Five Critical Questions in Process Improvement

Dick Waina, Principal
Software Hell

- eBay suffered a 22-hour system crash—the longest, but not last, in a series of crippling software-related outages.
- Bad software cost U.S. businesses $85 billion in lost productivity in 1998.
- Typically 5 to 15 flaws in every 1,000 lines of code.
  - $30,000 to cleanse every 1,000 lines.

Businessweek Online, December 6, 1999
The IT World Has A Problem

- $274 billion/year — application software development
- 28% — projects expected to finish on time & budget
- 40% — projects canceled before completion
- $145 billion — spent in 1996 on canceled projects
- 42% — of original proposed features
- 50% — projects will cost 180% of original estimate
- 32,000 — new graduates to fill 195,000 openings

Performance is affected by:
- Process
- People
- Technology
- Environment

Data source: the Standish Group International
"We must learn - individually and as organizations - to welcome change and innovation as vigorously as we have fought it in the past . . . The corporate capacity for change must be dramatically increased."

Tom Peters: Thriving on Chaos
Typical Approach

“We need to do something about our quality and productivity.”

“I hear the Software CMM is the way to go.”

“Everybody’s doing it.”

“Let’s get to Level 2 (whatever that means) by the end of the year, and then shoot for Level 5 in two years.”
Structured Approach

Change Drivers
- declining market share
- reduced profits
- increasing personnel turnover
- new technologies

Desired State

Transition Process

Present State
Five Critical Questions

- **WHY?**
  - **MOTIVE** - What are critical business issues driving process improvement?

- **WHAT?**
  - **MODEL** – Which reference model best maps to the organization practices?

- **HOW?**
  - **METHOD** – How can you quickly and effectively identify improvement opportunities?

- **HOW MUCH?**
  - **MANAGING CHANGE** – What factors impact the effectiveness of introduced changes?

- **MEASURES** – What are critical factors in setting up a measurement program?

Some processes aren’t worth improving.
Kinds of Processes

- Identity - define the company, differentiate it from competitors
- Priority - strongly influence how well identity processes are carried out
- Background - necessary support to daily operations
- Mandated - legal requirements
- Folklore - deeply embedded in the fabric of the firm, but no longer have value

“Abandoning a process is far cheaper than redesigning or reengineering it.” Peter Keen, *The Process Edge*
Purpose Driven Process Improvement is a Service Mark of Multi-Dimensional Maturity
Learning Objectives

- Identify some key factors which impact the process improvement program.
- Know significant attributes of specific models in relation to process improvement needs.
- Understand the costs and benefits of various assessment methods.
- Be aware of some of the critical issues in planning and implementing process improvement programs.
- Be aware of some of the major issues in measuring the effects of process changes.
Motive

Why change?

- What are critical business issues driving process improvement?
- What’s the payback? Return On Investment?
- Are you using a top down (Grand Strategy) or bottom up (I Feel Your Pain) approach?
Summary of Improvement Benefits

Typical results of a well-established process improvement program include:

- Productivity improvements of 10% - 50%
- Quality improvements: significantly decreased error rates and field problems, resulting in reduced rework
- Improved ability to plan and control projects, reduced project delays
- Cycle time reductions of 20% - 50%
- Cost savings average 5:1 ROI
Other Benefits

- Fewer overtime hours
- More stable work environment
- Improved working conditions
- Improved quality of work life
- Improved employee morale
- Reduced employee turnover
- Improved management of project risk
- Improved customer satisfaction
- Better company image
Setting Direction

- Top Down
- Bottom Up
Top Down

**Strategic Objectives**
Business leaders determine critical business drivers and associated strategic objectives

**Business Purposes**
Department leaders identify business purposes and goals that support the strategic objectives

**Process Goals**
Technical and process leaders document process goals that support the business purposes

**Key Indicators**
Technical and process leaders determine key indicators that measure progress against goals
Answer the question, “What do we want to achieve?”

Strategic question areas should include business, customer, people, technology, culture, process

Understand what the current status is in each area
Strategic Objective Examples

- Market share/time to market
- Revenue growth/profit growth
- Company image
  - reliable, cost-effective, value-adding supplier
  - innovative, highly competent
  - preferred employer
Focus on activities that the organization performs that affect each strategic goal

Prioritize those activities

Determine how those activities will need to improve
Business Purpose Examples

- Increase predictability (cost, schedule, capability, quality)
  - Reduce rework, cycle time
  - Improve customer satisfaction (quality, responsiveness)
  - Improve employee satisfaction (reduce turnover)

“What do you want the process improvement program to accomplish? How will you determine if it has been successful?”
Process Goals

- Understand which processes support various business purposes
- Describe the processes addressing each business purpose or problem
- Determine whether specific processes have sufficient value and impact to warrant improvement
Process Goal Examples

- Understand and control customer requirements
  - Develop realistic plans
  - Accurately track progress in order to take corrective action when there are deviations from plans
  - Collect historical data
  - Minimize defects in deliverables
Key Indicators

- Key indicators help determine whether the process goals are being accomplished.
- What do I want to know?
Key Indicator Examples

- Planned vs. actual cost, effort, schedule
- Defect rate
- Amount of rework (quantity or cost)
- Productivity measurements
- Backlog
- Turnover
Bottom Up

Process Changes

Process owners identify related process changes

Remedies

Leaders and users brainstorm possible remedies to address the “pains”

Pains

Technical and process leaders meet with process users to identify significant problems
Pains

- These are issues which affect the success of every-day operations:
  - Requirements are found in multiple documents, and are not necessarily complete
  - Lack of baseline...scope creep
  - Lack of standardized change process
  - Working on wrong version of product
  - Defects, causing rework
Setting Direction

Strategic Objectives

Pains

Change Drivers

Desired State
Case Study

- Small to medium-size company
  - 100-200 software developers
  - typical project is 5-10 developers for 6-12 months
  - also many smaller projects, some larger

- Development and maintenance
  - Development: creation of a new software application
  - Maintenance: ongoing, continuous process of modifying and supporting a production application
    - correcting problems
    - responding to changing business requirements
    - adapting to new or changed technologies
Case Study

- **Strategic Objectives**
  - Top quality products
  - Cost effective operations

- **Business Purposes**
  - Uniformity of processes and procedures
  - Ability to reposition resources

- **Organization initiatives to improve ability to deliver:**
  - Improve/expand on product/delivery standards
  - Improve “Time-to-Market”
  - Improve communications
  - Improve internal training
  - Improve resource utilization
Case Study - “Pains”

😊 Schedules and budgets are routinely exceeded because they are not based on realistic estimates
😊 Inability to predict schedule, cost, design/code readiness
😊 Poor resource utilization
😊 Inadequate testing
😊 High incidence of software defects
😊 When hard deadlines are imposed, product functionality and quality may be compromised to meet schedule
😊 No objective basis for judging product quality
Combining a detailed list of “pains” with organization strategic initiatives helped the organization to envision a desired state.
Case Study - Desired State

😊 Processes are documented, usable and consistent
😊 Schedules and budgets are based on historical performance and are realistic
😊 Expected results for cost, schedule, functionality and product quality are usually achieved
😊 Disciplined processes are followed consistently because all participants understand their value
😊 Broad-scale, active involvement across the organization in improvement activities
😊 Roles and responsibilities are clear
Case Study - Direction

- Improve/expand on product/delivery standards
- Schedules and budgets are routinely exceeded because they are not based on realistic estimates
- High incidence of software defects

**Desired State**

Schedules and budgets are based on historical performance and are realistic.

Expected results for cost, schedule, functionality and product quality are usually achieved.

**Process Goals:**

- Increase predictability
- Reduce defects

**Key Indicators:**

- Cost/schedule variance
- Software failures in the field
Five Critical Questions

- **MOTIVE** - What are the critical business issues driving process improvement?
- **MODEL** – Which reference model best maps to the organization practices?
- **METHOD** – How can you quickly and effectively identify improvement opportunities?
- **MANAGING CHANGE** – What factors impact the effectiveness of introduced changes?
- **MEASURES** – What are critical factors in setting up a measurement program?
Why Use a Model?

- People generally have mental models of how a set of processes work.
- A specific model can provide:
  - a **language** and **constructs** which can facilitate communication about organization processes,
  - a standard of comparison,
  - investment guidance - where should I spend my next improvement dollar?
# Belief vs. Fact

<table>
<thead>
<tr>
<th>Belief</th>
<th>Fact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The CMM causes runaway bureaucracy.</td>
<td>Routine processes are handled more efficiently.</td>
</tr>
<tr>
<td>CMM-based SPI squelches creativity.</td>
<td>Technical people are freed for technical tasks.</td>
</tr>
<tr>
<td>Appraisals neglect important issues.</td>
<td>Appraisals provide essential focus and prioritization of issues.</td>
</tr>
<tr>
<td>Appraisals are not worth the expense.</td>
<td>Appraisals are well worth the investment.</td>
</tr>
</tbody>
</table>
"M" is for Model

"All models are wrong; some models are useful."
George Box, mathematician

"Models are simplified views of the real world"

Integrated product teams
System engineering
People issues
Organization culture
Technology
Marketing

Maturity Levels
Key Process Areas
Key Practices

The Capability Maturity Model for Software

Process descriptions, models, and instantiations are below the level of detail of the CMM
Which Model

- Which model best maps to the organization practices under consideration?
- Are you using the model as a set of Best Practices or an Idea Source?
- What questions do you want to answer?
How is a Model Constructed?

- Process areas
  - Goals
  - Practices
  - Explanatory material

*Levels*
Process Area Example

Key Practices

- Allocated req'mts are documented
- Changes to req'mts managed
- SE group is trained in req'mts mgmt.
- Measurements are made and used
- Activities reviewed by senior mgt.
- SQA reviews and audits the activities

Requirements

Requirements Management

Goal 1
System requirements allocated to software are controlled to establish a baseline for software engineering and management use.

Goal 2
Software plans, products, and activities are kept consistent with the system requirements allocated to software.

Requirements

Plans, activities and products

Levels?
Model Architecture

Same Processes, Two Models

Staged

Continuous

Process

Sandbox
Maturity levels have Key Process Areas
Provides clear road map for improvement

- Initial (1) None
- Repeatable (2) PA1, PA2, PA3
- Defined (3) PA7, PA8, PA9
- Managed (4) PA13, PA4
- Optimizing (5) PA15, PA16

Process Areas:
- PA7
- PA8
- PA9
- PA10
- PA11
- PA12
- PA15
- PA16
CMM Maturity Levels

- **Initial (1)**: Unpredictable and poorly controlled
- **Repeatable (2)**: Can repeat previously mastered tasks
- **Defined (3)**: Process characterized, fairly well understood
- **Managed (4)**: Process measured and controlled
- **Optimizing (5)**: Focus on process improvement

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## What Does it Mean to Move Up A Level?

<table>
<thead>
<tr>
<th>Level</th>
<th>Process Characteristics</th>
<th>Predicted Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimizing</td>
<td>Process improvement is a science</td>
<td>Probability</td>
</tr>
<tr>
<td>Managed</td>
<td>Product and process are quantitatively controlled</td>
<td>Probability</td>
</tr>
<tr>
<td>Defined</td>
<td>Engineering and management processes defined and integrated</td>
<td>Probability</td>
</tr>
<tr>
<td>Repeatable</td>
<td>Project management system in place; performance is repeatable</td>
<td>Probability</td>
</tr>
</tbody>
</table>

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Process Areas have capability levels

Provides broad picture of processes
Capability Levels

- **Capability Level 0: Incomplete**
  - either not performed or partially performed. One or more of the specific goals of the process area are not satisfied.

- **Capability Level 1: Performed**
  - satisfies the specific goals of the process area. It supports and enables the work needed to produce identified output work products using identified input work products.

- **Capability Level 2: Managed**
  - planned and executed in accordance with policy,
  - employs skilled people having adequate resources to produce controlled outputs,
  - involves relevant stakeholders;
  - monitored, controlled, and reviewed
  - evaluated for adherence to its process description.

Definitions from “CMMİSM for Systems Engineering/Software Engineering, Version 1.1”
Capability Levels, cont.

- **Capability Level 3: Defined**
  - a managed process that is tailored from the organization's set of standard processes according to the organization's tailoring guidelines,
  - contributes work products, measures, and other process-improvement information to the organizational process assets

- **Capability Level 4: Quantitatively Managed**
  - a defined process that is controlled using statistical and other quantitative techniques
  - focus is on special causes of variation

- **Capability Level 5: Optimizing (continuously improving)**
  - a quantitatively managed process that is changed and adapted to meet relevant current and projected business objectives
Domain of a Model

The system whose order and effectiveness are to be improved: e.g.,

- Software
- System Engineering
- People (Human Resources processes)
- System Acquisition
Some Models

- **SW-CMM® (staged)**
  - software

- **SE-CMM ® (continuous)**
  - system engineering

- **People CMM® (staged)**
  - people issues

- **Software Acquisition CMM® (staged)**
  - buying agency issues

- **CMMI^{SM-SE/SW} (both staged and continuous)**
  - system/software engineering
  - Integrated Product Team and Supplier Sourcing issues have been added
More Models

- Systems Security Engineering CMM ® (contin.)
  - security engineering practices
- Trusted CMM ® (staged)
  - high integrity software
- FAA-iCMM® (hybrid)
  - acquisition, engineering, and management processes
Choosing a Model

Which model and architecture best map to your objectives?

– What’s the domain of interest?
– Need a roadmap for improvement?
  • Staged
– Want a picture across all processes?
  • Continuous
– Focus on a few processes?
  • Continuous or Staged
– Beginning organizations should use a staged model.
– More mature organizations can get valuable insights from a continuous model.
CMM® or CMMI<sup>SM</sup> – Does it Matter?

- CMM® has a longer legacy and history of use.
- CMMI<sup>SM</sup> provides better coverage of some process areas.
- CMM® focuses primarily on software issues (but its underlying principles are broadly applicable).
- CMMI<sup>SM</sup> addresses a broad scope of general engineering and project management issues.
- CMMI<sup>SM</sup> ”raises the bar” for the Levels.
- SEI plans to not support the SW- CMM® starting about 2004.
Model Application

- Translation
  - Relate model terminology to organization terms

- Mapping
  - Relate organization processes to model process areas

- Tailoring
  - Understand differences between recommended model practices and organization processes/procedures
Who Should Know the Model?

Does the whole organization need to be trained on the model?

- Teach users the processes, not the model. Let the SEPG do the translation.

- However, the model can provide a language with which to discuss process concepts.
Case Study - Model

Process Goals:

1. Increase predictability:
   - Reduce requirements creep
   - Develop estimating database
   - Use planning templates

2. Reduce defects:
   - Peer reviews
   - Testing

Note that the focus is not on a Level, but on technical aspects of certain KPAs.

Select the model and components which best map to your critical issues

SW-CMM:
- RM
- PP/PTO
- PR
- SPE
  - testing
Five Critical Questions

- **MOTIVE** - What are critical business issues driving process improvement?
- **MODEL** – Which reference model best maps to the organization practices?
- **METHOD** – How can you quickly and effectively identify improvement opportunities?
- **MANAGING CHANGE** – What factors impact the effectiveness of introduced changes?
- **MEASURES** – What are critical factors in setting up a measurement program?
Method - Assess Organization

- Mentored Self Assessment
- Interim Profile℠
- SCAMPI℠
- Mini-assessments
- CBA-IPI
- SCE℠
Why Assess?

Why do you want to assess?
- Improvement
- Source Selection
- “Certification” of a Level

What do you want to know?

What will it cost?

Is the assessment a Major Event or a Quick Look?
Assessment Objectives

- Gather accurate data in an efficient, minimally disruptive way
- Help to identify and prioritize improvement opportunities
- Signal to the organization that a new way of life is beginning - in this case disruption is good
Assessment Project Life Cycle

- **Startup** - scoping the assessment
  - Organization
  - Model (which process areas and levels?)
- **Planning and preparation**
  - Select and train team
  - Identify interviewees and data sources
  - Logistics
- **Execution**
  - Data gathering
  - Data analysis and validation
  - Presentation of findings and recommendations
- **Wrap-up**
- **Action planning**
Assessment Outputs

- **FINDINGS**
  - Provide an accurate picture of processes, using the Capability Maturity Model (or other reference model) as a framework

- **RECOMMENDATIONS**
  - Provide guidance on process improvement activities appropriate to the current state of the organization's process.
  - Provide a framework and catalyst for action
  - Build ownership of results
  - Develop organizational commitment and energy
  - Sustain sponsorship and establish commitment
  - Facilitate continued process improvement
Example Findings

- The Software Development Plan process contains only high-level tasks for estimating size. There seems to be a lack of awareness of the detailed procedures contained in the Systems Engineering Estimating Process guide.
  
  **Consequence**: reliance on the metrics SME rather than understanding the documented process.

+ Projects use measurement triggers to prompt corrective actions based on actual results:
  - Current re-sizing activities on some projects may not fully support taking corrective actions based on size changes.
  
  **Consequence**: corrective action may be delayed.

+ An initial independent audit of SQA activities has been completed.
  - The frequency of these audits is not yet periodic.
Example Recommendations

- Provide additional training in estimating:
  - to improve sizing,
  - to decrease reliance on Metrics and Project Management SMEs
- Conduct periodic independent SQA audits in accordance with the Organizational SQA plan.
- Include estimated effort for SQA activities in schedules to facilitate estimated vs. actual analysis.
- Increase awareness of SQA activities with the business partners/customers.
- Include provisions/triggers in organization processes to guide interaction between SQA and business partner/customer SQA.
Develop Action Plans

- Action plans (based on business goals, and assessment findings and recommendations) drive the improvement project
- Manage the improvement phase like a project (but not Level 1)
- Model the expected behaviors
- Prepare the organization
Action Planning Techniques

- **Results** - What desired results do we want to achieve? How much improvement can we expect?
  - Prioritize by impact

- **Needs** - What do we need to change to effect this result? How soon do we need this result to improve?
  - Prioritize by urgency

- **Activities** - What tasks do we expect to be done to effect the needed change? Can this be done in time to get the desired results?
  - Prioritize by cost/feasibility

Assessment Types

- Self Assessment
- Mentored Self Assessment
- Interim Profile\(^{SM}\)
- Mini-Assessment
- CBA-IPI (CMM\(^{®}\)-Based Appraisal for Internal Process Improvement)
- SCE\(^{SM}\) (Software Capability Evaluation)
- SCAMP\(^{SM}\) (Standard CMM\(^{SM}\) Appraisal Method for Process Improvement)
Assessment Framework

Self Assessment → Mentored Self Assessment → Mini-Assessment → CBA-IPI/SCAMPI

SA Team → MSA Leader → Mini Team → Asst Team
CMM Self Assessment

- Educate the organization
- Begin to identify areas for improvement
- Provide scores by Key Process Area goal:

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3</td>
<td>Weak</td>
</tr>
<tr>
<td>4-5</td>
<td>Fair</td>
</tr>
<tr>
<td>6</td>
<td>Partially satisfied</td>
</tr>
<tr>
<td>7</td>
<td>Satisfied with weakness</td>
</tr>
<tr>
<td>8</td>
<td>Satisfied</td>
</tr>
</tbody>
</table>
Mentored Self Assessment

Based on the self assessment procedure:

- ensure organization understands the meaning and intent of the CMM
- provide an independent validation of the self assessment results
- MSA Leader: a trained and experienced assessor from outside the organization
- typically takes about 3 days
Interim Profile℠

- Maturity Questionnaire-based
- Process steps:
  - logistics and setup
  - initial data collection and analysis
  - review and revision of initial profiles (organization and project)
  - distribution of final profiles
  - method review
- Summary results reviewed by group
- Used to check status of progress improvement efforts between assessments
CMM Mini-Assessment

- Reduced-scale modification of the CBA-IPI or SCAMPISM
  - provide an independent verification of self assessment results
  - review the documented processes and implementation evidence
  - conduct several group interviews
  - provide suggestions for improvements based on an independent review
  - 2-4 trained and experienced assessors from outside the organization
  - scheduled to last three days or more, depending on KPAs reviewed
Differences (mini vs. IPI)

- Relaxed rules of evidence (corroboration not required)
- No validation meetings on preliminary findings
- No formal rating
- Outputs
  - findings report with strengths and weakness
  - assessment profile scored at the goal level
CBA-IPI/SCE℠

- SEI-defined process
- Typically uses six to eight people plus a Lead Assessor/Evaluator for six to eight days.
- The normal output of a CBA-IPI is a findings briefing which includes:
  - KPA strengths and weaknesses
  - Goal/KPA satisfaction
  - Maturity level satisfaction
  - Recommendations
- A written final report is optional

SCE is a Service Mark of Carnegie Mellon University
SCAMPI^SM

- SEI-defined process
- Typically uses six to eight people plus a Lead Assessor for seven to ten days.
- The normal output of a SCAMPI^SM is a findings briefing which includes:
  - KPA strengths and weaknesses
  - Goal/KPA satisfaction
  - Maturity level satisfaction
  - Recommendations
- A written final report is optional

SCAMPI is a Service Mark of Carnegie Mellon University
Assessment Considerations

- **Accuracy**
  - Are the improvement opportunities valid?
  - Did it miss any major weaknesses?

- **Cost**
  - Assessment preparation
    - Organization preparation
    - Team training and preparation
  - Assessment conduct

- **Organization Disruption**
  (any measurement impacts object being measured - this is a basic law of physics)
<table>
<thead>
<tr>
<th>Type</th>
<th>Accuracy</th>
<th>Cost</th>
<th>Disruption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>MSA</td>
<td>Fair</td>
<td>Low</td>
<td>Low</td>
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<td>IntProfSM</td>
<td>Fair</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Mini</td>
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*Values are the author’s estimates of accuracy, cost and disruption.*
Choosing an assessment method depends on what your goals are and what questions you want answered.

- Starting a process improvement program?
- Checking PI progress?
- Allocating PI dollars?
- Looking at a few processes?
- Benchmarking?
Case Study

Wanted to quickly determine what changes might have the greatest impact toward achieving the improvement objectives:

- Increase predictability
- Reduce defects
- y
- z
A CBA-IPI, while having the greatest accuracy and organizational impact, would be fairly expensive.

A mini-assessment could be used to provide a “quick-look” to identify greatest weaknesses quickly and relatively inexpensively.

A mentored self assessment was chosen as providing a reasonable amount of information at a low cost.
  - Less organization impact, least expensive
Ways to Reduce Assessment Costs

- Evaluate organizational readiness for PI.
- Use a reduced scale assessment method.
- Focus on evaluating action plan from previous assessment.
- For a large organization, combine assessment activities (e.g., training) for multiple groups.
- List a standard set of documents to review for each project and then tailor that list.
- Provide final report in viewgraph format rather than text report.

For more suggestions, see “Fifty Ways to Save Your Budget: Reduced Cost Systems Engineering Process Improvement,” Sarah Sheard, sheard@software.org
Five Critical Questions

- **MOTIVE** - What are critical business issues driving process improvement?
- **MODEL** – Which reference model best maps to the organization practices?
- **METHOD** – How can you quickly and effectively identify improvement opportunities?
- **MANAGING CHANGE** – What factors impact the effectiveness of introduced changes?
- **MEASURES** – What are critical factors in setting up a measurement program?
Managing Change

- How do you implement process changes/improvements?
- What factors most impact the effectiveness of introduced changes?
- Is the PI Program a Quick Fix or a Culture Change?

Quick Fix - some impact short term, lower probability of sustained success long term

Culture Change - lesser impact short term, higher probability of sustained success long term
Change is Difficult

“There is nothing more difficult to plan, more uncertain of success, or more dangerous to manage than the establishment of a new order. . .; for he who introduces it makes enemies of all those who derived advantage from the old order and finds but lukewarm defenders among those who stand to gain from the new one.”

Niccolo Machiavelli, The Prince, 1513
Introducing changes into an organization is a difficult and often an unsuccessful assignment.

Recent surveys (Maurer 1997) reveal bleak failure rates:

- Reengineering Efforts 33%
- Mergers and Acquisitions 29%
- Quality Improvement Efforts 50%
- New Software Applications 20%
A Maturity Subtlety

There are two different issues to be concerned with in process improvement:

**Process Maturity**
(focus - improve effectiveness/reduce variability of process performance)

**Organization Maturity**
(focus - establish environment that enables lasting process improvement)

*Process maturity* can’t be significantly improved beyond the capability of the *organization* to incorporate and sustain improvement.
Case Study

Recommendations

- Establish a full time process improvement focal point
- Develop action plan to prioritize and address identified weaknesses
- Specific action items were aligned with the organizational initiatives
  - Product/delivery standards (21)
  - Time to market (2)
  - Communications (2)
  - Internal training (6)
  - Resource utilization (4)
  - Quality (7)
Specific Action Items

- Include audits in schedule
- Educate project team on the quality assurance role
- Quality-defects/issues; issue tracking all the way through project; SQA audits
- Project start-up process
- SQA will mentor project managers on process
- Develop and publish software development policy
- Define and assign roles
- Document existing practices
- Review and revise time card work codes
- Identify projects to use new processes (start small, show successes)
- Initiate formal reviews – code/design/document/senior mgt, and include in schedule
Will It Work?

- These are all good recommendations.
- How can we make sure they’re carried out and sustained?
- What are some potential roadblocks?
Reasons for Failure

 Failures in strategy:

- Failing to define reasonable goals and plans.
  - Trap: Process improvement becomes a game.
- Failing to tie the improvement goals to business objectives.
  - Trap: Achieving a CMM Level becomes the primary goal.
- Having inadequate resources and unrealistic expectations.
  - Trap: Lack of management commitment.

*Rick Hefner: “Top Ten Reasons Improvement Efforts Fail”
*Karl Weigers: “Software Process Improvement: Ten Traps”*
Reasons for Failure, cont.

- Failures in planning:
  - Starting improvement efforts without an assessment (and/or without CMM knowledge).
  - Running improvement efforts like another Level 1 project, with no requirements, no plan, no tracking against plan, no configuration management, no quality assurance, etc.
    - Trap: Process Improvement becomes “just another program” which will soon go away.
  - Over-focussing on a common solution - "Let’s write a new standard development process."
    - Trap: Failing to scale formal processes to project size.
Reasons for Failure, cont.

- Failures in execution:
  - Ignoring middle management - Middle managers stand the most to lose, and are the most effective in resisting change.
    - Trap: Stalling on action plan implementation.
    - Trap: Time-stingy project leaders.
  - Confusing institutionalization with standardization - A strong culture does not imply everybody does it the same way.
    - Trap: Expecting defined procedures to make people interchangeable.
Reasons for Failure, cont

Failures in execution:

- Defining the process too early - Improvement is not simply about doing things differently; it requires a change in the culture to sustain the improvements.

- Trying a do-it-yourself approach - SEPG skills are different than software development and management skills.
  - Trap: Inadequate training is provided.
  - Trap: Process assessments are ineffective.
Risks to SPI

- Tendency for large complex organizations to resist the idea that simple processes might suffice.
- Temptation to derive actions on the spot.
- Attempt to derive actions from low-level data.
- While long delays after assessment are not desirable, neither is the activity of immediate transformation of observations to actions.
- An appraisal only identifies observations and risks; root-cause analysis must be performed.
  - Quantitative data are rarely available, and thus not analysed.
What is SPI?

A change in software process or culture which has a beneficial effect.

95% of all dieters regain the weight they have lost … and more … within one year of a diet.

Silver Bullet = Diet

60% of all those who change their lifestyle to eat less and exercise more maintain their weight loss.

Process Improvement = Lifestyle Change
When SPI is a Bad Idea

- The process being improved doesn’t have sufficient economic value added.
- Management doesn’t provide sufficient sponsorship and support.
When SPI is a Good Idea

- The process being improved is vital to the organization’s business.
- Management is committed to sponsoring and supporting change.
- People in the organization are willing to accept change.
Lasting Change

- Process improvement requires **people** in the organization to change their **behaviors**, and that requires attention to a whole range of **organizational and cultural issues** if process improvement is to be effective for the long term.
Process Change
Supported by Culture

Formal Process Change

Leadership Transformation

Tools & Enablers

Cultural Change
The Foundation
Process Change
Without Culture

Formal
Process Change
What is Culture?

Culture is a pattern of shared basic assumptions:

– that a group learned as it solved problems,
– that has worked well enough to be considered valid, and
– that is reinforced as the correct way to perceive, think, and feel in relation to resolving problems.
Culture

Beliefs + Behaviors + Assumptions

Expressed
- Speeches
- Newsletters
- Mission Statements

Modeled
- Priorities
- Decision Making
- Resource Allocation

Reinforced
- Rewards
- Recognition
- Promotions

The change(s) must be aligned with the culture
Examples of Culture

- Every 16-year-old gets a driver’s license.
- You shake hands when you meet someone.
- Everyone says “please” and “thank you.”
  - “Everything I Need to Know I Learned in Kindergarten”
- You take your shoes off when you enter the house.
- You take your food from the common bowl with your hand.
Questions About Organization Culture

- Is your organization reactive or proactive?
- Do you fight fires or prevent them?
- Are people assets or resources?
- What behaviors do you reinforce and reward?
Layers of Culture

Culture has three layers:

- **Assumptions** (the subconscious aspects)
- **Communications** (the visible aspects)
- **Expectations** (desired results)

*Kim Caputo: “Facilitating CMM Culture Change”*
Cultural Change

- involves rethinking those basic assumptions,
- deciding some assumptions are no longer valid, and
- learning a new pattern of shared basic assumptions.
Culture and the CMM

communications (the visible aspects)

assumptions (the subconscious aspects) "not discussed"

expectations (desired results)

Key Practices

Maturity Level Goals
Example - Code Checking

- Practice - Individuals check their own work.
- Expectation - We hired you because of what you know; we expect the best.
- Assumption - Individuals should know what to look for in their own code, and shouldn’t make mistakes anyway.
Example - Peer Reviews

 Practices:
  – Plan and coordinate peer review activities.
  – Perform peer reviews to prevent downstream defect escapes.

 Expectation - We use teams to review work products so that the output of an activity meets the needs of downstream activities.

 Assumption - One person can’t track all the details, and error detection is more probable when the work is examined by more than one person.
The Culture Change

- Assumption - Individuals should know what to look for in their own code, and shouldn’t make mistakes anyway.
- Assumption - One person can’t track all the details, and error detection is more probable when the work is examined by more than one person.
For a Change to Stick,

expectations must be:

- expressed - "Here's what we expect."
- demonstrated - "Here's what we do."
- reinforced - "Here's what we reward."
- believed - "Here's why this works for us."
Success Factors

- Major changes to the software process must start at the top.
- Ultimately, everyone must be involved.
- Effective change requires a goal, and knowledge of the current process.
- Change is continuous.
- Software process improvement requires investment.
- Software process changes will not be retained without conscious effort and periodic reinforcement.

(2nd Law of Thermodynamics)

*Watts Humphrey: Managing the Software Process*
Managing Change Continuum

- Mandated Approach
- Mediated Approach
- Managed Approach
Mandated Approach to Change

Mandated Approach

Mediated Approach

Managed Approach

Leader sets direction

Project plan constructed

Compliance enforced
Mediated Approach to Change

Mandated Approach

Mediated Approach

Managed Approach

Leader sets direction

Transition strategies applied

Stakeholders expected to buy in and change
Managed Approach to Change

Mandated Approach

Mediated Approach

Managed Approach

Stakeholders set direction

Stakeholders apply transition strategies

Change in behavior & structure is achieved
## Mandated vs. Managed Change Approach

<table>
<thead>
<tr>
<th></th>
<th>Where TIME Investment is Required</th>
<th>How ENERGY is Spent</th>
<th>Type of INVOLVEMENT Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mandated Change Approach</td>
<td>Back-end</td>
<td>Resisting, Enforcing compliance, Rework</td>
<td>Top-down Dictatorial Key players only</td>
</tr>
<tr>
<td>Managed Change Approach</td>
<td>Front-end</td>
<td>Planning Changing Learning</td>
<td>All stake holders, directly or through representation</td>
</tr>
</tbody>
</table>
Levels of Commitment

Resistance
- Violent Revolution
- Active Revolution
- Passive Resistance
- Noncompliance

Let It Happen
- Apathy
- Grudging Compliance

Help It Happen
- Formal Compliance
- Managed Mediated

Make It Happen
- Commitment Enrollment

Peter Senge: The Fifth Discipline
Degrees of Commitment

- **Noncompliance**: Does not see benefits of the vision and will not do what’s expected. “I won’t do it; you can’t make me.”

- **Apathy**: Neither for or against vision. No interest. No energy. “Is it five o’clock yet?”

- **Grudging compliance**: Does not see the benefits of the vision. But, also, does not want to lose job. Does enough of what’s expected because he has to, but also lets it be known that he is not really on board.

- **Formal compliance**: On the whole, sees the benefits of the vision. Does what’s expected and no more. “Pretty good soldier.”

- **Genuine compliance**: Sees the benefits of the vision. Does everything expected and more. Follows the “letter of the law.” “Good soldiers.”

- **Enrollment**: Wants it. Will do whatever can be done within the “spirit of the law.”

- **Commitment**: Wants it. Will make it happen. Creates whatever “laws” (structures) are needed.
Managed Change Can Decrease Productivity Loss

- Time
- Productivity
- The Change
  - Managed Change
  - Denial
  - Resistance
  - Typical Change
  - Exploration
  - Renewal
Critical Issues

- Develop sponsorship
- Develop the change package
  - The PI Project Plan
- Address transition issues
- Use a phased approach
  - Develop shared understanding
  - Design key strategies
  - Implement, align the organization
- Manage the change
Transition Strategies

Transition process

Present State

- Team Structure
- Leadership
- Education/Training
- Measures
- Communications
- Relationship Management
- Performance Management
- Business & Systems Integration

Desired State

1. Develop Shared Understanding
2. Design Key Strategies
3. Implement, Align Organization

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Transition Strategies

- **Team structure** – Establish the team and its structure to plan, implement and sustain the change:
  - sponsor,
  - leadership team,
  - change team, change coach,
  - transition team.

- **Leadership** – Establish the sponsorship development activities and learning organization environment for achieving and sustaining the desired change.

- **Education and training** – Establish the education and training to provide stakeholders the knowledge and skills of methods, tools and processes integral to the change initiative.
Transition Strategies, cont.

- **Communications** – Establish communications for the change within all levels of the organization.

- **Business and technology integration** – Determine the desired changes in business performance and integrate the technology-driven changes that will support it, such as systems life cycle, project management, or new tools.

- **Performance management** – Identify the desired behaviors and performance results for the change; establish the reinforcement mechanisms for each behavior (positive and negative) to institutionalize the change.
Transition Strategies, cont.

- **Relationship management** – Determine how the change will impact your customer or supplier and establish a win-win business relationship for working together.

- **Measures** – Establish the business value, process and readiness measures that should be tracked and monitored to enable learning and measure progress, as well as results.
Team Structure - Case Study

- Establish a process improvement focal point:
  - combined SEPG/SQA group
- Train them, use their leveraged resources to:
  - define process changes
  - follow up on implementation
Team Structure: SEPG

- Define a charter for the SEPG that is based on continuous long term process improvement
- Specify tasks and responsibilities other than assessment preparation
- Provide real authority to make a difference
- Involve working engineers
SEPG Structure and Membership

- A management steering committee to provide oversight
- Process focal point, half to full time depending on organization size and level of activity
- Representatives from various organizational units
  - Leads of all software teams
  - Leads of software functions, if defined (requirements, design, code, and test)
  - Leads of support functions (software configuration management and software quality assurance)
- SEI recommends 3-5% of organization resources be focussed on process improvement
Typical SEPG Organization

Management
Steering
Committee

Software
Engineering
Process Group

Process
Action Team
Process
Action Team
Process
Action Team
Process
Action Team
SEPG Functions

- Obtain and maintain the support of all levels of management
  - Work with line managers to provide a broad perspective of the improvement effort and help them set expectations

- Facilitate the creation and maintenance of process definitions
  - Maintain collaborative working relationships with software engineers and managers, especially to obtain, plan for, and install new practices and technologies.

- Arrange for any training or continuing education related to process improvements

- Assist projects in process tailoring and improvement
SEPG Functions

- Track, monitor, and report on the status of particular improvement efforts
- Maintain a process database
  - Collect metrics on all projects in order to understand the effectiveness of organizational-level processes
- Maintain a Process Asset Library
  - Collect samples of project artifacts (software plans, product documents such as specifications and design) for the use of other projects
- Collect and distribute Lessons Learned
  - Gather experiences from various projects to establish a “corporate memory” of good things to do and bad things to avoid
- Facilitate software process assessments
Training for new members begins with an SEPG Orientation

- Members participate in defining the policy chartering the SEPG

- Initial formal training (introductory course)

Advice for SEPG Members

- Plan ahead
- Be persistent
- Be sensitive to the needs of the participants
- Study the participants' organization
- Identify opinion leaders
- Solicit feedback from resisters
- Keep participants and management informed
- View the transition from the perspectives of both participants and management
- Provide awareness of alternatives to the software technology to be transitioned
- Identify root causes of problems
- Continually collect and analyze data about the transition process
- Share the success
Team Structure: Process Action Teams

- Set up and use PAT’s to define and implement process changes
- Include Executive Sponsor, Team Leader, Team Members, and a Facilitator
- Use a defined process for evaluating, developing and implementing process changes
The Process Improvement Proposal Process

- Focus is on capturing improvement ideas from working professionals
- Organizational infrastructure (e.g., SEPG)
- Evaluation and implementation process
  - PIP Form - one page
  - PIP meeting agenda
    - entry criteria
    - exit criteria - expected results of the meeting.
  - PIP Evaluation Criteria
    - impact, urgency, cost/feasibility
    - reasons for returning, deferring or accepting a PIP
PIP Form

Date: ____________ Author: ____________ Project: ______________________

Process Name: _____________________________________ ID #: __________

Improvement Description: ____________________________________________

Improvement Benefits (Check One)

Improved Quality: ____ Reduced Cycle Time: ____ Reduced Risk: ____

Benefits Description (Quantify Where Possible): ________________________

________________________________________________________________

Key Process Area: ________________________ Goals #: ________________

Key Practices (Fill One)[Optional]____________________________________

Commitment To Perform #: _______ Ability To Perform #: _______

Activities Performed #: ____ Measurement #: ____ Verification #: ____

Log #: ____ Received: ____ Evaluated: ____ Author Notified: ____

Status: Accepted: ____ Returned: ____ Deferred: ____

Time To Implement: __________ Implemented On: __________

Reason Returned/Deferral Condition/Implementation Plan: ________________
Evaluating PIP’s

- **Results** - What desired results do we want to achieve? How much improvement can we expect?
  - Prioritize by impact

- **Needs** - What do we need to change to effect this result? How soon do we need this result to improve?
  - Prioritize by urgency

- **Activities** - What tasks do we expect to be done to effect the needed change? Can this be done in time to get the desired results?
  - Prioritize by cost/feasibility
### Example PIP Evaluation

<table>
<thead>
<tr>
<th>PIP #</th>
<th>IMPACT</th>
<th>URGENCY</th>
<th>COST</th>
<th>TOTAL*</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIP #1</td>
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<td>High</td>
<td>High</td>
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<td>$1000</td>
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</tr>
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<tr>
<td></td>
<td>7</td>
<td>5</td>
<td>$5000</td>
<td></td>
</tr>
</tbody>
</table>

*TOTAL = (IMPACT + URGENCY)/$K
Process Flow for Process Action Teams


Pilot?

No

E
Leadership - Case Study

- Establish sponsorship development activities
  - Educate leaders first and get them on board, including the marketing team that drives Change Requests
- Establish learning organization environment
  - Adopt a servant-leader mind-set; empower employees
- Engage sponsors in leading and sustaining the desired change
  - Have leaders model the expected behaviors
  - Make sure leaders monitor team progress
- Establish senior management reviews of SQA
Education and Training - Case Study

- Use Process Action Teams to develop training
- Provide training on Project Workbooks
- Establish subject matter expert networks to coach and mentor project managers and software leads
Communications - Case Study

- Develop Communication Plan
- Establish process improvement bulletin board and monthly newsletter
- Post organizational policies and distribute color copy to everyone
Integrate software engineering processes with Change Request process

Post process goals together with business goals

Determine how process changes will be integrated into business operations
Add objective process improvement goals to leader incentives
Include software engineering process knowledge and skills in performance reviews
Include audits in project schedules
Start providing bonuses for “fire prevention”, avoiding weekend fixes
Manage customer expectations re project performance

Share process improvement plans with marketing and long-time key customers
Measures - Case Study

- Establish and collect measures for size, effort, duration, defects
- Compute cost/schedule variance and defect rate
Five Critical Questions

- **WHY?**
  - MOTIVE - What are critical business issues driving process improvement?

- **WHAT?**
  - MODEL – Which reference model best maps to the organization practices?

- **HOW?**
  - METHOD – How can you quickly and effectively identify improvement opportunities?

- **HOW MUCH?**
  - MANAGING CHANGE – What factors impact the effectiveness of introduced changes?

- **MEASURES** – What are critical factors in setting up a measurement program?
Evaluate Impact

The final step* in process improvement is to determine the impact on the organization of the changes which have been implemented.

This implies some set of measures which can be compared against a baseline in order to determine quantitatively how successful the process improvement program has been.

*(and the first step in the next cycle)
Measurement

- How can you measure the effects of process changes?
  - Need a baseline of historical data
  - Gather current data to compare against past experience

- What are some hidden dangers of measurement?
Measurement and the CMM

Measurement appears in the Software CMM in two ways:

- Each KPA has a measurement Common Feature: “Measurements are made and used to determine the status of [KPA] activities.”
- Some KPA Activities Performed involve measurement, e.g.:
  - size, effort and cost estimates and actuals
  - staffing levels
  - critical computer resources
  - number of audits and reviews
  - number of changes to configuration items

In the CMMI there’s a Measurement PA at Level 2.
Measurement Principles

- Use issues and objectives to drive the measurement requirements
- Define and collect measures based on the technical and management processes
- Collect and analyze data at a level of detail sufficient to identify and isolate problems
- Implement an independent analysis capability
- Use a systematic analysis process to trace the measures to the decisions
- Interpret the measurement results in the context of other project information
- Integrate measurement into the project management process
- Use the measurement process as a basis for objective communications
- Focus initially on project-level analysis

Issues and Objectives

- Project objectives are goals and requirements:
  - cost
  - schedule
  - quality
  - functionality
  - technical performance.

- Issues are areas of concern that present obstacles:
  - problems
  - risks
  - lack of information.
Define and Collect Measures

- Define and collect measures based on the technical and management processes.
- Measures should be collected as a natural by-products of the work performed.
- Consider processes of other team members and subcontractors.
Collect and analyze data at a level of detail sufficient to identify and isolate problems.

Periodically collect, process and analyze measurement data.

Specific data depends on project issues.
Implement an independent analysis capability.

Measurement data should be assessed by independent group.
  - Ensures objectivity
  - Accurate, unbiased assessment of project status.
Systematic Analysis Process

- Use a systematic analysis process to trace the measures to the decisions.
- The meaning of the numbers must be understood.
- There should be a clear flow from the data through the analysis to the conclusions.
- The analysis process should provide repeatable results.
Project Context

- Interpret the measurement results in the context of other project information.
- No measurement result is good or bad by itself.
- A variance between planned and actual only indicates a possible problem, not the cause.
Integrate measurement into the project management process.

Measurement provides insight into current phase

It also can project consequences of current actions on later phases.
Objective Communications

- Use the measurement process as a basis for objective communications.

- Involve entire project in developing the measurement process.

- All parties should use same data and have a common understanding of the data definitions.
Focus initially on project-level analysis.

Project success means meeting specific project objectives.

Implement a consistent measurement process on all projects.

Organization-level data can be derived from well-defined project measures.
Setting Up A Metrics Program

- **Planning:**
  - Define information needs
  - Define metrics and analysis methods
  - Define selected measures
  - Define the collection process of measurement data:

- **Implementation:**
  - Collect the measurement data
  - Analyze the measurement data to derive metrics
  - Manage the measurement data and metrics
  - Report the metrics

- **Evaluation:**
  - Review the usability of the selected metrics

*Timothy Perkins, “The Nine-Step Metrics Program”*
What Information Should I Collect?

- Quality Measures
- Productivity and Schedule Measures
- Business and Corporate Measures

*Capers Jones, “Software Measurement Programs and Industry Leadership”*
Quality Measures

- Customer Satisfaction
- Defect Quantities
- Defect Removal
- Delivered Defects
- Defect Severities
- Service Response Time
- Complexity
Productivity and Schedule Measures

- Size Measures
- Activity-Based Schedule Measures
- Activity-Based Cost Measures
- Monthly Milestone Reports
- Annual Software Measurements
Business and Corporate Measures

- Market Share
- Portfolio
- Competition
- Salary/Benefit Comparisons
If you are in this tutorial, you are probably a Level 1-2 organization

Time is not on your side

You need to show quick wins against your business goals

Don’t over-reach: create measures considering your current and next level
A technique to help set direction:

**Goals**
What activities do I manage or execute? Based on my organization’s business strategies and these activities, what goals do I want to achieve?

**Questions**
What do I want to know? What activities do I want to achieve or improve? What will I need to do to meet my strategic goals?

**Measures**
What formalized measurement goals (active and passive) will I need to track progress in these process improvement activities against the business purposes and strategies?
GQM Progression

QUESTION a

QUESTION b

METRIC

a. Enabling Questions
b. Operational Questions
GQM Example

- What are our business goals?
  - Improve customer satisfaction by reducing defects.

- What do we want to achieve (measurement goals) in order to satisfy our business goals?
  - Reduce post-delivery defects to “N” per KLOC

- What questions will help us plan & manage progress toward our goals?
  - Where are defects introduced & removed?
  - How effective are peer reviews?

- What measures are necessary to answer these questions?
  - Defects detected in peer reviews, testing ...
  - Defect categorization, rework time ...
The GQM Approach

Step 1: Identify your business goals.
Step 2: Identify what you want to know or learn.
Step 3: Identify your sub-goals.
Step 4: Identify the entities and attributes.
Step 5: Formalize your measurement goals.
Step 6: Identify your measurement questions & indicators.
Step 7: Identify the data elements.
Step 8: Define and document measures and indicators.
Step 9: Identify the actions needed to implement your measures.
Step 10: Prepare a plan for implementing the measures.
Goal-based Metrics

People
- Career Development
  - % w/ career development plan
  - % reviews on-time
- Training
  - Training hours delivered
  - % required completed
  - Attendees/no shows by course

Productivity
- Maintenance scope
- Portfolio size
- Delivery rates
- FTE distribution
- Effort distribution

Customer
- Actual vs committed delivery dates
- Availability of critical reports
- Data Quality
- Systems change delivery rate
- On-line availability
- Defects over time
- Budget compliance
- Customer satisfaction
- Creativity (survey)
- Customer support responsiveness
- Punctuality
- Reliability
- System usage
- Duration (estimated vs actual)
- Response time
- Assurance (survey)
- Innovation (survey)
- Data integrity (survey)
- Help desk call response

Quality
- Defects over time
- Requirements defects
- Design defects
- Code defects
- Test defects
- Failures in production

Process
- Non conformities
- Action items
- Escalated issues

Product
- SEI-CMM
  - KPA deployment
  - Evidence matrices coverage
  - KPAs satisfied
  - Levels satisfied
  - Action items

SQA Results

Data

RD

MM

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Measurement Program - Implement

- Create a safe environment for collecting and reporting data
  - Collect the measurement data
  - Analyze the measurement data to derive metrics
  - Report the metrics

- Interpret the measurement results in the context of other project information
  - Use the measurement process as a basis for objective communications

- Manage the measurement data and metrics
  - Have a complementary suite of measures
Analyze and Report

Measure Analysis:  
- Steady improvement
  → Stay the course  
- Significant improvement
  → Raise the (goals) bar  
- Steady decline
  → Look for factors (sponsorship, resources, training, incorrect process or measures)
Summary Report

Review summary data and revisit Strategic Objectives and Business Purposes periodically, as performance improves and objectives, goals and measures all improve!
Measurement Program - Evaluate

- Review the usability of the selected metrics
- Be ready to change
Evaluate Impact

- Verify measure collection
- Communicate the measures
- Show relationship to work that is done
- Incorporate collection into project plans
- Track effectiveness of measures
- Improve when necessary
- Communicate results
- Watch for dysfunction
- Be aware of variances - determine root cause
- **Explain** what the results mean
- **Use** the results (if you’re not going to improve, don’t measure!)
- Revisit “Motive” phase regularly

Collect Measures

Analyze and Report

Summary Reports
Continuously Improve Measures

Key Indicators

Collect Measures

Review & Revise

Improve/Replace

Regularly monitor measures and revise collection procedure, frequency, tool, granularity

Replace a measure with a new one because of: collection difficulty, obsolescence, instability, complexity, disuse, misuse, dysfunction, no use!
Case Study - Measures

What measures?
- Primary
  - Increase predictability
  - Reduce defects
- Supplemental

Use the two key indicators:
  - Cost/schedule variance
  - Software failures in the field

Use supplemental metrics:
  - Requirements change rate
  - Project plan change rate
  - Defects in design, code and test
  - Customer satisfaction
Measurement Dangers

- What are some dangers of measurement?
- Are the measures relevant, significant, objective?
- Can the measures become dysfunctional?
Are the Measures Relevant?

- How will you know if your critical parameters have improved?
- How do those measures relate to the Key Process Areas?
- Will moving up maturity levels achieve improved effectiveness?
Are the Measures Significant?

- The appearance of process maturity is not a substitute for having process maturity - there’s more to the CMM than an assessment!
- Does the organization prepare with rigor for an assessment but afterwards give less than that effort to sustain and improve?
- Is the CMM maturity level consistent with measured improvements in business and quality?
Are the Measures Objective?

“Think of the organizational measurement system as the dials and indicators in an airplane cockpit. For the complex task of navigating and flying an airplane, pilots need detailed information about many aspects of the flight:

- fuel,
- air speed,
- altitude,
- bearing,
- destination
- other indicators

that summarize the current and predicted environment.”

Robert Kaplan and David Norton
“Now consider what this analogy would be like if it included a multitude of tiny gremlins controlling wing flaps, fuel flow, and so on, of a plane being buffeted by winds and generally struggling against nature, but with the gremlins always controlling information flow back into the cockpit instruments, for fear that the pilot might find gremlin replacements.”

Robert D. Austin
Two Uses of Metrics

- **Informational**
  - process/product insight, decision-making
  - should not affect behavior

- **Motivational**
  - provoke greater effort in pursuit of organizational goals
  - should affect behavior

- Mixing the two purposes can have negative effects (esp. transforming informational measures into motivational)
“Nearly 80% of software measurement programs fail within the first two years.”

Goodman, “Practical Implementation of Software Metrics”

Two problem areas:
- Meaning: technical problems
- Motivation: psychological problems
Technical Problems

- **Unclear meaning**: numbers may not be clearly understood, due to not realizing the implicit model between the numbers and the reality.
  - e.g., *what is the meaning in the real world of the Technical Complexity Factor in the Function Point Method? How does this impact project effort?*

- **Inappropriate operations**: not all numbers can be meaningfully averaged or otherwise combined or manipulated.
  - e.g., *a 2000 LOC program probably will take something other than twice as along as a 1000 LOC program to complete.*
Psychological Problems

- “Dysfunction occurs when the validity of information … is compromised by the unintended reactions of those being measured.”

- “The major problem for most incentive systems is … bias intentionally introduced by those being measured.”

*Austin, “Measuring and Managing Performance in Organizations”*
Dysfunctional Measures

How dysfunction unfolds

- Measurement indicators
- True performance

Austin, “Measuring and Managing Performance in Organizations”
Dysfunctional Measures

Traditional Examples:

- Standardized tests (coaching and preparation skews results)
- Production targets ("storming" ignores quality and equipment maintenance)
- Sales commissions (overselling, not providing value to the customer)
- Stock value (quick cuts, short-term changes)
- "Kills" (Vietnam deaths encouraged/inflated)
- Piecemeal pay (can lead to quality problems)
Dysfunctional Measures

SPI Examples:

- Planned vs. actual (re-baselined cost, schedule)
- Defects (over/understated, misdiagnosed)
- Maturity levels (do processes add business value?)
- ISO 9000 certification (more than just documented standards?)
- Malcolm Baldridge Award (is it sustainable?)
Prevent Dysfunction

- Don't have the measures take the place of the underlying goals.
- Workers should be internally motivated; measurement should provide them with self-assessment information.
- Reinforce, don't enforce, human behavior.
- Watch out for opportunistic behaviors.
- Set solid objectives and plans.
- Make measurement part of the process.
- Understand benefits and limitations.
- Focus on cultural issues.
- Create a safe environment for collecting and reporting data.
- Be ready to change.
- Have a complementary suite of measures.

*Carol Dekkers, “Secrets of Highly Successful Measurement Programs”*
Tying It All Together

- MOTIVE - Why change?
- MODEL – Which model?
- METHOD – How to assess?
- MANAGING CHANGE – How to implement improvements?
- MEASURES – How to measure progress?
Purpose Driven Process Improvement℠ Framework

- **Motive**
- **Model**
- **Method**
- **Managing Change**
- **Measures**

- Strategic Objectives
- Business Purposes
- Process Goals
- Key Indicators

- Select Model
- KPAs/Goals

- Select Methodology
- Conduct Assessment

- Develop Action Plans
- Implement Changes

- Summary Reports
- Analyze and Report
- Collect Measures
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