



In moving toward a model of operational excellence, a company must first identify its strategic objectives, operational and financial, and then build a set of metrics for measuring progress as well as benchmarking performance relative to industry leaders. For decision-makers, which metrics to measure and how to effectively implement each into analyses can be an overwhelming task.

LNS Research has established a list of the most important metrics for the executive dashboard, including the cost of quality, overall equipment effectiveness, percentage of products in compliance, on time and complete shipments, and new products introduction. Of these metrics, we believe that measuring the cost of quality can be the most beneficial to your organization.

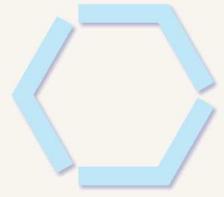
At a high level, the cost of quality measures the costs incurred in delivering a high quality product. Although many companies and people refer to the cost of quality term, its actual meaning is often misinterpreted. We've seen it used in various ways, frequently being considered in relation to producing defective products or other rework related issues, which are only components of the overall formula. However, the total cost of quality is actually comprised of two separate costs: the cost of good quality and the cost of poor quality. To understand the concept and how it can be used as an actionable metric, LNS Research breaks down the variables in this research spotlight. We also discuss how the cost of quality metric can be used to improve business performance.



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Defining the Cost of Quality

LNS Research always advocates for the standardization of processes to provide the most visibility across enterprises and, if possible, industries. Leveraging the power of trending and statistical analyses allows companies to benchmark internally and externally. With the cost of quality, it could be argued that there are numerous ways to define and measure it. To foster this atmosphere of standardization, we will employ the widely used ASQ Cost of quality definition as our starting point.



Research Spotlight

A Holistic Measurement of the Cost of Quality

Stated above, there are two different variables in the cost of quality equation: the Cost of Good Quality (CoGQ) and the Cost of Poor Quality (CoPQ). Essentially, the CoGQ relates to costs incurred to assure quality in products and prevent poor quality. The CoPQ is a measurement of the failure costs incurred in producing the product. This can be understood in the following formula:

$$CoQ = CoGQ + CoPQ$$

Broken down further, each of these variables has more specific dimensions. The CoPQ accounts for internal and external failure costs, while the CoGQ encompasses appraisal and prevention costs.

Cost of Poor Quality

The CoPQ quantifies the traditional quality costs companies measure. These include scrap, rework, and returned materials. As these costs emerge from production line issues as well as external services employed by companies, such as the use of the supply-chain, it is important to identify their origin in the calculation. The CoPQ formula can be extended to show Internal Failure Costs (IFC) and External Failure Costs (EFC), giving us the following equation:

$$CoPQ = IFC + EXC, \text{ where:}$$

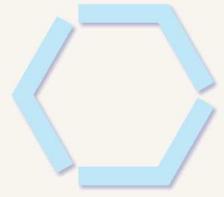
$$IFC = Scrap Costs + Rework Costs$$

$$EFC = Returned Product Costs + Warranty Costs + Product Recall Costs$$

Costs incurred internally and externally are caused not only by defects in products, but also by inefficiencies in production and processes. A more in-depth list of factors affecting IFC and EFC is below:

Factors Affecting IFC

- Weaknesses in quality resolution (CAPA/FMEA)
- Delayed work schedules
- Poor Materials Planning
- Materials shortages
- Equipment downtime
- Materials review
- Reengineering/redesigning products



Factors Affecting EFC

- Poor service management
- Unresolved customer complaints
- Weak enterprise communication
- Environmental/sustainability nonconformances
- Adverse reputation events

Cost of Good Quality

Contrast to the CoPQ, the CoGQ is much less likely to be measured by a company. These are the costs that companies incur when producing quality products, such as people and software. Although these costs may be measured disparately, they are not often accounted for in the cost of quality equation by executives and plant managers. Broken down, the CoGQ is made from two different variables: Appraisal Costs (AC) and Prevention Costs (PC), giving us the following formula:

$$\text{CoGQ} = \text{AC} + \text{PC}$$

AC = % of labor, software, and equipment costs focused on appraisal activities

PC = % of labor, software, and equipment costs focused on prevention activities

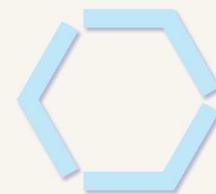
Appraisal Cost Components

Associated with measuring, evaluating, and auditing products or services, appraisal costs generally assure conformance to quality standards and performance requirements. Activities that fall into this category include inspections, testing, and calibration. To effectively measure these costs, it is helpful to break them down into three broad categories: employee costs, software costs, and equipment costs. This allows executives and managers to appoint a percentage to each cost in relation to total revenue.

Prevention Cost Components

Preventive cost measures the costs associated with activities designed to prevent poor quality in products or services. Activities that fall into this category include quality planning, risk management, continuous improvement team initiatives, corrective and preventive actions, and audit management. Similar to appraisal cost, preventative cost can be broken down into three broad categories, employee costs, software costs, and equipment costs, and measured as a percentage of total revenue for comparison.

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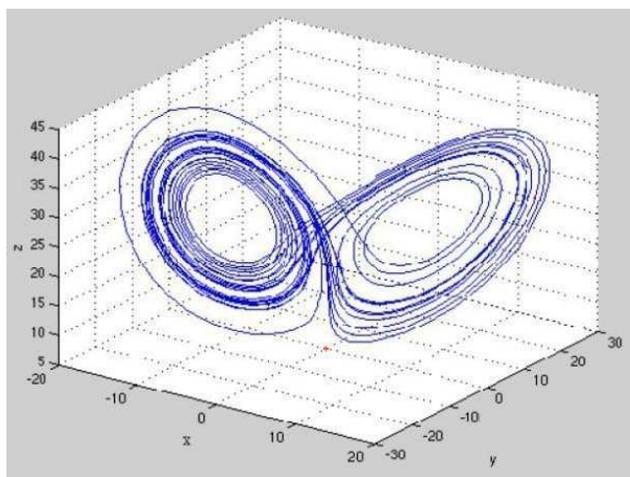


Research Spotlight

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Cost of Quality is not Linear

An important concept to understand is that the cost of quality is not linear. In mathematical terms, this means that increasing the CoGQ by \$1 does not necessarily equate to a \$1 increase in the total cost of quality. The relationship is not 1:1. For example, investing \$1 in a new piece of calibration equipment or software is an addition of \$1 to the CoGQ, but it could also lower the scrap rate, decreasing the CoPQ disproportionately. For this reason, it is important to continuously measure the CoPQ and CoGQ in relation to each other as well as total cost of quality. Companies can justify investments being made in CoGQ through subsequent reductions in CoPQ and overall reductions in the total cost of quality.



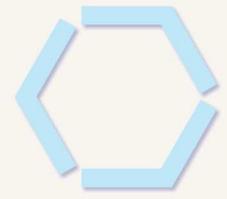
There seems to be difficulty for departments in measuring the cost of quality aspects beyond internal failure costs.

Challenges in Measuring the Cost of Quality

Quality departments are generally very effective at measuring internal failure costs. However, there seems to be difficulty for these departments in measuring the cost of quality aspects beyond internal failure costs, including external failure costs, appraisal costs, and preventative costs. Moreover, if these costs are measured, the information is often not considered together within the cost of quality formula.

Measuring external failure cost is a challenge because there is often a lag in the occurrence of costs. An end-customer may not be impacted by an event for months, or even years, after the product is manufactured. This creates a variance in costs and measurement over time. Companies need to know how to associate a cost from, for instance, four years ago to the product today. Also, communication issues both internally and externally can impact the integrity of external failure costs. Many companies do not have strong communication with trading partners, making it difficult to understand which quality issues have caused which specific chargebacks. Without a clear view of the root causes of failures, the CoPQ is adversely affected.

The CoGQ metrics are usually measured separately, but not holistically by companies. People, processes, and technology in quality operations are looked at as fixed costs and



Research Spotlight

A Holistic Measurement of the Cost of Quality

are frequently not considered in the context of the total cost of quality metric. This can create a skewed picture of the actual impacts of appraisal and preventative costs. Also, in some instances, a conflict of interest can emerge between quality management and the CoGQ metric. As the CoGQ can be broken down on a granular level to employees, software, and equipment, managers that must reduce the cost of quality quickly may decide to reduce the number of fulltime employees. This is not a strategic decision, and is very rare, but it may be used as a short-term solution.

Benchmarking the Cost of Quality

It is very difficult to get benchmark data on the cost of quality, which is why LNS Research has made it a main focus in our Quality Management Systems research project. For executives and managers who are already attempting to benchmark the cost of quality, perhaps with an organization such as APQC, it is important to benchmark the total cost of quality in the context of its four main variables: appraisal costs, preventative costs, internal failure costs, and external failure costs. For benchmarking purposes, we have also found that it works best to view each of these costs as a percentage of total revenue rather than as a raw dollar figure. This makes it easier to compare and contrast the effects of people, processes, and technologies.

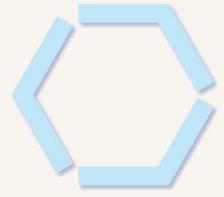
When it comes to benchmarking the cost of quality to make better decisions, companies should pay close attention to the tradeoffs between CoGQ and CoPQ. In our experience, it is often the case that spending or investing in CoGQ more than makes up for itself in reductions in the CoPQ. A great example of this would be an investment in Enterprise Quality Management Software (EQMS), which has proven to be a very useful quality management tool and has provided compelling ROIs for most users. The tools available in an EQMS provide companies with multiple ways to measure and resolve quality issues.

Implementing an EQMS and integrating it with other functional areas of business, such as engineering, manufacturing, and the supply-chain, can facilitate the measurement of many cost of quality aspects. For instance, scrap rates or supplier defect rates are centralized throughout the organization and can be measured in comparison to one another. EQMS is a great method for increasing visibility for executives and plant managers. Regardless of the CoGQ investment, the main focus should be on realizing positive ROIs by implementing capabilities or processes that will reduce the CoPQ.

Closing Thoughts

By identifying operational and financial strategic objectives, the correct set of metrics and benchmarking capabilities will allow you to effectively measure your progress and gains.

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For companies that do not have a strong metric system in place, the cost of quality is a great starting point. Its holistic nature creates a view of how business activities within the company and externally can effect long and short-term goals. Additionally, by watching the trends in this metric over time, drilling down on the individual components, a company can attain a stronger understanding of its strengths and weaknesses. By taking a quality management approach to measuring the impact of each of your decisions, we believe that you will see direct results in business performance.

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