

# IBM Prescriptive Quality on Cloud

Use prescriptive analytics for earlier, more definitive identification of quality problems to help improve process and product quality



## Better process and product quality via the Internet of Things

Quality of process, materials, components and products continues to be an area of keen focus for manufacturing organizations. Quality problems can surface throughout the manufacturing process. Quality of raw materials or components may vary among suppliers, production runs or delivery dates. Likewise, process quality may vary by location, time of day, production environment, or operator. Quality is critical to the success of automotive, aviation, electronics, chemical and petroleum, consumer goods, food, industrial products and pharmaceutical industries.

In addition to established methods of obtaining operational data the Internet of Things, proving to be one of the great technology phenomena of our time, can further facilitate immediate and detailed insight into manufacturing quality problems. By infusing intelligence into manufacturing equipment, new capabilities such as cognitive computing give businesses deeper insights into manufacturing processes and unlock the true value of production assets. For the first time, this new world of intelligence, connectivity, and analytics gives manufacturing organizations a means to obtain a more detailed and accurate understanding and greater control of process and product quality.

## Cost of quality

The American Society for Quality (asq.org) indicates that “Many organizations will have true quality-related costs as high as 15 to 20 percent of sales revenue, some going as high as 40 percent of total operations. A general rule of thumb is that costs of poor quality in a thriving company will be about 10 to 15 percent of operations.”<sup>1</sup> For many organizations even single digit–1% to 9%–reduction in quality costs can result in substantial savings.

The sooner quality problems are identified and resolved, the better the overall efficiency of the supply chain and manufacturing process. Consistent manufacturing quality provides a variety of quantitative benefits for participants in the supply chain, including:

- Material and supply cost reductions
- Increased production yield, reduced scrap and rework
- Reduced overall manufacturing costs
- Reduced service or warranty costs

## Limitations of traditional quality control techniques

Statistical process control has been a staple of quality management for decades. However, many traditional statistical process control methods are reactive in nature, which hinders their ability to detect cumulative defects early in the manufacturing process. Additionally, industry efforts to apply modern analytical methods are difficult to implement and scale in big-data environments required for intricate, global supply chains due to complex computational requirements and software constraints.

The limitations of SPC methods are well-recognized:

- Cumulative defects must reach statistical significance before being reported
- Detection is slow, requiring a large number of cumulative defects to trigger a valid alarm
- False positives caused by tightening control limits are common
- Most methods have little ability to detect trends before reaching cumulative evidence levels
- Problems areas are not prioritized, so corrective measures are often not given required priority

## IBM Quality Early Warning System

To address these limitations, IBM Research has developed techniques to enhance and improve traditional process control methods. The result is an advanced set of statistical algorithms called Quality Early Warning System (QEWS) which can detect emerging quality problems sooner and with fewer false alarms than typically achieved by traditional statistical process control. To achieve earlier detection, QEWS is sensitive to subtle changes in data values, such as shifts that are small in magnitude or trends that grow slowly over time. For a given level of statistical confidence, QEWS typically needs fewer data points than traditional statistical process control.

## IBM Prescriptive Quality on Cloud

As part of the Cognitive Processes and Operations solutions in the IoT for Manufacturing offering, IBM Prescriptive Quality on Cloud incorporates QEWS algorithms to deliver an enterprise-wide software-as-a-service (SaaS) solution to help organizations accurately identify sources of quality problems, allowing process engineers, quality control, operations, reliability and maintenance personnel to quickly act and resolve them.

The solution provides a line-of-business user experience that makes it easy for personnel with quality responsibilities to upload, analyze and act upon data obtained from production equipment and other key sources to improve process and product quality. Depending upon type and format of data, IBM Prescriptive Quality on Cloud can enable an organization to quickly realize benefits by applying out-of-the-box quality models to analyze production data.

The definitive nature of IBM Prescriptive Quality on Cloud analysis and alerts eliminates the need for subjective judgment of SPC control charts and other traditional tools, and provides

- Detect subtle changes in failure rates of materials, components, subassemblies or completed products hours, or days and potentially weeks earlier than SPC methods
- Detect if equipment calibration is trending beyond prescribed control limits
- Precisely identify the source of quality problems and quickly act to remedy them

### Assess supplier quality

IBM Prescriptive Quality on Cloud is applicable to the “appraisal” category where verification of incoming material against agreed specifications prevents introduction of substandard materials or components into the manufacturing process. IBM Prescriptive Quality on Cloud can provide substantive, detailed quality metrics to enable quality control and procurement personnel to work with the supplier to resolve the issue. Over time, cumulative material assessments contribute to individual supplier ratings. Reduction or elimination of quality problems at the earliest stage of the manufacturing process can have the most significant impact in reducing cost of quality.

### Assess process quality

IBM Prescriptive Quality on Cloud is also applicable to the “internal failure” category where waste, scrap, and rework decrease production yield and contribute significantly to cost of quality. It does this in two ways. First, by monitoring material, component or product attributes throughout the manufacturing process. Second, by monitoring settings or calibrations of critical manufacturing equipment. For each of these, the immediate benefit is earlier and definitive identification of quality problems and prevention of wasteful production cycles.

### Assess quality of critical manufacturing steps

IBM Prescriptive Quality on Cloud can monitor key attributes— dimensions, roughness, density, volume, weight, flex, test results, etc.—of parts, components and products as they complete critical manufacturing steps. In the event an attribute exceeds a threshold an alert is issued thereby helping quality control, process engineering, production personnel, and maintenance to isolate, investigate and resolve the problem to prevent any further manufacturing of sub-standard product. For example, an alert can guide personnel to investigate the specific manufacturing step associated with the problem and determine if the cause is faulty materials, improper equipment setup, equipment degradation, or even operator error in certain circumstances.



Figure 1. Earlier, more definitive identification of quality problems in comparison to traditional SPC methods.

lines of business with consistent and accurate information. The example below shows how IBM Prescriptive Quality on Cloud, employing the QEWS algorithm (indicated by the blue spikes on the lower evidence chart) identifies a quality problem associated with an electrostatic painting process significantly earlier and more definitively than traditional statistical process control (indicated by the red data points in the upper variable value chart).

By combining analytics with efficient cloud delivery, IBM Prescriptive Quality on Cloud enables personnel responsible for quality management to:

- Rapidly evaluate massive amounts of data to identify the most appropriate thresholds
- Drill down into data to quickly identify suspect materials or parts

## Assess calibration of critical equipment

IBM Prescriptive Quality on Cloud can also monitor setting and calibration parameters—speed, temperature, flow, humidity, voltage, viscosity, etc.—of manufacturing equipment or environments to ensure they operate within specifications required for production quality. In the event that a parameter exceeds a threshold, an alert is issued helping quality control, production personnel or reliability engineers to isolate, investigate and resolve the specific problem, such as fluctuation in motor speed or vibration that causes an uneven surface in a milling operation, drop in hydraulic pressure that causes variations in an extrusion process, or change in humidity or air flow affecting a painting process.

## Prioritized alerts address the most critical problems

The wealth of real-time data provided by an instrumented, connected shop floor or production environment to monitor the performance and quality of manufacturing activities can be overwhelming without the aid of analytics. IBM Prescriptive Quality on Cloud prioritizes and reports quality data to allow operations personnel to focus on the activities most needing attention, monitor developing trends, and gain an overall assessment of quality metrics. As shown in the image below activities are color coded and prioritized. An alert indicates the notification threshold has been exceeded within the last 10 data points. Caution means the data points are verging on the alert threshold. Alert but improving means an alert as issued before the last 10 data points but data are now returning to an acceptable condition. Acceptable indicates all data points are within threshold or a few points that exceeded threshold are now within the acceptable range.

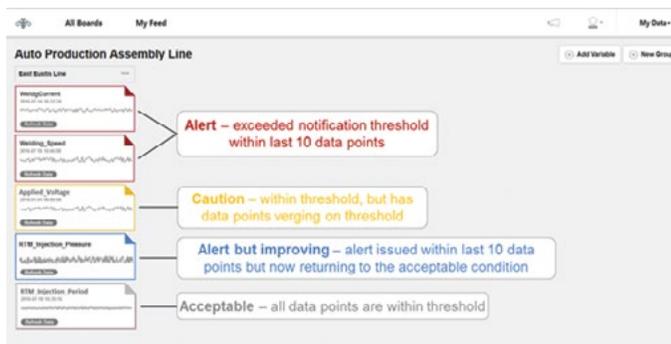


Figure 2. Prioritization of alerts enables lines of business to address those problems needing immediate attention.

## Benefit multiple lines of business

IBM Prescriptive Quality on Cloud helps support quality control throughout the manufacturing process by providing early, more definitive alerts to process and product quality problems. This proactive approach enables personnel to spend less time on problem detection and more time on problem resolution, thereby helping increase production yield and lower overall operational costs.

Quality control personnel clearly benefit from the ability to identify and resolve process and product quality problems as early as possible in the production cycle. Benefits extend to other lines of business as well.

Procurement benefits by identifying suppliers who deliver substandard parts, reviewing contractual specifications to remedy the problem, or finding a new supplier. Product design can be advised of component modifications, such as a minor change in dimensions to make assembly easier. Process engineering can fine tune adjustments or make modifications to production equipment, calibration or an assembly process to eliminate process variation. Operations benefits from learning the problem is associated with a prescribed procedure or possibly a need to provide better operator training. Maintenance benefits through alerts that are caused by impending equipment degradation or failures that could result in reduced yield, scrap, or the need for rework.

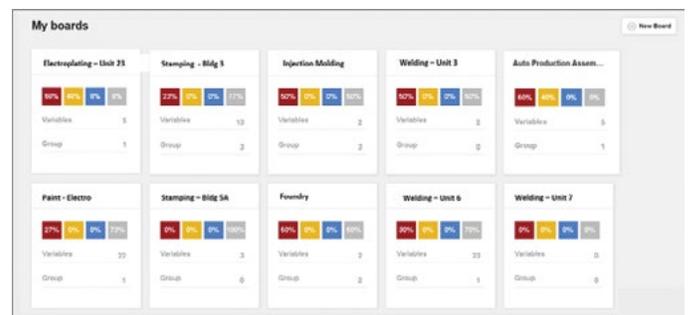


Figure 3. Easily organize, analyze, manage, and share process and quality data across lines of business.

## SaaS offers many advantages

IBM Prescriptive Quality on Cloud is a SaaS solution that offers deployment, operational and financial advantages in comparison to an on-premise strategy.

Accelerate implementation and avoid the expense of additional IT infrastructure and overhead costs. IBM's secure SoftLayer data centers can manage the entire offering infrastructure with automatic application provisioning and registration services. Global availability makes it easy to realize the benefits of prescriptive quality regardless of location. IBM allows you to select from multiple deployment options—cloud, single tenant, or hybrid—in order to meet your specific needs.

In contrast to on-premise, SaaS solutions can offer a more predictable and cost effective environment with an established service-level-agreement. In many cases this enables organizations to move from a capex to an opex financial model. For IBM clients who currently have a PMQ entitlement “Bridge to SaaS” offers a means to try out a SaaS approach using existing committed funding.

IBM Prescriptive Quality on Cloud is one of the solutions in the Cognitive Process and Operations solutions suite of the IoT for Manufacturing offering, along with Prescriptive Maintenance on Cloud and Prescriptive Warranty on Cloud, that offer an innovative way to address the move to Industry 4.0 capabilities. Together, they can help improve process and product quality in manufacturing, increase asset availability and reliability, and reduce warranty costs.

These solutions are built on IBM's open platform (IOP) which enables customers to take advantage of Open Source programming tools and models such as Python, R and Spark, as well as provides support for Hadoop and RDBMS data lakes.

## IBM Quality Early Warning System for early detection

Established data acquisition methods and newer IoT technologies can deliver a bounty of operational data to desktops and devices of personnel responsible for process and product quality. In a manufacturing environment data value is a function of timely analysis that can transform it into meaningful action.

As mentioned above, cost of poor quality in a company may vary between 15 to 20 percent of sales revenue. Definitive detection of quality issues, early in the supply chain or manufacturing process can deliver significant cost savings.

IBM's Quality Early Warning System algorithms provide a significant advantage over traditional SPC methods by detecting emerging quality problems sooner and with fewer false alarms. For a given level of statistical confidence, QEWS typically needs fewer data points than traditional statistical process control. It is designed to provide timely, accurate and relevant alerts to detect, identify and help proactively remedy quality problems to improve production yield, reduce scrap and rework, and reduce warranty costs.

### Learn more

To learn more about IBM Prescriptive Quality on Cloud and its complementary solutions—IBM Prescriptive Maintenance on Cloud and IBM Prescriptive Warranty on Cloud contact your IBM representative or IBM Business Partner, or visit:

[ibm.co/pqoncloud](http://ibm.co/pqoncloud)

[ibm.co/pmoncloud](http://ibm.co/pmoncloud)

[ibm.co/pwoncloud](http://ibm.co/pwoncloud)

Footnotes

1. The ASQ Quality Improvement Pocket Guide: Basic History, Concepts, Tools, and Relationships, Grace L. Duffy, ASQ Quality Press, 2013, pages 62–65.

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