A Project report on

ANALYSIS OF NCR LOG BY PARETO CHART

By

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C E R T I F I C A T E

This is to certify that Mr. Sumedh Jaikant Prabhune, has successfully completed the Dissertation entitled "Analysis of NCR Log by Pareto Chart" under my supervision, in the partial fulfilment of Bachelor of Engineering – Mechanical Sandwich Engineering of Savitribai Phule Pune University.

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This is to certify that **SUMEDH J. PRABHUNE** of Indira college of Engineering and Management, Pune has completed his Industrial In-Plant Training in our organization under the guidance of Mr. Soham Shah (Former QA Engineer) & Mr. Amar Shitole (General Manager)

The Industrial project completed on the topic **"ANALYSIS OF NCR LOG BY PARETO CHART"** between the duration of **15th-JUNE-2020 to 15th-DECEMBER-2020.**

He has been sincere & hardworking in all his efforts. We wish him the very best in all his future endeavors.

Thanking you,

FOR, ASK ENGINEERS

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DECLARATION

I declare that this written submission represents my ideas in my own words and where other ideas and words have been included; I have adequately cited and referenced the original sources. I also declare that I have adhered to all academic principles honestly and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be caused for disciplinary action by the institute/industry and also can evoke penal action from the sources which have thus been properly cited or from whom proper permission has not been taken when needed.

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ABSTRACT

Pareto Analysis is a statistical technique in decision-making used for the selection of a limited number of tasks that produce significant overall effect. It uses the Pareto Principle (also known as the 80/20 rule) the idea that by doing 20% of the work you can generate 80% of the benefit of doing the entire job. This tool helped us to analyze the existing data from the non-conformance log , by categorizing the defects in the products which were cause of the non-conformances occurrences we have taken the count of each category out of which is most impacting , same has been prioritized prime to be worked on as early as possible whereas the other are dealt with same approach to reduce the non-conformance from either the customer end or the internal end. This chart helped us gaining knowledge graphically with better understanding of the problems.

1. INTRODUCTION

Nowadays in industrial sector the competition is rising second by second. The focus of every competitor is to provide better quality product or service to the vendors/customers without any delay in the delivery time. When it comes to the important factor consideration is “quality” which has become one of the utmost important aspect of every MNC industry which is being adapted by the small scale as well as medium scale industries. If the quality is not maintained properly for a product it may result into the financial as well as the reputational loss. To maintaining such, we use the basic quality tools for analysis of the problems in the process. Here in this project we have used one of the basic quality tools known as the “Pareto Chart”, This tool helped us to analyze the existing data from the non-conformance log , by categorizing the defects in the products which were cause of the non-conformances occurrences we have taken the count of each category out of which is most impacting , same has been prioritized prime to be worked on as early as possible whereas the other are dealt with same approach to reduce the non-conformance from either the customer end or the internal end. This chart helped us gaining knowledge graphically with better understanding of the problems. In the late 1940s Romanian-born American engineer Joseph M. Juran suggested the principle and named it after Italian economist Vilfredo Pareto.

1.1. WHAT IS PARETO CHART?

A Pareto chart is a bar graph. The lengths of the bars represent frequency or cost (time or money) and are arranged with longest bars on the left and the shortest to the right. In this way the chart visually depicts which situations are more significant. This cause analysis tool is considered one of the seven basic quality tools. (ASQ, 2019-2020)

1.2. WHEN DO WE USE THIS CHART?

- When analysing data about the frequency of problems or causes in a process.
- When there are many problems or causes and you want to focus on the most significant.
- When analysing broad causes by looking at their specific components.
- When communicating with others about your data.

We can apply the 80/20 rule to almost anything, however the following is stated most of the time: -

- 80% of customer complaints arise from 20% of your products and services.
- 80% of delays in the schedule result from 20% of the possible causes of the delays.
- 20% of your products and services account for 80% of your profit.
- 20% of your sales force produces 80% of your company revenues.
- 20% of a systems defects cause 80% of its problems.

Pareto analysis is a ranked comparison of factors related to a quality problem and is a statistical decision-making technique used for the selection of a limited number of tasks that produce a significant overall effect. It helps to identify and focus on the vital few factors.

Pareto diagrams and tables are presentation techniques used to show the facts and separate the vital few from the useful many. They are widely used to help project teams and steering committees make key decisions at various points in the “Root Cause Corrective Action” sequence.

1.3. PARETO DIAGRAM – BASIC ELEMENTS

A Pareto diagram displays the relative impact each contributing factor has on the overall problem. It ranks the sources from largest to smallest and shows the total cumulative impact for the two largest, three largest, etc.

Essentially, the Pareto Principle states that sources of a problem can be divided into two categories:

- The vital few: A small number of sources that account for most of the problem.
- The useful many: The large number of remaining sources that individually and collectively account for a relatively small part of the entire problem.

The Awkward zone is when there is not a clear breakpoint between the vital few and useful many.

When diagnosing the cause, it makes sense to look for the vital few and not to become distracted by the useful many. A Pareto diagram is helpful at this point. By ranking the impact of several factors on a given effect, it reveals the most significant sources of a quality problem. These sources should be investigated further.

Regardless of the form chosen, well-constructed Pareto diagrams and tables include three basic elements:

- The contributors to the total effect, ranked by the magnitude of their contribution
- The magnitude of the contribution of each expressed numerically
- The cumulative-percent-of-total effect of the ranked contributors

If you have already studied Stratification, you will notice that a Pareto diagram presents the results of stratifying a problem by one variable. The contributors to the effect are the categories for that stratification variable.

1.4. PROBLEM STATEMENT

During lean project implementation period the daily non-conformance were adding up on the daily basis. Root causes were common for non-conformances such as oversize / undersize dimension, burr, dent & damage, coating peel off, deep gas cut patches on material, tapping/drilling issues, radius / chamfer on the step. Analyzing all type of problems individually was time consuming. To analyze the non-conformances in least time & dealing with the problem at same time by taking proper measure was required to carry out.

1.5. OBJECTIVES

A Pareto chart has the following objectives:

- Separate the few major problems from the many possible problems so you can focus your improvement efforts.
- Arrange data according to priority or importance.
- Determine which problems are most important using data, not perceptions.
- Additionally, optimize time required for carrying out activity.

1.6. SCOPE

As far as we know according to Indian industry some of the industries are trying to get the attention of foreign customers to grow their own industry by reputation as well as providing the authentic quality service. So, implementing this project for new coming start-ups as well as small scale industry may benefit them as time investing in this work will be quite less. Also, anyone familiar with using computer can easily understand and implement same as well as develop new strategies to tackle the problem at their origin point rather than after the occurrence.

1.7. METHODOLOGY

Methodology is a collection of methods, practices, processes, techniques, procedures, and rules. In project management, methodologies are specific, strict, and usually contain a series of steps and activities for each phase of the project's life cycle. They are defined approaches that show us exactly what steps to take next, the motivation behind each step, and how a project stage should be performed. It is as follows: -

1. Decided to group various defects in selective category.
2. Then used the appropriate measurements. Common measurements were frequency, quantity, cost and time.
3. Periodic Data to be covered for NCR was decided for the analysis.
4. Collected some updated data along with existing data and categorization was done.
5. Subtotalled the measurements for each category.
6. Determined the appropriate scale for the measurements we have collected. The maximum value was the largest subtotal from step 5. Marked the scale on the left side of the chart.
7. Constructed and labelled bars for each category. Placed the tallest at the far left, then the next tallest to its right, and so on. As there were many categories with small measurements, they were grouped as "other."
8. Calculated the percentage for each category: the subtotal for that category divided by the total for all categories. Drew a right vertical axis and labelled it with percentages. Made sure that two scales matched. For example, the left measurement that corresponds to one-half should be exactly opposite 50% on the right scale.
9. Calculated and drew cumulative sums: added the subtotals for the first and second categories and placed a dot above the second bar indicating that sum. To that sum added the subtotal for the third category and placed a dot above the third bar for that new sum. Continued the process for all the bars. Connected the

dots, starting at the top of the first bar, the last dot reaching 100% on the right scale.

2. LITRETURE REVIEW

A Pareto chart is a type of chart that contains both bars and a line graph, where individual values are represented in descending order by bars, and the cumulative total is represented by the line. The chart is named for the Pareto principle, which, in turn, derives its name from Vilfredo Pareto, a noted Italian economist. The left vertical axis is the frequency of occurrence, but it can alternatively represent cost or another important unit of measure. The right vertical axis is the cumulative percentage of the total number of occurrences, total cost, or total of the unit of measure. Because the values are in decreasing order, the cumulative function is a concave function. To take the example below, in order to lower the amount of late arrivals by 78%, it is sufficient to solve the first three issues. The purpose of the Pareto chart is to highlight the most important among a (typically large) set of factors.

In quality control, it often represents the most common sources of defects, the highest occurring type of defect, or the most frequent reasons for customer complaints, and so on. Wilkinson (2006) devised an algorithm for producing statistically based acceptance limits (like confidence intervals) for each bar in the Pareto chart. These charts can be generated by simple spreadsheet programs, specialized statistical software tools, and online quality charts generators. The Pareto chart is one of the seven basic tools of quality control. (Wikipedia, 2020)

2.1 HISTORY OF PARETO METHOD.

In 1906, Italian economist Vilfredo Pareto discovered that 80% of the land in Italy was owned by just 20% of the people in the country. He extended this research and found out that the disproportionate wealth distribution was also the same across all of Europe. The

80/20 rule was formally defined as the rule that the top 20% of a country's population accounts for an estimated 80% of the country's wealth or total income.

Joseph Juran, a Romanian American business theorist, stumbled on Pareto's research work 40 years after it was published, and named the 80/20 rule Pareto's Principle of Unequal Distribution. Juran extended Pareto's Principle in business situations to understand whether the rule could be applied to problems faced by businesses. He observed that in quality control departments, most production defects resulted from a small percentage of the causes of all defects, a phenomenon which he described as "the vital few and the trivial many."

Following the work of Pareto and Juran, the British NHS Institute for Innovation and Improvement provided that 80% of innovations come from 20% of the staff; 80% of the decisions made in meetings come from 20% of the meeting time; 80% of your success comes from 20% of your efforts; and 80% of complaints you make are from 20% of your services.

Today, Pareto Analysis is employed by business managers in all industries to determine which issues cause the most problems within their departments, organizations, or sectors. A good approach typically involves conducting a statistical technique, such as a cause and effect analysis, to produce a list of potential problems and the outcomes of these problems. Following the information provided from the cause and effect analysis, the 80/20 analysis can be applied.

Quality is essentially about learning what you are doing well and then doing it better. It also means finding out what you may need to change to make sure you meet the needs of your service users. Quality is about knowing what you want to do and how you want to do it, learning from what you do, using what you learn to develop your organization and its services, seeking to achieve continuous improvement and about satisfying your stakeholders (those different people and groups with an interest in your organization). The meaning of quality differs depending upon circumstances and perceptions. For example,

quality is a different concept when focusing on tangible products versus the perception of a quality service. The meaning of quality is also time-based or situational.

2.2 WHAT 'QUALITY' GENERALLY MEANS?

1- Quality is fitness for use: Quality means the product or service does what it is intended to do. Poor quality of a product or service costs users if it does not do what is expected out of it.

2- Quality is meeting customer expectations: Quality is satisfying the customer. The customer defines quality. The customer perceives the quality of a product or service.

3- Quality is exceeding the customer expectations: Quality is the extent to which the customers or users believe the product or service surpasses their needs and expectations. Quality is delighting the customer.

4- Quality is superiority to competitors: Quality is how a company's products and services compare to those of competitors or how they compare to those offered by the company in the past.

Some quality characteristics can be enumerated as for service: Responsiveness, credibility, availability, reliability, safety, security, competence, understanding of customer, accuracy, completeness, timeliness and communication. Quality management is an organization-wide approach to understanding precisely what customers need and

consistently delivering accurate solutions within budget, on time and with the minimum loss to society.

The results of a Pareto analysis are typically represented through a Pareto chart. The chart represents the various factors under consideration in ranked order. The presentation of this chart is in the form of a bar graph in descending order and helps to predict easily which factors are vital few by providing a clear indicator through superimposing a line graph that cuts an 80 percent cumulative percentage and also helps in determining those factors which have least amount of benefits and vice-versa.

Joseph Juran extended this concept and found it to be applicable in a broad array of aspects in everyday life (Cervone, 2009). For example it can be applied in a number of contents such as searching for books on-line in digital library catalog, determining which tasks in a project will have the most impact, assessing major causes of customer complaints from products or services, identifying those products or services that account 80 percent of the profit and many more.

3. ANALYTICAL WORK

For the analytical part we required the following pre-requisite: -

1. Non-Conformance Data. (old data along with the updated log)

After working on data, it was sorted out, & categorization was done. To avoid the unnecessary time wasted on the industry data as some NCR logs were not complete, we have filtered out the only Non-conformance reports which were suitable to be worked on. According to industry Non-Conformance log, The data consisted of around 803 NC cases which included numerous reasons such as Material reject, Dimension oversize, Dimension undersize, Return & Rework, Material defect, Tool issue, Material crack, Outer Diameter and Radius on step, Less material length, Less material stock.

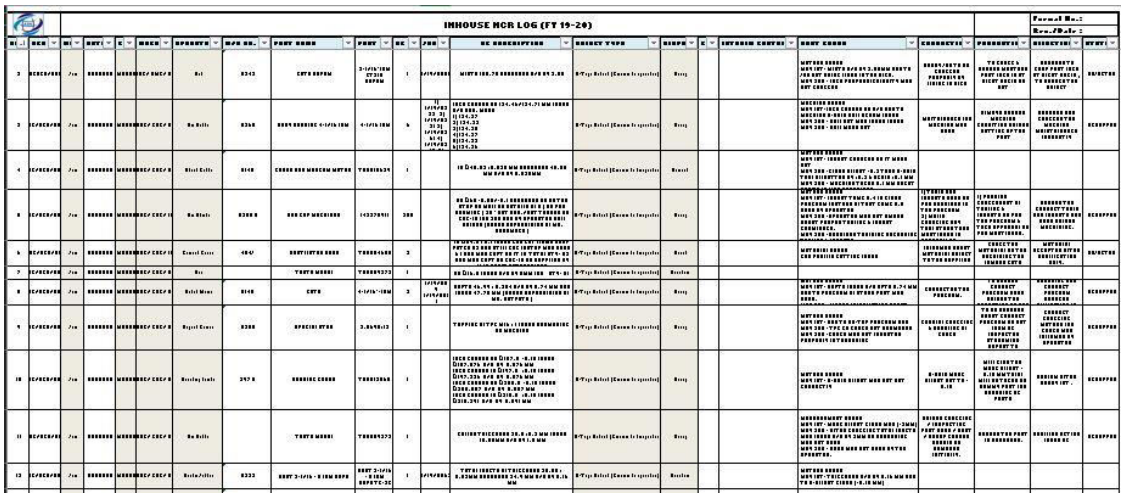


FIGURE 3.1.1: - OVERVIEW OF NON-CONFORMANCE LOG

As we can see the log data is wide to fit in single screenshot so we have took more screen shot as in for the close in to get the brief idea about how the company Non-Conformance log looks like.

Calculation part has been in the written form which is as shown below

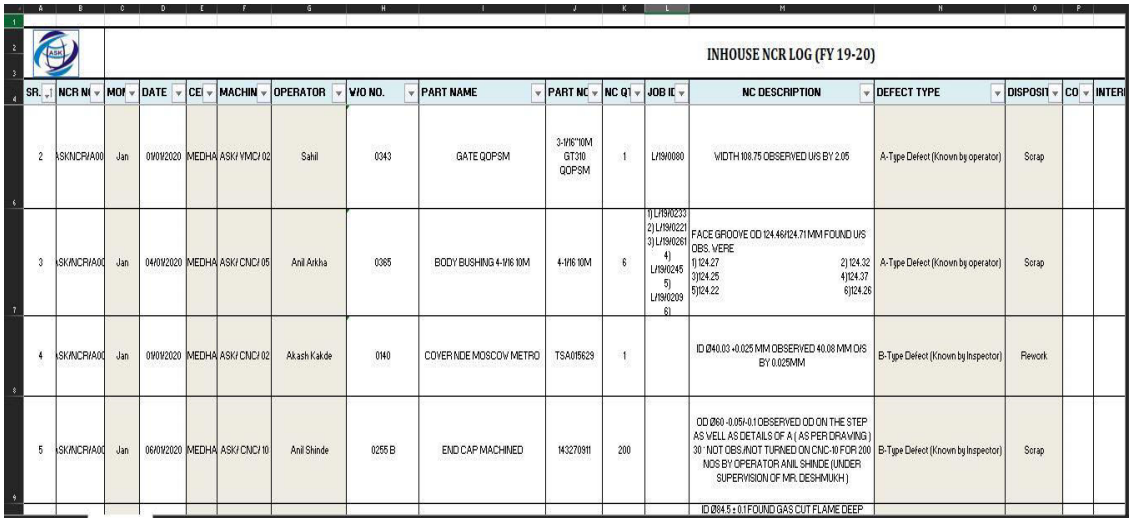
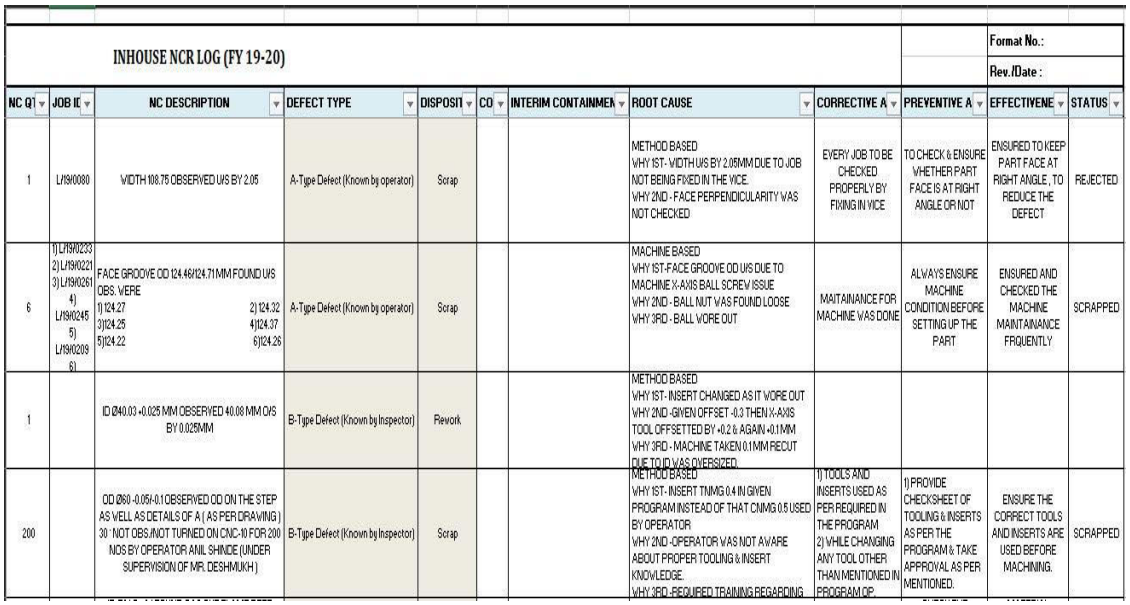


FIGURE 3.1.2: - NCR LOG CLOSE-IN VIEW-I



INHOUSE NCR LOG (FY 19-20)

Format No.:
Rev./Date :

NC QT	JOB ID	NC DESCRIPTION	DEFECT TYPE	DISPOSIT	CO	INTERIM CONTAINMEN	ROOT CAUSE	CORRECTIVE A	PREVENTIVE A	EFFECTIVENE	STATUS
1	L/19/0080	WIDTH 108.75 OBSERVED U/S BY 2.05	A-Type Defect (Known by operator)	Scrap			METHOD BASED WHY 1ST- WIDTH U/S BY 2.05MM DUE TO JOB NOT BEING FIXED IN THE VICE. WHY 2ND - FACE PERPENDICULARITY WAS NOT CHECKED	EVERY JOB TO BE CHECKED PROPERLY BY FIXING IN VICE	TO CHECK & ENSURE WHETHER PART FACE IS AT RIGHT ANGLE OR NOT	ENSURED TO KEEP PART FACE AT RIGHT ANGLE , TO REDUCE THE DEFECT	REJECTED
6	1) L/19/0233 2) L/19/0221 3) L/19/0261 4) L/19/0245 5) L/19/0209 6)	FACE GROOVE OD 124.46/124.71MM FOUND U/S OBS. WERE 1) 124.27 2) 124.32 3)124.25 4)124.37 5)124.22 6)124.26	A-Type Defect (Known by operator)	Scrap			MACHINE BASED WHY 1ST-FACE GROOVE OD U/S DUE TO MACHINE X-AXIS BALL SCREW ISSUE WHY 2ND - BALL NUT WAS FOUND LOOSE WHY 3RD - BALL WORE OUT	MAITAINANCE FOR MACHINE WAS DONE	ALWAYS ENSURE MACHINE CONDITION BEFORE SETTING UP THE PART	ENSURED AND CHECKED THE MACHINE MAINTAINANCE FRQUENTLY	SCRAPPED
1		ID Ø40.03 +0.025 MM OBSERVED 40.08 MM O/S BY 0.025MM	B-Type Defect (Known by Inspector)	Rework			METHOD BASED WHY 1ST- INSERT CHANGED AS IT WORE OUT WHY 2ND -GIVEN OFFSET -0.3 THEN X-AXIS TOOL OFFSETTED BY +0.2 & AGAIN +0.1 MM WHY 3RD - MACHINE TAKEN 0.1 MM RECUT DUE TO ID WAS OVERSIZED.				
200		OD Ø60 -0.05/-0.1 OBSERVED OD ON THE STEP AS WELL AS DETAILS OF A (AS PER DRAWING) 30 : NOT OBS./NOT TURNED ON CNC-10 FOR 200 NOS BY OPERATOR ANIL SHINDE (UNDER SUPERVISION OF MR. DESHMUKH)	B-Type Defect (Known by Inspector)	Scrap			METHOD BASED WHY 1ST- INSERT TNMG 0.4 IN GIVEN PROGRAM INSTEAD OF THAT CNMG 0.5 USED BY OPERATOR WHY 2ND -OPERATOR WAS NOT AWARE ABOUT PROPER TOOLING & INSERT KNOWLEDGE. WHY 3RD -REQUIRED TRAINING REGARDING	1) TOOLS AND INSERTS USED AS PER REQUIRED IN THE PROGRAM 2) WHILE CHANGING ANY TOOL OTHER THAN MENTIONED IN PROGRAM OP.	1) PROVIDE CHECKSHEET OF TOOLING & INSERTS AS PER THE PROGRAM & TAKE APPROVAL AS PER MENTIONED.	ENSURE THE CORRECT TOOLS AND INSERTS ARE USED BEFORE MACHINING.	SCRAPPED

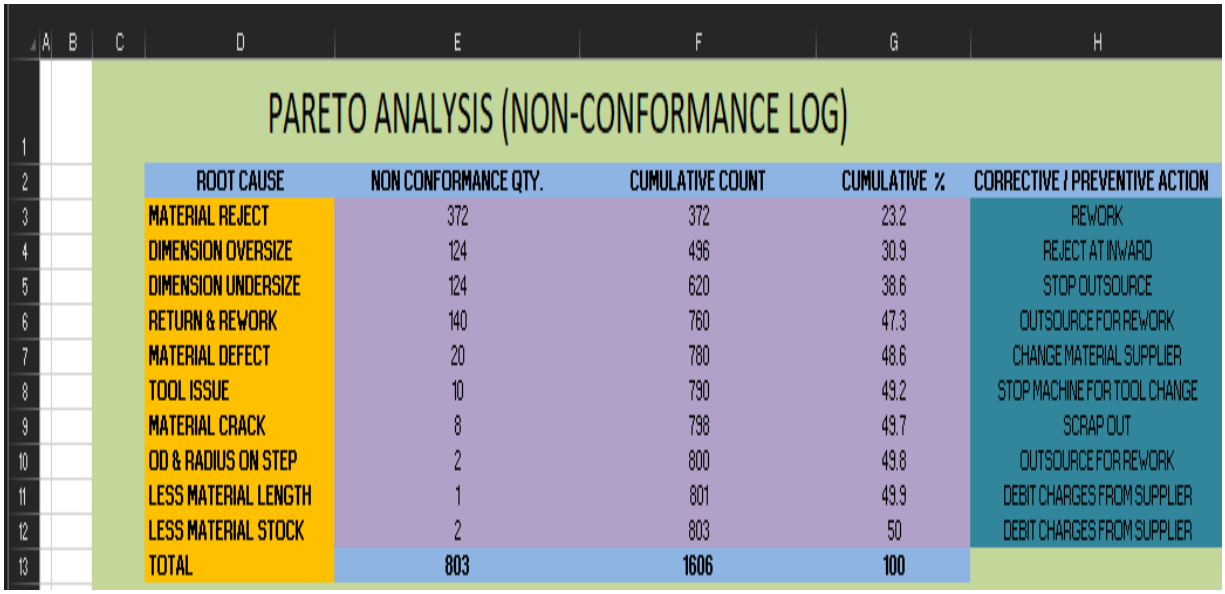
FIGURE 3.1.3: - NCR LOG CLOSE-IN VIEW-II

3.1.WORKING (EXCEL METHOD): –

1. WE USED ROOT CAUSE AS MAIN PARAMETERS. USING FILTER, WE HAVE MEASURED INDIVIDUAL NCR QUANTITY FOR ROOT CAUSE.
2. REFERRING TO FIGURE 3.1.1. NON-CONFORMANCE QTY TOTAL HAS BEEN DONE WITH "=SUM" FUNCTION.
3. FOR CALCULATING CUMULATIVE COUNT WE USED THE BASIC FORMULA $F_4=(E_4+F_3)$, $F_5=(E_5+F_4)$ AND SO ON TILL F_{12} EXCEPT FOR THE F_3 AS $F_3 = E_3$.
4. FOR CALCULATING CUMULATIVE PERCENTAGE WE USED THE FORMULA G_3=(F3/$F$13) *100, G_4=(F4/$F$13) *100, & SO ON TILL G_{12}.
5. FOR CORRECTIVE/ PREVENTIVE ACTION FORMATTING WE HAVE USED "IF" FORMULA.

6. WE LINKED THE SAME CONDITION TO THE ROOT CAUSE WITH THE HELP OF “VLOOKUP” FORMULA.

3.2.CALCULATIONS: -



PARETO ANALYSIS (NON-CONFORMANCE LOG)

ROOT CAUSE	NON CONFORMANCE QTY.	CUMULATIVE COUNT	CUMULATIVE %	CORRECTIVE / PREVENTIVE ACTION
MATERIAL REJECT	372	372	23.2	REWORK
DIMENSION OVERSIZE	124	496	30.9	REJECT AT INWARD
DIMENSION UNDERSIZE	124	620	38.6	STOP OUTSOURCE
RETURN & REWORK	140	760	47.3	OUTSOURCE FOR REWORK
MATERIAL DEFECT	20	780	48.6	CHANGE MATERIAL SUPPLIER
TOOL ISSUE	10	790	49.2	STOP MACHINE FOR TOOL CHANGE
MATERIAL CRACK	8	798	49.7	SCRAP OUT
OD & RADIUS ON STEP	2	800	49.8	OUTSOURCE FOR REWORK
LESS MATERIAL LENGTH	1	801	49.9	DEBIT CHARGES FROM SUPPLIER
LESS MATERIAL STOCK	2	803	50	DEBIT CHARGES FROM SUPPLIER
TOTAL	803	1606	100	

FIGURE 3.2.1. PARETO ANALYSIS DATA TABLE

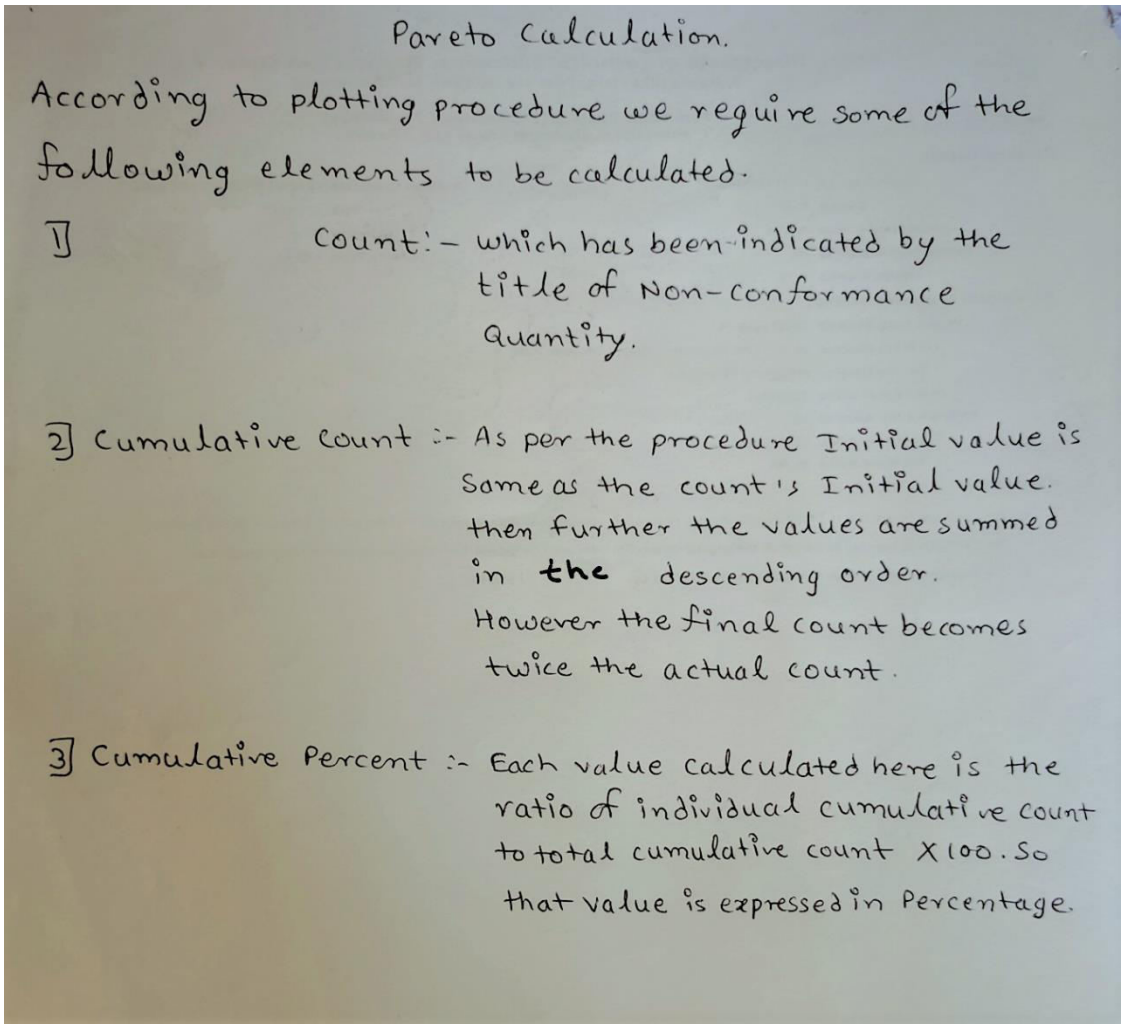


FIGURE 3.2.2 PARETO ANALYSIS ELEMENTS

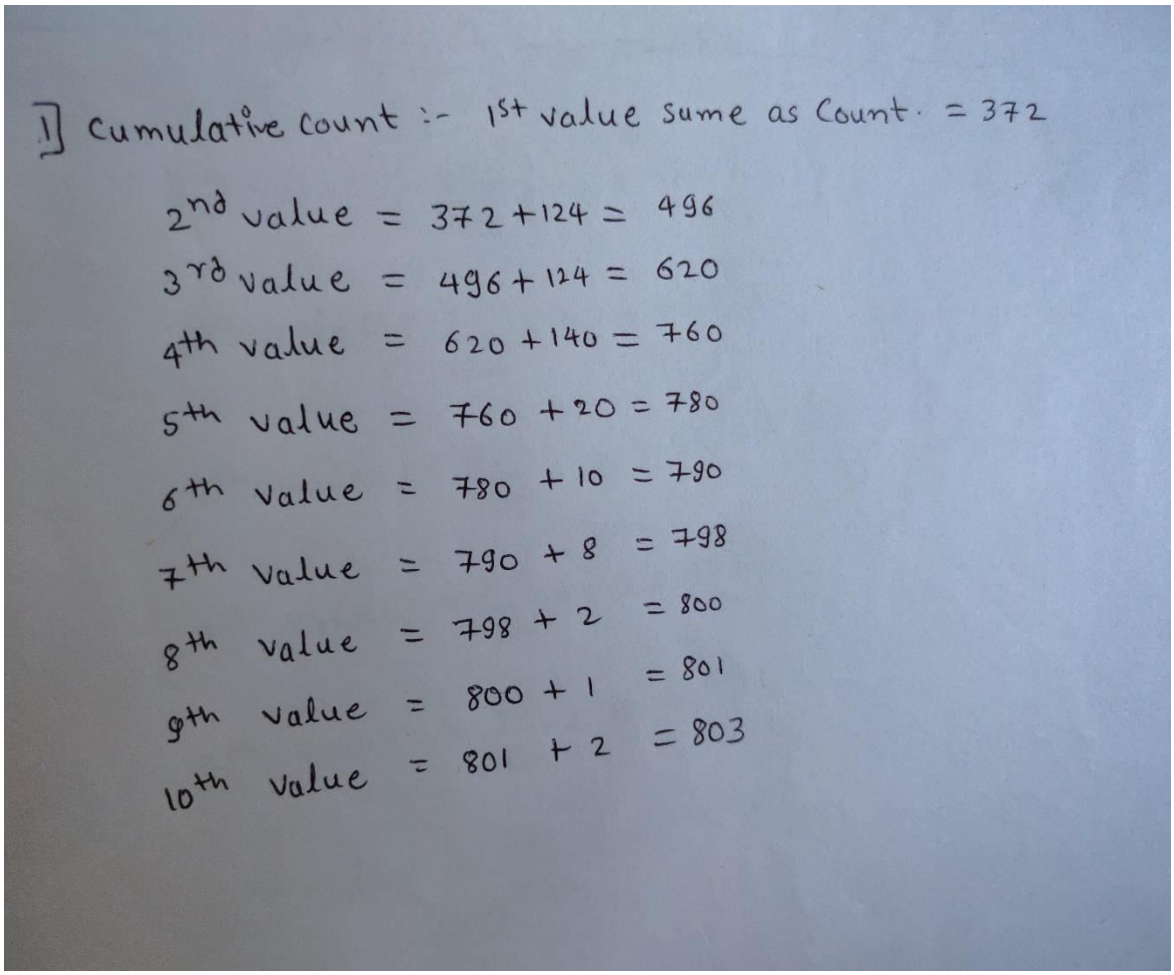


FIGURE 3.2.3 CUMULATIVE COUNT CALCULATIONS (HAND-WRITTEN)

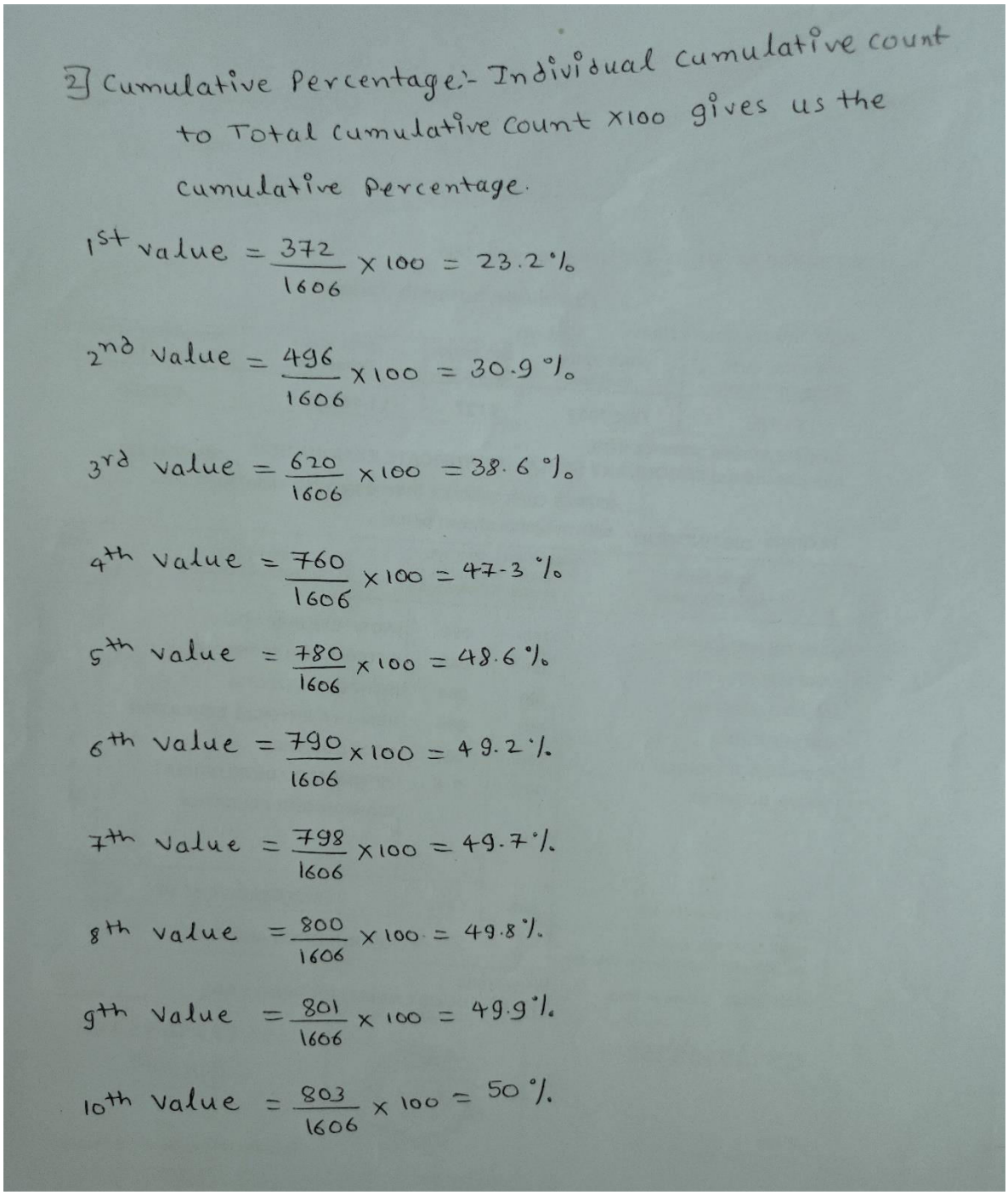


FIGURE 3.2.4 CUMULATIVE PERCENTAGE CALCULATIONS

These calculations are based on the formulae used in the excel worksheet.

3.3.APPLICATION & USE: -

- You can use Pareto charts for the purpose of inventory control. You can analyse the increasing contribution to sales. You can do this among the sales personnel and the regions.

  You can use a dual-axis template if you will not get confused by it. Otherwise, you can also use a single scale with a Pareto.
- If you are utilizing a dual-axis chart, you can format it accordingly. You can use colour coding to make the chart more readable. You can change the colours of the axes if you think it will be easier to understand.
- One thing this chart does not do is arrange the information in an ascending order. Remember, such charts arrange categories in descending order. This is so you can immediately identify which category is the most frequent or severe. This is one of the key features of Pareto charts.
- If you want to modify the axes' options in Excel, just right click on the axis of your choice. Then click on "Format Axis" and "Axis Options."
- If you are using an old version of Excel, you can also create or work with a template. Just try to experiment with the options and functions. Also, each time you make a modification, make sure to check if the formulas still work properly.

3.4. BENEFITS: -

- **Efficiency of the organization**

  When you perform a Pareto analysis, you would have to make a list of the problems in your organization. Then you arrange these problems (and the causes) according to the most severe to the least. Once you see the visual representation of all the problems, you can start planning. Focus on whatever issues you rank as the highest first. Do this when thinking about problem resolution. Aside from the problems, you should also focus on their causes. In doing this, you will be able to resolve them better. With this will come an improved efficiency of an organization. Organizations can function better when the employees establish the root causes of concerns. Then they will be able to resolve the most serious problems. This will then give the most benefits to the organization.

- **Improved problem-solving skills**

  When you perform such an analysis, it can help improve your problem-solving skills. It will enable the employees to organize work-related concerns into facts. Once you have done that, you can start planning the necessary steps to solve the concerns. It is also possible for a group of people to perform a Pareto analysis together. They would have to arrive at a consensus about the different issues and their severities. Then they can identify the causes of the problems in order to find solutions to them.

- **Enhanced decision-making**

  This analysis can also help enhance the decision-making process. Those who conduct the Pareto analysis can examine and compare the effect of changes. With this information, they can focus on making decisions in order to solve the problems. They decide which processes and procedures they need to implement changes. Then they document all this information while performing the analysis. Documenting everything allows for better preparation.

  This also enhances the decision-making for changes in the future.

4. CONCLUSION

From the project work we can conclude that the pareto method used for analysis is much better in its own way. Pareto principle are used to evaluate different defects and causes for these defects responsible for rejection of components at different stages of operations. Pareto Diagrams (known more commonly as the 80/20 Pareto rule) are very useful for managers and figuring out problems in the workflow process. As we have demonstrated using a real-life example in Excel, you can clearly figure out which top 20% of your company's processes are causing 80% of the problems. By taking care of the main problems, you make sure the overall processes of your business are running smoother as you take care of potential or actual bottlenecks. This helped us in

1. Taking future decision based on this data analyzed.
2. Breaking of complex problem into no. of small pieces for easy approach.
3. With use of this method we can focus the efforts to the appropriate and most impacting issue by prioritizing task importance.
4. This helped us to find most significant factors which are contributing in major proportion when it comes to the non-conformance rise.
5. Working on this project helped me improve my knowledge about the basic quality tools as well as their implementation in the industrial work.

5. REMARK

Applying this method, we came to know about the most impacting defects causing non-conformances in the industry. However, we cannot apply same method to all the problems for analysis base as all elements may not be compatible to the method, but we can use this method for solving the most critical problems. The 80-20 rule is a precept, not a hard-and-fast mathematical law. In the rule, it is a coincidence that 80% and 20% equal 100%. Inputs and outputs simply represent different units, so the percentage of inputs and outputs does not need to equal 100%.

6. SCOPE FOR FUTURE WORK

Pareto charts can be used to identify problems to work on. They can help you produce greater efficiency, conserve materials, reduce costs or increase safety. They are most meaningful, however, if the customer, the person or organization that receives our work, helps define the problem categories.

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