Quality Function Deployment

Translating voice of the customer (customer requirements) to product specifications
Quality Function Deployment

QFD Facilitates:

• Setting target values for operating (e.g. Design and manufacturing) requirements
• Guiding what to measure
• Comparisons to competitors
Quality Function Deployment

A process of translating customer requirements into technical requirements during product development and production.

QFD benefits companies through improved communication and teamwork between all constituencies in the value chain, such as between marketing and design, between design and manufacturing, and between purchasing and suppliers.
The “House of Quality” worksheet

Technical requirements

Voice of the customer

Relationship matrix

Technical requirement priorities

Customer requirement priorities

Competitive evaluation
Quality Function Deployment Process

- Technical requirements
- Component characteristics
- Process operations
- Quality plan
## Example 1: Energy Drink

<table>
<thead>
<tr>
<th></th>
<th>Price</th>
<th>Size</th>
<th>Calories</th>
<th>Sodium</th>
<th>Fat</th>
<th>Customer requirements</th>
<th>Competitive Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taste</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td></td>
<td>○</td>
<td>4</td>
<td>3  4  5</td>
</tr>
<tr>
<td>Nutrition</td>
<td>●</td>
<td>○</td>
<td></td>
<td>●</td>
<td>○</td>
<td>4</td>
<td>3  2  3</td>
</tr>
<tr>
<td>Visual Appeal</td>
<td>○</td>
<td>●</td>
<td></td>
<td>○</td>
<td></td>
<td>4</td>
<td>3  4  4</td>
</tr>
<tr>
<td>Value</td>
<td>●</td>
<td>○</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>4  3  4</td>
</tr>
<tr>
<td>Our priority</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Competitor A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Competitor B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 = Low up to 5 = High

● = very strong relationship
○ = strong relationship
△ = weak relationship
Building the House of Quality

- Identify customer requirements
- Identify technical requirements
- Relate the customer requirements to the technical requirements
- Conduct an evaluation of competing products or services
- Evaluate technical requirements and develop targets
- Determine which technical requirements to deploy in the remainder of the production/delivery process
## Example 2: QFD for Dry Cleaners

### Customer requirements

<table>
<thead>
<tr>
<th>Customer requirements</th>
<th>Importance weighting</th>
<th>Operating requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completely clean</td>
<td>15</td>
<td>Good training</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clean DC solvent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clean DC filters</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No rust on SP line</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Firm press parts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Good equip. maintenance</td>
</tr>
<tr>
<td>Perfect press</td>
<td>0</td>
<td>4-hr format</td>
</tr>
<tr>
<td>No delays at counter</td>
<td>0</td>
<td>2-wk OUT</td>
</tr>
<tr>
<td>Quick turnaround</td>
<td>0</td>
<td>Visual daily</td>
</tr>
<tr>
<td>Friendly service</td>
<td>0</td>
<td>Visual daily, clean monthly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visual daily, clean monthly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Change monthly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Monthly, Plus as needed</td>
</tr>
</tbody>
</table>

### Technical evaluation

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>AB</td>
<td>X</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>B</td>
<td>X</td>
<td>B</td>
<td>A</td>
<td>X</td>
</tr>
<tr>
<td>X</td>
<td>A</td>
<td>B</td>
<td>X</td>
<td>AB</td>
</tr>
</tbody>
</table>

### Relationship values

- **Strong** = 9
- **Medium** = 3
- **Small** = 1

### Competitive Evaluation

- **X** = Us
- **A** = Comp A
- **B** = Comp B

### Correlation

- **+** = Strong positive
- **0** = Positive
- **X** = Negative
- **•** = Strong negative

### Example

**QFD for Dry Cleaners**

1. **Customer requirements**
2. **Operating requirements**
3. **Importance weighting**
4. **Target values**
5. **Technical evaluation**
6. **Relationships**
Classifying Customer Requirements by the Kano Model

• Some requirements are basic and expected – their absence leads to dissatisfaction – slow or missing telephone dial tone
• Some requirements are functional – these are “must” and customers state these overtly – price, performance, delivery ...
• Some latent requirements bring delight to the customer – the 3M Post-It
• All may be determined by customer interaction and survey – before you begin product or service design
The graphic view of Kano

- Delighters
- Satisfiers
- Dis-satisfiers

Satisfaction

Not Delivered

Fully Delivered

Dis-satisfaction
QFD first seeks customer’s voice (VOC)

• The whole process of the QFD can be linked to GIGO (Garbage In Garbage Out) in positioning a new product
• This is because, if the voice of the customer has not been captured properly, the final product will also not be the one actually desired by the marketplace
• It is therefore extremely important to capture the correct voice of the customer before taking any other step in the QFD planning process.
• We explain this by the example of a company proposing to develop a new car to counter sagging sales
The Example: Designing and Launching new model

A product development team wanted to determine what customers wanted in a new car. After interviewing about 120 car drivers, the team came out with the following chart of the customer requirements.
VOC: Desired product attributes in a new car

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy to drive</td>
<td>5</td>
</tr>
<tr>
<td>Quiet riding, no squeaks or rattles</td>
<td>4.8</td>
</tr>
<tr>
<td>Excellent finish</td>
<td>4.6</td>
</tr>
<tr>
<td>Smooth riding even on rough road</td>
<td>4.5</td>
</tr>
<tr>
<td>Excellent gas millage</td>
<td>3.9</td>
</tr>
<tr>
<td>Aerodynamic design</td>
<td>3.8</td>
</tr>
<tr>
<td>Hugs the road</td>
<td>3.7</td>
</tr>
<tr>
<td>Free from breakdowns</td>
<td>3.6</td>
</tr>
<tr>
<td>Fast acceleration</td>
<td>3.4</td>
</tr>
<tr>
<td>Virtually maintenance free</td>
<td>3.3</td>
</tr>
<tr>
<td>Durable – will last 150,000 miles</td>
<td>3.2</td>
</tr>
<tr>
<td>Protects the driver and passenger in case of accident</td>
<td>3</td>
</tr>
<tr>
<td>Classic styling</td>
<td>2.2</td>
</tr>
<tr>
<td>Has instruments to read critical functions</td>
<td>2</td>
</tr>
<tr>
<td>Has many electronic devises</td>
<td>1.4</td>
</tr>
<tr>
<td>Has convertible roof</td>
<td>0.25</td>
</tr>
</tbody>
</table>
So, new Car for whom?
Look at the Segments in the marketplace

• Such classification of customer requirements clearly reveals the attribute that is most important for the performance driver is least important for the practical driver, and vice versa.
• The simplistic listing of the customer requirements would have definitely ended up in the development of incorrect product for the market and a failure.
• Reading the voice of the customer is therefore the most critical and challenging aspect of the whole QFD process.
Translating VOC into technical requirements – A pitfall that was overlooked

A product development team was all set to translate the requirements of the customer into technical requirements as per the QFD matrix.

Fallacy: The survey was based on aggregate data management and its basic assumption was that there is one best answer for everyone (the whole market)
A better approach: Classification of needs

The product development team was asked by the perceptive CEO to classify the needs of various types of drivers and then give it a rating, instead of proceeding simply with the aggregate data management. After a market survey the product development team divided customers into two broad categories:

1. The performance driver
2. The practical driver

The team then came with the following findings.
Two different profiles of desired product attributes were discovered...

**Performance driver**
- Fast acceleration
- Aerodynamic design
- Hugs the road
- Easy to drive
- Excellently finished
- Quiet riding
- Classic styling
- Smooth riding
- Free from breakdowns
- Excellent gas millage
- Virtually maintenance free
- Protects drivers
- Exellently finished
- Many electronic devices
- Aerodynamic design
- Hugs the road
- Instruments to read functions
- Classic styling
- Convertible roof
- Fast acceleration

**Practical driver**
- Excellent gas millage
- Virtually maintenance free
- Free from breakdowns
- Easy to drive
- Durable
- Quiet riding
- Smooth riding
- Protects drivers
- Excellently finished
- Many electronic devices
- Convertible roof
- Fast acceleration
Two different Product development paths followed this QFD...
Other methods in design: Concept Engineering

- Understanding the customer’s environment
- Converting understanding into requirements
- Operationalizing what has been learned
- Concept generation
- Concept selection
DFMEA

Design Failure Mode and Effects Analysis (DFMEA)

Identification of all the ways in which a failure can occur, to estimate the effect and seriousness of the failure, and to recommend corrective design actions.
DFMEA Specifications

- Failure modes
- Effect of failures on customers
- Severity, likelihood of occurrence, and detection rating
- Potential causes of failure
- Corrective actions or controls
Other Tools for Quality Planning

- The Seven Management and Planning Tools
- These are different from the 7 basic TQM tools to manage quality
Affinity Diagram

Poor Quality Cost

Equipment Cost
- Instruments
- Inspection
- Process control

Material
- Scrap
- Human jobs
- Downtime

Productivity
- Investigations
- Costs
- Failures
Interrelationship Diagraph
Tree Diagram
Other Planning Tools

- Matrix diagrams
- Matrix data analysis
- Process decision program charts
- Arrow diagrams
Process Decision Program Chart
Statistical Thinking

- All work occurs in a system of interconnected processes
- Variation exists in all processes
- Understanding and reducing variation are keys to success
Poka-Yoke (Mistake-Proofing)

An approach for mistake-proofing processes using automatic devices or methods to avoid simple human or machine error, such as forgetfulness, misunderstanding, errors in identification, lack of experience, absentmindedness, delays or malfunctions.
Three Levels of Mistake-Proofing

• Eliminate any possibility that the error or defect might occur
• Require time to stop a process and take corrective action
• Eliminate wasted resources that would add value to non-conforming work, but clearly results in scrap or rework
Common Poka-Yoke Examples
(from John Grout’s Poka-Yoke Web Page)
A Kaizen Blitz is an intense and rapid improvement process in which a team or a department throws all its resources into an improvement project over a short time period, as opposed to traditional kaizen applications, which are performed on a part-time basis.
Creativity and Innovation

Creativity – The ability to discover useful new relationships and ideas

Innovation – Practical implementation of creative ideas
Fostering Creativity

- Remove or reduce obstacles to creativity
- Match jobs to individuals’ creative abilities
- Tolerate failures and establish direction
- Improve motivation to increase productivity and solve problems creatively
- Enhance the self-esteem and build the confidence of organization members
- Improve communication so that ideas can be better shared
- Place highly creative people in special jobs and provide training to take advantage of their creativity
Wisdom from Texas Instruments

“Unless you change the process, why would you expect the results to change”
Quality System Certification

- ISO 9000
- ISO 14000
- QS 9000
The ISO 9000 QM System

- Series of standards agreed upon by the International Organization for Standardization (ISO)
- More that 100 countries have adopted
- A prerequisite for global competition?
- ISO 9000 directs you to “document what you do and then do as you documented”
Quality Certification

- ISO 9000, QS 9000
- Set of international standards on quality management and Quality assurance, critical to international business
- ISO 9000 series standards, briefly, require firms to document their quality-control systems at every step (incoming raw materials, product design, in-process monitoring and so forth) so that they’ll be able to identify those areas that are causing quality problems and correct them
The ISO 9000 Series Standards

• ISO 9000 requires companies to document everything they do that affects the quality of goods and services.
• Hierarchical approach to documentation of the Quality Management System
International Organization for Standardization (ISO)

National Bodies

- ANSI
  - Committees
  - Trade Orgs
  - Std Orgs
- Z1
- Auto
- ASQ

Technical Committee

TC 176 (Quality)

ISO

User
Why International Standards?

- They promote trade and cooperation
- Product standards allow consumers to purchase items from different manufacturers and know those items will perform equally
- Management system standards promote common approaches to managing quality and the environment. They promote dependability and a consistent use of statistics
ISO 9000 Consensus Process

1. New work item proposal
2. Draft International Std
3. Final Draft Int’l Standard
4. Working Draft
5. Committee Draft
6. Published Standard

Voting process:
- Formal Ballot
- Ballot

Decision:
- Votes
The Original ISO 9000 Series

- **ISO 9000** – Helps companies determine which standard of ISO 9001, 9002 and 9003 applies
- **ISO 9001** – Outlines guidelines for companies that engaged in design, development, production, installation and servicing of products or service
- **ISO 9002** – Similar to 9001, but excludes companies engaged in design and development
- **ISO 9003** – Covers companies engaged in final inspection and testing
- **ISO 9004** – The guidelines for applying the elements of Quality Management System
ISO 14000

ISO 14000 – A set of international standards for assessing a company’s environmental performance

Standards in three major areas
• Management systems
• Operations
• Environmental systems
ISO 10000 Series

ISO 10011 - Quality system auditing guide

ISO 10013 - Quality manual development guide
The ISO 9001: 1994 Clauses

2 Quality System

1 Management Responsibility
5 Document & Data Control
18 Training
17 Internal Quality Audits

14 Corrective & Preventive Action
16 Control of Quality Records

3 Contract Review
4 Design Control

7 Control of Customer-Supplied Product
6 Purchasing

Product Control

11 Inspection, Measuring, & Test Equipment
19 Inspection & Testing
12 Inspection & Test Status
8 Product Identification & Traceability

Vendor (Sub-Contractor)

Service

13 Control of Non-Conforming Product

15 Handling, Storage, Packaging, Preservation & Delivery
20 Statistical Techniques

19 Servicing

9000 – Fundamentals and Vocabulary
9001 – Requirements
9004 – Guidelines For Performance Improvements
10012 – Measurement Control
19011 – QMS/EMS Auditing
The New ISO 9001:2000

- Quality Management System – Put structure in what you do
- Management Responsibility – Put someone in charge
- Resource Management – Provide the resources to achieve goals
- Product realization – Design and make it to requirements
- Measurement, analysis and improvement – Know where you are and get better
Third party registration

- Register Accreditation Board
  - accredit
    - Register
    - Company
    - Customers
  - certify
    - Auditors
    - Course Providers
  - accredit
    - Auditors
  - train
    - Course Providers
  - hire
    - Register
    - Auditors
Registration Steps

The Registrar will:
• Request information from you
• Review your documents (mostly QA manual)
• Review your application
• Audit your facility
• Issue your certificate
• Conduct periodic surveillance
• Renew certificate after three years
ISO 9000 Registration Process

• The final audit begins with a review of the company’s Quality Manual, which the accredited registrar or third part audit team typically uses as its guide.

• The audit team checks to see that the documented quality system meets the requirement of ISO 9000 and that the organization is practicing what is documented.
ISO 9000 Registration Process

• When an organization feels that its quality system is good enough, it may ask an accredited registrar or other third party audit team for pre-assessment
Timeline for Registration

0.0 Decide to go for registration
   Form a steering committee

0.5 Write your QA Manual
   Write process procedures

1.0 Conduct internal reviews
   Refine your processes

1.5 Conduct system audits
   Undergo a “mock” audit

2.0 Receive registration
What ISO 9000 did for industry: The Quality Assurance Infrastructure

- Brought about the Quality Policy
- A quality system to accomplish the objectives set out in the quality policy
- Consistency to be achieved by ensuring that for each task same methods, materials, skills etc. are used every time
- Audits and reviews
  - People are operating by the documented system, and
  - The system meets the requirements

Examples: ISO 9000:2000, QS 9000
Inspection

- How much/How often
- Where/When
- Centralized vs. On-site
An ISO 9000 Practice: Where to Inspect the Process

- Raw materials and purchased parts
- Finished products
- Before a costly operation
- Before an irreversible process
- Before a covering process
# Examples of Inspection Points

<table>
<thead>
<tr>
<th>Type of business</th>
<th>Inspection points</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast Food</td>
<td>Cashier, Counter area, Eating area, Building, Kitchen</td>
<td>Accuracy, Appearance, Productivity, Cleanliness, Appearance, Health regulations</td>
</tr>
<tr>
<td>Hotel/Motel</td>
<td>Parking lot, Accounting, Building, Main desk</td>
<td>Safe, well-lighted, Accuracy, Timeliness, Appearance, Safety, Waiting times</td>
</tr>
<tr>
<td>Supermarket</td>
<td>Cashiers, Deliveries</td>
<td>Accuracy, Courtesy, Quality, Quantity</td>
</tr>
</tbody>
</table>
International issues

Environmental management systems
Occupational health & safety
Regulated industries
  • Medical devices
  • Pharmaceutical
  • Health care

Sector-specific applications
  • Automotive (QS-9000 and TS-16949)
  • Aerospace (AS-9000/AS-9100)
  • Telecommunications (TL-9000)
Introduction to QS 9000

Common Supplier Quality Standard established by the Big Three: Chrysler, Ford, GM

First introduced in North America in August 1994

Consists of:
Section I  ISO 9000-based requirements
Section II Customer-specific requirements
Why QS 9000

• Upgrade from existing ISO 9000 system
• Meeting mandatory requirements for the automotive industry
• Emphasis on Continuous Improvement and Defect Prevention
• Moving closer to TQM
Why QS 9000

The concerns for cost issues led to considerations on how to create a quality system that could help:

• Reduce liability issues
• Address suppliers with lower inputs
• Improve consistency and dependability
• Synchronize the supplier base
• Eliminate the practice of choosing a supplier just because they are there

These concerns are not clearly addressed in the ISO-9000 standard
What is QS 9000?

QS 9000 is basically one big section (ISO 9000) and two smaller customer specific sections:

Section I – ISO 9000-based requirements

Section II – Sector-specific requirements

Section III – Customer-specific requirements
What is QS 9000?

QS 9000 is composed of 20 core elements (clauses) listed below:

- Management Responsibility
- Management Responsibility - Element 4.1
- Quality System - Element 4.2
- Contract Review - Element 4.3
- Design Control - Element 4.4
- Document and Data Control - Element 4.5
- Purchasing - Element 4.6
- Control of Customer-Supplied Product - Element 4.7
- Product Identification and Traceability - Element 4.8
- Process Control - Element 4.9
- Inspection and Testing - Element 4.10
- Control of Inspection, Measuring and Test Equipment - Element 4.11
- Inspection and Test Status - Element 4.12
- Control of Nonconforming Product - Element 4.13
- Corrective and Preventive Action - Element 4.14
- Handling, Storage, Packaging, Preservation and Delivery - Element 4.15
- Control of Quality Records - Element 4.16
- Internal Quality Audits - Element 4.17
- Training - Element 4.18
- Servicing - Element 4.19
- Statistical Techniques - Element 4.20
How is the QS 9000 standard interpreted?

Current interpretations to the QS 9000 standard come from Ford, Daimler-Chrysler, GM and agencies such as:
AIAG
ASQ
IASG
And other Truck and OEM vehicle manufacturers
QS 9000 Documentation

The levels of documentation for QS 9000 resemble a pyramid.

The three main levels are:

**Level I**
- Management review records
- Quality manual
- Policies
- Objectives
- Organization
- Interaction of processes

**Level II**
- Records at any level
- Process documents
- Standard operating procedures
- Quality plans

**Level III**
- Lot history records
- Work instructions
- Wall reference charts
- Instructional computer screens

**Level IV**
- Forms - spec sheets - templates
- Drawings - data sheets - blueprints

Corporate manuals
Divisional manuals
Process manuals; fact books; purchasing manuals; training manuals; design history files
# Comparative Analysis

<table>
<thead>
<tr>
<th>QS 9000</th>
<th>ISO 9000</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Specifically geared towards the BIG THREE automotive manufacturers</td>
<td>• Non-specific by design</td>
</tr>
<tr>
<td>• A tool focused on the major players in the automotive industry</td>
<td>• A tool geared towards any type of industry</td>
</tr>
</tbody>
</table>
Differences: QS vs ISO

Major additional requirements for QS 9000:

3.1 Quality System Area

- Customer satisfaction
  Documented process showing key indicator of customer dissatisfaction, competitive benchmarks
- Continuous Improvement
  Prioritized action to improve stabilized process (CA for unstable process)
• Failure Mode and Effect Analysis (FMEA)

• Advance Product Quality Planning (APQP)
• Control Plan (CP)
  APQP is required for new and changed products
  CP covers Prototype, Pre-launch and Production

• Feasibility Review
  Conform manufacturing feasibility

• Production Part Approval Process (PPAP)
  Compilation of data for new or changed product
  (Cpk, FMEA, Test Results etc.)
APQP (Advanced Product Quality Planning) is a Five-Phase Process

- Concept Initiation/Approval
- Program Approval
- Prototype
- Pilot
- Launch

Planning
- Product Design & Development
- Process Design & Development

Product and Process Validation

Feedback Assessment and Corrective Action

Production Planning
3.2 Purchasing Area

- Government, Safety and Environment regulations
  Governmental and safety regulation

- Sub-contractor Development
  Evidence of developing sub-con to follow
  Selective or full QS 9000 requirements
3.3 Process Control Area

- Designation of special product/process characteristics

- Refers to characteristics that need extra attention e.g. Excessive variation affect product safety, fit, function, appearance etc.
3.4 Inspection & Test Area

Acceptance criteria for attribute characteristics
Attribute data sampling plan shall be zero defects

Layout Inspection and Functional Test
Shall be performed for all products (frequency established by customer)

Laboratory requirements
Documented policies, system, procedures, instructions
Procedure for receipt, handling, disposal of test samples
Quality Systems Documentation Progression

International Standards
ISO 90000

Customer Specific Requirements
QS 9000
Production Part Approval Process

Company Specific Requirements

Defines International Requirements

Customer Reference Manuals
Advanced Product Quality Planning & Control Plan
Failure Mode Effects Analysis
Measurement Systems Analysis
Statistical Process Control

Defines Customer Requirements
3.5 Customer-Specific Requirements

Some examples are

Chrysler-specific requirements
• Annual Layout – Complete annual layout for all parts
• Corrective Action – Chrysler 7 steps CA process
• Electronic Communication (Supply Partner Information Network, SPIN)

Ford-specific requirements
• Control Plans and FMEAs – Signatory approval
• Annual Layout – Minimum annually
General Motor-specific Requirements

• Layout inspection and functional test
• Unless specified otherwise there is no customer established frequency for annual layout

• Control Plan – No signatory requirement

• Electronic Communication
Implementing QS 9000

Basic Strategy

The first step is to implement a quality policy

The next step is to build compliant documents and a quality system

QS 9000 drives for Continuous Improvement...
Implementation

Implementation is mandatory for direct or indirect suppliers (first tier, second tier and so on)

Implementation paths
• Get to know the requirements of QS 9000 (7 packs, publication by AIAG)
• Find out the specific requirements from your customers
• Appoint Committee to oversee the project
• Gap analysis between existing system and QS 9000
• Determine whether external help is required
• Decide about certification body
Implementing QS 9000

Documentation

Then develop a general, company-wide quality policy

And then begin to assemble your QS 9000 related documents

Proper documentation...
Implementing a QS 9000 System

Write your Level I documents for each of the elements of the QS 9000 remembering to consider
Contractual requirements
Customer needs
Responsible parties for compliance to each element
An emphasis on problem prevention

Responsibility and control...
Quality Problems: Documentation Example

1. Quality Problem Occurs
   - Customer Problem
     - Yes: Conduct Disciplined Problem Solving
     - No: Cause Known
       - Yes: Conduct DOE
       - No: Cause Known

2. Cause Known
   - No: Revisit PFMEA
   - Yes: Corrective Action

3. Corrective Action
   - Update Control Plans and Plant Work Instructions

4. Revisit PFMEA
   - Yes: Cause Known
   - No: Conduct DOE

Note: The flowchart illustrates the decision-making process for handling quality problems, including the evaluation of customer issues, the determination of cause known, and the implementation of corrective actions. The flowchart is interactive, allowing for a step-by-step approach to problem-solving and documentation updates.
PFMEA & Control Plans

- Scrap, Rework Data
- Process Flow
- PFMEA
- Control Plan
- Work Instruction
- Warranty & Assembly Plant Data
Implementing QS 9000

Documentation contd.

Once the Level I documents are in place, it is time to create the Level II procedures and Level III work instructions for your organization. Issues such as:
• Authorization and responsibilities
• Training
• Documentation control
must be incorporated into these steps!

And conformance to customer specific requirements!!
The QS 9000 Audit

Simply put like ISO 9000, QS 9000 expects you to:

“Say what you do”, then do your tasks the same way

AND

“Do what you say”, then show objective evidence that you are doing what your documentation says
Suggestions to get QS 9000

Focus on the additional requirements if a company has already ISO 9000 certification

Thorough understanding of APQP before implementation

Emphasis on training of key staff, e.g. Line engineers

Prepare to put in more effort and discipline on documentation e.g. PPAP
Summary of QS 9000

• Designed for the automotive sector, QS 9000 aims at meeting customer-specific quality requirements

QS 9000 puts focus on
• Continuous improvement
• Defect prevention
• Reduction of variation and waste

• In long run, this would improve a parts supplier’s competitiveness
Evolution of QA Methods

- Inspection
- SPC
- DOE
- Taguchi
- Quality Mgmt Systems
- Six Sigma
- QS 9000 brings you here

Timeline:
- 1930
- 1950
- 1975
- 1985
- 1990
- 1995
- 2000
Recognition of QM through Awards

- Baldrige Award
- Deming Prize
- EU Quality Award
- Rajiv Gandhi Quality Award
Quality Awards

- Deming Prize
Recognizing Quality

Quality Awards
Include:
• Deming Prize (first major award)
• Baldrige Award (established by Congress)
• Statewide awards: EU, India, other

Provide:
• Recognition (shouldn’t be primary goal)
• Path to improved quality

Baldrige Award criteria
• Juran: criteria summarize TQM
Malcolm Baldrige National Quality Award

1.0 Leadership
2.0 Strategic Planning
3.0 Customer and Market Focus
4.0 Information and Analysis
5.0 Human Resource Development and Management
6.0 Process Management
7.0 Business Results
Baldrige Award details

• A US National Quality Award
• Started in 1987
• Awards in three categories – manufacturing, service, small business – no more than two awards per category per year
• Stresses ‘management by fact’
• Consists of a three level judging process
• A seven-category, 1000-point scoring system: Leadership, information and analysis, strategic quality planning, human resource utilization, quality assurance of products and services, quality results, customer satisfaction
Leadership

Contributes 100 points
• Senior executive leadership
• Quality values
• Management for quality
• Public responsibility

Symbolism and Active involvement
Intimate knowledge of how the work actually gets done

Impressive listening skills
• Skip-level communication
Information and analysis

Contributes 70 points
• Scope and management of quality data and information
• Competitive comparisons and benchmarks
• Analysis of quality data and information

Must demonstrate fact-based management

Information base must be comprehensive, accessible and well-validated

Use benchmarking as an enabler of change, a learning process
Strategic Quality Planning

Contributes 60 points

• Strategic quality planning process
• Quality goals and plans
Human Resource Utilization

Contributes 150 points
• Human resource management
• Employee involvement
• Quality education and training
• Employee recognition and performance measurement
• Employee well-being and morale

Empower the employees and unleash the full potential of the workforce

Quality training involves increased awareness, problem-solving tools, group process skills and job-specific skills

“Empowerment is in the eyes of the empowered.”
Quality Assurance of Products and Services

Contributes 140 points
- Design and introduction of quality products and services
- Process quality control
- Continuous improvement of processes
- Quality assessment
- Documentation
- Business process and support service quality
- Supplier quality

Instead of functional lines, emphasize on process
Quality Results

Contributes 180 points
• Product and Service Quality results
• Business process, operational and support service quality results
• Supplier quality results

Looking for ‘meaning trends’

Sustained improvement on critical measures over a period of at least three years

Use statistical methods to correlate objective quality results with measures of customer satisfaction
Customer Satisfaction

Contributes 300 points
• Determining customer requirements and expectations
• Customer relationship management
• Customer service standards
• Commitment to customers
• Complaint resolution for quality improvement
• Determining customer satisfaction
• Customer satisfaction results
• Customer satisfaction comparison

Customer information from a wide range of sources – focus groups, surveys, one-to-one meetings, sales, visits etc.

Measures are objective and validated, not anecdotal
The Deming Prize

• Honoring W. Edwards Deming

• Japan’s highly coveted award

• Primary focus is on statistical quality control
Employee-Drive Quality

Training (and education) Involves:
• Basic job skills
• Tools for continuous improvement, SPC, etc.
• Cross-training

Must be considered as investment, not expense!

Old (and still prevalent) approach
• Exploit division of labour (hire unskilled)
• Inhibits pride in workmanship

Cross-training can build better understanding
The EU FQM Excellence Model

A framework for organisational management systems, promoted by the European Foundation for Quality Management to help organisation to be more competitive

Establishes a management system by measuring where organisations are on the path to excellence; helping them understand the gaps; and then stimulating solutions

Positive correlation exists between adoption of EFQM Excellence Model and improved organisational results
EFOM model can be used in four ways

1. Helps develop vision and goals for the future in a tangible, measurable way
2. A framework to identify and understand the systemic nature of the business, the key linkages and cause and effect relationships
3. A process to allow a company recognize its most successful customer experience (internal and external) and promote them to achieve the organizational target guided by the mission statements
4. A self-assessment tool that checks the current health of the organisation to better balance priorities, allocate resources and generate realistic business plans
Using the EFOM Model

Model is a non-prescriptive framework based on nine criteria; five are ‘enablers’ and four are ‘results’

‘Enabler’ criteria cover what an organisation does. The ‘results’ criteria cover what an organisation achieves.

‘Results’ are caused by ‘enablers’ and feedback from ‘results’ help to improve ‘enablers’

Model recognises approaches to achieving sustainable excellence in all aspects of performance
Rajiv Gandhi National Quality Award (RGNQA)

Named after late Prime Minister Rajiv Gandhi for the thrust he had given to the quality movement in India so it could move into 21\textsuperscript{st} Century with pride

Instituted by the Bureau of Indian Standards in 1991

Encourages Indian manufacturing and service organisations to strive for excellence

Specially recognizes the leaders of quality movement in India; RGNQA is awarded annually

Intends to drive Indian products and services to higher levels of quality to meet challenges in domestic and export markets.
RGNQA helps Indian Industry to improve quality by:

- Encouraging them to maximize consumer satisfaction and to successfully face competition in the global market
- Recognizing achievements of organisations which have improved quality to set an example for others
- Establishing guidelines and criteria for industry in evaluating their own quality improvement efforts
- Providing specific guidance to organisations willing to learn how to achieve excellence in quality
- Designed in line with US Malcolm Baldrige National Quality Award, the Japanese Deming Prize and the European Quality Award
Employee-Driven Quality

Organization
Involves:
• Close supplier/customer (next process) contact
• Multi-functional teams etc.

Unites workers for constancy of purpose
Typical formats:
• Quality circles
• Cells and teams (pioneered in manufacturing)
• Project teams when work flows are separated

Gangs versus teams
Team training: team dynamics, problem-solving, quality tools
Recognizing Quality

Benchmarking

Definition: Identifying and documenting best practices
• Competitors
• Other industries

Start by selecting and benchmarking own process
• Metrics: comparisons (e.g. LT:Content ratio)
• Practices: steps, errors, delays etc.

Typical steps summarized in the next slide

Concept and methods are evolving
The Benchmarking Process: Common Steps

**Getting Started**
- Planning
- Organizing and Managing for benchmarking

**Conducting Research**
- Collect information: Who's the best? What to ask?

**Collecting & Sharing Information**
- Surveys
- Site visits
- Determine any third parties

**Preparing to Benchmark**
- Identify key process
- Form team
- Understand your own processes

**Selecting whom to Benchmark**
- Establish relationship
- Plan to collect and share information

**Analyzing, Adapting and Improving**
- Compare data
- Plan to surpass
- Implement and monitor
- Improve

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**Continuous Improvement**
Software Quality Assurance
Software Disasters

- Green Party Convention fails (By rounding error and erroneous use of Excel the wrong number of delegates is computed, 2002)
- Mars Climate Orbiters, Loss (mixture of pounds and kilograms, 1999)
- Ariane 5, Explosion (Data conversion of a too large number, 1996)
- Denver Airport (Computerized baggage handling fails, 1995)
- Pentium Processor, Division Algorithm (incomplete entries in a look-up-table, 1994)
- Patriot Scud (rounding error, 1991)
- NASA Mariner 1, Venus probe (period instead of comma in FORTRAN DO-Loop, 1962)
Software Quality

Currently test-based; Good practices are being documented

Process Quality
• Ensuring conformance with user requirements
• Identifying defects by testing and code-walkthrough
• Monitoring the product through its phases of development by unit and integration tests

Product Quality
• Identifying user specified quality needs
• Prioritizing quality needs
• Resolving quality conflicts, if any
• Building them into the development process
• Allocating effort and time for them, heavily test-based
Assuring Software Quality – An Example

Quality factors
- Needs database
- Quality conflicts
  - Cost of quality
  - Criteria for good requirements

Analyze need for quality
- User opinions
- Req. spec.
- Design req.
  - Level of quality
  - Quality needs data flow
  - Engineering defects

Convert quality needs to requirements
- Traceability
- Quality specification guidelines
  - Factors and criteria

Document SW Quality requirements
  - Software
Evolution of QA Methods ...

Software Development is stuck at testing

- Inspection
- SPC
- DOE
- Taguchi
- Quality Mgmt Systems
- Six Sigma