Research Spotlight

Reducing the Cost of Quality with Real-Time SPC

The level of global competition faced by today's organizations has put more pressure on the bottom line than ever before. To realize market-leading performance, executives not only have to work to achieve growth targets, they also have to continuously reduce costs in operations. In many cases, they are positively impacting operational costs by focusing on the quality of products and processes through the cost of quality (CoQ) metric.

The cost of quality is a metric that is being used by many organizations to benchmark performance. Unfortunately, beyond just measuring performance, many companies struggle to find concrete approaches for improving it. In this Research Spotlight we will examine how market leaders are using Statistical Process Control (SPC) to deliver real-time, role-based quality insights to shop-floor personnel and executives for driving continuous improvements in metrics.

By reading this report, industry leaders can gain an understanding of why and how organizations are leveraging SPC to reduce variability of manufacturing processes, enable proactive decision making by shop-floor personnel, and provide executive visibility with analytics. Specifically, the report will address:

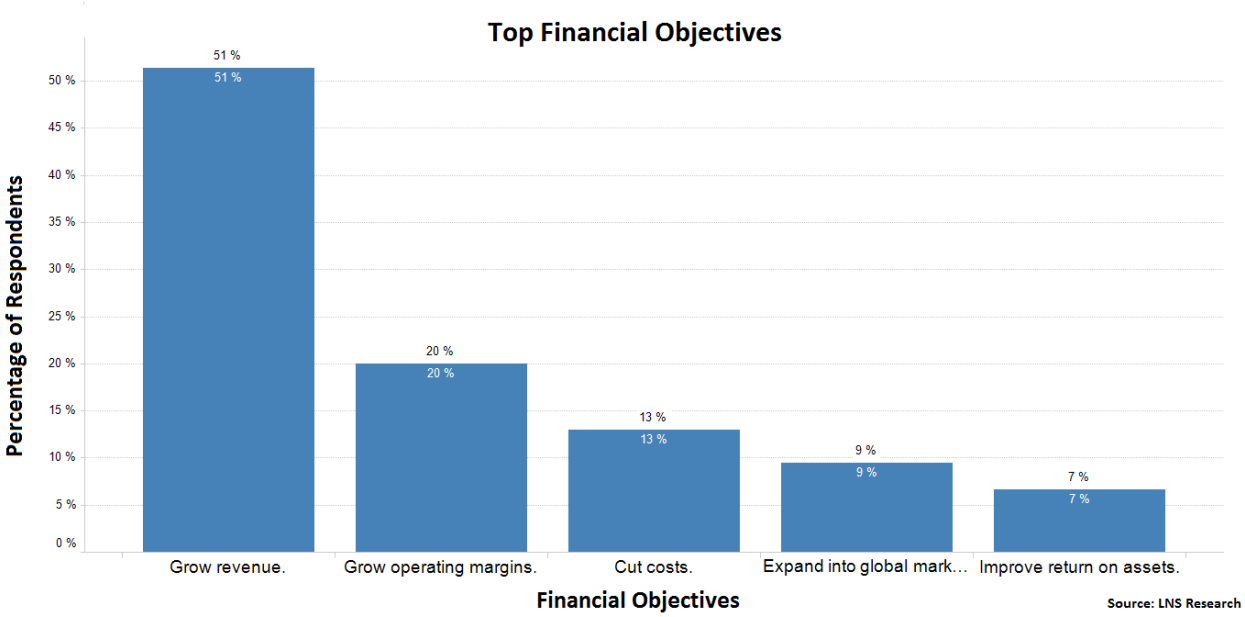
- Why Quality Is Important: Benchmark Data
- Understanding the Cost of Quality Variable
- The Role of SPC in Measuring the Cost of Quality
- Optimizing Real-Time Visibility Capabilities with the LNS Research Model of Operational Excellence

By using technologies such as statistical process control (SPC) that provide detailed process information, market leaders are analyzing real-time metrics with a deep level of granularity.

Why Quality Is Important: Benchmark Data

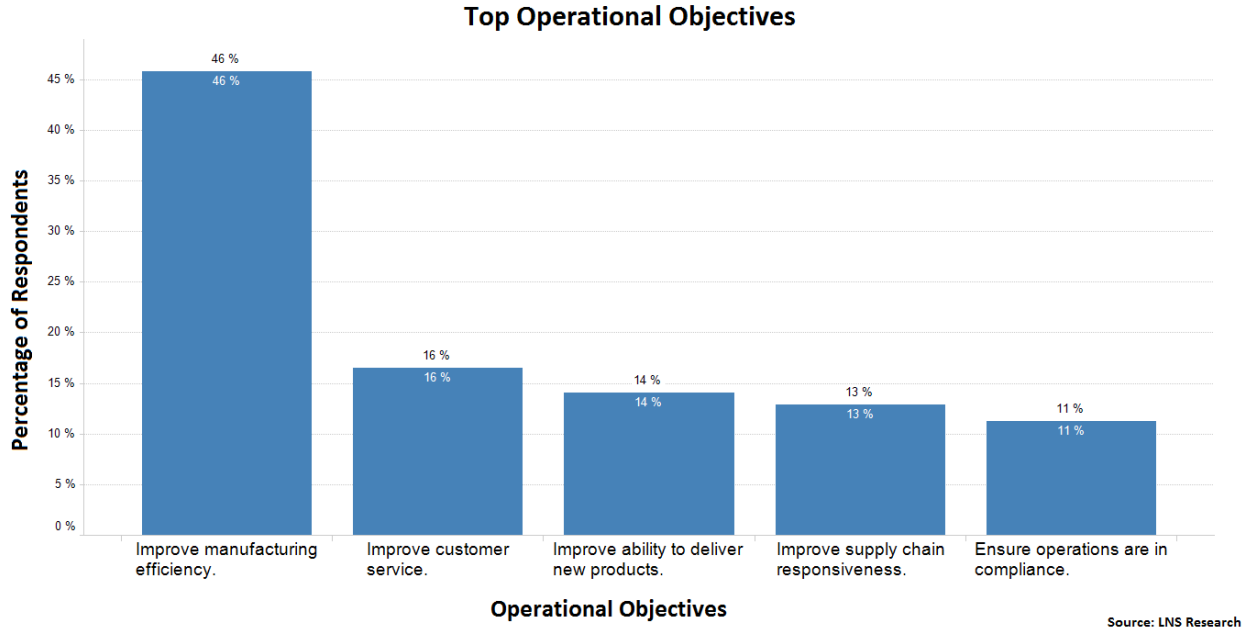
To put the areas of executive focus into perspective, it is often helpful to analyze benchmark data. The LNS Research 2012-2013 Quality Management Survey asked nearly 400 executives about their performance in key financial, operational, and quality performance indicators. The following section analyzes the top objectives of these executives.

Top Financial Objectives



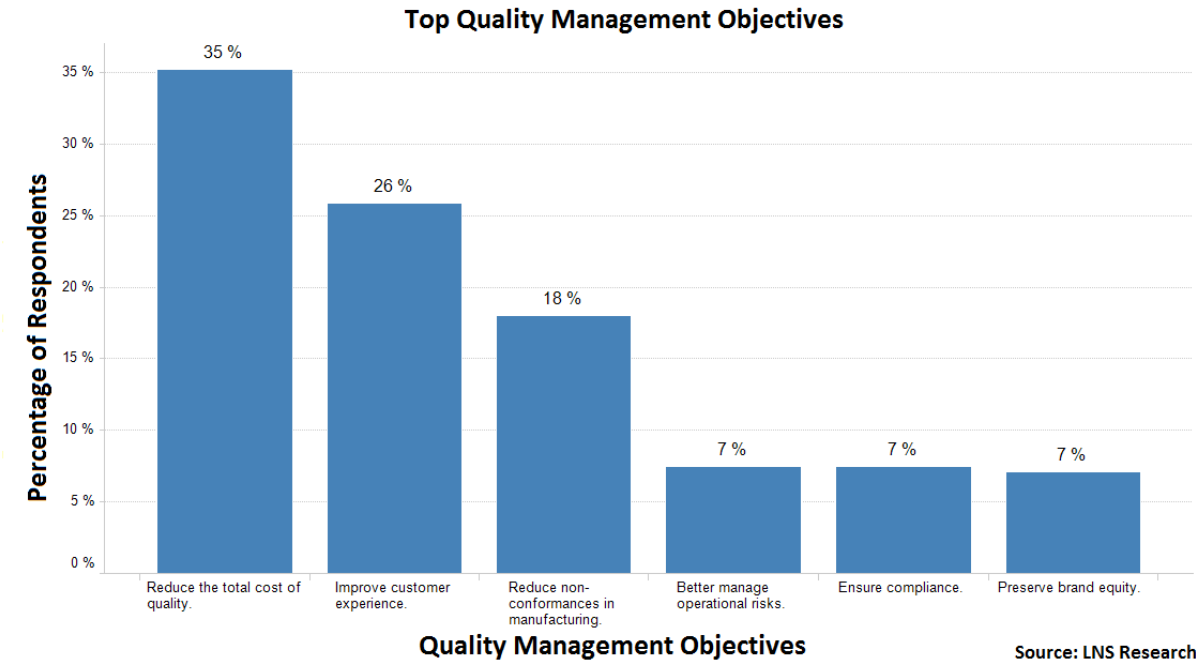
It comes with little surprise that a majority of executives, 51%, chose “Grow revenue” as their top financial objective in 2012. The second most common response was “Grow operating margins,” at 20%. While many executives are honing in on improving profitability, pressures from stakeholders often result in a heavy focus on the top line.

Top Operational Objectives



When asked about their top operational objectives, at 46% a considerable number of executives chose “Improve manufacturing efficiency.” The second highest result was “Improve customer service,” with a 16% response rate. Interestingly, the results from this survey spanned across all industries, each with different focus areas along the value chain. This question sheds light into the importance of manufacturing in corporate strategy.

Top Quality Management Objectives



While the results were slightly more diversified for the top quality management objective question, a large number of respondents still chose a single answer, “Reduce the cost of quality.” Despite the apparent executive attention on the CoQ, our benchmark data, in addition to discussions with industry leaders, has revealed that many organizations are not leveraging this metric to its full potential. However, many companies have relatively cost-effective resources available to attain the level of visibility the CoQ metric can provide.

An interesting connection between the above data points can be made. In both quality and operations, companies are focused on reducing costs, and many of these costs overlap. By utilizing SPC technology to reduce variability in manufacturing processes, direct impacts can be made on the cost of poor quality. Additionally, these operational improvements also enable the ability to deliver high quality products and processes, which tends to go hand-in-hand with revenue growth. The following sections will highlight the role of SPC in measuring the cost of quality, first by defining the cost of quality and then by drilling into the importance of building real-time visibility capabilities.

Understanding the Cost of Quality

The cost of quality metric measures the costs incurred in delivering high quality products and processes. Despite its widespread use, between and even within organizations there tend to be differences in the variables used to measure the metric, which makes both internal and external benchmarking difficult. A common misconception is that the cost of quality metric only focuses on the costs incurred from defects in products and processes or other rework-related issues. In reality, though, this is only part of the equation.

The metric has several key variables, which are the foundation of its calculation. At a high level, there are two parts: the cost of good quality (CoGQ) and the cost of poor quality (CoPQ). The CoGQ relates to costs incurred to assure the quality of products and prevent poor quality. The CoGQ should be viewed as an investment (e.g. technology and personnel) in reducing the CoPQ, and is made up of appraisal and prevention costs. Whereas the CoPQ can be viewed as a direct measurement of the failure costs incurred in producing a product, and is composed of internal failure and external failure costs.

The Non-Linearity of the Cost of Quality Equation

One of the most important concepts to understand is that the cost of quality is not a linear equation, which means that $1 investment in the CoGQ does not necessarily have the same impact on the CoPQ. In cases for software in particular, successful implementations typically deliver a far greater than 1:1 ratio of dollars saved versus dollars invested. It is helpful to consider this concept in relation to the detection of quality defects and failures along the value chain and how the right investment in technology can disproportionately impact the metric. The graph below shows the relationship between the costs of non-conformances and the time until detection of those non-conformances.

For the purposes of visualizing the impact of software, the types of software investments are categorized into two buckets: software that is implemented with the intentions to correct quality issues (corrective actions) and software that is implemented to prevent quality issues (preventive actions) before they occur.

Graphically, corrective actions will move the curve downward, making the cost of an external failure less expensive. These actions provide the capability to act in a timely manner if a defective part or component does make it into the supply chain. With capabilities such as traceability, a company can quickly identify the source of the non-conformance and conduct more targeted recalls rather than casting a wide net over its portfolio of products. Although corrective actions are necessary to mitigate risk and maintain long-term business performance, they focus mainly on reducing external failure costs and to help to prevent quality issues from happening.

Definitions

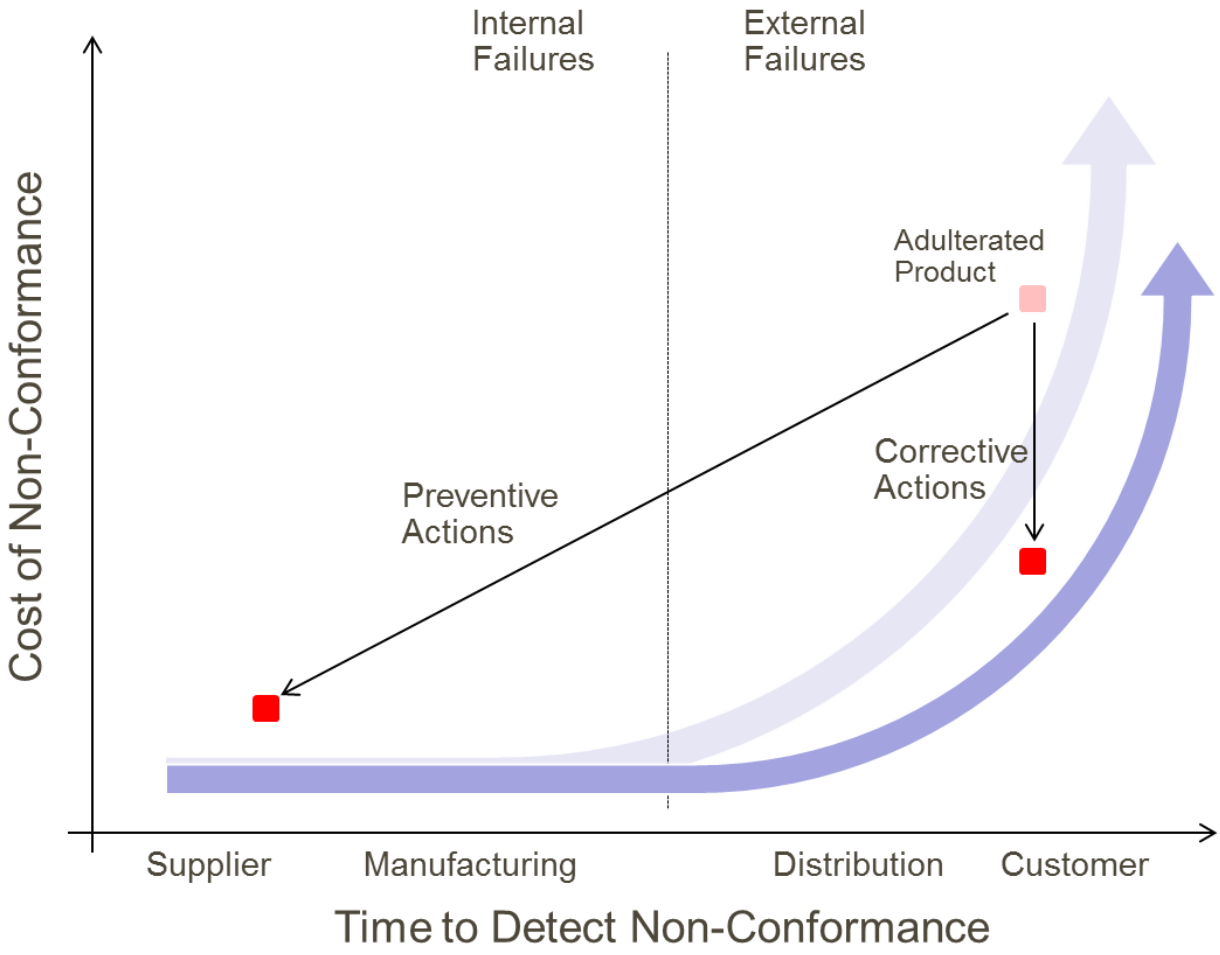
Cost of Quality = Cost of Good Quality (CoGQ) + Cost of Poor Quality (CoPQ)

Cost of Good Quality = Appraisal Cost + Prevention Costs

Cost of Poor Quality = Internal Failure Costs + External Failure Costs

More extensive information on measuring and benchmarking the cost of quality can be found in LNS's Research Spotlight, The Cost of Quality as a Holistic Business Measurement.

The Impact of Time to Detect Non-Conformances on Total Cost

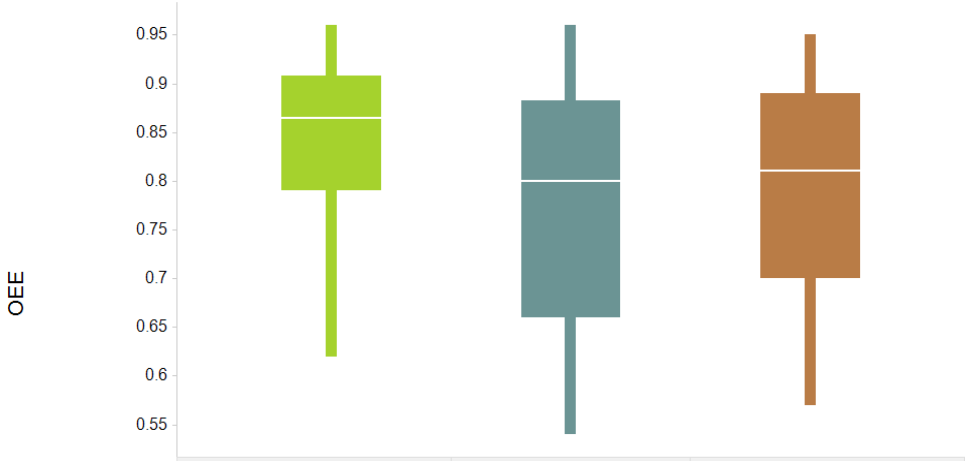


A preventive action such as implementing SPC is critical to catching quality issues before they leave manufacturing and move toward the customer. In manufacturing, SPC not only provides insight into the effectiveness of processes, it also helps to identify and eliminate operator errors that can have negative long-term impacts on the cost of quality. By investing in SPC, companies can respond more quickly to internal failures and reduce the total cost of quality. In contrast to a quality defect turning into an expensive external failure cost, SPC enables organizations to resolve issues early and internally. The following section will discuss SPC's relationship with the cost of quality in more depth.

Benchmarking the KPI Improvements of Real-Time SPC

SPC software generally provides data collection, analysis, visualization, and workflow capabilities designed to help track and reduce variability in production processes. Primarily, users of SPC are machine operators, manufacturing supervisors, continuous improvement professionals and Six Sigma project managers. Users obtain value and justify an ROI in SPC software through reductions in manufacturing process variability and the subsequent reduction it provides in scrap rates, material variance, and, notably, the cost of quality.

Real-Time Visibility of Quality Metrics in Manufacturing



	Currently	No Plans	Planned
Count	38	14	29
Median	0.865	0.8	0.81
Outliers	0	0	0

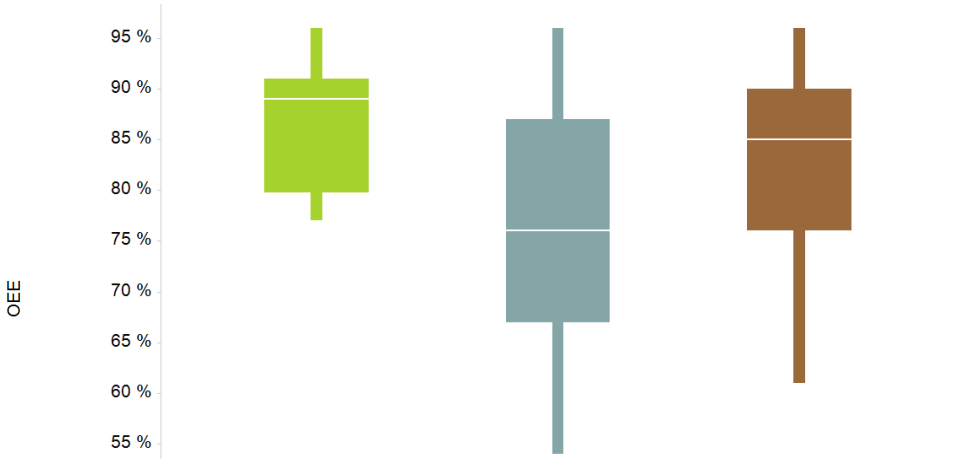
Real-time visibility of quality metrics in manufacturing.

The intersection of the cost of quality and SPC highlights the need for real-time visibility of quality metrics. With SPC, market-leading companies are tying process variation data to the organization's ability to monitor and reduce costs associated with delivering high quality products and processes.

The intersection of the cost of quality and SPC highlights the need for real-time visibility of quality metrics. With SPC, market-leading companies are tying process variation data to the organization's ability to monitor and reduce costs associated with delivering high quality products and processes. As shown in the chart above, based on a recent LNS Research quality management survey with over 500 respondents, companies that have real-time visibility of quality metrics in manufacturing processes experience a 6.5% higher median performance in overall equipment effectiveness (OEE). SPC's ability to deliver consumable process variation data has been helping organizations for quite some time.

However, the benefits to using these solutions are typically not felt outside of the realm of manufacturing operations management. Because most EQMS vendors do not deal well with real-time process data, implementing SPC in addition to this solution is a natural extension. The delivery of real-time data is essential to improving the cost of quality metric, and SPC can fill the improvement gaps.

Statistical Analysis used to Monitor and Analyze Real-Time Supplier Quality Data



	Current	No Plans	Planned
Count	16	31	34
Median	0.89	0.76	0.85
Outliers	0	0	0

As shown in the data point above, companies that have extended SPC capabilities to supplier facilities have experienced a median OEE performance that is 13% higher than companies without the capability. Because the OEE equation encompasses quality, asset availability, and efficiency, the ability to monitor upstream production in real-time and identify non-conformances as they occur is a critical component to improving each of these variables. In many cases, market leaders are requiring that suppliers sync data through Web-based portals to attain a holistic view of production across the value chain.

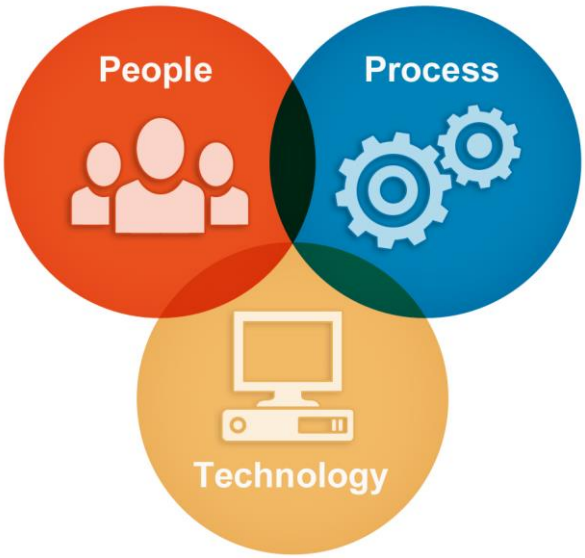
Measuring the cost of quality takes an organizational effort. Companies with market leading performance are working to align and then optimize people, processes, and technology around reducing the cost of quality.

Real-Time SPC in the Context of Operational Excellence

Although many organizations have operational excellence initiatives, there is often a disconnect between local efforts and those of the broader enterprise. For this reason, investments of time and capital in key resources—people, processes, and technology—often do not yield their highest return. The LNS Research Model of Operational Excellence has helped many organizations overcome this common challenge. The model aims to help executives align and then optimize key resources to make measureable improvements toward strategic objectives.

The following section will discuss the role of people, processes, and technology in achieving market leading performance in quality management. It will also discuss the importance of developing and executing a quality metrics program.

Building a Roadmap for Capturing the Value of Real-Time SPC



It is clear that deploying real-time SPC can deliver demonstrable benefits in manufacturing efficiency and the reduction of the CoQ, but to ensure success it is critical to have a roadmap for understanding how to capture value from these investments. In taking an operational excellence approach to an SPC deployment, there are several steps needed to transform the traditionally shop floor-focused solution into enterprise intelligence:

1. **Attain executive backing**

   Getting buy-in from leadership is critical for both up-front support and long-term viability of any initiative. The right level of buy-in from leadership for an SPC deployment is often best achieved by leveraging shop-floor data in a way that makes it relevant to not only machine operators and supervisors, but also leadership.

2. **Extend and standardize capabilities across the enterprise**

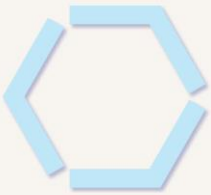
   In the past, it was common for SPC data collection and analysis methods to be unique to each plant. By rolling out a singular SPC solution to distributed facilities as well as suppliers, a standardized set of data can be collected, which is the foundation for identifying improvement areas.

3. **Develop formal training**

   If approached strategically, personnel responsible for the quality of products and processes can be empowered to not only monitor real-time SPC data, but also use it as a tool to make real-time production decisions. This approach can be the source of competitive advantage for process-intensive organizations.

4. **Quantify the cost of variances**

   By integrating SPC data with ERP, organizations can analyze production variances to translate them into dollars and cents. Once this is completed, variances can be quantified to show their relative impact to key quality metrics such as scrap and rework.



5. **Turn shop floor data into enterprise intelligence**

   Without today's emerging solutions for consuming massive amounts of data, turning enterprise-wide SPC data into intelligence would be nearly impossible. Business intelligence tools can help to visualize the data, and also quickly filter it by product line, product, region, supplier, etc., which can be significantly more powerful in getting executive attention.

6. **Enable continuous improvement**

   Take advantage of metrics that range from the shop-floor to the top floor to continue on a path toward continuous improvement with SPC software.

With this approach, the real-time data holds considerably more value as it becomes relevant to key players in the organization in addition to those who traditionally use it.

Using Quality Metrics

Depending on the industry served and the positioning in that industry's supply chain, there are a range of quality metrics an organization can measure to get the most out of SPC data. Across industries, LNS identifies several key quality management metrics that should be measured as early and effectively as possible: cost of quality, overall equipment effectiveness, percentage of products in compliance, on-time and complete shipments, and new products introduction.

The use of SPC software can directly and indirectly influence many of these metrics' variables. For instance, as mentioned previously, the cost of quality is composed of the costs of good quality and the costs of poor quality. SPC software can help to reduce the instance of internal failure costs that make up a portion of the cost of poor quality. Catching these quality issues early in the production process can have enormous benefits to the cost of quality and profitability.

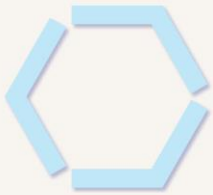
Similar benefits can be realized when breaking down the variables of OEE. (See Taking Overall Equipment Effectiveness beyond the Plant Floor).

The use of SPC software can directly and indirectly influence many of metrics' variables, such as cost of quality, OEE, percentage of products In compliance, on-time and complete shipments, and new products introduction.

Actionable Recommendations

Reducing the cost of quality takes an organizational effort. Companies with market-leading performance are working to align and then optimize people, processes, and technology around this goal. In many cases, deploying SPC at the enterprise level and delivering value for the shop floor as well as executives is a vital component for having the capability to analyze data in real-time and get the most out of key resources.

The following is a set of recommendations for organizations interested in reducing the cost of quality and other key quality metrics with SPC.



- Globally standardize SPC to deliver common processes and metrics for improved decision making as well as reduced IT costs
- Make SPC data consumable by translating the costs of variances into dollars and cents as well as leveraging business intelligence tools
- Focus on using analytics to determine relationships between higher-level operational performance metrics like OEE and more specific quality metrics like temperature, flow, pressure, and in-line test results
- Make reducing the cost of quality an executive priority by placing it on the executive dashboard and routinely including it in meetings that involve senior leadership
- Develop internal educational programs, SOPs, and best practices for how to reduce the cost of quality, particularly as it relates to delivering real-time data from the shop floor

LNS Research provides advisory and benchmarking services to help Line-of-Business, IT, and Industrial Automation executives make critical business and operational decisions. LNS research focuses on providing insights into the key business processes, metrics, and technologies adopted in industrial operations.

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