

OPERATIONS IMPROVEMENT INITIATIVES AND  
OPERATIONAL PERFORMANCE: A SURVEY OF  
COMPANIES THAT PARTICIPATE IN THE COMPANY  
OF THE YEAR AWARD (COYA)

MOTARI WILLIAM OGWAGWA

UNIVERSITY OF NAIROBI  
SCHOOL OF BUSINESS  
MBA OFFICE  
P. O. Box 30197  
NAIROBI

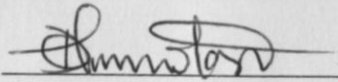
A MANAGEMENT RESEARCH PROJECT IN PARTIAL FULFILLMENT OF  
THE REQUIREMENT FOR AWARD OF MASTERS OF BUSINESS AND  
ADMINISTRATION DEGREE, SCHOOL OF BUSINESS, UNIVERSITY OF  
NAIROBI.

2006

# DECLARATION

This research project paper is my original work and has not been submitted for a degree in this or any other university.

Signed:



**MOTARI WILLIAM OGWAGWA**

UNIVERSITY OF NAIROBI  
SCHOOL OF BUSINESS  
MBA OFFICE  
P. O. Box 30197  
NAIROBI

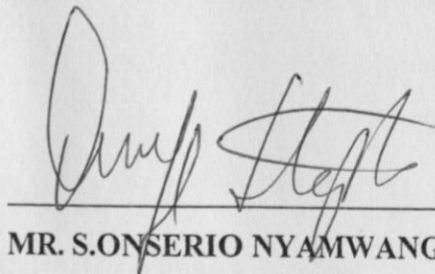
Date:

31/10/2006

MEDICATION

This research project has been submitted for examination with my approval as University Supervisor.

Signed:



**MR. S.ONSERIO NYAMWANGE**

**Lecturer, Department of Management Science, School of Business,  
University of Nairobi.**

Date:

31/10/2006

## ACKNOWLEDGEMENT

I am grateful for my supervisor Mr. Gervais Njoroge whom I would like to acknowledge for his kind, special guidance, advice, patience and valuable contribution during the entire period of the study not to mention his intellectual support that helped to shape the direction of the study.

I am also deeply indebted to my family, my wife Lilian Kerubo, and son Collins for their encouragement, understanding, patience and moral support during this entire period. My special thanks to Nyaboke and the MBA 2003 students for their thoughtful suggestions. I express my heartfelt appreciation and gratitude to all of them.

Lastly, I would like to appreciate the assistance given from those firms participating/participated in the study. I would like to thank the award (COYA) specifically the staff who took an extra mile in completing the long questionnaire to make this study

## DEDICATION

In memory of my Late father mzee Malach Motari Gichana, for his wisdom and love of knowledge that has been the guiding principle in my quest for education and knowledge.

UNIVERSITY OF NAIROBI  
SCHOOL OF BUSINESS  
MBA OFFICE  
P. O. Box 30197  
NAIROBI

## ACKNOWLEDGEMENT

I am grateful for my supervisor Mr. Onserio Nyamwange whom I would like to acknowledge for his kind special guidance, advice, patience and valuable contribution during the entire period of the study not to mention his intellectual support that helped to shape the direction of this study.

I am also deeply indebted to my family, my wife Lilian Kerubo, and son Collins for their encouragement, understanding, patience and moral support during this entire period. My special thanks to Nyaboke and the MBA 2003 students for their thoughtful suggestions, I express my heartfelt appreciation and gratitude to all of them.

Lastly, I would like to appreciate the assistance given from those firms participating/participated in the Company Of the Year Award (COYA) specifically the staff who took an extra mile in completing the long questionnaire to make this study complete.

To you all I say THANK YOU and I acknowledge God's providence during the entire course.



## ABBREVIATIONS

ABM	-	Activity Based Management
AMT	-	Advanced Manufacturing Technology
BPR	-	Business Process Re-engineering
CAD	-	Computer Aided Design
CAM	-	Computer Aided Manufacturing
CIM	-	Computer Integrated Manufacturing
COYA	-	Companies of the Year Award
EDI	-	Electronic Data Interchange
ERP	-	Enterprise Resource Planning
GOK	-	Government of Kenya
ISO	-	International Standard Certification Organizations
JIT	-	Just in Time Technology
KIM	-	Kenya Institute of Management
MRP (I)	-	Materials Requirements Planning
MRP (II)	-	Manufacturing Resource Planning
SME's	-	Small and Medium Enterprises

## ABSTRACT

The purpose of this study was to establish the relationship between operational improvement methods and operational performance. In this context, the study examined a classification of six improvement initiatives and 35 specific techniques in relation to eleven operational performance objectives.

The study focused on companies that participate in the company of the year award (COYA). Primary data was collected using semi-structured questionnaire and descriptive statistics was used for analysis.

Results showed that, most firms were familiar with the methods, with quality based being rated the most familiar and widely used improvement initiative. Others included Technology and Time-based methods. Quality, learning and growth, customer satisfaction and innovation were rated as common performance objectives sought in relation to improvement methods. Tests of independence revealed that improvement methods are related to performance objectives. The respondents stated the challenges and constraints in the utilization of the improvement methods to include among others; a rapidly changing environment, communication barriers and an absence of strategy.

On the basis of the findings of the study, recommendations on exploring and exploiting other improvement methods such as Gemba Kaizen (process-based) and technology-based is likely to offer a good competitive stand in future. Lastly, this study recommends further research areas on, specific improvement method and specific performance objectives, applications of the methods in the service sector or public sector and an analysis of pre and post implementation effects of any of the improvement initiatives on a specific performance objective.

## CHAPTER FOUR TABLES OF CONTENTS

Declaration	i
Dedication	ii
Acknowledgement	ii
List of abbreviations	iv
Abstract	v
Table of Contents	vi
List of Tables	viii

### CHAPTER ONE INTRODUCTION

1.1 Background of the Study	1
1.2 Statement of the Problem	5
1.3 Objectives of the Study	6
1.4 Importance of the Study	6

### CHAPTER TWO LITERATURE REVIEW

2.1 Improvement Techniques: Historical Perspective	7
2.2 Understanding Improvement Methods	9
2.3 Focus of Improvements	9
2.4 Specific Improvement Methods	11
2.5 Popularity of Improvement Methods	14
2.6 Operations Measurement	15
2.7 Improvement Methods and Operational Performance	17

### CHAPTER THREE RESEARCH METHODOLOGY

3.1 Research Design	19
3.2 The Population	19
3.3 Data Collection	19
3.4 Data Analysis	20

## **CHAPTER FOUR DATA ANALYSIS AND FINDINGS**

4.1	Introduction	21
4.2	General overview of firms	21
4.3	Familiarity with improvement methods	22
4.4	Extent of usage of improvement methods	22
4.5	Choice of operational measures for operational performance	28
4.6	Improvement methods and performance objectives	29
4.7	Problems and issues encountered with using improvement methods	31
4.8	Utilization of improvement methods and operational performance	32

## **CHAPTER FIVE CONCLUSION AND RECOMMENDATIONS**

5.1	Summary and Conclusions	33
5.2	Recommendations	34
5.3	Limitations of the Study	34
5.4	Further Research	35

<b>BIBLIOGRAPHY</b>	36
---------------------	----

<b>APPENDICES</b>	40
-------------------	----

<b>APPENDIX I Questionnaire</b>	40
---------------------------------	----

<b>APPENDIX II List of Companies participating in COYA as at June 2005</b>	50
--	----

<b>APPENDIX III Descriptive Statistics</b>	51
--	----



## CHAPTER 4 LIST OF TABLES

Table 2.1 Measures of operational performance	16
Table 4.1 Familiarity with improvement methods	22
Table 4.2 Extent of usage of improvement methods	23
Table 4.2a Quality based methods	24
Table 4.2b Time-based methods	24
Table 4.2c Employee based methods	25
Table 4.2d Technology-based methods	26
Table 4.2e Process-based methods	27
Table 4.2f Technology-based methods	27
Table 4.3 Choice of operational measures for operational performance	28
Table 4.4 Mean performance objectives in relation to usage	29
Table 4.5 Extent of improvement methods on performance objectives	30
Table 4.7 Problems and challenges encountered	31
Table 4.6 Appendix III Descriptive statistics	51

## CHAPTER ONE: INTRODUCTION

### 1.1 BACKGROUND

#### 1.1.1 Improvement Initiatives

Organizations today are faced with unprecedented competition on global basis. Today's environment is often turbulent. Stalk et al (1992) argue that, competition in such environment is becoming less like a game of chess and more like an interactive video game where competition should be treated as a "war of movement" with successful companies moving quickly in an out of products, markets and sometimes even entire business. In order to gain competitive advantage in this turbulent business environment companies are constantly being encouraged to make the transition to the latest management prescriptions, panaceas and theories which come and go rather like waves on a beach.

To succeed in today's environment an organization must focus first on customers rather than on products and production. But customers today are often unable or unwilling to specify the characteristics or features, of a product or service until they are ready to take delivery. According to Zachman (1992), this suggests a strategy of assemble to order of products custom built from standard components and uniquely tailored to each customer's specific needs. An assemble to order strategy applies not only to manufacturing and assembly but also to most service industries including banking and insurance as well as government services.

To compete organizations are downsizing and according to Drucker (1998), we are entering a period of change. A shift from command and control organization to information based organizations of knowledge specialists. The typical large business 20 years hence will have fewer than half the levels of management of its counterpart today and no more than one third managers."

The need to improve the effectiveness of operations has over time, given rise to a series of philosophies, tools and techniques many of these appeared at the time to offer the solution to the continuing under performance of organizations. The faddish nature of such panaceas as value engineering, quality circles, flexible manufacturing systems, total quality management and worker empowerment often led to wide swings in managers perceptions of their value from 'good' to bad.

The idea of designing business for improvement has been around for a longtime and structured method, for doing this emerged in the 1980's. The failure of the pure systems approach hailed a new wave of improvement philosophies. Empowerment, agility, total quality, world class, MRP, benchmarking and re-engineering each aimed to radically alter the culture of operations as well as provide a different approach for building new infrastructural abilities. With the relentless pressure on performance which now prevails there is growing interest on business improvement initiatives.

The way in which the organization structures itself today when common data is readily available and can easily be shared is quite different from the way it had to be organized when the data was difficult to obtain. New business processes are emerging that are often crossing previous functional boundaries.

According to Tapscott and Caston (1992), a new corporation is emerging with fundamental restructuring and transformation of enterprises which in turn cascades across enterprises to create the extended enterprises, and re-casting of relationships between suppliers, customers affinity groups and competitors". These new corporations have moved beyond the constraints of organizational hierarchy. At their best these new philosophies and techniques have structures and motivation for the improvements efforts of ailing organizations. At worst, they have been regarded as vague concepts, which are unlikely to change an organization.

The most important decision for a manager embarking on any improvement path is that of selecting a direction for that path. As Hayes and Pisan (1994) describe the danger of

improvement themes like “world-class” is that they do little to ensure that the long-term direction of improvement will fit with competitive needs of the business. Any improvement strategy should be closely tailored in direction and nature to the peculiarities of the individual firms situation. The most difficult challenge is that of building an appropriate infrastructure (systems policies, routines and common values understandings) rather than the installation of machines, plant and equipment.

In the last decade, there has been an exponential increase in the number of publications citing the attributes and impact of continuous and discontinuous change in the business environment. This impact of changes, according Scott-Morton (1992), can be felt in the areas of productivity performance, demographic, technological innovation and the growing demand form of market place for ever higher levels of service and quality. Without demonstrable positive links to improved performance, however improvement initiatives such as these may be classed by managers as just more ‘fads’ or buzzwords the proliferation of which have lead to initiative diminishing. Furthermore, some are widely regarded as ‘a corporate miracle’ of the 20<sup>th</sup> century. According to Harrington (1996), improvements initiatives are a way organizations do business.

In order to gain long-term competitive advantage many companies are focusing on these improvement initiatives. It is essential that these initiatives should be supported by process performance measurement. Assessing performance provides the opportunity of recognizing problems and taking corrective action (Harrington, 1996).

Although improvement initiatives have been used for almost 15 years most enterprises do not have an integrated and holistic system of gauging and linking them to performance. Despite dramatic changes in the business environment, performance measurement systems have only been affected marginally. Operational performance objectives including quality, speed, reliability and flexibility have been used quite often in the recent years. Additionally, Drury (2000) mentions that, the dominant performance monitoring has been financial measures. According to Kaplan and Norton (1992), in addition to



financial performance measures, non-financial performance aspects such as customer satisfaction or job satisfaction still play a modest role.

### 1.1.2 Company of the Year Award

In today's business environment the best managed companies are distinguished by their capacity to learn, adopt and innovate in the midst of constantly evolving economic conditions, knowledge and technology. Today's consumer's demand that products and services be tailored to their specific circumstances. Thus future challenges to organizational management will be: to demonstrate effectiveness, a capacity to learn and a democratic accountability.

On this understanding the Kenya Institute of Management (KIM) launched the COYA award. COYA is an annual exercise whose objective is to identify and publicly recognize companies and managers who have excelled and continue to demonstrate excellence and integrity in their management practices. Participating companies are evaluated on wider issues that include: investment in human capital, better resource utilization, workplace and process design, documentation, information, communications, technology, creativity and innovation, quality management, financial management, marketing management and corporate citizenship management. According to the findings of the COYA ("Kenya celebrates management excellence", Daily Nation (Kenya), July 2005) exercise done in 2005, Kenyan participating companies are doing better evidenced primarily by increased earnings and bigger profits.

The goal of the company of the year award is (KIM, Bulletin July-September, 2005) to strive to identify and celebrate outstanding management excellence in creative problem-solving in business organization in Kenya. The number of participating companies has been rising from 18 to 25 in 2003 and 2004 respectively. As at 2005, there were 40 companies participating in the award. In addition the complexity, size and nature of business have also widened.

## 1.2 Statement of the Problem

Despite the application of improvement initiatives there are little studies to show how organizations have improved in operational performance. This study focuses on operations improvement initiatives as indicators of successful operational performance. A number of researches have been carried in Kenya addressing specific improvement initiatives. These studies have examined the strategic use of these methods by firms in the changing business environment (Kioko, 2000; Ngacho, 1999).

According to a research done by Ngure (2001), the perception of process improvement consulting on the manufacturing sector, the demand for process improvement services among Kenyan firms is very low and many are not aware of the potential for improved competitiveness.

Other research studies have looked at the importance of various change or methods of improvement such as Total Quality Management (TQM), Business Process Re-engineering (BPR), Activity Based Costing (ABC), Advanced Management Technology (AMT), Benchmarking and Value analysis in assisting firm attain competitive advantage over its competitors (Gitonga, 2005; Omufira; 2001; Munyiri 2001). A major findings from this researches, is that the usage of improvement initiatives have added value to organizations process and delivery. Total Quality Management (TQM) and International Standards Certification (ISO) are evidenced as widely used techniques.

Ombura (2002), had widened the study by focusing on the use of all the techniques and not on a single methods or techniques. In his findings, whereas the multiple applications of the operations improvement programs deliver competitive advantage they are not equivalent in terms of scope and involvement.

To the best of the knowledge of this researcher no studies have been done in Kenya to establish a relationship between these improvement methods and improvement in operational performance. This study sought to answer the questions: -

- (i) What is the nature of the relationship between operational performance and operation improvements methods?
- (ii) What are the challenges facing organization in their endeavour to use improvement methods?

This study was a survey of companies that participate in the company of the year award (COYA). It sought to establish the extent of operations improvements initiatives and their effects on operational performance.

### **1.3 Objectives of the Study**

The objectives of the study were: -

- (i) To determine the relationship between operations performance and the usage of improvement methods by firms participating in the Company of the year award (COYA).
- (ii) To establish the challenges facing the organization to meeting the operational performance improvement.

### **1.4 Importance of the Study**

- i. The findings of the study will stimulate interest among managers and decision makers on the potential for improvement methods for building new operational capabilities.
- ii. Academicians will find this study of interest, as it will show the practical extent to which operations improvement programs have been practically applied in real practice for enterprise excellence.
- iii. The research will add new knowledge to the domestic industry. Aosa (1992) pointed out that, the available literature is full of case studies from the west and cannot be replicated without amendments in the firms operating in Africa as it has its own peculiar characteristics.

## CHAPTER TWO: LITERATURE REVIEW

### 2.1 Improvement Techniques: Historical Perspective

Having experimented with a number of management fads such as collecting firms, like stocks and bonds into diversified portfolios, many western managers realized that corporate success was inherently transitory if not under-pinned by sound operational abilities at the operating- unit level.

In the 1970's firms frequently attacked the problem of operations performance by addressing structural aspects of their operations strategy (Hayes, 1980). Sudden dramatic restructuring led to organizational units being selected for survival on the basis of their cost (and occasionally quality) performance and under-performing units were closed or sold off. Components, even whole products were often outsourced to overseas suppliers, who could produce them at lower cost and thus provide an immediate apparent savings.

Such methods did rid operating networks of many poorly performing units, which were unlikely to get better overtime. According to Hayes et al (1988), organizational units are often unable to improve or perform because of the nature of the tasks assigned to them as well as measures used to evaluate their performance. Units may perform poorly because they have received the lowest share or investment capital, which leads to poor performance resulting in less investment. Secondly poorly performing units are often required to produce a wide variety of low-volume products or services just to support the product range.

In the 1980's technology apparently revolutionised operations. Thousands of engineers' throughout the world worked to develop robots able to pick individual objects from a cluttered floor or wrote software that would supposedly slice through the complexity of managing a job-shop. More employees worked as visitor guides than as operators (Ramchandran, 1986).



Automated systems, which wrested control a way from mistaken-prone operators while at the same time improving productivity and quality were touted as the new panacea. A number of Technological manufacturing systems emerged (MRP I, MRPII, FMS, CIM) each promising huge competitive leaps in performance. Whilst these new systems provided great advantages in tackling the information complexities in manufacturing systems that made a broad range of products and often improved the trade off between cost and variety, they failed to embody some critical elements of manufacturing competitiveness.

Despite these problems computer integration has become a necessary, rather than sufficient conditions for success in many operations (Rodgers et al, 1992). Long-term success however, demands the creation of ever-more powerful systems- ones that are difficult for competitors to replicate and are steadily improved. The 1990's oversaw the failure of the pure systems approach and an emerging new wave of improvement philosophies, empowerment, total quality management, world class, Benchmarking, ISO series and Re-engineering all aimed at radically altering the culture of operations as well providing a better approach of organizational infrastructural abilities.

According to Hammer (1993), at their best these new philosophies and techniques provides structure and motivation for improvement efforts of ailing organizations. At their worst, they become fuzzy clouds of semantic over kill. Infrastructural improvement and performance (Hayes et al, 1994) relies heavily on the synthesis of each of these approaches. It is of little use to 'empower' an unnecessary plant or seek computer integration without thought of the implications this will have for future opportunities.

Kenya's rate of economic growth has been declining steadily since the 1970's (ROK, 2000) and shows insignificant signs of improvements. Due to liberalization of the economy firms, which used to operate in a controlled environment are now facing competition. Based on this kind of environment it is deemed necessary to constantly improve operations within the firm for survival and sustained growth.

## 2.2 Understanding Improvement Methods

Organizations face challenges of choosing from a plethora of methods that claim to effectively and efficiently reduce costs and improve service and add value to customers. According to Euske and Steven (1996), the understanding of the four major components in improvement methods provide basis of assessing the applicability of a method in a specific situation, help to identify and define the problem, how to address it and who should address it, the potential weaknesses and opportunities linked to the various methods.

In trying to decide an improvement method, a manager need to understand, how comfortable the improvement team is with the methods focus or perspective, how well the team understands the method language, how much the team knows a about the methods tools and how effectively the team can use the tools to convert its output into specific actions and changes. Many issues internal and external have caused improvements to become necessary in today's market place (Andersen, 1999). The performance level of most processes shows a tendency to decrease overtime unless forces are exerted to maintain it. Today's customers are becoming more and more demanding. Supply and the quality of the supply are ever increasing which in turn cause the expectations to rise dramatically.

## 2.3 Focus of Improvements

Initiatives of building improvements are characterized primarily by the approaches described below. Hayes, Wheelwright and Clark (1988) suggest that, the common approaches include:

### 2.3.1 Reconfiguring the Structures

A common top down approach to boosting the performance of an operation is wholesale re-structuring of the operating strategy through plant rationalization and construction, the

installation of new technology and provision of platforms that will permit and encourage continued improvement once the structural change is in place.

### 2.3.2 Demonstration Project

It provides an opportunity for the firm to make a bold leap in its operating capabilities as it focuses on one part of a firm's total operation. It will assemble the very best people, ideas and technologies to show what can be done and how the operations may be carried out in a radically different way than the operations exist in the firm. Such projects break free of existing inhibitive norms in the company, challenge and motivate most able people in the firm to become pioneers and free themselves of the bureaucratic bonds which may have been stifling their imagination and careers.

### 2.3.3 Continuous Benchmarking

The most valuable form of benchmarking for improvement is operational benchmarking which compares one's own operations with another using physical, clearly measurable characteristics such as lead-times, variable cost, yields, defects etc. It is a diagnostic method for assessing what degree of improvement is possible but also provides the beginnings of improvement method itself.

### 2.3.4 Business Process Improvement

There are infinite ways to slice an operation into its constituent processes but some clearly dominate an operation and hence provide an excellent starting point for an improvement path. The focus on process improvement grows from the fact that traditional departmental subdivisions have become an increasingly frayed approximation to the optimal.

### 2.3.5 Bottom-up Improvement

Building improvements from the ground up is the implicit objective behind the empowerment of the early 1990's. Many firms showed tremendous improvement in performance as a result of what might be termed as 'grass roots improvement efforts. The strategy addresses why change must occur, what is it that needs to be improved, how the improvement will take place and how the change will affect each individual's job.

## 2.4 Specific Improvement Methods

According to Euske and Steven (1996) there are several improvement methods but collectively can be clustered into six based on common perspectives, similar languages and shared tools. These include quality based, time based, employee based, technology based, process based and activity based methods in each cluster the methods are closely related to each other than those in the other cluster.

### 2.4.1 Quality Based Methods

Quality improvements started in the United States in the early 1980's. When Deming first introduced Total Quality Management (TQM), the Japanese adopted the philosophy while the U.S rejected its principles. During those ensuing years Japanese industries made very successful progress with quality and production by adopting TQM principles of Deming along with Juran, Taguchi and others. TQM has not been successful; a survey conducted for a report made by electronic business magazine (Burrows, 1992) showed that no contacted companies had ended their TQM program and 90% of the companies using TQM had indicated their quality had improved when compared with their competitors.

TQM is defined as both philosophy and a set of guiding principles that represent the foundations for continuous organizational improvement (Joseph et al; 1994). It is a management system that has customer satisfaction as its prime business objective.



According to the organization that annually presents the prestigious Malcolm Baldrige National Quality Award (Millen; 1993). TQM promotes the ideas of: Knowing your market; never sitting on your laurels; and trying to be a head of your time.

The management system endorsing TQM begins with top management commitment and leadership. Management determines the total quality scenario for its organization and must review and encourage its progress towards its achievement. According to Mueller and Stuart (1994), the important features of TQM include: communication of all quality concepts, employee commitment to continuous improvement and systems based on a comprehensive approach of collecting analyzing and acting on information with respect to customer satisfaction.

In order to understand what practices are necessary to increase performance organizations have begun using benchmarking as a way of acquiring knowledge and improving further. Benchmarking can be defined as the search for industry best practices that lead to superior performance (Camp, 1989). Pioneered by Xerox, benchmarking has been widely adopted by companies as an improvement initiative (Port and Smith, 1992). At the core of successful benchmarking lies a regular documented worldwide scan for organizations that are skilled at what they do, regardless of industry (Garvin, 1991). As a process for measuring your performance against best-in-class companies, then using the analysis to meet and surpass the best-in-class companies (Pryor and Katz, 1993) benchmarking is one way of identifying and understanding the practices needed to reach new goals. The inclusion of benchmarking in the Baldrige Quality Award reflects its popularity (Hackman and Wageman, 1995).

Other quality-based techniques include the ISO 9000 standards for internal quality and awards including Japans Deming prize. More recently quality has become a key basis for competition (George et al, 1990).

#### **2.4.2 Time Based Methods**

The time-based methods use time based analysis tools such as cycle- time maps, set up reduction, supplier audits, JIT and physical flow analysis. A 'time' perspective relates to them. According to George et al (1990) time – based competition is projected to add further challenges business.

#### **2.4.3 Employee-Based Methods**

Workforce health and quality of working life should be treated as an important aspect in organizations. They should be incorporated into a sound performance measurement system. Employee aspects may cover a broad range of subjects including communication, job conditions, physical discomfort, psychological well being and workload supervision opportunities for growth or socialization. According to Dilworth (1992) time based methods include compensation, empowerment skill-based pay, learning organization, self-directed work teams and broad banding. The human related issues are considered as key enablers of improvement/ change in an organization (French et al, 1994; Cummings et al, 1998).

#### **2.4.4 Technology Based Methods**

The technology-based methods are based on the perspective of information usage. This method include: EDI, CIM, CAD, C, MRP and JIT. Technology based methods could identify how workers are sharing information (Davenport, 1993).

#### **2.4.5 Process Based Methods**

The process-Based methods involve studying process components and activities to understand process flow. Workflow systems support execution of process (McLellan, 1996). According to Edward et al (1994) business process redesign is a vision led structured methodology for the fundamental rebuilding of business process through

balanced interactions of work tasks, people, information Technology. A conscious reshaping of an organization behind a new corporate vision, the market place and the customer. Using a holistic 'fresh start approach' business process redesign reviews all business activities from end to end.

This may result in a redefinition of processes, organizational structures and technology to allow the company to streamline, delete or change the way in which work is done. Caron (1993) argue that the ultimate objective of business process redesign is to yield sustainable improvements in profitability, productivity, service and quality, whilst maximizing the potential of the individual and the team.

The focus on process improvement rather functional improvement, grow from the fact that traditional department subdivision of operations has become an increasingly frayed approximation to the optimal. Stalk et al (1992) relates to an example in which organization may make more sense to organize an operation around the process that delivers the order through a small mini- factory focused on small set of jobs, from order entry to delivery rather than glean the load- sharing advantages of a larger manufacturing shop which might have been appropriate for increased asset utilization but a disaster for lead times and responsive to customers.

#### **2.4.6 Activity-Based Methods**

Activity-based, are methods of accounting for overheads which are particularly suitable for an advanced manufacturing Technology environment. Throughout much of the past, cost has been a major basis of competition (George et al, 1990). Activity-based costing has led to the development of Activity-based management (ABM), the management process that uses the information provided by an activity-based cost analysis to improve organizational profitability (Drury, 2000). Activity -based management includes performing activities more efficiently, eliminating the need to perform certain activities that do not add value for customers, improving the design of products and developing better relationships with customers and suppliers.

## 2.5 Popularity of Improvement Methods

According to Nazim et al (1995), the commonly used methods in industry are TQM, JIT, concurrent engineering benchmarking business process reengineering and networking methods. Euske et al (1996) states that empowerment an employee-based method allows people to innovate and use their own judgment, thus it focuses on the individual employees role. Activity based costing, an activity- based method identifies costs with outputs and thus focuses on the work that employees perform and the cost of performing it. JIT management a time- based method reduces waste delay and unevenness and thus focuses on minimizing their impact on the organization. Process mapping, a process-based method takes a process view of interdepartmental processes with the ultimate focus on better coordination with upstream suppliers and downstream customers. Benchmarking allows a firm to compare its performance with that of its competitors, which in turn is used as an input for planning to achieve continuous improvement (Nazim, 1995).

## 2.6 Operations Measurement

In today's competitive business world, enterprises must continually improve the quality of their products and services to stay a head of the competition. During the past few years many organizational efforts have been undertaken by modern enterprise, wherein a process-centered company has received a lot of attention. In this context assessing process performance is essential because it enables individuals and groups to assess where they stand in comparison to their competitors. In addition (Alaa and Noble, 1996) assessing performance provides the opportunity of recognizing problems and taking corrective action. In recent years Andersen (1999) operational parameters of performance measurements includes quality cost, speed, reliability and flexibility.

According to Andersen (1999), performance measurement is the system of quantifying action, where measurement means the process of quantification and the performance of the operation is assumed to derive from actions taken by its management. Performance is here defined as the degree to which an operation fulfils the five objectives, at any point in time in-order to satisfy its customers.



**Table 2.1: Measures of Operational Performance**

Performance objective	Some common measures
Quality	<ul style="list-style-type: none"> <li>Number of defects</li> <li>Level of customer complaints</li> <li>Warranty claims</li> <li>Meantime between failures</li> <li>Customer satisfaction score</li> </ul>
Speed	<ul style="list-style-type: none"> <li>Customer query time</li> <li>Order lead time</li> <li>Frequency of delivery</li> <li>Actual verses theoretical throughput time</li> </ul>
Flexibility	<ul style="list-style-type: none"> <li>Time needed to develop new products</li> <li>Range of products/services</li> <li>Machine change-overtime</li> <li>Average batch size</li> <li>Average capacity/maximum capacity</li> </ul>
Dependability	<ul style="list-style-type: none"> <li>Percentage of orders delivered late</li> <li>Average lateness of orders.</li> <li>Meeting deadlines</li> <li>Mean deviation from promised arrival</li> <li>Schedule adherence</li> </ul>
Cost	<ul style="list-style-type: none"> <li>Minimum delivery time</li> <li>Variance against budget</li> <li>Utilization of resources</li> <li>Labour productivity</li> <li>Added value</li> <li>Efficiency</li> <li>Cost per operation hour</li> </ul>

Source: Andersen (1999)

Simons (2000) argues that an improved performance measurement system should include financial parameters derived from accounting systems. According to Simons (2000) performance measures from the accounting systems include costs/expenses incurred, divisional profits, Returns on investment, revenues, residual income and ability to stay within budgets. According to Kaplan and Atkinson (1998) financial measures have traditionally been used and continue to be the most widely used.

These measures only reflect the financial performance of the organization. Additionally these measures (Drury, 2000) focus on areas such as competitiveness, product leadership and flexibility in responding to changes. Kaplan and Atkinson (1998) report that companies are now shifting from the industrial age competition to information age. The excessive reliance on financial measures (Simon, 2000) leads to over emphasis on external financial reporting; low awareness of operational issues; lack of understanding of how value is created and under-valuation of intangible assets such as intellectual capital.

According to Simon's (2000) changes in global markets, concern on an individual contribution to the overall performance and provision of information for future value creation through investment in customers and suppliers requires wider performance measures for long-term success.

Kaplan and North (1993) highlighted other performance measures to include measures such as market share, extent of innovation and customer satisfaction. These measures supplement the traditional financial measures. They are focused on corporations or organizations with strategic business units (Kaplan and Norton, 1996).

## **2.7 Improvement Methods and Operational Performance**

To gain long-term competitive advantage many organizations are focusing on improvement initiatives. It is argued that improvement is stepwise and essentially should be supported by a holistic performance measurement system. Despite dramatic changes in

the business environment performance system have been affected only marginally (Ansoff and McDonnel, 1990) both top management and lower management assess enterprise performance mainly through financial measures and non-financial aspects.

A consensus is emerging that successful firms of the future will be those that embrace continuous change as a business paradigm. Such firms will be able to adapt to changes in the market place and lead to the market in directions optimal to the firm's goal by continually adapting the products, process and internal structures to changes in business environment (Nigel et al, 2001).

The period 1990's onwards has been witnessing dramatic shift in paradigms in the manufacturing and service sector of the Kenyan economy. From the predominantly protected business environment in the 70's and 80's to the liberalized free market economy (GOK, 2003). The free market economy has exposed firms to unpredictable business environment resulting in numerous corporate reorganizations with a view to improving performance and survival.

The challenge is thus to determine the change in operational performance as a result of use of improvement methods. The focus of this study is therefore to address the relationship between performance and extent of usage of improvement initiatives and overallly the challenges facing the organizations using these methods.

## CHAPTER THREE: RESEARCH METHODOLOGY

### 3.1 Research Design

This study sought to establish the relationships between operations improvement initiatives and operational performance, it also sought to establish the challenges facing organizations using these improvement methods. For this purpose the study was a combination of survey/exploratory research and descriptive research designs owing to their capability to address the objectives.

### 3.2 The Population

The population of study comprised of all companies (manufacturing and service) that participate in the company of the year award. As at June 2005, there were 40 companies participating in this award. Companies participating in this award provide a good cross-sectional analysis of how firms build their improvement initiatives and the impact on operational performance. Participating companies have shown willingness for continued improvement and excellence through better management practices.

### 3.3 Data Collection

Primary data was collected using a structured questionnaire. The questionnaire will contained both open ended and close-ended questions. The open-ended question were aimed at obtaining qualitative data on the general overview of the operations improvement methods. The close-ended questions were used to obtain quantitative data for statistical analysis. To ensure validity and reliability of the questionnaire was pre-test it based on study objectives. For the secondary research, analysis of companies published prospectus, promotion materials, websites sources and annual reports was done to assess information on usage of improvement initiatives and operational performance.



The target respondents were the operations managers or their equivalent in these organizations. Administration of the questionnaires was done on the basis of 'drop and pick later' method, but the researcher was available to clarify any questions that may not have been clear. Where the companies head offices were located outside Nairobi the questionnaires were e-mailed.

### 3.4 Data Analysis

The data collected was edited, coded and tabulated before final analysis. The analysis was both descriptive and inferential. Descriptive analysis used tables, charts and graphs for illustrations; content analysis employed averages, percentages proportions and explanations.

The descriptive statistics provided a general picture on how firms build on improvement programs, the extent of usage of improvement methods, operational performance level in relations to improvement methods and challenges.

Inferential statistics was used in drawing conclusions. The study tested if there is a relationship between operational performance and improvement methods. The study employed statistical tests of significance to measure the relationships between the variables and how the various variables interact with each other. All inferential tests were at 5% level of significance.

## CHAPTER FOUR: DATA ANALYSIS AND FINDINGS

### 4.1 Introduction

This chapter analyses the data collected and presents the findings. The data is analyzed and presented in the form of proportions, means, percentages and tables. An inferential analysis using the student's t-test was employed to show the significance between performance and usage of improvement methods. The challenges facing the organizations to meeting the operational performance improvements were documented. The population of study consisted of 40 companies participating/participated in the company of the year award (COYA) as at June 2005. The collection instrument was administered to the respondents through 'drop and pick later' method and in most instances, the researcher was available to clarify on questions that were not clearly understood. The data was collected from 18 firms out of the 40 contacted. This represented a response rate of 45.0%.

### 4.2 General overview of the firms

For the purposes of COYA, companies are classified as small and medium enterprises (SMEs) if they have a turnover not in excess of Kshs500 million, an Asset base not exceeding Kshs500 million and whose total employment did not exceed 100 persons (IFC, 2005). The companies are either manufacturing, agricultural, investment and finance or commercial and service. From the respondents it was shown that, finance and investment companies participating are few at 11.1%, commercial, manufacturing, assembly and service categories are relatively represented with manufacturing at 39%. The findings based on number of years in operation, average number of staff and estimates annual turnover revealed that most of the firms have been in existence as at low as 8 years and at most over 50 years. 22% of the firms have less than 100 employees. The study indicated that, a sizeable proportion of 0.33 of the firms have annual sales exceeding Kshs1 billion. Thus, there's need to improve their operational effectiveness on a continuous basis so as to remain competitive.

### 4.3 Familiarity with improvement programs

Respondents were asked to indicate the extent of familiarity with operational improvement methods as tools for operational performance. Table 4.1 below illustrates the findings.

**Table 4.1: Familiarity with improvement methods.**

Improvement Method	Little unfamiliar %	Little familiar %	Familiar %	Very familiar %
Quality based	-	-	27.7	66.7
Time based			44.4	53.3
Employee based			33.3	38.8
Technology based			33.3	61.1
Process based			27.7	38.8
Activity based	5.5	5.5	27.7	33.3

Source: Survey Data

With regard to which improvement methods are familiar, the survey data revealed that majority of the firms were familiar with quality based methods leading with a response rate of 66.7%. This was followed closely at 61.1% and time based at 53.3%. Activity based methods and Employee based methods accounted for only 33.7% and 27.7% respectively. This confirmed with similar researchers done earlier (Ombura, 2002). This finding implies that most firms in Kenya have a primary concern on quality and this reflects their growth over the years.

### 4.4 Extent of usage of improvement methods

From the observations of familiarity with improvement methods Table 4.1 above, the study probed further the extent of usage of the methods, and the findings are tabulated in Table 4.2. The results of the probe established further that Quality methods were widely

used confirming to their familiarity. Technology and Time based accounted for 77.7% and 72.2% respectively. Employee based methods and Activity based method accounted for 15% and 22% respectively. It is evidently clear from the survey results that Kenyans firm are building structures, system and procedures for the enhancement and implementation of Quality, Technology and Time based improvement methods, little attention is given to process based and Activity based methods.

**Table 4.2 Extent of usage of improvement methods**

Improvement method	Great extent	Little extent
	%	%
Quality based	88.8	-
Time based	72.2	5
Employee based	66.7	16
Technology based	77.7	11
Process based	55.5	-
Activity based	44.4	22

Source: Survey Data

The following tables 4.2a, 4.2b, 4.2c, 4.2d, 4.2e and 4.2f shows the findings the specific improvement techniques and improvement objectives.

#### 4.4.1 Quality-Based Methods

The quality based objectives included, client satisfaction, quality service and employee motivation. Total quality management (72.2%) and international standards organization (55.5%) are the highest percentage of responses. The findings are illustrated in Table 4.2a. From Table 4.2a, the most popular method in the quality based category was total quality management and International Standards Organizations. The improvement objectives for Total Quality Management were client-based satisfaction and quality of service whereas for International Standards Organization (ISO) employee motivation was further identified.



**Table 4.2a Quality-Based Methods**

Techniques	Percentage response	Objective		
		Client satisfaction	Quality service	Employee motivation
	%	%	%	%
Total Quality management	72.2	33.3	11.1	-
Statistical process control	33.3	-	-	-
International standards organization (ISO)	55.5	11.1	11.1	5.5
Design of experiment	11.1	-	-	-
Quality function deployment	11.1	5.5	-	5.5

Source: Survey Data

**4.4.2 Time-based methods**

**Table 4.2b Time-based methods**

Method	Percentage response	Objectives		
		Reducing downtime	Minimizing rework and scrap	Zero defects
	%	%	%	%
Just in time.	55.5	22.2	-	-
Concurrent engineering	16.7	-	-	-
Overall equipment effectiveness	33.3	11.1	-	5.5
Total production maintenance	33.3	5.5	5.5	16.7
Supplier certification	55.5	5.5	11.1	-

Source: Survey Data

The most popular method for Time-based methods was Just in Time and supplier certification with a percentage of 55.5%. Reducing down time and ensuring zero defects were the widely objectives for time-based methods.

#### 4.4.2 Employee – based methods

Employee-based methods includes, empowerment compensation skilled based pay, and organizational learning. The various objectives sought in the usage of this methods were identified as; reward based on performance, individual productivity, responsibility and accountability, and encouraging staff to acquire skills. The findings are tabulated in Table 4.2c.

**Table 4.2c Employee based methods**

Method	Objective				
	% response	Reward based	Individual productivity	Responsible and accountable	Acquire skills
	%	%	%	%	%
Empowerment	66.6	22.2	16.6	11.1	-
Compensation	50.0	22.2	-	-	-
Skilled based pay	27.7	-	11.1	5.5	5.5
Learning organization	88.8	5.5	11.1	-	33.3

Source: Survey Data

From table 4.2c; learning organization, empowerment and compensation are the most popular methods. Reward based on performance, individual productivity and encouragement of staff to acquire more skills were some of the widely set improvement objectives.

#### 4.4.3 Technology – based methods

Firms are responding to technological changes and setting up their process and systems using technology based methods that includes; Electronic Data Interchange, Computer Aided Design, Computer Aided Manufacturing, Manufacturing Resource Planning and Enterprise Resource Planning. The objectives that were sought included; data availability, networking and efficiency. The findings are tabulated in Table 4.2d.

**Table 4.2d Technology based methods**

Techniques	Objectives			
	% response	Data Availability	Networking	Efficiency
	%	%	%	%
Materials Requirements Planning (MRP I)	27.7	-	-	-
Electronic Data Interchange (EDI)	50.0	-	-	-
Computer Integrated Manufacturing (CIM)	16.6	16.6	-	5.5
Computer Aided Design (CAD)	16.6	-	-	5.5
Computer Aided Manufacturing (CAM)	5.5	-	-	-
Manufacturing Resource Planning (MRP II)	22.2	-	5.5	5.5
Enterprise Resource Planning (ERP)	50.0	-	22.2	11.1

Source: Survey Data

#### 4.4.5 Process Based Methods

Table 4.2e Process Based Methods

Method	Objectives			
	% response	Efficiency	Savings in time	Process alignment
	%	%	%	%
Benchmarking	61.1	38.8	-	-
Business process re-engineering	38.8	5.5	-	11.1
Process mapping	38.8	-	-	27.7

Source: Survey Data

The most popular method was benchmarking. The improvement objectives were efficiency and process alignment. Other improvement objectives stated included; waste elimination, function re-alignment and elimination of redundancies.

#### 4.4.5 Activity-Based Methods

Table 4.2f Activity Based Methods

Method	% response	Objectives		
		Cost minimization	Elimination of waste	Efficiency
	%	%	%	%
Distributed channel cost	16.6	-	-	-
Customer costing	61.1	5.5	5.5	11.1
Product costing	33.3	5.5	-	5.5
Target costing	-	-	-	-
Activity-based management	16.6	-	-	-
Economic Value Analysis	44.4	-	-	11.1

Source: Survey Data



Customer costing was the most popular method with improvement objective being efficiency.

It is evident from the survey results that different objectives are sought by Kenyan firms that employ different improvement methods. Quality improvement methods, satisfies objectives related to customer satisfaction and employee motivation. Employee based methods satisfied wider objective as illustrated by Table 4.2c. The results additionally revealed that enterprise resources planning (ERP) and manufacturing resource planning (MRPII) were widely used technology improvement techniques for objective, related to networking and efficiency. As the rate of technology pace accelerates, management challenge is to optimize their use for competitive advantage.

#### 4.5 Choice of operational measures for operational performance

The respondents were asked to indicate the choice of measures for operational performance. Table 4.3 below tabulates the findings.

**Table 4.3: Choice of operational measures for operational performance.**

Operational Measures	Frequency	Proportion
Quality	16	0.88
Learning and growth	14	0.77
Speed	14	0.77
Flexibility	12	0.66
Cost efficiency	11	0.61
Financials (profits, revenues)	11	0.61
Market share	11	0.61
Innovation	11	0.61
Customer satisfaction	12	0.61

Source: Survey Data

Quality, speed, learning and growth are indicated from results as widely used operational objectives. The findings are consistent with empirical literature on the growth of non financial measures of performance (Kaplan and Norton, 1996) due to limitations of financial measures of performance.

#### 4.5.1 Performance objectives in relation to usage.

Respondents were asked to rate on a 5-point likert scale the performance objectives in relation to their usage to meet improvement objectives. The results of these ratings are ranked in Table 4.7.

**Table 4.4 Mean Performance Objectives In Relation To Usage**

Objective	Mean score
Quality	1.18
Learning and growth	1.50
Customer satisfaction	1.56
Innovation	1.60
Flexibility	2.00
Speed	2.00
Market share	2.13
Cost efficiency	2.13
Financials (profits, revenues)	2.72

Source: Survey Data

From table 4.4 above, it can be observed that, firms attach great importance to performance objectives related to quality, learning and growth. Financials as a performance measure with a mean score of 2.72 is least considered. Other measures that were mentioned included customer satisfaction, and shareholder value. These findings show the importance of shareholder value and the customer lifetime value as measures of performance.

#### 4.6 Improvement methods and performance objectives

The respondents were asked to indicate the extent to which improvement methods used helped in achieving performance objectives on a 5 - point likert scale with a score of 1 = very great extent and 5 = not at all.

**Table 4.5: Extent of improvement methods on performance objectives.**

Method	Score
Quality of product/service	1.25
Time/delivery speed	1.35
Customer satisfaction	1.36
Employee, job satisfaction	1.73
Capacity utilization	1.75
Profitability	1.82
Transfer of knowledge	1.83
Financial performance	1.88
Increased competitiveness	1.93
Reduced operating cost	2.00
Market share	2.06

Source: Survey Data

From the values on table 4.5, it was further probed whether improvement methods are related to performance objectives. ( $H_0$ : improvement methods are related performance objectives). The mean and standard deviation computed from the sample were 1.72 and 0.78 respectively. Using a population mean of 2.00 at a significance level of 5% a student t-statistic (for small samples) resulted to a value.

$$t = \frac{1.72 - 2.00}{0.278/3.316} = - 3.33$$

The critical value  $t_{0.05, (10 - 1)}$  degrees of freedom = 1.82 (From statistical tables)

The result showed that, the sample value was less than the critical value and thus failed to reject  $H_0$ ; concluding that evidence from the sample indicates a relationship between improvement methods and performance objectives. The implications to these companies is that, they need to employ and utilize these improvement initiatives so that they have competitive advantage an ever increasing competitive environment.

#### 4.6 Utilization of improvement methods and operational performance

##### 4.6.1 Performance objectives and measures of performance improvements

Given the extent of improvement on performance objectives, the respondents were asked to rate on a 5 – point likert scale, the extent of usage of specific measures on the performance objectives. The results are shown in table 4.6 (Appendix III). The measures for performance objectives quality and dependability were found to be used to a large extent. These measures were customer satisfaction frequency of delivery, meeting deadlines, mean deviation from arrival and efficiency.

##### 4.7 Problems and issues Encountered with using improvement methods

Table 4.7 problems and challenges encountered

Problems	Proportion (%)
Rapidly changing external environment	83.3
Communication barriers	77.7
Absence of strategy	55.5
Technological developments	38.8
Difficult to apply	33.3
Static internal environment	37.7
Difficult to understand	22.2
Sufficient knowledge or proficiency	16.7
Lack of resources	16.6
Lack of organization support	5.5
Lack of management consultants	-
Familiar with language used	-
Employee support	-

Source: Survey Data



It was observed that the issues and problems encountered in the use of improvement programs included; communication barriers, rapidly changing external environment and absence of strategy.

#### 4.8 Utilization of improvement methods and operational performance

Respondents were asked to briefly state their opinion in regard to utilization of improvement methods and operation performance 72.2% of the respondents indicated improvements in performance. Other suggestions that were given included: Educating line managers on the use and interpretation of these methods, benefits from other emerging methods such as Gemba Kaizen, lean management and supply chain management, and focus areas to include business modelling and process re-engineering.

This study revealed that, all the improvement methods listed on the questionnaire are familiar to a certain degree of extent with a small percentage indicating unfamiliarity with activity-based methods, quality based, time based, employee based, technology based and process based were the most five familiar methods. Quality based methods were the widely used, as were technology and time based.

From the 35 specific improvement techniques, six of the techniques were stated as widely used and satisfying objectives related to quality service, customer satisfaction, efficiency and learning. These techniques included, total quality management, just in time, learning organization, enterprise resource planning and customer costing.

Quality, speed, flexibility, financials, market share, innovation, learning and growth were identified and derived from a frequency table as widely used operational objectives. The study found out that performance objectives related to quality, learning and growth were

## CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

### 5.1 Summary and Conclusions

This chapter summarizes the findings of the study in relation to the objectives of the study. The first objective was to determine the relationship between operations performance and the usage of improvement methods by firms participating in the company of the year award. The second objective was to determine the challenges facing the organizations to meeting operational performance improvement. The findings were therefore focused on a general overview of the firms, commonly employed improvement methods, measures of operational performance, extent of improvement methods on performance objectives, and problems and constraints. This study reveals that, the categorization of participating companies into commercial, manufacturing, agricultural, finance and investment includes characteristics evident for segmentation and target analysis. All the firms indicated that their operations performance had improved by the use of operations initiatives.

This study revealed that, all the improvement methods listed on the questionnaire are familiar to a certain degree of extent with a small percentage indicating unfamiliarity with activity-based methods, quality based, time based, employee based, technology based and process based were the most five familiar methods. Quality based methods were the widely used as were technology and time based.

From the 35 specific improvement techniques, six of the techniques were stated as widely used and satisfying objectives related to quality service, customer satisfaction, efficiency and learning. These techniques included; total quality management, just in time, learning organization, enterprise resource planning and customer costing.

Quality, speed, flexibility, financials, market share, innovation, learning and growth were identified and derived from a frequency table as widely used operational objectives. The study found out that performance objectives related to quality, learning and growth were

common. From the 24 specific measures of performance objectives; 70% of them were identified by respondents from tabulation of mean scores to be related to performance objectives. The relationship between improvement methods and performance objectives was statistically tested for significance using the student's t-test. The test established that improvement methods are related to performance objectives at 95% level of confidence as evidenced from the sample. A majority of the respondents were more concerned about communication barriers, the rapidly changing external environment and an absence of an operational strategy. Moreover top management and employees support and availability of resources were identified by the respondents as non-hindrances factors.

## **5.2 Recommendations**

The six classifications of improvement methods identified are not equivalent in terms of scope and involvement. However they are broad based and have different aspects of focus and performance. This study additionally established that Kenyan firms are relying heavily on quality based methods. Firms participating in this award (COYA) need to differentiate themselves from their competitors by employing many of the improvement initiative methods, and by so doing they could be satisfying their broad objectives, and customer satisfaction to survive against the competitive. Finally, a comprehensive utilization of these methods could not only lead to competitive advantage, but also benefits from other emerging methods like Gemba Kaizen.

## **5.3 Limitations of the Study**

Care must be taken to generalize the results of this study as there were some limitations. First this study included only companies participating in the COYA. There were some that had participated before, but not participating as at June 2005. Secondly, out of 40 firms listed as at June 2005, only 18 firms responded. The sample here therefore may not be representative of all Kenyan firms, hence limiting the general applicability of the findings of the study.

## 5.4 Further Research

The current research was exploratory in nature, with the primary object of determining the existence of a relationship between operational performance and operational objectives. This study did not take into account non-participating company of the year award firms and specific industry. With regard to any further studies, it is recommended that the relationship should be established with a larger sample particularly in manufacturing or service. Further, it recommends a study to be done on a specific improvement initiative and a specific performance objective. Such a specific improvement initiative can also be studied on its effects on performance pre and post implementation with a time period.

By analyzing these effects, an organization can strive to improve operations performance to meet operational objectives. Furthermore a study can be done purely on the service sector for large-sized, medium to small sized or both.

Caro, M. Jarverpa, S.L, and Stoddard, D.B (1994): "Business Reengineering at WANA Corporation. Experiences and lessons learned from first five years" *MS Quarterly Journal* Vol. 18 Pp 213-258.

Chesper, T.H (1993). Process innovation Reengineering work through information technology. *Praxis and young centre for IT strategy, Harvard Business School.*

Stewart, J.B. (1992). *Operations Management, Design, planning and control for manufacturing and services* McGraw-Hill inc.

Drucker, P (1994): *The effective executive* Heinmann Professional.

Drury, C (2000). *Management and Cost Accounting*. International Thomson Business Press London.



## BIBLIOGRAPHY

- Andersen (1999). "Business Process improvement Toolbox" *ASQ Quality Press* Milwaukee Wisconsin
- Ansoff, H and McDonnel, E, (1990). *Implementing Strategic Management*; Prentice Hall International, Englewood cliffs, NJ
- Aosa E. (1992). An Empirical Investigations of aspects of strategy formulation and implementation with large private manufacturing companies in Kenya. *Unpublished PHD Dissertation University of Strathclyde.*
- Camp, R.C (1989). Benchmarking the search for industry practice that lead to superior performance. *ASQC quality press Milwaukee Winsconsin.*
- Caron, M. Jarvenpaa, S.L, and Stoddard, D.B (1994). "Business Reengineering at CIGNA Corporation. Experiences and lessons learned from first five years" *MIS Quarterly Journal Vol. 18 Pp 223-250.*
- Davenport, T.H (1993). Process innovation Reengineering work thorough information technology. *Ernest and young centre for IT strategy, Harvard Business School.*
- Dilworth, J.B, (1992). *Operations Management, Design, planning and control for manufacturing and services* McGraw-Hill inc.
- Drucker, P (1998) : *The effective executive* Heinmann Professional.
- Drury, C (2000). *Management and Cost Accounting*; International Thomson Business Press London.

- Euske, K.J and Steven, P.R (1996). "leveraging management improvement technology" *sloan management review vol 38 issue 1 pg 69*
- Garvin, D.A (1991). "How the Baldrige Award really works" *Harvard Business Review November-December Pp 80-93.*
- George, S and Thomas, M (1990). competing against time. How time based competition is re-shaping Global market. *New York free press*
- Gitonga, L.W (2005). Improvement through Benchmarking; A survey of the Kenyan construction industry firms. *Unpublished MBA research project university of Nairobi.*
- Hackman, J.R and Wageman, R (1995). "Total quality management, empirical, conceptual and practical issues" *Administrative Science quarterly vol40 no2 pp 309-42.*
- Hammer, M and James, C (1993). *Reengineering the corporation* New York Harper Collins.
- Hayes, R.H and Pisano, G.P (1994). 'Beyond world class' The new manufacturing strategy. *Harvard Business Review.*
- Hayes, RH, Wheelwright S,C and Clark, K.B (1998). *Dynamic manufacturing.* Free press.
- Kaplan R.S and Norton (1996). The Balanced scorecard Boston, M.A *Harvard Business School Press.*
- Kaplan, R.S and Atkinson A.A (1998). *Advanced Management Accounting;* Prentice Hall, NJ.
- Kenya, Republic of (GOK) *Various years from 1980-2003 Economic Survey,* Government Printer, Nairobi.

Kenya Institute of Management (KIM) 'Management excellence' *quarterly bulletin* vol 86 issue No. 23

Kioko, N. (2002). The Strategic use of International Standards. The case of ISO 9000 registered firms in Kenya. *Unpublished MBA Research Project, University of Nairobi.*

Nation Media Group, Kenya celebrates Management Excellence, *Daily Nation* July 14, 2005.

Ngacho, J.N (1999). Application of management science in manufacturing companies in Kenya. A survey of large scale manufacturing companies in Nairobi. *Unpublished MBA Research project University of Nairobi.*

Ngure, F. K (2001). A survey the perception process improvement consulting among manufacturing sector in Kenya. *Unpublished MBA research project University of Nairobi.*

Nigels, W, Stuart, C and Robert, J (2001). *Operations management 3<sup>rd</sup> edition* McGraw Hill Publishers.

Ombura, E. O (2002). Improvement methods applied in operations managements. A survey of practices of Kenyan firms listed in the NSE *unpublished MBA research project, University of Nairobi.*

Omufira, A.N (2001). The extent of Total Quality Management Implementation in construction industry: A case study of the Kenyan Building Industry. *Unpublished MBA research project University of Nairobi.*

Port, O and Smith, G (1992). 'Beg-borrow-and benchmark' *business week* 30<sup>th</sup> November Pp 74-5.

Pyror, I.S and Katz, S.J (1993). "How benchmarking goes wrong (and how to do it right)" *Planning review* vol. 21 No1 Pp 6-11.

Rodgers .J, Paul .W, Upton B. and Williams S.M (1992). Computer Integrated Manufacturing. *Handbook of industrial engineering* New York John Wiley sons.

Scott-Morton, M.S (1991). *The corporation of the 1990s. Information Technology and organizational Transformation*, Oxford University New York.

Simons, R. (2000). *Performance measurement and control systems and control systems for implementing strategy*; Prentice Hall Inc. New Jersey

Stalk, G, Evans, P, and Shulman, L.E (1992). Competing on capabilities; The new rules of corporate strategy. *Harvard Business Review*.

Tapscott, D and Caston. A (1992). 'Paradigm shift: The New Promise of Information Technology' McGraw-Hill, New York.

Zachmann, J (1992). "Framework for Information Systems Architecture" Zachman International, Los Angeles.



# APPENDICES

## Appendix I: Questionnaire

This research is aimed at understanding the extent to which your company and other companies in Kenya build and use improvement methods in operations management to gain a competitive advantage through operational performance.

Kindly respond to the questions set out below. The information given will be strictly confidential and only used for the purpose of this research. Your sincere participation will be highly appreciated.

### Part I: Background Information

Indicate the extent to which you use the following improvement methods (tick)

1. Company name \_\_\_\_\_

2. Please indicate by ticking [✓] the sector classification of your firm.

	Very familiar	Familiar	Not familiar	Very unfamiliar
Commercial and service	[ ]	[ ]	[ ]	[ ]
Manufacturing/Assembly	[ ]	[ ]	[ ]	[ ]
Agricultural	[ ]	[ ]	[ ]	[ ]
Finance and investment	[ ]	[ ]	[ ]	[ ]
Others (please specify)	[ ]	[ ]	[ ]	[ ]
.....	[ ]	[ ]	[ ]	[ ]
.....	[ ]	[ ]	[ ]	[ ]

3. How long has your firm been in existence

.....  
.....

4. The number of employees in the firm

.....

.....

.....

5. (i) What is the annual turnover of the firm in

Kshs.....

.....

(ii) What is the annual operational costs in Kshs.

.....

.....

**Part II: Improvement methods in operations management**

6. Indicate the extent to familiarity with the following improvement methods (tick [√] the appropriate box)

	Very Unfamiliar	Little unfamiliar	Little familiar	Familiar	Very familiar
(i) Quality-based methods	[ ]	[ ]	[ ]	[ ]	[ ]
(ii) Time-based methods	[ ]	[ ]	[ ]	[ ]	[ ]
(iii) Employee based methods	[ ]	[ ]	[ ]	[ ]	[ ]
(iv) Technology based methods	[ ]	[ ]	[ ]	[ ]	[ ]
(v) Process based methods	[ ]	[ ]	[ ]	[ ]	[ ]
(vi) Activity based methods	[ ]	[ ]	[ ]	[ ]	[ ]
(vii) Others (please specify)	[ ]	[ ]	[ ]	[ ]	[ ]

.....

.....

7. To what extent are the following methods used to build improvement programs in your firm (tick [√] the appropriate box)

	Very Great	Great	Little	Very	Not at
	Great	extent	extent	little	all
	extent				
(i) Quality based	[ ]	[ ]	[ ]	[ ]	[ ]
(ii) Time based	[ ]	[ ]	[ ]	[ ]	[ ]
(iii) Employee based	[ ]	[ ]	[ ]	[ ]	[ ]
(iv) Technology based	[ ]	[ ]	[ ]	[ ]	[ ]
(v) Process based	[ ]	[ ]	[ ]	[ ]	[ ]
(vi) Activity based	[ ]	[ ]	[ ]	[ ]	[ ]
(vii) Others (please specify)	[ ]	[ ]	[ ]	[ ]	[ ]

8. For the quality-based methods please tick [√] the ones used by the firm and briefly describe the improvement objective.

Objective: (Client based satisfaction, quality service and employee satisfaction)

- (i) Total Quality Management [ ]
- (ii) Statistical Process Control [ ]
- (iii) International standard organization [ ]
- (iv) Design for experiment [ ]
- (v) Quality function deployment [ ]
- (vi) Others (please specify).....

9. For time-based methods please tick [√] the ones used by the firm and briefly describe the improvement objective.

- (i) Just in time [ ]
- (ii) Concurrent engineering [ ]
- (iii) Overall equipment effectiveness [ ]
- (iv) Total production maintenance [ ]
- (v) Supplier certification [ ]

- (vi) Others(specify).....  
.....

Objective: (Reducing downtime, minimizing rework and scrap, zero defects)

10. For employee based methods please tick [√] the ones used by the firm and briefly describe the objective

- (i) Empowerment [ ] .....
- (ii) Compensation [ ] .....
- (iii) Skill-based pay [ ] .....
- (iv) Learning Organization [ ] .....
- (v) Others (specify) [ ] .....

Objective: (Reward based on performance, individual productivity, responsibility and accountability, pay for work done, encourage staff to acquire more skills).

11. For technology-based methods please tick [√] the ones used by the firm and briefly describe the objective.

- (i) Material Requirements Planning (MRP I) [ ]  
.....
- (ii) Electronic Data Interchange [ ]  
.....
- (iii) Computer Integrated Manufacturing [ ]  
.....
- (iv) Computer Aided Design [ ]  
.....
- (v) Computer Aided Manufacturing [ ]  
.....
- (vi) Manufacturing Resource Planning (MRP II) [ ]  
.....
- (vii) Enterprise Resource Planning (ERP) [ ]  
.....



(viii) Others (Please Specify)

.....  
.....

Objective: (Data availability, seamless integration, networking, efficiency)

12. For process based methods please tick [√] the ones bay the firm and briefly describe the improvement objective.

- (i) Benchmarking [ ] .....
- (ii) Business process re-engineering [ ] .....
- (iii) Process mapping [ ] .....
- (iv) Others (please specify) .....
- .....
- .....

Objective: (Efficiency, savings on time, process alignment)

13. For activity based methods please tick [√] the ones used by the firm and briefly describe the improvement objective.

- (i) Distributed channel cost [ ] .....
- (ii) Customer costing [ ] .....
- (iii) Product costing [ ] .....
- (iv) Target costing [ ] .....
- (v) Activity-based management [ ] .....
- (vi) Economic value analysis [ ] .....
- (vii) Others (please specify) .....
- .....
- .....

Objective: (Cost minimization, elimination of waste, efficiency)

14. Indicate by ticking [] the choice of measure(s) that your firm employs in measuring operational performance.

- |        |  |                          |
|--------|--|--------------------------|
| (i)    | Quality                                | <input type="checkbox"/> |
| (ii)   | Speed                                  | <input type="checkbox"/> |
| (iii)  | Flexibility                            | <input type="checkbox"/> |
| (iv)   | Cost efficiency                        | <input type="checkbox"/> |
| (v)    | Financials (profits, revenue, budgets) | <input type="checkbox"/> |
| (vi)   | Market share                           | <input type="checkbox"/> |
| (vii)  | Innovation                             | <input type="checkbox"/> |
| (viii) | Customer satisfaction                  | <input type="checkbox"/> |
| (ix)   | Learning and growth                    | <input type="checkbox"/> |
| (x)    | Others (please specify)                | <input type="checkbox"/> |
- .....
- .....

15. On a scale of 1 to 5 where ( 1 = very important, 5 = least important) rank the following performance objectives in terms of their usage ( tick the appropriate box)

- |        |   |                          |                          |                          |                          |                          |
|--------|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| (i)    | Quality                                 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| (ii)   | Speed                                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| (iii)  | Flexibility                             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| (iv)   | Cost efficiency                         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| (v)    | Financials (profits, revenues, budgets) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| (vi)   | Market share                            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| (vii)  | Innovation                              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| (viii) | Customer satisfaction                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| (ix)   | Learning and growth                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| (x)    | Others (specify)                        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

16. On a scale of 1 to 5 where (1 = very important, 5 = least important) indicate the extent to which improvement methods employed by your firm help in achieving objectives related to the following performance objectives.

	Very great extent	great extent	little extent	very little extent	not at all
(i) Financial performance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(ii) Customer satisfaction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(iii) Market share	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(iv) Quality of product/service	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(v) Time/delivery speed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(vi) Profitability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(vii) Capacity utilization	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(viii) Employee job satisfaction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(ix) Reduced operating cost	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(x) Transfer of knowledge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(xi) Increased competitive	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

17. For quality performance objective indicate by ticking  $\sqrt{\quad}$  the extent of usage of measure(s) of performance on a scale of 1 to 5 where ( 1= very great extent, 5=Not at all)

	Very great extent	great extent	little extent	very little extent	not at all
(i) Number of defects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(ii) Level of customer complaints	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(iii) Meantime failures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(iv) Customer satisfaction score	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

(v) Others (please specify)

.....

.....

18. For speed performance objective indicate by ticking [] the extent of usage of measure(s) of performance on a scale of 1 to 5 where (1=very great extent, 5 = Not at all)

		Very	great	little	very	not
		Great	extent	extent	little	at
		Extent	extent	extent	all	
(i)	Customer query time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(ii)	Order lead time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(iii)	Frequency of delivery	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(iv)	Actual versus theoretical throughput time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(v)	Others (please specify)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

.....

.....

19. For flexibility performance objective indicate by ticking [] the extent of usage of measure(s) of performance on a scale of 1 to 5 where (1=very great extent, 5= Not at all)

		Very	great	little	very	not
		Great	extent	extent	little	at
		Extent	extent	extent	all	
(i)	Time needed to develop new products	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(ii)	Range of products/services	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(iii)	Machine change-overtime	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(iv)	Average batch size	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(v)	Average/maximum capacity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

.....

.....



(vi) Others (please specify)

.....  
.....

20. For dependability performance objective indicate by ticking [ $\surd$ ] the extent of usage of measure(s) of performance on a scale of 1 to 5 where (1=very great extent, 5=Not at all )

	Very great extent	little extent	very little	not at all
(i) Percentage of orders delivered late	[ ]	[ ]	[ ]	[ ]
(ii) Meeting deadlines	[ ]	[ ]	[ ]	[ ]
(iii) Mean deviation from promised arrival	[ ]	[ ]	[ ]	[ ]
(iv) Schedule adherence	[ ]	[ ]	[ ]	[ ]
(v) Others (please specify)				

.....  
.....

21. For cost performance objective indicate by ticking [ $\surd$ ] the extent of usage of measure(s) of performance on a scale of 1 to 5 where ( 1=very great extent, 5=Not at all)

	Very great extent	little extent	very little	not at all
(i) Minimum delivery time	[ ]	[ ]	[ ]	[ ]
(ii) Variance against budget	[ ]	[ ]	[ ]	[ ]
(iii) Utilization of resources	[ ]	[ ]	[ ]	[ ]
(iv) Labour productivity	[ ]	[ ]	[ ]	[ ]
(v) Added value	[ ]	[ ]	[ ]	[ ]
(vi) Efficiency	[ ]	[ ]	[ ]	[ ]
(vii) Cost per operation hour	[ ]	[ ]	[ ]	[ ]
(viii) Others (please specify)				

.....  
.....

22. What problems do you encounter while generally using improvement methods (please tick ✓)

- (i) Difficult to understand
- (ii) Lack of resources
- (iii) Lack of organizational support
- (iv) Difficult to apply
- (v) Absence of strategy
- (vi) Communication barriers
- (vii) Static internal environment
- (viii) Rapidly changing external environment
- (ix) Technological developments
- (x) Lack of management consultants
- (xi) Familiar with language used
- (xii) Sufficient knowledge or proficiency
- (xiii) Employee support
- (xiv) Others specify

.....  
 .....

23. Briefly comment your opinion on the utilization of improvement methods by your firm and operational performance

.....  
 .....

## Appendix II: List of Companies participating in the company of the year award

Population size of 40 firms participating in the award as at June 2005.

Afya Sacco Society Ltd	Investment and Mortgages Bank Ltd
Agro-Chemical and Food Co. Ltd	Kenya Medical Research Institute
Assa Abloy (EA) Ltd	Kenya Electricity Generating Co.
Barclays Bank of Kenya Ltd	Kenya Agricultural Research Institute
Bidco Oil Refineries Ltd	Kenya Airports Authority
Blowplast Ltd	Kenya commercial Bank Limited
BOC Kenya Ltd	Kenya Pipeline Company Ltd
BrookHouse Schools Ltd	Kenya Revenue Authority Ltd
Brookside Dairy Ltd	Lubeschem Kenya Ltd
Budget Car Rental and Leasing	Mabati Rolling Mills Ltd
Chandaria Industries Ltd	Magadi Soda Company Ltd
Color Creations Ltd	Magana Flowers Kenya Ltd
Davis & Shirtiff Ltd	Mumias Sugar Company Ltd
Dodhia Packing Ltd	Nairobi Bottlers Ltd
E.A Portland Cement Co. Ltd	Oakland Media Services Ltd
Equator Bottlers Ltd	Osho Chemical Industries Ltd
General Printers Ltd	Safaricom Ltd
Getrudes Garden Children's Hosp.	Steadman Research Services Ltd
Githunguri Dairy Farmers Cooperative	Sarova Hotels Ltd
Glaxosmithkline Limited	

## Appendix III

## DESCRIPTIVE STATISTICS

Table 4.6: Performance objectives and measures of performance

Measures	N	Mean	Std. Deviation	Variance
Number of defects	18	1.29	1.40	1.97
Level of customer complaints	18	1.29	1.15	1.34
Meantime failures	18	1.47	1.12	1.26
Customer satisfaction	18	.88	.78	.61
Customer query time	18	1.47	.87	.76
Order lead time	18	1.47	1.23	1.51
Frequency of delivery	18	.58	.79	.50
Actual versus theoretical throughput time	18	1.64	1.58	2.49
Time to develop new products	18	1.47	.88	.76
Range of products/services	18	1.41	.71	.50
Machine change overtime	18	1.70	1.75	3.09
Average batch size	18	2.00	1.76	3.12
Average/maximum capacity	18	1.70	1.21	1.47
Percentage of orders delivered late	18	1.41	.93	.88
Meeting deadlines	18	1.29	.46	.22
Mean deviation from promised arrival	18	1.29	.91	.84
Schedule adherence	18	1.52	.87	.76
Minimum delivery time	18	1.23	1.20	1.44
Variance against budget	18	1.70	.98	.97
Utilization of resources	18	1.82	.80	.65
Labour productivity	18	1.70	1.04	1.09
Added value	18	1.70	.84	.72
Efficiency	18	1.23	.66	.44
Cost per operation hour	18	1.52	1.17	1.39
Valid N (listwise)	18			