

End to End Quality Control in Consumer Electronics

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Abstract

End-to-end quality control is the process of ensuring that a product meets all quality standards throughout its entire lifecycle, from design and manufacturing to delivery and customer use. It is important for every industry that manufactures tangible products used by customers on a day-to-day basis. For consumer electronics it is equally important because it helps to ensure that products are safe, reliable, and meet customer expectations for daily use of tangible products. End-to-end quality control can help to identify and fix defects early in the product development process, which can save time and money. It can also help to prevent customer returns and improve customer satisfaction. It includes both incoming inspection of materials and components, and in-process and final inspection of finished products.

Incoming quality control

Incoming inspection (often referred to as Incoming Quality control or IQC) ensures that all materials and components meet the required specifications. This is done by sampling and testing materials and components to verify that they meet the required properties. There are various methods to pick samples for testing including:

- Statistical sampling
- Random sampling
- First-off sampling
- Batch sampling
- Acceptance sampling

Upstream out-going quality control

IQC down-stream is as important as performing outgoing inspection (often referred to as Outgoing Quality control or OQC) at a previous node. OQC checks typically happen at a larger sampling rate compared to the downstream incoming checks. Typical OQC checks include nondestructive inspections like dimensional, cosmetic and functional checks based on drawing specifications, and destructive inspections and Reliability.

Performing 100% inspection at both IQC and OQC is not feasible in most cases. Sampling is widely used in businesses owing to benefits obtained when facing detrimental aspects of 100% inspection like:

- Destructive inspection where a quantity of product is destroyed during testing and a business wants to limit this
- Costs associated with 100% inspection are not economical

In process Quality control

In-process inspection (often referred to as In process Quality control or IPQC) ensures that products are being manufactured correctly throughout the production process. This is done by inspecting products at various sub-assembly stages of production. This ensures that an issue with the manufacturing process is caught earlier in the cycle to help save costs with finding defects further down in the supply chain.

Final inspection ensures that finished products meet all quality standards before they are shipped to customers. This is done by inspecting products for defects and verifying that they meet all specifications. This includes Cosmetic, Functional, Dimensional checks as well as Reliability checks

There are a number of different methods that can be used for End-to-end quality control, including:

- Design reviews
- Process audits
- Product testing and Reliability testing
- Customer feedback

Statistics

Statistical Control is really important when it comes to analyzing data from each of these inspection nodes. There are multiple data visualization methods to visualize, analyze and act on data obtained from inspections including (but not all inclusive) - box plots, histograms, pareto, scatter plot, correlation and regression analysis plots.

To resolve manufacturing issues and drive improvements, a technique called design for experiments (DOE) is typically used in consumer electronics. DOE is a statistical tool that helps understand the relationship between input variables and output variables. It is a structured approach to collecting data and making data driven inferences and driving decisions to improve a process. The goal of DOE is to find the optimal settings for key process input variables in order to improve process performance.

Benefits of end-to-end quality control

Here are some of the benefits of end-to-end quality control for consumer electronics:

- Improved product quality: End-to-end quality control helps to identify and correct defects early in the manufacturing process, which can lead to improved product quality.
- Reduced product defects: End-to-end quality control can help to identify and correct potential defects in the product design and manufacturing process. This can help to reduce the number of defective products that are shipped to customers.
- Reduced costs: By identifying and correcting defects early, end-to-end quality control can help to reduce the costs associated with product recalls and warranty claims.
- Increased customer satisfaction: By ensuring that products meet all quality standards, end-to-end quality control can help to increase customer satisfaction.
- Improved brand reputation: A reputation for high-quality products can help to improve a company's brand reputation and attract new customers.

If you want to improve the quality of your consumer electronics, end-to-end quality control is a good place to begin!

Keywords

Quality, Electronics, Control, Design,