

Evolution of Quality


What's next in digital era?

E-BOOK

Ankur Chaudhary, Manager Consulting Services
Manufacturing Practice - Hitachi Vantara

Sharad Nigam, Vice President,
Strategic Growth & Smart Operations
Hitachi India Pvt. Ltd.

Ruchika Rathore, Sr. Consultant
Research Services - Hitachi Vantara

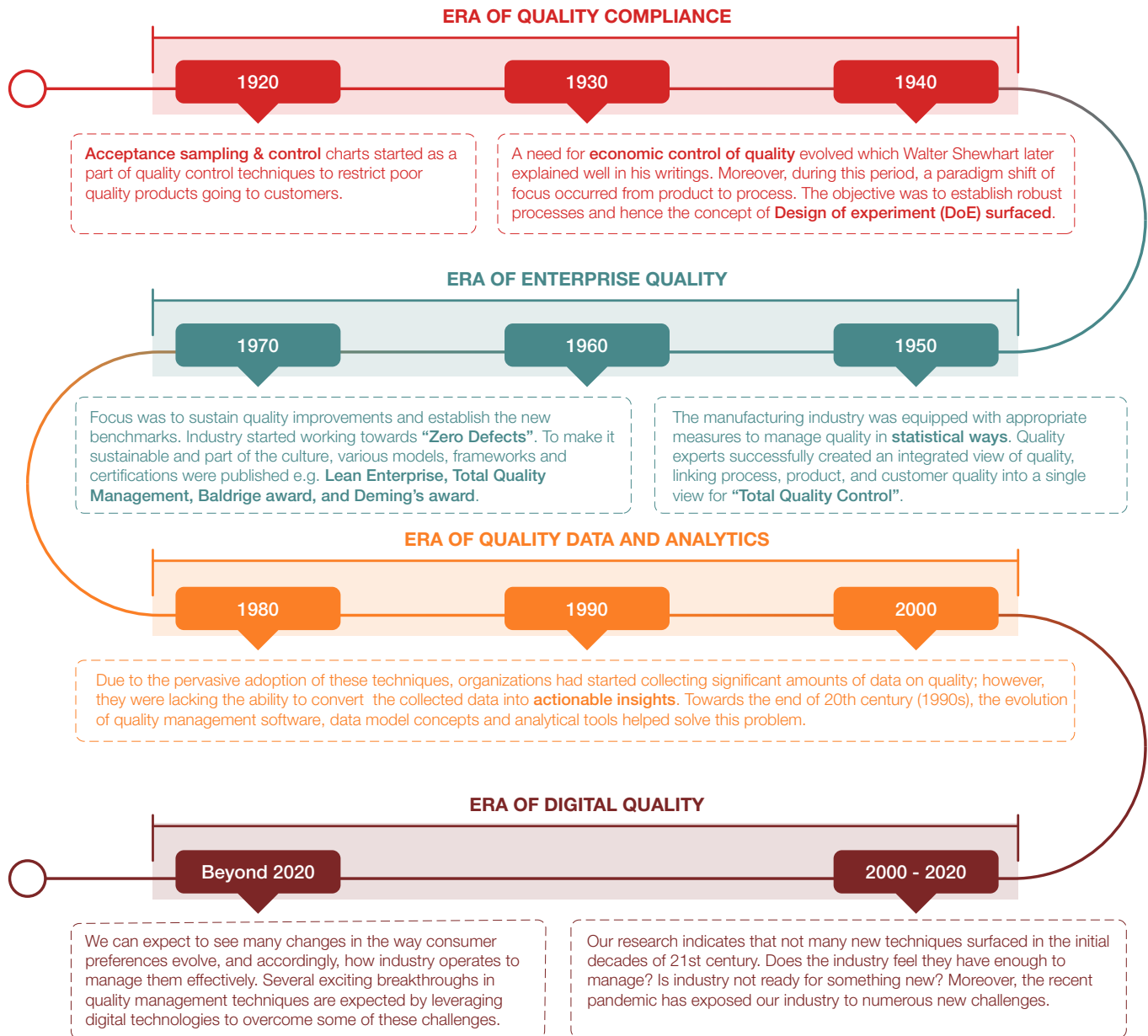


This point of view captures how quality concepts have evolved over the last century and explains how some common, but proven, quality tools are taking a new avatar in the current scenario with evolution of digital technologies.

As the focus shifted from quality control to quality assurance, strengthening process quality became a key pillar of delivering a quality product. A data-driven approach by leveraging digital has evolved to strengthen quality across the value chain.

Evolution of Quality Over the Last Century

Structured tools and techniques in quality management began early in the 20th century. Eventually, when organizations realized the multi-faceted impact of quality on a company's overall performance, quality became an integral part of the operating model. The following visual describes this evolution over the last century.



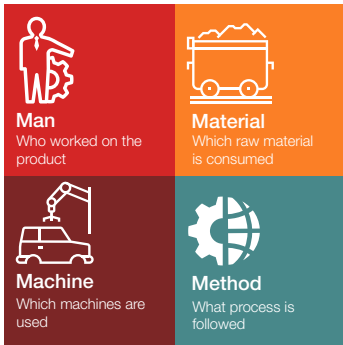
Quality management is becoming more effective by leveraging digital across the value chain. Digital has helped to strengthen quality by working closely with suppliers, focusing on internal processes and serving customers. Examples include:

- 1. Automated and intelligent process for SQI (Supplier Quality Improvement):** Leverages digital on incoming inspection results to get actionable insights. AI applied on collected quality inspection data, automatically analyzes the potential quality risks and initiates supplier corrective action process (SCAR) embedded with supporting insights for internal teams to optimize quality parameters.
- 2. Digital Design of Experiments (DoE):** DoE helps organizations to assess the impact of change in process input in relation to the output. Though effective, it is a long and time-consuming exercise requiring a pool of resources. With digital tools, this process can be done in real-time. 4M data (human, machine, material and method) is captured directly from machines, analysis is done using AI-based algorithms and optimization is done across multiple process stages in real-time.
- 3. Predictive Quality:** There are various real-world scenarios for deploying video & image analytics for quality management. In the automotive industry, video & image analytics capture details of a part on the production line. AI-based algorithms are used to determine missing holes & nuts, count the total nuts and also map the coordinates of each hole to ensure a quality product.
- 4. Remote Monitoring for Quality:** Operational performance data of the machines or products is collected for root cause analysis, which helps to carryout diagnosis remotely. Remote monitoring enables continuous improvement in quality and on the other hand, performance data collected from machines provides increased visibility of sites for improved maintenance costs and reduced capital expenditures.
- 5. Proactive sensing to act before customers complain:** In the present hyper-connected world with ever demanding customers, there are numerous platforms to feed us the pulse of product performance. Customer engagement applications, block chain & near field communications (NFC)-based smart packaging & traceability solutions, and big data analytics-based customer insights put you on top of the situation.



Digitalization Leading to Real-time, Interactive and Prescriptive Processes

At Hitachi, we expect quality functions to evolve from descriptive to prescriptive in coming years. As the collection of data becomes more real-time and quality management documents become live, potential for on-line analytics on data sets will become feasible and hence, quality will move from descriptive to predictive. With further application of artificial intelligence and machine learning, it is expected to reach the end goal of being prescriptive.

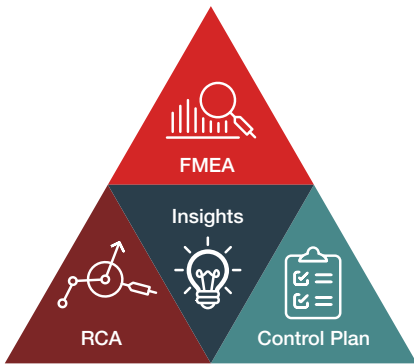


1. Descriptive Quality Control: Ensures end-to-end traceability from customer to supplier. It includes the following.

- Method / Standard Operating Procedure (SOP) monitoring with image analyzer
- Real-time digital enabled visual inspection
- Continuous monitoring of 4M aspects to enable real time decision making

Hitachi will:

- Develop genealogy report for products
- Plot real-time control charts
- Conduct quick analysis and make decisions



2. Predictive Quality Assurance: Develop and Deploy predictive models to detect production issues. It includes the following.

- Integrated PFMEA with Root Cause Analysis
- Advanced image analytics triggering skill gaps leading to quality issues
- Output quality parameter prediction based on process inputs

Hitachi will:

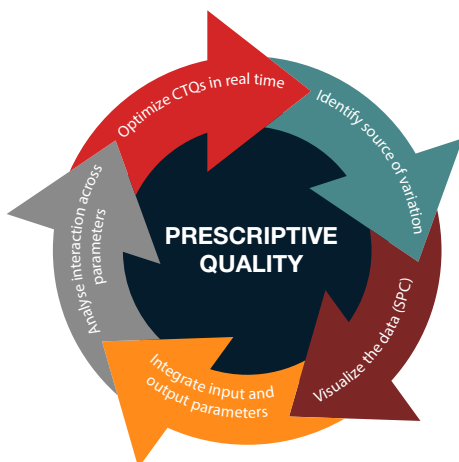
- Develop FMEA and establish Critical to Quality (CTQ). with linkage to causes, sub-causes & counter measures.
- Define process control plan
- For failures, conduct RCA and refresh FMEA and control plan

3. Prescriptive Quality Assurance: Carries out real-time optimization of operating parameters and includes the following

- Refined control limits for Critical to Quality (CTQ) parameters
- Method modification recommendations based on variability in human, machine & materials
- Systemic update of operator skills based on real-time quality performance

Hitachi will:

- MI / AL based closed loop system to continuously track CTPs and CTQs, monitor relationship and recommend potential changes in CTPs to achieve desired CTQs



Hitachi is working to develop and deploy digital solutions to enhance Quality performance

Predicting Process Quality to Reduce Rework

Challenge: A tire manufacturing company was facing issues of rework during the inspection post curing process.

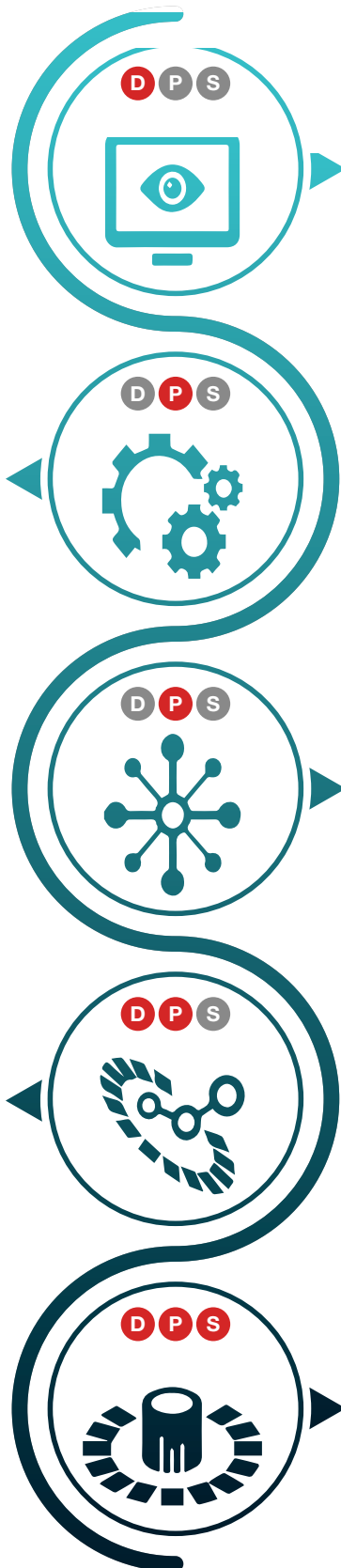
Solution: Team has taken various process parameters into consideration, integrated data from machinery & other sources and discovered critical factors which were impacting final quality. Team developed an AI & ML-based model which was used to predict the quality of the tire post treading and before curing thus helping the operator to take action for repair and rejection optimization.

Digital Standard Operating Procedures (DSOPs)

Background: Standard Operating Procedures (SOPs) are documents with details of work instructions for a process. Generally, SOPs are kept in a record room and sometimes displayed on the asset.

Solution: Hitachi worked to improvise these SOPs and digitize them with process steps converted into sequential activities. The deployment of video analytics helped in checking the compliance to SOPs, activity logging, time taken, enhanced communication on the shop floor and raising quality alerts. This could result in actionable insights to improve process productivity and quality.

- D** Descriptive
- P** Predictive
- S** Prescriptive



Smart Inspection System

Challenge: Inspection is a time consuming, challenging as well as error prone process whether it is a sheet metal part, or any other product being inspected for surface defects.

Solution: Hitachi's Automotive Products Research laboratory (APL) and the Center for Social Innovation (CSI) Detroit developed deep-learning-based image processing software with the ability to process images in different lighting conditions for inspection. The high sensitivity inspection system can categorize different surface defects such as dents, nodules and scratches. It also stores the details of the surface analysis data for remote monitoring and to track production performance.

Smart Ink for Quality Mgmt.

Background: Economic development in Southeast Asia has increased demand for food and medical supplies requiring quality control. However, cold chains are underdeveloped.

Solution:

Use case 1: Food chain platforms that use temperature sensing ink along with block chain, logistics management, image diagnosis and simulators to provide quality control and traceability. Hitachi has been conducting field tests through smartphones to capture temperature detection code, storage temperature, time and place of product.

Use case 2: In the case of pharma products, deterioration is indicated by the reduction in their effect. Temperature sensing ink combined with IoT enables uninterrupted temperature monitoring of medical supplies throughout the supply chain from production to consumption.

Advance Process Control for Prescriptive Quality

Background: An electrical goods manufacturer was facing challenges around the high cost of quality due to destructive testing. Additionally, in-process rejections were higher.

Solution: Hitachi integrated IoT data from machinery, sensors and other sources to discover critical factors and optimal process parameters through correlation & optimization analysis.

The expected outcomes include ~40% reduction in cost of quality, higher yield and significant reduction in operating costs.

For more information or to discuss how Hitachi Vantara can help in your digital transformation journey, you may visit <https://www.hitachivantara.com/en-us/solutions/industry-solutions/manufacturing.html> or reach out to manufacturing@hitachivantara.com.



We Are Hitachi Vantara

We guide our customers from what's now to what's next by solving their digital challenges. Working alongside each customer, we apply our unmatched industrial and digital capabilities to their data and applications to benefit both business and society.

Hitachi Vantara



Corporate Headquarters
2535 Augustine Drive
Santa Clara, CA 95054 USA
hitachivantara.com | community.hitachivantara.com

Contact Information
USA: 1-800-446-0744
Global: 1-858-547-4526
hitachivantara.com/contact

HITACHI is a trademark or registered trademark of Hitachi, Ltd. All other trademarks, service marks, and company names are properties of their respective owners.

GEN-67-A BTD October 2020