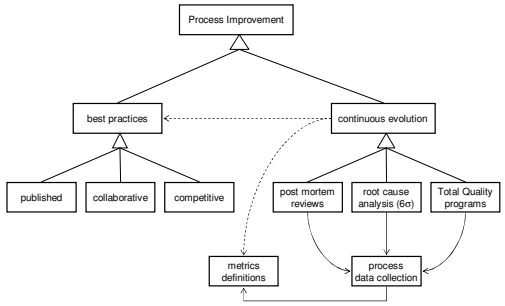
TOPIC

- 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

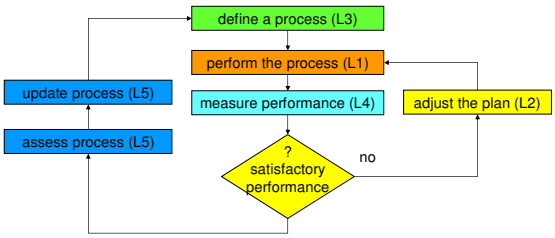
Process Improvement



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

Process Improvement 1A



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

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

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

Six Sigma Philosophy

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

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

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

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

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

Common Software Metrics

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

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
  - design time/KLOC
  - review time/KLOC
  - coding time/KLOC
  - testing time/KLOC
- defect based productivity metrics
  - estimated bugs / KLOC
  - bugs discovered / week of testing
  - bugs fixed / week of debugging
  - failures / customer / year

rational metrics use

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

Final Exam

- Thursday 4/26, in this room
- format:
  - closed book, no notes
  - 10 short essay-type questions, plus 1 XC
- scope:
  - all reading and lectures since the break
- difficulty:
  - very similar to mid-term
- office hours:
  - today, Wed, Thu 9:30-18:00

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

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