BEM3104 Engineering Quality Control

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Introduction to Quality (Khaled Heiza, 2025)

- This chapter provides an overview of the definitions concepts and philosophy of quality engineering and management

Definitions of Quality

- Fitness for use (Juran)
- Conformance to requirements (Crosby)
- Degree of excellence
- Performance exceeding expectations (Q = P/E)
- 'The totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs' – ANSI/ASQ

Quality Dimensions (Garvin, 1998)

- Quality dimensions are independent
- focus on a few dimensions (e.g. Japanese cars – reliability, conformance, and aesthetics)

Dimension	**Meaning**
Performance	Primary product characteristics
Features	Secondary characteristics added features
Conformance	Meet specifications or industry standards, workmanship
Reliability	Consistency of performance overtime
Durability	Useful life
Service	Resolution of problems and complaints, ease of repair
Response	Human-to-human interface
Aesthetics	Sensory characteristics
Reputation	Past performance, ranking first

Quality Control

QC – the use techniques and activities to achieve, sustain and improve quality of products or service. It integrates these related techniques and activities:

1. Specifications of what is needed
2. Design of the products/service to meet specs.
3. Production or installation to meet full intent of specs.
4. Inspection to determine conformance to specifications
5. Review usage to provide information for revision of specs. – if needed

The aim should be towards quality improvement

Statistical Quality Control (SQC)

- Part of Total Quality Management (TQM)
- Collection, analysis and interpretation of data for QC activities
- Two major parts;
- Statistical Process Control
- Acceptance Sampling

Quality Assurance

- All those planned or systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality
- Need systems and procedures to ensure consistency in methods for producing products

Total Quality Management (TQM)

- philosophy and a set of guiding principles
- foundation of continuously improving organization
- philosophy to achieve excellence
- process in set of interrelated activities using specific inputs to produce/deliver specific outputs
- process = business and production
- customers refers to external and internal
- suppliers also both external and internal
- customer-supplier chains

Historical Review

- Middle age – Craft – Guilds (training)
- Industrial Revolution – Specialization of labor
- Decline in workmanship, product still not complicated – still 100% inspection
- 1924 – Walter Shewhart developed statistical chart (Book: Economic Control of Quality of Manufactured Product)
- Dodge & Romig developed acceptance sampling as a substitute for 100% inspection
- 1942 - US Managers failed to recognize value of SQC
- 1946 – ASQC (now ASQ) was formed

Historical Review

- 1950 – William Edwards Deming lectures CEOs in Japan on SQC
- 1954 – Joseph Juran went to Japan – Management's responsibility for quality
- 1960 – Quality Control Circle (QCC) formed in Japan – quality improvement
- 1980's – US Quality Movement, TQM Concepts published

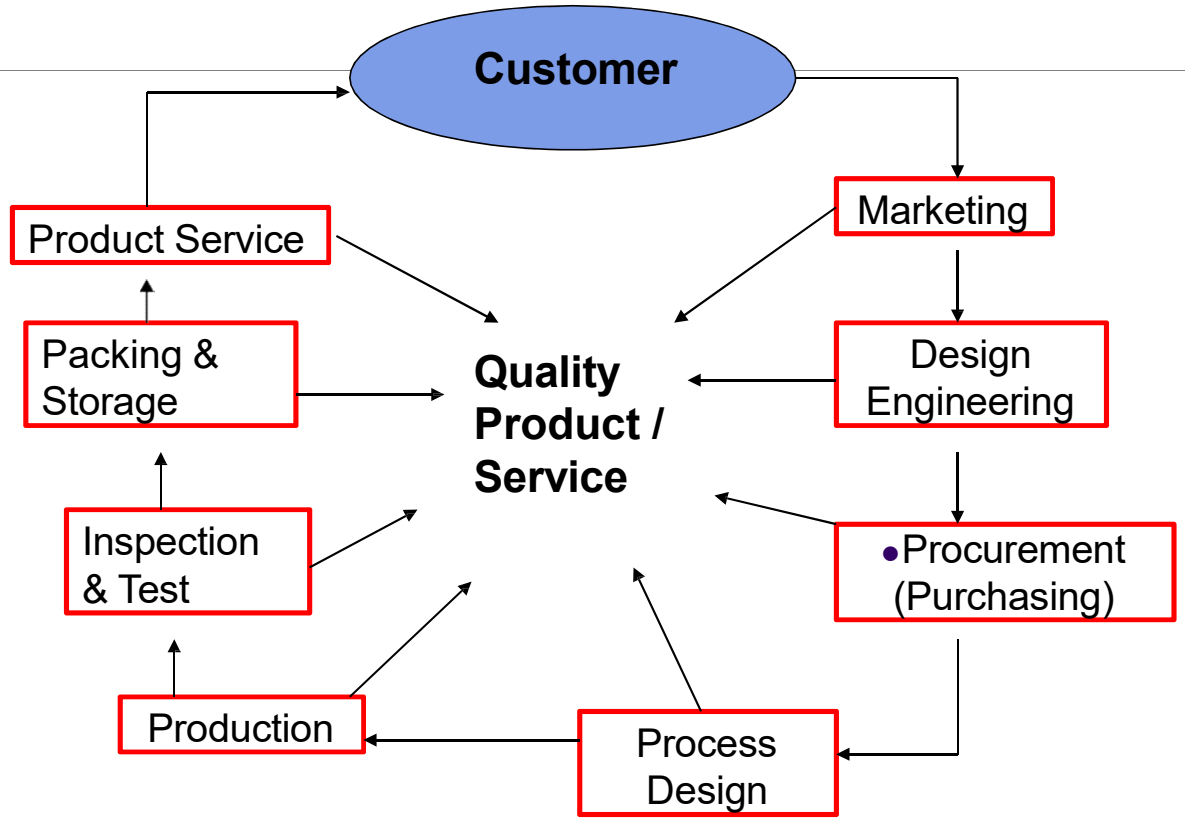
Historical Review

- Late 1980's – automotive industry emphasize SPC, suppliers required to use Malcolm Balridge Award established (to measure TQM implementation) Taguchi method, Design of Experiments (DOE)
- 1990's – ISO 9000 series became Global QA std., QS 9000 introduced by automotive industry customer satisfaction ISO 14000
- 2000 – New ISO 9000:2000 version, Six Sigma Program introduced information technology

Responsibility for Quality

- Quality not responsibility of any one person or department – everyone's job (operator to CEO)
- Start from marketing – determine customer requirements until product received by satisfied customer
- Delegated to areas with authority to make quality decisions
- Areas responsible (figure next slide)

Responsibility for Quality



Marketing

- Evaluate level of quality customer needs and willing to pay
- Provides product quality data
- Marketing information from customer complaints, sales report, product service product liability
- Information-monitoring and feedback system needed to collect data
- Provides product brief – translate into preliminary set of specs.
- Product brief
  - Performance characteristics
  - Sensory characteristics
  - Installation
  - Applicable standards, statutory regulations
  - Packaging
  - Quality verification
- Marketing is vital link in product development

Design Engineering

- Translate customer's requirements into operating characteristics (specs, tolerances, etc.)
- Simple and not complex is best design
- Increase complexity, quality difficult to achieve
- Need early involvement of marketing, production, quality (dept.), customers (called concurrent engineering)
- Selection of tolerances (tight tolerance – better product but production & quality cost may increase)
- Tolerance should be determined scientifically (use Design of experiments)
- Material selection – physical characteristics reliability, etc.

Design Engineering

- Not only functional aspects, safety must also be considered, easily repaired & maintained
- Design reviews conducted at appropriate times in product development to identity, anticipate problems and take appropriate corrective action
- Quality is designed into product before released to manufacturing

Procurement

- Responsible in buying quality material/components
- 4 categories (different quality requirements)
- Standard Materials : Coil steel, angle irons
- Standard Hardware : Fasteners, fittings'
- Minor Components : Gears, etc
- Major Components : Transmission,
- engines, hard disk, etc.
- Single supplier versus multiple supplier (material shortage due to 'natural' disasters or unnatural causes, e.g. Strike, equipment breakdown)
- Supplier Quality Survey – to determine capability to supply quality materials/component (Facilities, Quality Procedures, Financial) ISO 9000 registration
- Inspection of incoming materials – proof of conformance

Procurement

- Statistical evidence using process control charts, process, capability
- Supplier surveillance to control quality in suppliers plant using quality plan
- Supplier quality rating system to evaluate performance – actual quality, customer complaints, delivers, price
- Need two way communications between supplier and buyer to improve (supplier partnership)
- Should consider Total Cost of Buying rather than price alone. (costs of returned goods, warranty, following problems, etc)

Process Design

- Responsible for developing processes and procedures that will produce a quality product
- Activities include process selection and development, production, planning and support activities
- Sequencing of operations to minimize production difficulties – methods study
- Also include design of equipment, inspection devices, and maintenance of product equipment

Production

- Responsible to produce quality products
- Quality not inspected into product by built into a product
- Convey quality expectations to employees
- Motivate employees
- Provide proper tools for a job, instructions on method of assembling/processing/doing job
- Need training to employees (work skills + quality techniques)
- Discuss sources of quality variations, methods for improving quality
- Objective is “quality mindedness”

Inspection and Test

- responsible to evaluate quality of purchased and manufactured items
- inspection results reported and connective action taken
- inspection by quality department staff and some inspection items by production
- must not view QC personnel's as 'policeman' – not totally responsible for quality
- measuring equipment must be maintained, calibrated
- efficiency of appraisal (inspection, test) depends on inspection method and procedures (when, how many, where)
- focus on statistical quality control for quality improvement
- dependency on mass inspection for QC is waste of time, money, effort

Packaging and Storage

- to preserve and protect quality of product
- need specifications during shipment (truck, rail, air, ship)
- vibration, shock, environmental conditions
- how to handle product during loading, unloading, warehousing
- need specifications for proper storage to minimize deterioration/degradation

Product Service

- to fully realize intended function of product during its expected life
- sales and distribution, installation, technical assistance, maintenance, disposal after use
- service during warranty, improper installed (after sales service)

Quality Assurance

- QA or QC as a function within an organization
- Assists and supports other areas/depts. to assure quality
- Determines effectiveness of the system
- Appraise current quality level
- Determines quality problems/potential and assists in correction of problem
- Improve quality with cooperation from other departments

Chief Executive Officer (CEO)

- CEO of a company has ultimate responsibility for quality
- Must have knowledge of quality and involvement in quality improvement
- Create quality council, participate in meetings
- Developing mission and vision
- Need measurement of quality performance
- Malcolm Baldrige National Quality Award (in Malaysia – Prime Minister's Quality Award)

Computers and Quality Control

- Need computers and software as tools to assist Quality function
- Data collection - collect, utilize and disseminate quality information incorporate in IT system
- Linkages developed between data records
- Type and amount of data – sources of data process inspection stations, scrap and rework reports, product audits, testing laboratories, customer complaints, incoming material inspection

Computers and Quality Control

- Data analysis, reduction and reporting -
- Statistical analysis – Excel, Minitab, SPSS, Statgraphics, JMP
- Process control – automated system
- Automated test and inspection – using sensors + other devices
- System design – integrate with other systems, eg CAD/CAM, MRPII, MIS, ERP, etc.