

Starting Out or Starting Over in Process Improvement – A Five Step Recipe for Success



Dick Waina, Principal,
Multi-Dimensional Maturity



Learning Objectives



- ▶ Understand how reasons for change 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.
- ▶ Establish an understanding of the relationships among the various aspects of process improvement programs.



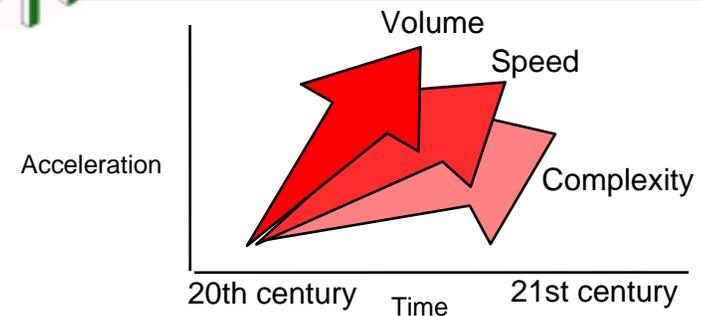
Five Critical Questions



- MOTIVE - Why change?
- MODEL – Which model?
- METHOD – How to assess?
- MANAGING CHANGE – How to implement improvements?
- MEASURES – How to measure progress?



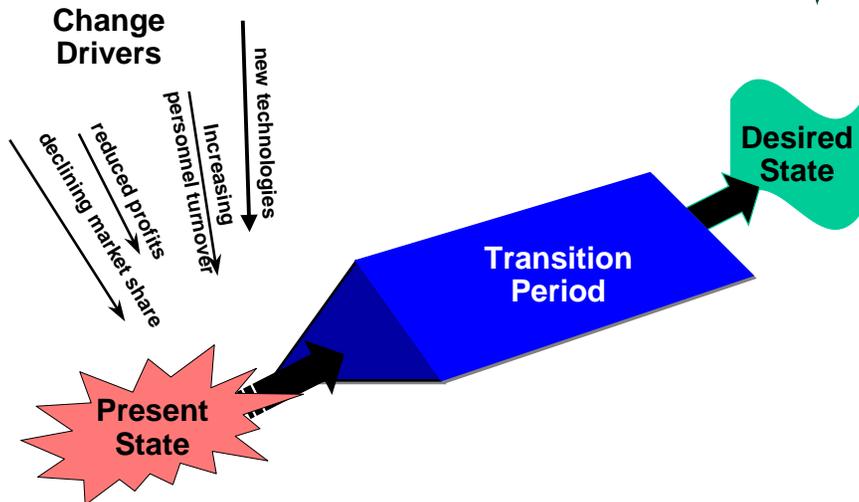
Need for Change



"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

Basic Change Model

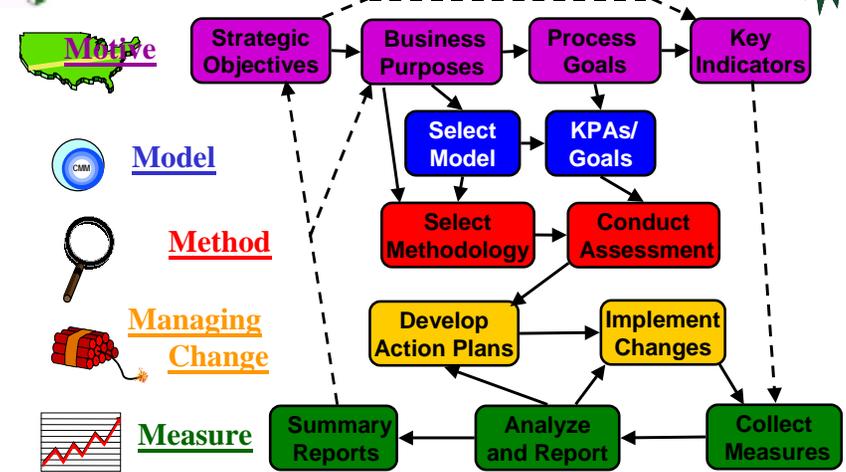


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Purpose Driven Process ImprovementSM Framework



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Purpose Driven Process Improvement is a Service Mark of Multi-Dimensional Maturity 5/30/2001

Motive

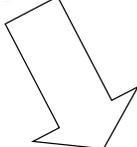
- ▶ Why change? 
- ▶ What are the critical business issues driving process improvement?
- ▶ Are you using a top down (Grand Strategy) or bottom up (I Feel Your Pain) approach?

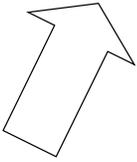
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Setting Direction

- ▶ Top Down 

- ▶ Bottom Up 

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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 (approved by business and department leaders)

Key Indicators

Technical and process leaders determine key indicators that measure progress against goals (approved by other leaders)



Strategic Objectives



- ▶ 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
- ▶ Interview each organizational level, and base subsequent questions on the previous level's outputs



Strategic Objectives



Examples:

- ▶ Market share/time to market
- ▶ Revenue growth/profit growth
- ▶ Company image
 - reliable, cost-effective, value-adding supplier
 - innovative, highly competent
 - preferred employer



Business Purposes



- ▶ Focus on activities that the organization performs that affect each strategic goal
- ▶ Prioritize those activities
- ▶ Determine how those activities will need to improve
- ▶ Interview each level, and base subsequent questions on the previous level's outputs



Business Purposes



Examples:

- ▶ Increase predictability (cost, schedule, capability, quality)
- ▶ Reduce rework, cycle time
- ▶ Improve customer satisfaction (quality)
- ▶ 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
- ▶ Use tools (Ishakawa diagrams, Pareto, run charts, etc.) to identify and prioritize problems
- ▶ Determine whether specific processes have sufficient value and impact to warrant improvement
- ▶ Describe the processes addressing each business purpose or problem
- ▶ Look for patterns
- ▶ Explore alternate solutions
- ▶ Develop strategies for further improvement



Process Goals



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.

Techniques:

- ▶ Goals-Questions-Measures
- ▶ Balanced Scorecard
- ▶ Dashboard
- ▶



Key Indicators

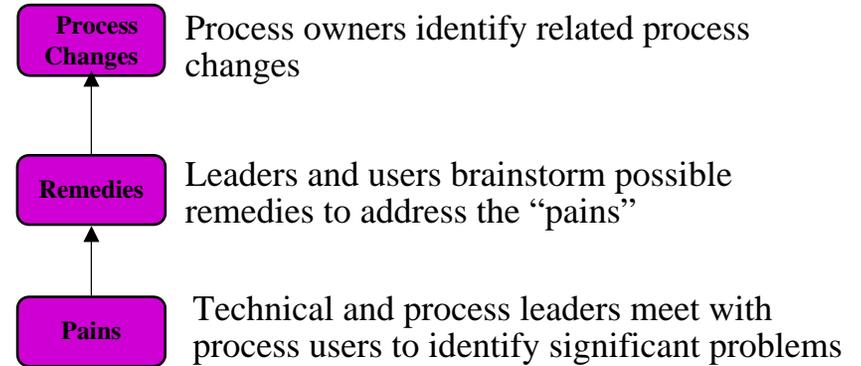


Examples:

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



Bottom Up



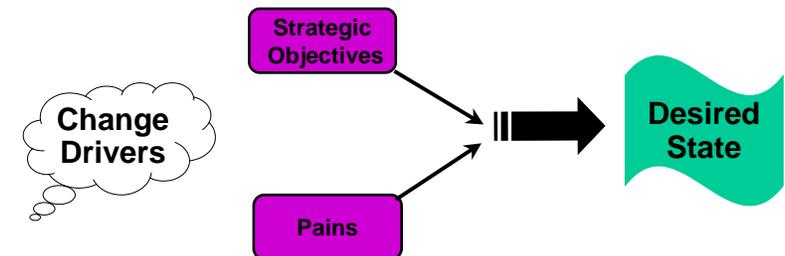
Pains



- ▶ 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





Case Study



- ▶ Small industry-leading company doing web-site development
- ▶ Rapid growth
- ▶ 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 - Present State



“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



What’s Your Opinion?



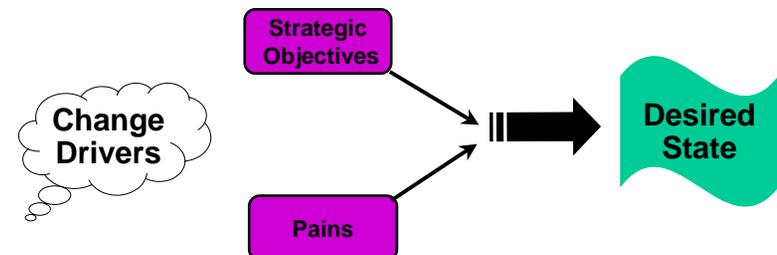
- ▶ Top Down?
- ▶ Bottom Up?
- ▶ ???



Case Study



- ▶ Combining a detailed list of “pains” with organization strategic initiatives enabled 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

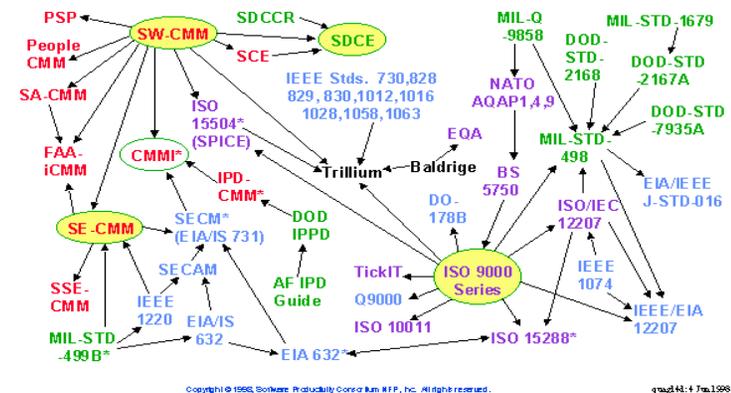
Process Goals:
 Increase predictability
 Reduce defects

Key Indicators:
 Cost/schedule variance
 Software failures in the field

Five Critical Questions

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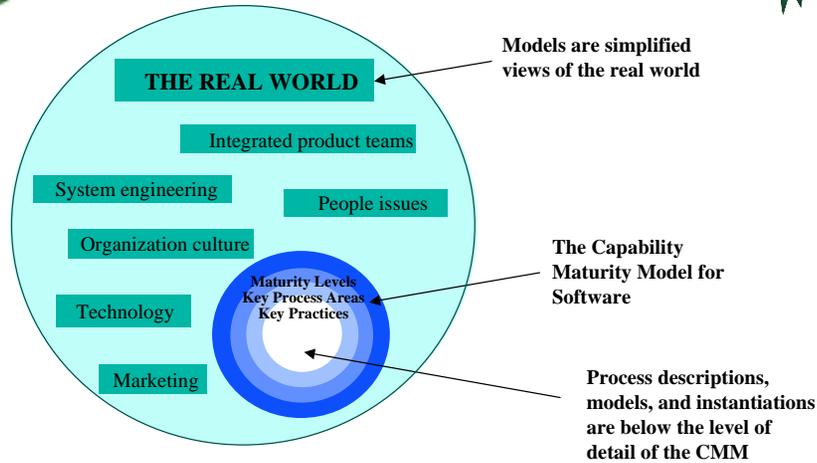
The Model Quagmire



Source: Software Productivity Consortium



“M” is for Model



“All models are wrong; some models are useful.”
Mark Paulk, SEI



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?



Domain of a Model



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

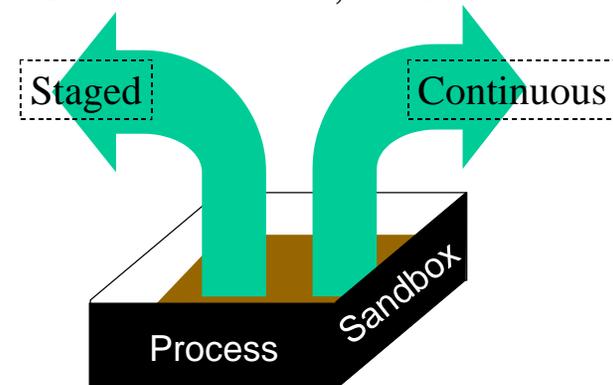
- CMMI
 - Software CMM
 - System Engineering CMM
- People CMM
- System Acquisition CMM



Model Architecture

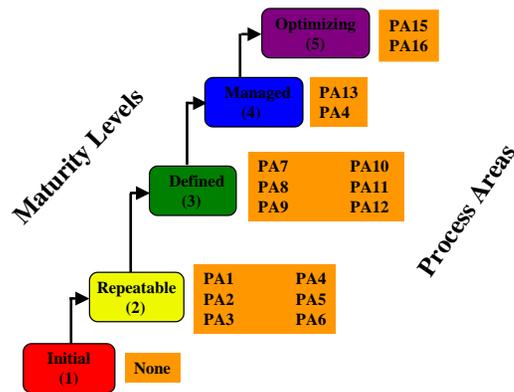


Same Processes, Two Models



Model Architecture: Staged

- ▶ Maturity levels have KPAs
- ▶ Provides clear road map for improvement



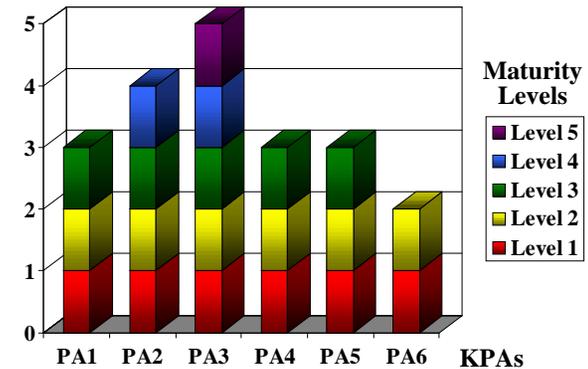
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Model Architecture: Continuous

- ▶ KPAs have maturity levels
- ▶ Provides broad picture of processes



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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**

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Some Models

- ▶ CMMISM-SE/SW (both staged and continuous)
 - system/software engineering
- ▶ SW-CMM[®] (staged)
 - software:
- ▶ SE-CMM (continuous)
 - system engineering
- ▶ People CMM[®] (staged)
 - people issues
- ▶ System Acquisition CMM[®] (staged)
 - buying agency issues

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CMM[®] is registered in the U.S. Patent and Trademark Office

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More Models



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



What's Your Opinion?



- ▶ CMMI?
- ▶ SW-CMM?
- ▶ SE-CMM?
- ▶ People CMM?
- ▶ ???



Case Study - Model



Business Goals:

- ▶ Increase predictability:
 - Reduce requirements creep
 - Develop estimating database
 - Use planning templates
- ▶ Reduce defects
 - Peer reviews
 - Testing

SW-CMM:
 RM
 PP/PTO
 PR
 SPE
 - 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



Five Critical Questions



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Method



- ▶ How you can quickly and effectively identify improvement opportunities?
- ▶ Is the assessment a Major Event or a Quick Look?



Assess Organization



Mentored Self Assessment

CBA-IPISM

Interim ProfileSM



SCESM

Mini-assessments



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 Outputs



▶ **FINDINGS**

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

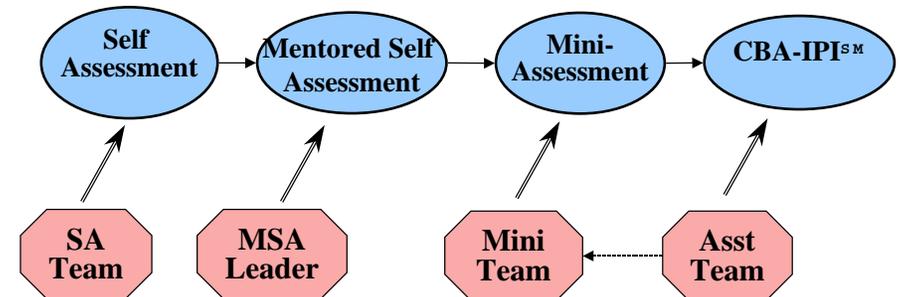
▶ **RECOMMENDATIONS**

- 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

Assessment Considerations

- ▶ Accuracy
- ▶ 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)

Assessment Framework



CMM Self Assessment

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

0-3	Weak
4-5	Fair
6	Partially satisfied
7	Satisfied with weakness
8	Satisfied
9-10	Outstanding

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



Interim ProfileSM



- ▶ 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-IPISM
 - 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/SCESM



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



Comparison



Type	Accuracy	Cost	Disruption
Self	Low	Low	Low
MSA	Fair	Low	Low
IntProf SM	Fair	Low	Low
Mini	Moderate	Moderate	Moderate
CBA-IP SM	High	High	High
SCE SM	High	High	High

* Values are the authors' estimates of accuracy, cost and disruption.



Assessment Conduct



- ▶ Assessment Project Life Cycle
 - Startup
 - Planning
 - Conduct
 - Wrapup
- ▶ Organization Action Planning



Assessment Workbooks



- ▶ Minimize preparation effort
- ▶ Increase consistency among assessment teams
- ▶ Separate workbook for each assessment type
- ▶ Provided in zipped files on central Lead Assessor library



Workbook Contents



- ▶ Training (refresher training, warmup exercises)
- ▶ Plans (incl. assessment agreement, daily schedule)
- ▶ Organization data (org/project questionnaire)
- ▶ Mini-teams (expl. questions, findings templates)
- ▶ Interviews (scripts, times, KPA assignments)
- ▶ Consolidation (wallchart templates, criteria)
- ▶ Findings (draft/final templates)
- ▶ Wrap-up (summary data, team member evaluations)
- ▶ SEI Submittal (LA requirements checklist, PAIS, feedback forms)



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



Principles for Action Planning



- ▶ Clear and unambiguous objectives
- ▶ Leadership by modelling desired behavior
- ▶ Incremental steps
- ▶ Measurement of progress
- ▶ Buy-in at all levels

Mogilensky and Manduke, The C.L.I.M.B. Principles of Process Improvement Action Planning



What's Your Opinion?



- ▶ CBA-IPI?
- ▶ SCE?
- ▶ Mini-assessment?
- ▶ Mentored Self Assessment?
- ▶ Self Assessment?
- ▶ Just ask people?



Case Study



- Want to quickly determine what changes might have the greatest impact toward achieving the improvement objectives:
- Increase predictability
 - Reduce defects



Case Study- Assessment



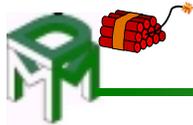
- ▶ A CBA-IPISM, while having the greatest accuracy and organizational impact, would be fairly expensive.
- ▶ A mini-assessment could be used to provide a “quick-look” to identify greatest weaknesses quickly and relatively inexpensively.
- ▶ A mentored self assessment was chosen as providing a reasonable amount of information at a low cost.



Five Critical Questions



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Managing Change



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



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 (30 action items)
 - 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 QA role
- ▶ Quality-defects/issues; issue tracking all the way through project; SQA audits
- ▶ Project start-up process
- ▶ SQA will mentor project managers on process
- ▶ Software development policy
- ▶ Define and assign roles
- ▶ Document existing practices
- ▶ Review industry materials to get a head-start on processes
- ▶ 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?



Reasons for Failure



- ▶ Failures in strategy:
 - Failing to define reasonable goals and plans.
 - Failing to tie the improvement goals to business objectives.
 - Having inadequate resources and unrealistic expectations.
- ▶ 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.
 - Over-focussing on a common solution - "Lets write a new standard development process."

Rick Hefner: "Top Ten Reasons Improvement Efforts Fail"



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.
 - Confusing institutionalization with standardization - a strong culture does not imply everybody does it the same way.
 - 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.



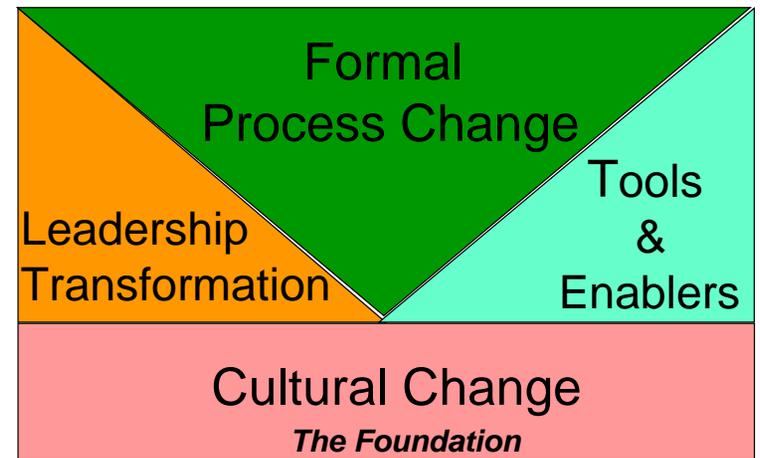
Lasting Change



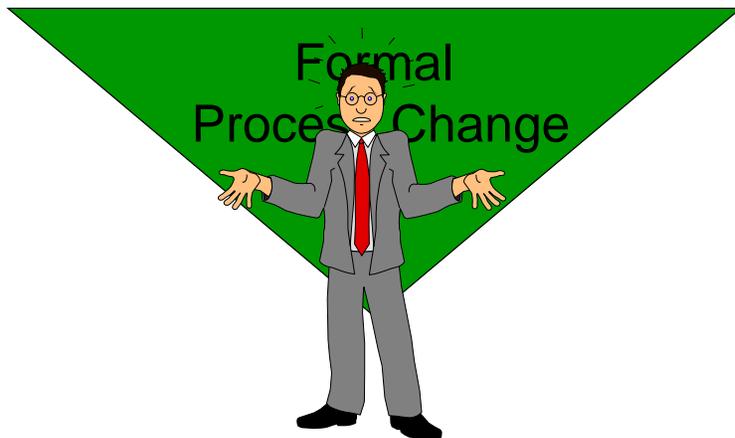
▶ Process improvement requires people in the organization to change their behaviors, and that requires attention to a whole range of organizational and cultural issues if process improvement is to be effective for the long term.



Process Supported by Culture



Process Without Culture



What Is Culture?



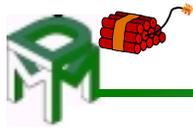
Culture has three layers:

communications (the visible aspects)

assumptions (the subconscious aspects)

expectations (desired results)

Kim Caputo: "Facilitating CMM Culture Change"



Cultural Assumptions



Culture has 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.

Kim Caputo: "Facilitating CMM Culture Change"

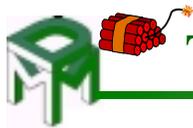


Cultural Change



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

Kim Caputo: "Facilitating CMM Culture Change"



The CMM and Culture



Key communications (the visible aspects)

Practices

assumptions (the subconscious aspects)
"not discussed"

expectations
(desired results)

Maturity Level Goals

Kim Caputo: "Facilitating CMM Culture Change"

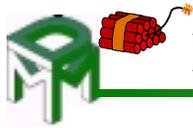


Example - Peer Reviews



- ▶ **Practices:**
 - Perform peer reviews to prevent downstream defect escapes
 - Plan and coordinate peer review activities
- ▶ **Expectations** - We use teams to review s/w work products so that the output of an activity meets the needs of downstream activities.
- ▶ **Assumptions** - One person can't track all the details, and error detection is more probable when the work is examined by more than one person.

Kim Caputo: "Facilitating CMM Culture Change"



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."

Kim Caputo: "Facilitating CMM Culture Change"

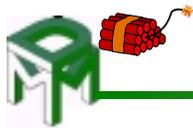


Process and Culture

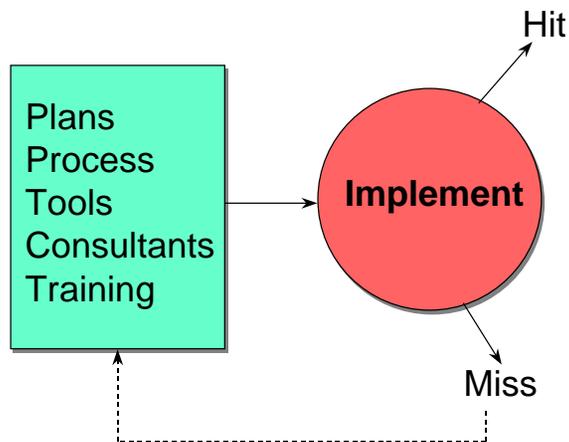


- ▶ Major changes to the software process must start at the top.
- ▶ Ultimately, everyone must be involved.
- ▶ Effective change requires a goal and knowledge of the current process.
- ▶ Change is continuous.
- ▶ Software process changes will not be retained without conscious effort and periodic reinforcement.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

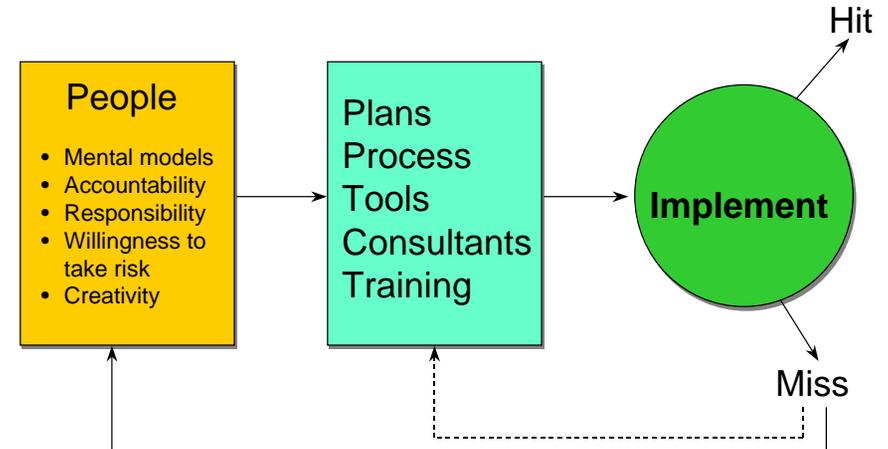
Watts Humphrey: Managing the Software Process



The Silver Bullet

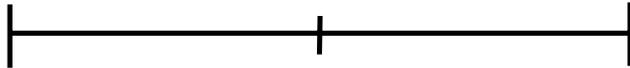


Leveraged Improvement Model



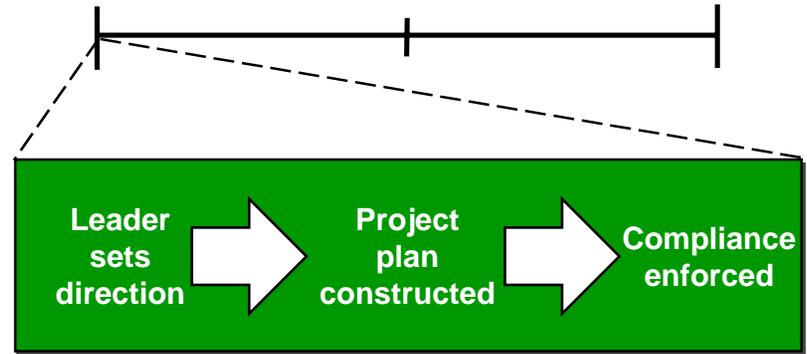
Managing Change Continuum

Mandated Approach Mediated Approach Managed Approach



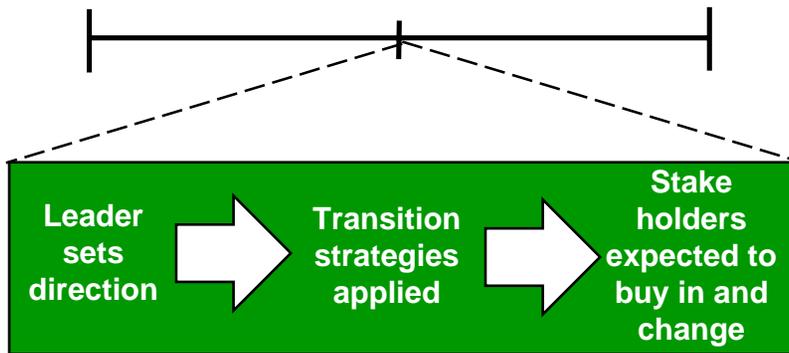
Mandated Approach to Change

Mandated Approach Mediated Approach Managed Approach



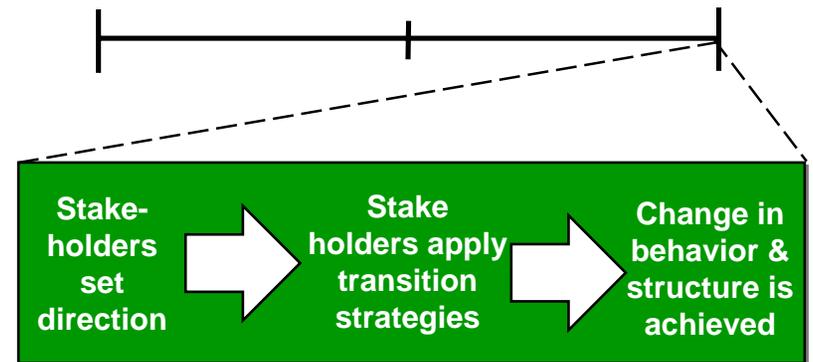
Mediated Approach to Change

Mandated Approach Mediated Approach Managed Approach

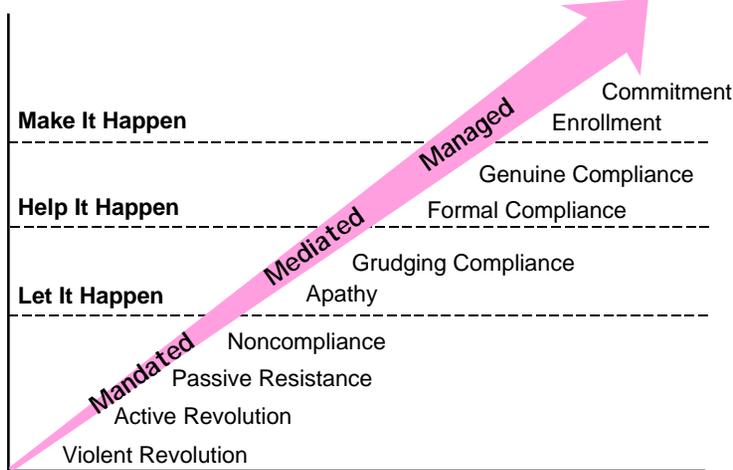


Managed Approach to Change

Mandated Approach Mediated Approach Managed Approach



Levels of Commitment

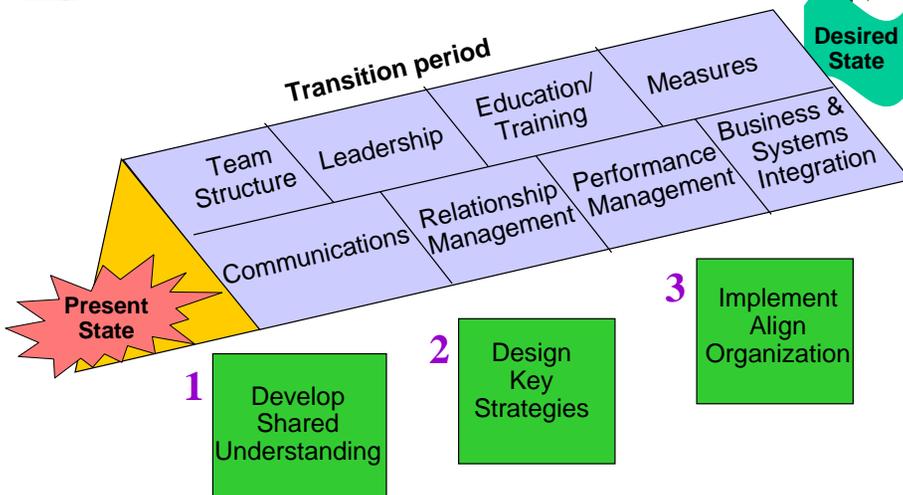


Peter Senge: The Fifth Discipline

Critical Issues

- ▶ Develop sponsorship
- ▶ Manage the change
- ▶ Address transition issues
- ▶ Use a phased approach
 - Develop shared understanding
 - Design key strategies
 - Implement, align the organization
- ▶ Develop the change package

Transition Strategies



What's Your Opinion?

- ▶ Quick Fix?
- ▶ Culture Change?
- ▶ Forget it?



Case Study - Changes



Follow the implementing change process: determine the transition strategies that will be most effective in implementing new processes.

- ▶ Organizational Structure:
 - Establish a process improvement focal point
- ▶ Sponsorship:
 - Establish senior management reviews of SQA
- ▶ Education/Training:
 - Provide training on Project Workbooks
- ▶ Communications:
 - Develop Communication Plan



Case Study - Changes



- ▶ Business/Technology Process Integration
 - Develop standard project startup process
- ▶ Performance Management:
 - Include audits in project schedules
- ▶ Relationship Management:
 - Manage customer expectations re project performance
- ▶ Measures:
 - Establish and collect measures for size, effort, duration, defects, project success



Sponsorship



- ▶ Put senior management understanding before commitment.
- ▶ Put senior management commitment before assessment.
- ▶ Put assessment before improvement implementation.
- ▶ Document the current process before the improved one.
- ▶ Implement CMM ® Level n before Level n +1
- ▶ Implement basics on the projects before standardizing them across the organization.
- ▶ Provide Level 2 process support before Level 3 process support.
- ▶ Try out a new process before asking everyone to do it.

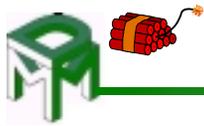
Darryl Davis, "On the Cart and the Horse: Putting Process Improvement Activities in the Right Order"



Team Structure: SEPG



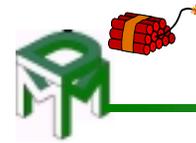
- ▶ Define a charter for the SEPG that is based on continuous long term process improvement
- ▶ Specify tasks and responsibilities other than assessment preparation
- ▶ Provide real authority to make a difference
- ▶ Involve working engineers



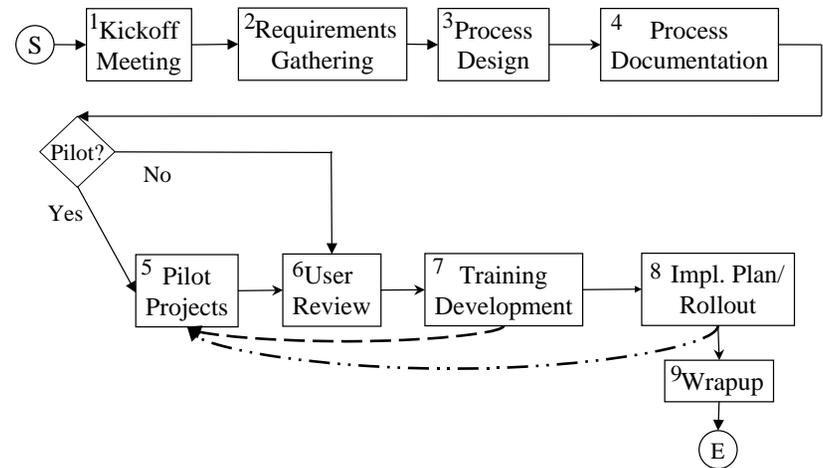
Team Structure: Process Action Teams



- ▶ Set up and use 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



Process Flow for Process Action Teams



Five Critical Questions



- MOTIVE - Why change?
- MODEL - Which model?
- METHOD - How to assess?
- MANAGING CHANGE - How to implement improvements?
- MEASURES - How to measure progress? 



Measure



- ▶ How can you measure the effects of process changes?
- ▶ What are the hidden dangers of measurement?

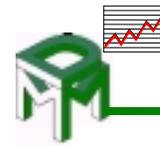


Evaluate Impact



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)

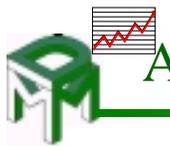


Starting Out With Metrics



Assumption:

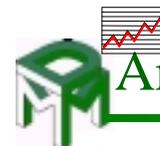
- ▶ If you are in this tutorial, you are probably a Level 1-2 organization
- ▶ Time is not on your side
- ▶ You need to show quick wins against your business goals
- ▶ Don't over-reach: create measures considering your current and next level



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?

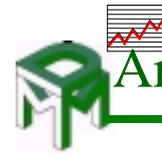


“Think of the organizational measurement system as the dials and indicators in an airplane cockpit. For the complex task of navigating and flying an airplane, pilots need detailed information about many aspects of the flight:

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

that summarize the current and predicted environment.”

Robert Kaplan and David Norton



Are the Measures Objective (2)



“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



Setting Up A Metrics Program



▶ Planning:

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

▶ Measurement implementation:

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

▶ Measurement program 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”

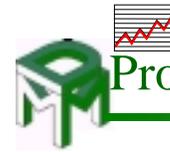


Quality Measures



- ▶ Customer Satisfaction
- ▶ Defect Quantities
- ▶ Defect Removal
- ▶ Delivered Defects
- ▶ Defect Severities
- ▶ Service Response Time
- ▶ Complexity

Capers Jones, "Software Measurement Programs and Industry Leadership"



Productivity and Schedule Measures



- ▶ Size Measures
- ▶ Activity-Based Schedule Measures
- ▶ Activity-Based Cost Measures
- ▶ Monthly Milestone Reports
- ▶ Annual Software Measurements

Capers Jones, "Software Measurement Programs and Industry Leadership"



Business and Corporate Measures



- ▶ Market Share
- ▶ Portfolio
- ▶ Competition
- ▶ Salary/Benefit Comparisons

Capers Jones, "Software Measurement Programs and Industry Leadership"



Goals-Questions-Measures



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?



The GQM Approach



- Step 1: Identify your business goals.
- Step 2: Identify what you want to know or learn.
- Step 3: Identify your subgoals.
- 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.



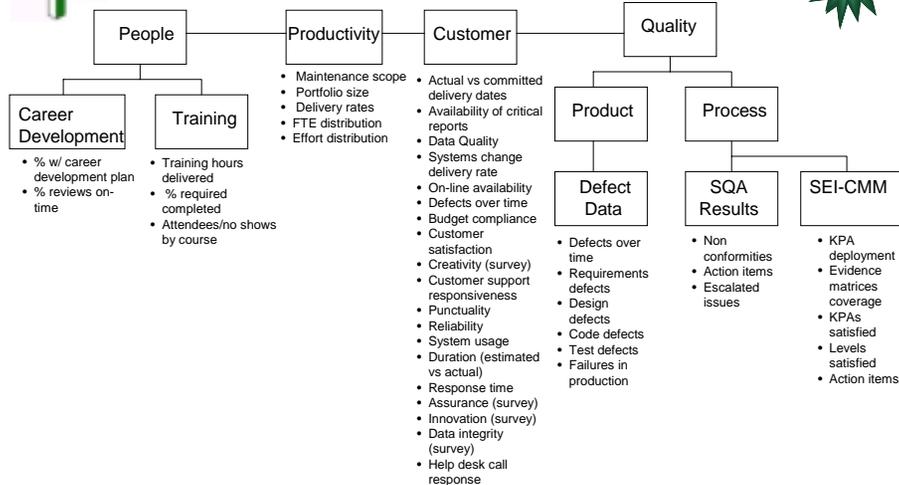
GQM Example



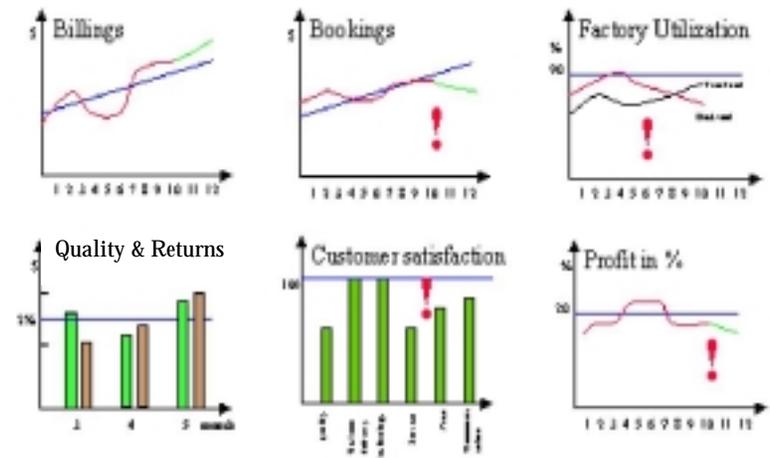
- ▶ What are our business goals?
 - **Improve customer satisfaction by reducing defects.**
- ▶ What do we want to achieve (measurement goals) in order to satisfy our business goals?
 - **Reduce post-delivery defects to “N” per KLOC**
- ▶ What questions will help us plan & manage progress toward our goals?
 - **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 ...**

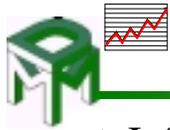


Goal-based Metrics



Dashboard





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)



Measurement Problems



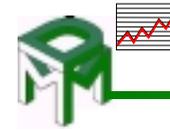
- ▶ “Nearly 80% of software measurement programs fail within the first two years.”
Goodman, “Practical Implementation of Software Metrics”
- ▶ Two problem areas:
 - Meaning: technical problems
 - Motivation: psychological problems



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 long 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.”

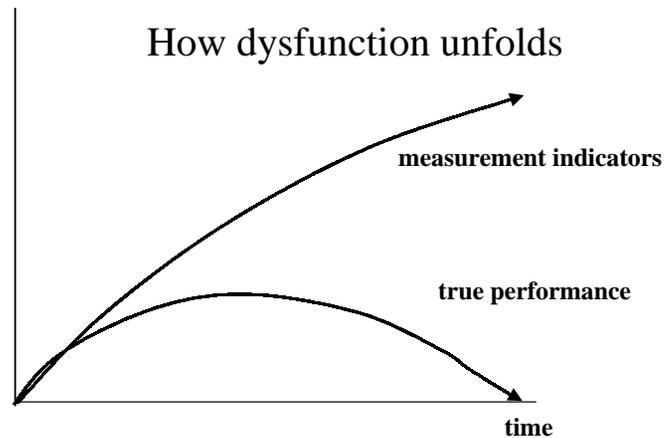
Austin, “Measuring and Managing Performance in Organizations”



Dysfunctional Measures



level of performance



Austin, "Measuring and Managing Performance in Organizations"

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Dysfunctional Measures



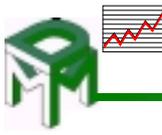
Traditional Examples:

- ▶ 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)

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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 Baldrige Award (is it sustainable?)

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Prevent Dysfunction



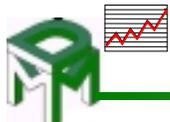
- ▶ Don't have the measures take the place of the underlying goals.
- ▶ Workers should be internally motivated; measurement should provide them with self-assessment information.
- ▶ Reinforce, don't enforce, human behavior.
- ▶ Watch out for opportunistic behaviors.
- ▶ Set solid objectives and plans.
- ▶ 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"

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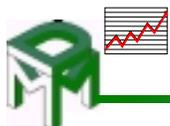
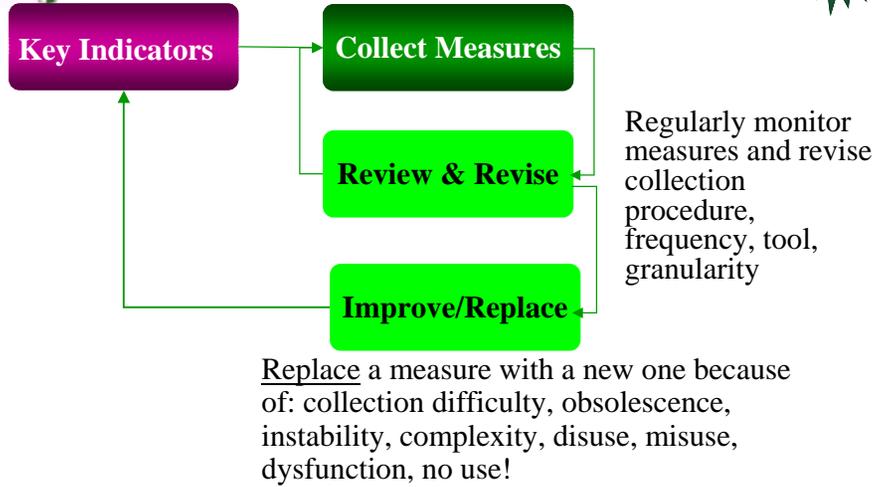
Evaluate Impact



- ▶ 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 "Set Direction" phase regularly and re-execute the model when necessary



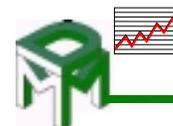
Continuously Improve Measures



Analyze and Report

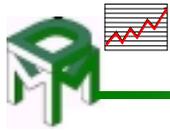


- | | |
|---------------------------|--------------------------------------------------------------------------------------|
| <u>Measures Analysis:</u> | <u>Action:</u> |
| Significant improvement | → Raise the (goals) bar |
| Steady improvement | → Stay the course |
| Steady decline | → Look for factors (sponsorship, resources, training, incorrect process or measures) |



Summary Report





Implementing A Software Measurement Program



- ▶ Have the decisions drive the measures.
- ▶ Interpret the measurement results in the context of other project information.
- ▶ Integrate software measurement into the project management process throughout the life cycle.
- ▶ Use the measurement process as a basis for objective communications.
- ▶ Focus initially on project-level analysis software measurement principles

George Brobeck and Joyce Statz, "Practical Software Measurement"



Successful Measurement Secrets



- ▶ 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"



What's Your Opinion?



▶ 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*

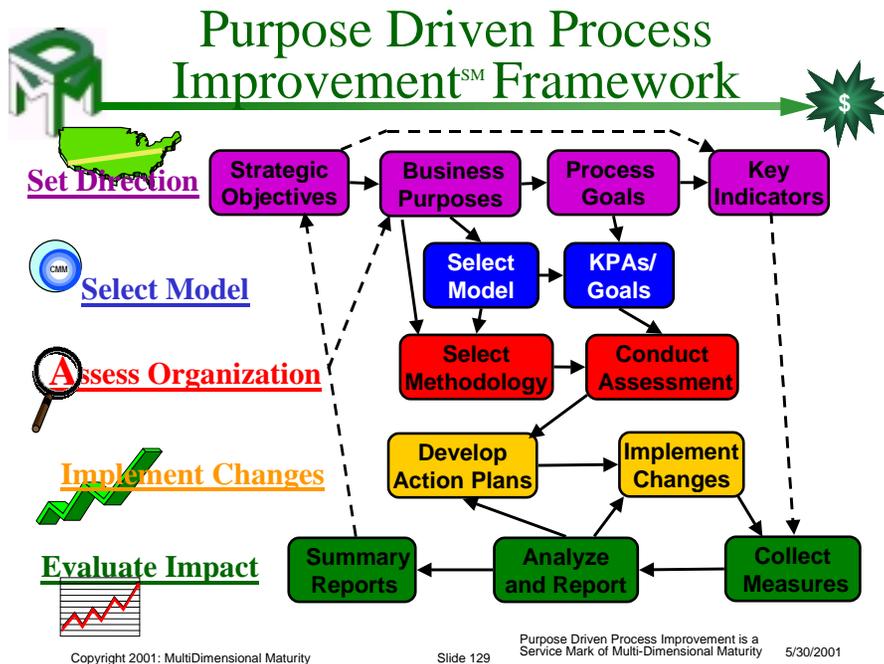


Tying It All Together



- MOTIVE - Why change?
- ↓
- MODEL - Which model?
- ↓
- METHOD - How to assess?
- ↓
- MANAGING CHANGE - How to implement improvements?
- ↓
- MEASURES - How to measure progress?





Some Final Thoughts

- ▶ Review dynamics of the system you've created and recognize patterns indicating potential problems
- ▶ Balancing Process with Delay - be conscious of normal delays in response to a goal and don't over-react with corrective action.
- ▶ Limits to Growth - resources or other constraints may slow growth after a period of great success.
- ▶ Shifting the Burden - use of tools or consultants to advance the organization may be substituted for really growing new project leaders and process knowledge.

The Fifth Discipline, Peter Senge

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Some Final Thoughts (2)

- ▶ Eroding Goals - priorities (e.g., Y2K or key projects) shift resources away from continuous process improvement; using the CMM to reach a "Level" instead of to support business goals.
- ▶ Escalation - A's success is dependent on being ahead of B, and vice versa, leading to continuous competition; balance marketing/sales promises with actual process capability and quality.
- ▶ Success to the Successful - revenue producers drive resource allocations and sometimes limit process improvement.

The Fifth Discipline, Peter Senge

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Some Final Thoughts (3)

- ▶ Tragedy of the Commons - a limited common resource (e.g., subject matter experts) gets used up because each individual is maximizing his own goals.
- ▶ Fixes that Fail - focussing on short term goals can have deleterious long-term effects.
- ▶ Growth and Underinvestment - growth approaches a limit which can only be overcome by investing in additional capacity; investment resources may not be readily available.

The Fifth Discipline, Peter Senge

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Case Study - Changes



Follow the implementing change process: determine the transition strategies that will be most effective in implementing new processes.

- ▶ Organizational Structure:
 - Create a combined SEPG/SQA group
 - Train them, use their leveraged resources to:
 - define process changes
 - follow up on implementation
- ▶ Sponsorship:
 - Educate leaders first and get them on board, including the marketing team that drives Engineering Change Requests (ECRs)
 - Have leaders model the expected behaviors
 - Make sure leaders monitor team progress



Case Study - Changes



More Transition Strategies:

- ▶ Education/Training:
 - Use Process Action Teams to develop training
 - Establish subject matter expert networks to coach and mentor
- ▶ Communications:
 - Establish process improvement bulletin board and monthly newsletter
 - Post organizational policies and distribute color copy to everyone
- ▶ Business/Technology Process Integration
 - Post process goals together with business goals
 - Integrate software engineering processes with Engineering Change Request process



Case Study - Changes



More Transition Strategies:

- ▶ Performance Management:
 - Add objective process improvement goals to leader incentives
 - Include software engineering process knowledge and skills in performance reviews
 - Start providing bonuses for “fire prevention”, avoiding weekend fixes
- ▶ Relationship Management:
 - Share process improvement plans with marketing and long-time key customers
- ▶ Measures:
 - Determine baselines for ECR turnaround time
 - Break down the process and measure the parts
 - Establish objective process measurement goals