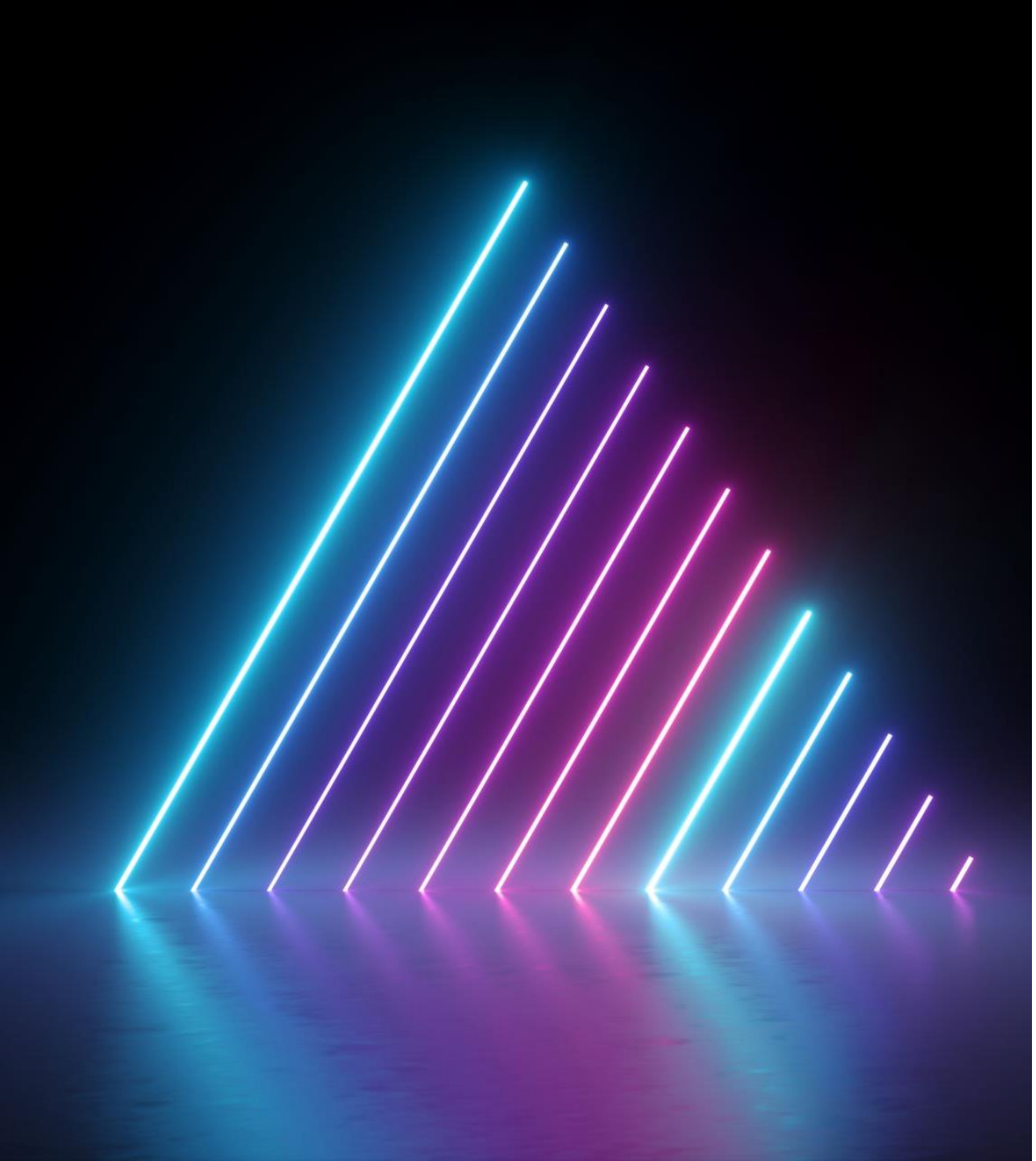


# *Quality Management and Costing*

# Introduction

Management plays an instrumental role in the effective performance of quality-related activities in an organization. A well-managed quality organization can be useful in many ways including better communication, less number of conflicts in responsibilities and activities, better customer satisfaction, and lower cost. More simply, a well-managed quality organization is essential in producing an acceptable quality item at competitive prices.

# Introduction

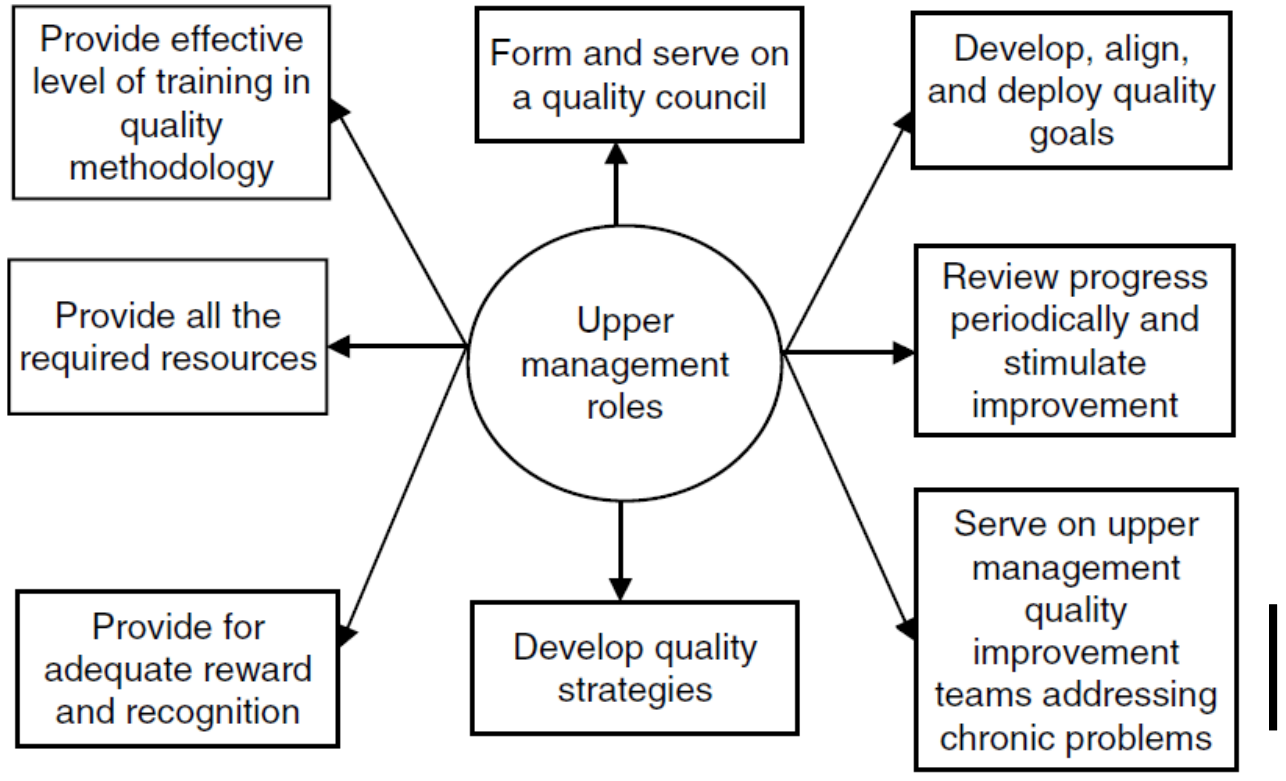
The cost of quality plays a pivotal role in management decision making. In business terms, it provides the economic common denominator through which individuals involved with management and quality can interact effectively. Similarly, in monetary terms, it is extremely useful in measuring the effectiveness of the quality department, quality planning, and so on. Moreover, the cost of quality could be a key factor in the survival of companies. For example, in the fiscal year 1977 for Firestone the cost of replacing 7.5 million poor quality tires in a recall case was around $135 million after taxes, i.e., greater than the company's net income for the year.

# Upper and Middle Management Quality-Related Roles

The active leadership by upper management is of all the ingredients for successfully achieving superiority in the quality area.

Some of the upper management roles with respect to quality are presented in Figure.

The quality strategy developed by the upper management is executed by people such as middle managers, supervisors, professional specialists, and the workforce.



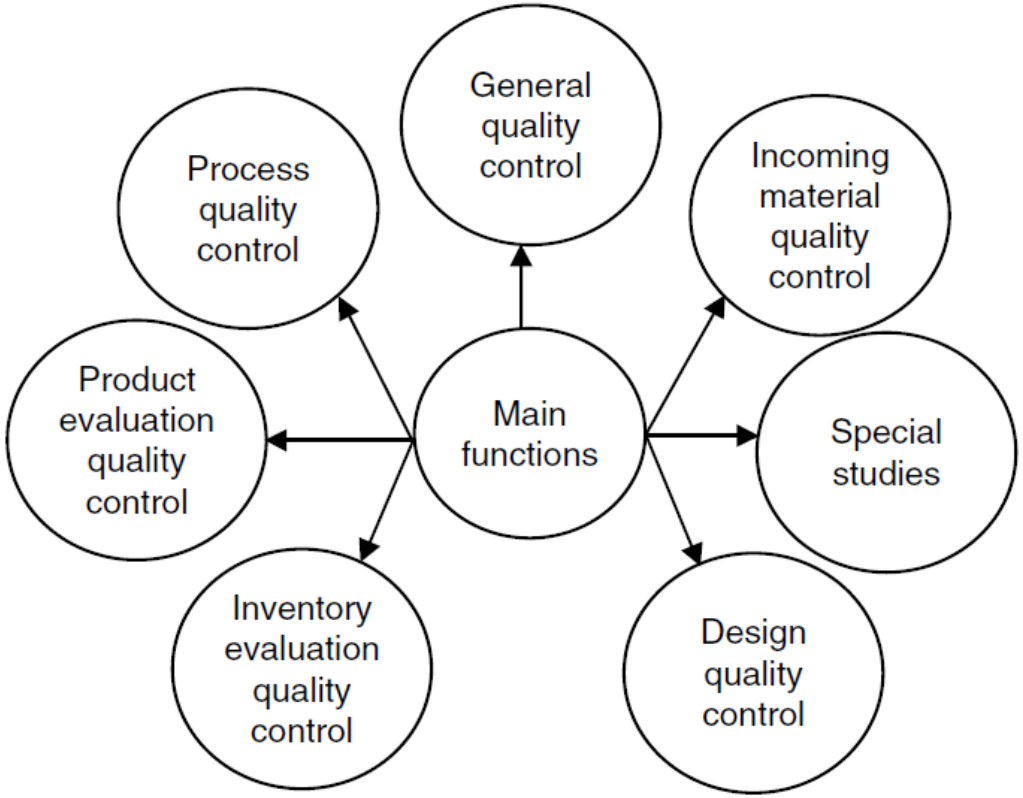

Important upper management quality-related roles

# Quality Control Engineering Functions and Quality-Related Responsibilities Among Various Organizational Groups

Quality control engineering performs numerous functions. They may be grouped under seven distinct categories as shown in Figure.

Most of these areas of responsibility are to determine:

- Needs of customers (marketing),
- Plan the quality system (general management/manager, quality control),
- Establish product design specifications (engineering), Produce products according to design specifications (shop operations)
- Collect complaint data (marketing)…..




Main Functions of the Quality Control Engineering

# Quality Control Engineering Functions and Quality-Related Responsibilities Among Various Organizational Groups

- Develop manufacturing process design (manufacturing engineering)
- Develop quality level for business (general management/manager)
- Analyze complaint data (quality control) determine process capabilities (quality control),
- Compile quality costs (finance)
- Qualify suppliers on quality (materials)
- Analyze quality costs (quality control)
- Design test and inspection equipment (quality control)
- Final product inspection (quality control)
- Plan inspection and test procedures (quality control)
- In-process quality measurements (quality control)
- In-process quality audit (quality control)
- Feedback quality information (quality control)
- And obtain corrective action (quality control)

# Steps for Planning the Quality Control Organizational Structure and Quality Control Organizational Methods

Over the years many professionals have outlined various steps for planning the quality control organizational structure. The following steps are considered the most useful to achieve this goal effectively:

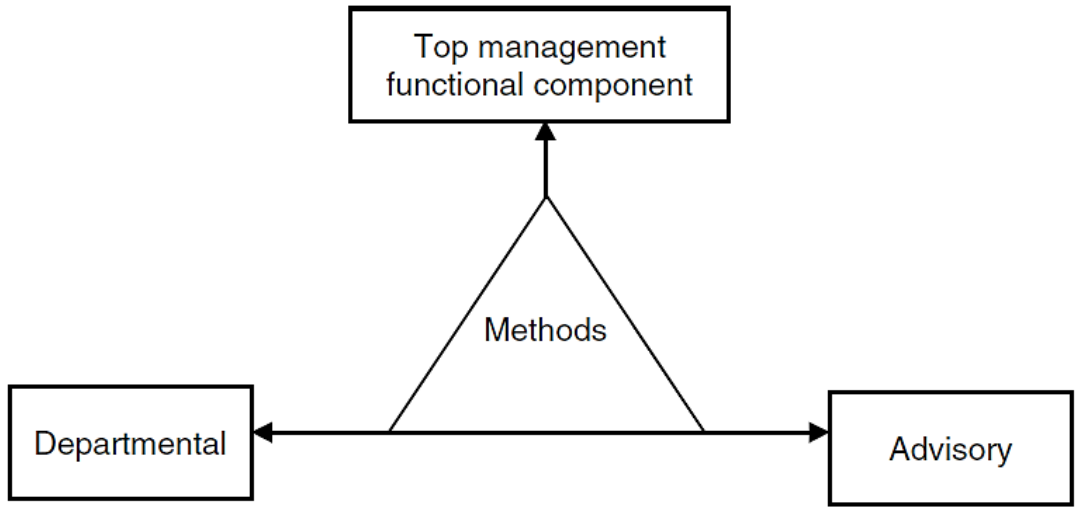
- Define the company/enterprise goals for which the quality organization

is being formed.

- Develop objectives for implementing the enterprise goals.
- Identify basic work activities for achieving the set objectives.
- Group work activities into basic functions.

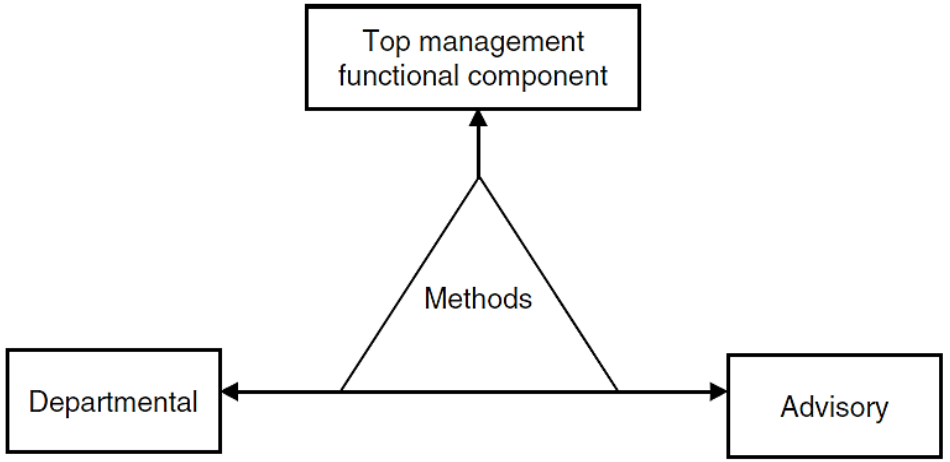
# Steps for Planning the Quality Control Organizational Structure and Quality Control Organizational Methods

- Combine the functions into job packages.
- Consolidate job packages into an organizational unit for satisfying enterprise needs.
- Locate the unit in that part of the enterprise organizational set up or structure where its (enterprise) goals can be achieved most effectively.



# Steps for Planning the Quality Control Organizational Structure and Quality Control Organizational Methods

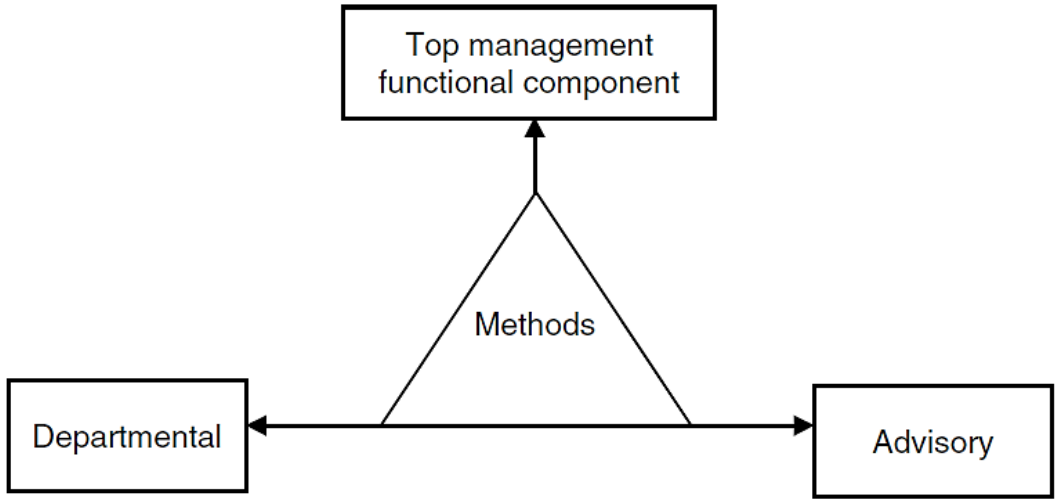
- In the case of "top management functional component" method, the quality control is made a functional element of upper management.
- More specifically, the position of the quality chief is quite similar to that of the controller, and he/ she reports directly to the president.
- The main advantage of this method is that the quality chief can exercise his/her authority to place quality-related responsibilities at appropriate places within the organization.



# Steps for Planning the Quality Control Organizational Structure and Quality Control Organizational Methods

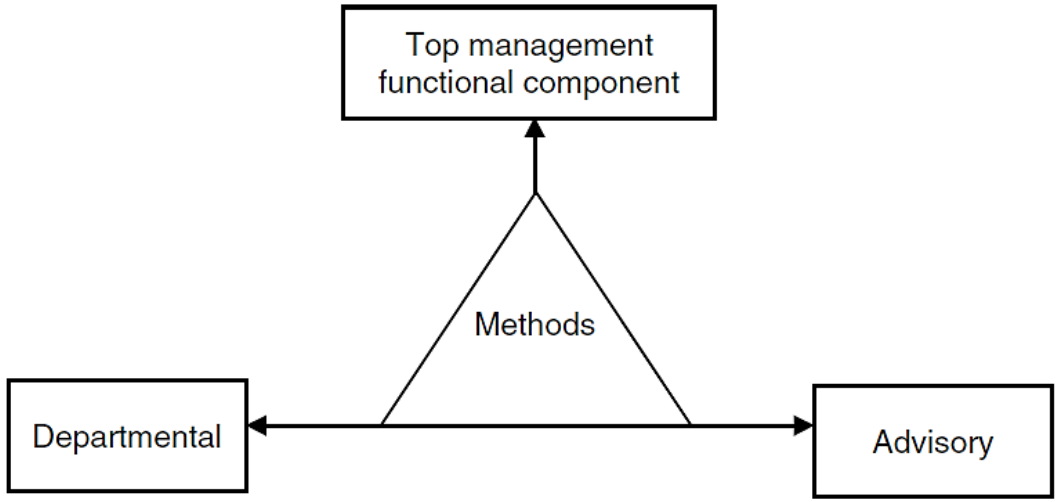
In the case of "departmental" method a separate department is created to perform the quality function. The head of the department reports to the general manager, who in turn reports to the president.

The main advantage of this method is that it provides a definite responsibility for quality to the department chief. In turn, this gives good incentives to the individual to produce effective results.



# Steps for Planning the Quality Control Organizational Structure and Quality Control Organizational Methods

In the case of “advisory” method quality personnel such as inspectors, inspector supervisors, etc. act as “process advisors.” More specifically, these individuals do not exercise authority but simply act as advisors to production and engineering departments. They report to a general manager, who in turn reports directly to the president. The main advantage of this method is that it does not require substantial changes and reduces the probability of having differences between production and inspection people. In contrast, its main drawbacks are the lack of authority and no definite responsibilities for quality personnel.



# Quality Manager Attributes, Functions, and Reasons for Failure

There are numerous reasons for the failure of quality managers to perform

their job effectively. Some of these are as follows [6]:

• Failure to communicate effectively with right individuals.

• Overlooking to emphasize fitness for use; instead emphasizing

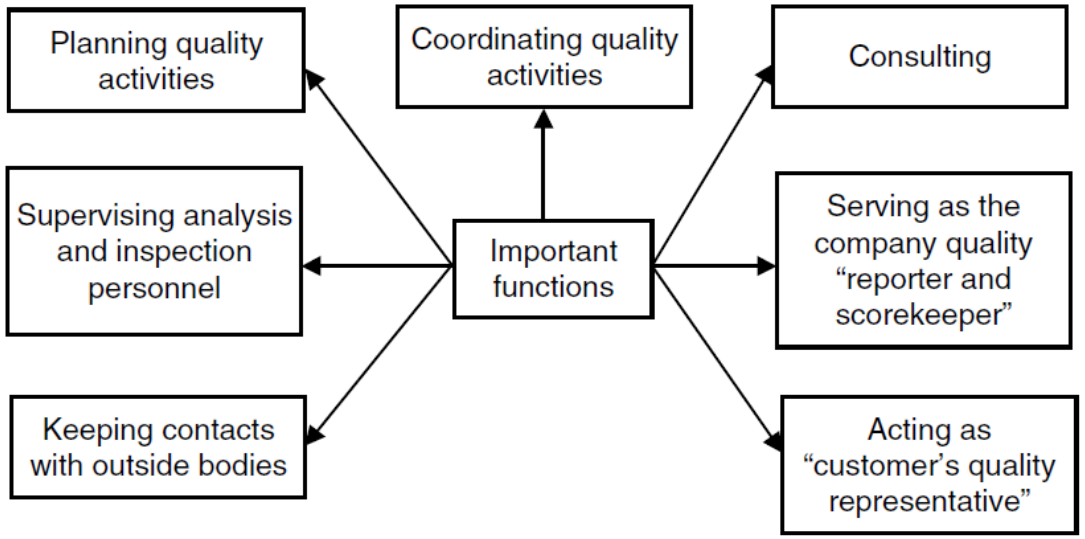
conformance to specifications.

• Placing emphasis on problems for which there are already satisfactory solutions.

• Failure to diagnose the problem first, instead emphasizing special skills as solution to all problems.

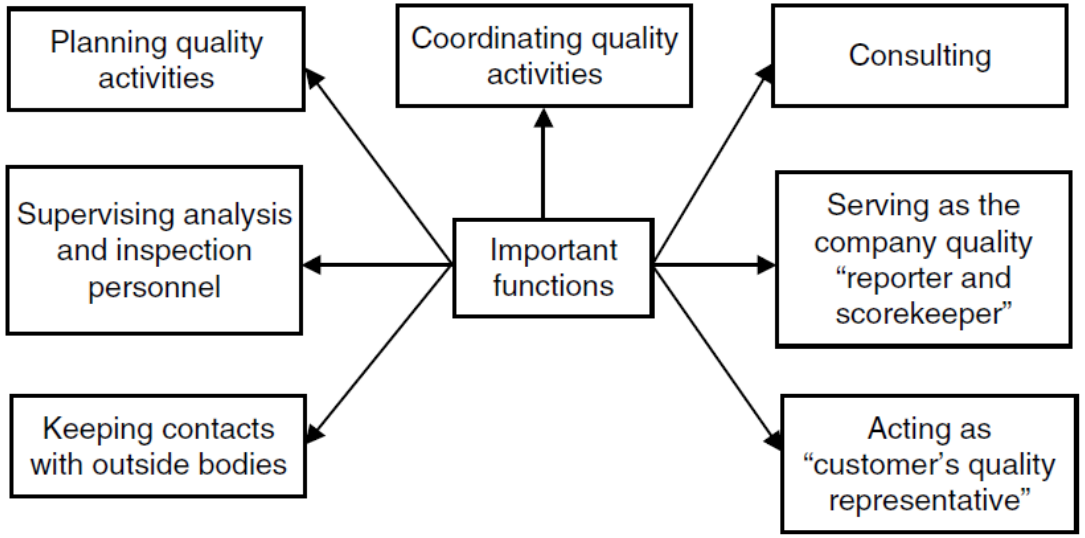
• Failure to secure appropriate inputs from all desirable/important

individuals because of functioning as loners.



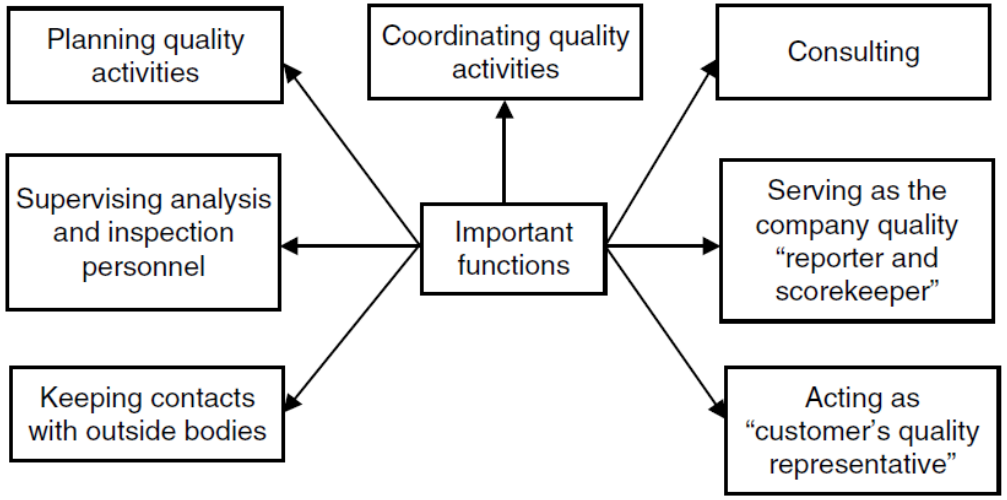
# Quality Control Manual and Quality Auditing

There are many benefits of having a quality control manual including useful for making various quality related decisions, a reference document, useful for the continuity of quality control organization operations despite the manpower turnover, and it can be used as a textbook when training quality manpower.



# Quality Control Manual and Quality Auditing

Auditing is an important element of quality control. There are various reasons for its performance including to determine whether operators perform their tasks according to specified quality plans, to determine whether the end product meets the important quality specifications, and to determine whether equipment and machinery are operating according to expectations



# Quality Control Manual and Quality Auditing

Some of the useful auditing guidelines are as follows:

- Use checklists to conduct audits.
- Choose an unbiased person to perform audits.
- Perform audits without prior announcements.
- Maintain audit schedules.
- Avoid conducting audits with the intention of catching someone performing his/her tasks incorrectly.
- Ensure that no individual performs quality audits for more than six months at a time.
- Do not make deals with people when auditing.
- Ensure that all audit results are recorded effectively.
- Audit all the work shifts involved.
- Distribute the auditing results to all concerned individuals.
- Take all necessary follow-up actions.

# Procurement Quality Control

Nonetheless, some of the specific reasons for having procurement quality assurance are to determine whether the technical and contractual requirements are adequately specified in the request for proposal document, to help the suppliers of procured parts/materials understand the specified requirements, to rate vendor conformance, to rate vendor performance, and to determine whether the requirements are being satisfied effectively

# Useful Guidelines for Controlling Incoming Parts/Materials

Some of these guidelines are as follows:

- Develop close relationships with suppliers.
- Develop compatible quality measurement procedures among suppliers and users.
- Ensure the availability of satisfactory storage facilities.
- Audit and survey part/material suppliers.
- Use acceptance sampling tables.
- Ensure the availability of effective material handling equipment and services.
- Establish a system for disposing immediately nonconforming materials and parts.

# Useful Guidelines for Controlling Incoming Parts/Materials

Review, periodically, the effectiveness of inspecting incoming parts and materials.

- Ensure that measuring equipment and gauges used in the quality work are maintained in good condition.
- Ensure the availability of satisfactory receiving inspection and test facilities.
- Use statistical methods to analyze data on incoming materials.
- Provide adequate training to the inspectors of incoming materials and parts.
- Make quality procurement and other necessary information available to vendors.

# Formulas for Determining Accuracy and Waste of Inspectors and Vendor Quality Rating

There is a possibility that inspectors can reject good items and accept bad ones. The check inspectors can be used to review the output of regular inspectors to minimize the occurrence of this scenario. More specifically, the check inspectors re-examine the procedure followed by the regular inspectors as well as their total output (i.e., all accepted and rejected items). Two formulas to estimate accuracy and waste of regular inspectors are presented below

# Formulas for Determining Accuracy and Waste of Inspectors and Vendor Quality Rating

***Regular Inspector Accuracy Estimation Formula***

The percent of defects correctly identified by the regular inspector is expressed by

$$\mathrm{PDC} = \left[\frac{N - M}{N - M + \theta}\right](100)$$

Where

PDC = percent of defects correctly identified by the regular inspector
$N$ = number of defective items found by the regular inspector
$M$ = number of items without defects rejected by the regular inspector as revealed by the check inspector.
$\theta$ =number of defective items missed by the regular inspector as revealed by the check inspector.

# Formulas for Determining Accuracy and Waste of Inspectors and Vendor Quality Rating

***Regular Inspector Waste Estimation Formula***

The percent of good items rejected by the regular inspector is expressed by

$$\text{PGIR} = \frac{M(100)}{TI - (N - M + \theta)}$$

where PGIR is the percent of good items rejected by the regular inspector and $TI$ is the total number of items rejected.

# Formulas for Determining Accuracy and Waste of Inspectors and Vendor Quality Rating

Assume that a regular inspector inspected a certain number of items in a lot and found 30 defective. Subsequently, a check inspector re-examined all the items (i.e., good and defective) and found four items without defects rejected by the regular inspector and five defective items missed by the regular inspector. Calculate the percent of defects correctly found by the regular inspector.

$$\text{PDC} = \left[\frac{30-4}{30-4+5}\right](100)$$

$$= 83.87\%$$

It means that 83.87% of the defects were correctly found by the regular inspector.

# Formulas for Determining Accuracy and Waste of Inspectors and Vendor Quality Rating

***Vendor Quality Rating Formula***

Vendor quality rating is necessary to ensure adequate quality of purchased items. Usually, the vendor performance is measured by considering factors such as procured items' cost, delivery, and quality. Frequently, weights assigned to cost, delivery, and quality are 40, 30, and 30%, respectively . Nonetheless, vendor quality rating index is defined by

$$\text{VQRI} = \frac{\text{LAB}(100)}{\text{LRB}}$$

where
VQRI = vendor quality rating index
LAB = total number of lots accepted by the buyer
LRB = total number of lots received by the buyer (i.e., all lots whether accepted or rejected)

# Formulas for Determining Accuracy and Waste of Inspectors and Vendor Quality Rating

Assume that an engineering product manufacturer received a total of 40 equal shipments of a certain component from a vendor over a period of one year. Two of these shipments were rejected by the incoming material inspection group. Calculate the value of the quality rating index. Thus, the total number of lots accepted by the manufacturer is given by

$$\begin{aligned} \text{LAB} &= (\text{Total no. of lots received}) - (\text{lots rejected}) \\ &= 40 - 2 \\ &= 38 \end{aligned}$$

$$\begin{aligned} \text{VQRI} &= \frac{38}{40}(100) \\ &= 95\% \end{aligned}$$

Thus, the value of the quality rating index is 95%.

# Quality Costs

The concept of “quality costs” has emerged since the 1950s. It may mean different things to different people. For example, some may equate quality costs with the costs of attaining quality and the others may equate them with the extra costs incurred because of poor quality . In the early 1970s, the cost of quality was around 10% of the sales income in many U.S. manufacturing organizations.

# Classifications of Quality Costs

Quality costs may be classified under five distinct categories :

- Costs of internal failures
- Costs of external failures
- Administrative costs
- Prevention costs
- Appraisal and detection costs

Each of the above classifications is discussed below separately.

# Quality costs: Costs of internal failures

These costs occur after the delivery of the product to the buyer and are associated with items such as components, materials, and products that fail to meet quality requirements. More specifically, the internal failure costs are associated with things such as scrap, in-house components and materials failures, rework, re-inspection and retest, redesign, and failure analysis.

# Quality costs: *Costs of External Failures*

These costs occur after the delivery of the product to the buyers. More specifically, costs due to faulty products shipped to the buyers. These costs are associated with items such as failure analysis, repair, investigation of customer complaints, replacement of defective items, liability, warranty charges, and customer defections.

# Quality costs: *Administrative Costs*

These costs are associated with administrative-related activities including reviewing contracts, clerical, preparing proposals, forecasting, management, preparing budgets, and performing data analysis.

# Quality costs: Prevention Costs

These costs are associated with actions taken to prevent the production of defective components, products, and materials. These actions include evaluating suppliers, reviewing designs, coordinating plans and programs, training personnel, calibrating and certifying inspection and test devices and instruments, receiving inspection, collecting quality-related data, and implementing and maintaining sampling plans.

# Appraisal and Detection Costs

These costs are associated with appraisal and detection actions. Three principal components of such costs are cost of testing, cost of auditing, and cost of inspection (i.e., in-process, source, shipping, receiving, etc.).

# Quality Cost Indexes

Often various quality cost indexes are used by organizations to monitor their performance. The values of these indexes are plotted periodically, and their overall trends are monitored. This section presents three such indexes

## Index I

$$\alpha = \frac{\text{TQC}}{\text{DLC}}(100)$$

Where,
$\alpha$ = quality cost index expressed as a percentage
TQC = total quality cost
DLC = direct labour cost
It is to be noted that this index does not provide management with that useful information for decision making and problem diagnosis [4]. Often, the index is used to eliminate inflation effects.

# Quality Cost Indexes

**Index II**

This index is defined by

$$\theta = \frac{\text{TQC}}{\text{TS}}(100)$$

where
$\theta$ is the quality cost index expressed as a percentage
and
$TS$ is the total sales.

# Quality Cost Indexes

**Index III**

This index is defined by

$$\gamma = \left[\frac{\text{TQC}(100)}{\text{VO}}\right] + 100$$

where $\gamma$ is the quality cost index and $VO$ is the value of output.
The values of $\gamma$ may be interpreted as follows [4]:

- $\gamma = 100$ (It means that there is no defective output).
- $\gamma = 105$ (It can readily be achieved in a real-life environment).
- $\gamma = 110–130$ (This occurs in organizations where the quality costs are ignored).