



Carnegie Mellon University
Software Engineering Institute

Software Engineering Measurement and Analysis Initiative

**Presentation at the
PSM Users Conference**

**July, 1998
Dave Zubrow
Software Engineering Institute**



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SEMA Strategy

**Develop and transition measurement
and analysis practices and techniques**

- provide guidance
- consult and collaborate

**Disseminate industry and government
data on software engineering practices
and innovations**

- conduct impact studies
- Software Engineering Information
Repository



Technology and Guidance Supporting Software Measurement

Goal Driven Software Measurement Course

- Getting started with software measurement and aligning measurement activities with organization goals and needs

SEI Handbook 96-002-HB

Quantitative Software Process Management

- Measuring for Process Management and Improvement

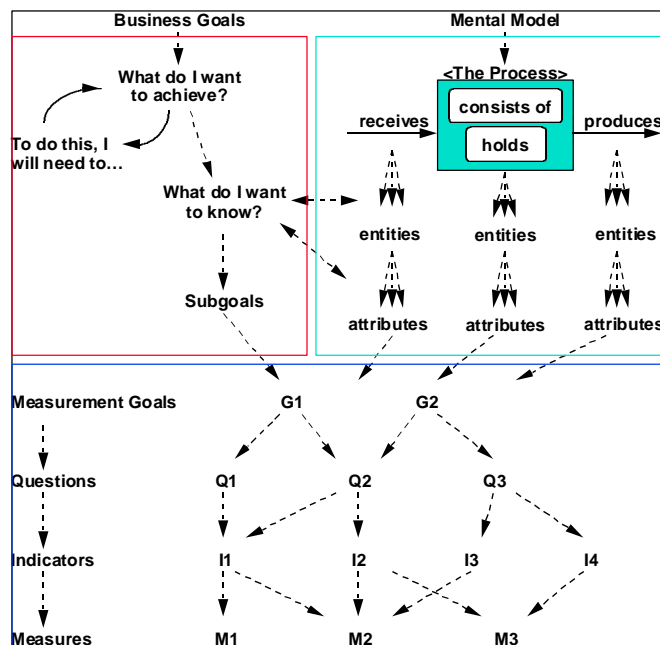
SEI Handbook 97-003-HB

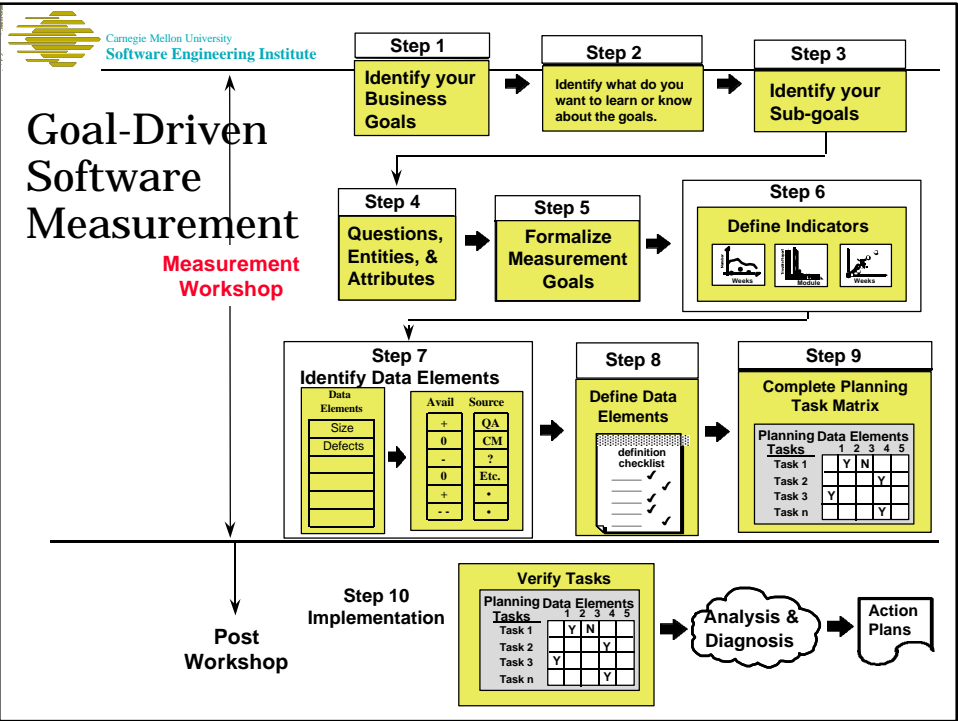


Business Goals define the Need

The Process provides the opportunity

Alignment is the Key





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What is IT Performance Measurement

Quantitative characterization of an *organization's* accomplishment of some *aspect* of its *goals* with a focus on the *contribution of IT*

- **quantitative** - need something more discriminating than success/failure, yes/no
- **organization** - focus is on the organization or enterprise view, not a specific project or program
- **aspect** - performance is multidimensional, what to measure is not obvious
- **goals** - for measurement to be meaningful, we need a reference point for comparison and judgement
- **contribution of IT** - attribution of performance to IT performance



A Balanced Perspective on Performance

Can improvement in one area be made without sacrificing another?

Financial
How do we look to shareholders?

Customer
How do customers see us?

A Balanced Perspective

Internal Business
What must we excel at?

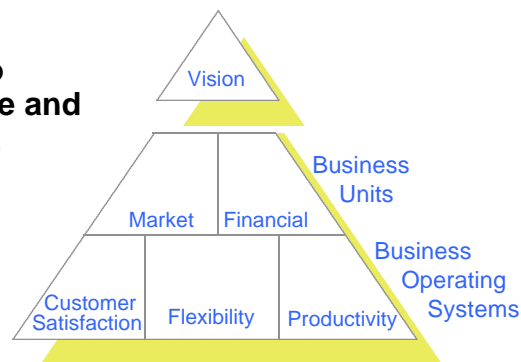
Innovation and Learning
Can we continue to improve and create value?

Watch out for masked trade-offs, unintended consequences

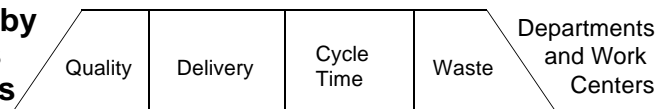


How are the data produced

Information used to assess performance and guide improvement



Data generated by work processes and transactions





Defining Performance Measures

Indicator Template

Measures

- Defects
- Cost of Quality
- Schedule Predictability
- Effort Predictability
- Cycle Time
- Maintenance Effort
- Project Mix
- Customer Satisfaction



INDICATOR TEMPLATE

Objective _____

Questions _____

Visual Display

Input(s)

Data Elements _____

Responsibility for Reporting _____

Form(s) _____

Algorithm _____

Assumptions _____

Interpretation _____

X-reference _____

Probing Questions _____

Evolution _____

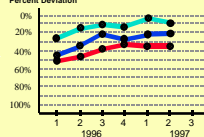


Enterprise Metrics

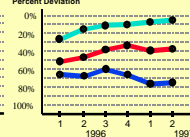
Project Size:

- Small
- Medium
- Large

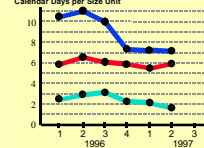
Schedule Predictability



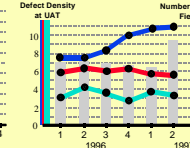
Effort Predictability



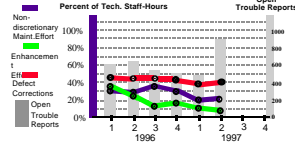
Cycle Time



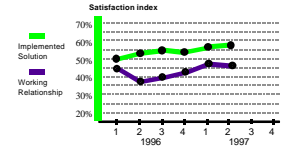
Quality



Maintenance Effort



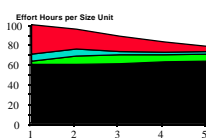
Customer Satisfaction



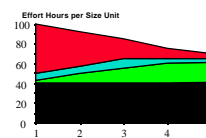
Cost of Quality:

- Rework
- Appraisal
- Prevention
- Performance

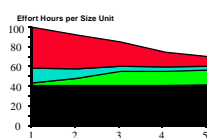
COQ - Large Projects



COQ - Medium Projects

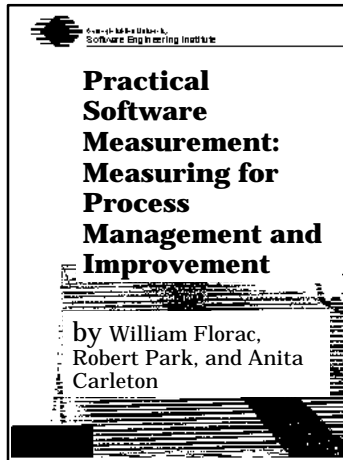


COQ - Small Projects





Quantitative Software Process Management



The Role of Measurement in Process Management

The Perspectives of Process Measurement

Planning Measurement for Process Management

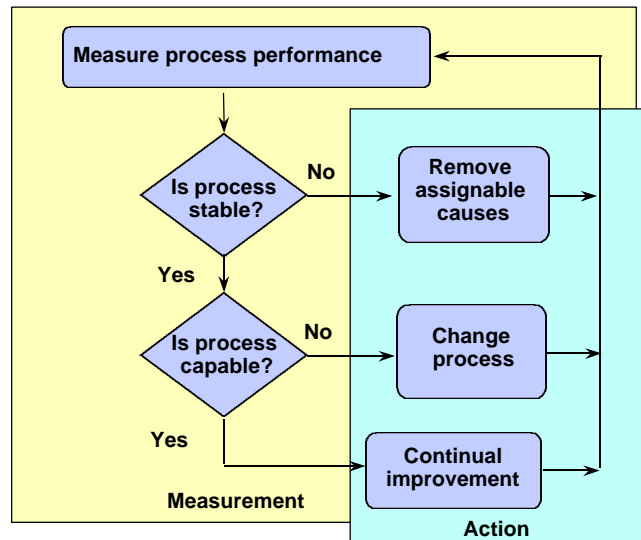
Applying Measurement to Process Management

More About Analysis and Use of Process Measures

Principles of Successful Process Measurement

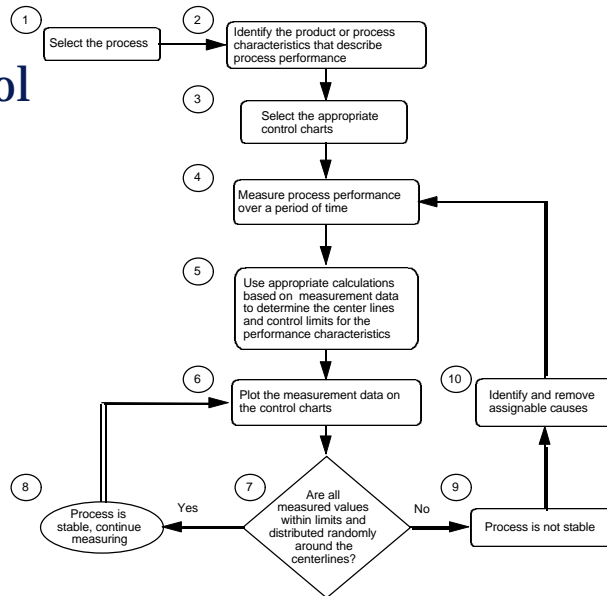


A Process Management Paradigm





Steps for Using Control Charts to Evaluate a Process



Proposed Next Steps in Guidance Development

**Integration of Goal-Driven Software Measurement
and PSM guidance**

Guidance on IT Performance Measurement

**Course on the Application of Statistical Process
Control to Software**



Technology Impact Studies

PSP

- **In-class effects**
- **In-practice effects**

CMM-based Software Process Improvement

- **Benefits study**
- **Transition study**

Product Line Practices

- **Benefits and transition study (underway)**

Measurement Program Success Factors (underway)



PSP Claims

The PSP was designed to improve performance in five key areas that are important from a business perspective:

- **size estimation accuracy**
- **effort estimation accuracy**
- **product quality (defect density)**
- **process quality (yield or early defect removal)**
- **productivity**



The First PSP Study: In Class Effects

Sample size

- 23 training classes
- 298 software engineers
- 300,000+ lines of code
- 15,000+ hours of effort

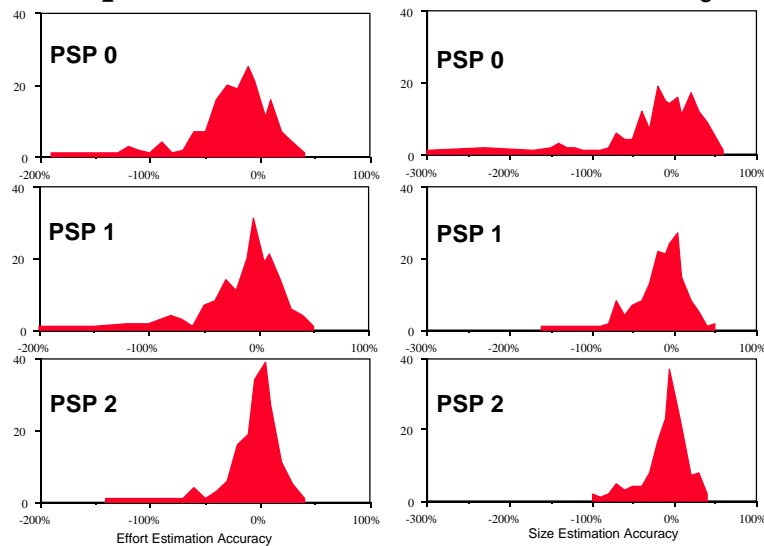
Data from project plan summaries

- estimated and actual effort by phase
- estimated and actual program size
- defect injection and removal by phase

Repeated measures analysis of variance

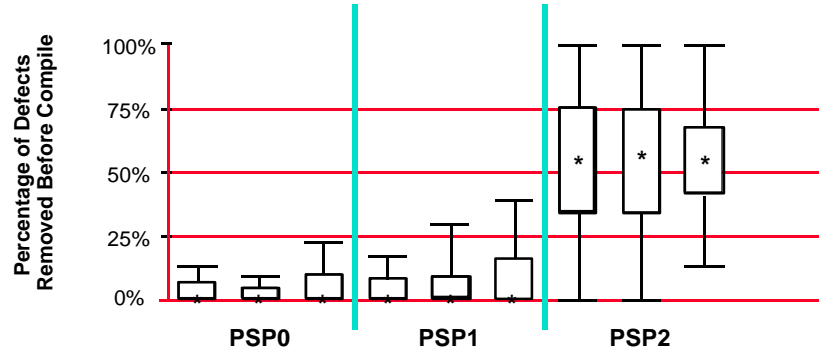


Improved Estimation Accuracy





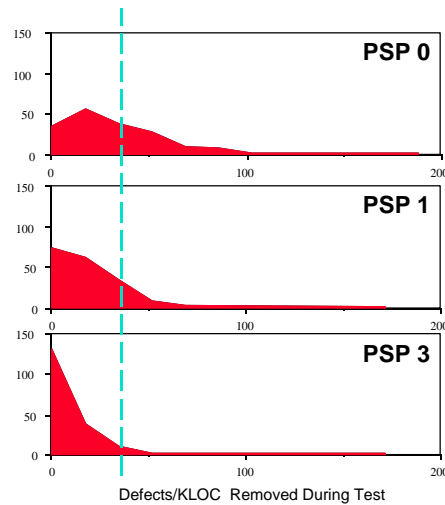
Improved Yield



Fewer Defects Remain in Compile

One defect per 30 lines of code is very common.

One defect per 30 lines of code is rare.





Conclusions of the First Study

During PSP training engineers experience

- significant improvements in estimation accuracy
- significant improvements in process quality
- significant improvements in product quality
- at no cost to productivity



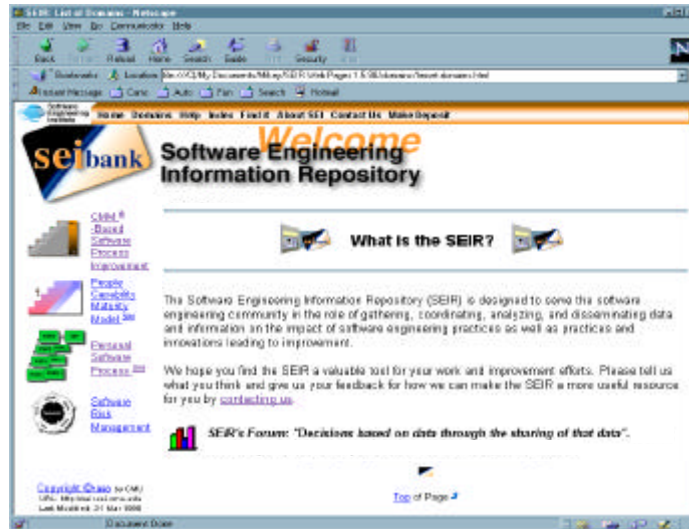
Second PSP Impact Study

We are currently working with early-adopter organizations.

- Preliminary results presented at 1998 SEPG conference.
- There are over 50 projects in the data set so far.
- Approximately 10 engineers have provided data for a benchmarking study.
- The next presentation of study results is planned for 1998 Software Engineering Symposium.



Software Engineering Information Repository



SEIR's Role:

The Software Engineering Information Repository (SEIR) is designed to serve the software engineering community in the role of:

- **Gathering**
- **Coordinating**
- **Analyzing**
- **and Disseminating data and information**

on the impact of software engineering practices as well as practices and innovations leading to improvement.



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Process Maturity Profile of the Software Community 1997 Year End Update

May 1998

We could not have produced this report without the support of those organizations and lead assessors who have returned their appraisal information to the SEI.

Our gratitude goes to them for their continued cooperation with our data gathering effort.

Software Engineering Measurement and Analysis Team

The Software Engineering Institute is a federally funded research and development center sponsored by the U.S. Department of Defense and operated by Carnegie Mellon University.
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Maturity Profile Outline

Introduction

Current Status

Community Trends

Organizational Trends

Summary



Introduction -1: Purpose and Source

Characterize the software process maturity of the software community

This briefing uses information from reports of Software Process Assessments (SPAs) and CMM[®] Based Appraisals for Internal Process Improvement (CBA IPIs)

• © CERT and CMM are registered in the U.S. Patent and Trademark Office.



Introduction -2: Data Description

SPAs and CBA IPIs conducted since 1987 through December 1997 and returned to the SEI by March 1998

- **980 assessments including 492 CBA IPIs**
- **782 organizations**
- **220 participating companies**
- **172 reassessed organizations**
- **4056 projects**

•Please refer to: Terms Used in this Report on page 29



Introduction -3: Report Contents

This briefing includes three primary sections:

Current Status

- Snapshot of the software community based on the most recent assessments of reporting organizations
- Only assessments since 1992

Community Trends

- Global distribution of assessments
- Growth in the number of assessments performed
- Shifts in the maturity profile over time

Organizational Trends

- Analysis of Key Process Area (KPA) satisfaction
- Time to move up in maturity



Current Status

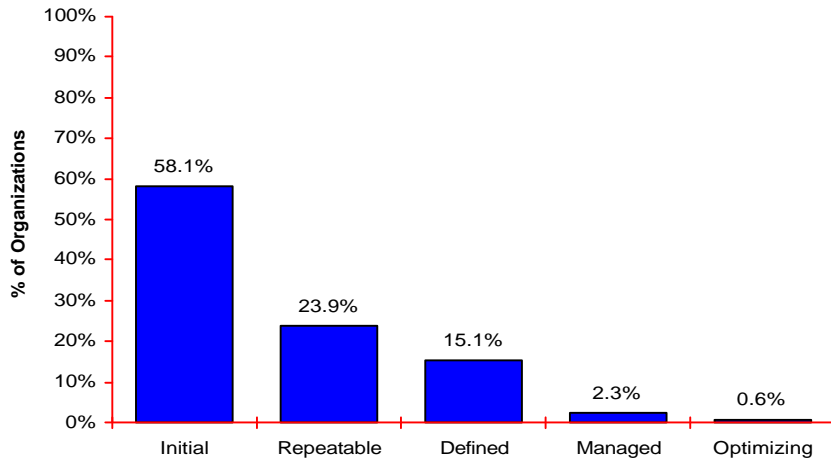
SPAs or CBA IPIs conducted from 1992 through

- **100** organizations
- **202** participating companies
- **3429** projects
- **22.9%** offshore organizations

- Please refer to: Terms Used in this Report on page 29



Organization Maturity Profile May 1998



Based on most recent assessment, since 1992, of organizations



Community Trends

SPAs or CBA IPIs conducted from 1987 through

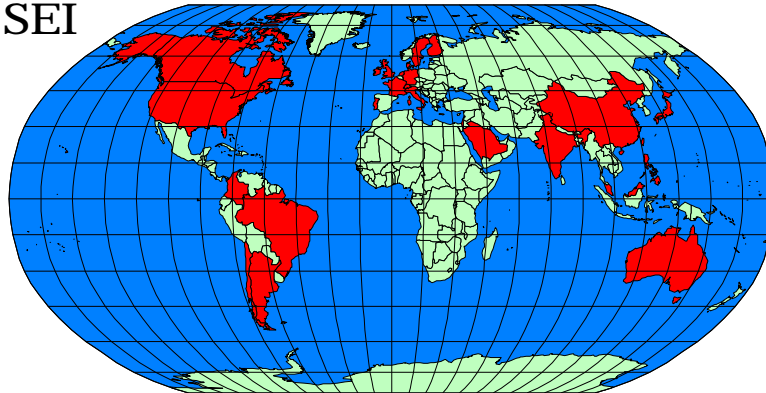
- assessments including CBA IPIs
- organizations
- participating companies
- reassessed organizations
- projects

• Please refer to: Terms Used in this Report on page 29



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Countries where Assessments have been Performed and Reported to the SEI

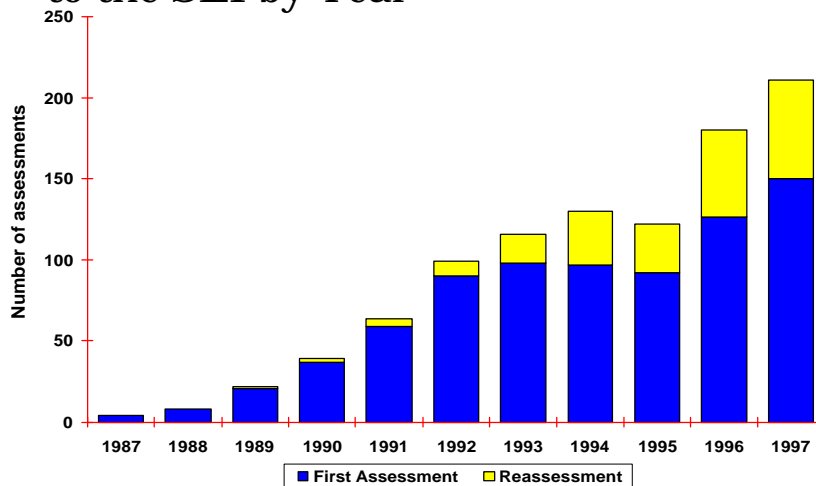


Argentina	Australia	Barbados	Brazil	Canada	Chile	China	Colombia
Denmark	Finland	France	Germany	Hong Kong	India	Ireland	Israel
Italy	Japan	Korea Dem. People's Rep.	Malaysia	Netherlands	Philippines	Portugal	Puerto Rico
Saudi Arabia	Singapore	Sweden	Switzerland	Taiwan	United Kingdom	United States	



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Number of Assessments Reported to the SEI by Year



Based on 980 assessments conducted through Dec. '97 and reported to the SEI by Mar. '98



Organizational Trends

SPAs or CBA IPIs conducted through

Key Process Area (KPA) profiles

- » satisfaction of all KPAs by maturity level for organizations assessed at levels 1 and 2

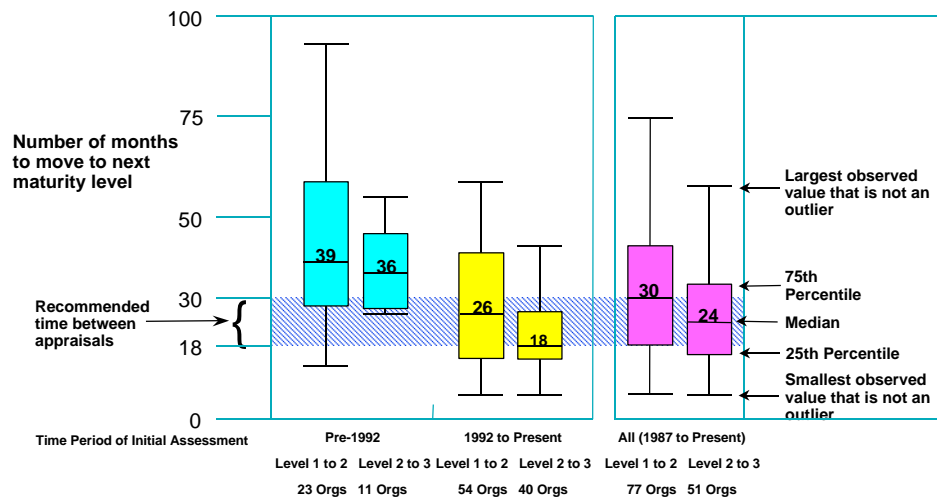
Reassessed organizations including CBA IPIs

- » accounting for assessments
- » although some organizations conducted multiple reassessments, only the first and latest assessments were used in creating the charts

•Please refer to: Terms Used in this Report on page 29



Time to Move Up





Interactive Numeric Analysis Maturity Profile - 1

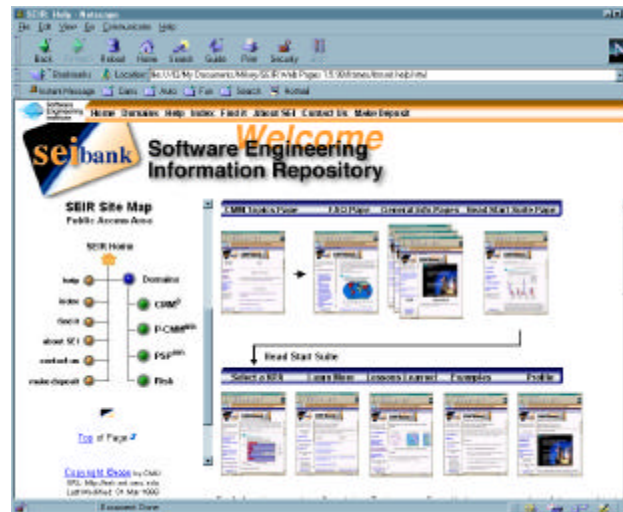


Database Driven Web Page Technology Maturity Profile - 2

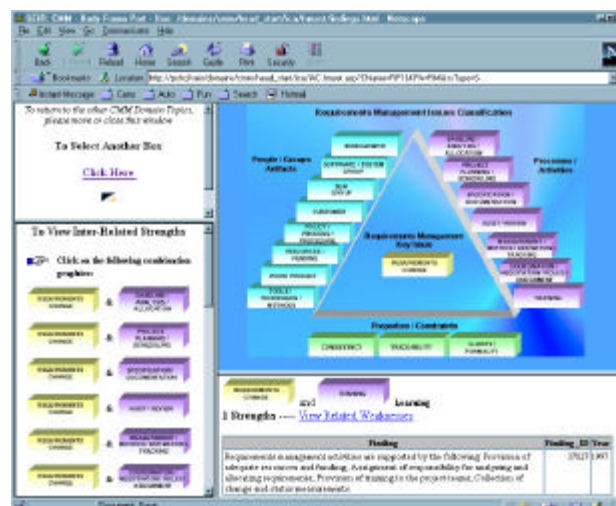




A Head Start for Improvement Efforts



Content Analysis of Key Findings from software process improvement





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Proposed Next Steps for the SEIR

Interface with PSM Insight

Incorporation of SEI Software Technology Review

Web-based Software Measurement Encyclopedia



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**Software Engineering
Information Repository**

**To register for a free account visit the
SEIR web site at:**

[HTTP://SEIR.SEI.CMU.EDU](http://seir.sei.cmu.edu)



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Summary

SEMA's Focus

- measurement guidance to enhance internal capabilities
- objective and credible information on improvement practices to accelerate the adoption of effective engineering practices

SEMA's Strengths

- diverse expertise
- experience in software measurement
- understanding of software improvement technologies
- strong analytical capability
- objective empirical validation



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For More Information

SEMA Web Site

<http://www.sei.cmu.edu/technology/measurement>

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