

The Quality Paradigm

“We shall build good ships here; at a profit if we can, at a loss if we must, but always good ships.”

– motto used at Newport News Shipbuilding

Quality Paradigm Elements

- Defining the nature of quality
- Empirical approach
- Customer focus
- Defect Elimination
- Managing for quality
- Process management
- Quality standards

Defining the Nature of Quality

- What is quality? How is it characterized?
- IEEE Definition: “the totality of features and characteristics of a product or service that bears on its ability to satisfy given needs”
- The characterization of quality depends on the perspective from which it is viewed.

Quality Perspectives

- Transcendental Perspective
 - Quality can be identified but not defined.
 - “I know it when I see it!!”
 - “I know when its missing!!”
- User Perspective
 - The user view of quality is in the context of use.
 - Quality is gauged with regard to fitness for use.
- Manufacturing Perspective
 - A process perspective.
 - View of quality as resulting from performing the right tasks.
 - Assumption that an improved process will result in improved products.

Quality Perspectives (2)

- Product Perspective
 - The product view is conformance to specification.
 - Did we build what was wanted as detailed in the specification?
- Value-for-money Perspective
 - Equates quality with what customers are willing to pay.
 - It must be good if people will pay a lot for it.
 - This view provides the foundation for trade-offs.
 - This view is typical later in product development cycles when change requests are handled.

Empirical Approach

- Improvements are based on measurement and experimentation, rather than on theory alone.
- It is very data oriented and calls for monitoring many variables inside and outside the organization. These numerical measures are used to guide the search for better performance.
- Statistical analysis of data.
- Relies on suitable measures of both processes and products.

Customer Focus

- There are a variety of customers. Each customer is the client for a particular product.
- There are both external customers and internal customers – other employees who depend on your work to be able to perform their jobs properly.
- Internally you can think of users of your particular artifact as the customer.
- Hence, having a customer focus becomes a way of thinking.

Deming on Customer Focus

- *“Everybody here has a customer. And if he doesn't know who it is and what constitutes the needs of the customer...then he does not understand his job.”*
- *“Your study of the consumer -- what he finds right and what he finds wrong -- and your innovation are all bound up together. It will affect design and redesign of your product or service.”*

Defect Elimination

- The quality paradigm tries to leverage defect prevention.
- Defect detection and removal is a costly activity.
- By moving towards preventing defects, you free considerable resources for pursuit of new opportunities.

“Inspection with the aim of finding the bad ones and throwing them out is too late, ineffective, costly. Quality comes not from inspection but from improvement of the process.”

– W. Edwards Deming

Managing for Quality

- Employees work in the system, but management creates the system.
- There must be management commitment to quality.
- Adopting the paradigm implies a move towards continuous process improvement which requires commitment from both management and workers.

Management by Results

- Most American managers manage, at least in part, by Management by Results.
- In this style of management, the emphasis is on the organizational chart and the key control points within that structure.
- Each manager, beginning at the top, is given certain goals for the next year. They, in turn, set goals and impose controls on each of their subordinates.
- For example, the sales department may be told to increase sales by 10%, production to increase productivity by 5%, engineering to get products into production 10% faster, purchasing to reduce costs by 5%, and so on.
- At the lower levels, these goals become quotas or work standards.

Management by Results (2)

- Management by Results is simple, logical and consistent.
- It seems to have been quite successful.
- It is practiced to some degree by many major American corporations.
- It is widely taught in business schools.

Management by Results (3)

- Management by Results encourages an organization to look inward at its own structures rather than outward at the world in which the customer operates.
- It is a system of controls. The rewarded accomplishments are therefore necessarily measurable and short term.
- The near horizon gets attention and countable accomplishments get priority even though an organization's survival may depend on the un-measurable activities undertaken to accomplish long-term results.
- When measurable controls are unattainable or impractical, individuals and groups tend to fabricate conformance.

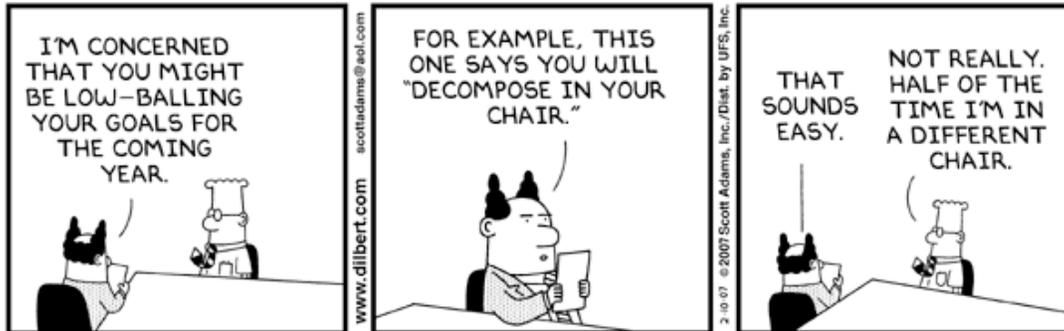
- An electronics firm sometimes ships incomplete instruments. A service representative then flies around the country installing the missing parts. The shipment quota for the month is met. Profits, at least on paper, hold firm.
- A chemical plant reports it cannot efficiently run at the mandated inventory levels, so it keeps inventories higher until June 30 and December 31 when inventories are measured. For those days, it depletes the inventories to an acceptable level, perhaps losing two days production as a consequence.

- Many managers annually negotiate safe goals and manage to exceed them, just barely. Some managers include on their list of negotiable goals, goals which were already secretly accomplished prior to the negotiation.
- Production which exceeds the standards is stored so it can be pulled out and used another day.
- A meter reader stops at a tavern at 2:00 rather than exceed his work standard.
- Problems are hidden from management, in hopes they will blow over or not be noticed.

- The inevitable contradictions between the controls of different departments leads to finger pointing, blame games and an endless series of excuses like "if it weren't for them..."
- Related to the blame-it-on-them mentality is a cover-your-rear mentality: play it safe, don't trust anyone and make sure that when the system breaks down, someone else is at the switch. In times of stress, circle the wagons. Don't help others, especially if they're under fire.
- Behind the worst shortcomings of Management by Results is fear. Fear is the prime motivator in a Management by Results system. And the more rigid and unrealistic the controls are, the deeper is the fear.



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Process Management

- Process is treated explicitly.
- Emphasis on process improvement rather than individual accountability.
- The process management premise: A quality product is largely governed by the quality of the process used to develop and maintain it.
- The entire software development task is treated as a process that can be controlled, measured, and improved.
- There is guidance for recognizing, defining, measuring, and improving processes.

Process Improvement

Improving process is seen as a way to achieve:

- Better quality product
- Increased efficiency
- Increased Effectiveness
- Reduced Costs
- Increased Process Flexibility
- Improved Staff Satisfaction

“Putting out fires is not improvement. Finding a point out of control, finding the special cause and removing it, is only putting the process back to where it was in the first place. It is not improvement of the process.

You are in a hotel. You hear someone yell fire. He runs for the fire extinguisher and pulls the alarm to call the fire department. We all get out. Extinguishing the fire does not improve the hotel. That is not improvement of quality. That is putting out fires.”

– W. Edwards Deming

Beware the Hawthorne Effect

- From 1924-1932 a series of experiments conducted at the Hawthorne Works (owned by Western Electric) studied the effects of lighting level, breaks, length of work day, etc. on worker productivity.
- They found that whenever a change in conditions was introduced, productivity increased regardless of the change (even if it was a return to the original conditions).
- The researchers concluded that workers increased their productivity in response to being studied.

Capability Maturity Model Integration for Development (CMMI-DEV)

- Describes principles and practices underlying software process maturity.
- Intended to help organizations evolve their software processes to higher levels of maturity.
- Capability/maturity levels may be used to identify the strengths, weaknesses, and risks of using a software supplier.
- The level of an organization can be assessed by an independent auditor, usually external. Authorized auditors must undergo formal training.

CMMI Process Areas

- Causal Analysis and Resolution (CAR)
- Configuration Management (CM)
- Decision Analysis and Resolution (DAR)
- Integrated Project Management +IPPD (IPM+IPPD)
- Measurement and Analysis (MA)
- Organizational Innovation and Deployment (OID)
- Organizational Process Definition +IPPD (OPD+IPPD)
- Organizational Process Focus (OPF)
- Organizational Process Performance (OPP)
- Organizational Training (OT)
- Product Integration (PI)
- Project Monitoring and Control (PMC)
- Project Planning (PP)
- Process and Product Quality Assurance (PPQA)
- Quantitative Project Management (QPM)
- Requirements Development (RD)
- Requirements Management (REQM)
- Risk Management (RSKM)
- Supplier Agreement Management (SAM)
- Technical Solution (TS)
- Validation (VAL)
- Verification (VER)

CMMI Practices

- For each process area a list of practices (or capabilities) is given.
- A software development organization improves their capability by implementing the practices documented.
- There are a number of levels of capability which are achieved by applying more definition and control to the key development processes.
- The practices only define *what* is needed to be done and not *how*. The intent of CMMI is to describe what capabilities a software development process should have and not prescribe how those capabilities are achieved.

CMMI-DEV Paths

- CMMI supports two improvement paths.
- The “continuous” path enables organizations to incrementally improve processes corresponding to an individual process area (or process areas) selected by the organization.
- The “staged” path enables organizations to improve a set of related processes by incrementally addressing successive sets of process areas.
- For the continuous representation, “capability levels” are defined. For the staged representation, there are “maturity levels.”
- The continuous representation focuses on process area capability and the staged representation focuses on organizational maturity.

Capability and Maturity Levels

<i>Level</i>	<i>Continuous Representation Capability Levels</i>	<i>Staged Representation Maturity Levels</i>
Level 0	Incomplete	N/A
Level 1	Performed	Initial
Level 2	Managed	Managed
Level 3	Defined	Defined
Level 4	Quantitatively Managed	Quantitatively Managed
Level 5	Optimizing	Optimizing

Capability Levels

- Incomplete: An “incomplete process” is a process that either is not performed or partially performed. One or more of the specific goals of the process area are not satisfied.
- Performed: A performed process is a process that satisfies the specific goals of the process area. It supports and enables the work needed to produce work products.
- Managed: A managed process is a performed process that has the basic infrastructure in place to support the process. It is monitored, controlled, and reviewed. The process discipline reflected by capability level 2 helps to ensure that existing practices are retained during times of stress.

- Defined: A defined process is a managed process that is tailored from the organization’s set of standard processes. At capability level 2, the standards, process descriptions, and procedures may be quite different in each specific instance of the process (e.g., on a particular project). At capability level 3, the standards, process descriptions, and procedures for a project are more consistent, except for the differences allowed by the tailoring guidelines.
- Quantitatively Managed: A quantitatively managed process is a defined process that is controlled using statistical and other quantitative techniques.
- Optimizing: An optimizing process is a quantitatively managed process that is improved based on an understanding of the common causes of variation inherent in the process.

ISO 9000

- ISO 9000 standards specify quality-system requirements for use when a contract between two parties requires the demonstration of a supplier's capability to design and supply a product.
- The two parties could be an external client and a supplier, or both could be internal, such as the marketing and engineering groups within the same company.
- Of the ISO 9000 series, ISO 9001 is the standard most pertinent to software development and maintenance.
- Organizations use it when they must ensure that the supplier conforms to specified requirements during several stages of development, including design, development, production, installation, and servicing.
- ISO 9000-3 provides guidelines for applying ISO 9001 to the development, supply, and maintenance of software.

ISO 9001 Requirements

- Management Responsibility
- Quality System
- Contract Review
- Design Control
- Document and Data Control
- Purchasing
- Control of Customer-Supplied Product
- Product Identification and Traceability
- Process Control
- Inspection and Testing

ISO 9001 Requirements (2)

- Control of Inspection, Measuring and Test Equipment
- Inspection and Test Status
- Control of Nonconforming Product
- Corrective and Preventative Action
- Handling, Storage, Packaging, Preservation and Delivery
- Control of Quality Records
- Internal Quality Audits
- Training
- Servicing
- Statistical Techniques

CMMI versus ISO

- Clearly there is a strong correlation between ISO 9001 and the CMMI, although some issues in ISO 9001 are not covered in the CMMI, and vice versa.
- Both emphasize processes which are well documented and practiced as documented.
- The level of detail differs significantly: section 4 in ISO 9001 is about five pages long; sections 5, 6, and 7 in ISO 9000-3 comprise about 11 pages; and the CMMI is more than 500 pages.

CMMI versus ISO (2)

- The clauses in ISO 9001 that are not well addressed in the CMM, are *control of customer-supplied product and handling, storage, packaging, preservation, and delivery*.
- CMMI explicitly emphasizes continuous process improvement, while ISO 9001 addresses only the minimum criteria for an acceptable quality system.
- An ISO 9001-compliant organization would satisfy most of the CMMI level 2 and many of the level 3 goals.
- A level 2 (or 3) organization would probably be considered compliant with ISO 9001 but even a level 3 organization would need to ensure that it adequately addressed the delivery and installation process.