Lecture 2

1. Review
2. First Seven Tools
3. Second Seven Tools
Review

Apa yang anda ketahui tentang variabilitas?

Apa perbedaan konsep antara Pengendalian Kualitas Statistik, Desain Eksperimen dan Sampling Penerimaan?
• Factories are full of random events:
  ★ machine failures
  ★ changes in orders
  ★ quality failures
  ★ human variability

• The economic environment is uncertain
  ★ demand variations
  ★ supplier unreliability
  ★ changes in costs and prices
General Statement: Variability is the enemy of manufacturing.
"As much as 95% of quality related problems in the factory can be solved with seven fundamental quantitative tools."

Kaoru Ishikawa
First Seven Tools of Quality

1. Histograms
2. Pareto Charts
3. Cause and Effect Diagrams
4. Run Charts
5. Scatter Diagrams
6. Flow Charts
7. Control Charts
First Seven Tools of Quality

- Kaoru Ishikawa developed seven basic visual tools of quality so that the average person could analyze and interpret data.
- These tools have been used worldwide by companies, managers of all levels and employees.
A histogram is a bar graph that shows frequency data.

Histograms provide the easiest way to evaluate the distribution of data.
Examples of How Histograms Can Be Used

- Histograms can be used to determine distribution of sales.
- Say for instance a company wanted to measure the revenues of other companies and wanted to compare numbers.
**Histogram (3)**

### Set of measurements

<table>
<thead>
<tr>
<th>Value</th>
<th>Value</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>21.2</td>
<td>20.5</td>
<td>19.9</td>
</tr>
<tr>
<td>23.1</td>
<td>21.4</td>
<td>18.1</td>
</tr>
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<td>14.2</td>
<td>23.9</td>
<td>12.2</td>
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<tr>
<td>25.1</td>
<td>29.2</td>
<td>26.6</td>
</tr>
<tr>
<td>16.1</td>
<td>23.1</td>
<td>23.8</td>
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<td>23.6</td>
<td>22.5</td>
<td>22.0</td>
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<td>20.7</td>
<td>21.1</td>
<td>15.6</td>
</tr>
<tr>
<td>19.5</td>
<td>20.4</td>
<td>21.1</td>
</tr>
<tr>
<td>etc.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Frequency

- **Measurement value**
- **Frequency**

*All bars are of equal width*

*Overall shape shows distribution*

*This cell indicates that there are about 10 measurements between 16 and 18*
Pareto Chart Defined

- Pareto charts are used to identify and prioritize problems to be solved.
- They are actually histograms aided by the 80/20 rule adapted by Joseph Juran.
  - Remember the 80/20 rule states that approximately 80% of the problems are created by approximately 20% of the causes.
Vilfredo Pareto was a 19th century Italian economist.

Vilfredo Pareto, who noticed that around 80% of the wealth of the country was held by around 20% of the population.
Joseph Juran, a 20th century quality consultant (and guru), noticed that this also applied to defects, where around 80% of the problems would be in 20% of the defects, which meant that if you focused on that 20%, you could have a big effect with minimal effort.

He called this the 'Pareto Principle'.

### Pareto Charts (4)

<table>
<thead>
<tr>
<th>Item measured</th>
<th>Measure or count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 1</td>
<td>12</td>
</tr>
<tr>
<td>Item 2</td>
<td>2</td>
</tr>
<tr>
<td>Item 3</td>
<td>32</td>
</tr>
<tr>
<td>Item 4</td>
<td>4</td>
</tr>
<tr>
<td>Item 5</td>
<td>19</td>
</tr>
<tr>
<td>Item 6</td>
<td>9</td>
</tr>
<tr>
<td>Item 7</td>
<td>1</td>
</tr>
</tbody>
</table>

*Items are measured and sorted into order*
Pareto Curve

Cumulative line adds height of each bar in turn
Percentage scale enables identification of causes of top 80% of problems
Pareto Pyramid

- Animals
- Pedestrians
- Motorcycles
- Cycles
- Cars
- Trucks

Last month vs. This month
Paired Pareto Chart

- Various categories: Trucks, Cars, Cycles, Motorcycles, Pedestrians, Animals
- Comparison between this month and last month
- Legend: □ = This month, ■ = Last month
Cause and Effect Diagram Defined

- The cause and effect diagram is also called the Ishikawa diagram or the fishbone diagram.
- It is a tool for discovering all the possible causes for a particular effect.
- The major purpose of this diagram is to act as a first step in problem solving by creating a list of possible causes.
An Example of When a Cause and Effect Diagram Can Be Used

- This diagram can be used to detect the problem of incorrect deliveries.
- When a production team is about to launch a new product, the factors that will affect the final product must be recognized. The fishbone diagram can depict problems before they have a chance to begin.
Common v.s. Special Causes

Special cause

Common causes
Example Cause Effect Diagram
Scatter Diagrams Defined

- Scatter Diagrams are used to study and identify the possible relationship between the changes observed in two different sets of variables.
An Example of When a Scatter Diagram Can Be Used

- A scatter diagram can be used to identify the relationship between the production speed of an operation and the number of defective parts made.
- Displaying the direction of the relationship will determine whether increasing the assembly line speed will increase or decrease the number of defective parts made. Also, the strength of the relationship between the assembly line speed and the number of defective parts produced is determined.
Flow Charts Defined

- A flow chart is a pictorial representation showing all of the steps of a process.

Examples of When to Use a Flow Chart

- Two separate stages of a process flow chart should be considered:
- The making of the product and The finished product
Run Charts Defined

- Run charts are used to analyze processes according to time or order
An Example of Using a Run Chart

- An organization’s desire is to have their product arrive to their customers on time, but they have noticed that it doesn’t take the same amount of time each day of the week. They decided to monitor the amount of time it takes to deliver their product over the next few weeks.
Example Run Chart
Control charts are used to determine whether a process will produce a product or service with consistent measurable properties.
An Example of When to Use a Control Chart

Counting the number of defective products or services

- Do you count the number of defects in a given product or service?
- Is the number of units checked or tested constant?
Example Control Chart

Proportion of forms that are defective, $p$

Day of month

UCL

Average, $p^-$

LCL
Second Seven Tools of Quality

1. Relations Diagram
2. Affinity Diagram
3. Tree Diagram
4. Matrix Diagram
5. Matrix Data Analysis Chart
6. Process Decision Program Chart
7. Activity Network
In many problem situations, there are multiple complex relationships between the different elements of the problem, which cannot be organized into familiar structures such as hierarchies or matrices.

The Relations Diagram addresses these situations by showing relationships between items with a network of boxes and arrows.
The most common use of the Relations Diagram is to show the relationship between one or more problems and their causes, although it can also be used to show any complex relationship between problem elements, such as information flow within a process.
Items are identified 'chunks' of the problem.

Arrows show a directed relationship between individual items.
Affinity Diagram ('KJ' diagram)

- A diagram that is used as a method of sorting qualitative data, which usually comes in the form of short phrases or sentences (e.g. 'Customers are unhappy with delivery delays'). It is often done with Post-it Notes, although the original method used 3" x 5" cards.
Affinity Diagram ('KJ' diagram)

- It is a great method of working as a group to sort out issues and fuzzy situations. It is also useful for sorting such as customer comments from surveys.
- Building an Affinity Diagram is often known as 'doing a KJ', after its originator, Kawakita Jiro (this is in order of surname, given name, as in the Japanese tradition).
The personnel department of a food supermarket chain store identified a high resignation rate of good checkout staff. There was information available from exit interviews about their reasons for leaving, but this was disorganized and there was no clear area that they felt they could address. They decided to use the KJ method and an Affinity Diagram to try to better understand why these people were leaving (see as illustrated).

As a result, the checkout process was investigated further and eventually completely redesigned. This included a redesigned booth and hourly breaks for operators. Consequently, there were significantly fewer leavers (and as a bonus, customer satisfaction increased).
The Matrix Diagram allows a many-to-many comparison of two lists, by turning the second list on its side to form a matrix. The illustration below shows how the relationship between two items can now be indicated in the cell where the row and column of the two items cross.

Common extensions to the Matrix Diagram include the use of different symbols to indicate different comparison levels and the weighting of the items being compared.
There are a number of different shapes of matrix for comparing more than the basic two lists. These include the L-Matrix (the basic matrix as below), C-Matrix, T-Matrix, X-Matrix and Y-Matrix.

The Matrix Diagram is a core tool in Quality Function Deployment (QFD).
Matrix Diagram

<table>
<thead>
<tr>
<th>List 1</th>
<th>List 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 1</td>
<td>Item A</td>
</tr>
<tr>
<td>Item 2</td>
<td>Item B</td>
</tr>
<tr>
<td>Item 3</td>
<td>Item C</td>
</tr>
<tr>
<td>Item 4</td>
<td>Item D</td>
</tr>
<tr>
<td>Item 5</td>
<td>Item E</td>
</tr>
</tbody>
</table>

becomes

<table>
<thead>
<tr>
<th></th>
<th>Item A</th>
<th>Item B</th>
<th>Item C</th>
<th>Item D</th>
<th>Item E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 1</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Item 2</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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</tr>
<tr>
<td>Item 3</td>
<td>○</td>
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<tr>
<td>Item 5</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
When comparing a large set of items, the complexity of the situation can make it difficult to determine how different factors relate to one another.

In particular, it can be useful to find groups of items that behave in similar ways.

For example, a washing powder may have different efficiencies at achieving 'softness' and 'stain removal' in garments made of acrylic, polyester, wool and various fiber mixtures.
Matrix Data Analysis Chart (MDAC)

- If similar affects are found in a group of fibers, then changing the powder ingredients may affect the whole group in a similar way.
- The Matrix Data Analysis Chart (or MDAC) helps classify items by identifying two major characteristics common to all items and then plotting each item as a point on a standard x-y chart.
- This makes it easier to see how the individual items relate both to the characteristics and to one another, thus:
Matrix Data Analysis Chart (MDAC)

<table>
<thead>
<tr>
<th>Measured Item</th>
<th>Characteristic A</th>
<th>Characteristic B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 1</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Item 2</td>
<td>5</td>
<td>-4</td>
</tr>
<tr>
<td>Item 3</td>
<td>-8</td>
<td>-5</td>
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<td>Item 4</td>
<td>-5</td>
<td>3</td>
</tr>
<tr>
<td>Item 5</td>
<td>7</td>
<td>-5</td>
</tr>
<tr>
<td>Item 6</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

Chart shows clustering and positioning of items relative to one another.
The Process Decision Program Chart (PDPC) provides a simple method to help in identifying both risks and counter measures.

Quite simply, if the plan is displayed diagrammatically (typically in a Tree Diagram), then identified risks and countermeasures are added in subsequent boxes, as below.

This may appear to be quite trivial, but as with many other tools, the construction and thought involved is as important as the final diagram.
Activity Network

- One of the 'second seven tools', this is a classic project planning tool for piecing together a multi-task complex set of interdependent activities.
- It allows you to calculate what task starts when, what float there is in the project, etc.
- Also called an 'Activity-on-Node Diagram', the alternative (but potentially more troublesome) method of doing this is with an 'Activity-on-Arrow Diagram', or simply 'Arrow Diagram'.
Activity Network

Tasks are shown as boxes.

Arrows show dependencies. Task 3 cannot begin until both Task 1 and Task 2 have been completed.

Task 4 is a predecessor to Task 5 and a successor to Task 2.

There is both a start and end point to the project.
Kata motivasi pertemuan ini

TINDAKAN

Tanpa tindakan tidak pernah ada sukses. Sukses ... harus bertindak. Sebab bagian terpenting dari kesuksesan adalah keberanian bertindak.

Sekarang Juga !