

# Introduction and Historical Background

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- 2 Expansion and Development of Statistical Quality Control in US During WW II
- 3 Use and Further Development of Statistical Quality Control in Post War Japan
- 4 Re-emergence of Statistical Quality Control in US and The World

# Origins of Statistical Quality Control

- ① Sampling Inspection began with mass production at Western Electric Company while the Bell Telephone Company was establishing a nation wide telephone communication network.
  - ▶ Harold Dodge, Harry Romig developed Tables for Sampling Inspection
  - ▶ Their ideas formed the theoretical basis for Statistical Quality Control in 1930.
  - ▶ Western Electric Inspection Engineering Department formed
  - ▶ Quality Assurance Department at Bell Telephone Labs formed
- ② Walter Shewhart's Theory of Common and Special Causes led to the idea of a control chart (control the process during production to make good product rather than separate the good from the bad after production).

# Origins of Statistical Quality Control

- ① 1931 Book the Economic Control of Quality of Manufactured Product
  - ▶ methods worked effectively and were made part of regular procedures in production divisions
  - ▶ W. E Deming of the Census Bureau met Shewhart in 1927 and was impressed by his ideas and felt they applied to much more than manufacturing
  - ▶ Deming felt Shewhart was Brilliant but made everything too complicated.
  - ▶ Deming became a master teacher of Shewhart's ideas as they were popularized through ASTM, American Standards Association and American Society for Mechanical Engineers

# Origins of Statistical Quality Control

Expansion of the use of the ideas of statistical quality control in the US were slow outside of the organizations where they were developed.

- ① Reluctance to try new ideas "Our situation is different"
- ② Few industrial statisticians trained in the ideas that could serve as catalysts
- ③ More rapid growth in Britain
  - ▶ Coal industry
  - ▶ Coke
  - ▶ textiles
  - ▶ spectacle glass
  - ▶ lamps
  - ▶ building materials
  - ▶ chemical industry

# Expansion and Development of Statistical Quality Control in US During WW II

- Manufacturing switched from consumer goods to defense equipment
- Military became large consumers and able to influence practices of their suppliers
- Bell Telephone Laboratories were invited to cooperate with the Army Ordnance and the American Standards Association Technical Committee in developing war standards for quality control
- Dodge and Romig completed the Army Ordnance Sampling Inspection Tables, and their use was introduced to the armed services through a number of intensive training courses.
- The tables employed a scheme that automatically switch to tightened inspection when a suppliers quality level degraded. This forced suppliers to bear the cost of rejected lot and encouraged them to improve quality.

# Expansion and Development of Statistical Quality Control in US During WW II

- In 1940 the military established a widespread training program for suppliers of military equipment.
  - ▶ American War Standards Z1.1-1941
  - ▶ Guide for Quality Control Z1-2-1941
  - ▶ Control Chart Method for Controlling Quality during Production Z1.3-1942
- These standards formed the text for training courses, developed E. L. Grant and W. E. Deming in 1942, that were taught in a nation wide program to personnel of Defense Supplier Companies by the War Production Board

# Expansion and Development of Statistical Quality Control in US During WW II

Specific needs addressed by this program were:

- Education of industrial executives regarding the basic concepts and benefits of statistical quality control
- Training of key quality control personnel in industry
  - ▶ Women took many of the QC and manufacturing positions during the war



- Advisory assistance on specific quality control problems
- Training of subordinate quality Control personnel
- Training of instructors
- Publication of Literature



# Expansion and Development of Statistical Quality Control in US During WW II

- Training of instructors was an essential responsibility of OPRD
- Instructors chosen from faculty at local educational institutions that would provide training to personnel from defense supplier companies
- Instructors were competent university teachers of statistics who only needed to have their knowledge extended to:
  - ▶ Theory relevant to statistical quality control
  - ▶ Be Familiarized with practical applications
  - ▶ Learn instructional techniques that were found to be most useful
- OPRD encouraged formation of local quality control societies where neighboring companies could exchange experiences and information

# Expansion and Development of Statistical Quality Control in US During WW II

- As result of the training, quality control techniques were used widely during WW II
- This insured quality and cost effectiveness of manufactured goods as war production ramp-ed up.
  - ▶ Example military aircraft increased from 6000 in 1940 to 85,000 in 1943
- Joseph Stalin stated that without the American Production of Defense Equipment the Allies would never had won the war.

# Further Development of Quality Control in Post War Japan

The widespread use of quality control techniques that were used so effectively during the war in the U.S. did not carry over as companies transitioned from producing defense equipment to civilian goods after the war

- The women who filled many positions in company quality improvement and inspection departments left the workforce after the war
- They were replaced by military veterans who were not trained in the vision and technical use of statistical quality control methods
- Manufacturing facilities in Europe and Asia lay in the ruins of war
- Demand for US manufactured products far exceeded the supply.
- Company top management failed to see the benefits of the the extra effort to improve and control quality

# Further Development of Quality Control in Post War Japan

U.S. Occupation forces were in Japan after WW II trying to help rebuild their shattered economy.

- At the request of General Douglas McArthur, W. E. Deming of the U.S. Census Bureau was summons to Japan to help planning the 1951 Japan Census
- Deming's expertise in quality control and his compassion for the plight of ordinary Japanese citizens brought him and invitation from JUSE "The Japanese Union of Scientists and Engineers" to speak to them about statistical quality control.
- Japanese Production lay in ruins and they were interested in how Shewhart's ideas might help them in reconstruction of their industry.
- They sought an Expert who would be willing to help them.

# Further Development of Quality Control in Post War Japan

- Deming was troubled by his experience in the U.S. where statistical quality control techniques were only widely used for a short time during WW II
- He consented to help them only if he could meet directly with top management of Japanese companies.
- His message to management in 1950 was:
  - ▶ Improve Quality
  - ▶ Less rework and waste
  - ▶ Productivity automatically improves
  - ▶ Capture the Market with Lower Cost and Better Quality
  - ▶ Stay in Business
  - ▶ Provide Jobs

# Further Development of Quality Control in Post War Japan

- With nothing to lose Japanese manufacturers wholeheartedly accepted his advice and adopted the techniques and philosophy espoused by Deming and other American experts.
- Widespread training ensued
- Japan rose from the ashes of war to become one of the largest economies in the world
- When Deming refused to accept the royalties from published transcripts of his 1950 lectures, JUSE Board of Directors used the funds to establish the Deming Prize
- As Deming Predicted in 1950 Japanese products began to gain respect in worldwide markets

# Further Development of Quality Control in Post War Japan

Japan begins to contribute to the quality control body of knowledge

- Kaoru Ishikawa developed the idea of "quality circles"
- Ishikawa wrote books including "A Guide to Quality Control" that defined the basic quality tools described in Christensen, Betz and Stein(2013)
- Genechi Taguchi developed the philosophy of off-line quality control where products and processes could be made insensitive to common sources of variation that are outside the engineers control (using Design of Experiments Techniques)

# Further Development of Quality Control in Post War Japan

- In 1973 the Arab Oil Embargo caused the price of gasoline in the U.S. to increase from an average of \$3 per barrel to \$12 per barrel.
- That price increase created a demand for smaller fuel efficient Japanese Cars.
- U.S. Drivers of the smaller Japanese cars found they also had higher quality (fit, finish & lower repair frequency) and lower cost.
- U.S. Auto manufacturers lost market share. Many factories were closed and workers laid off.
- NBC Documentary "If Japan Can, Why Can't We", that aired in 1979, was instrumental in motivating U.S. industry leaders to relearn the quality technologies that helped Japan's Economy but were in disuse in the U.S.



# Re-emergence of Statistical Quality Control in the U.S. and the World

- In 1980 U.S. Companies begin to accept quality goals as one of the strategic parameters in Business Planning
- Ford Motor Company adopted the slogan "Quality is Job 1"
- Ford Motor Company, copying the Department of Defense in WW II, set up extensive statistical process control training programs for their own personnel and their suppliers.
- Other U.S. Companies followed suit
- Market shares rebounded in Automobiles, Electronics and Steel
- The definition of Quality expanded from meeting manufacturing specifications to pleasing the customer
- SQC use expanded from manufacturing to diverse areas such as utility companies, health care institutions, banking and other customer service organizations

# Re-emergence of Statistical Quality Control in the U.S. and the World

- In 1988 the U.S. Congress established the Malcolm Baldrige National Quality Award which is similar to the Deming Prize in Japan.
- U.S. Government's recognition of the need to focus on quality for our economy to remain competitive.
- It is intended to stimulate U.S. Companies to improve the Quality of their products and services.
- Baldrige Award winners are required to share the techniques they used to improve with other companies
- The Six-Sigma philosophy was (A Baldrige Winner) Motorola Corporation's methods for improving quality.

# Re-emergence of Statistical Quality Control in the U.S. and the World

- The International Organization of Standardization created the Standards for Quality Assurance Systems (ISO 9000).
- Patterned, but expanded in nature, after the Guide for Quality Control Z1-2-1941 and the Control Chart Method for Controlling Quality during Production Z1.3-1942
- Many companies worldwide only buy from suppliers that are certified to comply with these standards.

# Relevant Current Topics

## **Trump wants US companies to leave China. Here's what it could mean**

Published Sun, Aug 25 2019 7:41 PM EDT Updated Mon, Aug 26 2019 10:09 AM EDT

**The New York Times**

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*Trump Asserts He Can Force U.S. Companies to Leave China*

**Mayor Pete Buttigieg's Response**

**“make US companies more competitive”**

# Companies can only be as good as their suppliers

## Supplier Management Process (Christensen Chapter 19)

- No rating
- Quality rating only
- Quality and Delivery rating
- Quality and Delivery: cost index
- Comprehensive method
  - ▶ Require Suppliers be ISO Certified
  - ▶ The Purpose of ISO Standards ISO standards are designed to make products and services better and to make companies, governments and other organizations more efficient. Some standards are designed for specific industries, like the food industry, or designed to help improve the environment

# Number of ISO Certified Companies is an indication of Commitment to Improve Competitiveness

Number of ISO Certified Companies by Country 2014

