



Roadmap to Quality Costs

How to Identify, Categorize, Monitor, Report Quality Costs for Products and Services

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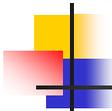
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Jeffrey Worthington- BIO

- **Director of Quality for the USEPA Office of Environmental Information.** Jeff served as the Director of Quality USEPA ORD National Risk Management Research Laboratory (NRMRL) and as the Director of Quality Assurance for TechLaw, Inc. He is an American Society for Quality (ASQ) **Certified Quality Manager** and ASQ **Certified Quality Auditor**. Jeff is a **Fellow of the ASQ**, a founding member of the Government Division, Past-Chair of the ASQ Energy & Environment Division, and a member of the ASQ Division Affairs Council. He is a founding member and past Director of the International Association for Information and Data Quality (IAIDQ). Jeff served as Editorial Board member for Quality Assurance, Science, and the Law, the Journal of Environmental Forensics, Environmental Laboratory magazine, and Environmental Testing and Analysis magazine.
- He has been with the Federal Government since 1994. Jeff co-led a team authoring the combined quality and management system for EPA's Environmental Technology Verification (ETV) program. He co-led the EPA team developing EPA's Information Quality Guidelines. Jeff co-authored peer review journal papers receiving 1) the USEPA Science and Technological Achievement Award (STAA), Level III for equating EPA policies and procedures to U.S. Supreme Court Sound Science Criteria (2002) and 2) an STAA Honorable Mention for developing electronic recordkeeping QA parameters (2006).
- Jeff received a National Security Telecommunications and Information Systems Security (NSTISSI) 4011 Certificate for information systems security (INFOSEC) professionals at the National Defense University (NDU) Information Resources Management College (IRMC) and is currently studying Chief Information Officer curriculum at IRMC.
- Jeff served as a Peace Corps Volunteer in Kpandu, Ghana from 1977-1979.

Jonathan D. Frodge, Ph.D. - BIO

- **Senior Limnologist, King County Water and Land Resources Division.** Jonathan has been with for over 18 years. He is the project manager for King County's Freshwater Program, designing and implementing the monitoring and evaluation programs for lakes in Sammamish and Union, and approximately 50 streams in King County.
- He developed and implements the King County Swimming Beach Monitoring Program, which is not funded by EPA's BEACH Program because it monitors freshwater beaches. He is the Technical Co-Chair of the WRIA8 Chinook Technical Committee developing ESA recovery plans for Puget Sound chinook salmon.
- Jonathan is past Region X Director for the North American Lakes Management Society, and is both a Past-President and current President-Elect of the Washington Lake Protection Association.
- He was an invited water quality expert to Lake Biakal in Siberia in 1990. Jonathan has studied the water quality effects of the introduction of triploid grass carp at the University of Washington. He has a M.S. in Wastewater Utilization from Humboldt State University and a B.A. in Environmental Biology from the University of Colorado.
- Jonathan served as a Peace Corps Volunteer in Enchi, Ghana, a remote bush site from 1977-1980.



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The opinions expressed in this technical presentation are those of the authors and do not necessarily reflect the views of the US EPA or King County.



ABSTRACT

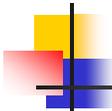
Science studies, information, data, information systems and other products and services of any organization must:

1. include the proper quality features and
2. be reasonably free of defects.

A third area that quality professionals may need to understand and address is related to the costs, or efficiency, of processes involved in product and service production. Some people refer to these costs as the “costs of quality.” When the costs concern product or service failure, they can also be termed the “cost of poor quality.”

Recognizing and knowing that something is a quality cost is important in order to identify areas for improvement. For example, re-working a data system to “cleanse” badly entered data is a form of “scrap and re-work.”

This presentation identifies major quality cost categories for government product and service types and suggests methods for measuring and monitoring quality costs.



OVERVIEW

- Cost and the quality model
- Q. What is a quality cost? A. *It is what it is.*
- Why are they important? “Ripple effect” down the value chain.
- Basic quality costs
- Information and data quality
- Information and data quality costs
- Cost improvement in planning
- Cost improvement in measuring
- Quality costs perspectives – quality-in-depth and the cube
- Conclusion



COST AND THE QUALITY MODEL

OEI Quality Principles

The OEI quality system incorporates the following 3 *quality principles*.

1. **Information quality** includes that part of CONTENT for which we are responsible, as well as DELIVERY.
2. **Quality** for OEI PRODUCTS and SERVICES includes 4 basic areas:
 - **Functions** - Does it have the functions and features I want?
 - **Internal Controls** - Does it work? Do we have adequate internal controls to avoid errors or defects? Do defects prevent me from using it?
 - **Customer Service** - Do customers get the service that they expect, and is it on time?
 - **Efficiency** - Did I effectively use my resources in the process? Are we on time and on budget?
3. **Customer Satisfaction** means "Do they respect us? Would they come back to us for more products and services?"



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Why should quality managers care about quality costs?

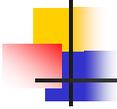


The costs for quality may be some of the most important measures for the quality system in terms of accountability.



Doctor Quality

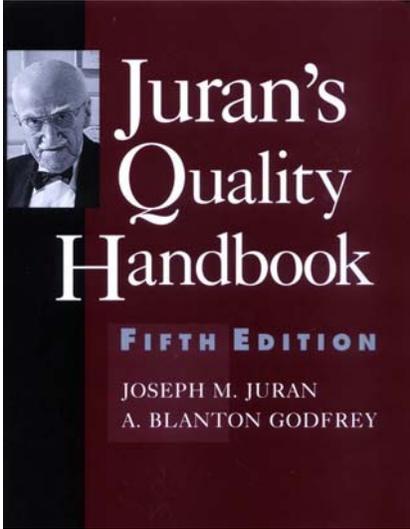
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What is a quality cost?



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**Thank You
Dr. Juran**

1904 - 2008



Dr. Joseph M. Juran

- 1937 – Pareto principle “law of the vital few” and “80-20 rule”
- 1951 – *Quality Control Handbook* – the standard reference work for all quality managers
- 1964 – *Managerial Breakthrough* book – general quality management process which lead later to “lean” and “six sigma”
- 1986 – *The Juran Trilogy*
 - Quality planning
 - Quality control
 - Quality improvement
- 1979- *The Juran Institute*



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Q. What is a quality cost?

A. It is what it is.

Quality costs are:

- costs associated with quality system processes or failures in product (or service) quality.

4 KINDS OF QUALITY COSTS (from Juran's Handbook)

1. **Internal failure costs** – costs found before delivery which are associated with the failure to meet explicit or implicit needs of external or internal customers.
2. **External failure costs** – costs associated with deficiencies that are found after product is received by a customer.
3. **Appraisal costs** – costs incurred to determine the degree of conformance to quality requirements.
4. **Prevention costs** – costs incurred to keep failure and appraisal costs to a minimum.



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INTERNAL FAILURE COST - These are costs associated with defects that are found prior to transfer of the product to the customer. They are costs that would disappear if no defects existed in the product prior to shipment. (from Juran's Handbook)

- *Scrap*: The labor, material, and (usually) overhead on defective product that cannot economically be repaired. The titles are numerous—scrap, spoilage, defectives, etc.
- *Rework*: The costs of correcting defectives to make them fit for use.
- *Failure analysis*: The costs of analyzing nonconforming product to determine causes.
- *Scrap and rework-supplier*: The costs of scrap and rework due to nonconforming product received from suppliers.
- *One hundred percent sorting inspection*: The costs of finding defective units in product lots which contain unacceptably high levels of defectives.
- *Re-inspection, retest*: The cost of re-inspection and retest of products that have undergone rework or other revision.
- *Avoidable process losses*: The cost of losses that occur even with conforming product. For example, “overfill” of containers (going to customers) due to excessive variability in filling and measuring equipment.
- *Downgrading*: The difference between the normal selling price and the reduced price to quality reasons.

EXTERNAL FAILURE COST - These are costs associated with defects that are found after product is shipped to the customer. These costs also would disappear if there were no defects. (from Juran's Handbook)

- *Warranty charges*: The costs involved in replacing or making repairs to products that are still within the warranty period.
- *Complaint adjustment*: The costs of investigation and adjustment of justified complaints attributable to defective product or installation.
- *Returned material*: The costs associated with receipt and replacement of defective product received from the field.
- *Allowances*: The costs of concessions made to customers due to substandard [products accepted by customer as is or to conforming product that does not meet fitness-for-use needs.

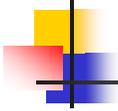
APPRAISAL COSTS - These are the costs incurred to determine the degree of conformance to quality requirements. (from Juran's Handbook)

- *Incoming inspections and test:* The costs of determining the quality of purchased product, whether by inspection on receipt, by inspection at the source, or by surveillance.
- *In-process inspection and test:* The costs of evaluation of conformance to requirements for product acceptance.
- *Product quality audits:* The costs of performing quality audits on in-process or finished products.
- *Maintaining accuracy of test equipment:* The costs of keeping measuring instruments and equipment in calibration.
- *Inspection and test materials and services:* The costs of materials and supplies in inspection and test work (e.g., x-ray film) and services (e.g., electric power) where significant.
- *Evaluation of stocks:* The costs of testing products in field storage or in stock to evaluate degradation.

In collecting appraisal costs, what is decisive is the kind of work done and not the department name (the work may be done by chemists in the laboratory, by sorters in Production, by testers in Inspections, or by an external firm engaged for the purpose of testing).

PREVENTIVE COSTS - These are costs incurred to keep failure and appraisal costs to a minimum. (from Juran's Handbook)

- *Quality planning:* This includes the broad array of activities which collectively create the overall quality plan and the numerous specialized plans. It includes also the preparations of procedures needed to communicate these plans to all concerned.
- *New-products review:* The costs of reliability engineering and other quality-related activities associated with the launching of new designs.
- *Process planning:* The costs of process capability studies, inspection planning, and other activities associated with the manufacturing process.
- *Process control:* The costs of in-process inspection and test to determine the status of the process (rather than for product acceptance).
- *Quality audits:* The costs of evaluating the executing the execution of activities in the overall quality plan.
- *Supplier quality evaluation:* The costs of evaluating supplier quality activities prior to supplier selection, auditing the activities during the contract, and associated effort with suppliers.
- *Training:* The costs of preparing and conducting quality-related training programs. As in the case of appraisal costs, some of this work may be done by personnel who are not on the payroll of the Quality Department. The decisive criterion is again the type of work, not the name of the department performing the work.



THIS EXAMPLE

Information and information systems



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Quality Costs and Information Processes	
INTERNAL FAILURE COSTS	
Scrap	Costs of disposal of failed information systems
Rework	Cost of re-designing information systems because: <ul style="list-style-type: none"> ■ Don't meet requirements ■ Customer requirements change ■ Poorly written code
100% sorting inspection	Cost of finding and correcting errors in databases (Does 100% inspection lead to 100% correctness?)
Re-test	Cost of re-inspecting an information system that was re-designed
Avoidable process loss	Cost of conducting inspection or reviews of information or information systems that is not needed
Down grading	Normal cost of system vs. reduced price (or reduction in bonus) for poor quality

Quality Costs and Information Processes

EXTERNAL FAILURE COSTS

Warranty changes	The cost of fixing information or an information system that cannot be charged to the purchaser
Complaint adjustment	The cost of investigating and resolving complaints regarding information or information systems. (help desk costs?)
Returned Material	The cost of receiving and replacing defective hardware.
Allowances	The cost of concessions made to customers because the information or information system was substandard.

Quality Costs and Information Processes

APPRAISAL COSTS

Incoming inspection and test	Cost of conducting tests on software, information systems, or hardware received.
In-process inspection and test	Cost of conducting tests to verify completed information system meets requirements
Product quality audits	Cost of testing and inspecting information system during development
Maintaining accuracy of testing equipment	Cost of updating security virus protection programs.
Inspection and test materials and services	Cost of automated software inspection programs.
Evaluation of stocks	Cost of inspecting archived or large databases to verify continued consistency

Quality Costs and Information Processes

PREVENTIVE COSTS

Quality planning	Cost of developing a new Quality Management Plan (QMP), cost of writing project quality plans, information policies and procedures, etc.
New products review	Costs of evaluation and other quality activities associated with designing a new information system or website.
Process planning	Costs of studies associated with designing new processes for software or information inspections.
Process control	Costs of evaluating information system or web processes to determine if the processes are adequate (vs. evaluating the web pages, etc.)
Quality audits	Cost of conducting assessment to verify the quality plan is being implemented. (Ex. Quality Staff assessment of OEI.)
Supplier quality evaluation	The costs of oversight of information management contracts and grants. The costs of assessing their processes and their quality plans.
Training	The costs of quality training in each office, division, and branch. This training may be done within the branches as well.

Are quality costs important in the information industry?

- **2008** – (April) – Census Bureau will return in their census planning to *paper questionnaires*, dropping “handhelds” for most census collection, additional cost will be \$2.2 – 3 BILLION (total cost for the change is not reported)
- **2005** – FBI Virtual Case File computer system - **\$170 million**
- **2002** – estimated annual costs of software bugs to U.S. economy - **\$22.5 billion/year**
- **2003** – Northeast Blackout, programming effort led to alarm failures - **\$6-10 billion**
- **1999** – NASA Mars Climate Orbiter misses safe Mars landing - **\$125 million**
- **1994** – Costs to postpone opening new Denver airport, software to operate baggage systems - **\$200 million (also happening now in new airport in London, England)**
- **1987** – California DMV data system to merge driver and vehicle registration systems, cancelled after 7 years - **\$44 million**
- **1986** – Therac-25 radiation treatment machine interfaced with computer software controls – **2 deaths**



What do computers control today? – the short list, examples

- Airplanes & airplane traffic control systems
- Power grids and power plants
- Medical treatment equipment
- Financial systems
- Commerce via the internet
- Most government information and many government services are delivered via the web

Quality Costs in the QUALITY PROCESS

- **Plan**
 - Corporate planning – standard quality costs should be identified for various product & service types
 - Program and project planning – should include quality costs goals for individual programs and projects
- **Do**
 - Corporate tools – formal guidance for identifying quality costs and developing procedures should be provided
 - Implementation tools – SOPs are needed to incorporate quality costs into implementation processes
- **Check**
 - Corporate assessment – formal guidance for assessing quality costs and developing assessment procedures should be provided
 - Assessment tools – are needed to consistently measure various types of quality costs including suggested acceptance criteria (some may be automated)
- **Act** – quality costs need to be integrated into the improvement process as if they are any other product or service feature

What are the challenges in measuring quality costs?

- **Attitude** – resistance to change
- **Processes** - establishing processes to track costs
- **Accountability** – concern that measures may be misused or misunderstood
- **Agreement** – “quality costs are not identified or agreed to”
- **Contracts** – cost accountability in contracts may not be uniform



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CONCLUSION

- Quality costs **are important considerations** for information management and information technology
- The basic model used for quality costs of the manufacture of goods and services is **applicable to information quality and associated processes**
- The quality cost model here can be useful in reviewing **other government products and services**

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