What are the New Seven Quality Tools

In 1976, the Union of Japanese Scientists and Engineers (JUSE) saw the need for tools to promote innovation, communicate information and successfully plan major projects.

A team researched and developed the seven new quality control tools, to be used with the 7 basic quality tools.

Often called the seven management and planning (MP) tools, or simply the seven management tools.
The New Seven Quality Tools (The Seven Management and Planning Tools)

The seven new tools, listed in an order that moves from abstract analysis to detailed planning, are:

1. Affinity Diagram
2. Relations Diagram
3. Tree Diagram
4. Matrix Diagram
5. Arrows Diagram
6. Process Decision Program Chart
7. Prioritization Matrix- Matrix Data Analysis

New Seven Q.C. Tools

Developed to organize verbal data diagrammatically.

Basic 7 tools effective for data analysis, process control, and quality improvement (numerical data)

Used together increases TQM effectiveness
Relation Between New Seven Q.C. Tools and Basic Seven Tools

**FACTS**
- Data
  - Numerical Data
  - Verbal Data

**The Basic Seven Tools**
- Define problem after collecting numerical data
- Define problem before collecting numerical data
- Analytical approach

**The Seven New Tools**
- Generate Ideas
- Formulate plans

**Benefits of Incorporating New Seven Q.C. Tools**
- Organize verbal data
- Generate ideas
- Improve planning
- Eliminate errors and omissions
- Explain problems intelligibly
- Secure full cooperation between teams
- Persuade powerfully

- Enhanced Keys to Organizational Reform
- Assess situations from various angles
- Clarify the desired situation
- Prioritize tasks effectively
- Proceed systematically
- Anticipate future events
- Change proactively
- Get things right first time
Five Objectives of Organizational Reform which will establish a Culture that:
- Identifies problems
- Gives importance to planning
- Stresses the importance of the process
- Prioritizes tasks
- Encourages everyone to think systematically

Benefits of Incorporating New Seven Q.C. Tools

Unstructured Problem [must be put into solvable form]

The Seven New Tools:

- Problem is mapped
- Problem becomes obvious to all
- People understand problem
- Cooperation is obtained
- Countermeasures are on target

- Thoughts are easily organized
- Problem can be clearly articulated
- Nothing is omitted
- Nub of problem is identified
- Things go well
- Plans are easily laid
- Nothing is omitted
- Nub of problem is identified

Problem is in solvable form
The New Seven Q.C. Tools and Organizational Change through TQM

Tool 1 – The Affinity Diagram

Gathers large amounts of verbal data (ideas, opinions, issues); then Organizes the data into groups based on natural relationship; and
Makes it feasible for further analysis and to find a solution to the problem.

Why use the Affinity Diagram?

To allow a team to creatively generate a large number of ideas/issues and then organize and summarize natural groupings among them to understand the essence of a problem and propose solutions.
How to construct an Affinity Diagram

- Select the topic to be analyzed
- Use brainstorming to collect verbal data and ideas
- Write each item on separate data card
- Spread out all cards on table or stick them on a board
- Move data cards into groups of similar themes (natural affinity for each other)
- Combine statements on data cards to new Affinity statement
- Make new card with Affinity statement
- Continue to combine until less than 5 groups
- Draw the final Affinity Diagram for the problem discussed
Affinity Diagram Example

Customer service is sub-standard

Figure 3

Why is customer service sub-standard?

- Too much turnover
- There aren’t enough phone lines
- Untrained staff
- Staff morale is low
- Staff feel unappreciated
- No standard systems
- Staff aren’t compensated enough
- There’s no measurement for what is and what isn’t good service
- Not enough management support
- Staff feel unappreciated
- There aren’t enough phone lines

Figure 5

Why is customer service sub-standard?

- Human Resource Issues
- Lack of standard processes and measurement
- Workplace culture
- Resources and tools
- Too much turnover
- No standard systems
- Not enough management support
- Staff morale is low
- Staff aren’t compensated enough
- There’s no measurement for what is and what isn’t good service
Affinity Diagram

incidents of customer’s complaints due to poor product quality

Personnel are not quality conscious
- Operators are making mistakes
- Inspectors do not check the quality during production
- Workers do not care about the product quality
- No quality training

Poor Subcontractor Material
- Raw material is sub-standard
- No incoming inspection
- Sub-contractors are not chosen properly
- Poor quality of raw materials
- Cheaper raw materials are being used

Defective products are reaching the customers
- Actual standards are not available
- Final inspection is very poor
- No calibration of the equipment
- Inspection methods are very poor
- Defective products not segregated
- Inspection & testing equipment are old

Employees Absenteeism
- Any other operator is asked to do the job when the actual operator is absent
- Leave rules are very relaxed
- There are not enough skilled operators
- There are no alternative operators
- No incentives for good attendance

Tool N. 2 : Relations Diagrams

For Finding Solutions Strategies by Clarifying Relationships with Complex Interrelated Causes. To allow a team to systematically identify, analyze, and classify the cause and effect relationships that exist among all critical issues.

- Useful at planning stage for obtaining perspective on overall situation.
- Facilitates consensus among team
- Assists to develop and change people’s thinking
- Enables priorities to be identified accurately
Relations Diagram

Makes the problem recognizable by clarifying the relationships among causes

Constructing a Relations Diagram

- Express the problem in form of “Why isn’t something happening?”
- Each member lists 5 causes affecting problem
- Write each item on a card
- Discuss info collected until everyone understands it thoroughly
- Move cards into similar groups
- Asking why, explore the cause-effect relationships, and divide the cards into primary, secondary and tertiary causes
Constructing a Relations Diagram

- Connect all cards by these relationships
- Further discuss until all possible causes have been identified
- Review whole diagram looking for relationships among causes
- Connect all related groups
- Next, complete the diagram

Example: Relations Diagram
Tool N. 3: Tree Diagram

For Systematically Pursuing the Best Strategies for Attaining an Objective
- Develops a succession of strategies for achieving objectives
- Reveals methods to achieve the results.
- Also known as Systematic diagrams or Dendrograms

Tree Diagrams

Advantages of Tree Diagrams
- Systematic and logical approach is less likely that items are omitted
- Facilitates agreement among team
- Are extremely convincing with strategies


Constructing a Tree Diagram

- Write Relations Diagram topic (Objective card)
- Identify constraints on how objective can be achieved
- Discuss means of achieving objective (primary means, first level strategy)
- Take each primary mean, write objective for achieving it (secondary means)
- Continue to expand to the fourth level
- Review each system of means in both directions (from objective to means and means to objective)
- Add more cards if needed
- Connect all levels
- Next, complete the diagram

Tree Diagram: Example of Customer Complaints due to poor quality

- Select better supplier
  - Check reputed ones
  - Conduct supplier audits
  - Choose one with better quality system
- Establish quality awareness programs
  - Provide training
  - Select good trainers
  - Allocate training budget
- Implement incentives for perfect attendance
- Improve final inspection
  - Full attendance award
  - Motivate create interest in work
  - Display attendance performance
  - Improve inspection & testing equipment
  - Provide training for inspectors
  - Strengthen the inspection method

To eliminate/decrease the incidence of customer complaints due to poor product quality
Tool 4 - Matrix Diagrams

For Clarifying Problems by “Thinking Multidimensionally”

To allow a team or individual to systematically identify, analyze, and rate the presence and strength of relationships between two or more sets of information.

Matrix Diagrams

- Consists of a two-dimensional array to determine location and nature of problem
- Discovers key ideas by relationships represented by the cells in matrix.
- Enable data on ideas based on extensive experience
- Clarifies relationships among different elements
- Makes overall structure of problem immediately obvious
- Combined from two to four types of diagrams, location of problem is clearer.
Constructing a Matrix Diagram

- Write final-level means from Tree diagram forming vertical axis.
- Write in Evaluation categories (efficacy, practicability, and rank) on horizontal axis.
- Examine final-level means to identify whom will implement them.
- Write names along horizontal axis.
- Label group of columns as “Responsibilities”.
- Label right-hand end of horizontal axis as “Remarks”.
- Examine each cell and insert the appropriate symbol:
  - Efficacy: O=good, ▲=satisfactory, X=none
  - Practicability: O=good, ▲=satisfactory, X=none

**Constructing a Matrix Diagram (cont.)**

- Determine score for each combination of symbols, record in rank column.
- Examine cells under Responsibility Columns, insert double-circle for Principal and single-circle for Subsidiary.
- Fill out remarks column and record meanings of symbol.
- Next, complete the diagram.
Example of Matrix Diagram:

Customer Complaints due to poor product quality

<table>
<thead>
<tr>
<th>Means</th>
<th>Efficacy</th>
<th>Practicability</th>
<th>Rank</th>
<th>President</th>
<th>Production</th>
<th>Quality Control</th>
<th>HRD</th>
<th>Finance</th>
<th>Purchasing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check reputed ones</td>
<td>☐</td>
<td>☐ = 3</td>
<td>☐ = 3</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐ = 3</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Conduct supplier audits</td>
<td>☐</td>
<td>☐ = 2</td>
<td>☐ = 2</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐ = 3</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Check with better quality system</td>
<td>☐ = 1</td>
<td>☐ = 4</td>
<td>☐ = 4</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐ = 3</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Provide training on quality awareness</td>
<td>☐ = 1</td>
<td>☐ = 4</td>
<td>☐ = 4</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐ = 3</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Select good trainers</td>
<td>☐ = 1</td>
<td>☐ = 4</td>
<td>☐ = 4</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐ = 3</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Allocate training budget</td>
<td>☐ = 1</td>
<td>☐ = 4</td>
<td>☐ = 4</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐ = 3</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Full attendance award</td>
<td>☐ = 1</td>
<td>☐ = 4</td>
<td>☐ = 4</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐ = 3</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Motivate/ create interest in the work</td>
<td>☐ = 1</td>
<td>☐ = 4</td>
<td>☐ = 4</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐ = 3</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Display attendance performance</td>
<td>☐ = 1</td>
<td>☐ = 4</td>
<td>☐ = 4</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐ = 3</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Improve inspection &amp; testing equipment</td>
<td>☐ = 1</td>
<td>☐ = 4</td>
<td>☐ = 4</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐ = 3</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Provide training for inspectors</td>
<td>☐ = 1</td>
<td>☐ = 4</td>
<td>☐ = 4</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐ = 3</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Strengthen the inspection method</td>
<td>☐ = 1</td>
<td>☐ = 4</td>
<td>☐ = 4</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐ = 3</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Efficacy/practicability</th>
<th>Scoring Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Good</td>
<td>☐ ☐ = 1</td>
</tr>
<tr>
<td>☐ Satisfactory</td>
<td>☐ ☐ = 2</td>
</tr>
<tr>
<td>☐</td>
<td>☐ ☐ = 3</td>
</tr>
<tr>
<td>☐</td>
<td>☐ ☐ = 4</td>
</tr>
</tbody>
</table>

Example of Matrix Diagram:

<table>
<thead>
<tr>
<th>TQ Implementation (Tree)</th>
<th>LQC Objectives (Matrix)</th>
<th>Schedules (AND)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal</td>
<td></td>
<td>Measures</td>
</tr>
<tr>
<td>Continue to implement total quality</td>
<td>Research customer needs via QFD</td>
<td>2003</td>
</tr>
<tr>
<td></td>
<td>Capture customer comments</td>
<td>Quarter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2004</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quarter</td>
</tr>
</tbody>
</table>

Information provided courtesy of Bell Canada
Example of Matrix Diagram:

Tool 5 - Arrows Diagram
For Working Out Optimal Schedules and Controlling Them Effectively

- Shows relationships among tasks needed to implement a plan
- Network technique using nodes for events and arrows for activities
- Allows overall task to viewed and potential snags to be identified before work starts
- Leads to discovery of possible improvements
- Makes it easy to monitor progress of work
- Deals promptly with changes to plan
- Improves communication among team
Constructing an Arrow Diagram

- From strategies on Tree diagram, select one (Objective of Arrow Diagram)
- Identify constraints to Objective
- List all activities necessary to achieving Objective
- Write all essential activities on separate cards
- Organize cards in sequential order of activities
- Remove any duplicate activities
- Review order of activities, find sequence with greatest amount of activities
- Arrange parallel activities
- Examine path, number nodes in sequence from left to right
- Record names and other necessary information
- Next, complete the diagram

**Arrow Diagram:**
*Example of building a room.*
**Tool 6 - Process Decisions Program Charts (PDPC)**

PDPCs are used for planning the activities needed to solve a problem when information is incomplete or the situation is fluid and hard to forecast.

Examples include planning an R & D project, mapping out a countermeasure against long-term chronic problems, and planning a sales campaign.

A PDPC consists of a series of steps linked in sequence. Its goal is to depict the events and contingencies likely to occur when progressing from a starting point to one or more final outcomes.
Tool 7 - Prioritization Matrix
(Matrix Data Analysis)

- Technique quantifies and arranges data presented in Matrix
- Based solely on numerical data.
- Finds indicators that differentiate and attempt to clarify large amount of information.

Prioritization Matrix is used by teams to narrow down options through a systematic approach of comparing choices by selecting, weighting, and applying criteria.
Constructing a Prioritization Matrix

- Determine your goal, your alternatives, and criteria for decision
- Place selection in order of importance
- Apply percentage weight to each option
- Sum individual ratings to establish overall ranking (Divide by number of options for average ranking)
- Rank order each option with respect to criterion (Average the rankings and apply a completed ranking)
- Multiply weight by associated rank in Matrix (in example, 4 is best, 1 is worst)
- Result is Importance Score
- Add up Importance Scores for each option
- Rank order the alternatives according to importance

Prioritization Matrix – Example from manufacturing

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Customer Acceptance</th>
<th>Cost</th>
<th>Reliability</th>
<th>Strength (least important)</th>
<th>Importance</th>
<th>Option Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Options</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage weight</td>
<td>40</td>
<td>.30</td>
<td>20</td>
<td>10</td>
<td>1.6</td>
<td>.90</td>
</tr>
<tr>
<td>Rank</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Importance score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage weight</td>
<td>30</td>
<td>.40</td>
<td>10</td>
<td>20</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Rank</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Importance score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage weight</td>
<td>25</td>
<td>.25</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td>Rank</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Importance score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design D</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage weight</td>
<td>0.3</td>
<td>.10</td>
<td>20</td>
<td>40</td>
<td>90</td>
<td>.10</td>
</tr>
<tr>
<td>Rank</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Importance score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sum of weights</td>
<td>1.25</td>
<td>1.05</td>
<td>75</td>
<td>95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average weight</td>
<td>.31</td>
<td>.26</td>
<td>19</td>
<td>24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Criterion Ranking</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Practical Application of New Seven Q.C. Tools

"Abilities Required for Applying New Seven QC Tools"

Cause Statements (hints are in yellow)

| A | Interpret data clearly | N | Understand seriousness of problem |
| B | Select appropriate tool | O | Think flexibly from various standpoints |
| C | Think systematically | P | Obtain appropriate verbal data |
| D | Give opinions | Q | Expose core of problem |
| E | Know what the problem is | R | Communicate well |
| F | Extract necessary information | S | Accurately understand real problem |
| G | Collect reliable verbal data | T | Have excellent intuition |
| H | Think multidimensionally | U | See to heart of problem |
| I | Obtain facts | V | Select appropriate type of verbal data |
| J | Interpret analytical results | W | Think in terms of word-based diagram |
| K | Generate ideas | X | Express genuine thoughts |
| L | Know that distorted data is useless | Y | Hear and respect other’s opinions |
| M | Grasp overall pictured | Z | Generate highly accurate verbal data |

Source: Foster, S., Managing Quality (Upper Saddle River, NJ: Prentice Hall, 2001)
Solution for "Abilities Required for Applying New Seven QC Tools"

Summary
New Seven Quality Tools

Benefits of New Seven Q.C. Tools
1- Provide Training in Thinking
2- Raise People’s Problem Solving Confidence
3- Increase People’s Ability to Predict Future Events

Roles of New Seven Q.C. Tools
1- Express verbal data diagrammatically
2- Make information visible
3- Organize information intelligibly
4- Clarify overall picture and fine details
5- Get more people involved
**Additional Readings**


---

**Conclusion**

"Quality truly begins with education and ends with education",  
*K. Ishikawa (1990).*
What can be Improved in the College of Engineering?