

## TOPIC

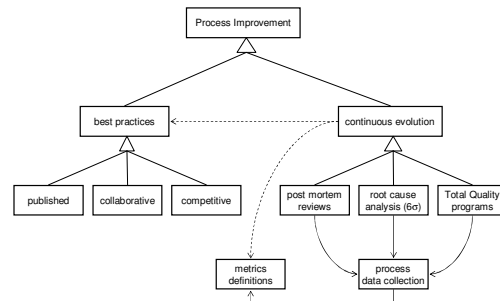
- Process Improvement
  - Best Practices Benchmarking
  - Capability Maturity Models
  - Root Cause Analysis (and 6σ)
  - Management standards: ISO 9000
- Metrics
  - Characteristics of good metrics
  - Common software metrics
  - Common process metrics
  - Rational metric use

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## Process Improvement



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## Best Practice Benchmarking

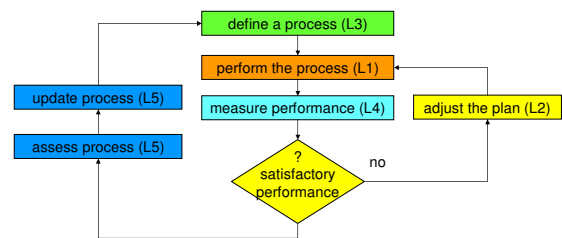
- Compare our processes with “best practices”
  - identify areas of short-fall
  - drive continuous improvement
- Sources of “best practices”
  - published “best practices” articles
  - collaborative studies, funded research
  - intelligence on our competitors’ practices
- Advantages
  - overcomes organizational inertia
  - draw on insights from other people
- Disadvantages
  - they tend to be highly industry specific

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## Process Improvement 1A



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## 5 Levels of Capability Maturity

- CMM-L1 able to reliably perform a task
- CMM-L2 manage task performance
- CMM-L3 follow defined processes
- CMM-L4 quantitatively managed
  - defined metrics for task performance
  - data is collected and use to manage work
- CMM-L5 optimized
  - process effectiveness is regularly assessed
  - measurement data drives process evolution

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## Capability Maturity Models

- assess an Organization’s capability
  - to define, manage, and improve processes
  - to guide it towards further improvements
- there are many detailed CMMs
  - software, collaboration, procurements, ...
  - individuals, teams, organizations, contractors
  - with details tailored to that particular domain
- each includes recommended practices
  - a best-practices stairway to greater maturity

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## root cause analysis

- Many software problems are not random
  - weak processes, common misunderstandings
  - the Pareto principle surely applies
- Finding instances one at a time is weak
  - we should find and fix the underlying problem
- Start with statistical studies of all problems
  - characterize bugs by phase, domain, nature
  - identify clusters of related problems
- Identify process changes to fix them

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## Six Sigma Philosophy

- Traditional production control
  - define acceptable performance
  - design a production process
  - measure product against specifications
  - errors indicate an out-of-spec product
- 6 $\sigma$  production control philosophy
  - understand causes of variation
  - specify process to manage variation
  - measure critical input parameters
  - measure critical output parameters
  - errors indicate process failures

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## Six Sigma (a methodology)



- identify Critical To Quality characteristics
  - things that determine product quality
- understand processes that control them
  - inputs and operations that govern the CTQs
  - input/output parameter coupling coefficients
- manage those process elements
  - specify and measure the inputs
  - define, manage, and measure the operations
  - use measurements to manage the process
- use statistical methods to identify problems
  - identify problem clusters
  - identify causes of those problems
- update processes
  - to eliminate sources of previous defects
- apply new measurements
  - to ensure those processes are working

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## ISO 9000 (management standard)

- assesses product development processes
  - are employees trained to do their jobs
  - are the processes defined and managed
  - does everyone have up-to-date process instructions
  - is process compliance measured and documented
  - incoming & outgoing products have clear requirements
  - is product quality defined and measured
  - is production managed by product quality data
  - is customer satisfaction tracked
  - is there a process improvement process
- does not actually assess product quality

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## Total Quality Mgt (a way of life)

- Continuous process improvement
  - make them visible, repeatable, measurable
- Understand how customer uses product
  - and you will understand what quality is
- Take a broad view of quality
  - all aspects of product, over its entire life
- Statistical analysis of quality variation
  - not just defects, but all variations in quality
- the goal is products that cannot fail

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## Metrics

- Metric
  - quantitative assessment
  - degree to which system has a characteristic
- Characteristics of a good metric
  - easily computable
  - computation is unique and unambiguous
  - well correlated w/desired characteristic
    - e.g. a linear 1x1 mapping
    - empirically persuasive

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## Common Software Metrics

- Size Metrics
  - Lines of Code (KLOC) ②
  - Kilobytes of code (KB) ②
    - simple program size
  - Cyclomatic Complexity ②
    - path complexity
  - Function Points ②
    - interface complexity
  - Classes & Interfaces
    - class complexity
  - Requirements ②
    - requirements complexity
- Characteristics
  - bugs/KLOC
    - defect density
  - Call Tree depth
  - Inheritance Tree depth
  - Afferent Coupling
    - package fan-in
  - Efferent Coupling ②
    - package fan-out
  - Module Cohesion
  - Comment ratios
  - White-space ratios

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## Productivity Metrics

- basis for estimating task duration
  - how long should it take to do this work
  - are we making progress at the expected rate
- code based productivity metrics ②
  - design time/KLOC
  - review time/KLOC
  - coding time/KLOC
  - testing time/KLOC
- defect based productivity metrics ②
  - estimated bugs / KLOC ②
  - bugs discovered / week of testing ②
  - bugs fixed / week of debugging ②
  - failures / customer / year ②

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## rational metrics use

1. Base your decisions on real data
  - but don't become a slave to your metrics ②
2. Don't waste peoples' time ②
  - No process without measurement.
  - No measurement without analysis.
  - No analysis without action.
3. Most metrics are imperfect ②
  - going without metrics is much worse
  - improve your metrics based on experience ②

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## Supplementary Slides

## (Process Management)

- monitor project execution
  - capturing process-defined work products
  - evaluating them against defined standards
  - determine if process is being properly followed
  - take corrective action when problems are found
- post-mortem each process
  - to identify what worked, and what didn't work
  - to identify and understand recurring problems
  - to identify corrective process revisions

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## Process Management Audits

- Assessment of our processes
  - are they clear and complete?
  - do we manage to them and audit compliance?
  - do we correct deviations?
- there are quality management standards
  - ISO9000 - Quality System Management
    - do we have and manage to measurable standards
    - Has a formal certification procedure

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