IBM’s Commitment to Quality and Innovation

Executive Summary
IBM has a strong quality heritage. Looking back over 100 years, IBM has diligently built quality into its products, solutions and processes. Every employee knows their role to continuously improve the quality of IBM deliverables to clients. Clients view quality as the end-to-end experience with the entire IBM corporation.

Today, IBM employees around the world invent and integrate hardware, software and services to help forward-thinking enterprises, institutions and people succeed on a smarter planet. IBM’s Integrated Supply Chain (ISC) organization manages the critical supply chain processes from opportunity to order to cash collection, source to pay and plan to deliver.

About IBM and Quality Management
“Dedication to every client’s success” is one of three IBM core values. IBM is only successful if our clients are successful. In support of this, the IBM Integrated Supply Chain (ISC) team focuses on operational excellence, from a client perspective. This requires flawless delivery, high quality installations and on-time serviceability of client orders. To sustain operational excellence across a wide variety of products and solutions, the IBM ISC team must manage supply, across a complex, multi-tiered supply chain to our end clients at the highest level of quality. This challenge sparked the need for IBM’s Quality Early Warning System (QEWS).

In 2012, ISC took Quality Early Warning System (QEWS) to the cloud. QEWS is an innovative solution developed by IBM to apply advanced algorithms to identify unfavorable quality trends in its end-to-end hardware supply chain processes. In addition to saving IBM an estimated $50 million in warranty costs, QEWS is an important step in IBM’s shift from descriptive-, or reactive analytics, to predictive analytics.

The Quality Early Warning System was developed, deployed, and refined over the time period starting in 2009. QEWS is a proprietary, patent pending, software solution that was developed through a collaborative effort from business and technology experts in IBM’s Research, Supply Chain, Manufacturing, and Information Technology organizations. QEWS has been widely deployed across IBM’s globally integrated enterprise, and brings all product brands and commodities into a standardized quality management system. The QEWS functions are available as a stand-alone cloud offering or imbedded in IBM’s Preventative and Quality Management (PMQ) Software as a Service (SaaS).

Problems Statement and Business Impact
The technology industry spends billions of dollars in warranty claims each year. Early detection of emerging issues in the end-to-end supply chain represents a smarter solution. Shifting problem detection and rapid response to emerging quality problems further back in the supply chain, enables improved productivity and lower overall costs.

In any supply chain operation, “time is money” when it comes to detecting quality problems. Even a small delay in detecting a quality problem can result in large costs from reworked or scrapped product, recall of defective product, increased warranty expenses, loss of customer satisfaction, and potentially even legal liability. The scale and complexity of IBM’s manufacturing
operations, internal and contracted, made it vital that supply chain quality problems are detected as early as possible – before suspect materials from suppliers ever enter IBM’s manufacturing plants or make it into production. The limitations of traditional Statistical Process Control (SPC) used in quality problem detection are well known, but better analytical methods have proved exceedingly difficult to implement on a scale useful for a complex, global supply chain. This is principally due to complex computational challenges and constraints in software implementation.

**Initiative Rationale**
The QEWS tool provides automated, enterprise-wide, quality visibility across the entire end-to-end supply chain, both for internal and outsourced manufacturing partners. This quality visibility includes early detection of emerging issues in the end-to-end supply chain using advanced analytics, a data repository, and an easy to use, fully customizable presentation layer. QEWS allows rapid containment of affected inventory, increased productivity in the supply chain, and significant downstream savings in warranty costs.

**Pain Points and Solution Overview**
The pain points / business challenges addressed by the QEWS solution include difficulty isolating and diagnosing quality problems as these occur inconsistently, gradually or manifest themselves as multiple problems over time. Additional pain points inherent in traditional statistical process control (SPC) methods include inefficient programs and methods to maintain quality, late and reactive error detection with a high percentage of defects, and a lack of insight into the types and causes of quality issues.

IBM’s QEWS solves these pain points by detecting problems, trends and issues earlier and more accurately through automated, “on the fly” detection threshold generation for rapid evaluation of massive amounts of data. QEWS improves efficiencies and reduces costs related to maintaining quality by generating actionable alarms that are automated, prioritized, readily analyzed, and easily pushed to system users inside and outside of IBM. The QEWS solution allows greater visibility into quality issues for proactive management through an effective dashboard: an easily navigable interface to enable quick navigation of vast amounts of quality data. Figures 1 and 2 are examples of summary and detail dashboards which are fully customizable based on user needs.

Figure 1 – Summary QEWS Dashboard:
Results, Validation and Quantification
The QEWS architecture is illustrated in Figure 3. Data from a variety of databases is extracted, transformed and loaded into a centralized data store in a format suitable for running QEWS. Patent pending algorithms for threshold detection, target setting and prioritization are applied, and a prioritized and a customized set of alerts are automatically distributed to a stakeholder distribution spanning approximately 400 users within IBM, IBM’s contract manufacturers and IBM’s suppliers. The dashboard serves as an alert repository and includes several analytical tools, including a cubic database with millions of records, for further investigation of developing quality problems.

Figure 3 – QEWS architecture summary:
The IBM Quality Early Warning System (QEWS) analyzes quality data across a complex supply chain consisting of nearly 100,000 part numbers, all major commodities, and all of IBM’s system brands spanning hundred’s of active machine-type models. QEWS has proved highly effective in protecting IBM’s supply chain and manufacturing operations. Subtle changes in failure rates (in components, subassemblies, firmware, or completed product) indicative of potential emerging quality problems are now typically detected weeks, and even months earlier than what was previously possible. The graphs in Figure 4 illustrate an example of earlier problem detection using QEWS analytics (top chart) versus traditional SPC (bottom chart); in this case many weeks earlier. This allows for quicker problem identification, faster problem resolution, and lower total costs.

Figure 4 – Example of earlier detection of QEWS versus SPC:

The definitive nature of QEWS also eliminates the need for subjective judgment of SPC control charts and other traditional tools, providing engineers, management and suppliers with consistent and accurate detection. The graphs below in Figure 5 illustrate the definitive nature of QEWS (top chart) by keeping the focus on developing issues, while traditional SPC (bottom chart) are often times ambiguous and sporadic.
QEWS’ automatic monitoring of the supply chain, and a clear dashboard showing real quality issues presented in priority order, empower IBM to work proactively with suppliers, rather than reactively. This customizable dashboard, shown earlier, includes a number of diagnostic, “drill down” tools for post alert analysis. These tools enable greater productivity across the ISC global workforce, and a standardized quality management system.

In addition to the IBM use of QEWS, the solution has been validated by IBM’s Global Business Services organization using external client data. In most cases, QEWS has demonstrated significantly earlier and more definitive problem detection than did traditional statistical methods.

**Sustaining the Initiative Value**
IBM continues to invest in the Quality Early Warning System (QEWS) as a key initiative in IBM’s transformation strategy. QEWS has enabled a monumental step in quality management for the technology industry at large. This is accomplished through proactive alerts and a more efficient and effective quality process; made possible by advanced analytics on an enterprise-wide scale. This system is also applicable for industries that rely on procurement and manufacturing as well as those who consume their products. IBM’s Quality Early Warning System standardizes the quality management process across the entire ISC globally integrated enterprise and enables a unified and consistent approach through automation of the advanced analytics and alert prioritizations. This has enabled personnel across the entire IBM supply chain to spend less time on problem detection, and more time on problem resolution. The resultant effort is increased productivity, greater client value, and lower overall operational costs. This value is also being demonstrated and extended through IBM’s Global Business Services group for external clients.

**Additional references and cloud based experience**
In 2012, QEWS was recognized by *InformationWeek* as a leading innovation. And it was a finalist in the technology category of the Institute for Supply Management’s (ISM) 2013 awards. Perhaps more importantly, QEWS illustrates IBM’s shift from descriptive to predictive analytics. It is one of over 30 supply chain analytics solutions currently in use. IBM is beginning to apply cognitive Watson technologies to analyze unstructured quality data. QEWS was also featured as an example of IBM’s use of big data and analytics in the book "Analytics Across the Enterprise - How IBM Realizes Business Value from Big Data and Analytics" by Brenda L. Dietrich, Emily C. Plachy, and Maureen F. Norton, May, 2014.

Details about the ISC migration of QEWS to run in the cloud are available in the *Supply Chain Management Review (SCMR)* March / April 2014 edition entitled, “How they did it, moving IBM’s smarter supply chain to the cloud.”

QEWS has already gained interest as a “showcase” application for demonstration to IBM’s clients; moving it to the cloud made it easier to use in collaborations with clients, suppliers and business partners. The application can be used across many of IBM’s clients’ manufacturing industries, from automobile to electronics. The advantage of having QEWS in the cloud is that it makes it easier and faster to integrate with a client's IT infrastructure. The client portal can be customized, and the user can choose the type of data to be displayed.