

ESTABLISHING A MEASUREMENT PROGRAM

ESTABLISHING A MEASUREMENT PROGRAM Guidelines from the SEL

The most important rule is to

Understand that software measurement is a means to an end, not an end in itself

Three key reasons for Software Measurement

Understanding Software

- Baseline models and relationships
- Key process characteristics

Managing Software Projects

- Planning and estimating
- Tracking actuals versus estimates
- Validating models

Guiding Process Improvement

- Understanding
- Assessing
- Packaging

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Understanding Software

The most important reason for measurement is to understand your business

How much are we spending on software development?

Where do we allocate and use resources throughout the life cycle?

How much effort do we expend specifically on testing software?

What types of errors and changes are typical on our projects?

How long will it take me to finish testing this software?

Is reliability a function of testing time?

Should I impose stronger testing standards?

...

So we need to build baseline models and relationships as a basis for all forms of understanding

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Understanding Software

Associated with whatever we want to understand are a set of characteristics that provide us with insights into achieving that particular goal

If we want to understand the cost of development

then key characteristics include:

- distribution of effort among development activities

- typical cost per line of code

- cost of maintenance

- hours spent on documentation

- computer resources required

- amount of rework expected

If we want to understand the reliability of our systems

then key characteristics include:

- number and classes of defects found

- how and when defects are found

- pass/fail rates for integration and system testing

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Managing Software Projects

Planning and estimating

Build models of relationships for key variables

Tracking actuals versus estimates

Track your progress in real time and compare to your baselines

Validating models

Learn how and when your models are changing so you can modify them

Focus on applying results rather than collecting data

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Guiding Process Improvement

The three basic steps are:

Understanding

Assessing

Packaging

Understanding and characterizing helps you understand where you are

Assessing involves learning what works and what doesn't

Packaging involves making what you have learned a part of your business

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Key Issue for Setting Up a Program

- Understand the goals
prioritize
- Understand how to apply measurement
multiple customers for the results
- Set expectations for change
measurement introduces change
- Plan to achieve an early success
show the investment is worth while
- Focus locally
gain should be to local organization
- Start small
let the scope evolve based upon success

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Key Issue for Setting Up a Program

- Organize the analysts separately from the developer
their goals and processes are different
- Make sure the measures apply to the goals
don't collect data for data's sake
- Keep the number of measures to a minimum
there is a real cost associated with measurement
- Avoid over-reporting measurement data
make the results as crisp and clear as possible
- Budget for the cost of the measurement program
include all costs in planning and tailor it to fit the goals and budget
- Plan to spend at least three times as much on data analysis and use as on
the data collection
the real payoff is in the analysis and use

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Costs

The cost of **data collection** should not add more than 2 percent to the software development or maintenance budget

includes completing forms, participating in interviews, attending training sessions and helping characterize project development

The **data processing** element of the measurement program may cost 3 to 7 percent of the total development budget

includes collecting, archiving, validating, and maintaining the measurement data

The cost of the **analysis** element of the measurement program ranges from 5 to 15 percent of the total project budget

includes design of studies, information analysis, project interaction, packaging

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Core Measures

Cost

reporting period dates

total effort

effort by development and maintenance activity

Errors

dates error reported and corrected

effort to isolate and correct the error

source and class of error

Process Characteristics

identification of programming language

indication of the use of significant processes

description of measurement study goals

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Core Measures

Project Dynamics

- changes to requirements
- changes to code
- growth of code
- predicted characteristics

Project Characteristics

- development dates
- total effort
- project size
- component information
- software classification

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Core Measures

- Collect effort data at least monthly, preferably weekly
- Clarify the scope of the effort collection (who, what, when, why)
- Collect defect data only for configuration controlled software
- Do not expect to measure error correction effort precisely
- Do not expect to find generalized, well-defined process measures
- Do not expect to find a data base of process measurements (check reports)
- Understand the high-level process characteristics
- Use simple definitions of life cycle phases
- Use lines of code to represent size
- Specify which software is to be counted

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Operation of a Measurement Program

Do not expect to automate data collection

Make providing data easy

Use commercially available tools

Expect measurement data to be flawed, inexact, inconsistent

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Example Goals: Understanding

Language Evolution Goal: Analyze the **project set** to **characterize** the **language usage trend** from the point of view of the **organization**

Measures: Project dates, sizes, and languages

Project Profiles Goal: Analyze the **project set** to **characterize** the **levels and trends of code reuse** from the point of view of the **organization**

Measures: Project dates, sizes, and percentage of reuse
Total effort on each project

Cost vs. Size Goal: Analyze the **project set** to **characterize** the **cost of reusing code** and the **cost of producing code levels** from the point of view of the **organization**

Measures: Project size, dates, reuse, and effort data

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Example Goals: Understanding

Effort Distribution Goals: Analyze the **project set** to **characterize** the **cost of each life-cycle phase** and the **characteristics of staffing profiles** from the point of view of the **organization**

Measures: Project phase dates, effort data, and developer activity data

Cost of Major Activities Goals: Analyze the **project set** to **characterize** the **cost of maintenance, documentation, quality assurance and configuration management** from the point of view of the **organization**

Measures: Developer activity data, effort, and software size

Defect Rate Goals: Analyze the **project set** to **characterize** the **average rate of uncovering defects**, the **defect rate in delivered software** and **which life-cycle phases yield the most defects** from the point of view of the **organization**

Measures: Project size, phase dates, and reported defects

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Example Goals: Understanding

Error Classes Goals: Analyze the **project set** to **characterize** the **what types of defects occur most often** from the point of view of the **organization**

Measures: reported defect information

Defects vs. size and complexity Goals: Analyze the **project set** to **characterize** the **relationship between defect rates and module size and complexity** from the point of view of the **organization**

Measures: Error reports by module, module size, and module complexity

Growth Rate Dynamics Goal: Analyze the **project** to **characterize** the **local rate of code production** from the point of view of the **organization**

Measures: Phase dates and weekly count of completed code

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Example Goals: Managing

Projected Cost, Scheduling, and Phases Goals:

Estimate cost, schedule, effort, and defects

Analyze the **project characteristics** to **predict** the **cost, schedule, effort, and defects** from the point of view of the **project manager**

Measures: Project size estimate, project characteristics, models, and relationships

Project Dynamics Goals:

Estimate cost, schedule, effort, and defects

Analyze the **project characteristics** to **predict** the **expected growth rate, change rate, and defect rate of source code** from the point of view of the **manager**

Measures: Project size estimate, project characteristics, models, and relationships

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Example Goals: Tracking

Tracking Code Production Goal: Analyze the **project code growth** to **track it against** the **estimated code growth** from the point of view of the **project manager**

Measures: Biweekly count of source library size, manager's updated-at-completion estimates

Tracking Software Change Stability Goal: Analyze the **project requirements and design changes** to **monitor/track** the **project stability** from the point of view of the **project manager**

Measures: Changes to source code and manager's predicted estimates

Tracking Staff Effort for Possible Replanning Goal: Analyze the **project staffing profile** to **monitor them for replanning** the **appropriate staffing profiles** from the point of view of the **manager**

Measures: Changes to source code and manager's predicted estimates

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Example Goals: Tracking

Tracking Test Progress Goal: Analyze the **project closed vs. open defect profiles** to **estimate** the **test progress** from the point of view of the **manager**

Measures: Failure report data and change data

Tracking Software Defect Quality Goal: Analyze the **project defect profiles** to **assess** the **defect quality** from the point of view of the **manager**

Measures: Defect report data, historical models, and size estimates

Checking if Cleanroom is being used Goal: Analyze the **project library code growth** to **check for** the **Cleanroom code growth characteristics** from the point of view of the **manager**

Measures: Project phase date estimates, completed source code, and historical models

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Example Goals: Guiding Improvement

Checking if Cleanroom is effective Goal: Analyze the **Cleanroom method as applied to several projects** to **evaluate it** with respect to **effort, effort distribution, software size, number of defects** from the point of view of the **organization**

Measures: Effort, effort distribution, software size, size growth, number and types of defects

Checking if Independent Validation and Verification is effective Goal: Analyze the **Independent Validation and Verification as applied to several projects** to **evaluate it** with respect to **cost and extra defects uncovered** from the point of view of the **organization**

Measures: Effort, number and types of defects

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Experience-Based Guidelines

Data collection should not be the dominant element of process improvement; application of measures is the goal

The focus of a measurement program must be self improvement, not external comparison

Measurement data are fallible, inconsistent, and incomplete

The capability to quantify a process or product with measurement data is limited by the abilities of the analysis

Personnel treat measurement as an annoyance, not a significant threat

Automation of measurement has limits