



Quality in Construction

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1 Continuing Education and 1 Contact Hour.**

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- Attend 90% of this presentation
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Project Background and Summary

- The standard construction quality process typically consists of Quality Planning, Quality Assurance (QA), and Quality Control (QC)
- However, “one of the fundamental tenets of modern quality management states that quality is planned, designed, and **built in** (emphasis added) – not inspected in”¹
- Built-In Quality (BIQ) is a new method that uses a real-time, interactive process to increase quality and reduce rework
- A BIQ program focuses upon the initial stages of a quality process by identifying customer expectation, converting these expectations into requirements, developing design operations, then performing the work

1. Project Management Institute (PMI) (2013) “A Guide to the Project Management Body of Knowledge (PMBOK),” Fifth Edition, ANSI/PMI 99-001-2013, Newton Square, PA., 189-214.

3



Project Introduction and Justification

- The results of a BIQ process provide input into QA/QC inspection
- A BIQ process differs from conventional QA/QC in that an electrical contractor and their customers, both internal (other contractors) as well as external (other stakeholders, including the owner) strive toward an integrated approach
- This collaborative focus is maintained throughout the project, from pre-construction planning through construction, commissioning, and owner occupancy

4



Some Organizational Definitions for Quality

There are many different definitions for *Quality*, some of the more recent definitions by organizations include-

Construction Industry Research and Information Association (CIRIA 1988)	"fitness for purpose"
Construction Industry Institute CII (1989)	"conformance to established requirements"
Associated General Contractors of America (AGC 1992)	"conformance to standards"
American Society of Civil Engineers (ASCE 2000)	"fulfillment of project responsibilities in the delivery of products and services in a manner that meets or exceeds the stated requirements and expectations of the owner, design professional and constructor"
International Organization for Standardization (ISO 9000)	"the totality of characteristics of an entity that bear upon its ability to satisfy stated and implied needs"
American Society for Quality (ASQ 2012)	"A subjective term for which each person has his or her own definition. In technical usage, quality can have two meanings: a. The characteristics of a product or service that bear on its ability to satisfy stated or implied needs b. A product or service free of deficiencies"



Researcher Definitions

Kuehn (1962)	"In the final analysis of the market place, the quality of a product depends on how well it fits patterns of consumer preference"
Edwards (1968)	"Quality consists of the ability to satisfy wants"
Gilmore (1974)	"Quality is the degree to which a specific product conforms to a design or specification"
Leffler (1982)	"Quality refers to the amounts of the unpriced attributes contained in each unit of the priced attribute"
Broh (1982)	"Quality is the degree of excellence at an acceptable price and the control of variability at an acceptable cost"
Feigenbaum (1991)	"Quality means best 'for certain customer conditions.' These conditions are (a) the actual use, and (b) the selling price of the product"
Crosby (1992)	"Quality (means) conformance to requirements"
Juran (1999)	"freedom from deficiencies" where deficiency is defined as "any fault (defect or error) that impairs a product's fitness for use"
Oakland (2006)	"Quality is meeting customer's requirements"
Ruman (2011)	"the fulfillment of the owner's needs per defined scope of works within a budget and specified schedule to satisfy the owner's/user's requirements"
Lichtig (2011A)	"consistently producing a product (outcome) that meets the customer's expectations and that is fit for the purpose intended"



Common Quality Attributes

- One common thread in all quality definitions is “satisfaction” (meeting customer implied needs or stated requirements), “conformance” (either to established requirements or standards), and “fitness” of use
- Constructed work that is in conformance with the contract documents should be of sufficient quality to meet customer expectations
- However, for the contract documents to have completely captured all expectations and be of sufficient quality to meet customer expectation assumes that:
 1. The contract documents are also in compliance with all applicable codes,
 2. Field documents (such as material substitutions, change orders, and AE clarification bulletins) are well documented, and
 3. A process exists whereby customer approval is obtained

7



Adopted Definition for Quality

- Within the context of our research, we have adopted the following quality definition-
producing a product that meets customer expectations and is fit for use

8



Quality Assurance (QA) Definitions

<u>Organization/Researcher (Reference)</u>	<u>Definition</u>
Stukhart (1985)	“The systematic activities implemented in a quality system so that quality requirements for a product or service will be fulfilled”
Kerzner (2001)	“the formal activities and managerial processes that are planned and undertaken in an attempt to ensure that products and services are delivered at the required quality level.”
Gryna (2001)	“the activity of providing evidence to establish confidence that quality requirements will be met”
Oakland (2006)	“the prevention of quality problems through planned and systematic activities, including quality documentation”
ASQ (2012)	“all the planned and systematic activities implemented within the quality system that can be demonstrated to provide confidence a product or service will fulfill requirements for quality”
ISO 9000 (2013)	“those planned and systematic actions necessary to provide adequate confidence that product or service will satisfy given requirements for quality”

9



Quality Control (QC) Definitions

<u>Organization/Researcher (Reference)</u>	<u>Definition</u>
Feigenbaum 1991	“a process for delegating responsibility and authority for a management activity while retaining the means of assuring satisfactory results”
Juran 1999	“a review of all quality factors involved in a production process”
Chung 1999	“the activities that are carried out on the production line to prevent or eliminate causes of unsatisfactory performance”
Gryna 2001	“the process employed to consistently meet standards”
Kerzner 2001	“a collective term for activities and techniques, within the process, that are intended to create specific quality characteristics”
Oakland 2006	“the activities and techniques employed to achieve and maintain the quality of a product, process, or service”

10



Adopted QA and QC Definitions

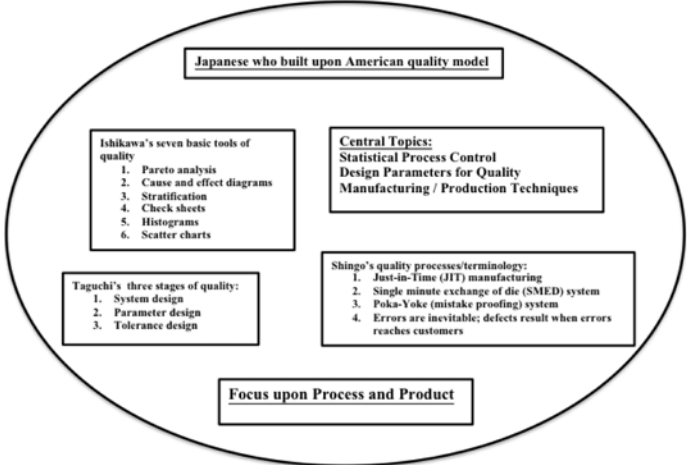
- “Quality assurance is the activity of providing evidence to establish confidence among all concerned that quality-related activities are being performed effectively.” (Ruman 2011)
- Quality control is a process of analyzing data collected through statistical techniques and comparing this data with actual requirements and goals to ensure compliance with standards



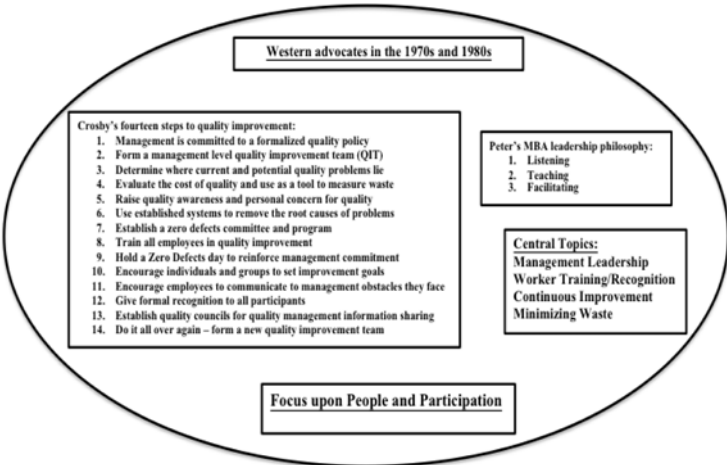
Comparison of Deming, Juran, and Feigenbaum Quality Philosophies



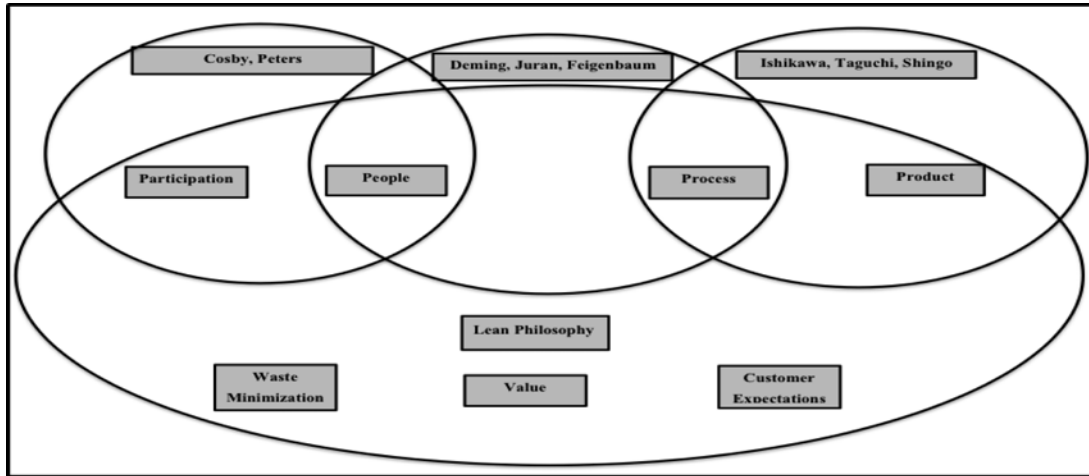
Comparison of Ishikawa, Taguchi, and Shingo Quality Philosophies



Comparison of Crosby and Peters



Quality Philosophies and Progression of the Quality Movement



15



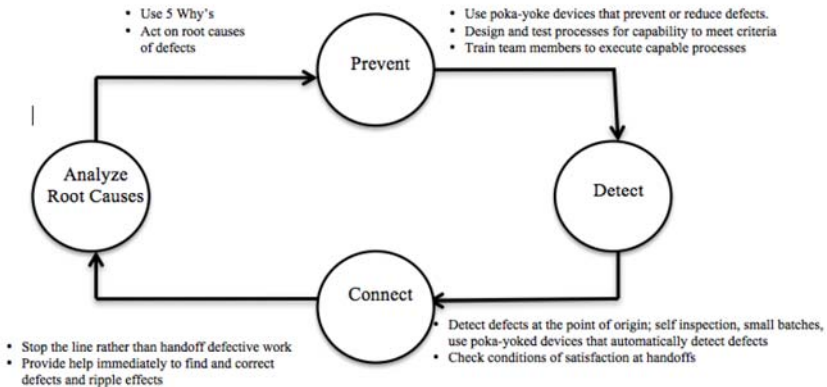
BIQ Process Assumptions

- A BIQ process is based on the following assumptions:
 - Simplifying production and assembly will enable cost-effective quality
 - Eliminating product- and process-variability will make production-to-expectations easier
 - The people doing the work are in the best position to control quality
 - Each performer must treat the next process as a customer; including both internal (contractors) as well as external (stakeholders, including the owner)
 - Quality depends upon assuring that craft workers understand each internal customer's expectations
 - First run studies and mock-ups should be used to physically confirm that what is "clear" is also "understood"
 - By focusing on building quality in (to a product), productivity improvement will follow

16



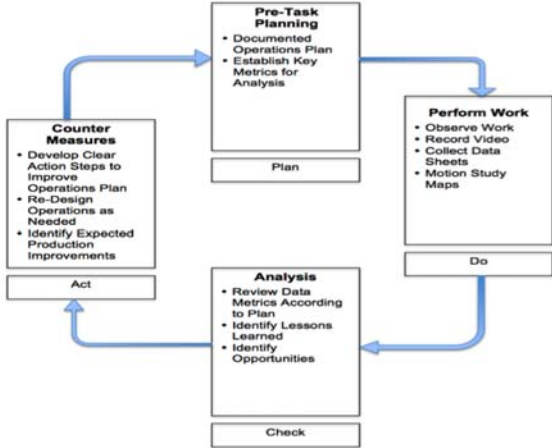
BIQ PDCA Process¹



1. Lichtig, W. A., "Developing a built-in quality plan for SMCS/WCC." *The Boldt Company*, whitepaper, June 2011.



BIQ Process Map¹

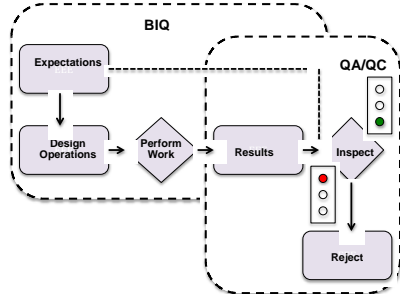


1. Lichtig, W. A., "The game tape process - a standard approach to continuous improvement in production." *The Boldt Company*, whitepaper.



BIQ Process Schematic¹

- A Built-In Quality (BIQ) program implements a new quality process in construction operations
- A schematic of an integrated quality process overlays the project BIQ process onto a traditional QA/QC approach-

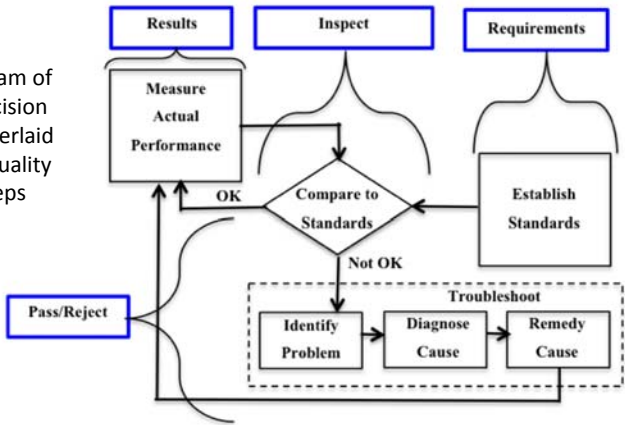


1. Lichtig, W. A., "Developing a built-in quality plan for SMCS/WCC." *The Boldt Company*, whitepaper, June 2011.



Decision Flow Diagram Overlaid with a BIQ View of Conformance and Fitness of Use¹

Flow diagram of Juran's decision process overlaid with BIQ quality process steps



1. Adopted from Juran, J. M., (1999). "Juran's Quality Handbook." Fifth edition. McGraw-Hill, New York



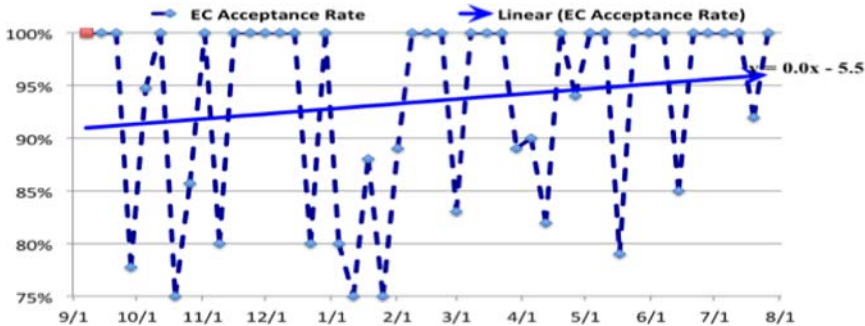
Results of a BIQ Process

- A project database was maintained of all electrical contractor inspections conducted over approximately one-year for a subject BIQ project
- Data was extracted from the database and weekly reports were produced for all inspections
- During this time, the EC success rates varied from a low of 75% to a high of 100%, with a weighted average of 93%
- EC weekly inspection acceptance rates were plotted during the same time period (with a linear trend line), indicating an improvement in the inspection success rate

21



EC Weekly Inspection Acceptance Rates with Linear Trend Line



22



Products of our Research

- BIQ Report, with procedures and best practices to mitigate the loss of labor productivity
- A BIQ Plan Template
- Abbreviated NECA Installation Standards
- Sample Reference and Checklist Forms
- BIQ Narrative Examples for Work Activities
- Examples of a BIQ Approach to Technical Specifications

23



Quality in Construction Questions?

Don't forget...

- 10:15 am – 11:30 am – Opening General Session with Amy Purdy
- 11:30 am – 5:00 pm – NECA Show Hours

24

