to the USD compared to 77.35 in 2009.

During the same period, Kenya tea was exported to 48 market destinations, compared to 46 destinations in 2009. Egypt continued to be the largest market for Kenyan tea having imported 93 Million Kgs, accounting for 21% of total export volume. Other top markets were Pakistan (76 Million Kgs), UK (73 Million Kgs), Afghanistan (49 Million Kgs), and Sudan (31 Million Kgs). The top five markets accounted for 73% of total volume exported while the other 43 markets accounted for 27%. Amongst the traditional markets, Afghanistan recorded the highest growth of 48% from 33 Million Kgs to 49 Million Kgs. (The Tea Board of Kenya Fact Sheet: 2010).

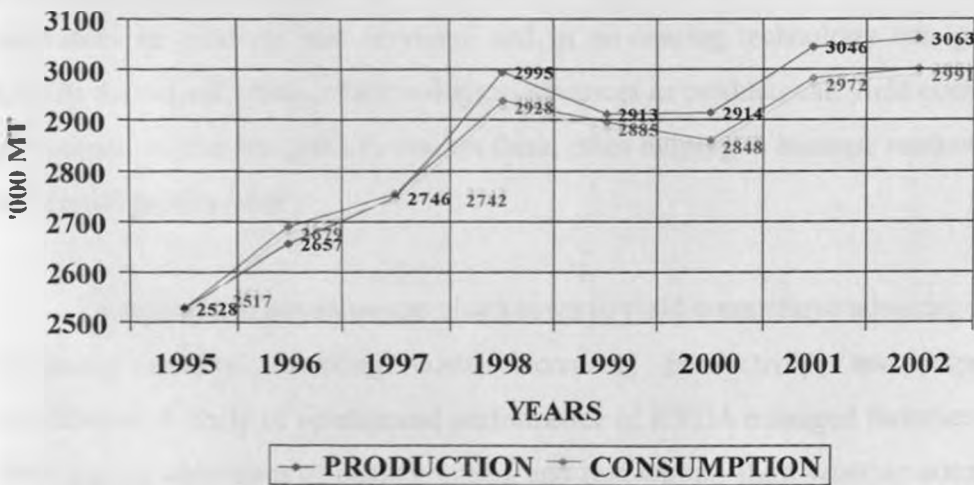
Globally, tea production rose from 2528 metric tons in 1995 to 3063 metric tons by the year 2002 while consumption rose from 2517 to 2991 during the same period. In those seven years, global tea surplus increased from a mere 11 metric tons to 72 metric tons and was estimated to have risen to 100 metric tonnes by 2004. This information is shown in Chart 1.1 below:

Chart 1.1 Global Tea Demand and Production



Source: *Tea Production in Kenya, an Industry in Crisis* by Richard Fairburn CEO Unilever Tea Kenya Ltd. 2005

Chart 1.2 Actual Global Tea Production and Consumption, 1995 to 2002



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Source: *Tea Production in Kenya, an Industry in Crisis* by Richard Fairburn CEO Unilever Tea Kenya Ltd. 2005

1.3 Research Problem

Agricultural production in developing countries has continued to face a prolonged crisis over the years. This has arisen from falling commodity prices made worse by the rising costs of production over the same period. A study by Tharian and Joseph (2005) found that the plantation sector faced growing market uncertainties and depressed farm gate prices for major crops among them, natural rubber, tea, and coffee, a situation which has called for strategic interventions from stakeholders.

The KTDA management, faced with market uncertainties and depressed prices undertook the strategic intervention of introducing automation of factory processes in the year 2005. The objective was to address the escalating costs and to better manage the uncertainties of the fluctuating profits. The thinking was that if costs were reduced through automation, the uncertainties of the global prices would be better smoothed thereby allowing for more predictable payments to crop producers. The automation process, which took a phased approach, has been going on for the last ten years. As at the end of 2010, a number of factories have had a large component of their fermentation process automated though others are yet to be automated.

Automating functions in organizations is one of the ways of improving operations performance objective of managing costs. According to Stevenson (2007), technology and technological innovation often have a major influence on business organizations. Technological innovation in products and services, and in processing technology can produce tremendous benefits for organizations. Technological advances in products can yield competitive advantages for companies that are quick to market them, often helping to increase market share and generate substantial profits (*ibid*).

Technological advances are also known to yield competitive advantages for companies by increasing quality, lowering costs, increasing productivity, and expanding processing capabilities. A study of operational performance of KTDA managed factories with respect to the performance objectives of quality, speed, and cost would show whether automation has brought benefits to the factories or not. With automation, the KTDA management hopes that costs would be contained and therefore justify automation. This study was, therefore, an empirical

investigation of the impact of automation to establish whether the objectives of the KTDA management with respect to automation have been realized. This study compared the performance of two sets of factories-those that are fully automated and those that are not and compared the trend of costs over time. The main idea was to compare the cost results and, if such results would be found to be significantly different, then a case would be made for or against automation.

From the time the machines were introduced, a reasonable time has passed. Over this time, there has been no study to find out whether management has actually obtained the benefits of reduction in costs and, indirectly, achieving competitiveness. It is not yet known if introduction of machines has brought a decrease in costs of production. This study investigated the impact of automation in the KTDA managed factories.

The study tested the null hypothesis that automation of the labour component in KTDA managed factories does not lead to improved operational performance, as measured by changes in labour costs represented by the cost per kilogram measurement unit (that is, there is no significant difference between automated and manual-operated factories in terms of labour costs). Specifically;

1. What has been the impact of automating the fermentation process on labour cost?
2. What has been the impact of automating the fermentation process on quality of made tea?
3. What has been the impact of automating the fermentation process on labour productivity (kilograms made tea per man-day)?

1.4 Research Objective

The objective of this study was to investigate the impact of automation on the operational performance of factories managed by the Kenya Tea Development Agency Ltd.

1.5 Value of the Study

The findings of this study are important, first and foremost, to the management of KTDA who would be able to have empirical results of the impact of their automation programme that

has been on-going for close to ten years now. The study is also of interest to the entire agricultural sector in Kenya to the extent that it shows whether automation leads to significant improvement in production of agricultural finished products and its contribution to competitiveness. This study also contributes to the literature on automation of what have been traditionally intensive human labour components of agricultural production in developing countries. Further, as little or no research has been done in the area of substituting automation for human labour in the agricultural sector in Kenya, the results of this study are an important addition to the existing body of knowledge on organizational competitiveness, as moderated by technology and innovation.



CHAPTER TWO: LITERATURE REVIEW

2.1 Automation

Automation is the use of control systems and information technologies to reduce the need for human work in the production of goods and services. In the scope of industrialization, automation is a step beyond mechanization. Whereas mechanization provides human operators with machinery to assist them with the muscular requirements of work, automation greatly decreases the need for human sensory and mental requirements as well. Automation plays an increasingly important role in the world economy and in daily experience.

Automation has had a notable impact in a wide range of industries beyond manufacturing (where it began). Once-ubiquitous telephone operators have been replaced largely by automated telephone switchboards and answering machines. Medical processes such as primary screening in electrocardiography or radiography and laboratory analysis of human genes, sera, cells, and tissues are carried out at much greater speed and accuracy by automated systems. Automated teller machines have reduced the need for bank visits to obtain cash and carry out transactions. In general, automation has been responsible for the shift in the world economy from industrial jobs to service jobs in the 20th and 21st centuries. (Automation, 2011)

2.2 Automation Objectives

Slack et al (2001) identifies two benefits of automation as saving direct costs and reducing variability in the operation. They go further to observe that automation is usually justified in the former but it is sometimes the latter that is more significant.

Automation offers a number of advantages over human labour. It has low variability, whereas it is difficult for a human to perform a task in exactly the same way, in the same amount of time, and on a repetitive basis. In a production setting, variability is detrimental to quality and to meeting schedules. Machines also do not get bored or distracted, nor do they go on strike, ask for higher wages, or engage in industrial action (Stevenson, 2007).

In order to deal with the Japanese assault of its market share in the 1980s, General Motors launched a radical business plan to automate and modernize its factories as well as its car models. The brand new, automated factories would, in theory, produce fuel saving, smaller cars of the highest quality in greater volume and more cheaply than the competition. 'In one masterstroke, GM would stop the invasion cold and leave the competition years behind' (Finkelstein, 2003). In this, automation was used as a strategic objective with the aim of clawing back lost market share.

The old focus on using automation simply to increase productivity and reduce costs was seen to be short-sighted, because it is also necessary to provide a skilled workforce who can make repairs and manage the machinery. Moreover, the initial costs of automation were high and often could not be recovered by the time entirely new manufacturing processes replaced the old. Automation is now often applied primarily to increase quality in the manufacturing process, where automation can increase quality substantially. For example, automobile and truck pistons used to be installed into engines manually. This is rapidly being transitioned to automated machine installation, because the error rate for manual installment was around 1-1.5%, but has been reduced to 0.00001% with automation (Automation, 2011)

Goldberg (2001) has argued that an organization needs to consider four sets of issues when making decisions regarding how much to automate. These are: business, operational, social and political, and regulatory issues. Business issues link the automation decision to the overall business, focusing on return on investment, flexibility, timing, and competitiveness of the automation. Operational issues are associated with the technological and physical constraints placed upon the process by its inputs and outputs as well as by the humans and machines involved. The operational capabilities of the process to perform from a cost perspective, quality perspective, availability perspective, features and innovativeness perspective, and environmental perspective must all be considered. Social and political issues address both the way in which the automation decision is made by the organization and the way in which automation might affect the organization and its human resources. Some organizations have cultures that thrive on being high tech and employing the latest and greatest technologies. Degree of automation also has significant implications for the skill sets of the employees. It may mean fewer operators are

needed, leading to concerns about job security, or it may require significant retraining efforts. This means that an organization's culture, decision-making process, and management of front-line employees can have a significant effect on automation decisions. Last but not least, regulatory issues are a major concern in most industries. Virtually all industries are subject to some regulatory requirement with respect to environmental or occupational safety and health concerns. Thus, all automation decisions must take into account the regulatory standards that must be met.

2.3 Automation Challenges

Although automation has been touted as a strategy to achieving competitiveness, it has been found to have certain disadvantages and limitations compared to human labour. Firstly, it can be costly. Roger Smith, Chairman and CEO of General Motors in the 1980s, spent \$40 – 45 billion to automate GM's processes. This was 14 times Ford's pretax earnings at the time. In addition, automation is much less flexible than human labour. Once a process has been automated, there is substantial reason for not changing it. Moreover, workers sometimes fear automation because it might cause them to lose their jobs. This can have an adverse effect on morale and productivity. In addition, automation as in the GMs case gets rid of direct labour and replaces it with more costly indirect labour comprising technicians and other people needed in an automated plant who are more expensive than the hourly worker.

Automation, as a means of reducing cost of production, has not always been successful. Various reasons account for this failure: The human labour displaced by machines is, very often, redeployed to other sections of the company, so that overall savings from labour costs are not realized. This redeployment happens because of existing labour contracts with employees and union restrictions on dismissal of workers. In other cases, the scale of automation is such that it does not significantly change the cost components of total production. This may happen when automation is partial or when for other reasons it fails to achieve the stated objectives (Stevenson, 2007).

Managers must carefully consider the issues surrounding automation particularly in respect of whether to automate or not and the degree to which to automate. Careful thought

should also be given to the extent to which automation integration would be achieved in the context of the overall production process. Stevenson (2007) has noted that if this integration is not achieved, gains from automation can be offset by losses in other performance objectives. GM, a company that was founded on the principle of cost savings and was once the prototype for efficiency had by 1986 become the industry's high cost producer. The average number of cars produced by each GM employee stood at 11.7 compared to 16.1 at Ford and 57.7 for Toyota. GM also earned 38% less than Ford and 26% less than Toyota on each of the vehicle they made. GM's plant productivity which had lagged Toyota's for years, actually declined further between 1984 and 1991, a period that should have reflected the gains from automation. The company's market shrunk while its manufacturing capacity increased. (Finkelstein, 2003)

Automation has important implications not only for cost and flexibility, but also for the fit with overall strategic priorities. If the decision is made to automate, care must be taken to remove waste from the system prior to automating, to avoid building waste into the automated system. In addition, companies may automate as an answer to the wrong ailment. For example, GM invested millions of dollars into automation ignoring the fact that production problems, not labour, were at the root of its problems. (*ibid*)

2.4 Impact of Automation.

Organizations automate for various reasons including reduction in direct labour costs, smoothening product variability, improvement in the production volumes and through this achieve better market share. In a study of automation and organizational performance, Wong and Ngin (1997) found out that automation was perceived to have resulted in greater improvements in operational performance and worker's well being than in labour management effectiveness and workers remuneration. Improvement in operational performance was not at the expense of labour management effectiveness, worker's well being or remuneration.

In industrial relations, 'automation' is frequently used as a synonym for "displacement". It may eliminate jobs outright, it may eliminate parts of several jobs; it may require new combination of skills and it may affect responsibility working conditions and the extent of worker control over rate of output. (Killingsworth, 1962). In a study of key success factors that

may lead to the success or failure of the BPR implementation in the Wrigley Company, Magutu *et al*, 2010 found out that the company managed to achieve competitive advantage by implementing BPR.

2.5 Tea Prices and Cost of Production Relationship

The producers of agricultural commodities have been facing serious crisis in the global market arising from falling commodity prices while the costs of production have been rising. A study by the World Bank shows that tea commodity prices have been falling hard at the same time that costs of production have been rising (World Bank Development Economics, 1999-2001).

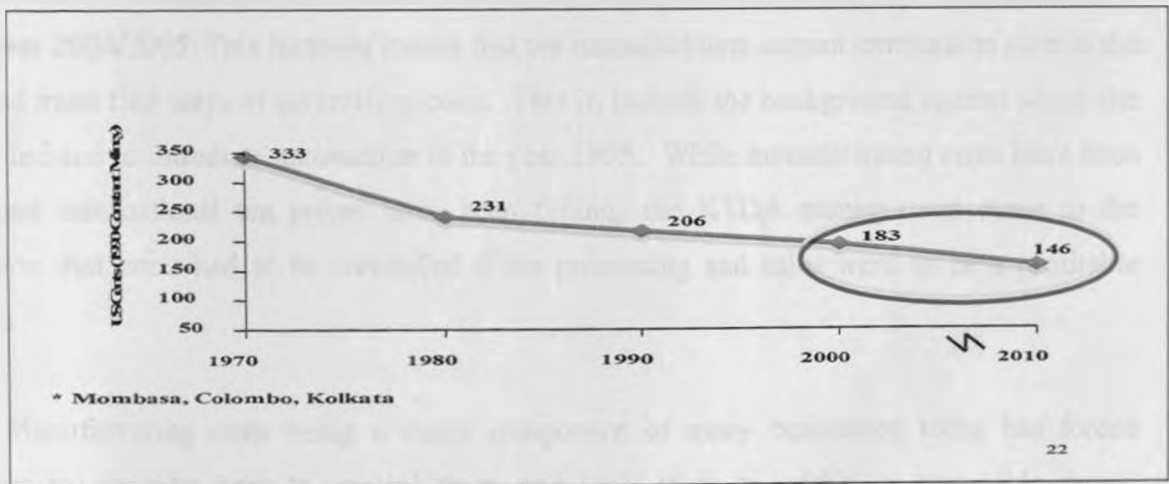
Tharian and Joseph (2005) have argued that the plantation sector is in a prolonged crisis that has been caused by growing market uncertainties and depressed farm gate prices. This has caused serious repercussions on the sector and has called for strategic interventions which have included setting up producers' consortiums in the primary marketing of tea, coffee, and other plantation crops. Tharian and Joseph (2005) have further observed that the fall in the annual average farm gate prices of the tea crop was 25 percent during the year 2003 compared to the peak levels of prices achieved in the 1990s. This situation has forced the planting community to begin adopting survival strategies broadly aimed at achieving cost savings. Specifically, the measures that have been undertaken have been in respect of labour displacement and even abandonment of prescribed agro-management practices, labour retrenchment, lockouts and resistance to routine tripartite wage negotiations. Routine practices have also been bypassed in a bid to reduce costs (*ibid.*).

According to Tharian and Joseph (2005), the future of the plantation sector is in great peril. They believe that the various cost reduction strategies and policy initiatives so far pursued by companies in the plantation sector have not been successful and, therefore, chances of long-term survival of the sector are bleak mainly due to the absence of a comprehensive exposition of the basic issues perpetuating the crisis.

Stevenson (2007) has argued that the cost of an organization's output is a key variable that affects pricing decisions and profits. Cost reduction efforts must be an ongoing activity in business organizations. Those organizations that have higher rates of productivity than their competitors have a competitive advantage. The KTDA has realized the need to undertake cost reduction efforts to remain competitive in the world markets. Since the year 2005, the company has put in place automated processes to substitute for the labour cost elements in tea production processes.

The KTDA has faced serious challenges arising from a combination of falling tea prices and rising costs of production. For example, during the period of rapid expansion in production, prices continued to decline in real terms while costs continued to rise and it was estimated that prices would fall below the cost of production by the close of the decade 2000-2010. This situation is shown in Chart 2.1 and Chart 2.2 next:

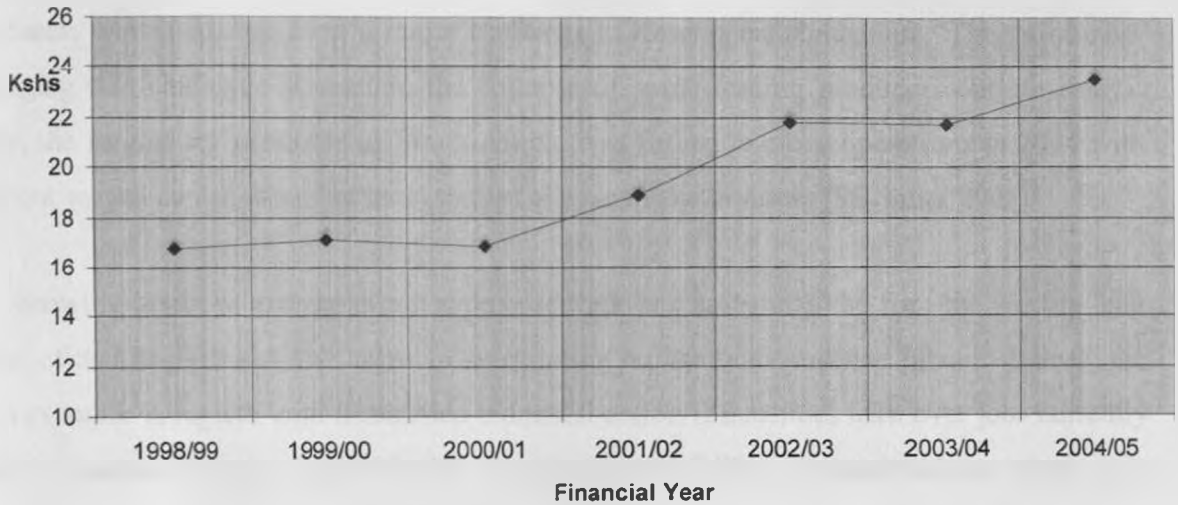
art 2.1: World Bank tea price prediction 3 Auction* Average 1970-2010



Source: World Bank Development Economics, International Tea Committee (ITC) Booklet 1999/ 2000/2001, and F O Lichts

The next chart shows the average cost of tea production per kilogram.

Chart 2.2: Annual average costs of production per kilo green leaf



Source: Experiences and Challenges in the Small scale tea production in a liberalized tea industry by Lerionka Tiampati, MD KTDA Ltd, 2005

Chart 2.2 shows that production costs have continued to rise, reaching their highest level in the year 2004/2005. This increase means that tea manufacturers cannot continue to sustain the trend and must find ways of controlling costs. This is, indeed, the background against which the KTDA decided to introduce automation in the year 2005. While manufacturing costs have been rising and international tea prices have been falling, the KTDA management came to the realization that costs had to be controlled if tea processing and sales were to be a profitable business.

Manufacturing costs being a major component of many businesses today has forced managers to consider how to control them and limit them to within a reasonable range. Competition in the world market is now the driving force among many organizations. If companies are to remain competitive, they must find a way of selling their products in the world markets at prices which appeal to customers. The key to successfully competing is to give customers what they want at the price they can afford to pay. This entails asking oneself: How can I keep costs getting into the final product to within acceptable levels? According to

Stevenson (2007), manufacturing businesses can achieve competitiveness by implementing a careful operations strategy geared towards reducing the cost component in the final product.

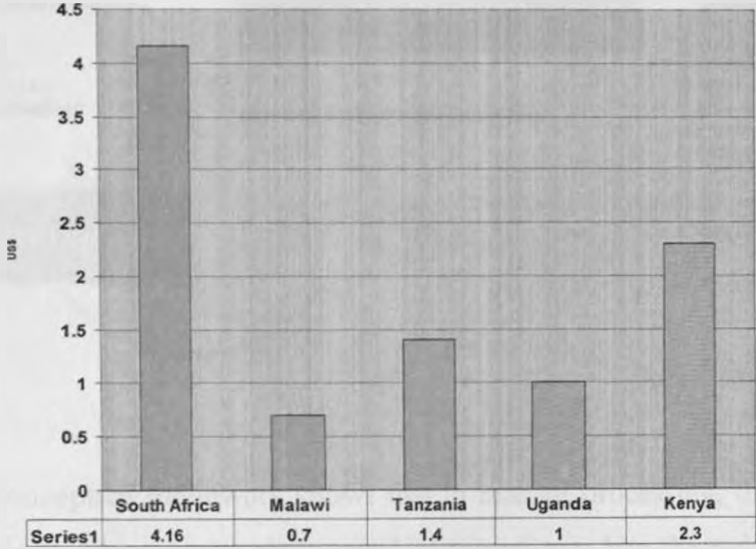
The operating environment of low producer prices and rising cost of production facing tea producers worldwide has been a major challenge to Kenyan tea companies. The seriousness of managing this challenge is seen in the collapse of some leading producers outside Kenya. Sapekoe, the largest tea producer in South Africa, was forced to close operations in 2004 with high labour wages contributing the most to the collapse of the business (Fairburn, 2005)

Growing activism among small scale producers has brought to the fore the need to look for ways of tackling the emotive issue of substituting human with machine labour. Indeed, the Kenyan example is replete with threatened industrial action if machines take over jobs currently handled by human beings. But with the rising costs and falling international tea prices, it is apparent that new strategies are needed. Managers of tea producing companies must evaluate their cost structures if they hope to remain competitive.

An analysis of the revenue distribution for KTDA managed factories showed that labour presented the greatest opportunity for cost savings (Chart 5). Thus the idea of automating the manufacturing process was born, starting with the fermentation process of tea processing (KTDA Strategic Plan, 2005-2009).

According to Slack and Lewis (2008), technology has a profound impact on all operations. Yet, despite a widespread acceptance of its significance, strategic analysis too often treats it as a “black box” fit only for technical experts. The KTDA introduced automation as a tool to enable it meet strategic organizational goals.

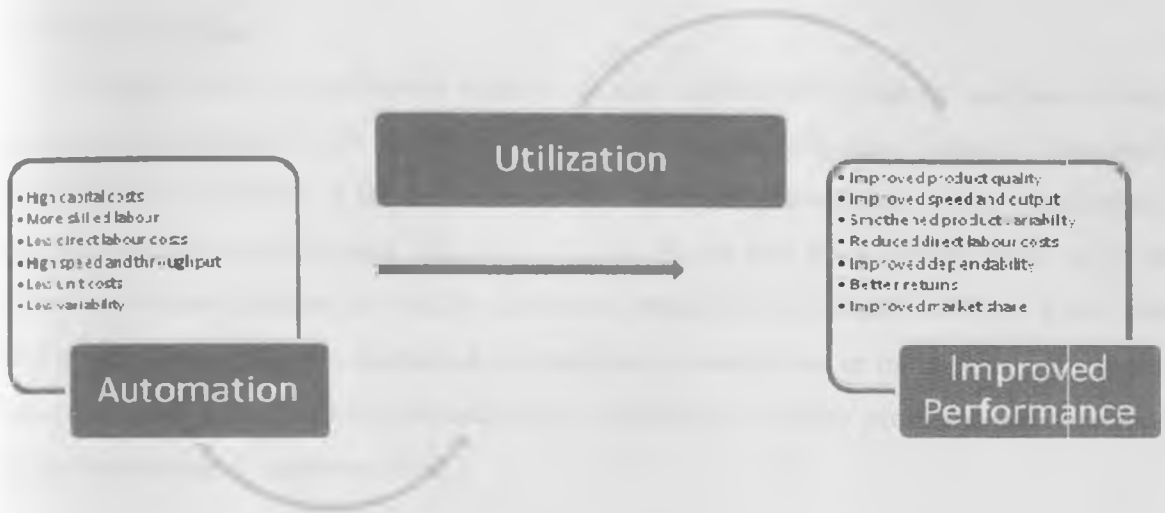
Chart 2.3: African Tea Producers Wage Rates



Source: Tea Production in Kenya, an Industry in Crisis by Richard Fairburn CEO Unilever Tea Kenya Ltd. 2005

Companies must be competitive to sell their goods and services in the market place. Competitiveness is an important factor in determining whether a company prospers or fails. Stevenson (2007) has noted that organizations fail, or perform poorly, for a variety of reasons. Being aware of those reasons can help managers avoid making similar mistakes. Among the reasons he cites are: putting too much emphasis on short-term financial performance at the expense of research and development, failing to take advantage of strengths and opportunities, and or failing to recognize competitive threats, neglecting operations strategy, placing too much emphasis on product and service design and not enough on process design and improvement, and neglecting investments in capital and human resources. Others are failing to establish good internal communications and cooperation among different functional areas, and failing to consider customer needs. This study will focus on the importance of operations strategy and how it has been affected by KTDA's automation efforts over the past ten years.

2.6 Conceptual Framework



The conceptual framework shows that in manual processing, the operations are saddled with high direct labour costs, slow speed of operations, low throughput and high unit costs. Manual processing also is associated with high variability, high flexibility, and low capital costs. When the operations are automated, the expectation is that processing will have low direct labour costs, high speed and throughput, low unit costs and low variability. The automation process, however, calls for high capital costs and more skilled labour.

The anticipated outcome of automation is improved product quality, improved speed and output, and smoothed product variability. It is also anticipated that automation would lead to reduced direct costs, improved dependability, better returns and ultimately improved market returns. The conceptual framework shows the movement from manual process to automation finally leading to improved performance. To test for a true difference among the three categories, the researcher tested the following null hypotheses: H_0 : Automation of the labour component in KTDA managed factories do not lead to improved operational performance, as measured by changes in factory costs represented by the cost per kilogram measurement unit (that is, there is no significant difference in pre-automation and post-automation labour costs).

H_0 : Cost savings from automation have not contributed to competitiveness (that is, there has been no significant savings in labour cost substitution).

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Research Design

The study used an exploratory research design. Exploratory research was used because the researcher intended to gain background information about the general impact of automation on operations performance in the tea industry. The researcher tested two sets of hypotheses for data relating to the performance objective of cost. Burns and Bush (2006), have noted that exploratory research design is usually conducted when the researcher does not know much about the problem and needs additional information or desires new or more recent information. Exploratory research is used to gain background information, clarify problems and hypotheses, and establish research priorities (*ibid.*).

3.2 Population and Sample Design

The population of study was all the factories managed by the Kenya Tea Development Agency Ltd. The list of all KTDA managed factories is shown in Appendix 2. This was a census-type of study as all the factories under KTDA management were studied. The 65 KTDA managed factories were divided into two clusters showing the levels of automation, namely: full automation and partial automation. Operating costs data for these categories were obtained from company records and related to the two levels of automation, namely: full automation and partial automation. Data for the two categories of factories were compared and statistical tests of independence conducted.

3.3 Data Collection

The study made use of primary and secondary data. Primary data was collected by means of a questionnaire (see Appendix 1) while secondary data principally related to factory labour costs, made tea quality and labour productivity for the past ten years beginning with year 2001 and ending in the year 2010 and obtained from company records. The data for cost elements (aggregated for manufacturing, packing labour, salaries and wages, medical, labour benefits, plant maintenance, building maintenance) was used to obtain a consolidated figure for cost per kilogram (the standard unit of measure in tea production). This data was then used to obtain

mean figures for cost per kilogram made tea, quality and labour productivity for the two levels of automation, namely: full automation and partial automation.

3.4 Data Analysis

Because the factories are at varying levels of automation, namely: full and partial, the factories were divided into these two categories. The labour costs of the two categories were obtained from company records and the mean cost per kilogram (which is the standard unit of measurement) calculated for the two categories. The mean cost per kilogram for the three levels of automation was used as the proxy for the measure of performance (the dependent variable). The mean cost per unit was regressed against measures of quality, average cost of tea made, and productivity (measured by kilograms made tea per man day which were selected as the independent variables. The objective of this regression analysis was to develop a statistical model that could be used to predict the values of the dependent variable (mean cost per kilogram) based on the values of the explanatory variables of (quality, average cost of tea made, and productivity). The regression equation took the following form:

$$Y_1 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + e_i$$

Where Y_1 = The dependent variable (mean total cost of production per kilogram)

β_0 = Y-intercept for the population

β_1, β_2 and β_3 = Slope for the population

Where X_1 is made tea quality, X_2 is average labour cost for tea factory, and X_3 is average labour productivity.

The dependent variable in both cases is mean labour cost per kilogram.

Independent samples tests among the three levels of automation were done to find out whether the mean cost per kilogram standard measure and the variances of this measure were significant across the two levels of automation. ANOVA F test statistics were used to test if the null hypothesis is true. To test for a true difference among the three categories, the researcher tested the following null hypotheses:

H_0 : Automation of the fermentation labour component in KTDA managed factories did not lead to improved operational performance, as measured by changes in labour costs

represented by the cost per kilogram measurement unit (that is, there was no significant difference between the two levels of automation). The equations for the null hypothesis are given below:

Equations

$$H_0: \mu_1 = \mu_2$$

$$H_a: \mu_1 \neq \mu_2$$

The alternative hypotheses are that there is a true difference between the labour costs and made tea quality for the two levels of automation. The measure for cost savings was the cost per unit of kilogram (CPU/kg made tea), productivity in kgs made tea per man-day, while made tea quality will be the annual average quality factor as determined by the Quality Control Department of KTDA. The significance of cost savings, labour productivity and made tea quality were calculated using the t-test of significance.

CHAPTER FOUR: DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

This research studied a total of sixty three (63) factories that are managed by the Kenya Tea Development Agency Ltd. The original plan envisaged dividing the factories into three levels of automation, namely: full, partial, and not-automated (or manual). Data obtained found that all the factories could be effectively classified into two mutually exclusive categories of automation, namely: full and partial. A total of thirty four (34) were fully automated meaning that they had two CFUs while twenty nine (29) were partially automated. Thus, slightly over half (or 54%) of the factories were automated while the rest, 46% were partially automated.

Questionnaires were dispatched to production managers of these factories with instructions to complete them as fully as possible. In the absence of production managers, their assistants who were equally knowledgeable completed the data collection instruments. The response rate was very high (97%). The questionnaire contained questions on general information about the factory (including level of automation), evaluation of impact of automation on operational performance, strategic impact of automation, and labour productivity data. The data obtained from the questionnaires was triangulated with secondary data obtained from company records kept at the KTDA head office. This composite data was analyzed and its results are discussed in the rest of this Chapter.

4.2 Evaluation of Impact of Automation on Operational Performance

4.2.1 Impact of Automation on Customer Focus

The study found that automation has made important contributions to the operational performance of factories, with those that have fully automated reporting consistently higher scores on the operational performance variables compared to those factories that are only partially automated. The study found that fully automated factories have higher operational performance on quality of products, reduced unwanted variability, faster response to customer requirements, and reduced rework of products. These findings are consistent with the observations made by Beckman and Rosenfield (2008) that automation provides an organization with the ability to collect data about performance of its processes and to analyze the variables

that contribute to the achievement of performance objectives. The study, however, found that partially automated factories had a higher score for processing of customer requests. The comparative scores for the two levels of automation for these operational performance variables are shown in the next table:

Table 4. 1: Comparison on operational performance for selected variables

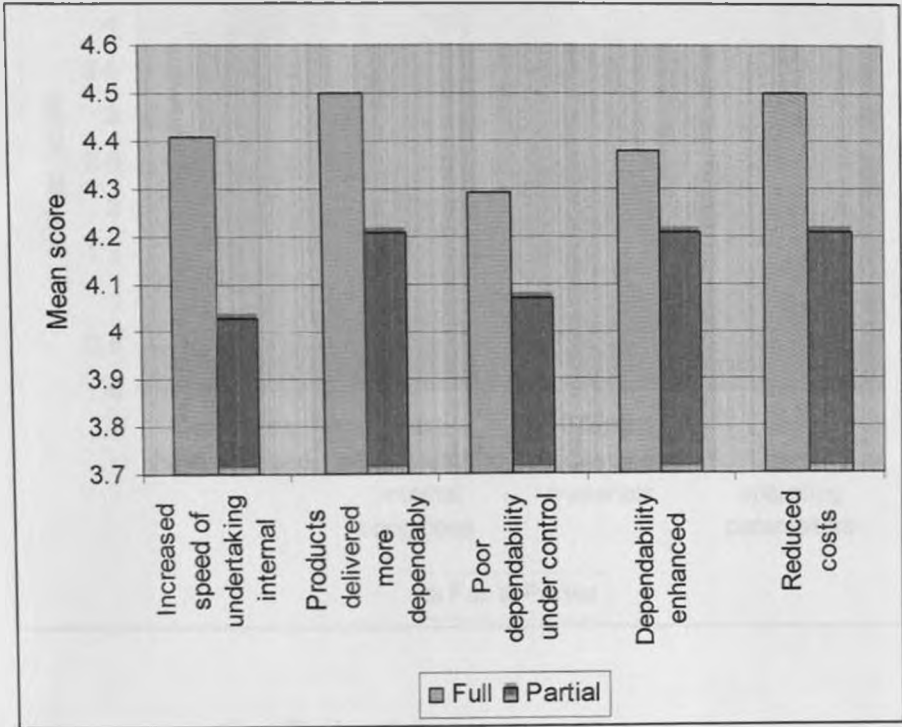
<i>Operational performance variable</i>	<i>Mean score performance (full automation)</i>	<i>Mean score performance (partial automation)</i>
Improved quality of products	4.24	4.10
Reduced unwanted variability	4.59	4.17
Faster response to customer requirements	4.06	3.93
Reduced rework of products	3.82	3.72
Short time processing customer requests	3.88	3.97

4.2.2 Impact of Automation on Dependability

The study found that fully automated factories scored higher on increased speed of undertaking internal processes, managed to deliver their products more dependably, and at the same time managed to keep factors causing poor dependability under control. They also managed to keep dependability of their processes more up to date. This in turn led to decreased costs directly or indirectly derived from higher dependability. These results are consistent with Slack et al (2001) who found that automation of operations leads to a reduction in variability of

the finished products thereby enabling the organization to achieve the dependability performance objective. The comparative scores for the two levels of automation is shown in the next Chart:

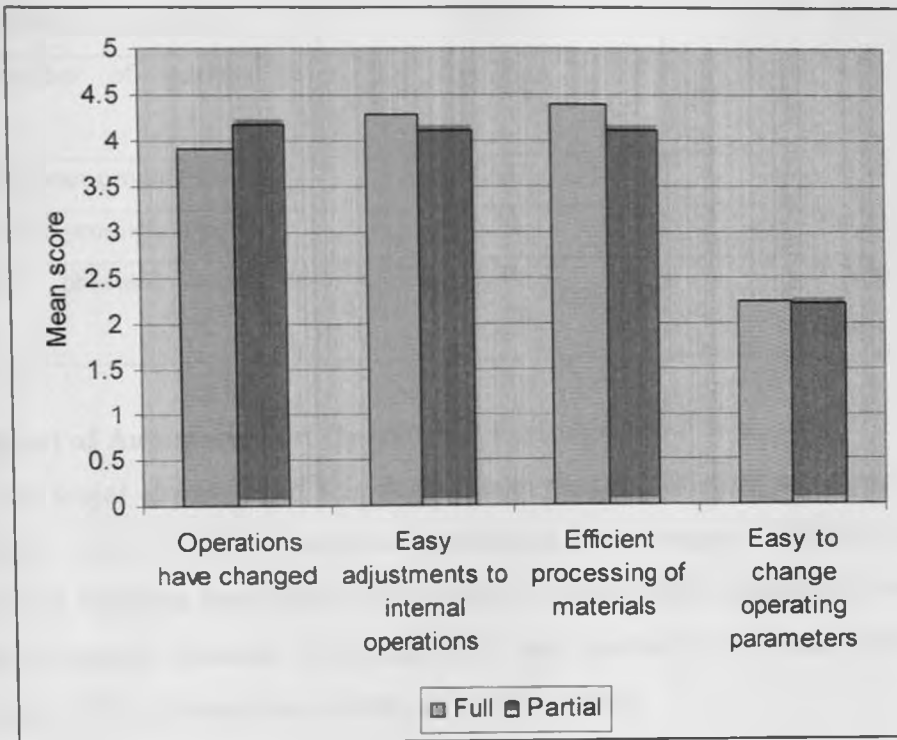
Chart 4.1: Performance on the Dependability Function



4.2.3 Impact of Automation on Flexibility

The study did not find much difference in operational performance on the basis of flexibility for the two categories of automation. Whereas fully automated factories registered higher performance on the variables of ability to make adjustments to internal workings of operations and increased efficiency in processing materials and information, partially automated factories scored higher on the variable of operations changing in response to changes in demand. The score was almost the same for flexibility in changing operating parameters which might point to the fixed nature of tea processing infrastructure. The comparative scores for the flexibility variables are shown in the next chart:

Chart 4.2: Performance on the Flexibility Function



4.2.4 Impact of Automation on Cost Reduction

Respondents in fully automated factories tended to report that they have registered improvements in performance arising from labour savings. This has been brought about by increased worker satisfaction, lower number of workers in the factory, improved labour productivity, reduced total production costs, and an easier to manage fermentation process. The scores for the two levels of automation are shown in the next table:

Table 4.2: Operational performance on cost reduction

<i>Operational performance variable</i>	<i>Mean score performance (full automation)</i>	<i>Mean score performance (partial automation)</i>
Increased worker satisfaction	4.41	4.03
Lower number of workers in factory	4.79	4.75
Improved labour productivity	4.68	4.57
Reduced total production costs	4.50	4.43
Automated process easier to manage	4.74	4.64

4.3 Overall Impact of Automation on Operational Performance

One of the major objectives of this study was to find out whether automation of KTDA managed factories leads to overall improved operational performance. The study shows that although automated factories have better performance on most of the operational variables, the difference in performance between fully automated and partially automated factories is not significant enough. This information is shown in Table 4.3 next.

Table 4.3: Impact of Automation on overall Operational Performance

<i>Statistical value description</i>	<i>Full automation</i>	<i>Partial automation</i>
Overall mean performance	4.00	3.86
Variance	0.61	0.65
Pooled Variance	0.63	
Hypothesized Mean Difference	0	
P(T<=t) two-tail	0.54	
t Critical two-tail	2.01	

From the table, the overall mean performance for fully automated factories is 4.00 which is marginally higher than that of partially automated factories with a score of 3.86. The variance for the two levels of automation is 0.61 and 0.65 for full and partial respectively giving a pooled variance of 0.63. Testing the hypothesis that there is no significant difference in operational performance on the basis of level of automation (hypothesized mean difference is

zero). the p-value for a two-tailed distribution is 0.54 which is greater than the 0.05 required to reject the null hypothesis. Further, the critical value of the t-score at the 95% confidence level is 2.01. Accordingly, we fail to reject the null hypothesis and conclude that available data does not seem to support the assertion that there is a significant difference in operational performance of studied factories when classified by level of automation.

These results might point to a failure to integrate the gains from technology with the overall strategic objectives of the organization, which would lead to increased market share and substantial profits. Stevenson (2007) has noted that technology and technological innovation, as a means of reducing cost (and therefore leading to higher profits), has not always been successful. Failure to achieve the expected profits and other operational performance objectives may occur when the human labour displaced by machines is redeployed to other sections of the company so that overall savings from labour costs are not realized. The redeployment happens because of existing labour contracts with employees and union restrictions on dismissal of workers.

The researcher decided further to investigate if there are differences in labour productivity between factories on the basis of level of automation. It was found that the mean value for labour productivity was 80.74 and 84.34 for full and partial automation respectively. The respective variance scores were 157.60 and 184.0 with pooled variance being 170.82. This information is shown in Table 4.4 next:

Table 4.4 Summary Results for Differences in Labour Productivity by Level of Automation

<i>Statistical value description</i>	<i>Full automation</i>	<i>Partial automation</i>
Mean	80.74	84.34
Variance	157.60	184.04
Pooled Variance	170.82	
Hypothesized Mean Difference	0.00	
P(T<=t) two-tail	0.55	
t Critical two-tail	2.10	

From table 4.4, it is seen that the p-value is 0.55 which is much greater than 0.05 which is required to reject the null hypothesis that there is a difference in labour productivity between factories classified according to level of automation. Accordingly, there is not sufficient data to reject the null hypothesis. It is, therefore, concluded that available data does not seem to show existence of a significant difference in labour productivity for factories under the two levels of automation. Failure to obtain benefits in labour productivity may arise because the scale of technology substitution for human labour may be too low. Stevenson (2007) noted that in cases where the scale of automation is such that it does not significantly change the cost component of the total production, such as when the scale of automation is partial, the gains from technology are not realized.

Comparisons of global figures for performance on labour productivity, quality of tea made, average cost of tea made, and mean labour cost per kilogram for factories under the two levels of automation do not seem to show any significant difference. The global comparisons are shown in Table 4.5 next:

Table 4.5 Global Comparisons for Productivity, Quality, Average Cost, and Labour Cost

<i>Global value description</i>	<i>Full automation</i>	<i>Partial automation</i>
Labour productivity	80.74	84.34
Tea Quality	78.56	79.11
Average Cost of Tea Made	52.29	54.74
Mean Labour Cost per Kg	9.62	10.82

The significance of these global figures are discussed in the ANOVA model below, which show that there the three variables of labour productivity, made tea quality, and average cost of tea made do not significantly explain the dependent variable of mean labour cost per kilogram.

4.4 Anova for Overall Operational Performance Model

An important objective of the study objectives was to investigate the extent to which the independent variables explained the dependent variable of mean labour cost per kilogram, separately analyzed by level of automation. Results from the analysis did not find that labour cost is strongly explained by the variables of labour productivity, tea quality, and average cost of tea made. This is shown by the low R coefficient for both levels of automation (0.387 and 0.375). These coefficients are lower than the threshold value of 0.60 (+ or -) which would be classified as indicating important variables for explaining labour cost. It is, therefore, concluded that the three variables are not very strong in explaining the changes in factory labour costs when considered together. This is shown in the model summary in Table 4.6 next:

Table 4.6 Model Summary for Regression Equation

<i>Level of automation</i>	<i>R</i>	<i>R Square</i>	<i>Adj. R Square</i>	<i>S.E. of Estimate</i>
Full with two CFUs	0.387	0.150	0.052	1.84460
Partial with one CFU	0.375	0.140	0.028	1.44494

The overall regression model for mean labour cost per kilogram is also not significant for fully automated and partially automated factories at the 95% significance level (respective p-values are 0.230 and 0.314). This information is shown in Table 4.7 and Table 4.8 next. Thus, it is concluded that the three predictor variables do not significantly explain the cost components of tea factories studied.

Table 4.7: ANOVA for Fully Automated Factories

<i>Statistical description</i>	<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
Regression	15.629	3	5.210	1.531	0.230
Residual	88.466	26	3.403		
Total	104.095	29			

Dependent variable: Mean labour cost per kilogram

Predictors: (Constant), labour productivity, average total cost for tea made, made tea quality

The results from Table 4.7 show that the regression model is not significant for the three predictor variables. The F-test statistic is not significant on its own F distribution or when considered from the probability value (score is 0.230). This means that the selected independent variables do not significantly explain the gains from automation as measured by the mean labour cost per kilogram which was the variable chosen to represent gains from automation. Thus, automation does not seem to significantly translate into cost savings.

Table 4.8 ANOVA for Partially Automated Factories

<i>Statistical description</i>	<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
Regression	7.842	3	2.614	1.252	0.314
Residual	48.021	23	2.088		
Total	55.863	26			

Dependent variable: Mean labour cost per kilogram

Predictors: (Constant), labour productivity, average total cost for tea made, made tea quality

From the results discussed, it does not appear that the three independent variables of labour productivity, average total cost for tea made, and made tea quality adequately explain the cost component of the factories under study. This may therefore call for enriching of the model with additional variables.

4.5 The Cost Model and Significance Tests for the Independent Variables

The overall labour cost model is given as follows:

For fully automated factories: $\text{Cost} = 11.880 + 0.030X_1 - 0.035X_2 - 0.033X_3$

And for partially automated factories: $\text{Cost} = 19.959 - 0.099X_1 - 0.004X_2 - 0.001X_3$

Where X_1 is made tea quality, X_2 is average total cost for tea factory, and X_3 is labour productivity. The dependent variable in both cases is mean labour cost per kilogram.

From the model for fully automated factories, labour cost increases as tea quality increases. The relationship of cost to the other variables of average total cost for tea factory and labour productivity is negative which means that there is an inverse relationship between cost and the variables, Thus, as cost increases, labour productivity decreases and vice versa.

4.6 Strategic Impact of Automation

The study found that automation generally helped the surveyed organization make better strategic decisions. Specifically, factories which had achieved full automation reported that they had acquired an advantage over competing factories. Automation had been undertaken out of the recognition that it would translate to strategic results. Stevenson (2007), for example, has stated that competitiveness has now become an important factor determining whether a company fails or prospers. Technology and technological innovation, properly deployed and integrated into the overall strategic objectives of an organization, often have a major influence on business performance as they yield competitive advantages in the form of speed to market, increased market share, and generation of substantial profits (ibid.).

Fully automated factories reported that automation enabled them capture data which would easily be converted to information and knowledge and deployed to obtain competitive advantage. However, there was a limitation in the sense that available CFU technology was not proprietary and therefore could not confer advantages on its own. This meant that competitive advantage could only be gained through strategic deployment of automation capabilities. The next table shows the scores for strategic impact of automation for fully and partially automated factories:

Table 4.9: Strategic Impact of Automation

<i>Strategic variable</i>	<i>Full automation mean score</i>	<i>Partial automation mean score</i>
Competitive advantage acquired	4.24	3.75
Improved data capture	4.18	4.46
Technology difficult to copy	2.00	1.86
Mechanisms in place to prevent technology copying	2.24	1.76

Thus, from the table, factories with full automation reported more strategic capabilities acquired compared to those with partial automation. This means that automation confers competitive capabilities over rivals who do not have the benefits of such technology. Strategic capabilities help in gaining competitive advantage and improved data capture abilities if the automation strategy is properly integrated with other performance objectives (Stevenson, 2007).



CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

Technology is a critical strategic tool for organizations operating in the competitive world we live in. However, wrong technology or wrongly deployed technology can fail to realize an organization's strategic goals. Carefully deployed, technology can be a major driver of strategy in that the capabilities it provides can be the basis of competitive advantage. Technology decisions are closely intertwined with many other decisions and appropriate technology confer major opportunities (Beckman and Rosenfield, 2008). To correctly use technology, an organization needs to review the external technology environment, develop a good understanding of internal process capabilities, and decide for itself what the appropriate technology.

This study looked at the impact of automation on operational performance for tea factories managed by the Kenya Tea Development Agency. Whereas the study found that fully automated factories, compared to partially automated ones, have higher operational performance scores on the variables of customer focus, dependability, flexibility, and cost, the overall difference in performance for the two classes of factories was not significant. Further, the overall cost model for fully automated and partially automated factories was not found to be significant

5.2 Summary

The study found that, as generally accepted; partially automated factories were more flexible and therefore able to process customer requests faster compared to their fully automated counterparts. They were also more likely to change their operations to meet changes in customer demands than the fully automated ones. This raises interesting questions: Why is a less automated organization more able to respond to customer needs? Why is it more able to change to meet changes in customer demands compared to more automated organizations? These are questions that future studies may need to look into.

The results of the study showed that the global performance of fully automated and partially automated factories on the metrics of labour productivity, tea quality, average cost of

tea made, and mean labour cost per kilogram were not significant on the basis of level of automation. However, the study found that automation generally helped the surveyed organization make better strategic decisions. Specifically, factories which had achieved full automation reported that they had acquired an advantage over competing factories.

5.3 Conclusions from the Study

The study did not find any significant difference in the operational performance of factories on the basis of level of automation. Results did not also show any significant difference in the cost models compared on the basis of level of automation. This probably means that operational performance in general and cost performance in particular for tea factories depend on other additional and possibly complex variables over and above to those studied.

It was found that less automated factories seemed to perform better on customer-focused measures of performance compared to their fully automated counterparts. Various authors have shown that only by focusing on the customer can an organization do well. For example, Beckman and Rosenfield (2008) have noted that customer-centric organizations are replacing the product-centric organizations of the past. It is only by being customer-centric that an organization can hope to be competitive. For this study, a contradiction is perceived where the more technologically advanced factories lag behind in customer-centric metrics.

Automation can gain an organization competitive advantage. This study found that fully automated organizations reported acquiring an advantage over competitors. Technology provided tools to enhance data capture and convert it into competitive information. This finding is consistent with the literature on technology in organizations. West (2000), for example, reported that technology can be the source of unique competitive advantage for a firm, particularly when it is not easily copied. Beckman and Rosenfield (2008) add that understanding where that advantage might lie—whether in proprietary nature of the technology, in its ability to achieve greater economies of scale, or in its ability to disrupt the industry along some other dimension—is critical step in developing a technology strategy.

5.4 Recommendations

It is recommended that KTDA managed consciously develop an automation and technology strategy for all its factories. Further, management should ensure that such strategy has the customer right in its heart. This is to avoid operating at variance with the customer who is the main reason for the organization's existence.

It is recommended that KTDA management develop alternative technology options to be used in addition to the existing CFU technology. This is because trends in the external environment show that changes are continuously taking place and over-reliance on one aspect of technology can very seriously threaten the survival of an organization. It is, therefore, recommended that KTDA consider a range of technologies; both those within the manufacturing industry and also from outside for possible use in its factories. To make this choice, management should ask itself if the current automation is really achieving strategic objectives and whether management is able to achieve the degree of flexibility it needs to respond readily to changes in the environment. This is because the study found that fully automated factories were less flexible in making changes to operating parameters compared to partially automated factories. Management should also ask itself what economies of scale can be achieved from automating. Management should also consider the kind of technology it needs to achieve a leadership position and ask itself whether it needs to look for alternative technology.

5.5 Limitations of Study

The study considered a limited number of variables and it is possible that the performance of the factories is impacted by many more variables including weather fluctuations, crop volumes and whether labour displaced by machines is declared redundant or redeployed within the factory.

In addition, the study focused at a section of the manufacturing process, fermentation, which may not have the expected impact on performance solely. The study did not also consider the impact of the collective bargaining awards (appendix 3) would have been on the performance of the factories without the automation intervention.

5.6 Suggestions for Further Research

Because the study found that there is no significant difference in performance between the two categories of factories, it is recommended that further investigation be undertaken to understand the critical variables that affect the operational performance of tea manufacturing companies, particularly those that have an impact on overall cost. This is because cost is the single most important variable identified in literature as having the most impact on the organization's profitability and thus is a key to survival.

Research should be undertaken to find out what happens to the workers who are replaced by the machines- are they redeployed within the factory with unchanged remuneration? If this is the case, then it would appear that introducing machines to factory processing does not change the overall cost structure and therefore does not meet the strategic goals of the KTDA.

An interesting finding from this study is that less automated factories (that is, partially automated) had higher operational performance scores for the key customer-focused variable of processing customer requests. This seems to imply that the gains from automation are not leveraged to the customer's benefit for the case of fully automated factories. Is it possible that factories which are fully automated has defined in this study lose touch with their customers? If this is the case, it could mean that automation has made organizations less customer-friendly and would be counterproductive in the long-run, unless the inflexibility is addressed.

The regression model for fully automated factories showed that mean labour cost per kilogram increases as quality of made tea increases. This seems to imply that automation increases the cost of producing quality tea. There is need, therefore, to investigate the possible cause for this situation with a view to providing actionable insights.

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APPENDICES

APPENDIX 1: QUESTIONNAIRE

SECTION A: GENERAL INFORMATION.

1. Name and Designation Factory.....

2. What is the level of your factory's automation?

- I. Full – two CFUs. ()
- II. Partial – One CFU ()
- III. Not automated – Nil CFU ()

3. If the factory is fully or partially automated, in which year / month was this done?

- i) First CFU.....
- ii) Second CFU.....

SECTION B: EVALUATION OF IMPACT OF AUTOMATION ON OPERATIONAL PERFORMANCE

The questions below relate to the role of automation on the performance of KTDA managed factories. Kindly indicate the extent to which you agree with the following statements: The scale ranges from Strongly Disagree to Strongly Agree. Please use the numbers in brackets for the respective agreement level. Strongly Disagree (1), Disagree (2), Neither Agree nor Disagree (3), Agree (4), Strongly Agree (5).

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	1	2	3	4	5
Automation has improved quality of our products					
Automation has reduced unwanted variability in the tea processing					
Automation has enabled faster response to customer's requirements					
4. Automation has shortened the time it takes to process customer requests					
5. Automation has reduced the number of customer complaints					
6. Automation has reduced rework of products					
7. Automation has increased the speed of undertaking internal process					
8. Automation has made it possible for customers to benefit from reduced costs					
9. Automation has enabled our products and services to be delivered more dependably					
10. Automation technology has helped bring some of the factors that cause poor dependability under control					
11. Automation has enhanced the dependability of processes within the operations					

Automation has allowed our operations to change in response to changes in customer demand					
Automation technology has allowed for adjustments to the internal workings of the operations processes					
Automation has allowed efficient processing of materials, information and of customer needs					
Automation has made it more difficult to change operating parameters					
Automation has resulted in increased worker satisfaction					
Automation has resulted in total lower numbers of workers in the factory					
Automation has resulted in improved labour productivity					
Automation has helped reduce total production costs					
An automated fermentation process is easier to manage					
The objectives of automating the fermentation process have been achieved					

STRATEGIC IMPACT OF AUTOMATION

In this section, you are requested to indicate the extent to which you agree with the following statements: Indicate whether you strongly disagree or strongly agree or in between.

1. Our factory has acquired an advantage over competing factories through adoption of CFUs: _____
2. The technology we possess has helped us to capture data over time: _____
3. Our technology is difficult to copy/imitate: _____
4. We have put in place mechanisms to prevent our technology from being copied by competitors: _____

APPENDIX 2: LIST OF KTDA MANAGED FACTORIES

KAMBAA
THETA
KAGWE
GACHEGE
MATAARA
NJUNU
MAKOMBOKI
IKUMBI
NGERE
GACHARAGE
NDUTI
KANYENYAINI
GITHAMBO
KIRU
GATUNGURU
CHINGA
RAGATI
IRIAINI
GATHUTHI
GITUGI
NDIMA
KANGAITA
KIMUNYE
MUNUNGA
THUMAITA
RUKURIRI
MUNGANIA
KATHANGARIRI

TI
ONGO
OI
EMBE
ORO
RU
NYO
CHIMIKURU
ANKOBA
BIRIGO
ANSIONGO
ANGANYI
OMBE
LANCHORE
AMOKAMA
NYAMACHE
ITUMBE
EBEREGE
OGEMBO
KAPKOROS
TIRGAGA
MOGOGOSIEK
KOBEL
KAPSET
ROROK
LITEIN
TEGAT
TEGAT/TOROR
KAPKATET
MOMUL

BUT
TUMO
DETE
SARA
LAL
NYAMWAMU

APPENDIX 3: KTDA MANAGED FACTORY COMPANIES CBA WAGE INCREASE TREND

CBA PERIOD	TOTAL % WAGE INCREASE	MEANS
1993/1994 1 st Jan. 1993-31 st Dec. 1994	23-49%	Negotiated
1995/1996 1 st Jan. 1995-31 st Dec.1996	21-43%	Negotiated
1997/1998 1 st Jan. 1995-31 st Dec.1998	44%	Industrial Court Award
1999/2000 1 st Jan.1999-31 st Dec.2000	20-25%	Negotiated
2001/2002 1 st Jan. 2001-31 st Dec.2002	24-32%	Industrial Court Award
2003/2004 1 st Jan.2003-31 st Dec.2004	5%	Negotiated
2005/2006 1 st Jan.2005-31 st Dec.2006	10%	Negotiated
2007/2008 1 st Jan.2007-31 st Dec.2008	16%	Negotiated
2009/2010 1 st Jan.2009-31 st Dec.2010	18%	Negotiated
2011/2012 1 st Jan.2011-31 st Dec.2011	20%	Negotiated