The Cost of Quality (COQ)

Philip Crosby once said, “Money is the language of management; you need to show them the numbers."

This was true when he first said it many years ago & it's even more true today as industries have become more competitive & complex.

Joseph Juran also understood the important link between Money & Quality when he introduced the concept of Quality Cost in his first edition of the *Quality Control Handbook* published in 1951.

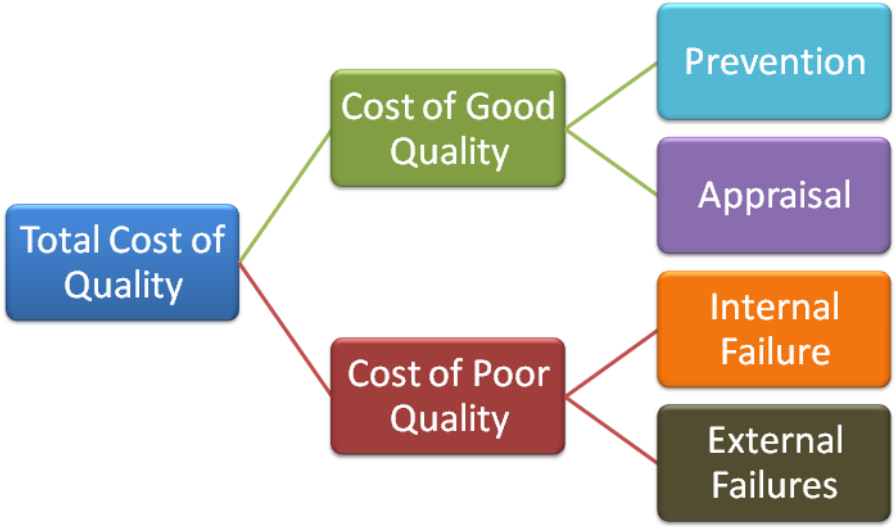
The concept was further expanded on by Armand Feigenbaum in his 1956 Harvard Business Review Essay *Total Quality Control* when he introduced the 4 Quality Cost Categories that are commonly referred to today.

When it comes to Quality & Cost, there are 4 different Categories that can be utilized to capture your quality related costs, these are:

- **Prevention Cost -** costs associated with activities specifically designed to prevent poor quality in products.
- **Appraisal Cost -** costs associated with activities specifically designed to measure, inspect, evaluate or audit products to assure conformance to quality requirements.
- **Internal Failure Cost -** costs incurred when a product fails to conform to a quality specification before shipment to a customer.
- **External Failure Cost -** costs incurred when a product fails to conform to a quality specification after shipment to a customer.

The **Total Quality Cost** then is simply the sum of all these cost categories; Prevention, Appraisal, & Failure Costs (Internal & External).

The Total Quality Cost can be summarized as all investments in the prevention of defects, the testing of product to assure Quality, or the failure of a product to meet a customer requirement.



As you can see, there are really two "good" quality cost categories (Prevention & Appraisal) and two "bad" categories (Internal Failures & External Failures).

This is where the Cost of Quality perspective can be very powerful in that it helps you understand where you're investing (or wasting) your money. Are you spending your money preventing defects and assuring quality, or are you spending your money performing rework and handling customer complaints?

This perspective can also help you understand the difference between the actual cost of the product your producing & what the cost could be if Quality was perfect.

Let's go through each cost category and discuss which quality activities fall into each category.

Prevention Cost

An Ounce Of Prevention is Worth a Pound of Cure – Benjamin Franklin

Prevention Costs are those costs or activities that are specifically designed to prevent poor quality in products. These costs ensure that product is built right the first time by preventing or reducing errors from occurring.

Investments this category result in a lower total COQ over time always have the best Return On Investment (ROI). Prevention costs should be viewed as an investment in cost-avoidance.

By avoiding a non-conformance you'll eliminate all the waste associated with that non-conformance.

These include the wasted material (scrap/rework/etc), the man-power required to investigate and disposition the non-conforming material, and the lost opportunity cost/equipment capacity associated with your time & equipment and many more hidden costs.

Also if your prevention activities are powerful enough, you can also eliminate any need to appraise a product for conformance.

In essence, you are ensuring that the product or service is always made right the first time; examples include:

Prevention Activities (Costs)	
Design Prevention	
Design Qualification Testing	FTA, FMEA & FMECA
Market Research	Field Evaluation or Testing for New Products
Prototype Testing & Iteration	New Product Design Review & Analysis
Design Review Meetings	Design Validation & Verification
Equipment Fixture Design	Defect Proofing (Poke-Yoke)
Supplier Management Prevention	
Supplier Evaluation	New Supplier Qualification
Supplier Capability Surveys	Supplier Reviews, Ratings & Quality Planning
Supplier Scorecard	Supplier Quality Agreements

Prevention Activities (Costs)	
Operations Prevention	
New Employee Screening	New Employee Training & Education
Controlled Storage	Internal Process Capability Evaluations
Developing a Process Control Plan	Predictive Equipment Maintenance
Quality Prevention	
Quality Planning	Quality Education & Training
Quality Improvement Projects	Process Qualification, Validation & Verification
Procedure Writing	Implementation of a Quality Data System
Quality System Audits	Development of Quality Control Plans

W. Edwards Deming once said "Quality comes not from inspection but from improvement of the process." What he's saying here is that we should shift our focus from failures & appraisal, to prevention through improvement.

Appraisal Cost

Appraisal costs are associated with any activity specifically designed to measure, inspect, evaluate or audit products to assure conformance to quality requirements. These are costs incurred to check & verify that product was built right the first time.

Appraisal costs are also considered an investment, not a loss, because you're assuring that quality specifications have been met, and you're preventing unnecessary failure costs, etc. Below is a list of examples of activities that are generally classified as Appraisal activities:

Appraisal Activities (Costs)	
Supplier Management Appraisal	
Receiving Inspection	Source Inspection
Routine Supplier Audits	Routine Supplier Surveys
Operations Appraisal	
In-Process Testing	Finished Goods Inspection
Laboratory Testing	Equipment Setup Inspection & Testing
Measurement Equipment Costs	Destructive Testing Material Costs
Quality Appraisal	
Product Audits	Periodic Review of Documentation
Control Charts & SPC	Maintenance & Calibration of Test Equipment

Internal Failure Cost

Internal Failure Costs are any cost incurred due to the failure of a product to meet a customer requirement where the non-conformance was detected prior to shipment to the customer.

These costs are incurred when product is not built right the first time, prior to delivery to the customer. These costs are a financial loss.

It's important to remember that the further along in the operating process that a failure is discovered the more expensive it is to correct.

As these types of failures are identified, either internally through Appraisal or externally by the customer, corrective action should be taken to eliminate the causes of these failures, see below for a list of Failure Costs:

Internal Failure Costs	
Scrap or Sorting	Rebuilding or replacing Equipment tooling
Re-work or re-processing	Scrap or Rework due to Design Change
Re-inspection or re-testing	Root Cause Investigation Support Costs
Extra Material Handling	Lost Equipment capacity due to downtime
Excess Inventory Costs	Labor losses due to equipment downtime
Excess Capacity Needs	Rejected or Downgraded Raw Material
Supplier Corrective Actions	Internal Corrective Actions
Material Review Board	Employee Turnover

External Failure Cost

External Failure Costs are any cost incurred due to the failure of a product to meet a customer requirement where the non-conformance was detected after shipment to the customer. **External Failure Costs are, by far, the most expensive category of Quality Cost.**

Because the non-conformance went undetected, your company now has paid to package and ship this defect to a customer, which will only result in dissatisfaction and return. If the non-conformance had been detected in the process, it could have been sorted, scrapped or re-worked prior to shipment.

These failures occur because the Prevention activities & Appraisal process (Inspection & Testing) did not detect the error before shipment which now has resulted in customer dissatisfaction & additional costs. **Failure costs can also be viewed as a penalty for poor quality. This penalty can be avoided through prevention & appraisal.**

High risk or frequently occurring external failures can also result in very costly actions like Recalls & Legal situations, see below for a list of external failure costs:

External Failure Costs	
Warranty Costs	Customer Complaints & Investigation
Repair Costs	Product Liability & Legal Fees
Customer Returns or Rejects	Overhead Cost of Field Service Team
Lost Sales & Customers	Product Recalls & Market Actions
Product Service Calls	Loss of Reputation or Goodwill