Measuring Acquisition Processes

What, You Mean I have to Measure?

Wolfhart Goethert
Matthew Fisher

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Purpose of Briefing

Discuss measurements of *acquisition* processes

Provide insight on the types of indicators and measurements that can be used for these processes
Why Measure Acquisition Processes?

Provide management visibility into software acquisition processes and practices

Identifies process improvement opportunities

Helps establish problem priorities

Provides a basis for orderly improvement efforts
What Acquisition Processes Should be Measured?

Successful application of (software) measurement depends on having well-established measurement goals.

“The data collection process must be driven by the . . . questions that we formulate based on our needs. In short, know what question is to be answered before collecting the data.”

—Juran
Topics

Background Information
- Trends in software acquisition
- What’s the problem?
- One solution – SA-CMM

SA-CMM® and Measurements
- Structure
- Template for Measurement & Analysis
- What should be measured
- Example Process and Product measures

Measures at an Organizational Level
- Balanced scorecard
- Methodology
- Example indicators

Summary
Trends 1

Software is pervasive throughout our society.

Demand for software-intensive systems has been growing consistently and steadily.

2000 Defense Science Board Study:

- There is tremendous growth in software content in both manned and unmanned systems.

- Software requirements now amount to the bulk of the overall specification requirements (65% for the B-2, 80% for the F-22).
Trends

However, there are widespread problems in projects involving software.

2000 Defense Science Board Study reported that:

- 53% of projects were late and over budget
- 16% were on time
- 31% were canceled before completion
What’s the Problem? 1

Studies indicate many problems are in managing the (software) acquisitions.

Software acquirers and software suppliers have a closely linked relationship.

“By regularly putting the development process under extreme time pressure and then accepting poor-quality products, the software user community has shown its true quality standard.”

[DeMarco 87]
What’s the Problem? 2

The studies have shown that:

The Acquirer ‘s management processes and practices and resultant decisions can negatively impact the software development processes of the Suppliers.
What Can Be Done?

Focus on improving the processes of the Acquirer

A process management maxim states that

The quality of a system is highly influenced by the quality of the process used to acquire, develop, and maintain it.

Under this maxim we could improve the processes and practices of the Acquirer by using a CMM-Based Process Improvement approach.

That is, develop and apply a CMM that focuses on improving software acquisition processes.

The SA-CMM is intended to fulfill this role
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Summary
SA-CMM Overview

The SA-CMM® is:

- a Capability Maturity Model (CMM) whose intended use, along with its associated training and appraisal methodology, is to help improve an organization’s software acquisition process

- a yardstick to benchmark an organization’s current process capability and performance

- focused inward to process and acquisition management

- applicable to systems and Information Technology (IT) acquisitions or any acquisition involving products and services
SA-CMM

The SA-CMM was developed to

- increase awareness of the criticality of software in an acquisition
- provide a model of key features for the process of acquiring software products and services

The SA-CMM is

- reflective of “best” processes in software acquisition
- able to provide quantifiable indication of capability based on maturity level.
# SA-CMM Key Process Areas

<table>
<thead>
<tr>
<th>Level</th>
<th>Focus</th>
<th>Key Process Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Optimizing</td>
<td>Continuous process improvement</td>
<td>Acquisition Innovation Management, Continuous Process Improvement</td>
</tr>
<tr>
<td>4 Quantitative</td>
<td>Quantitative management</td>
<td>Quantitative Acquisition Management, Quantitative Process Management</td>
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<tr>
<td>2 Repeatable</td>
<td>Basic project management</td>
<td>Transition to Support Evaluation, Contract Tracking and Oversight, Project Management, Requirements Development and Mgt. Solicitation, Software Acquisition Planning</td>
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<tr>
<td>1 Initial</td>
<td>Competent people and heroics</td>
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</table>
SA-CMM Structure

Maturity Levels

Key Process Area

Key Process Area

Key Process Area

Goals

Measurement & analysis

Activities

Commitment to perform

Ability to perform

Verification

Institutionalization

Features

Measurement & analysis
Standard Template for Measurement and Analysis

**Measurement 1:** Measurements are made and used to determine the **status** of the activities for <x> and the resultant products.

**Measurement 2:** Measurements are made and used to determine the **effectiveness** of the <x> activities and resultant products.

*(This measurement template is in Levels 4 and 5 only.)*

<x> represents the appropriate KPA oriented process.
What Should be Measured?

Acquisition Process

Status (Level 2-5)

Indicators

Effectiveness (Level 4-5)

Processes

Products

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</tbody>
</table>

**Higher Quality**

**Productivity**

**Lower Risk**

**Higher Risk**

**Rework**

**Requirements Development and Mgt.**
Requirements Development and Management (RDM) - Example

**Purpose:** To establish a common understanding of the software requirements by the acquisition project team, the end user, and the contractor.

Includes both technical and non-technical requirements.

Involves development of the requirements and management of any changes.

Starts with description of an operational need and ends with transfer of responsibility to the maintainer.
RDM Example

Operational or end user requirements → RDM → Requirements for Solicitation (product requirements)

Typical Process Activities

- Translation of operational or end user requirements into solicitation documentation (specifications)
- Baselining SW requirements
- Controlling all subsequent requirement changes
RDM - Measurement Opportunities

**RDM**

- **Development of Requirements**
- **Management of Requirements**

**Process Measures**

- Total Effort
  - Actual
  - Planned
  - Reporting
  - Periods

**Product Measures**

- Trouble Reports
  - Module
RDM - Process Measures - Status

RDM Sub-Process
- development of software related contractual requirements
- management of requirements

Typical Measures
- effort expended
- funds expended
- progress toward completion
- number of change requests appraised
- completion of milestones
RDM - Process Status Indicators

Effort Expenditure

Staff Availability

---

Cumulative Staff-hours

Cost Dollars

Actual

Planned

---

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<th>Reporting Periods</th>
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<td></td>
</tr>
<tr>
<td>High Grade</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Process Audit Results

Reason Codes

1. Documentation is missing, incomplete, ambiguous or erroneous.
2. Inadequate tools, facilities, or equipment to support the process.
3. Inadequate process training.
4. Required data is missing, incomplete, ambiguous or erroneous.
5. Process quality control gates do not exist or are not enforced.
RDM - Product Measures

Products
- requirements baseline
- RDM activities’ work products
- operational requirements documents (ORD)
- system specification
- change requests

Measures (used for tracking status)
- requirements added, deleted, modified
- changes to ORD
- severity and priority of defects in documents
RDM - Status of Requirements

Change requests by priority

Requirement stability by type of change
RDM - Status of Requirements

Status of “TBDs”

Type of Changes

Choice of indicators depends upon what you want to know.
RDM - Product Status Indicators

Quality of products

<table>
<thead>
<tr>
<th>Severity</th>
<th>Open</th>
<th>Closed</th>
<th>Open</th>
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<td>0</td>
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<td>13</td>
<td>8</td>
<td>6</td>
<td>47</td>
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Number of Deficiencies That Have Been Open x Days

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<tr>
<th>Severity Levels</th>
<th>x &lt; 30</th>
<th>30 &lt; x ( \leq 60 )</th>
<th>60 &lt; x ( \leq 90 )</th>
<th>x &gt; 90</th>
<th>Totals</th>
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<tbody>
<tr>
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<td>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>3</td>
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<tr>
<td>Severity 2</td>
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<th>Focus</th>
<th>Key Process Areas</th>
</tr>
</thead>
</table>
| 5 Optimizing | Continuous process improvement      | Acquisition Innovation Management  
Continuous Process Improvement                                              |
| 4 Quantitative | Quantitative management            | Quantitative Acquisition Management  
Quantitative Process Management                                      |
| 3 Defined   | Process standardization             | Training Program  
Acquisition Risk Management  
Contract Performance Management  
Project Performance Management  
Process Definition and Maintenance                                    |
| 2 Repeatable | Basic project management            | Transition to Support  
Evaluation  
Contract Tracking and Oversight  
Project Management  
Requirements Development and Mgt. Solicitation  
Software Acquisition Planning                                       |
| 1 Initial   | Competent people and heroics        |                                                                                  |
SA-CMM Measurement Summary

The choice of measures and indicators for the SA-CMM key process areas depend upon what you must know to give the acquisition manager insight into the related process activities.

Two useful measures for each KPA that can provide this insight are:

- compliance with defined processes
- status of activities against original plan
Topics

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Summary
A Balanced Scorecard Perspective on Performance

CUSTOMER
How do our customers see us?

FINANCIAL
How do we look to shareholders?

INTERNAL BUSINESS PROCESS
What must we excel at?

LEARNING and GROWTH
Can we continue to improve and create value?

Vision and Strategy

Source: A Management Guide for the deployment of strategic metrics, Raytheon
What Measures Should Be Taken?

Successful application of software measurement depends on having well-established measurement goals.

“The data collection process must be driven by the... questions that we formulate based on our needs. In short, know what question is to be answered before collecting the data.”

—Juran

[Rozum 92]
Methodology

Mission of Organization

Goals and Objectives

Balanced Scorecard
- Customer
- Financial
- Learning & Growth
- Internal Business Process

GQ(I)M

Indicators

- Trouble Reports
- Module
- Number
- Weeks
## Example Results

<table>
<thead>
<tr>
<th>Balanced Scorecard Dimension</th>
<th>Measurement Areas</th>
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<tbody>
<tr>
<td>Internal Business</td>
<td>• Availability and capability of resources</td>
</tr>
<tr>
<td></td>
<td>• Quality (deficiencies)</td>
</tr>
<tr>
<td></td>
<td>• Timeliness (on-time delivery, cycle time)</td>
</tr>
<tr>
<td></td>
<td>• Productivity</td>
</tr>
<tr>
<td></td>
<td>• Compliance with customer requirements</td>
</tr>
<tr>
<td>Innovation and Learning</td>
<td>• Improve quality (process, products, services)</td>
</tr>
<tr>
<td></td>
<td>• Improve communication</td>
</tr>
<tr>
<td></td>
<td>• Trend in employee satisfaction</td>
</tr>
<tr>
<td></td>
<td>• Enhance staff capability</td>
</tr>
<tr>
<td>Customer</td>
<td>• Quality of products</td>
</tr>
<tr>
<td></td>
<td>• Timeliness (% products delivered on time)</td>
</tr>
<tr>
<td></td>
<td>• Responsiveness (% compliant with req.)</td>
</tr>
<tr>
<td></td>
<td>• Communication</td>
</tr>
<tr>
<td></td>
<td>• Financial Control</td>
</tr>
<tr>
<td></td>
<td>• Resource availability and capability</td>
</tr>
<tr>
<td>Financial</td>
<td>• Effective financial controls</td>
</tr>
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</table>
Internal Business - Example 1

Open and Closed Deficiencies

<table>
<thead>
<tr>
<th>SEVERITY</th>
<th>PRIORITY</th>
<th>1</th>
<th>2</th>
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<tr>
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<td>2</td>
<td>3</td>
<td>4</td>
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</tbody>
</table>
Internal Business – Example 2

On Time Delivery

As of July 2001

Number of Projects

On Time

Weeks Late

0 5-1 0 0-1 1-2 2-3 3-4 4>

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Innovation and Learning - Example

Compliance with Requirements

Period 1: 10 projects (38%)
Period 2: 12 projects (44%)
Period 3: 15 projects (60%)

- Full compliance with requirements
- 95 - 80% compliance with requirements
- >80% compliant with requirements
Customer - Example

Delivery Dates

Number of Projects

As of July 2001

<table>
<thead>
<tr>
<th>Weeks Late</th>
<th>0-1</th>
<th>1-2</th>
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<tr>
<td>4+</td>
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Time to Fix “Show-Stoppers”

Number of Projects

As of July 2001

<table>
<thead>
<tr>
<th>Days</th>
<th>0-2</th>
<th>2-5</th>
<th>5-10</th>
<th>10-15</th>
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<tbody>
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Financial - Example

Expenses

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<tr>
<td>Misc.</td>
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- What’s the problem?
- One solution – SA-CMM

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➡️ Summary
Summary

Reliance on software to provide system functionality is increasing.

Projects involving software acquisitions typically experience cost overruns, schedule slippage, and failure to achieve performance goals.

Studies show these problems result in part from the Acquirer’s management of the acquisition.

The SA-CMM was developed to:
- increase awareness of the criticality of software in system acquisitions
- provide a model of features for the process of acquiring (software) products and services
- provide a model to instill discipline in the acquisition process.
- help process improvement.
Summary 2

The SA-CMM calls for measurement of key acquisition activities to aid the management of acquisitions.
Summary

At the project level:

The choice of measures and indicators for the SA-CMM key process areas depend upon what you must know to give the acquisition manager insight into the related process activities.

Two useful measures for each KPA that can provide this insight are:

- compliance with defined processes for the KPA
- status of activities against original plan for the KPA
Summary

At the acquisition organizational level:

A balanced score card approach can provide additional measures and indicators to support meeting the enterprise business needs.

Work is underway in applying the balanced score card approach to acquisition organizations.
Successful application of (software) measurement depends on having well-established measurement goals.

“The data collection process must be driven by the... questions that we formulate based on our needs. In short, know what question is to be answered before collecting the data.”

—Juran

Bottom Line

Make it simple and usable for acquisition project manager and the acquisition organization
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<th><strong>Contact Information</strong></th>
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<tr>
<td><strong>Name</strong></td>
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