

Cost of Quality: What You're Not Measuring

The four categories of quality costs. The hidden factory that consumes 10-25% of revenue. How to build a COQ model from existing accounting data and connect quality costs to process capability improvement.

Ref: Juran Quality Handbook & ASQ CoQ Guide & Campanella (Principles of Quality Costs) & Harrington

I — Publication

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Reading 12 min

Quality Economics

II — The Four Categories

Prevention Costs

Prevention costs are incurred to keep defects from occurring. Quality planning, process validation, DOE studies, SPC implementation, training, preventive maintenance, supplier qualification, design reviews, and error-proofing (poka-yoke) all fall here. Prevention is the only category where spending more reduces total quality costs. Every dollar of prevention displaces multiple dollars of failure, yet most organizations spend less than 5% of their quality budget on prevention.

Appraisal Costs

Appraisal costs are the cost of determining whether output conforms to requirements. Incoming inspection, in-process inspection, final inspection, gage calibration, test equipment maintenance, audit labor, and laboratory testing. Appraisal catches defects after they occur but before they reach the customer. It is a detection strategy, not a prevention strategy. An organization that spends most of its quality budget on appraisal is paying to find problems instead of paying to prevent them.

Internal Failure Costs

Internal failure costs arise when defects are found before shipment. Scrap, rework, reinspection after rework, material review board (MRB) time, yield loss, process downtime for root cause analysis, and the opportunity cost of the production time consumed by defective product. These costs are incurred inside the factory walls and are partially visible in the accounting system—scrap and rework are typically tracked, but MRB time, reinspection labor, and downtime for investigation rarely are.

External Failure Costs

External failure costs occur when defects reach the customer. Warranty claims, returns, field service, customer complaints, product liability, recalls, and lost future sales. External failures are the most expensive category per defect because they include not only the direct cost of correction but also the indirect costs of customer dissatisfaction, brand damage, and regulatory consequences. A defect that costs \$5 to prevent, \$25 to catch at incoming inspection, and \$100 to rework internally can cost \$1,000 or more as a warranty claim.

III — The Hidden Factory

What the Accounting System Misses

The standard cost accounting system tracks material cost and direct labor for planned operations. It does not track the unplanned operations that defects create. A part that requires rework consumes a second pass through the machine, additional operator time, additional inspection, and additional material handling. None of this appears as a line item under "quality cost" in most accounting systems. It is buried in overhead, absorbed into standard cost variances, or invisible entirely.

The hidden factory is the set of operations that exist solely because the process does not produce conforming output on the first pass. Sorting stations, rework areas, reinspection loops, quarantine management, concession processing, and the engineering time spent dispositioning nonconforming material are all part of the hidden factory. In a typical discrete manufacturing operation, the hidden factory consumes 15-25% of total production capacity. The organization has built and staffed a second factory inside the first one, dedicated to fixing what the first one produces wrong.

How to Find It

Start with the value stream map. Walk the physical production flow. At each station, ask: "What happens when a defect is found?" Follow the rework path. Count the people involved. Measure the floor space occupied by quarantine and rework areas. Time the MRB meetings. Calculate the cost of incoming material on the reject dock. Add the scrap reported in the ERP system to the scrap never reported (dropped parts, damaged material, overruns to compensate for expected yield loss). The result is the first honest estimate of internal failure cost. It is always larger than anyone expected.

The 10-25% Estimate

Juran's estimate that quality costs represent 20-40% of revenue in a typical manufacturing company was published in 1951. Campanella's 1999 update put the range at 15-25% for companies without

mature COQ programs. More recent ASQ surveys converge on 10-20% for companies that are actively measuring, with the lower end representing organizations with established prevention programs. For organizations that have never measured COQ, 15-25% of revenue is a defensible initial estimate. The first reaction to this number is always disbelief. The second, after measurement, is alarm.

IV — Building a COQ Model

Mapping to Existing GL Codes

You do not need a new accounting system to start measuring COQ. Most quality costs already exist in the general ledger under other names. Scrap is in material variance accounts. Rework labor is in direct labor or manufacturing overhead. Inspection labor is in quality department headcount. Calibration is in maintenance or metrology. Warranty costs are in customer service or sales deductions. The first step is to map each GL code to the PAF category it represents.

What Data You Already Have

The ERP system tracks scrap quantities and costs. The quality system tracks nonconformance reports, rework hours, and MRB dispositions. The calibration system tracks gage costs. Warranty and returns data exist in the CRM or financial system. Training records exist in HR. The data are scattered across systems, but they exist. The challenge is extraction and classification, not data collection.

What You Need to Start Collecting

The gaps are usually in prevention costs (how much engineering time goes to quality planning vs. firefighting?) and in hidden internal failure costs (how much production time is consumed by rework that is not formally logged?). A time study of the quality engineering team and a work sampling study of the rework area will fill the largest gaps. These do not need to be precise to be useful. An estimate within 20% is sufficient for the initial COQ model.

A Starter Template

For discrete manufacturing: collect prevention costs (training, SPC program, DOE studies, process validation), appraisal costs (inspection labor, gage calibration, test equipment, audit time), internal failure costs (scrap, rework, reinspection, MRB, yield loss), and external failure costs (warranty, returns, field service, complaints). Report monthly. Express as percentage of revenue and as absolute dollars. Track the trend. The first three months establish the baseline; subsequent months measure the return on prevention investments.

V — Connecting COQ to Capability

Every Sigma Shift Has a Dollar Value

A process operating at $Cpk = 1.00$ produces approximately 2,700 ppm nonconforming. At $Cpk = 1.33$, approximately 63 ppm. At $Cpk = 1.67$, approximately 0.6 ppm. Each step from 1.00 to 1.33 to 1.67

reduces defects by roughly 40x. If each defect costs \$50 in scrap and rework, and the process produces 100,000 parts per year, the improvement from Cpk 1.00 to 1.33 saves approximately \$13,000/year. From 1.33 to 1.67, approximately \$3,000/year. The diminishing returns are real—the first improvement is worth 4x the second—but the total reduction from 1.00 to 1.67 eliminates \$16,000/year in failure costs for a single characteristic on a single part number.

The Economic Argument for SPC

SPC implementation costs are prevention costs: training, software, time to construct and maintain control charts, time to investigate signals. The return is in reduced failure costs: fewer defects, less scrap, less rework, fewer warranty claims. The [Cpk calculator](#) converts capability to expected ppm. Multiply ppm by unit defect cost to get the annual failure cost attributable to that characteristic. Compare to the annual cost of SPC for that characteristic. The ratio is typically 5:1 to 20:1 in favor of SPC for any characteristic where the current capability is below 1.33.

This calculation is the bridge between the quality department and finance. Quality engineers speak in Cpk, sigma levels, and ppm. Finance speaks in dollars, margins, and ROI. COQ translates one into the other.

VI — Reporting to Management

COQ as Percentage of Revenue

The single most important number is total COQ as a percentage of revenue. This makes quality costs comparable across divisions, sites, and time periods regardless of volume. For a plant doing \$50M in revenue with \$7.5M in quality costs, COQ is 15%. If the industry benchmark is 10%, the gap represents \$2.5M/year in addressable cost. This number gets attention at the executive level in a way that "Cpk improved from 1.1 to 1.4" does not.

Trend Charts That Drive Action

Plot total COQ monthly, broken into the four categories. The goal is to watch prevention increase and failure decrease over time. A healthy COQ trajectory shows prevention costs rising slightly, appraisal costs stable or declining, and failure costs declining faster than prevention rises. The net effect is reduced total COQ. If failure costs are not declining, the prevention investments are not targeted at the right problems.

Pareto of Quality Costs

The Pareto chart of failure costs by defect type, product line, or process step identifies where to invest next. The top three defect types typically account for 60-80% of failure costs. Targeting the largest cost driver with a DOE, SPC implementation, or error-proofing project produces the fastest ROI. Report the Pareto monthly. When the largest bar shrinks, the next bar becomes the target. This is continuous improvement in financial terms.

What the Plant Manager Needs to See

One page. COQ as percentage of revenue (trend, 12 months). Pareto of failure costs (top 5 categories). Prevention spending vs. failure cost reduction (scatter or dual-axis trend). One project highlight: the specific improvement action, its prevention cost, and the measured reduction in failure cost. No statistical terminology. No jargon. The language is dollars, percentages, and before/after comparisons. The audience cares about margin impact, not methodology.

VII — Related Instruments

INSTRUMENT	SPECIFICATION
Cpk / Ppk Calculator	Capability to ppm conversion for defect cost estimation.
Pareto Chart Generator	Rank quality costs by category to identify the vital few.
FPY / RTY Calculator	First pass yield and rolled throughput yield for hidden factory quantification.

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