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Measuring Acquisition Processes

What, You Mean I have to Measure?

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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

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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

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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 2

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.

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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
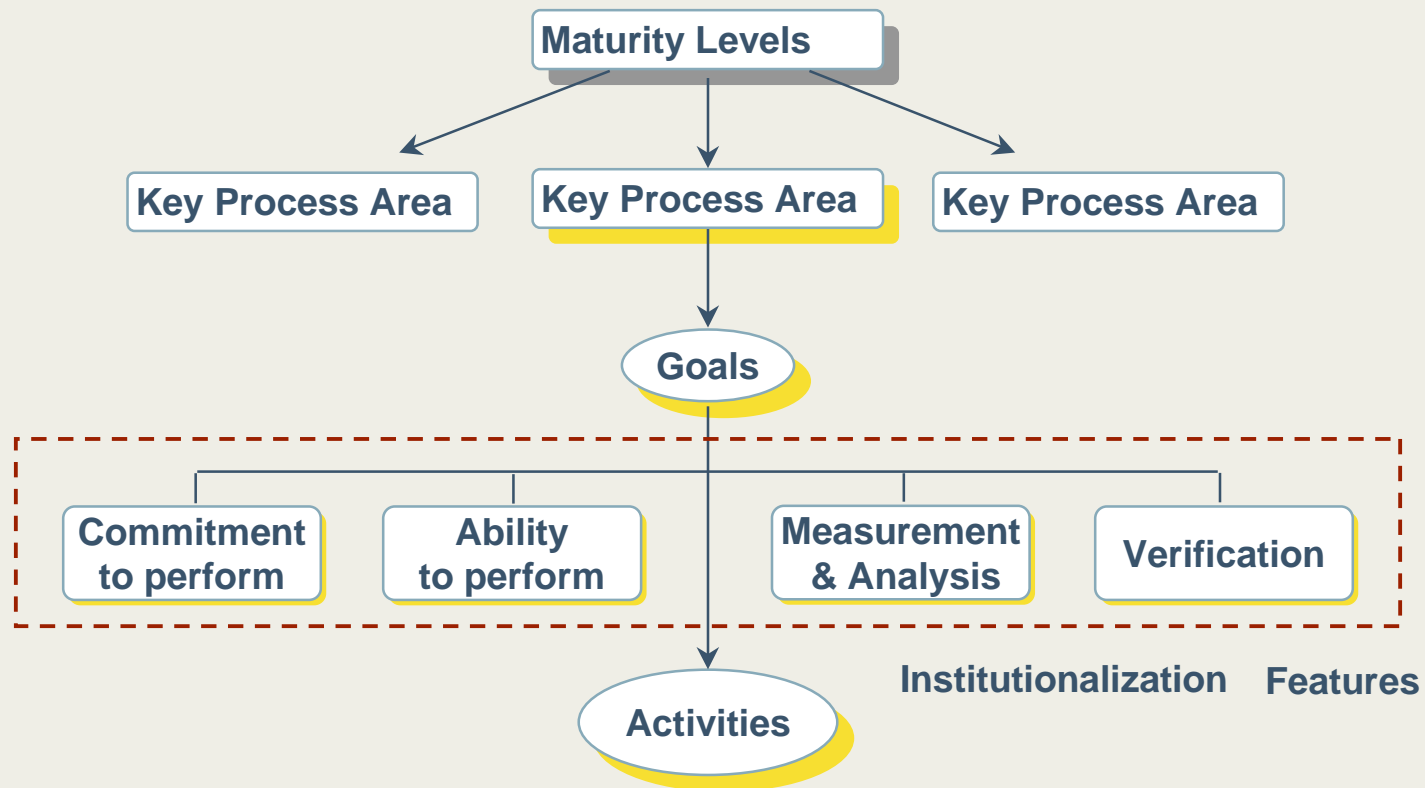
SA-CMM

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.
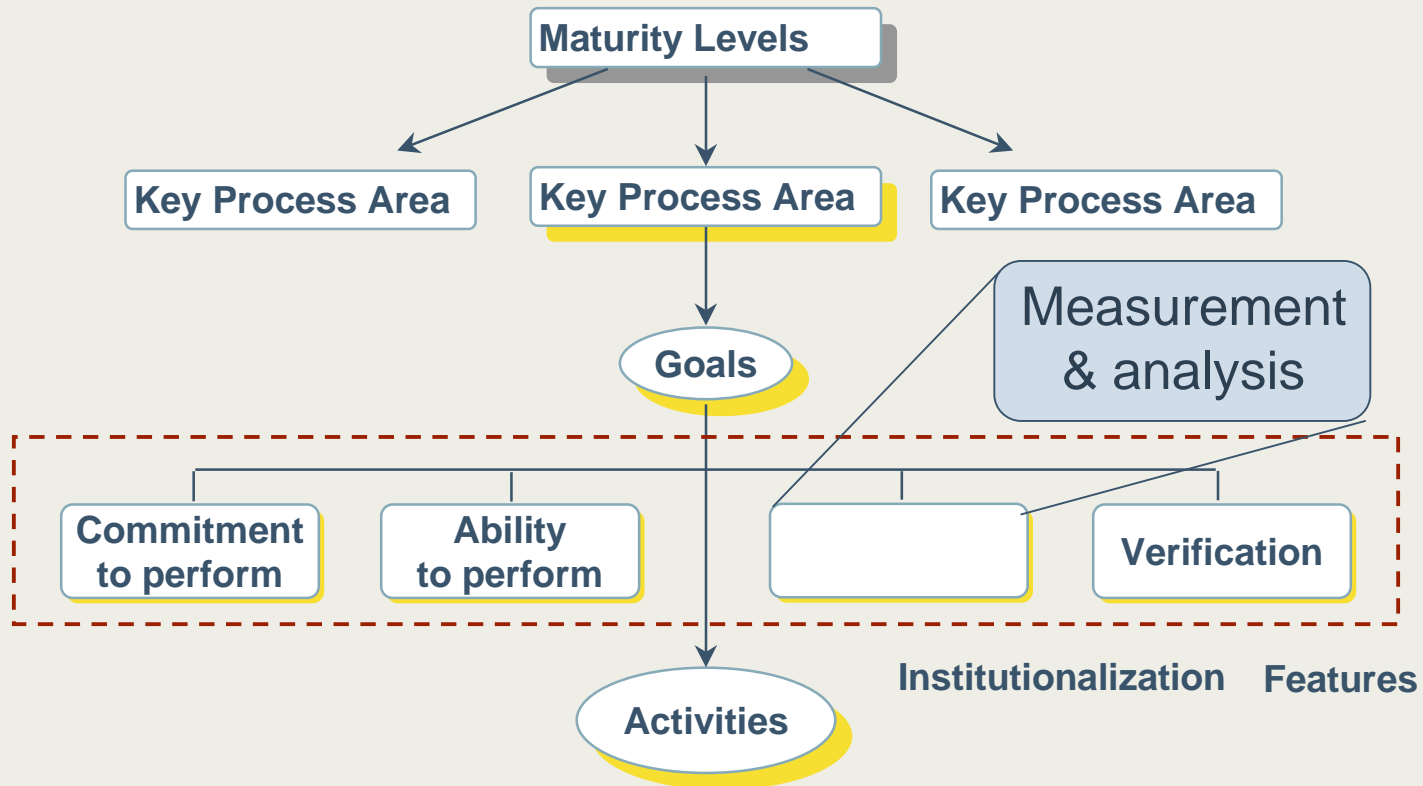
SA-CMM Structure

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Maturity Levels

Key Process Area   Key Process Area   Key Process Area

Goals

Commitment to perform   Ability to perform   Measurement & Analysis   Verification

Institutionalization   Features

Activities

SA-CMM Key Process Areas

Level	Focus	Key Process Areas	
5 **Optimizing**	*Continuous process improvement*	**Acquisition Innovation Management** **Continuous Process Improvement**	**Higher Quality Productivity** **Lower Risk**
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**	**Higher Risk** **Rework**
1 **Initial**	*Competent people and heroics*		

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SA-CMM Structure

Maturity Levels

Key Process Area | Key Process Area | Key Process Area

Goals

Measurement & analysis

Commitment to perform | Ability to perform | | Verification

Institutionalization Features

Activities

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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.
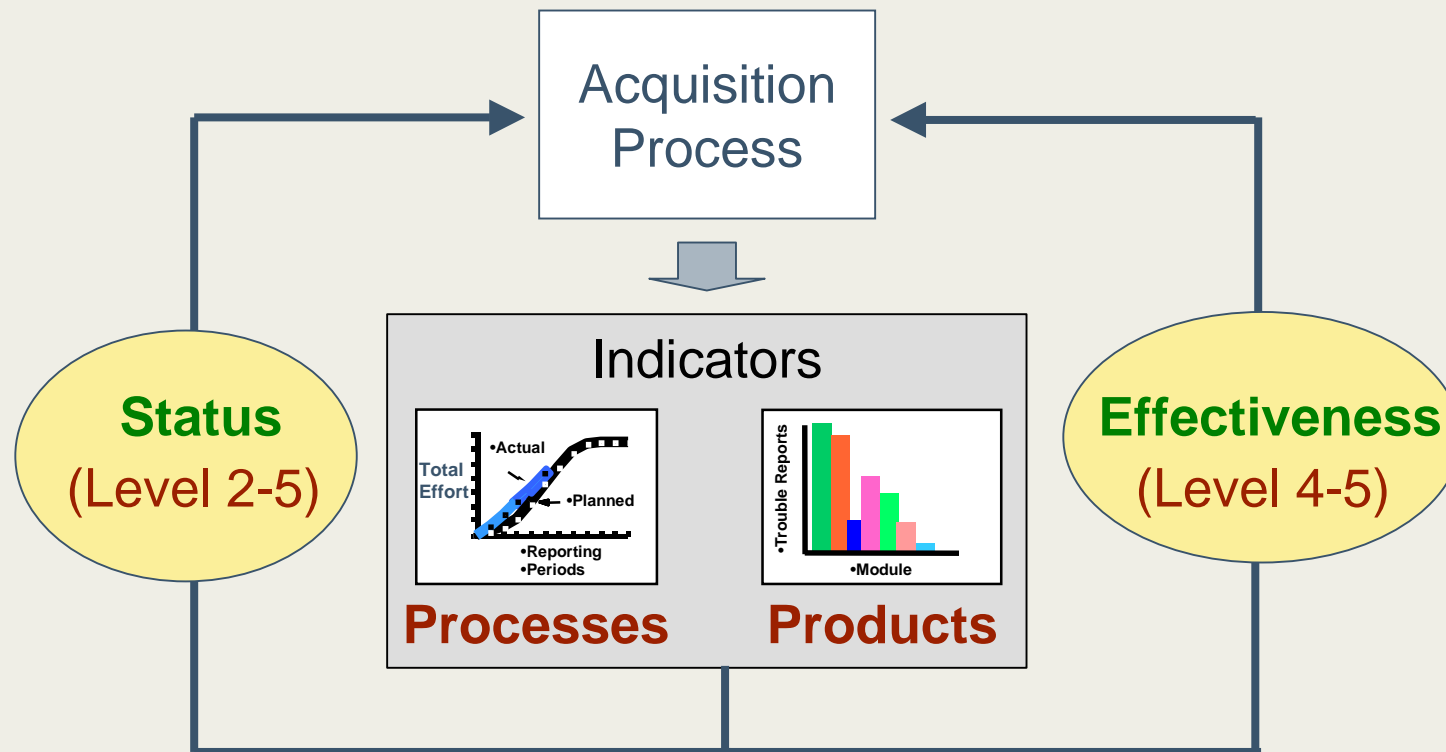
Measurement 2: Measurements are made and used to determine the **effectiveness** of the <x> activities and resultant products.
(This measurement template is in Levels 4 and 5 only.)

<x> represents the appropriate KPA oriented process.

What Should be Measured?

Acquisition Process

Indicators

Processes

Products

Status (Level 2-5)

Effectiveness (Level 4-5)

SA-CMM Key Process Areas

Level	Focus	Key Process Areas
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 Mainten
2 Repeatable	*Basic project management*	Transition to Support Evaluation Contract Tracking and Oversight Project Management Solicitation Software Acquisition Planning
1 Initial	*Competent people and heroics*	

Higher
Quality
Productivity
Lower Risk

Requirements Development and Mgt.

Higher Risk
Rework

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.
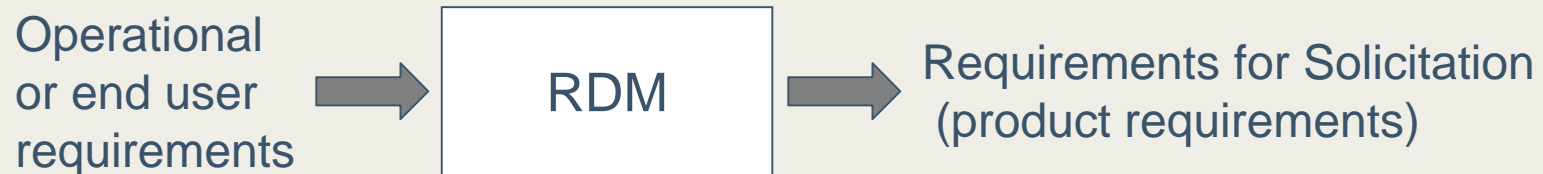
Includes both technical and non-technical requirements.

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.

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RDM Example

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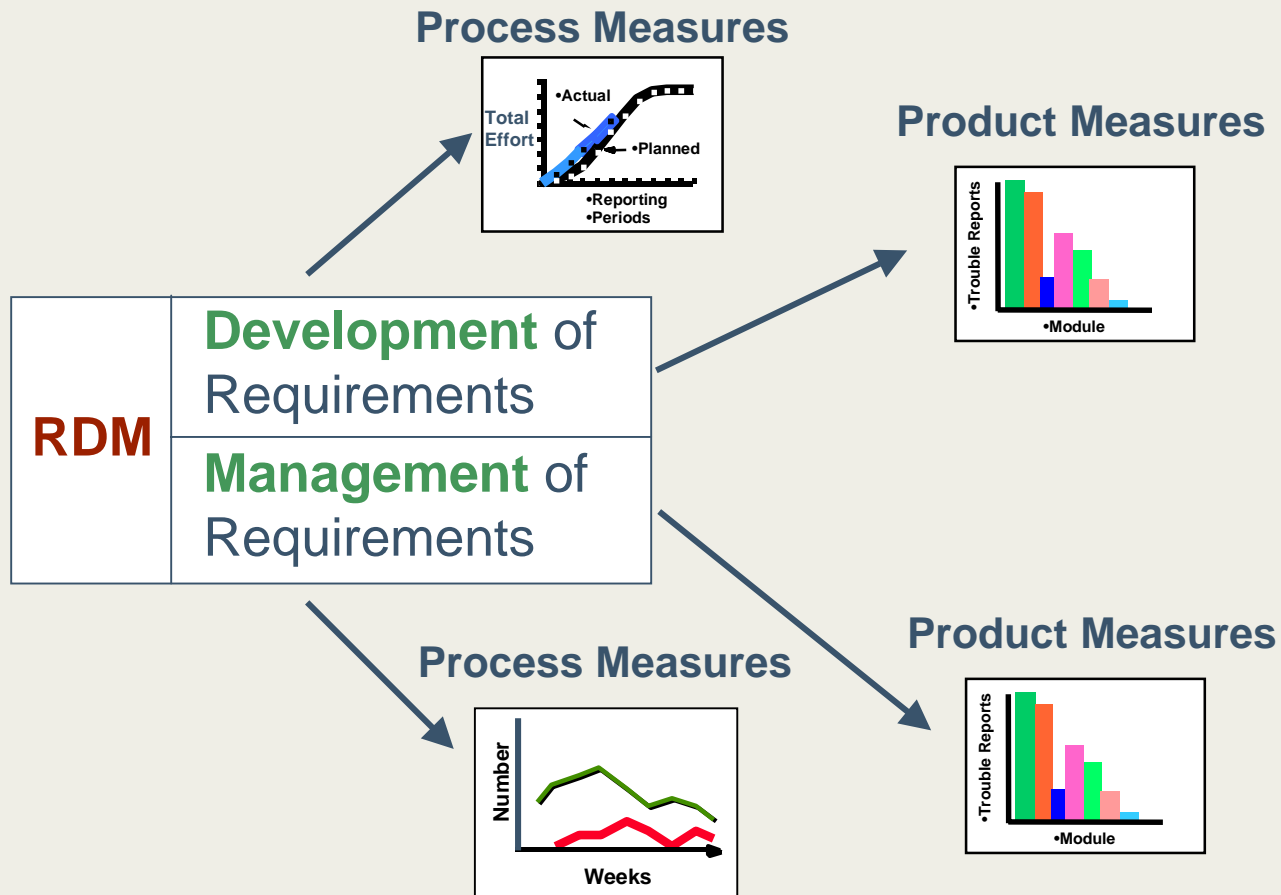(product requirements)

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

Process Measures

Product Measures

RDM
Development of Requirements
Management of Requirements

Process Measures

Product Measures

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RDM - Process Measures - Status

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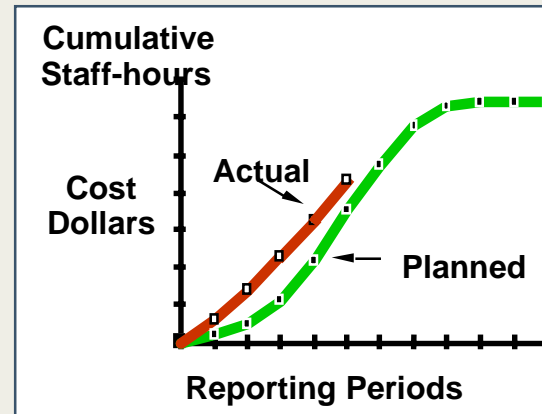- management of requirements

Typical Measures
- effort expended
- funds expended
- progress toward completion
- number of change requests appraised
- completion of milestones

RDM - Process Status Indicators

Effort Expenditure

Cumulative Staff-hours

Cost Dollars

Actual

Planned

Reporting Periods

Staff Availability

		Req.	Avail	Recruitment
Staff Type 1	**Entry**			
	Journeyman			
	High Grade			
Staff Type 2	**Entry**			
	Journeyman			
	High Grade			
Staff Type n	**Entry**			
	Journeyman			
	High Grade			

RDM - Process Compliance

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)
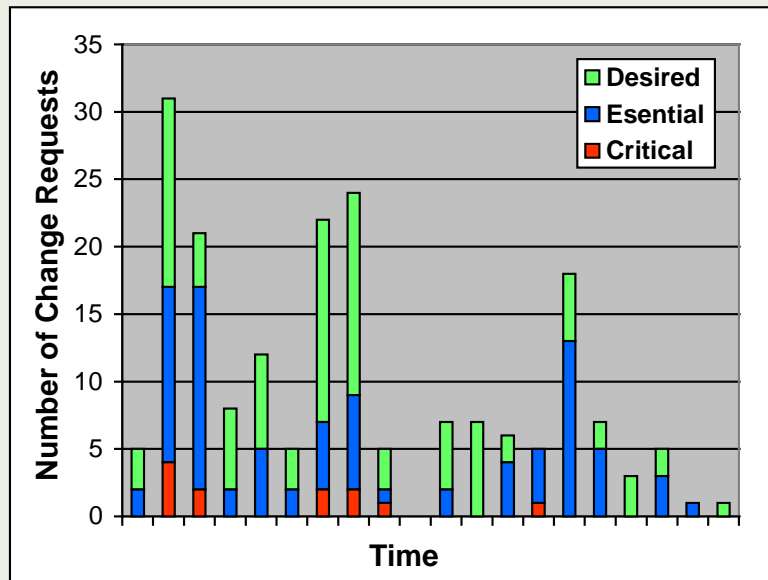- system specification
- change requests

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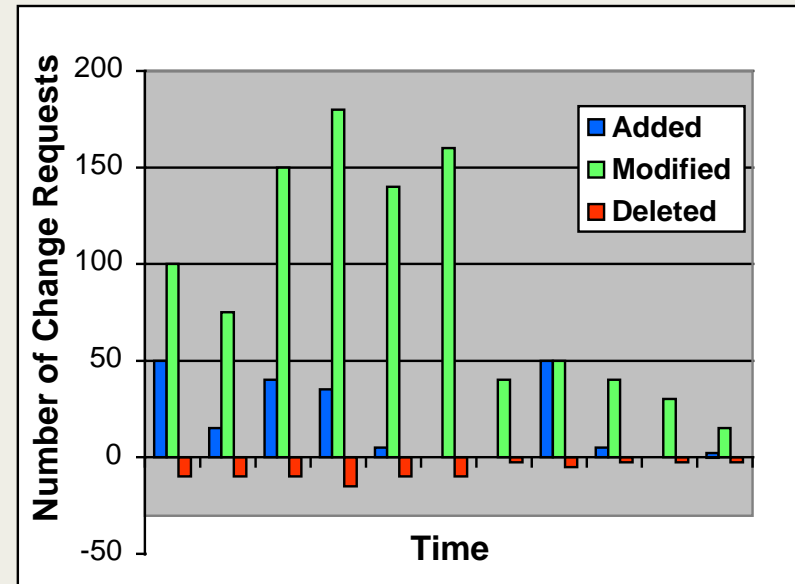- severity and priority of defects in documents

RDM - Status of Requirements [1]
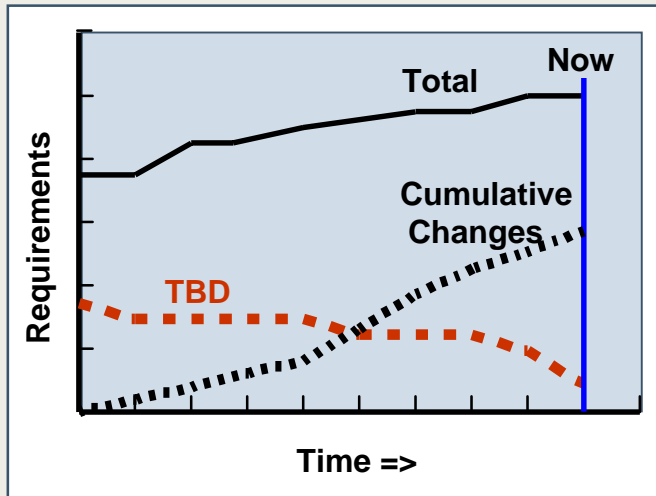
Change requests by priority

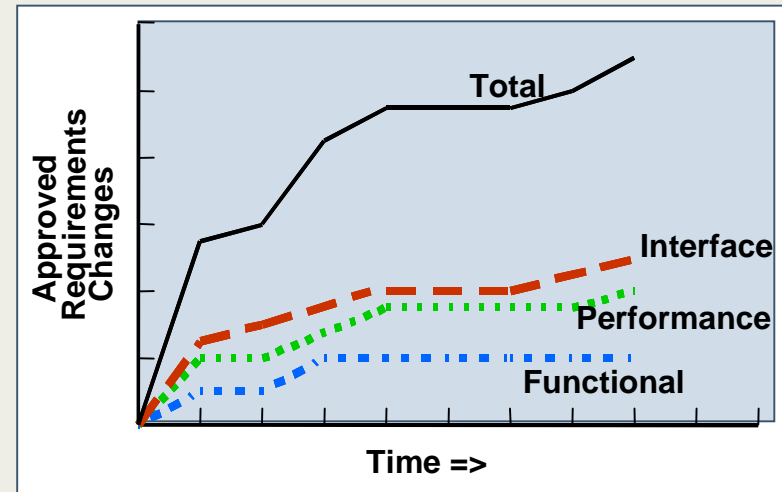## Requirement stability by type of change

RDM - Status of Requirements 2

Status of "TBDs"

Type of Changes

Choice of indicators depends upon what you want to know.

RDM - Product Status Indicators

Quality of products

Open and Closed Deficiencies						
	PRIORITY					
	1		2		3	
	Open	Closed	Open	Closed	Open	Closed
SEVERITY 1						
2						
3						
4						
5						

Severity Levels	Number of Deficiencies That Have Been Open x Days				Totals
	x < 30	30 < x ≥ 60	60 < x ≥ 90	x > 90	
Severity 1	2	1			3
Severity 2	3	1	1		5
Severity 3	3	2	1	1	7
Severity 4	4	3	3	2	12
Severity 5	8	6	3	3	20
Totals	20	13	8	6	47

SA-CMM Key Process Areas

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3 Defined	*Process standardization*	**Training Program Acquisition Risk Management Contract Performance Management Project Performance Management Process Definition and Maintenance**
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1 Initial	*Competent people and heroics*	

Higher Quality Productivity Lower Risk

Higher Risk

Rework

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

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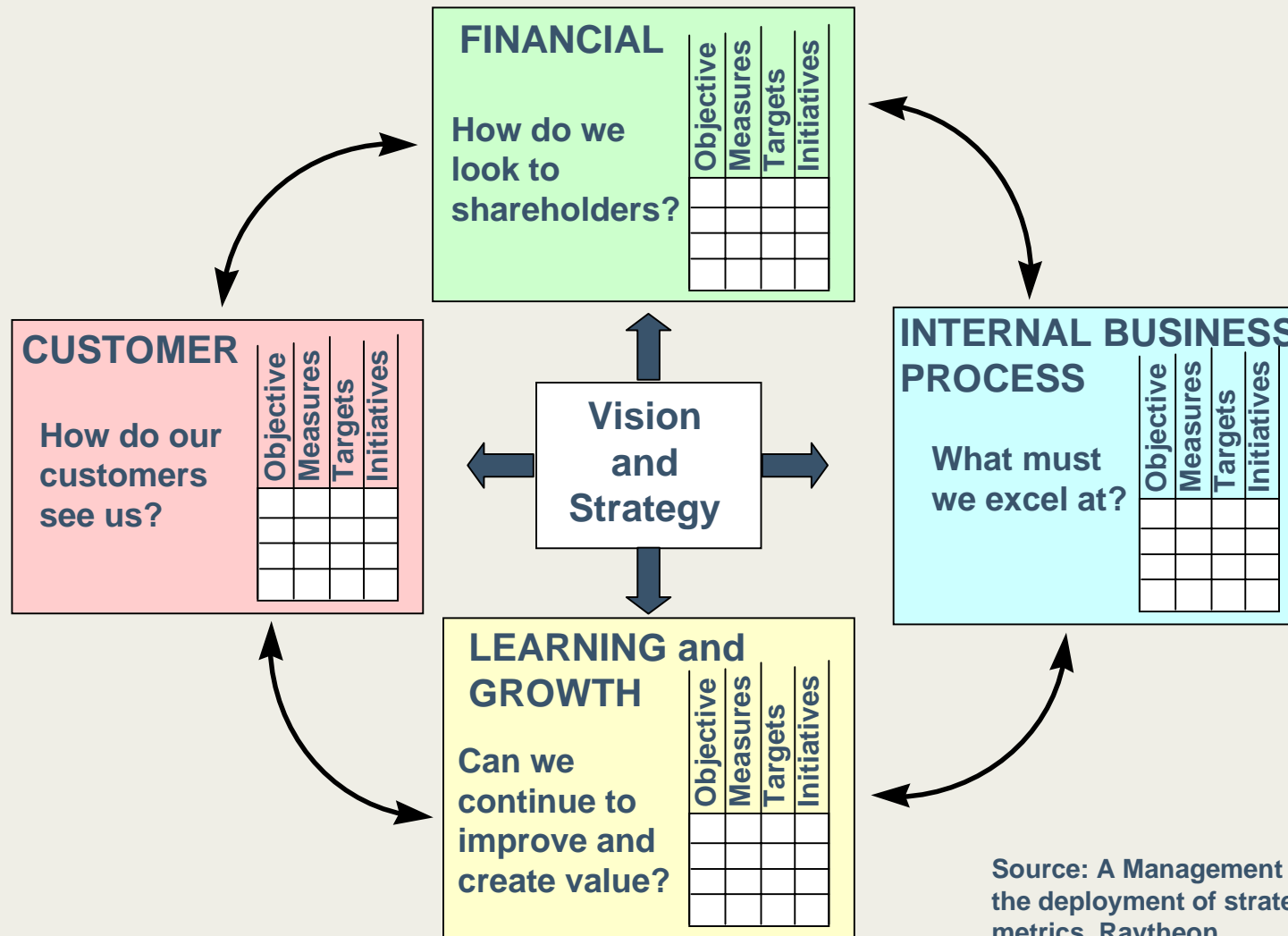
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⇨ Measures at Organizational Level
- Balanced scorecard
- Methodology
- Example indicators

Summary

A Balanced Scorecard Perspective on Performance

FINANCIAL

How do we look to shareholders?

Objective	Measures	Targets	Initiatives

CUSTOMER

How do our customers see us?

Objective	Measures	Targets	Initiatives

Vision and Strategy

INTERNAL BUSINESS PROCESS

What must we excel at?

Objective	Measures	Targets	Initiatives

LEARNING and GROWTH

Can we continue to improve and create value?

Objective	Measures	Targets	Initiatives

Source: A Management Guide for the deployment of strategic metrics, Raytheon

What Measures Should Be Taken?

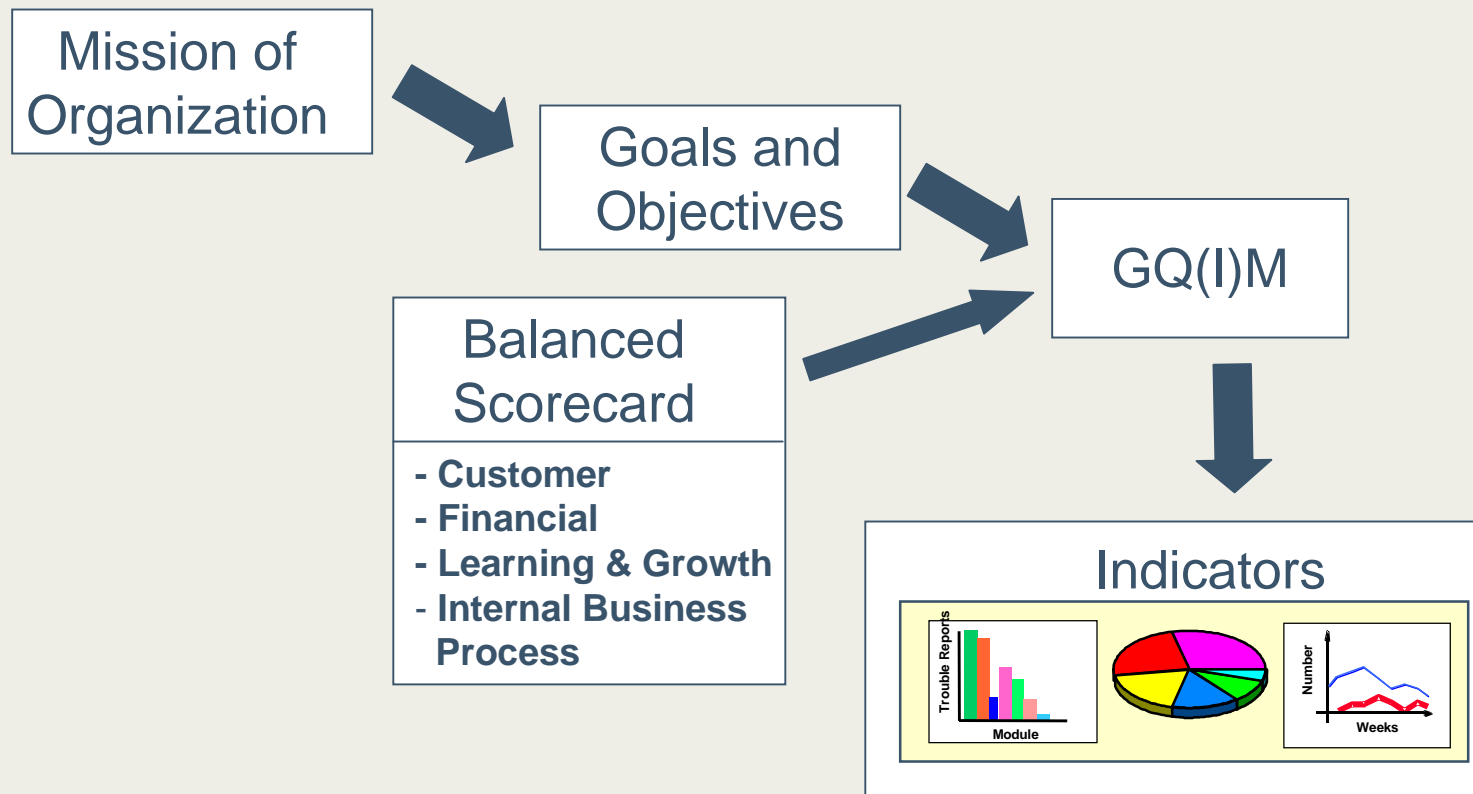Successful application of software measurement depends on having well-established measurement goals.

"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."

<div align="right">

—Juran

</div>

[Rozum 92]

Methodology

Mission of Organization → Goals and Objectives

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

Goals and Objectives + Balanced Scorecard → GQ(I)M → Indicators

Example Results

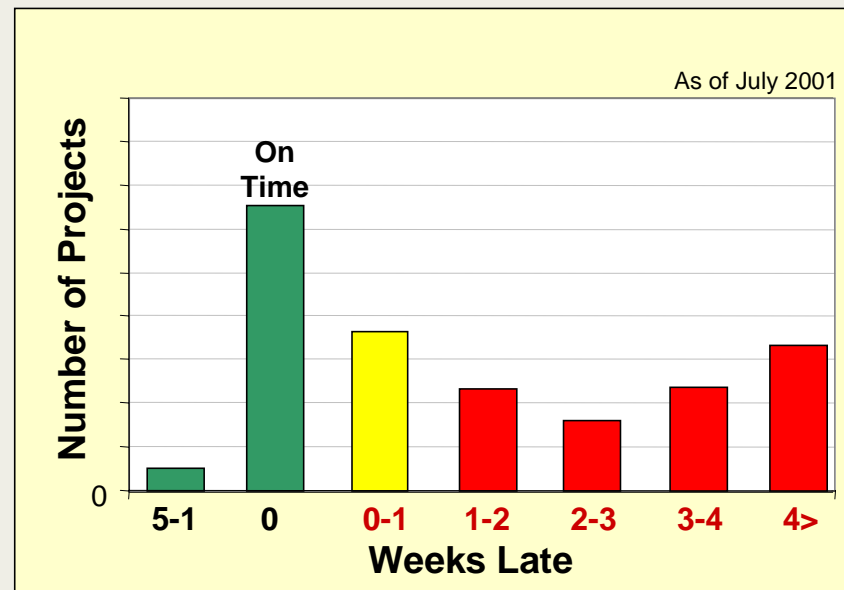| Balanced Scorecard Dimension	Measurement Areas
Internal Business	• Availability and capability of resources • Quality (deficiencies) • Timeliness (on-time delivery, cycle time • Productivity • Compliance with customer requirements
Innovation and Learning	• Improve quality (process, products, services)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

Internal Business - Example [1]

Open and Closed Deficiencies

		PRIORITY					
		1		2		3	
		Open	Closed	Open	Closed	Open	Closed
SEVERITY	1						
	2						
	3						
	4						
	5						

Internal Business – Example 2

On Time Delivery

Innovation and Learning - Example

Compliance with Requirements

Number of Projects

	Period 1	Period 2	Period 3
Full compliance	10 38%	12 44%	15 60%
95-80% compliance	5 19%		10 40%
>80% compliant	11 42%	15 56%	

Reporting Period

■ Full compliance with requirements
■ 95 - 80% compliance with requirements
■ >80% compliant with requirements
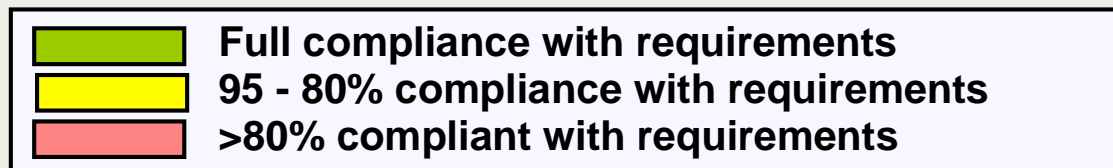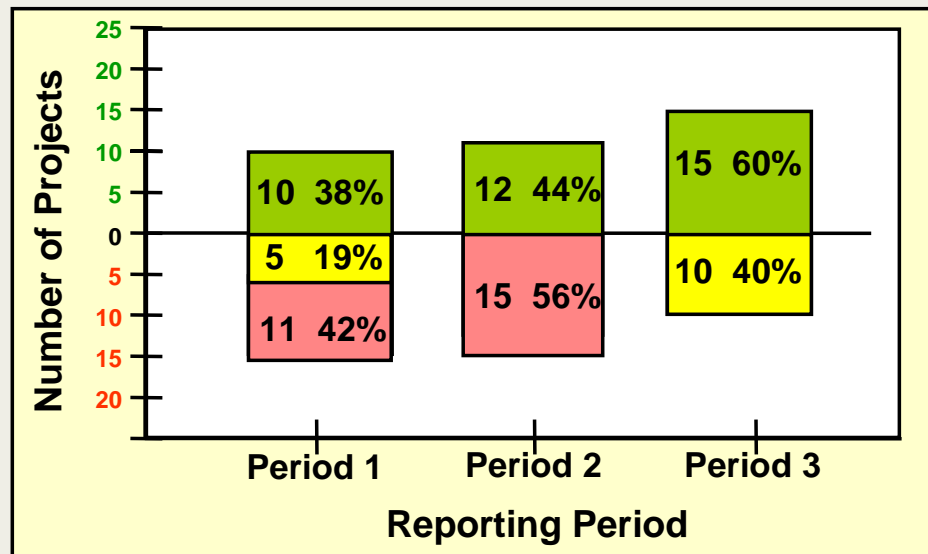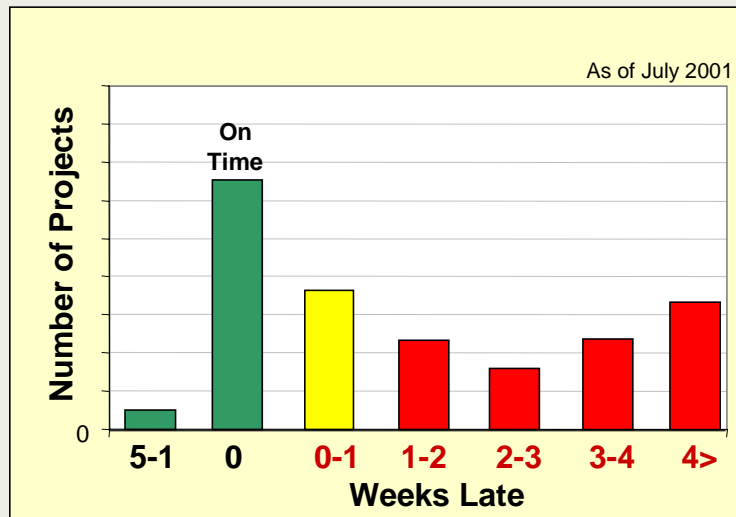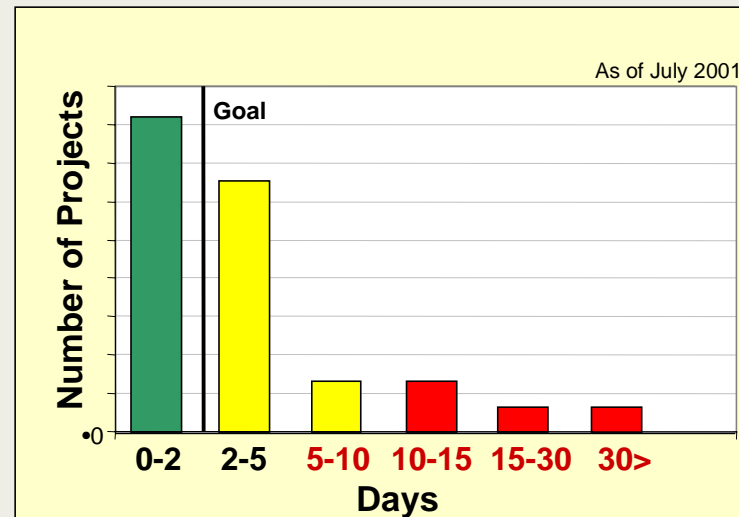
Financial - Example

Expenses
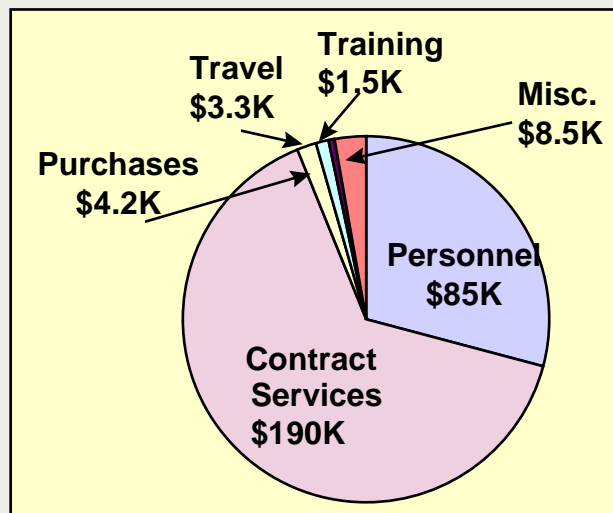
Area	Dollars
Personnel	85
Contract Services	190
Purchases	4.2
Travel	3.3
Training	1.5
Misc.	8.5

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⇨ Summary

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Summary [1]

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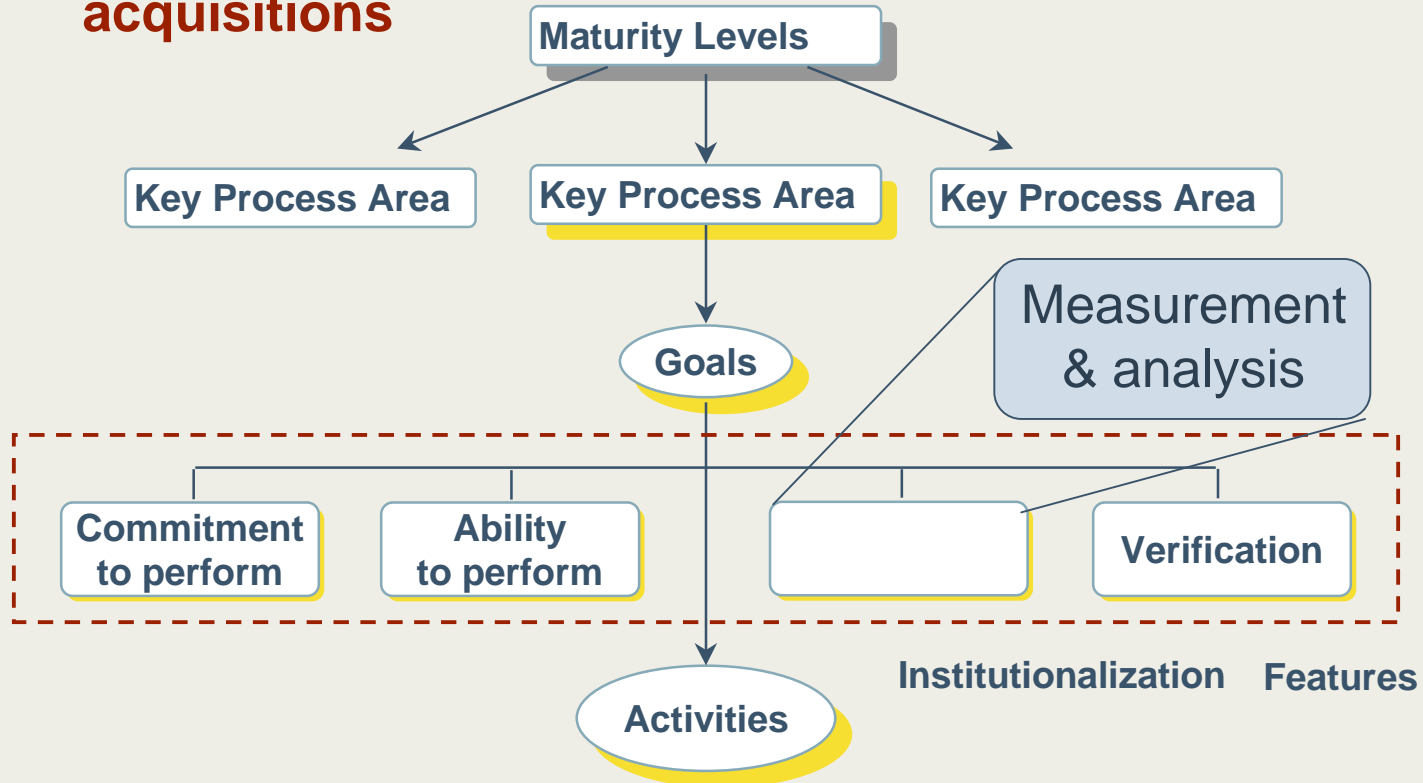
The **SA-CMM** was developed to
- increase awareness of the criticality of software in system acquisitions
- provide a model of features for the process of acquiring (software) products and services
- provide a model to instill discipline in the acquisition process.
- help process improvement

Summary 2

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

```
                    ┌──────────────────┐
                    │ Maturity Levels  │
                    └──────────────────┘
           ┌───────────────┼───────────────┐
           ▼               ▼               ▼
  ┌────────────────┐ ┌────────────────┐ ┌────────────────┐
  │ Key Process Area│ │ Key Process Area│ │ Key Process Area│
  └────────────────┘ └────────────────┘ └────────────────┘
                           │
                           ▼
                        ( Goals )            ┌──────────────────┐
                                             │   Measurement    │
                                             │   & analysis     │
                                             └──────────────────┘
  ┌───────────────────────────────────────────────────────────────┐
  │ ┌────────────┐  ┌────────────┐      ┌────────────┐ ┌──────────┐│
  │ │ Commitment │  │  Ability   │      │            │ │Verification││
  │ │ to perform │  │ to perform │      │            │ │          ││
  │ └────────────┘  └────────────┘      └────────────┘ └──────────┘│
  └───────────────────────────────────────────────────────────────┘
                           │            Institutionalization  Features
                           ▼
                      ( Activities )
```

Summary [3]

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 4

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

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Summary 5

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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