Business Systems - Operations Management

Session 8 Quality Planning & Control

Facilitator:
Dr. Jonathan Farrell

This Evening's Program

• Quality Planning & Control
  – The different approaches to quality
  – Reconciling the operation’s & the customer’s views of quality
  – Conformance to Specification
  – SPC and process capability concepts
  – Six Sigma
  – Quality in Services
• Case Study – Calling Sue (in the Folder of Readings)
• Exercise – the Cost of Quality (refer to the Folder of Readings)
Quality planning and control seeks to deliver products and services at their required specification or above it.

**What is Quality?**

Performance that pleases the customer with predictable uniformity and dependability.

i.e. meeting the customer’s requirements or specifications, all the time.
“Good quality does not necessarily mean high quality. It means a predictable degree of uniformity and dependability at low cost, with a quality suited to the market”

W. Edwards Deming

The Dimensions of Quality

- **Performance** – primary characteristics
- **Features** – secondary characteristics
- **Reliability** – consistency of performance over time
- **Durability** – useful life
- **Serviceability** – ease of repair
- **Response** – speed, courtesy, competence, GUI
- **Aesthetics** – sound, feel, look, etc.
- **Reputation** – perceptions of quality
The Cost of Quality

1. **Appraisal Costs** – inspection, testing, etc.
2. **Prevention Costs** – identification, training, corrective action, redesign
3. **Internal Failure Costs** – scrap, rework, repair
4. **External Failure Costs** – warranty repair and / or replacement, loss of goodwill / reputation, complaints handling

Levels of Quality

- Total Quality Management
- Quality Assurance
- Quality Control
- Inspection
- SPC
- Batch sampling
- Quality standards
- Error detection
- Quality systems/ISO
- Quality design
- Quality process
- Quality strategy
- Organisation
- Includes customers and suppliers
Perceived quality is governed by the gap between customers’ expectations and their perceptions of the product or service.

- Customers’ expectations for the product or service
- Customers’ perceptions of the product or service

**Expectations > perceptions** → Perceived quality is poor

**Expectations = perceptions** → Perceived quality is good

**Expectations < perceptions** → Perceived quality is good

---

Quality

- **Quality**
  - **Quality of Design**
    - Degree to which design achieves purpose
  - **Quality of Conformance**
    - Faithfulness with which the operation agrees with design

- **Reliability**
  - Ability to continue working at accepted quality level

- **Variables**
  - Things you can measure

- **Attributes**
  - Things you can assess accept/reject
Some measure of operation's performance over time is often measured using process control charts. This helps in identifying whether the variation in process performance is due to "natural" causes or "assignable" causes.

**Question:** How do we know if the variation in process performance is "natural" in terms of being a result of random causes, or is indicative of some "assignable" causes in the process?
Process control charting

The last point plotted on this chart seems to be unusually low.

How do we know if this is just random variation or the result of some change in the process which we should investigate?

Some kind of “Guidelines” or “Control limits” would be useful

Process Control Charting

- Alternating and erratic behaviour - Investigate
- Two points near control limit - Investigate
- Apparent trend in one direction - investigate
- Suspiciously average behaviour - Investigate
- Five points one side of centre line - Investigate
- Sudden change in level - Investigate

In addition to points falling outside the control limits other unlikely sequences of points should be investigated
The “standard deviation” is a measure of the “Spread” or “Variation” of a distribution.

The chances of measurement points deviating from the average is predictable in a normal distribution.
Process variation and its effect on process Defects per Million Opportunities (DPMO)

- **3 sigma process variation**
  - LSL \( \rightarrow \) USL
  - 66,800 Defects per million opportunities

- **4 sigma process variation**
  - LSL \( \rightarrow \) USL
  - 6,200 Defects per million opportunities

- **5 sigma process variation**
  - LSL \( \rightarrow \) USL
  - 230 Defects per million opportunities

- **6 sigma process variation**
  - LSL \( \rightarrow \) USL
  - 3.4 Defects per million opportunities

Who’s the better shot?

Heidi

Stephen
Process Variability

Off target \textit{ACCURACY : A}

Scatter \textit{PRECISION : P}

Total Quality Management

Management of \textit{variation} in the process.

Note: The vast majority of variation is due to process design, and is the responsibility of management, not the operators.
General Principles of Total Quality Management

1. All processes exhibit variability
2. Work to improve the process, not the output
3. Management of processes should be based on facts and data
4. Improvement should become a way of life
5. Involve those who are closest to the process
6. Improvement efforts must be plan driven, not reaction driven
7. Quality is always customer driven
8. Quality does not cost - it pays
   - Cost of failure > cost of prevention
   - Overcome the Trade-off Mentality

TQM Principles

- Continuous improvement
- Customer focus
- Fact based decisions
- Employee involvement

TQM
1. Identify the problem
e.g. process unstable

2. Quantify current situation and goals

3. Identify possible solutions:
creativity
brainstorming
innovative thinking

4. Collect data (cycle times, errors)

5. Analyse the data

6. Formulate solutions (adaptive thinking)

7. Implement preferred solution

8. Monitor the process and quantify results

9. Repeat the Process
Business Systems - Operations Management
Session 8 Quality Planning & Control

**Continuous Improvement - a Culture**

- Collect & analyse data.  **Plan**
- Alter the plan  **Act**
- Measure results  **Check**
- Take corrective action.  **Do**

**PDCA**

**Fact based decision making: the quality tools**

1. Pareto analysis
2. Flowcharts
3. Check sheets
4. Histograms
5. Scatter diagrams
6. Control charts
7. Fishbone diagram
Analyse the data:
Pareto diagram

Understand the process:
flow charts
### Check Sheet

COMPONENTS REPLACED BY LAB  
TIME PERIOD: 22 Feb to 27 Feb 2004  
REPAIR TECHNICIAN: Bob

<table>
<thead>
<tr>
<th>Component</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrated Circuits</td>
<td>3</td>
</tr>
<tr>
<td>Capacitors</td>
<td>1</td>
</tr>
<tr>
<td>Resistors</td>
<td>1</td>
</tr>
<tr>
<td>Transformers</td>
<td>1</td>
</tr>
<tr>
<td>Commands</td>
<td>1</td>
</tr>
<tr>
<td>CRT</td>
<td>1</td>
</tr>
</tbody>
</table>

### Analyse the Data: Histogram

- **Number of payments received**
- **When received**

- **March**

- **Weeks**
  - Wk1
  - Wk2
  - Wk3
  - Wk4
  - Above
Analyse the data: scattergram

Analyse the data: control charts
### Cause and Effect Diagram

#### Ishikawa Diagram

**Cause category**

**Suggestions**

- Measurement

**Process**

- Defective from vendor
- Not to specifications
- Material-handling problems

**Environment**

- Faulty testing equipment
- Incorrect specifications
- Improper methods
- Inaccurate temperature control
- Dust and Dirt

**Human**

- Inadequate training
- Lack of concentration
- Poor supervision

**Machines**

- Out of adjustment
- Tooling problems
- Old/worn

**Materials**

- Ineffective quality management
- Deficiencies in product design
- Not to specifications

**Measurement**

- Defective from vendor
- Not to specifications
- Material-handling problems

- Poor process design
- Ineffective quality management
- Deficiencies in product design

---

**Quality Problem**

---

**Ishikawa Diagram Fishbone Diagram**

**Cause and Effect Diagram**
Business Systems - Operations Management
Session 8 Quality Planning & Control

TQM Objectives

• All systems exhibit variation. The task of quality management is to reduce this variation.
• We must recognise the difference between common (random) causes and special (assignable) causes.
• By eliminating the latter we get the process in control (stable).
• By eliminating the former we are able to increase capability (ability to meet specifications).

Statistical Process Control (SPC)

• A methodology for monitoring a process to identify special causes of variation and signal the need to take corrective action when appropriate
• SPC relies on control charts
Control Charts

Control Chart Applications

- Establish state of statistical control
- Monitor process and signal when process goes out of control
- Determine process capability
Typical Out-of-Control Patterns

- Point outside control limits
- Sudden shift in process average
- Cycles
- Trends
- Hugging the control limits
- Instability

In Control versus Capable

- In Control
  - The natural variability of the product / service is within the limits of what we consider acceptable e.g. six sigma

- Capable
  - The product / service is produced within the limits of the design specification
Process Stability

Without knowing if a process is stable, management does not know where to start work on improving it.

Stable Processes (in control)

Provided all points fall at random about the centreline, and between the UCL and LCL, the process is deemed stable (in control).

If points fall outside the control limits, or in a non-random pattern, the process is deemed unstable (out of control).
In Control and Capable

Spec.  Average  Spec.

Lower Control Limit LCL  Upper Control Limit UCL

In Control but Incapable

Spec.  Average  Spec.

Lower Control Limit LCL  Upper Control Limit UCL
Specifications and Control Limits

Understand the difference between specifications and control limits.

A process may be stable (in statistical control) but be incapable of producing output consistent with specifications.

The control limits depend on the total process, and cannot generally be worked out beforehand.

The various definitions of Quality

- The transcendent approach views quality as synonymous with innate excellence.
- The manufacturing-based approach assumes quality is all about making or providing error-free products or services.
- The user-based approach assumes quality is all about providing products or services that are fit for their purpose.
- The product-based approach views quality as a precise and measurable set of characteristics.
- The value-based approach defines quality in terms of ‘value’.
TQM In Services

- Service quality is more difficult to measure than the quality of goods
- Service quality perceptions depend on
  - Intangible differences between products
  - Intangible expectations customers have of those products

Service Quality

The Operations Manager must recognise:

1. The tangible component of services is important
2. The service process is important
3. The service is judged against the customer’s expectations
4. Exceptions will occur
Determinants of Service Quality

- Reliability
- Responsiveness
- Competence
- Access
- Courtesy
- Communication
- Credibility
- Security
- Understanding/knowing the customer
- Tangibles

Quality in Service Industries

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Quality Measure Area</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legal practice</td>
<td>Receptionist</td>
<td>Is phone answered by the second ring?</td>
</tr>
<tr>
<td></td>
<td>Billing</td>
<td>Accurate, timely, and correct format</td>
</tr>
<tr>
<td></td>
<td>Partner</td>
<td>Promptness in returning calls</td>
</tr>
</tbody>
</table>
### Quality in Service Industries

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Quality Measure Area</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hotel</td>
<td>Reception desk</td>
<td>Use customer’s name</td>
</tr>
<tr>
<td></td>
<td>Doorman</td>
<td>Greet guest in less than 30 seconds</td>
</tr>
<tr>
<td></td>
<td>Room</td>
<td>All lights working, spotless bathroom</td>
</tr>
<tr>
<td></td>
<td>Minibar</td>
<td>Restocked and charges accurately posted to bill</td>
</tr>
</tbody>
</table>

### Quality in Service Industries

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Quality Measure Area</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital</td>
<td>Billing</td>
<td>Accurate, timely, and correct format</td>
</tr>
<tr>
<td></td>
<td>Pharmacy</td>
<td>Prescription accuracy, inventory accuracy</td>
</tr>
<tr>
<td></td>
<td>Lab</td>
<td>Audit for lab-test accuracy</td>
</tr>
<tr>
<td></td>
<td>Nurses</td>
<td>Charts immediately updated</td>
</tr>
<tr>
<td></td>
<td>Admissions</td>
<td>Data entered correctly and completely</td>
</tr>
</tbody>
</table>
### Quality in Service Industries

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Quality Measure Area</th>
<th>Standard</th>
</tr>
</thead>
</table>
| Restaurant    | Waiter               | Serves water and bread within 1 minute  
|               |                      | Serves your meal correctly  
|               |                      | Servers your wine correctly and keeps it topped up correctly  
|               |                      | Clears all main course items and crumbs prior to dessert  
|               |                      | Knows and suggest specials and desserts |

### Quality in Service Industries

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Quality Measure Area</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department Store</td>
<td>Display areas</td>
<td>Attractive, well-organised, stocked, good lighting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stockrooms</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sales Assistants</td>
</tr>
</tbody>
</table>
Service Specs at UPS

Case Study – Calling Sue

- What were the gaps between the customers’ expectations and perceptions in the process described?
- How were the customers’ expectations influenced from the outset?
- What aspects of the bank's service quality specification have been revealed to the customer? Are these reasonable for such an account?
- Evaluate Sue’s reaction to the problems at every stage? Was the bank’s service recovery successful?
- What costs have been caused by these problems, and how do they compare with the underlying costs at the root cause of the problem?
Gap Analysis – Calling Sue

Customer's expectations concerning a product or service

Customer's perceptions concerning the product or service

Customer's own specification of quality

The actual product or service

Management's concept of the product or service

Organisation's specification of quality

Previous Experience

Word of mouth communications

Image of product or service

Gap 1

Gap 2

Gap 3

Gap 4

Call Sue - Customer Problems

• One cheque book arrived after 9 days
• Business accounts had incorrect spellings and current account had wife's initials reversed
• The credit / cash cards arrived without the PINs
• One week later they still had not arrived
• Names on envelope still correct but correct names on guarantee cards
• Credit cards had expired and ATM would not accept PINs for the original cards
Exercise—Cost of Quality

- These two problems examine the cost of quality in terms of the cost to inspect for defects versus the cost of not doing so and fixing it later.