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NPTEL ONLINE
CERTIFICATION COURSE

Failure Analysis and Prevention

Industrial Engineering Tools for FA: Pareto Diagram

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Pareto diagram

- A range of issues so confused
- Resolve this dilemmas: Pareto analysis.
- Pareto analysis is a ranked comparison of factors related to a quality problem.
- To identify and focus on the vital few factors.



The Pareto Principle

- Vilfredo Pareto (1848-1923): the concentration of wealth among citizens of the city of Venice
- Relative few people (20%) had the majority of the wealth (80%)
- 1950s, Dr. Juran called this "universal" phenomenon, the Pareto principle.
- In any group of factors contributing to a common effect, a relative few account for the bulk of the effect.
- Juran coined the "vital few" and "useful many".



Vital few

- Multiple root causes for a problem: 80% of the effect is contributed by 20% of these causes.
- These 20% categories which contribute to 80% of the effect are called "vital few" causes and the balance 80% categories are called the "useful many".
- Need to work on the vital few causes. The effort to return ratio will be much better
- May not be economical to work on the "useful many" causes.
- Pareto diagram is a graphical tool to explore this principle in a given situation.



Application

- This principle is some times simply called "80-20" rule.
- Categorization of activities that we do in a day: spending 80% of our time on 20% of the categories.
- Categorization our monthly expenses: 20% of the categories will contribute to 80% of expenses.
- 80% of the revenue comes from 20% of the customers
- 80% of the revenue comes from 20% of the product categories.
- 80% errors / defects in the process come from 20% of the category of the causes



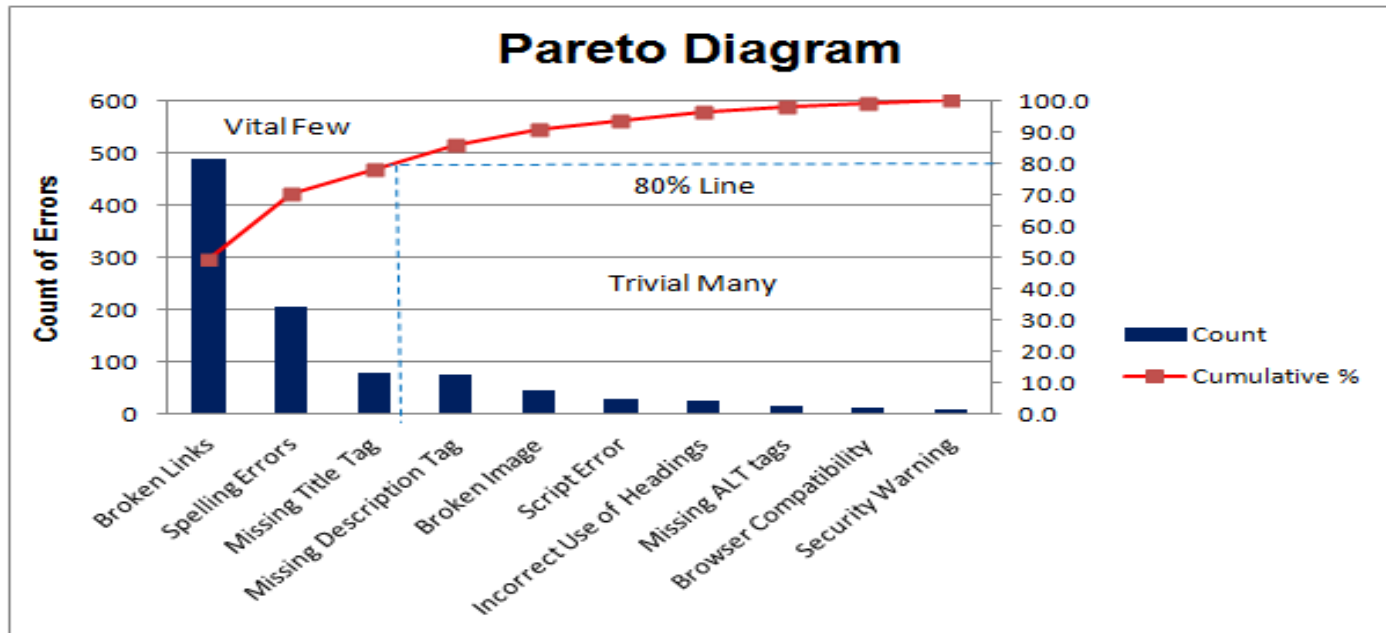
Pareto table

- A typical Pareto diagram and a Pareto table which helps us to construct the diagram are shown below

Cause	Number of occurrence	%	Cumulative %
B	66	33	33
F	46	23	56
A	36	18	74
H	22	11	85
C	16	8	93
E	12	6	99
D	2	1	100
Total	200	100	



Pareto diagram



Limitations

- The separation between "vital few" and "useful many" may not always be 80% and 20%. It can be anywhere between 60% to 90%,
- Some times there may not be any significant difference between the different categories. Then Pareto principle may be valid in another set of factors.
- Try a different set of categories. Some examples are: type of errors, cause of errors or cost of errors.
- Pareto analysis should be done only on objective data collected from the process.
- Opinion of people and votes of people are not data and Pareto analysis on these are not valid. The only exception is customer opinion on customer perception or customer satisfaction.
- These are data and we can do Pareto analysis on them



Case study

- Customer complaints at ABC Airways



Drawing Pareto Diagrams

1. Gather the Data

Survey of Customer Complaints at ABC Airways	
Cause	No. of Complaints
Bad Food	1300
Slow Check In	100
Lost Luggage	2100
Delayed Flights	3500
Dirty Planes	500
Rude Attendants	150

2. Calculate Total

7650



Drawing Pareto Diagrams

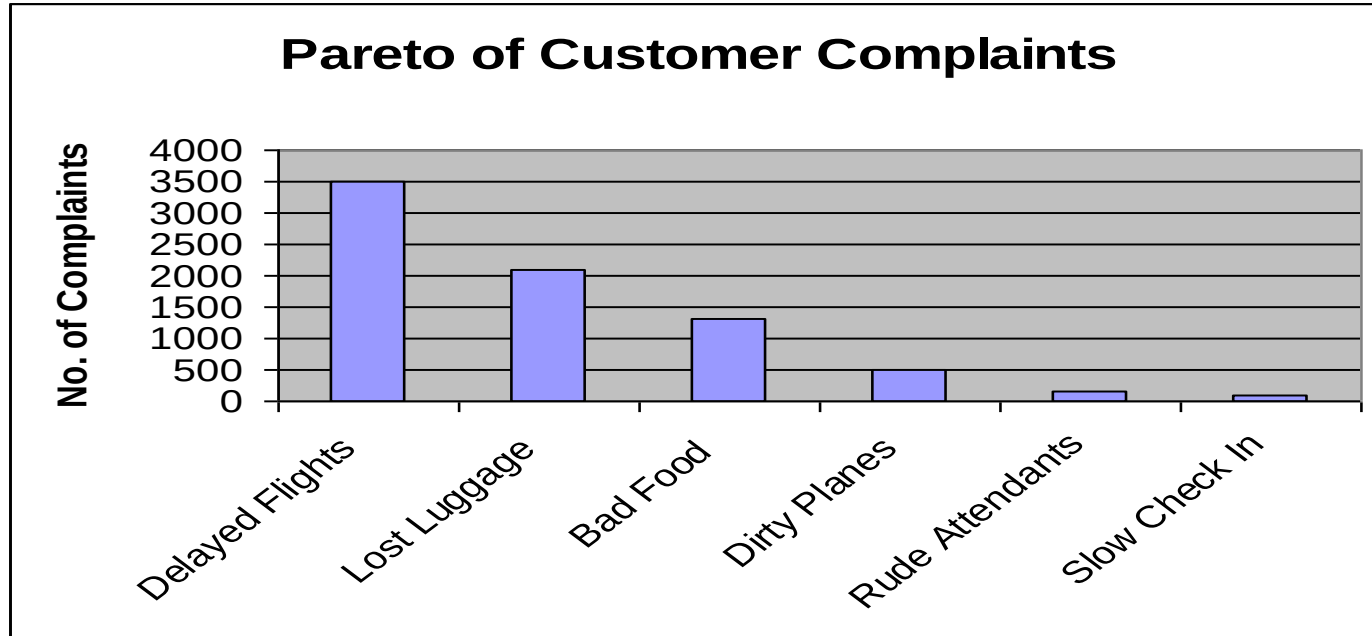
3. Arrange Data in Descending Order and Calculate Percentages

Survey of Customer Complaints at ABC Airways			
Cause	No. of Complaints	Percentage	Cuml.Percent
Delayed Flights	3500	46%	46%
Lost Luggage	2100	27%	73%
Bad Food	1300	17%	90%
Dirty Planes	500	7%	97%
Rude Attendants	150	2%	99%
Slow Check In	100	1%	100%



Drawing Pareto Diagrams

4. Draw the Graph



How to construct

- Arrange the categories of errors or causes in descending order of number of occurrences in the Pareto table
- Calculate the % of the number of occurrences
- Calculate the cumulative % for each category
- Mark the categories in X-axis
- Draw the scale for number of occurrences with highest being the total on left side Y axis
- Draw the scale of % with highest being 100% on right side Y axis



Drawing Pareto diagram

- Draw the number of occurrences as bars touching each other with respect to left hand Y-axis scale
- Draw the cumulative % as line graph with respect to right side Y-axis scale
- Draw a horizontal line from around 80% from the cumulative % axis and draw a vertical line from where it touches the cumulative % axis.
- The categories towards the left of this line are "vital few" causes or errors. The categories to the right of this line are "useful many" errors or causes