QUALITY CONTROL AUTOMATION
A CASE STUDY OF KATSINA STEEL ROLLING MILL COMPANY

BY

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PGD/MCS/558/97/98

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MARCH, 2000

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A PROJECT SUBMITTED TO THE DEPARTMENT OF MATHEMATICS/COMPUTER SCIENCE, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF POST GRADUATE DIPLOMA IN COMPUTER SCIENCE.

MARCH, 2000

<u>DEDICATION</u>

THIS PROJECT IS DEDICATED TO MY BELOVED MOTHER, MAIMUNA SHEHU AND MY FATHER, ALHAJI SHEHU UMAR, WHO SACRIFICE THEIR MATERIAL COMFORT RIGHT FROM MY INFANCY STRUGGLE DAY IN DAY OUT TO BROUGHT ME UP , GUIDE ME AS WELL AS FINANCE ALL MY LIFE DEALINGS AS WELL AS MY EDUCATION, SO MAY ALLAH (S. W. A.) GRANT THEM WITH PARADISE (AMEN).

APPROVAL

This project has been approve by the undersigned, as meeting the requirements of the Department of Mathematics/Computer Science, Federal University of Technology, Minna.

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DR. YOMI AIYESIMI
PROJECT SUPERVISOR   ***DATE***

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DR. S.A.REJU
HEAD OF DEPARTMENT   ***DATE***

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THE EXTERNAL EXAMINER   ***DATE***

ACKNOWLEDGEMENT

ABSTRACT

The project focuses more at using the secondary Data in designing the Automated Quality control system for the company,

The company has been facing a lot of difficulties with the present (Manual) system of quality control.

It is envisaged that full automation of the quality control of the company which will remove all delays, lapses and problems that are being encountered in the manual system.

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CHAPTER ONE

1.1   INTRODUCTION

Katsina steel rolling mill company (K. S. R. C) has its Headquarters at five Kilometers of Kano road, Katsina and this serves as well as company's administration and the Factory side. The Federal government of Nigeria and Kobe steel Limited of Japan on June 1979 signed the formal agreement for the construction of the company.

While the ceremony for the erection of the first column was held in October 1980 and in December 1980 the project co-ordinator was appointed as General Manager of the company. In January 1981, while in February of the same year the Katsina steel rolling company Limited was in corporate and the first inaugural Board meeting took place in April 1981, and the foundation stone of the company was ceremoniously laid. The first lot of Billets was delivered to the company and the foundation stone of the staff Housing Estate was laid in February 1982, while the company was formally Commissioned on the 6Th December 1982, by the then President of Nigeria, Alhaji Shehu shagari and the production started in the same date.

The company is purely and perfectly owned and controlled by Federal Government and the company's promoters and officials are directly appointed by the Government. The company specializes in the production of Rib bed and plain wire cool ranging from 6mm to 12mm diameter and basic plain and ribbed Bar Rods ranging from 12mm to 40mm diameter as well as Hard drawn and Annealed wire products, which are consumed in the whole Federation of its 60 percent and remaining 40 percent are consumed by other countries especially our neighbouring countries.

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These products are used for the construction of bridges, in building and other steel construction all over the country. The basic raw materials are obtained both locally and through importation, these raw materials are billet bars, which are un-heated steel, but purely refined. So these materials are locally obtained from Delta steel, Aladja of present Delta state, which constitutes the largest percentage over that obtained from abroad, those obtained from abroad are mostly from Kobe steel company of Japan and its subsidiaries which constitutes some small percentages. Therefore, one of the most important applications of statistical theory to be found in statistical control techniques of which Quality control Automation is well known example.

This is often thought of as being purely on industrial discipline. The quality control theories and technique may however be just as usefully applied to many process of a repetitive nature in almost every other sphere of activity. Since, the risk of error in sampling methods is larger when small samples are used, the sample statistics will fall within a comparative wide range and minor fluctuations are likely to be concealed.

On the other hand, small sample nevertheless stands a reasonable chance of revealing sudden major change. The technique of quality control has two main applications. The first application is in the process control in which an actual process, such as the performance of the machine is measured to assess the present performance and by implication to provide a guide to short-term future performance. The second application is in acceptance inspection, which evaluates past performance of the process by measuring the quality of the goods produced.

So this enable the management discern a defect in a process almost as soon as it occur and so to prevent the production of faulty goods arising from that defective.

Therefore, the project is aimed at examining the extent to which the quality goals of manufactured goods are satisfied without necessary checking every item produced and also for indicating whether or not there variations. If any are exceeding the normal expectation by the means of statistical methodology and to analyze the available data and suggest the possible solutions to be taken to put the production within the specification.

1.2   AIMS AND OBJECTIVE OF THE PROJECT

We are now in the Era of intense competition in new product development, but good product development and products are impossible without effective research. Therefore, the aims and objectives of this Project being carried out are based on the following:

(a)   For examining the quality of the manufactured goods in Katsina steel rolling mill.

(b)   To identify the variations, if any are exceeding the normal expectation by the mean of statistical methodology.

(c)   To detect any defective product in the production line.

(d)   To analyze the available data and suggest the possible solutions to be taken into production line within the specification.

Therefore, the project is important to the company and its consumers, because the welfare of the number of staff is depends upon the quality of products also the consumers can only be attracted by the good quality of the company products and the quality of the products can only be achieved by detecting and eliminating the above problems, if any, so that the company can achieve the desire goal of making sure that the consumers are satisfied, which can result in more income and more incomes of the company can therefore, bring about good welfare of the staff.

1.3 IMPORTENCE OF STEEL BARS PRODUCTION AT KATSINA

The mill was planned to have production capacity of 210,000 tones per year based on specified product – mix of reinforcement bars and wire rod. The capacity was expected to expand to 420,000 tones per annum at the second stage and 720,00 tones per year at the third stage. The major civil structure for the second expansion was laid along with the first stage to minimize interference with the production- line, while erecting the second stage.

Therefore, the production of steel bars have very important role to the Katsina area, since the Firm owes the community in which they are situated a function to perfect the welfare and interest of such locality such as loans, donation or Road building as well as some social responsibilities to service during their existence.

In the light of the above issues, Katsina steel rolling mill company provides some of such services, which includes the construction of express Road linking Kofar Kaura and Kofar Kwaya Roads in the city of Kastina, the company also provides clinic in which it treat both its staff and other individuals from the town at subsidized rates, also a Primary School is constructed and operating for both staff children and others who can pay the due and other charges per term.

The production steel bars in Katsina provides employment to indigenes at all level, that it assist in reducing unemployment in the area, so the total number of people directly employed by the company of about 50 percent are indigenes.

One of the major source of revenue for financing public expenditure by the state Government of Katsina is being paid by this company, which have been paying taxes frequently.

The production of steel bars in the area have significance which transforms the state to a little bit commercial centre by boasting business activities of the area in providing the steel bars that attract many customers from different part of the country and from other African countries, which cause improvement of transportation, benefited by the indigenes.

1.4   IMPORTANCE OF STEEL PRODUCTION AT NATIONAL LEVEL

Nigerians efforts towards the development of a viable steel industry began soon after independence in 1960, but it was not until after the end of Nigerian civil war that serious work began.

The chronology of the development of steel industries in Nigeria started in 1960, where various proposal were received from England, United state of America (U S. A), Western Germany etc., on the feasibility study of establishing steel plants in Nigeria. In 1970, Tiajpromexport of USSR was commissioned to co-ordinate steel development in the country.

Therefore, in 1973, iron ore was discovered at Itakpe and in 1975, Federal Government accepted the report of selection of Ajaokuta site as the best plant. In 1977, the signing of contracts of Delta steel plant was awarded, and in 1979 the contract of Ajaokuta steel plant signed with Tiajpromexport of USSR, also the contract for the three Inland rolling mills at Oshogbo, Katsina and Jos signed, In 1982, Katsina rolling mill and Delta plant at Ovwian-Aladja were commissioned. Also in 1983, Jos and Oshogbo steel rolling mills were commissioned.

The aspirations and hope achieved today in the steel sub-sector by the Federal Government are the cumulative result efforts started about Thirty years ago when Government first appreciated the strategic importance of steel development as a vehicle of industries growth in Nigeria.

So, production of steel in Nigeria have very importance role to the Nation as steel companies being among major sectors that the Federal Government generates its source of income, also steel production companies provide welfare and interest of their locality. As the tradition, companies import some of their raw materials and export some of their finished goods, therefore the pay of some exercise duties go to the Federal Government as income which is being used to finance its expenditures. The companies of steel production in the country are frequently paid dues liable to industrial training fund (I.T.F) that aid to boast the training of young and fresh Nigerian, also they provide employment to many Nigerian at all levels, that helps in reducing unemployment in the country and such employees are drawn from all part of the country.

The expansion program embarked upon by the company that help in economic development, the foreign exchange reserves position increased as the companies process their raw materials locally and keep off from importing.

1.5   <u>SCOPE AND LIMITATION</u>

The project have some limitations especially in field of data collection, it is because most of the data collected do not cover all varieties of steel, various steel were not available in the company, due to the present economy constraints in the country, since some of these raw materials are imported from other countries.

Another factor for not collecting a complex data is that, not all varieties of steel that are marketable in the area and also transportation is another problem, because most of the materials are being transported by vehicles, to the company and the manufactured goods are also experiencing the same thing.

Therefore, the data collected covers only Five varieties of the steel which are NST 34, NST 37, NST 44, NST 50 and NST 60.But the data for NST 44 and NST 50, are very small for sufficient analysis, therefore, they are omitted for the analysis. These varieties of steel which are being manufactured in the company are for making plain bars, Deformed bars and Hard drawn wire which are normally from NST 34, NST 37 and NST 60.

So, our analysis will only be based upon these three varieties of steel mentioned above, since the available data are only for them so far.

CHAPTER TWO

2.1   LITERATURE REVIEW

The top management of a company, of course bears overall responsibility for that company's products and services, but factory managers, Department managers, section managers, supervisors and foreman all are responsible for the quality of product and services produced by their respective factories, Departments, sections, group and teams. Meanwhile, the duty of Engineers and technical specialties are systematically and methodically to prepare, revise and improve standard that will enable their companies to supply the societies with products as economically as possible.

Controlling quality does not simply mean studying statistics or preparing control charts, but the aims of quality control should be the first to strengthen a country's economic base be enabling it to export large volumes of higher quality, reasonable price products, and finally to secure a firm economic formulation for the future, by establishing an active exporting industrial technology. So the ultimate importance of quality control should among consumers, employees and shareholders raise the country's standard of living and to make live better for the world as a whole.

Therefore, this project is being prepared as the essay which mainly concentrates on the quality of manufactured products in Katsina steel rolling mill, since the quality of the products produced in the company determine how best the company stands.

It also qualifies the company to reach its goal position so that it will be recognized all over the nation. As we already know the basic raw materials of this company are billets bars, which are UN-heated steel, but purely refined.

So the quality of products are base on each department should analyze, and continuously improve its work statistically. In other words, each department should consider how to use control chart and other statistical tools. When the real problem has been discovered, it is already half way to be solved, if the control is not properly exercise, the problem areas can not be considered discovered, and the people will simply run into confusion.

The key points in investigation and analysis with the aim to detect problem, so by just checking and leaving things at that will not do any good, if the work is not going well, so if there is some abnormality, something must be done about it. The causes must be found and eliminated from the process to ensure that work proceeds smoothly when processing.

Therefore, to perform work according to the standard, we need to have standard especially operation standard, both staff and production-line, workers are responsible for discovering problems and should be prepared to act as investigators, and make decisions. However, when considering the quality of individual products both producers and consumers think not so much about the quality of individual units, but rather of the quality of dozen of hundreds.

So, far from all my investigation both in Department of Mathematics and Computer science, Federal University Technology Minna and Katsina steel rolling mill, and no one has ever been introduce project on this particular topic in this company as the case study. Therefore, it is because of this reason that is why Iam motivated and interest to go through this project and having so much interest in the industrial statistics.

This project is based on finding how the company produces its products to consumers satisfaction and therefore, decide in advance what quality of the product to

plan, produce and sold, so to this we must to consider the following four aspects of quality, plan, design and control comprehensively.

(a) Quality: Characteristics of quality in the narrow sense, performance, purity, strength, dimension, tolerance, appearance, reliability, lifetime fraction, defective e.t.c.

(b) Cost: Characteristics that relate to cost and price that is (profit), cost control and profit control cover the unit cost, loses, productivity, raw materials cost, production cost and selling price.

(c) Delivery: Characteristics relate to quantities and times in production volume, sale volume change over lose, inventory consumption change in production e.t.c. Quality control is impossible without numerical data.

(d) Service: Problems arising after production has been shipped require the follow up. Safety and environmental characteristics, product liability, product liability prevention, composition period warranty, before sale and sale services

2.2 THE MEANING OF QUALITY CONTROL

A Quality control is a statistical device principally used for the study and control of repetitive process. The control process is the device for describing in concrete terms what a statistics control is device for attaining control and a device for judging whether control has been attained.

A process is said to be under statistical control if the samples are in random manner, that is, there is no traces of assignable cause of variation. Therefore, to determine or detect whether or not assignable of variation is effecting the production process. If sample values of (X) are plotted for a significant range of out put and time, and if these values all fall within the control limits and show no runs above or below average or runs up or down, then it can be said that the process is in a state of statistical measure of quality. In the use of control process, it is the goal of management to reduce fluctuations in a process until they are in a state of statistical control at the level desired.

A control process may be used to specify the goal of management. It is also an instrument for attaining that goal. To see whether a process is in control, past data pertaining to the process are plotted on a control chart, if the data conform to the pattern of random variation within the control limits, the process will be judged as being in control at a level equal to the mean line on the chart, if the data do not conform to this pattern, department from the pattern are then investigated and assignable cause tracked down.

2.3 THE IMPORTANCE OF QUALITY CONTROL IN THE COMPANY

In any production company some variation in quality is inevitable and the Variation can be sub- divided into two categories. Random variation, and variation due to assignable causes. Random variations are variation in the quality, which is the result of many complexes Cause, the result of each cause being slight in nature, nothing can be done about this Source of variation except to modify the process. While variations due to assignable Causes are variations in quality control over which we can have some degree of Control in the production line of the company such as:

a. Differences among machines

b. Differences among workers

c. Differences among materials

d. Differences in each of these factors over time

e. Difference in their relationship to one another

So the knowledge of the behaviour of variations is the foundation, which control chart rest, and it significant to the company since these chart of control is the guide to the company over its production line. Therefore, quality control is very important in any company because it can be described as the back bone, which raise the company to higher standard.

2.4   THE ROLE OF COMPUTER IN THE CONTROL PROCESS

A computer is an electronic machine, which is capable of processing data in a wide Variety of ways with an extremely high degree of speed and accuracy. When trying to figure out the various events, discoveries and invention that had taken place up to success in the development of a modern day. Ultra fast computer required an intensive analysis of computational mathematical and other relevant field of studies.

Essentially, a computer performs three functions:

i)   It receives data *(INPUT)*

ii)   It processes data by various computation

iii)   It emits data *(OUT PUT)*

INPUT —————————▶ *PROCESSING* —————————▶ *OUT PUT*

Therefore, computer has very important role to play, since it process the Input data and give out the Out put as the result, so in the quality control process, computer can be used significantly by processing the Input data pertaining the process which can be plotted on a control chart, that can show whether the process of the quality control is in control or not. It is by the used of computer that speed and accuracy can be determined in short possible time, it is a process in a control chart that the hypothesis of random variation is reasonable one to adopt for managerial purposes. It can be used to indicate whether the variations in production line are cause by the assgnible cause or not

CHAPTER THREE

3.1   METHOD OF DATA COLLECTION

There is various steel of about nine varieties, these varieties have the same name, but they only differ by their steel grade and their code, these are as follows:

Steel Grade	Colour Code	Deoxide Type	Carbon (C_{12})	Silicon (Si)	Mang. (Mn)	Ladle Analysis Phos, Sulp, Cu.N
Nst 34IC	Brown	K	.06-12	.18-0.28	0.4-0.6	_
Nst 37-2	White	K	.112-17	" "	" "	_
Nst 44-2	Yellow	K	.14-20	" "	" "	_
Nst 50-2	Green	K	.18-24	" "	" "	_
Nst 50-c	Half Grn.	K	.25-34	" "	.45-7	_
Nst 60-2	Blue	K	.35-42	.15-.25	.6-.8	_
Nst 60 mn	Half blue	K	.35-42	.20-.30	.9-1.2	_
Nst 65mn	Blue Cres.	KK	.28-48	" "	1.3-1.6	_
Nst 70-2	Red	K	.38-48	.15-.25	.7-.9	_

Table 3

Therefore, the above table shown the steel grades and colour code of steel varieties as well as their chemical composition that is available. However, special grades can be made available on mutual agreement with the customer. So these steel with a low Carbon steel grade are specifically for drawing very small diameters, while these steel with higher Carbon steel grade are for drawing a large diameter ranging from 1.6-5.0mm.

The steel grade and colour code depends on their chemical composition, which determine the type of steel and its strength.

So the method of conducting the experiment of each type of steel produced, to make sure that the finished products are in proper production line are as follows:

There are about six parameters that are being considered for the sample experiment, these are: Tensile strength, Material elongation, Reduction (Area), Yield point, Ben test, Area, Breaking force and the weight of sample in kilogram per meter and the size of sample in millimeter. These observations were usually recorded into the physical test result, by the process work in formulae as:

Table 3.2

PARAMETER	FORMULA	UNIT
Tensile Strength	Breaking force/ Area	Kgf /mm
Material Elongation	$L_1/ L_0 - 1 \times 100$	%
Reduction Area	$(1-A1/A0) \times 100$	%
Yield Point	(Meas.xTon./sec.)/200/original area	Kgf/mm
Bend Test	(ST-37(a)) RST-37(2a))(2a)) (ST-44/60),(2.5a))	180°
Area	For plain $(\pi D/4)$,For ribbed(Wt/ 7.854)x1000	mm

Note: L_1 is Original length. L_0 is a new length.

A_1 is the Original Area of the sample.

A_0 is the New Area of the sample.

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(a) is the thickness of the sample.

Therefore, the experiment conducted with the above formulae and expected to be within the specification as it is stated to each of the following three different products which are Deformed bars (Ribbed bars), Plain bars and Hard drawn wire that are shown below:

PLAIN AND DEFORMED BARS SPECIFICATION

Table 3.3

PARAMETER	UNIT	DEFORMED BAR	PLAIN BAR
Tensile strength	N/mm	570-710	340-470
Yield strength	N/mm	420minimum	235minimum
Elongation	%	14minimum	24minimum
Bending	180°	2.5a	1a

HARD DRAWN WIRE SPECIFICATION

Table 3.4

Diameter (mm)

Annealed & Hard drawn wire	5.0	4.5	4.0	3.5	3.2	3.0	2.8	2.5	2.0	1.6
Tolerance	+0.1mm								+0.07mm	
Tensile strength	600-900N/mm (Hard)									
Anneal and Hard	270-540N/mm (Annealed)									

The specifications shown in the range that when experiment is conducted and the result obtained was not in the specification, therefore, the products is defective and further investigation could be made under statistical control process, whether the causes of variation come due to the differences among machines, workers material or factors over time. Therefore, the data collection was by the secondary source, which is already, exists and being used for any investigations purposes. The data of this project were obtained from the Quality control laboratory of Katsina steel rolling mill company limited (K.S.R.C) by the Chief Technical Officer of the Laboratory together with explanation of how they carried out the sample experiment for each of the manufactured products shown above.

3.2   ESTIMATE OF PARAMETERS OF QUALITY CONTROL

A process is said to be under statistical control if the samples are in random manner that is there is not traces of assignable cause of variation. So to determine or detect whether or not assignable causes of variation is affecting the production process, samples of manufactured products are taken at a regular interval of time and tested, the sample size taken will depend on the industry and it should be noted that the more the samples, the higher the cost but the more accurate result.

Control charts are the simple statistical devices used in detecting systematical patterns of variations in data resulting from repetitive process and maintaining specified or acceptable standard of quality. The charts were derived by Dr. W. A. Shewart in 1924, and was named after him, that is – Shewart control chart.

Typically a control chart consist of three Horizontal lines which are as follows:

i)   THE CENTRAL LINE (CL)

ii)   THE UPPER CONTROL LIMIT (UCL)

iii)   THE LOWER CONTRO LIMIT (LCL)

Sometimes, there are additional two lines called the warning limits.

```
        |          Out of control
        |_____ UCL
W.L →   |-------------------------------------------------
        |
        |
        |
        |_____ CL
        |
        |
W.L →   |-------------------------------------------------
        |_____ LCL
        |          Out of control
        |
        |_____
```

Sample Number
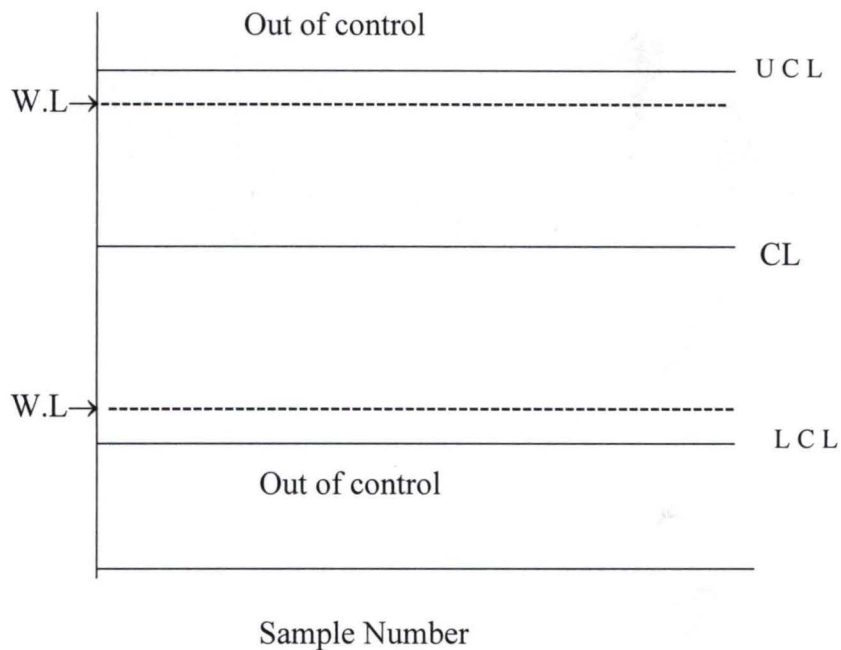
Therefore, control charts can be classified into two categories, which are:

i) Variable control chart.

ii) Attribute control chart.

The variable control chart that measure the quality characteristics of manufactured products qualitatively by measuring them in specific unit that is in diameter or weight in quantitative charts based on these continuos variables are called variable control charts, which includes the mean (X) chart and R-chart, where (R) stands for Range.

But, when the quality characteristics of products are identified by their presence or absence, the attribute control charts are considered, that is the product may be termed good or bad, so these includes the P-chart and C-chart. So the chart can be interpreted as:

i)   Any point between the control limits is attributed to chance and process is said be in control.

ii)   Any point beyond either control limits on a control charts is said be regarded as assignable causes of variation. That is the process is out of control.

iii)   If two consecutive points fall outside the warning limits, assignable causes of variation can be assumed to be present.

iv)   If many consecutive points (atleast eight) lie on one side of the central limit line, this may be evidence of assignable causes of variation.

So the quality control is the device for specifying and attaining a state of statistical control, it is also a device for judging whether the state of control has been attained.

X-CHART AND R-CHART

The mean chart (X- chart) shows variations in the averages of sample, while R-chart shows variations in the range of samples. Therefore, let n-samples of (K) size each and the observation of each sample is recorded as:

Sample/No	1	2	3	-----	K	Mean (X)	Range (R)
1	X_{11}	X_{12}	X_{13}	-----	X_{1K}	X_1	R_1
2	X_{21}	X_{22}	X_{23}	-----	X_{2K}	X_2	R_2
3	X_{31}	X_{32}	X_{33}	-----	X_{3K}	X_3	R_3
4	X_{41}	X_{42}	X_{43}	-----	X_{4K}	X_4	R_4
5	X_{51}	X_{52}	X_{53}	-----	X_{5K}	X_5	R_5
↓	↓	↓	↓	↓	↓	↓	↓
n	X_{n1}	X_{n2}	X_{n3}	-----	X_{nk}	X_n	R_n

$$X = \Sigma x_{ij}/k \qquad \text{and} \qquad R_i = x_i(L) - x_i(S)$$

The smallest where $x_i(L)$ is the largest value in the ith sample and $x_i(S)$ is value smallest value in the ith sample.

An X- charts shows variation, if the charts is being used to study past data, the central line in the set at (X) is the average of all the data.

$$CL = \upsilon$$

$$ULC = \upsilon + 3\sigma$$

$$LCL = \upsilon - 3\sigma$$

While for the current control data, it can be as

$CL = \upsilon$

$UCL = \upsilon + 3\sigma_x$

$LCL = \upsilon - 3\sigma_x$ Where (X) is $\upsilon = \sum x_i /n$ and σ is var $(x) = \sum (x - x) /n-1$

R-CHAR

An R- chart show variation in the range of sample, if the chart is being used to analyze past data, the central line will be the average of the sample ranges, as

$CL = R$

$UCL = R + 3\sigma$

$LCL = R - 3\sigma$

For chart to attaining current control, it can as:

$CL = R$

$UCL = R + 3\sigma_R$

$LCL = R - 3\sigma R$

Since the distribution of the sample ranges is rather skewed, there is some tendency in some quarters to used probability limits instead of 3σ or 3σ.

P- CHART AND C- CHART

P-chart which is a fraction or proportion defective that gives a clear picture of the fraction defective in a sample or sub-group.

$P = d/n$

Where (n) is the total number of items expected in a sample.(p) is fraction defective in a sample and (d) is number of defective items in a sample.

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But $E(P) = P$ and $Var.(P) = P(1-P)/n = OP$

Where OP is the standard deviation of fraction defective. So the control limits are as:

$$CL = P$$

$$UCL = P + 3\sqrt{P(1-P)}/n = P + 3OP$$

$$LCL = P - 3\sqrt{P(1-P)}/n = P - 3OP$$

While for C- chart is based on Poisson distribution and must satisfy the following condition:

i)   The average of defective must be less than the total possible defective that is the opportunity for defective is large while change for defective is small.

ii)   Area of opportunity should be the same.

$$CL = C$$

$$UCL = C + 3\sqrt{(C)}$$

$$LCL = C - 3\sqrt{(C)}$$

Where (C) is average number of defective for a number of sub-group.

We should note that, if the lower control limit is negative, it should be change to zero and any decimal point in result of LCL and UCL should be rounded.

COST AND BENEFIT ANALYSIS

The basic idea of cost analysis is simple, to decide on the worth of the project involving public expenditure, it is necessary to weight up the advantages and disadvantages. The province of cost benefit is usually confined to public projects because the advantages and disadvantages are defined in terms of social gains and loses. It is assumed correctly one suspect, that the most private decisions are not concerned with the effects on profits, sales or producer status.

The idea of weighting up the pros and cons appears well founded in rationality since it would seem odd deliberately to choose a policy which is known to have harmful net effects. It is of course possible to disagree over what are good or bad effect and it is precisely because such disagreement is possible that cost benefit analysis is a somewhat tendentious subject. The next sections show that cost benefit is consistent with the assumption that social objectives can be defined in terms of individual preferences, even though the process of aggregating individual preferences to obtain total social preferences presents some serious difficulties.

Essentially, cost benefit analysis purports to be a way of deciding what a society prefers. Where only one option can be chosen from a series of options, cost benefit analysis should inform the decision maker as to which option is social most preferred.

Therefore, considering the Automation of Quality Control of Katsina Steel Rolling Mill Ltd. The following points are to be observed for the analysis such as:

COSTS

i)   Cost of controlling the quality of the products (monetary)

ii)   Non-monetary such as:

a) Time spent in making the test.

b) Products west for the test.

BENEFITS

i)   Sales / profit.

ii)   Competitions.

iii)   Welfare / Motivation.

iv)   Acceptance.

v)   Market share increase.

vi)   Growth of the company.

For the analysis of the cost benefit analysis the sampling method is used as per one Iron rod to be analyzed.

a) Cost of using the machine to test the strength of the iron rod is five hundred Naira per one iron rod (500),. The cost of labour involved in the quality is one thousand Naira (1000.00) and other materials involved in the test is five hundred Naira (500.00) which involve the cost of the rod wasted for the purpose of testing is two hundred, thirty Naira and fifty kobo for one piece of iron rod.

b) For the non-monetary, it is to considered the time used in conducting the test, the company produce 210,000 metric tons per day and the company operates on 24 hours services. Therefore, the company will test 210 irons per day since only one iron is sampled and test in every one thousand of iron in a ton, there to find the

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time used in testing one rod is 210/24 = 8.76 ≅ 9 iron rod per hour, and the time spent per rod is 60/8.76 = 6.8 min. per rod.

Therefore, the total amount (=N= 2,230.50 + 6.8 min.) per rod, for both the monetary and non- monetary cost.

While the cost and benefit of purchasing the system and the services training of the personnel is often an overriding factor, most organizations will have a spending limit within which the best available solution to their problem must be found. Therefore, costs are usually compared with the benefits which can be obtained, that is an organization will make sure that the expenditure is not just possible but desirable. So the cost of elements and training of personnel are as follows:

a) New staff may be needed to operate the new system or the existing staff may need to be trained or the staff may no longer needed, so the cost of training the existing staff is (=N= 28,500) for Certified Systems Engineering Courses for three months.

b) Equipment may need to be purchased and maintained, which include the complete system and the its accessories which costs as:

i) Complete system (Pentium III 450-500 (= N= 148,000 to168,000))

ii) Dust cover (=N= 600)

iii) U.P.S (1,400 BACK-UP PRO) (=N= 55,000)

iv) Anti-Glare (=N= 1,200)

v) Diskette Rack (1,500)

vi) 3.5 diskette packet (=N= 360)

vii)   Z-drive diskette (=N= 23,000)

viii)   Printer. HP Laser Jet 5 Plus (=N= 20,500)

So the total amount for installation computer system training of the personnel is two hundred and seventy eight thousand one hundred and sixty Naira (=N= 278,160.00), while the building need more floor space which is part the company's capital asset.

For the benefit, the quality of the rod makes acceptable in the market thereby making higher sales. The company is able to make a profit of seventy five Naira fifty Kobo (75.50) per rod. Due to the profit from the profit from the sales of the company's products, the company is able to sustain good welfare package for its workers in turn of staff clinic, staff canteen, staff bus, staff children school, local and abroad training, this motivated the workers of this company to work as expected.

The market share of the company has grown with about 50%, there by making the company the market leader of steel, this is so because some people went as far to Delta steel company and abroad to buy the billet and give it to Kastina steel rolling mill company to manufacture at some charges, this growth of the company's market share increases its sales and profit as well as the company's size.

Analysis:- From the forgoing assessment one can conclude that monetary wise the cost of the quality control out weight the benefit,the cost of the quality control out weight the benefit, the cost is (=N=) 2,230.50 while the benefit is only (=N= 75.50k.) Another cost is time wasted in conducting the test per rod. In general perspective however, the non-monetary gain of quality control has far away out weight its costs, this is the background of the peaceful and solid stability of the company since its inception.

CHAPTER FOUR

CHOICE OF SOFTWARE AND THE PROGRAMING

LANGUAGE

There are two parts to an electronic digital computer system, which are Hardware and software. The Hardware is physical components of a computer system. When one enters a computer room all that is seen is hardware.

Software is a sreies of programs desinged to perform a specific task. Program simply consists of sequence of instructions needed to be performed to accomplish a task. It is the software that enable the hardware to be put into effective use, it has been sometimes said that computer with out a program is an 'electronic idiot' because it can not do anything constructive or profitable.

Example of software:

➢ The system software are programs written usually by computer manufacturers, they contribute to the effective control and performance of the computer system, they provide several advantages and conveniences for programmers and computer users.

➢ Application software may be provided by the computer manufacturer or supplier, but in many cases the user produces his own applications programs called User Programs, such as payroll program, Stock control program e.t.c

➢ Utility software is a developed program that can accomplish a particular task. They are standard packages that are developed by a software organization, example is Microsoft Excel.

Microsoft Excel is a windows application program or software that provides users with a powerful spreadsheet feature or environment, it can be referred to as an Electronic

spreadsheet because it provides the facilities that you have in a document on an electronic system.

A spreadsheet is made up of 'cells' organized into rows and columns. It can be defined as any documentable that consists of a series of rows and columns which is suitable for any form of data analysis. Therefore, within the Microsoft excel environment, you can work with any data set easily and conveniently, Data can be inputted, processed, stored in memory and also produce an output.

This data also can be edited by the use of some word processing features; it can be updated and corrected easily. Graphs can assist the user in making decision or for report presentation can also be produced.

In Microsoft excel documents are called workbooks. Workbooks keep the sheets or pages you need together in the same file, it can contain different charts, sheets, visual basic modules and other types of documents, you can switch between sheets by clicking the sheets number tabs at the bottom of the workbook.

A workbook is also called a spreadsheet in Microsoft excel, it is the printable document that you can use to store and manipulate data. Each worksheet is a rectangle grid of 256 columns and 16,384 rows, therefore Microsoft excel can be used for the following tasks: -

- Data analysis for Automated business tools.

- Any accounting application that involves repetitive calculation.

- Producing reports, planing and projecting company's performances.

4.2   <u>DATA ANALYSIS</u>

Control charts based upon measurements of quality characteristic are often found to be a more economical means of controlling quality than control chart based on Attributes.

Variable charts that are most commonly used X and R- charts, significantly changes in either the means of the standard deviation are an indication of the process. When control is undertaken employing an X – chart to control the general variability of the process. The two taken together will give a reasonable good control of the whole process.

Therefore, as it was mention in previous chapter the project of our analysis will only be upon these three varieties of steel which are NST 60, NST 37 and NST 34, since their sufficient data are available for analysis. And we are going to use the mean X – chart and Range chart in the process for each variety of the steel, and analysis is only limited to the strength of the steel which is more important factor to determine the quality of steel product.

ANALYSIS FOR NST 60 STEEL

The available data collected for NST 60 steel is for about two hundred and fifty samples (250), which has twenty five (25) observation number as row in ten columns, from the table 4.1 below and has the following: -

X-CHART

$CL = \upsilon = 65.24$

$CL = \upsilon + 3\sigma_x = 65.24 + 3(0.57) = 66.95$

$LCL = \upsilon - 3\sigma_x = 65.24 - 3 (0.57) = 63.49$

R- CHART

$CL = R = 19.51$

$UCL = R + 3\sigma_R = 19.51 + 3(2.56) = 27.19$

$LCL = R - 3\sigma_R = 19.51 - 3(2.56) = 11.8$

DATA OF TENSILE STRENGHT (Kgf/mm) FOR NST 60 STEEL.

SAMPLE NO	1	2	3	4	5	6	7	8	9	10	MEAN	RANGE
1	55.40	56.60	56.90	54.70	49.70	67.90	71.10	67.90	71.70	74.00	64.39	24.30
2	60.80	56.50	59.40	50.60	58.80	71.30	71.10	70.70	67.60	74.00	64.79	23.40
3	57.20	61.00	58.90	57.60	59.50	75.80	69.90	69.30	62.20	73.00	64.90	18.60
4	57.50	62.50	62.40	61.40	53.50	73.00	69.70	69.40	70.20	73.00	64.90	19.50
5	60.00	57.10	61.50	62.00	55.80	75.80	66.10	69.10	67.20	73.80	64.80	20.00
6	56.60	59.70	60.50	59.90	57.20	70.60	71.10	70.80	75.50	66.70	64.69	18.90
7	61.30	61.80	57.40	60.60	52.40	70.60	66.10	67.80	67.90	73.50	64.86	21.10
8	60.40	56.50	57.10	59.30	55.80	74.10	66.10	67.20	69.20	67.50	65.20	18.30
9	62.40	56.50	58.00	61.30	76.40	75.30	71.40	62.70	68.60	68.80	65.42	19.90
10	65.70	58.50	56.30	57.40	75.80	71.30	71.80	63.00	72.60	70.20	65.27	19.50
11	58.40	58.60	60.80	57.40	72.40	71.60	65.20	65.50	71.70	69.00	65.12	15.00
12	62.50	58.20	59.30	57.40	76.70	70.80	66.20	63.30	60.00	69.80	65.32	19.30
13	62.00	58.80	57.00	58.90	68.30	71.20	65.70	69.40	61.80	70.70	65.56	14.20
14	62.00	56.10	64.60	56.40	69.00	73.90	65.80	68.50	54.50	67.80	65.69	19.40
15	61.10	56.90	56.00	78.00	76.10	75.10	60.50	70.60	60.30	68.60	66.00	22.00
16	60.50	59.40	64.60	77.00	70.50	74.90	65.10	69.60	59.00	70.10	66.00	18.00
17	62.60	58.90	56.00	68.00	69.60	75.40	64.50	68.40	58.90	70.20	65.61	19.40
18	61.80	62.40	53.40	69.00	70.50	72.90	63.90	67.80	60.60	66.20	65.65	19.50
19	59.40	61.50	60.40	71.00	69.60	73.10	57.10	68.20	61.10	67.00	65.77	16.00
20	62.40	60.50	58.30	68.00	72.20	73.50	70.60	69.40	63.50	70.10	65.92	15.20
21	58.20	57.40	62.60	70.00	74.30	75.30	70.60	68.60	60.60	68.80	65.74	17.90
22	61.80	57.10	52.30	69.00	75.90	77.80	65.90	69.70	58.00	67.40	65.51	25.50
23	57.90	58.80	57.40	76.00	71.20	74.60	70.30	71.80	58.70	70.20	65.52	18.60
24	57.70	58.20	58.50	78.00	67.10	70.90	69.30	71.30	59.00	73.20	64.93	20.30
25	56.90	56.10	54.40	51.00	69.10	71.50	70.10	73.20	58.10	75.00	63.54	24.00
										X=	65.24	19.51
										S=	0.57	2.83

34

34

MEAN CHART FOR NST 60
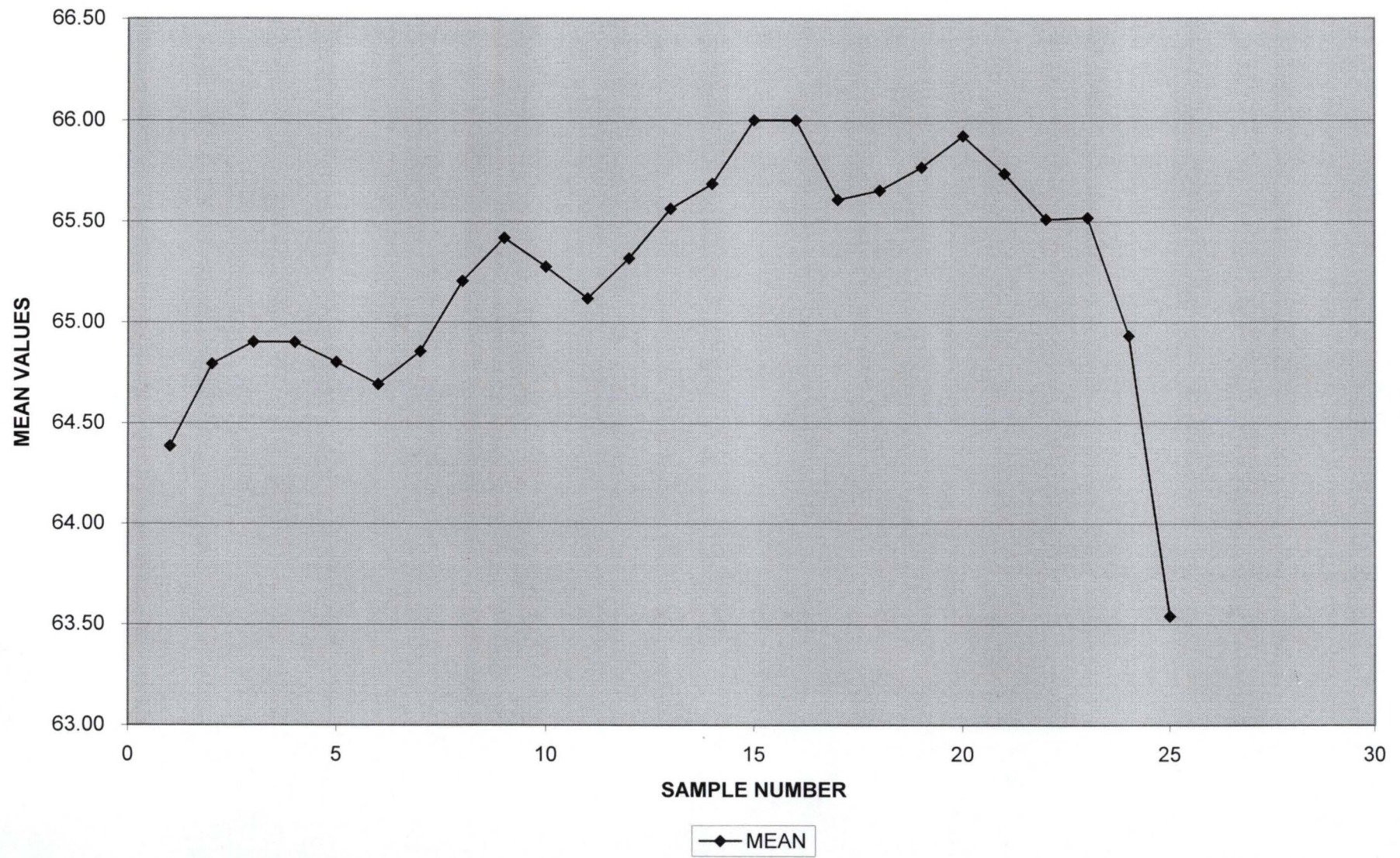
35   35

RANGE CHART FOR NST 60
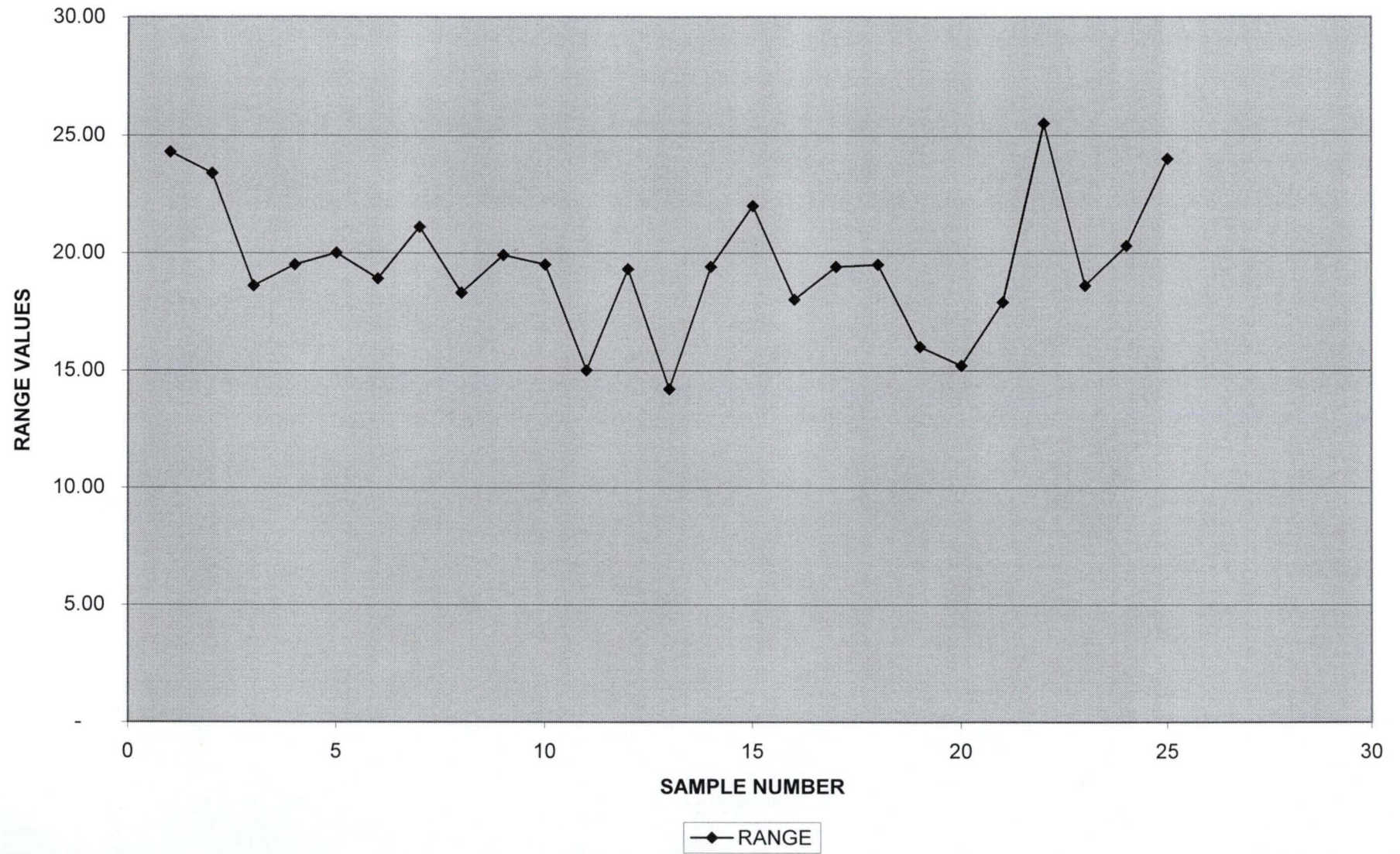
36 36

ANALYSIS FOR NST 37 STEEL

The available data collected for NST 37 Steel is of about one hundred and twenty samples (120) which has fifteen observations as rows in eight (8) columns, from the table 4.2 below and has the following characteristics:

X-CHART

$CL = X = 43.92$

$UCL = X + 3\sigma_x = 43.92 + 3(0.9740) = 46.82$

$LCL = X - 3\sigma_x = 43.92 - 3(0.9740) = 41.00$

R- CHART

$CL = R = 7.98$

$UCL = R + 3\sigma_R = 7.98 + 3(2.829488) = 16.47$

$LCL = R - 3\sigma_R = 7.98 - 3(2.829488) = - 0.51$

DATA OF TENSILE STRENGHT (Kgf/mm) FOR NST 37 STEEL

SAMPLE NO	1	2	3	4	5	6	7	8	MEAN	RANGE
1	50.00	42.20	43.50	44.30	44.90	45.40	45.90	42.30	44.81	7.80
2	53.60	41.60	44.60	46.80	44.30	48.10	43.10	42.60	45.59	12.00
3	48.80	41.50	44.30	46.80	39.80	48.70	43.30	43.40	44.58	9.00
4	48.80	45.50	44.30	44.60	40.00	46.20	43.80	44.40	44.70	8.80
5	43.00	45.60	44.40	43.80	43.90	47.70	44.10	44.40	44.61	4.70
6	42.90	42.80	42.50	41.30	41.50	44.80	46.00	45.00	43.35	4.70
7	48.60	42.40	39.00	45.40	50.30	43.20	41.90	44.50	44.41	11.30
8	50.30	40.20	39.30	40.10	52.80	45.80	42.20	39.00	43.71	13.80
9	39.30	40.10	38.90	41.30	44.20	49.10	41.30	38.70	41.61	10.40
10	41.40	41.20	39.90	44.40	47.00	43.80	43.40	43.00	43.01	7.10
11	43.20	43.50	41.20	45.30	47.60	44.60	42.00	41.50	43.61	6.40
12	42.40	40.40	42.20	47.10	46.10	45.20	47.20	41.60	44.03	6.80
13	45.30	41.70	44.00	47.40	42.40	45.40	43.50	45.10	44.35	5.70
14	44.60	44.00	44.20	38.40	42.90	44.50	41.50	43.50	42.95	6.20
15	41.40	45.10	44.30	41.70	45.10	45.70	40.70	43.80	43.48	5.00
								$X=$	43.92	7.98
								$S=$	0.974	2.829

MEAN CHART FOR NST 37
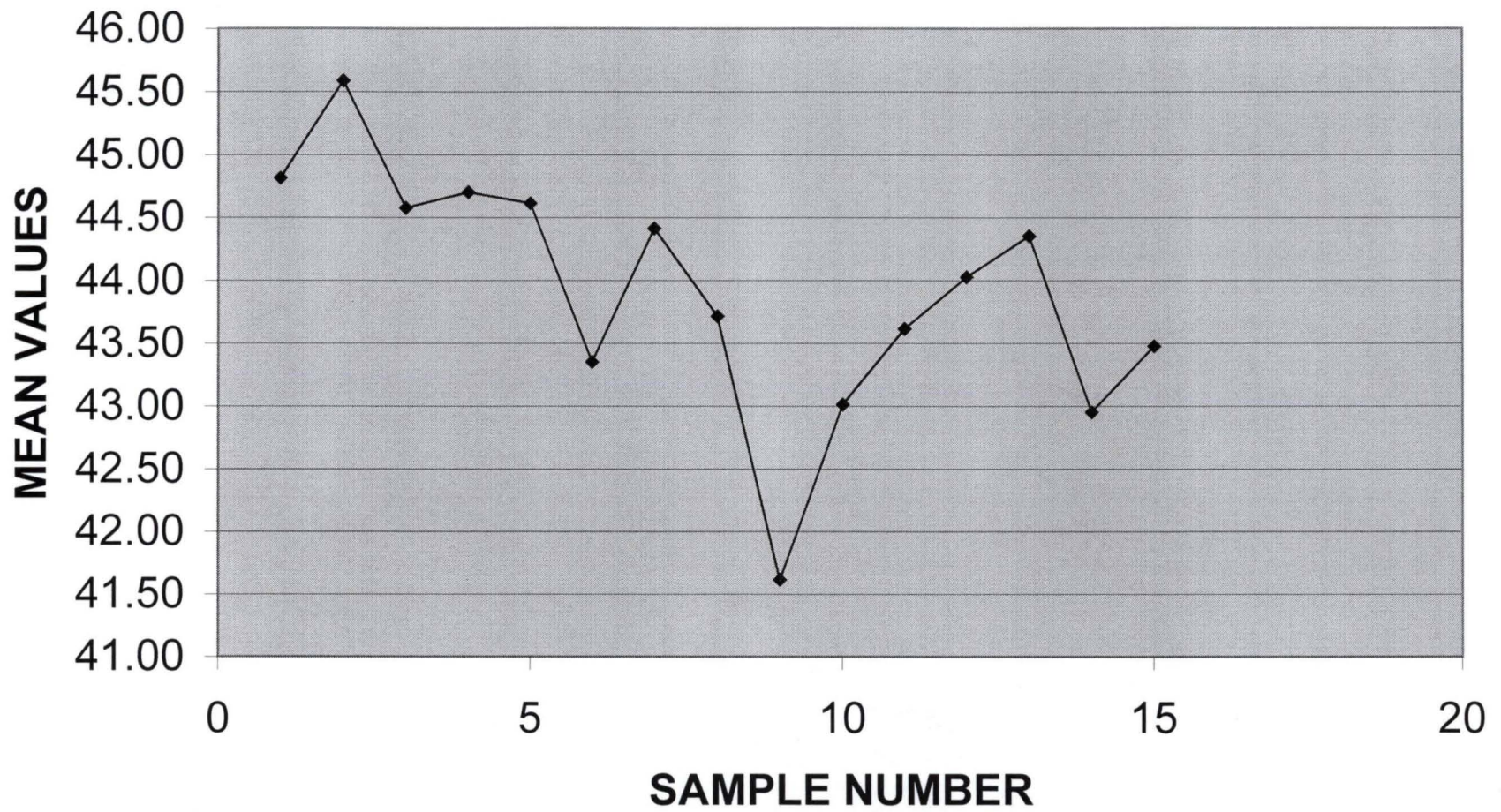
Chart plotting MEAN VALUES (y-axis, 41.00 to 46.00) against SAMPLE NUMBER (x-axis, 0 to 20). Legend: MEAN.

RANGE CHART FOR NST 37

40

40
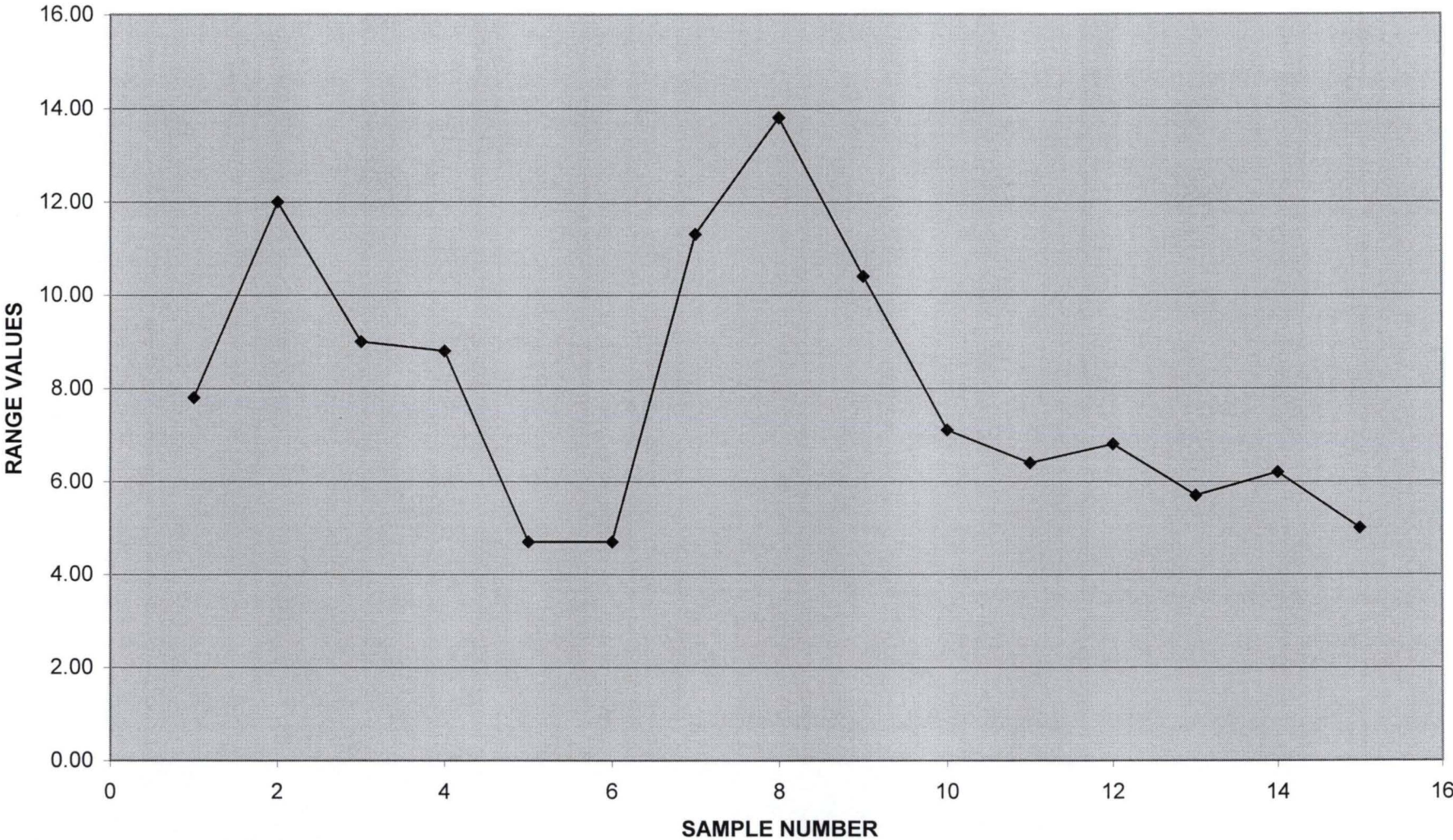
ANALYSIS FOR NST 34 STEEL

The available data collected for NST 34 Steel is of about one hundred and fifty samples (150), which has fifteen observations number as rows in ten (10) columns from the table 4.3 below and has the following characteristics:

X-CHART

$CL = X = 40.44$

$UCL = X + 3\sigma_x = 40.44 + 3(1.197664) = 44.03$

$LCL = X - 3\sigma_x = 40.44 - 3(1.197664) = 36.85$

R- CHART

$CL = R = 11.95$

$ULC = R + 3\sigma_R = 11.95 + 3(2.170868) = 18.46$

$LCL = R - 3\sigma_R = 11.95 - 3(2.170868) = 5.44$

DATA OF TENSILE STRENGHT (Kgf/mm) FOR NST 34 STEEL

SAMPLE NO	1	2	3	4	5	6	7	8	9	10	MEAN	RANGE
1	48.90	42.40	44.20	37.40	42.40	40.30	42.00	36.70	36.70	48.20	41.92	12.20
2	47.60	44.60	37.30	37.70	38.50	43.80	41.40	40.40	37.50	37.60	40.64	10.30
3	45.50	42.40	43.20	35.80	38.00	44.80	42.00	38.50	35.60	36.00	40.18	9.90
4	43.80	42.90	37.30	35.20	37.00	39.40	41.40	37.80	39.10	34.00	38.79	9.80
5	44.30	45.00	36.50	36.50	37.00	39.20	41.70	39.20	38.80	38.60	39.68	8.50
6	50.00	39.60	36.00	37.10	37.00	44.80	41.00	41.70	38.00	36.70	40.19	14.00
7	50.30	45.00	37.50	38.50	34.20	46.50	40.50	40.40	37.50	39.80	41.02	16.10
8	39.30	46.90	37.10	38.60	35.30	44.40	4.08	40.20	41.20	40.20	40.40	11.60
9	39.60	43.80	35.80	37.80	33.70	44.80	39.60	44.20	35.60	36.70	39.16	11.10
10	35.20	42.10	36.90	37.50	29.30	44.00	40.10	42.20	36.80	34.80	37.89	14.70
11	36.50	45.80	39.30	36.40	33.80	43.50	38.60	47.50	36.90	47.00	40.53	13.70
12	40.50	45.60	47.50	36.20	33.40	45.00	39.20	46.00	35.00	45.00	41.34	14.10
13	39.80	45.80	42.90	36.70	43.50	45.90	40.60	42.80	36.10	42.10	41.60	9.80
14	38.60	42.70	46.00	36.80	42.40	44.60	39.50	48.20	38.30	42.90	42.31	11.40
15	39.90	42.70	39.80	36.90	39.10	44.10	38.50	36.30	48.40	44.10	40.98	12.10
										X=	40.44	11.95
										S=	1.198	2.1709

42~42

MEAN CHART FOR NST 34
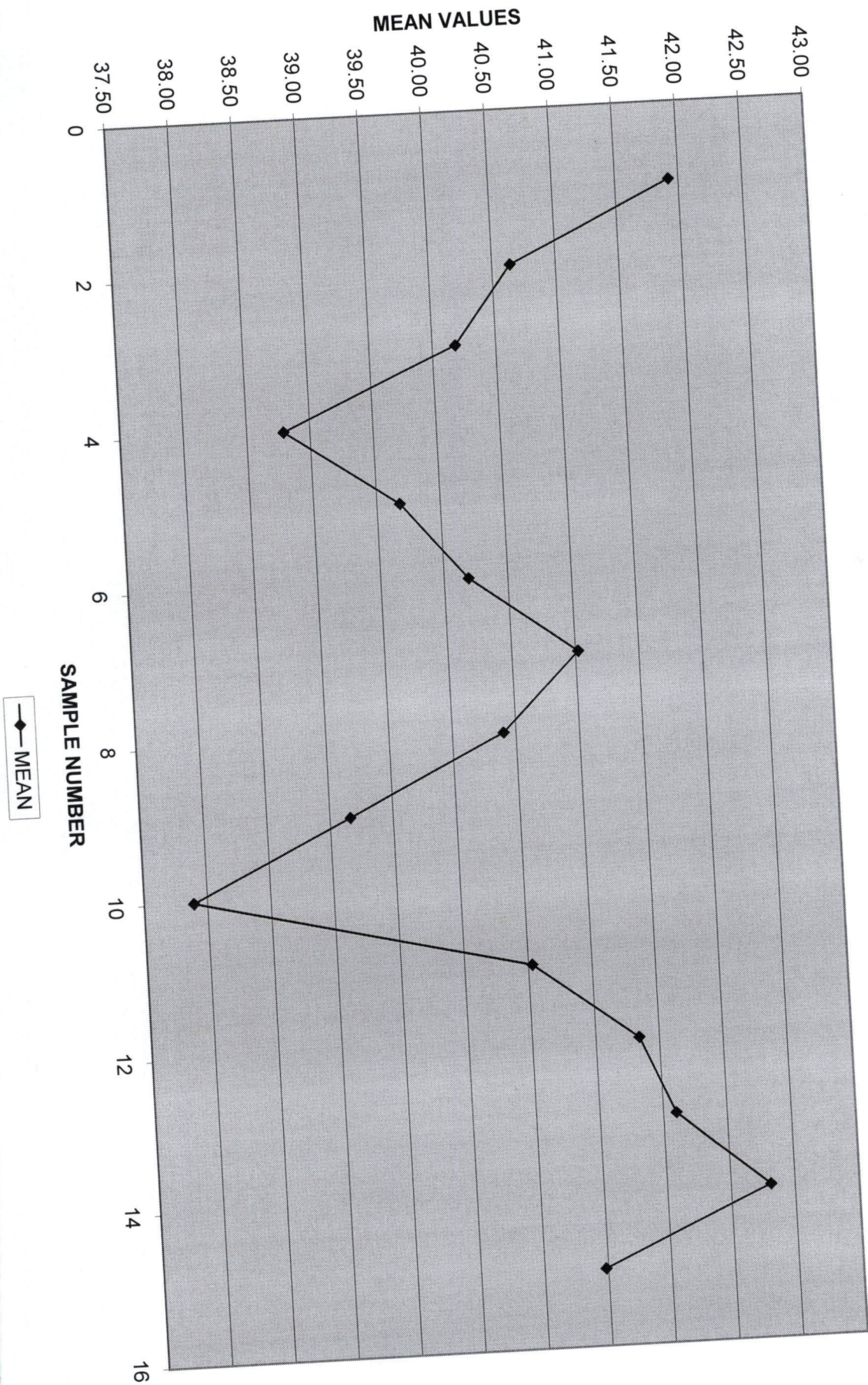
43 43

RANGE CHART FOR NST 34
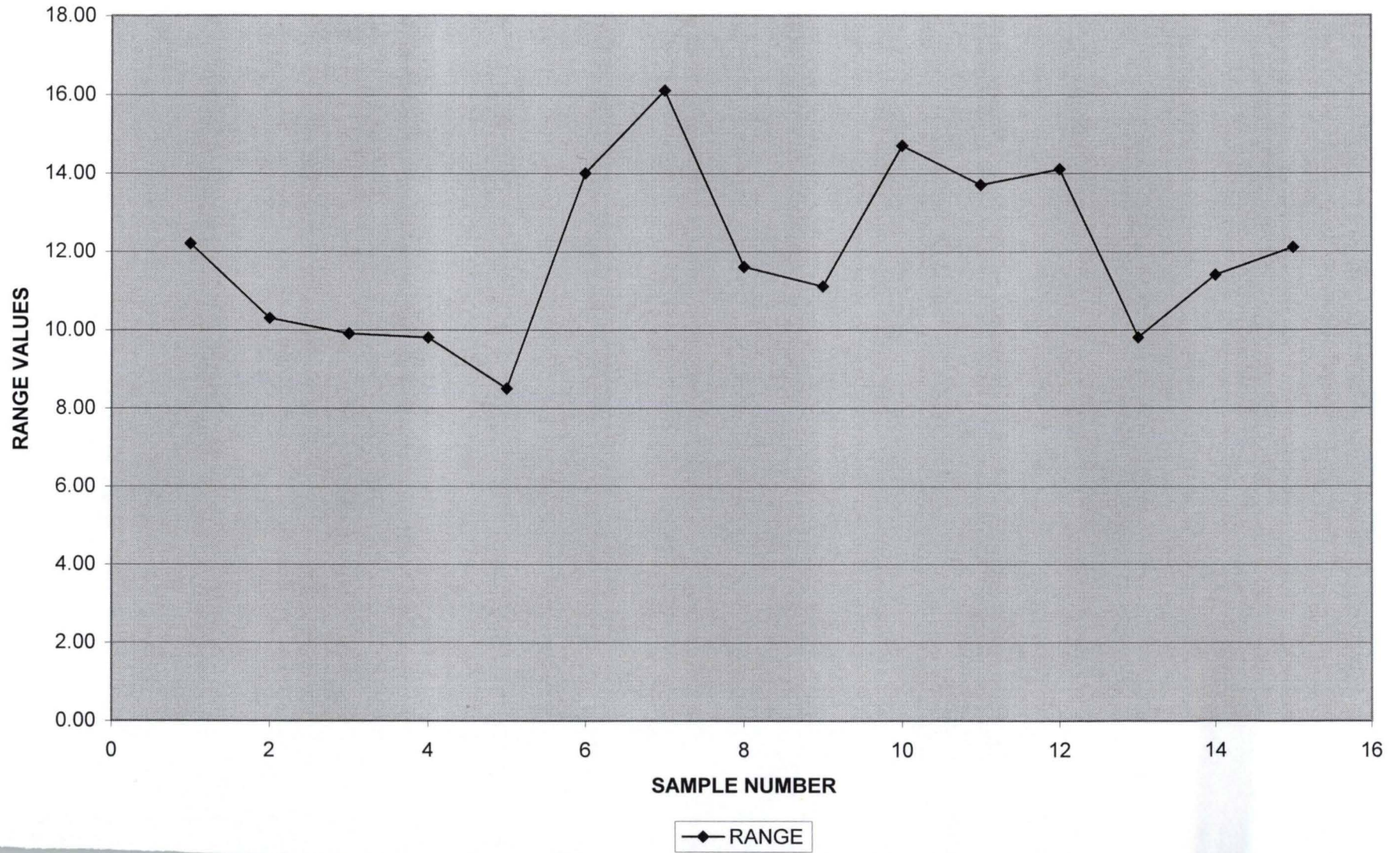
44 44

INTERPRETATION OF CONTROL CHARTS

Simply drawing up control chart is not very useful, they are not good for anything unless we examine them closely, read off information about the state of quality, process, work and search out and eliminate the courses of abnormalities matter.

Therefore, we must learn how to read central chart and practice for obtaining information from the movements of the points.

We must be able to tell at a glance what has happened to a process, what kinds of changes have occurred in the distribution and some of the assignable cause have arisen.

So, what can be considered from X-chart and R-chart of NST 60, Steel is that, we can see that eight (8) of the twenty five (25) points lie above the centre line, and eleven (11) points lie below the centre line while the remaining six points lie on the centre line in the X-chart (Fig 4.1). Therefore, those values all fall within the control limits and about 50% of the points are within control limit, so, we can conclude that the process in control and strength of this steel is within the specification. It is also shows that in the R-chart (fig 4.1) that points lie within the limits as that of the above X- chart, but in this case the range of the sample are in fully control process.

In our second analysis for NST 37 steel, we can observe from the X-chart (Fig 4.3) that seven (7) of the fifteen (15) point lie above the centre line, and also seven (7) points are lie below the centre line while the only one point lie on the centre line. Therefore, about 50% of the points lie below and the above the centre line. So, the process is normally distributed, and the process is in control, the strength of this steel is

within the specification. While the R-chart in (Fig 4.4) shows the range of the samples that eight (8) points lie below the centre line and six (6) points above, so this an indication that the production of this steel is in specification line.

While in the analysis of NST 34 steel, one can observe from the X-chart in (Fig 4.5) that six (6) points out of fifteen points lie above the centre line and four points lie below the line, while the remaining five points lie on the centre line limit, so the process is in good control system. Therefore, the distribution is in normal. While the R- chart in (Fig 4.6) shows that the range of samples are in good position because the points were distributed in balance position. It can be concluded that all the steels that have been analyzed so far are having the good strength and the production line, which is within specification.

CHAPTER FIVE

5.1   **RESULT AND DISCUSSION**

In Statistics, it is important not only to obtain the reliable result, but also to draw a correct inference from the result. The result obtained from X- chart and R- chart of the three different kinds of steel grades analyzed in the chapter four are as follows:

In the table 4.1 of NST 60 steel shows the mean calculated as 65.1 of X and the standard deviation of 6.69 and in the R- chart, the mean of range (R) is 19.51 with the standard deviation of 2.56 for the 250 samples of the steel.

Therefore, the X-chart (Fig 4.1) shows that the variation in averages of samples, where the points were distributed randomly at above and below the central line (CL), so half of the 25 points were below and other half were above, the process is regarded as being in the Control state. While in the R-chart (Fig 4.2) shows the range variation of the sample, where the points were dispersed randomly between the central line (CL), no other point that fall above or below the Upper control limit or Lower control limits, so the process is also in the control state and the production line is within the specification, but action should be taken for point 13 and 22 of the observation number in the R- chart, because point 13 is close to lower control limit which is the warning area and point 22 is also closer to Upper control limit which is also in the warning area.

In table 4.2 of NST 37 steel shows the calculated grand mean (X) as 43.92 and the standard deviation as 2.83 for 120 samples, so the X- chart (Fig 4.2) shows the variation in the average of samples, where 15 points are randomly distributed between the central line which indicated that really in the control state, but action should be taken for the first five consecutive points which lie on the same side of above central line. While in the R-

chart (Fig 4.4) shows the range variation of the samples, where points are dispersed randomly between the central line, which is resulting the process in the state of control, but action should be taken for the point 8 of the observation number, which is warning area, also the last six consecutive points which lie below the central line, should be checked properly, so that any assigniable cause can be avoided in the long run.

However, in table 4.3 of NST 34 steel shows the calculated grand mean (X) as 40.44 with the standard deviation of 4.03 and the calculated range mean (R) as 11.96 with standard deviation as 1.77 for the 150 samples of the steel.

Therefore, the X- chart (Fig 4.5) shows the variation in averages of samples, where the 15 points of the observations that is randomly distributed between the central line. So it indicated that the points lie below and above the central line which shows that the process is being in the controlled state. While the R-chart (Fig 4.6) shows the range variation of the samples, where the points were distributed randomly within the control line limits. So the process is also in the Control State, but action should be taken for point 5 and point 7 of the observation. It is because the fifth point is closer to the lower limit, which is warning area. Also point 7 is closer to the Upper control limit which is the warning area.

So, the results of the above analysis are obtained by the mean chart (X- chart) and R- chart, show that all the processes are in control state, but some actions are needed to be taken in all the three numbers of steel production, so that those points that are in the warning areas are to be checked to find out the assigniable cause, So that the sensitivity of the control charts are increase, in order to avoid any abnormality in the long run.

5.2   <u>**RECOMMENDATION**</u>

Really, the total quality control is a complete revolution in the style approach to the management. It means that top and middle management, engineers, administrations and all other employees, as well as affiliated companies, that work together as a team to understand the philosophy of statistical quality control, acquire a feeling for total quality control, put it into practice, and build upon effective management organization.

This will rationalize every working place and all type of work, as well as individual companies and industry as a whole. Export of products and Technology will increase raising the standard of living globally.

Eventually, I would like to re-emphasize the following points:

- Quality control should be promoted through the co-operation of all the employees of the company, working together to do what should be done. It is not just the job of the Quality control promotion office, the Quality control department, but is the responsibility for all people in the organization.

- The enthusiasm, and leadership of top management, especially the company's General manager, are indispensable for achieving this goal.

- Quality control should be practiced not simply because it is fashionable. It's purpose is to rationalize Industry, establish technology, and enable company to develop the ability to secure good profit and beat international competition through quality rather than through unfair trashing practices such as dumping.

- Quality control must be confirmed through out the life of a company.

- If quality control is practiced in earnest, the money spent on it can be recovered in a matter of months or days. However, if problems such as those described in the analysis are not rectify, in the long run the production of good production image will be terminated.

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APPENDIX I FOR NST 60 STEEL

SAMPLE NO	1	2	3	4	5	6	7	8	9	10
1	55.40	56.60	56.90	54.70	49.70	67.90	71.10	67.90	71.70	74.00
2	60.80	56.50	59.40	50.60	58.80	71.30	71.10	70.70	67.60	74.00
3	57.20	61.00	58.90	57.60	59.50	75.80	69.90	69.30	62.20	73.00
4	57.50	62.50	62.40	61.40	53.50	73.00	69.70	69.40	70.20	73.00
5	60.00	57.10	61.50	62.00	55.80	75.80	66.10	69.10	67.20	73.80
6	56.60	59.70	60.50	59.90	57.20	70.60	71.10	70.80	75.50	66.70
7	61.30	61.80	57.40	60.60	52.40	70.60	66.10	67.80	67.90	73.50
8	60.40	56.50	57.10	59.30	55.80	74.10	66.10	67.20	69.20	67.50
9	62.40	56.50	58.00	61.30	76.40	75.30	71.40	62.70	68.60	68.80
10	65.70	58.50	56.30	57.40	75.80	71.30	71.80	63.00	72.60	70.20
11	58.40	58.60	60.80	57.40	72.40	71.60	65.20	65.50	71.70	69.00
12	62.50	58.20	59.30	57.40	76.70	70.80	66.20	63.30	60.00	69.80
13	62.00	58.80	57.00	58.90	68.30	71.20	65.70	69.40	61.80	70.70
14	62.00	56.10	64.60	56.40	69.00	73.90	65.80	68.50	54.50	67.80
15	61.10	56.90	56.00	78.00	76.10	75.10	60.50	70.60	60.30	68.60
16	60.50	59.40	64.60	77.00	70.50	74.90	65.10	69.60	59.00	70.10
17	62.60	58.90	56.00	68.00	69.60	75.40	64.50	68.40	58.90	70.20
18	61.80	62.40	53.40	69.00	70.50	72.90	63.90	67.80	60.60	66.20
19	59.40	61.50	60.40	71.00	69.60	73.10	57.10	68.20	61.10	67.00
20	62.40	60.50	58.30	68.00	72.20	73.50	70.60	69.40	63.50	70.10
21	58.20	57.40	62.60	70.00	74.30	75.30	70.60	68.60	60.60	68.80
22	61.80	57.10	52.30	69.00	75.90	77.80	65.90	69.70	58.00	67.40
23	57.90	58.80	57.40	76.00	71.20	74.60	70.30	71.80	58.70	70.20
24	57.70	58.20	58.50	78.00	67.10	70.90	69.30	71.30	59.00	73.20
25	56.90	56.10	54.40	51.00	69.10	71.50	70.10	73.20	58.10	75.00

52
52

APPENDIX II FOR NST 37 STEEL

SAMPLE NO	1	2	3	4	5	6	7	8
1	50.00	42.20	43.50	44.30	44.90	45.40	45.90	42.30
2	53.60	41.60	44.60	46.80	44.30	48.10	43.10	42.60
3	48.80	41.50	44.30	46.80	39.80	48.70	43.30	43.40
4	48.80	45.50	44.30	44.60	40.00	46.20	43.80	44.40
5	43.00	45.60	44.40	43.80	43.90	47.70	44.10	44.40
6	42.90	42.80	42.50	41.30	41.50	44.80	46.00	45.00
7	48.60	42.40	39.00	45.40	50.30	43.20	41.90	44.50
8	50.30	40.20	39.30	40.10	52.80	45.80	42.20	39.00
9	39.30	40.10	38.90	41.30	44.20	49.10	41.30	38.70
10	41.40	41.20	39.90	44.40	47.00	43.80	43.40	43.00
11	43.20	43.50	41.20	45.30	47.60	44.60	42.00	41.50
12	42.40	40.40	42.20	47.10	46.10	45.20	47.20	41.60
13	45.30	41.70	44.00	47.40	42.40	45.40	43.50	45.10
14	44.60	44.00	44.20	38.40	42.90	44.50	41.50	43.50
15	41.40	45.10	44.30	41.70	45.10	45.70	40.70	43.80

APPENDIX III FOR NST 34 STEEL

SAMPLE NO	1	2	3	4	5	6	7	8	9	10
1	48.90	42.40	44.20	37.40	42.40	40.30	42.00	36.70	36.70	48.20
2	47.60	44.60	37.30	37.70	38.50	43.80	41.40	40.40	37.50	37.60
3	45.50	42.40	43.20	35.80	38.00	44.80	42.00	38.50	35.60	36.00
4	43.80	42.90	37.30	35.20	37.00	39.40	41.40	37.80	39.10	34.00
5	44.30	45.00	36.50	36.50	37.00	39.20	41.70	39.20	38.80	38.60
6	50.00	39.60	36.00	37.10	37.00	44.80	41.00	41.70	38.00	36.70
7	50.30	45.00	37.50	38.50	34.20	46.50	40.50	40.40	37.50	39.80
8	39.30	46.90	37.10	38.60	35.30	44.40	4.08	40.20	41.20	40.20
9	39.60	43.80	35.80	37.80	33.70	44.80	39.60	44.20	35.60	36.70
10	35.20	42.10	36.90	37.50	29.30	44.00	40.10	42.20	36.80	34.80
11	36.50	45.80	39.30	36.40	33.80	43.50	38.60	47.50	36.90	47.00
12	40.50	45.60	47.50	36.20	33.40	45.00	39.20	46.00	35.00	45.00
13	39.80	45.80	42.90	36.70	43.50	45.90	40.60	42.80	36.10	42.10
14	38.60	42.70	46.00	36.80	42.40	44.60	39.50	48.20	38.30	42.90
15	39.90	42.70	39.80	36.90	39.10	44.10	38.50	36.30	48.40	44.10

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```
******SHFUPDAT.PRG
******THIS PROGRAM ALLOWS USER TO ENQUIRE INTO THE...
******* INDUSTRIAL DATABASE USING THE SAME SCREEN THAT WAS
USED FOR THE ENTRY
******* AND MAKE AMENDMENTS TO ANY DESIRED RECORD...
SET TALK OFF
SET DELIMITER OFF

SELE 1
USE MAINFL
INDEX ON RECKEY TO MAINFL

SELE 2
USE STALG INDEX STALG

SELE 3
USE ACTIVITY INDEX ACTIVITY

SELE 4
USE TYPEOWN INDEX TYPEOWN

DEFINE WINDOW HWIN FROM 3,65 TO 22,78 COLOR W+/R,W+R,W+/R
DEFINE WINDOW DERROR FROM 10,15 TO 16,55 COLOR
W+/R,W+/R,W+/R
DEFINE WINDOW dmainwin FROM 3,5 TO 22,78 COLOR G+/W,G+/N,W+/R

SELE 1
activate wind DMAINWIN
DO WHILE .T.
SELE 1
STORE SPACE(9) TO MRECKEY
STORE SPACE(30) to mname,maddress,MMAJRAW
store 0 to mstate,mlga,mtypeown,misic,mnofw,mnomw
store 0 to mprodcap,mactout,moutval,moutsal,mturnover,minvestl,minvestf
store ctod(' / / ') to mdatestab,mrepdate
store ' ' to mreg
@0,32 say 'UPDATE SCREEN' COLOR W+/R
@3,3 SAY 'ESTAB. CODE [■■■■■■■■■]'
@5,3 SAY 'NAME [■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■]'
@7,3 SAY 'ADDRESS [■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■]'
@9,3 SAY 'STATE [■■]   LGA [■■■■]   DATE ESTABLISHED [■■/■■/■■]'
@10,3 SAY 'ISIC [■■■■] No. OF FEMALE STAFF [■■■■] No. OF MALE
STAFF [■■■■]'
@11,3 SAY 'PROD. CAPACITY [■■■■■■■■■■]    ACTUAL OUTPUT
[■■■■■■■■■■]'
@12,3 SAY 'OUTPUT VALUE [■■■■■■■■■■■■■■] SALES VALUE
[■■■■■■■■■■■■■■]'
@ 1 3 , 3  S A Y  ' M A J O R   R A W   M A T E R I A L S
```

```
[■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■]'
@14,3 SAY 'TURNOVER [■■■■■■■■■■■■■■]      TOTAL  LOCAL
INVESTMENT [■■■■■■■■■■■■■■■]'
@15,3 SAY 'TOTAL  FOREIGN  INVESTMENT [■■■■■■■■■■■■■■■]
OWNERSHIP [■]'
@16,3 SAY 'LAST REPORT DATE [■■/■■/■■]  REGISTERED ? [■]'

SET INTEN OFF
@3,16 GET MRECKEY COLO R+/N
READ
IF MRECKEY = SPACE(9)
  DEAC WIND DMAINWIN
  RETURN
ENDIF

SELE 1
SEEK MRECKEY
IF .NOT. FOUND()
  SAVE SCREEN TO TS
  @13,10 FILL TO 13,50 COLOR N/N
  @7,50 FILL TO 13,51 COLOR N/N
  ACTIVATE WIND DERROR
  @3,3 SAY 'CODE DOES NOT EXIST !...'+CHR(7)+CHR(7)
  BB=INKEY(0)
  DEAC WIND DERROR
  RESTORE SCREEN FROM TS
  LOOP
ENDIF

@5,9 SAY NAME COLO R+/N
@7,12 SAY ADDRESS COLOR R+/N
@9,10 SAY STATE COLOR R+/N
MSTATE = STATE
SELE 2
SEEK MSTATE


*******FOR LOCAL GOVERNMENTS
SELE 1
@9,23 SAY LGA COLO R+/N
MLGA = LGA
SELE 2
SEEK MLGA

SELE 1
@9,49 SAY DATESTAB COLO R+/N
@15,56 SAY TYPEOWN COLO R+/N
```

```
MTYPEOWN = TYPEOWN
SELE 4
SEEK MTYPEOWN
SELE 1
@10,9 SAY ISIC COLOR R+/N
MISIC = ISIC
SELE 3
SEEK MISIC
SELE 1
@10,37 SAY NOFW COLOR R+/N
@10,62 SAY NOMW COLOR r+/N
@11,19 SAY PRODCAP PICT '99,999,999' COLOR R+/N
@11,48 SAY ACTOUT PICT '99,999,999' COLOR R+/N
@12,17 SAY OUTVAL PICT '999,999,999.99' COLOR R+/N
@12,47 SAY OUTSAL PICT '999,999,999.99' COLOR R+/N
@13,24 SAY MAJRAW COLO R+/N
@16,21 SAY REPDATE COLOR R+/N
@14,13 SAY TURNOVER PICT '999,999,999.99' COLOR R+/N
@14,54 SAY TOTINVESTL PICT '999,999,999.99' COLOR R+/N
@15,29 SAY TOTINVESTF PICT '999,999,999.99' COLOR R+/N
@16,47 SAY IIF(REGISTERED=.T.,'Y','N') COLOR R+/N


B_B=-4
WHATHLP = 'BDC'
K = 0
***ON KEY LABEL F5 DO PICKHELP &&WITH SUBSTR(WHATHLP,1,K)

DO WHILE B_B=-4
   K = K + 1
   IF K > 3
     K = 1
   ENDIF
   B_B = INKEY(0)
    IF B_B = -4
      DO PICKHELP WITH SUBSTR(WHATHLP,K,1)
    ENDIF
ENDDO

************HERE, ATTEMPT IS MADE TO OVERWRITE THE EXISTING
DATA...
****EXCEPT THE USER PRESSES ENTER...
SELE 1
mname = NAME
Maddress =address
MState=state
Mlga=lga
Mdatestab =datestab
Mtypeown =typeown
```

```
      @7,50 FILL TO 13,51 COLOR N/N
      ACTIVATE WIND DERROR
      @3,3 SAY 'LGA NOT RECOGNIZED !...'+CHR(7)+CHR(7)
      BB=INKEY(0)
      DEAC WIND DERROR
      RESTORE SCREEN FROM TS
      LOOP
  ENDIF

  CLEAR TYPE
  @9,49 GET MDATESTAB COLO R+/N
  READ

  ON KEY LABEL F5 DO PICKHELP WITH "D"
  @15,56 GET MTYPEOWN PICT '9' COLO R+/N
  READ
  SELE 4
  SEEK MTYPEOWN
  IF .NOT. FOUND()
      SAVE SCREEN TO TS
      @5,9 SAY MNAME COLOR r+/w
      @13,10 FILL TO 13,50 COLOR N/N
      @7,50 FILL TO 13,51 COLOR N/N
      ACTIVATE WIND DERROR
      @3,3 SAY 'CODE NOT RECOGNIZED !...'+CHR(7)+CHR(7)
      BB=INKEY(0)
      DEAC WIND DERROR
      RESTORE SCREEN FROM TS
      LOOP
  ENDIF

  CLEAR TYPE
  ON KEY LABEL F5 DO PICKHELP WITH "C"
  @10,9 GET MISIC PICT '9999' COLOR R+/N
  READ
  SELE 3
  SEEK MISIC
  IF .NOT. FOUND()
      SAVE SCREEN TO TS
      @5,9 SAY MNAME COLOR r+/w
      @13,10 FILL TO 13,50 COLOR N/N
      @7,50 FILL TO 13,51 COLOR N/N
      ACTIVATE WIND DERROR
      @3,3 SAY 'CODE NOT RECOGNIZED !...'+CHR(7)+CHR(7)
      BB=INKEY(0)
      DEAC WIND DERROR
      RESTORE SCREEN FROM TS
      LOOP
```

```
      ENDIF
      CLEAR TYPE

      @10,37 GET MNOFW PICT '9999' COLOR R+/N
      @10,62 GET MNOMW PICT '9999' COLOR r+/N
      @11,19 GET MPRODCAP PICT '99,999,999' COLOR R+/N
      @11,48 GET MACTOUT PICT '99,999,999' COLOR R+/N
      @12,17 GET MOUTVAL PICT '999,999,999.99' COLOR R+/N
      @12,47 GET MOUTSAL PICT '999,999,999.99' COLOR R+/N
      read
      if moutsal > moutval
         SAVE SCREEN TO TS
         @5,9 SAY MNAME COLOR r+/w
         @13,10 FILL TO 13,50 COLOR N/N
         @7,50 FILL TO 13,51 COLOR N/N
         ACTIVATE WIND DERROR
         @3,1  SAY  'SALES  CANNOT  BE  MORE  THAN  OUTPUT
      !...'+CHR(7)+CHR(7)
         BB=INKEY(0)
         DEAC WIND DERROR
         RESTORE SCREEN FROM TS
         LOOP
      ENDIF

      @13,24 GET MMAJRAW COLO R+/N
      @16,21 GET MREPDATE COLOR R+/N
      @14,13 GET MTURNOVER PICT '999,999,999.99' COLOR R+/N
      @14,54 GET MINVESTL PICT '999,999,999.99' COLOR R+/N
      @15,29 GET MINVESTF PICT '999,999,999.99' COLOR R+/N
      @16,47 GET MREG PICT '!' VALID REQUIRED MREG$'YN' COLOR R+/N
      READ

      sele 1
      REPLA name with upper(mname)
      repla address with upper(maddress)
      repla state with mstate, lga with mlga, datestab with mdatestab
      repla typeown with mtypeown, isic with misic, nofw with mnofw
      repla nomw with mnomw, prodcap with mprodcap, actout with mactout
      repla outval with moutval, outsal with moutsal, majraw with upper(mmajraw)
      repla repdate with mrepdate, turnover with mturnover
      repla totinvestl with minvestl, totinvestf with minvestf
      repla registered with iif(mreg='Y',.t.,.f.)

      B_B = INKEY(0)

      *************************FINAL ENDDO
ENDDO
```

```
RETURN

PROCEDURE PICKhelp
para nosel
SELE &nosel
MMM = FIELD(1)
BROW  NOAPPEND  NOMENU  NOEDIT  NODELETE  FREEZE  &MMM
WINDOW HWIN
RETURN
```

```
********SHFINTRO.PRG
***** THIS PROGRAM DISPLAYS THE LICENCE PLATE OF THE PACKAGE
deac wind all
DEFINE WINDOW WINTRO FROM 5,10 TO 18,50 DOUBLE COLOR
w+/n,B+/n,RG+/G+
ACTIVATE WINDOW WINTRO
@0,13 SAY 'ABOUT ESTABOS' COLOR W+/R
@2,12 say 'ESTABOS (v1.0)' color rb+/n
@3,12 say '————————————————————' color rb+/n
@5,13 say 'Developed By'
@6,10 say 'E & S company, Abuja' color bg+*/n
@7,13 say 'Licensed to:'
@9,1 say 'Federal Ministry of Industries, Abuja'
set cursor off
wait ''
set cursor on
```

```
Misic  =isic
Mnofw  =nofw
Mnomw  =nomw
MProdcap=prodcap
Mactout  =actout
Moutval  =outval
Moutsal=outsal
MMajraw=majraw
Mrepdate  =repdate
Mturnover=turnover
Minvestl  = TOTINVESTL
Minvestf  = TOTINVESTF
mreg=IIF(REGISTERED=.t.,'Y','N')


@5,9 GET MNAME VALID REQUIRED MNAME<>SPACE(30) COLO R+/N
@7,12  GET  MADDRESS  VALID  REQUIRED  MADDRESS<>SPACE(30)
COLOR R+/N
READ


ON KEY LABEL F5 DO PICKhelp with "B"
@9,10 GET MSTATE PICT '99' VALID REQUIRED MSTATE  <>0 COLO
R+/N
READ
SELE 2
SEEK MSTATE
IF .NOT. FOUND()
   SAVE SCREEN TO TS
   @5,9 SAY MNAME COLOR r+/w
   @13,10 FILL TO 13,50 COLOR N/N
   @7,50 FILL TO 13,51 COLOR N/N
   ACTIVATE WIND DERROR
   @3,3 SAY 'STATE NOT RECOGNIZED !...'+CHR(7)+CHR(7)
   BB=INKEY(0)
   DEAC WIND DERROR
   RESTORE SCREEN FROM TS
   LOOP
ENDIF


*******FOR LOCAL GOVERNMENTS
ON KEY LABEL F5 DO PICKhelp with "B"
@9,23 GET MLGA PICT '9999' VALID REQUIRED MLGA  <>0 COLO R+/N
READ
SELE 2
SEEK MLGA
IF .NOT. FOUND()
   SAVE SCREEN TO TS
   @5,9 SAY MNAME COLOR r+/w
   @13,10 FILL TO 13,50 COLOR N/N
```

SUPER · PRG

START

INPUT SUPERVISOR OPTION

IF OPTION = GRANT ACCESS — YES → SPECIFY USER ACCESS LEVELS

NO

IF OPTION = DELETE USER — YES → INPUT USER CODE → DELETE USER

NO

IF OPTION = AMMEND RIGHTS — YES → MODIFY RIGHTS

NO

STOP

START

DISPLAY
MENU
OPTIONS

MENU

IF
OPTION =
'ADD' — YES → ADD

NO

IF
OPTION =
'ENQUIRY' — YES → ENQ

NO

IF
OPTION =
'REPORTS' — YES → REPORTS

NO

IF
OPTION =
'MAINTENANCE' — YES → MAINT

NO

IF
OPTION =
'HELP' — YES → HELP

NO

IF
OPTION =
'DELE' — YES → DEL

NO

STOP

SHFADD.PRG

```
                    ADD

                     │
                     ▼
         ┌─────────────────────┐
        ╱   DISPLAY            ╱
       ╱    FIELDS            ╱
      └─────────────────────┘
                     │
                     ▼
         ┌─────────────────────┐
        ╱  INPUT  RECORD      ╱
       ╱   KEY               ╱
      └─────────────────────┘
                     │
                     ▼
                  ◇ IF
                 RECORD      ──YES──►  ┌──────────────┐
                  EXIST                ╱  FLASH       ╱
                  ◇                   ╱   ERROR      ╱
                     │                └──────────────┘
                    NO
                     ▼
         ┌─────────────────────┐
        ╱  ACCEPT             ╱
       ╱   OTHER             ╱
      ╱    FIELDS           ╱
      └─────────────────────┘
                     │
                     ▼
                   MENU
```

PROCEDURE SHFHELP

HELP

IF HELP TYPE = 1 — YES → BROWSE HELP TEXT

NO

DISPLAY LICENCE-PLATE

MENU

SHFENQ.PRG

ENQ

ACCEPT RECORD KEY

IF FOUND() —NO→ FLASH ERROR

YES

DISPLAY INFORMATION

ANY MORE ? —YES→

NO

MENU

SHFDELE.PRG


```
DEL
   │
   ▼
ACCEPT
RECORD KEY
   │
   ▼
IF FOUND()  ──NO──▶  FLASH ERROR
   │
  YES
   │
   ▼
DELETE RECORD?  ──NO──▶  ANY MORE?  ──YES──▶
   │                         │
  YES                        NO
   │                         │
   ▼                         ▼
DELETE RECORD
   │
   ▼
MENU
```

SHFMNT.PRG

MAINT

IF OPTION=CHANGE PASSWORD

YES → INPUT NEW PASSWORD → REPLACE OLD PASSWORD WITH NEW PASSWORD

NO

IF OPTION=FILE MAINT.

YES → BROWSE CODE FILES

NO

MENU

PROCEDURE REPPWRTN

```
         ┌──────────────┐
         │   REPORTS    │
         └──────┬───────┘
                ▼                                         ◄──────────────┐
        ┌───────────────┐                                                │
        │  DISPLAY      │                                                │
        │  REPORT       │                                                │
        │  OPTIONS      │                                                │
        └───────┬───────┘                                                │
        ┌───────────────┐                                                │
        │   SELECT      │                                                │
        │   REPORT      │                                                │
        │   OPTIONS     │                                                │
        └───────┬───────┘                                                │
                ▼                                                        │
             ◇ IF                                                        │
          OPTION=    ─── YES ──────►  ┌──────────┐ ──────────────────►   │
             1                        │  PRINT   │                       │
             │ NO                     └──────────┘                       │
             ▼                                                           │
             ◇ IF                                                        │
           OPT:=     ─── YES ──────►  ┌──────────┐ ──────────────────►   │
             2                        │  PRINT   │                       │
             │ NO                     └──────────┘                       │
             ▼                                                           │
             ◇ IF                                                        │
           OPT=      ─── YES ──────►  ┌──────────┐ ──────────────────►   │
             3                        │  PRINT   │                       │
             │ NO                     └──────────┘                       │
             ▼                                                           │
             ◇ IF                                                        │
           OPT=      ─── YES ──────►  ┌──────────┐ ──────────────────►   │
             4                        │  PRINT   │                       │
             │ NO                     └──────────┘                       │
             ▼                                                           │
             ◇ IF                                                        │
           OPT=      ─── YES ──────►  ┌──────────┐ ──────────────────►───┘
             5                        │  PRINT   │
             │ NO                     └──────────┘
             ▼
         ┌──────────────┐
         │    MENU      │
         └──────────────┘
```