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Acquisition Measurement Tutorial and Workshop

Presentation to PSM TWG

March 2005

Sponsored by the U.S. Department of Defense

Hypothesis

DOD Suppliers have improved their development processes significantly over the last 20 years.

- Improved CMM/CMMI ratings
- Improved productivity
- Lower defect rates
- Higher percentages of award fees

We should start to look elsewhere for improvements

Organizations - 1

Acquisition Organizations – Manage the acquisition of systems, products and services. May be part of a larger hierarchy that includes product centers.

Customer Organizations – Take delivery of systems, products and services. Include warfighters, agents, life cycle support centers, and logistics centers. Also, those who perform Operational Test and Evaluation (OT&E) and who deploy systems.

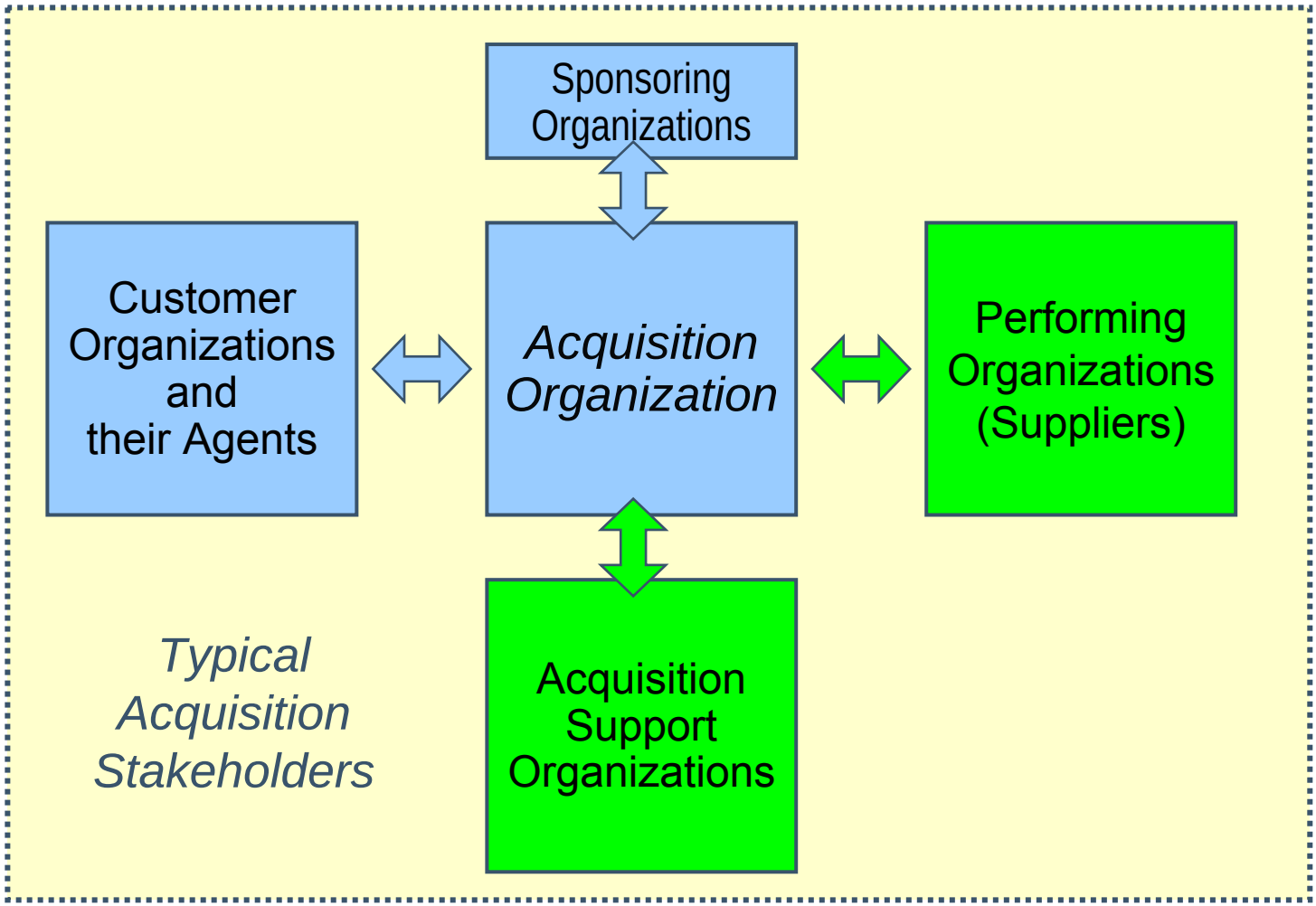
Sponsoring Organizations – Fund system development and sustainment. Include planners, policy makers as well as Program Executive Officers (PEOs) and Designated Acquisition Commanders (DACs)

Organizations - 2

Performing Organizations (Suppliers) – Develop and maintain systems, and provide services to support development and maintenance. May be commercial or government entities.

Acquisition Support Organizations – Provide engineering and support services to the acquisition organization, usually independently of Performing Organizations. Include SETA and IV&V contractors and FFRDCs.

Acquisition Relationships



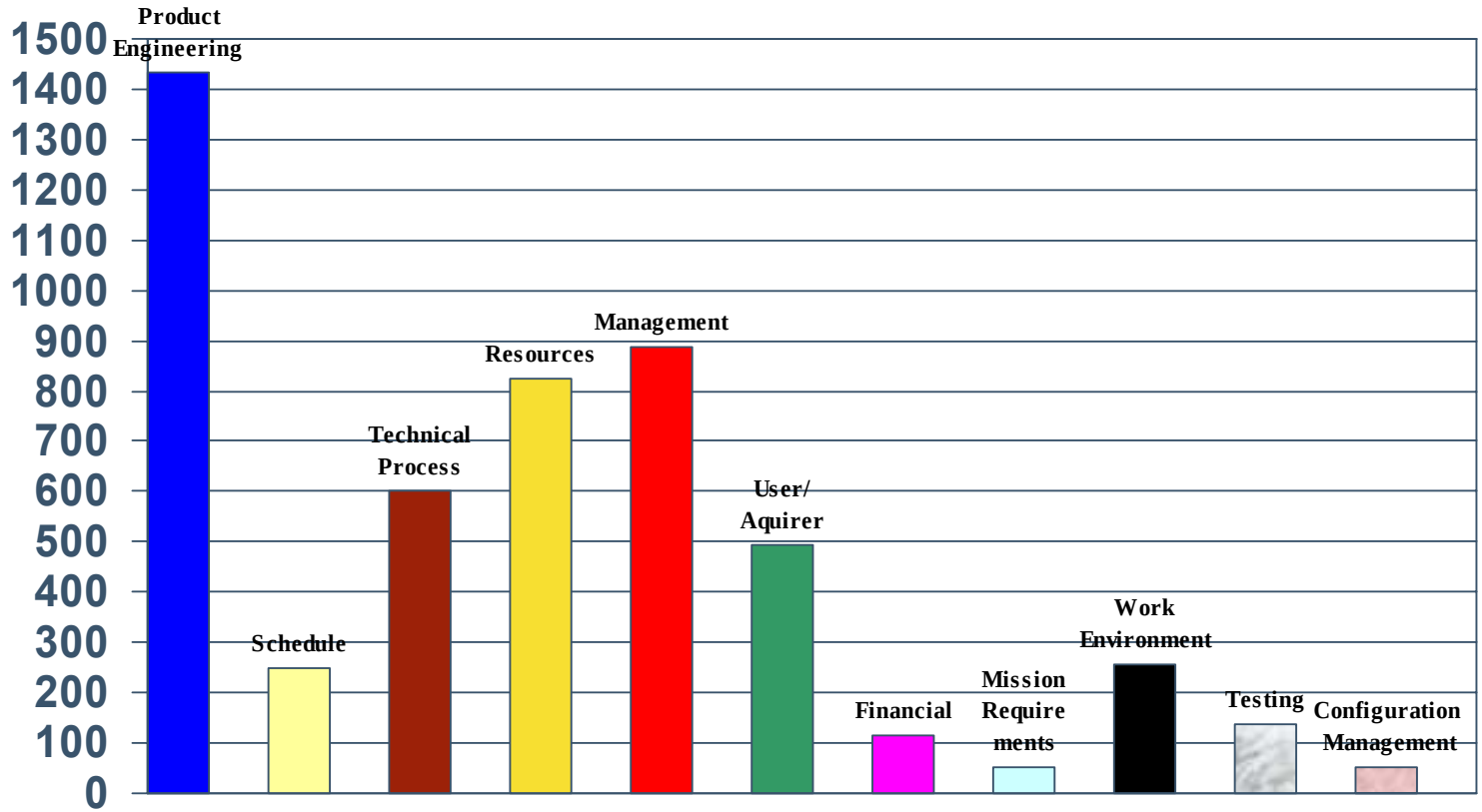
Program Assessment Findings

The following results combine SEI findings with findings from the Tri-Service Assessment Initiative (TAI).

- **56 DoD Program Assessments,**
- **4000+ risks and issues**

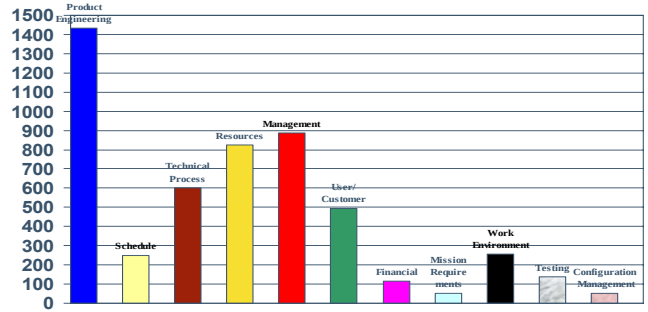
"Despite an increased process focus within Department of Defense (DoD) programs over the past 15 years, there is an increasing gap between program cost, schedule, and technical performance requirements and the capability of program teams to realize them."

Key Risk Areas (Circa 1994-2002)



Examples from SEI and TAI of the top 5 categories follow.

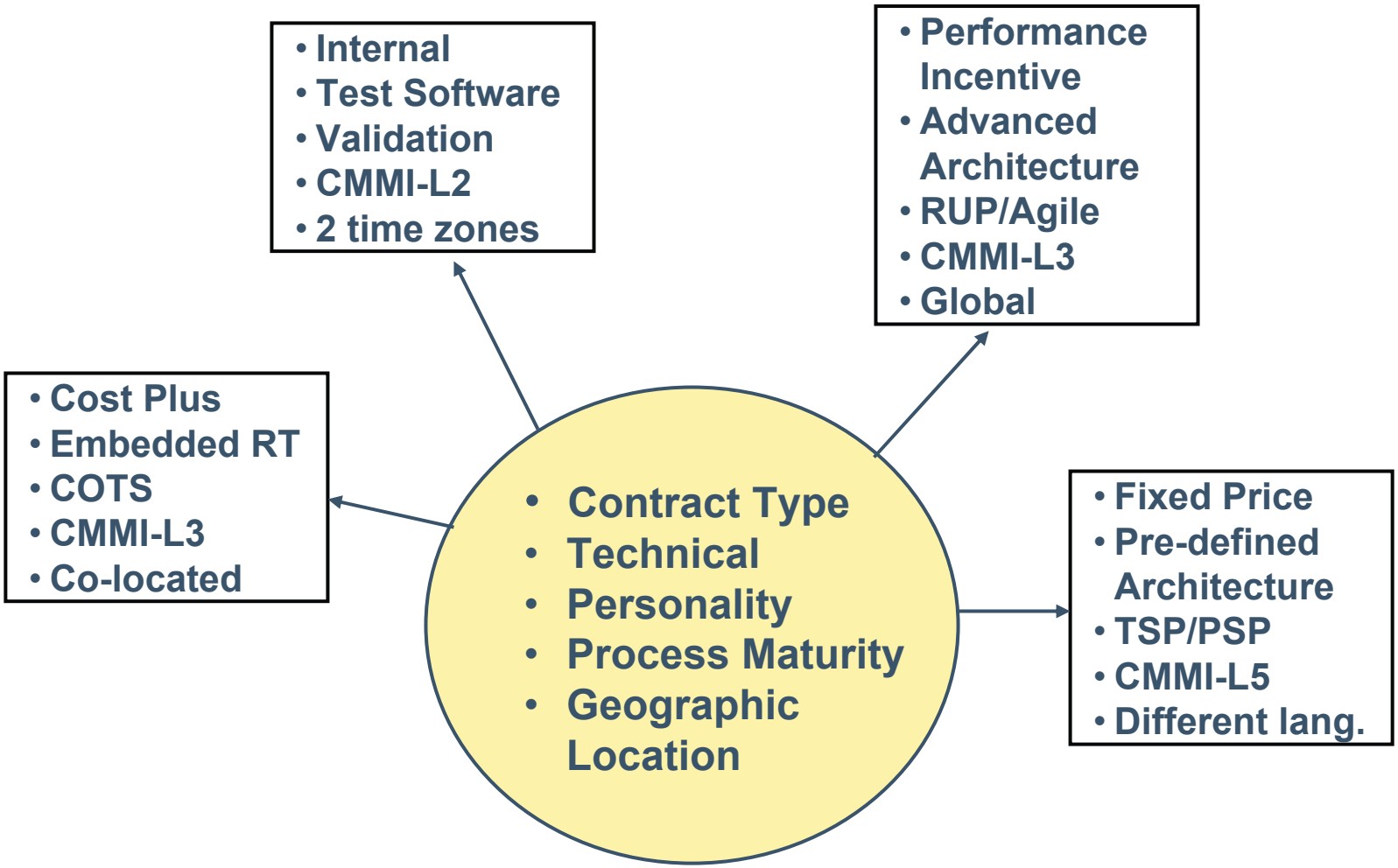
User/Acquirer



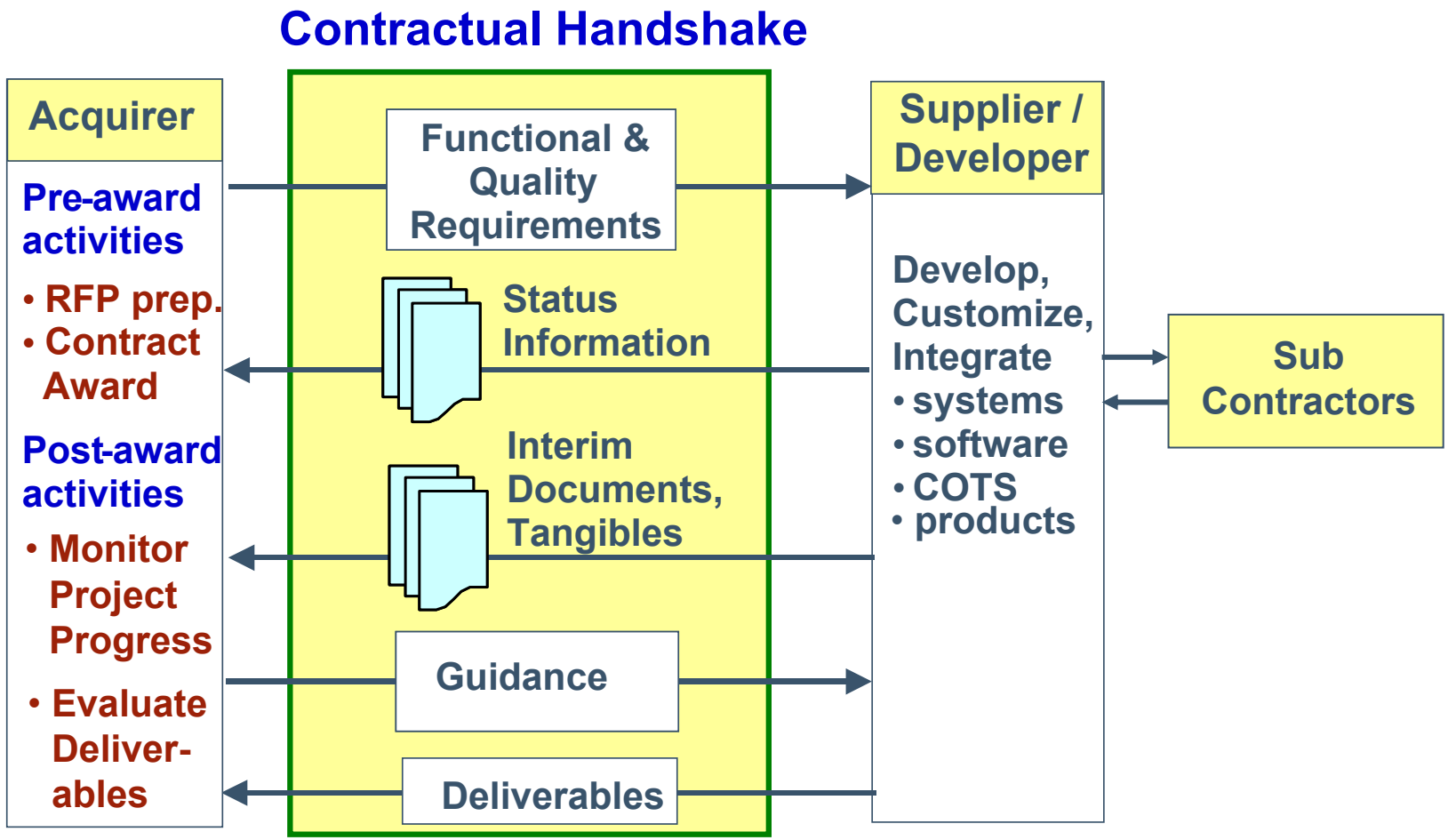
End User/Acquirer Interaction that affects development and deployment of the product.

- ***Acquirer has a short term horizon and is not sufficiently proactive – decisions are made late***
- ***The acquirer and operations-users do not communicate effectively and sufficiently***
- ***Operations community lacks continuity and skills to judge validation of requirements***
- ***Lack of communication between contractor, acquirer (PMO, PEO) and operations cause work to be done prior to official approval, then sometimes rejected***
- ***Insufficient operations involvement may cause contractor to to develop unsuitable interfaces or lose image with users***

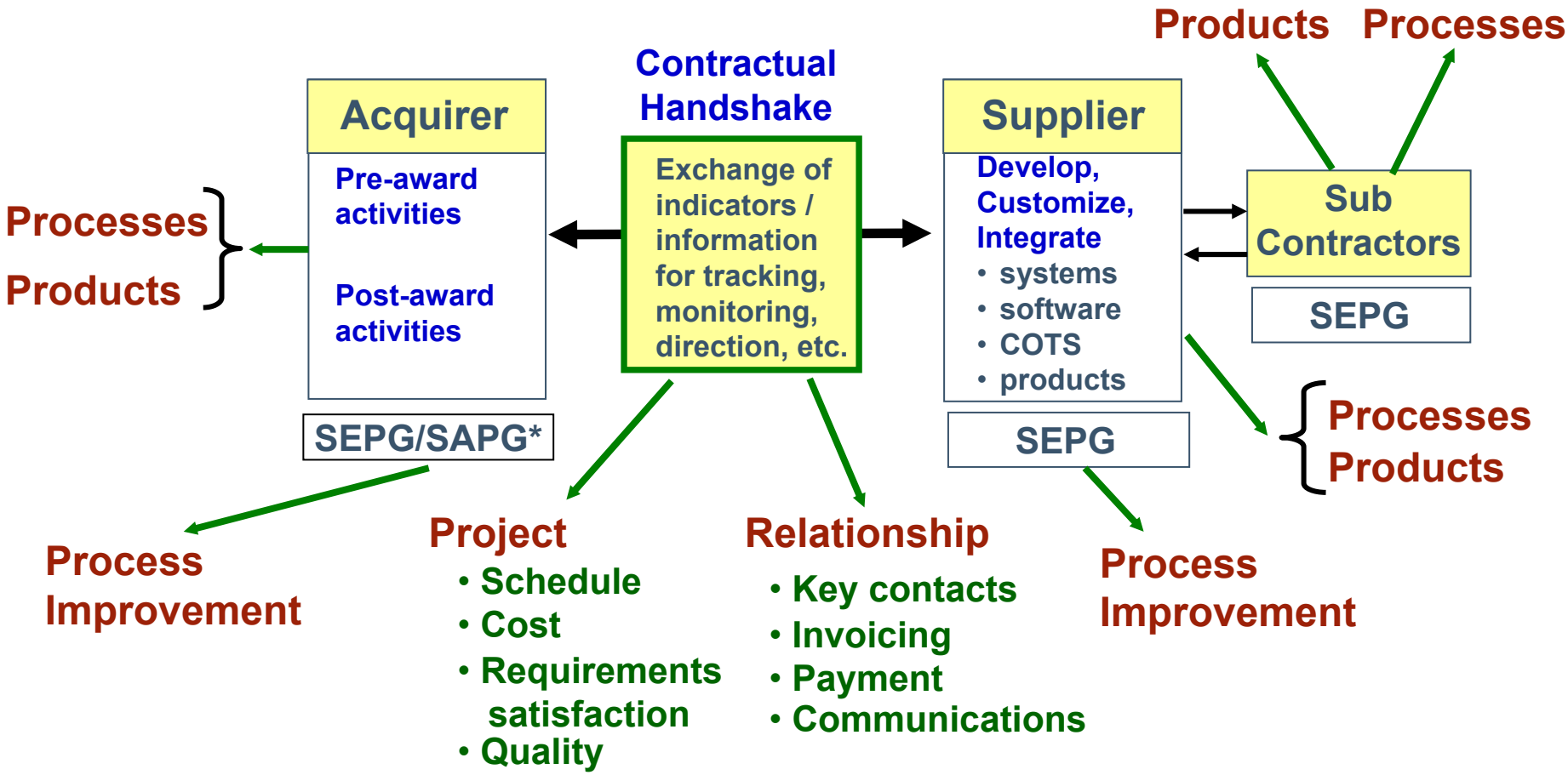
Complexity Factors in Acquisition



Acquisition Roles and Information Exchange



Measurement Opportunities



* SEPG/SAPG = Software Eng. Process Group / Software Acq. Process Group

Acquirer Processes

Requirements definition and management

- Coordination with End Users
- Coordination with PEOs

RFP Development

- Proposal processing

Project monitoring and control

- Conducting program reviews
- Providing direction to contractor

Document / Test Data Reviews

Change management

Risk management

Other Coordinating Processes

- Issue tracking
- Action item tracking
- Reviews by warfighter and logistics organizations
- Validation and technical reviews
- Managing information and material that comes from {acquirer and customers} and goes to {suppliers and developers}.

Elements of a Project Dashboard

Progress & Efficiency Indicators:

- Compare planned values to actual results
- Provide estimates for completion or performance

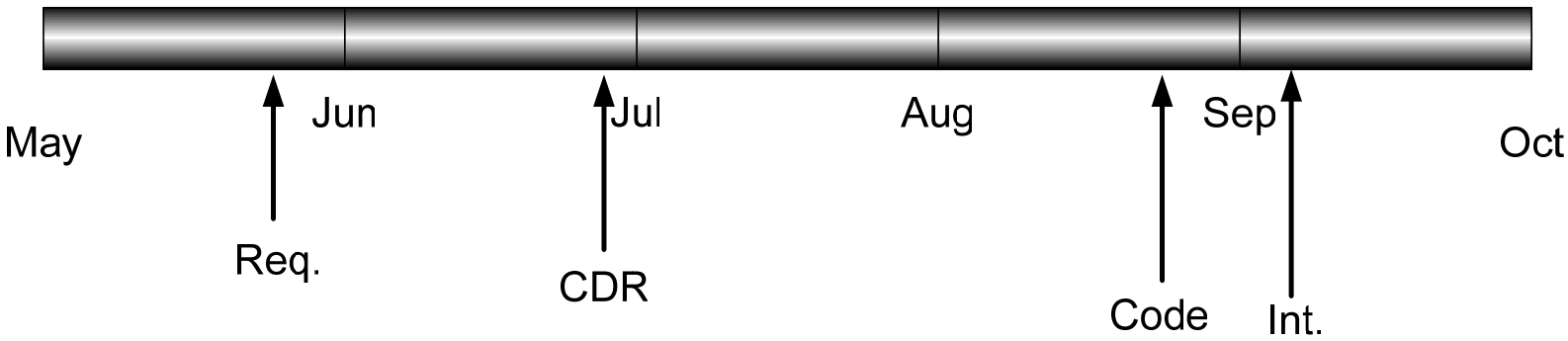
Warning & Analysis Indicators:

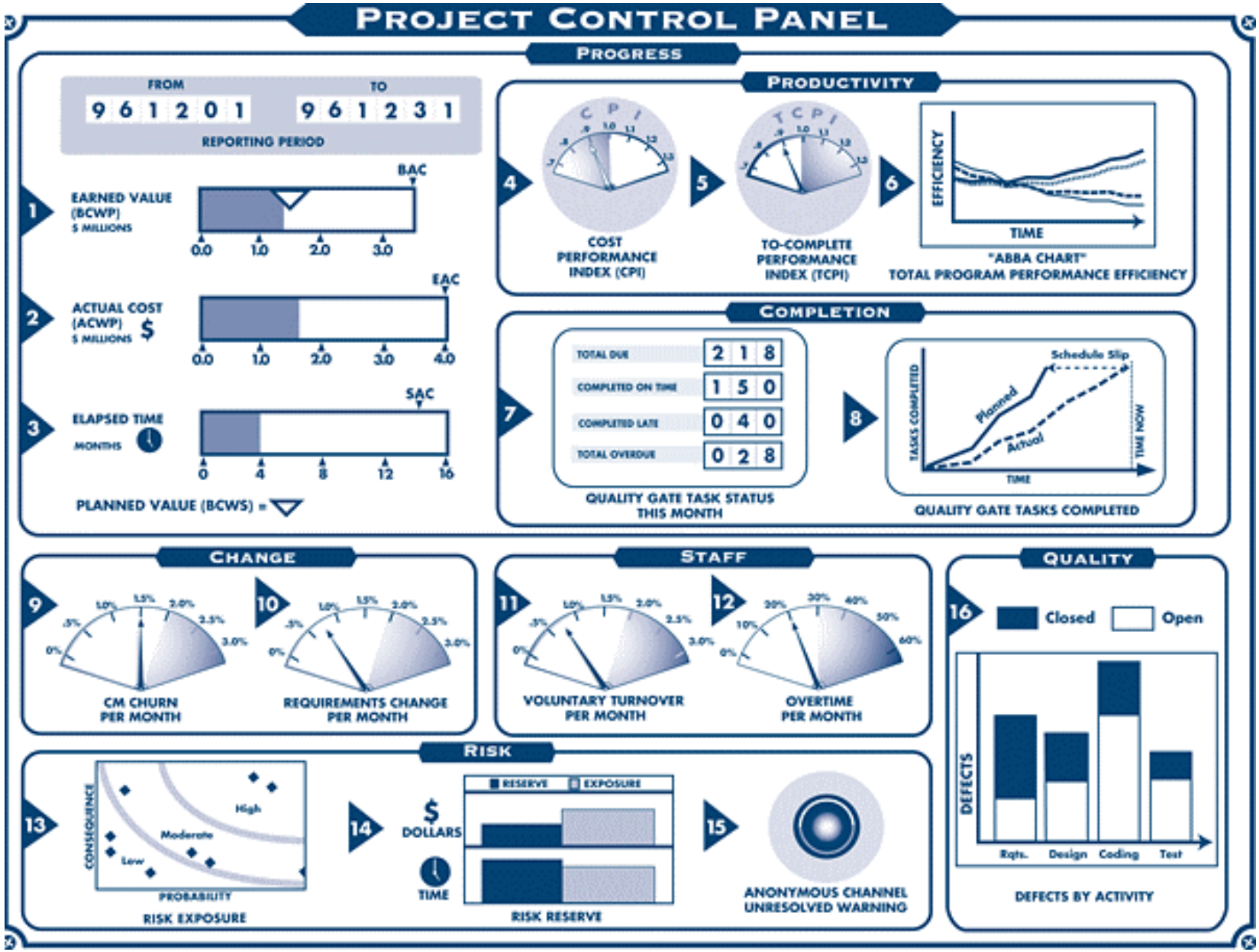
- Risk
- Quality
- Process Adherence
- Change Responsiveness
- Staffing Level, Turnover
- Relationship & Contract Issues

Dashboard Contents

May have multiple versions
to support differing viewpoints
(we'll describe this later)

May change warning or progress indicators at different stages of the life-cycle





"The Program Manager's Guide to Software Acquisition Best Practices, 1997

Progress as measured by Completion Criteria

- Milestones completed
- Size completed
- CM-items baselined
- Quality Gates completed
- Tests passed
- Defects removed

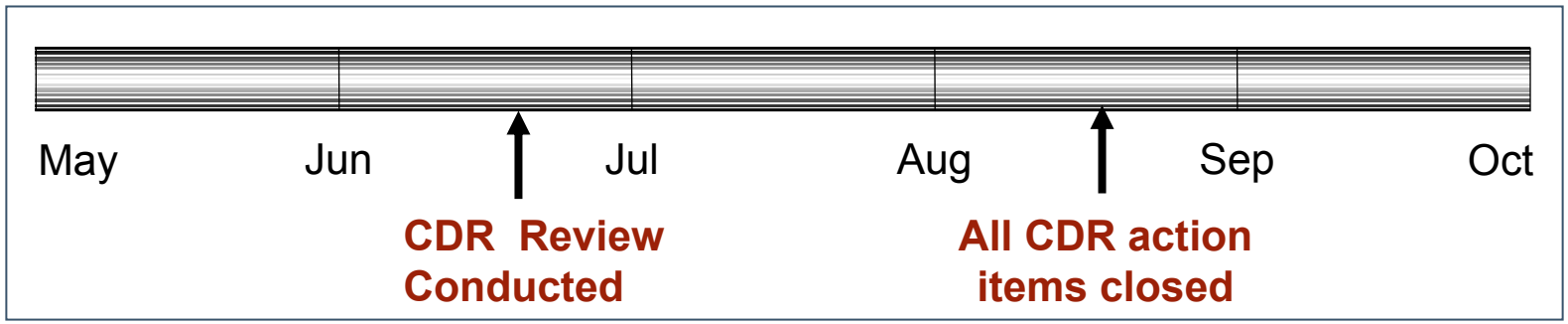
Lifecycle Dependent

Precise completion criteria are necessary for everything that is measured. These criteria must be measurable and observable.

Completion - Milestones

Milestone completion Criteria

- Do all parties have the same definition of completion for each milestone?
- Are the criteria observable and measurable?

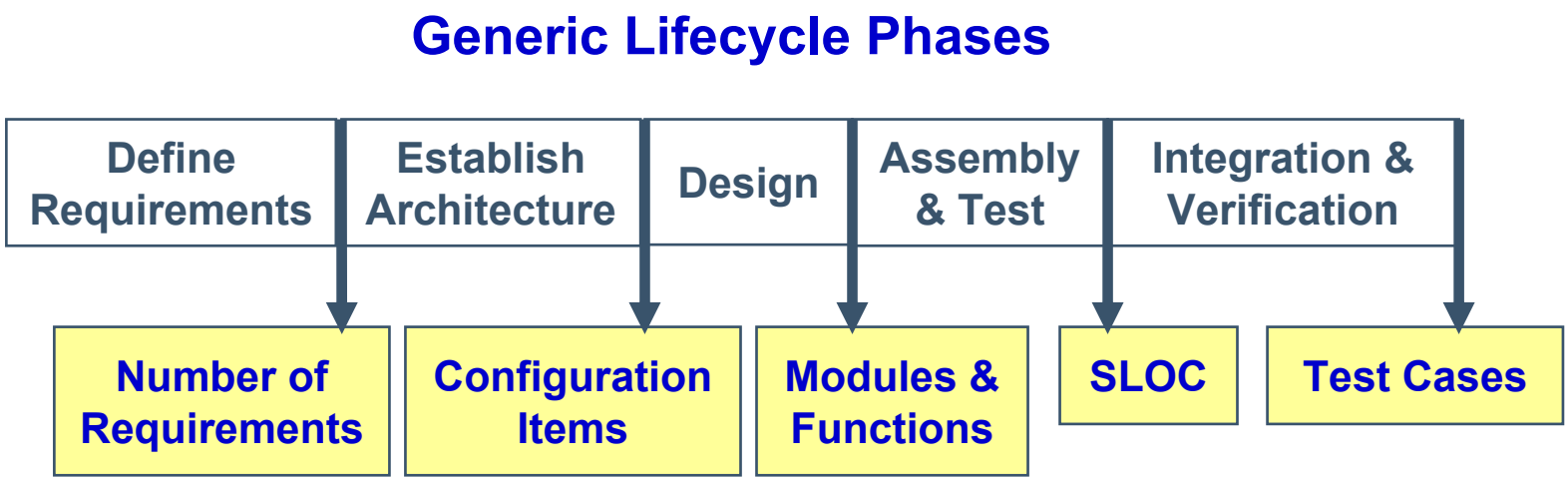


A checklist methodology may be used to address issues:

Software Effort & Schedule Measurement: A Framework for Counting Staff-hours and Reporting Schedule Information
http://www.sei.cmu.edu/publications/documents/92.reports/92.tr.021.html

Completion -- Size

- No one size measure is best for all occasions.
- Size may depend on the stage of the life cycle
  - Measure what is available at the end of a phase to predict the end-product size
  - Compare changing size estimates



Implications of the Size Indicator

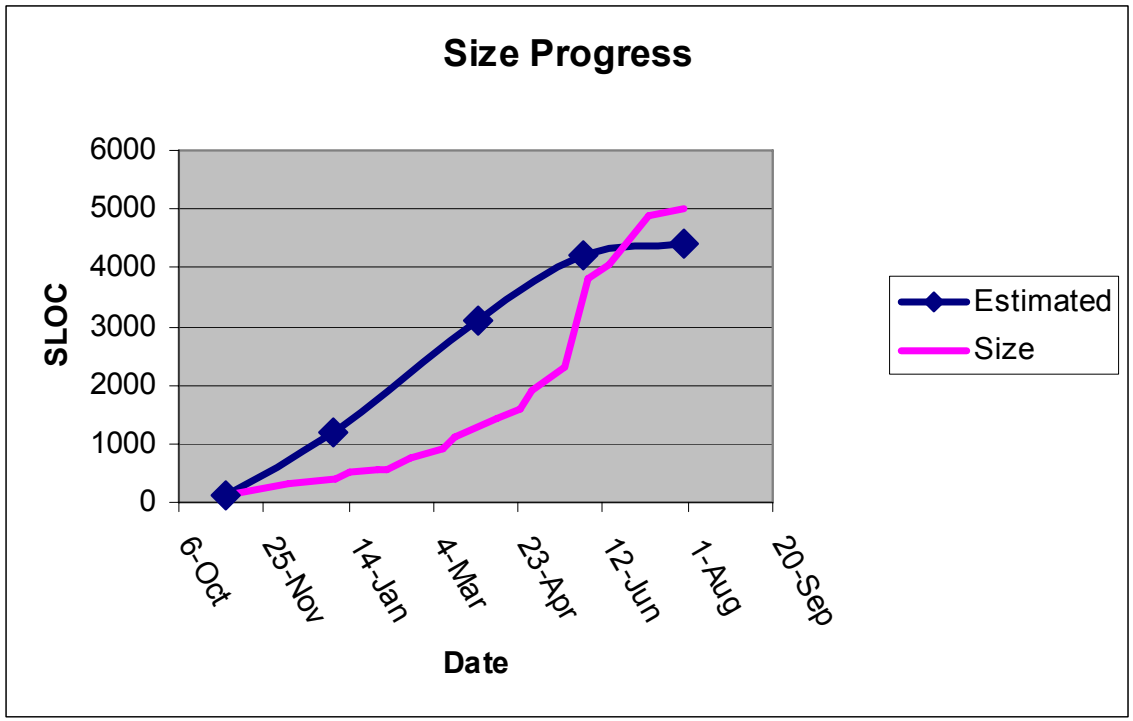
Developer: Counts size of product.

- Supports productivity measurement of development processes.
- Provides normalization factor for comparison and analysis with estimates for cost, schedule, and defects.

Acquirer: Measures progress

- Supports estimates of task effort and duration for coordination of other activities.
- Supports estimates of delivery date.

Size Indicator for Development Phase



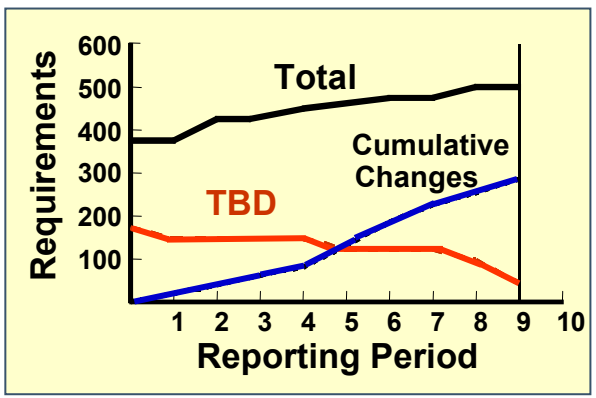
This data allows the developer's progress to be monitored and their productivity to be determined.

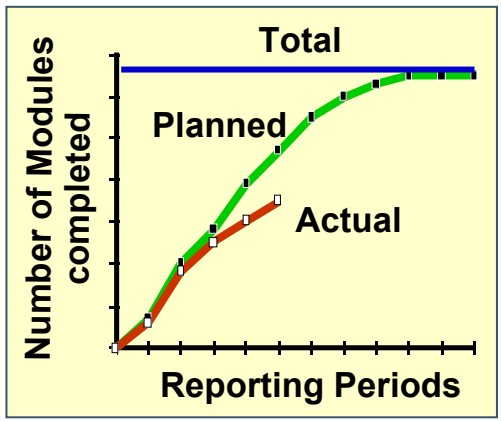
This data is obtained during the Assembly and Test Phases

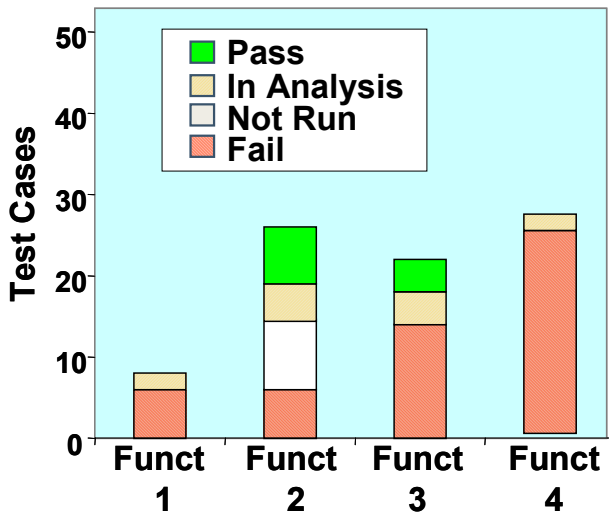
Other Progress Indicators

Generic Lifecycle Phases

Define Requirements	Establish Architecture	Design	Assembly & Test	Integration & Verification
Number of Requirements	Configuration Items	Modules & Functions	SLOC	Test Cases







Test Progress Indicators - 1

Two progress indicators are useful during verification & validation.

- # Tests passed
  - Focus is on accomplishing the product goals.
- # Open defects
  - Must be below a specified threshold before product is released. (NOTE: The threshold will be tighter for safety critical and performance critical systems and looser for business information systems.)
  - Focus is on quality with the goal of achieving little or no user trouble reports after deployment.

Test Progress Indicators - 2

Have the requirements been met? Did the product pass or fail?

- Indicates progress toward product readiness

How many open defects remain and what is the defect closure rate?

- Provides an excellent way to predict the product release date

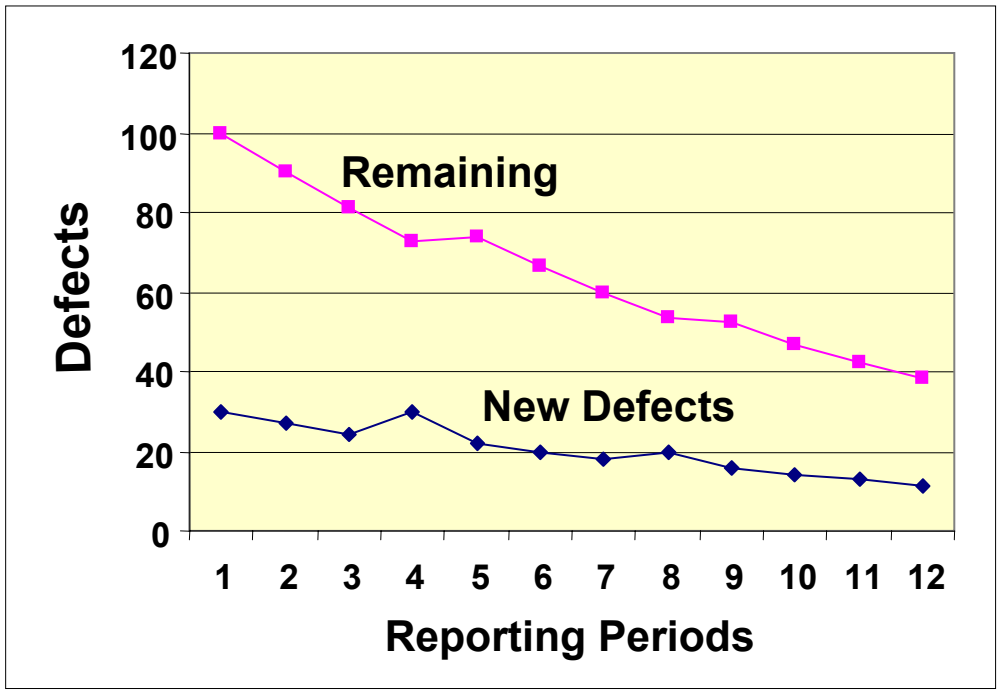
How many defects have been found during test?

- If much less than the expected defect density, tests may be inadequate or # testers may be insufficient
- If much higher than the expected defect density, there may be a quality control problem?

What is the test completion rate?

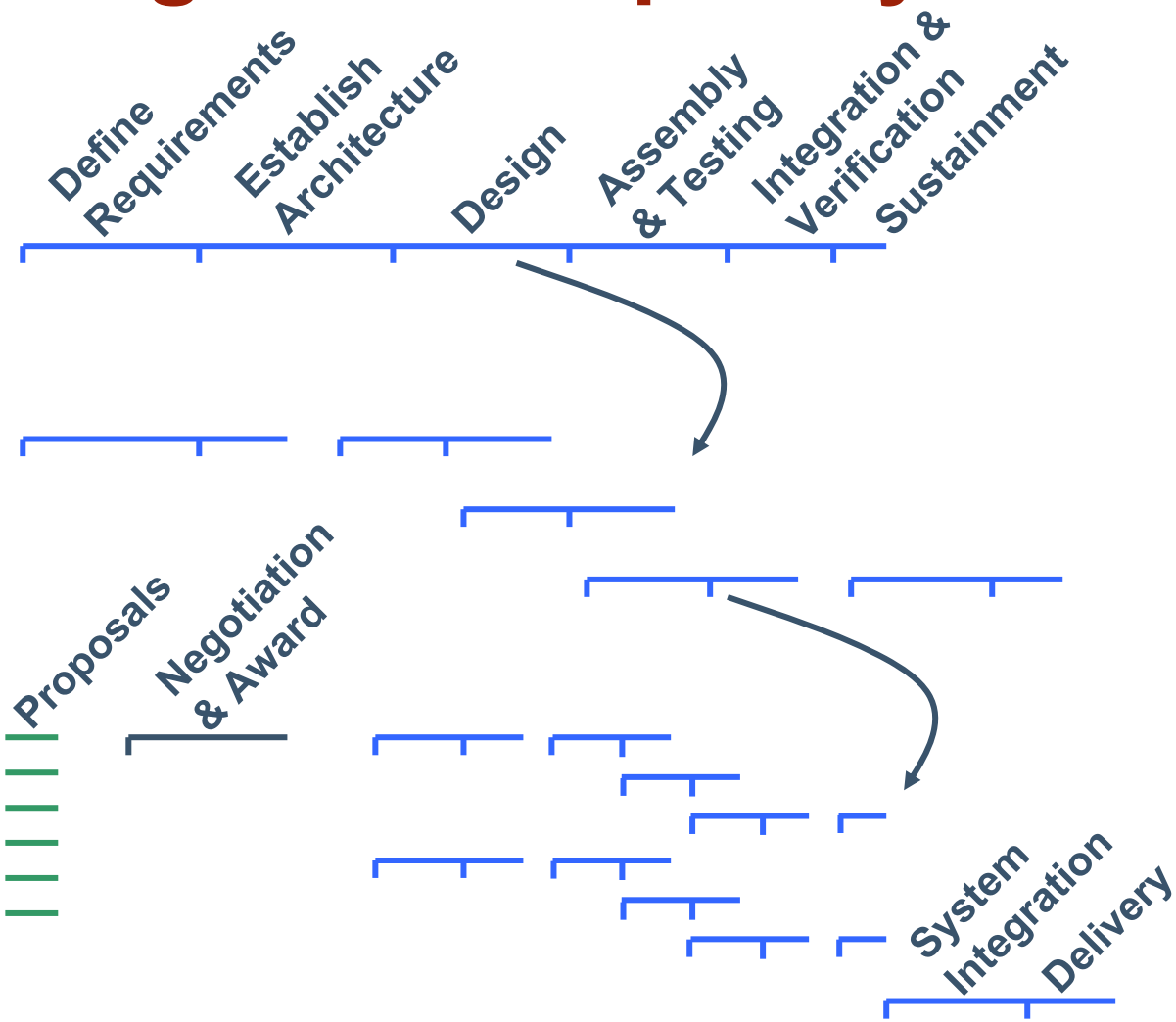
- Provides evidence that test resources (both people & facilities) are sufficient or not

Defect Closure Progress



- How soon can we release the product?
- Are we finding defects fast enough?

Progress Complexity Factors



Straight through development

Multiple builds and multiple releases

Multiple party development

Combining Progress Indicators

Necessary when you have:

- Multiple Teams
- Spiral or Evolutionary Development

May be done by allocating percentages to each team or phase.

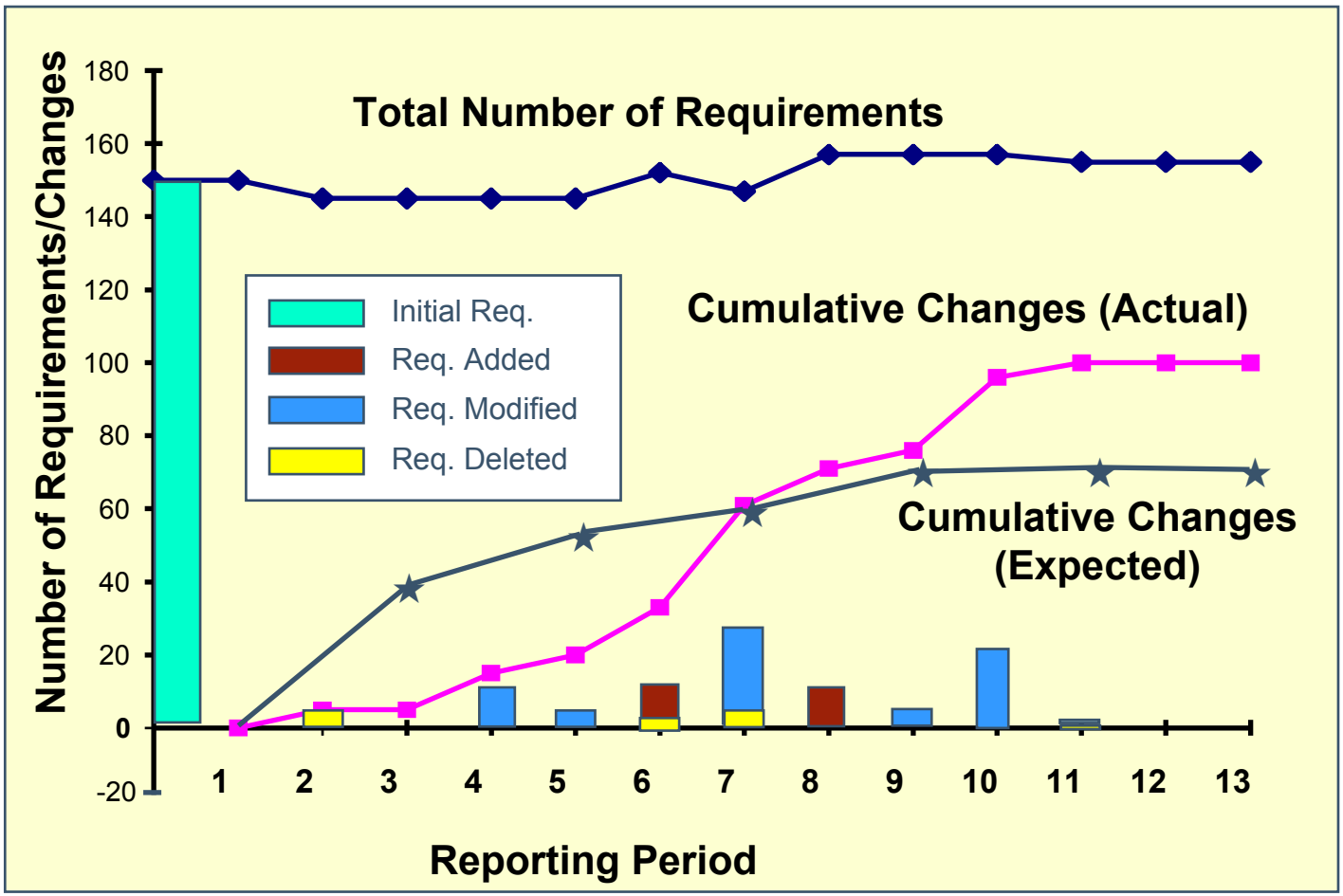
Display the composite, but keep the individual details for backup.

Possible Warning Indicators

- Requirements Stability
- Resource Availability, Turnover
- Risk
- Quality
- Change Responsiveness

What would you add?

Requirements & Stability



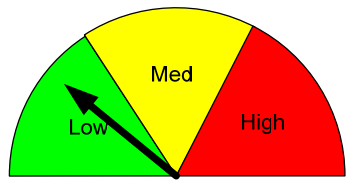
Requirements Stability - Impact

Key aspect of assessing stability ► determining the impact of a *new* or *changed* requirement.

Attribute (NOTE: percent value is project dependent)

Major	**Greater than 5% re-design, 5% re-code, or 5% re-test**
Routine	**Less than 5% re-design, re-code, or re-test**
Minor	**No significant re-design, re-code, re-test**

STATUS	THRESHOLD
RED	1 Major or 4 Routine
AMBER	2 Routine
GREEN	Below AMBER threshold



Resource Availability Indicator

(Example)		Jan		Feb		Mar		Apr	
		Actual	Auth.	Actual	Auth.	Actual	Auth.	Actual	Auth.
Project Mgt									
Engineer	Entry Level								
	Journeyman								
	High Grade								
Architect	Entry Level								
	Journeyman								
	High Grade								
Tester	Entry Level								
	Journeyman								
	High Grade								
Specialty	Entry Level								
	Journeyman								
	High Grade								

This table may be used by the supplier or the acquirer.

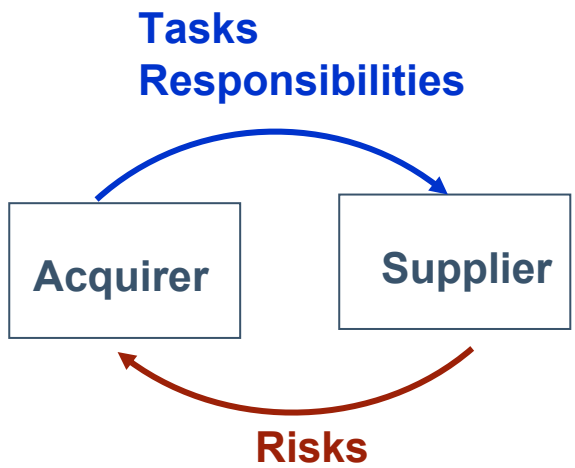
Significant differences between Actual and Authorized levels could be a warning indicator.

Risk Transfer

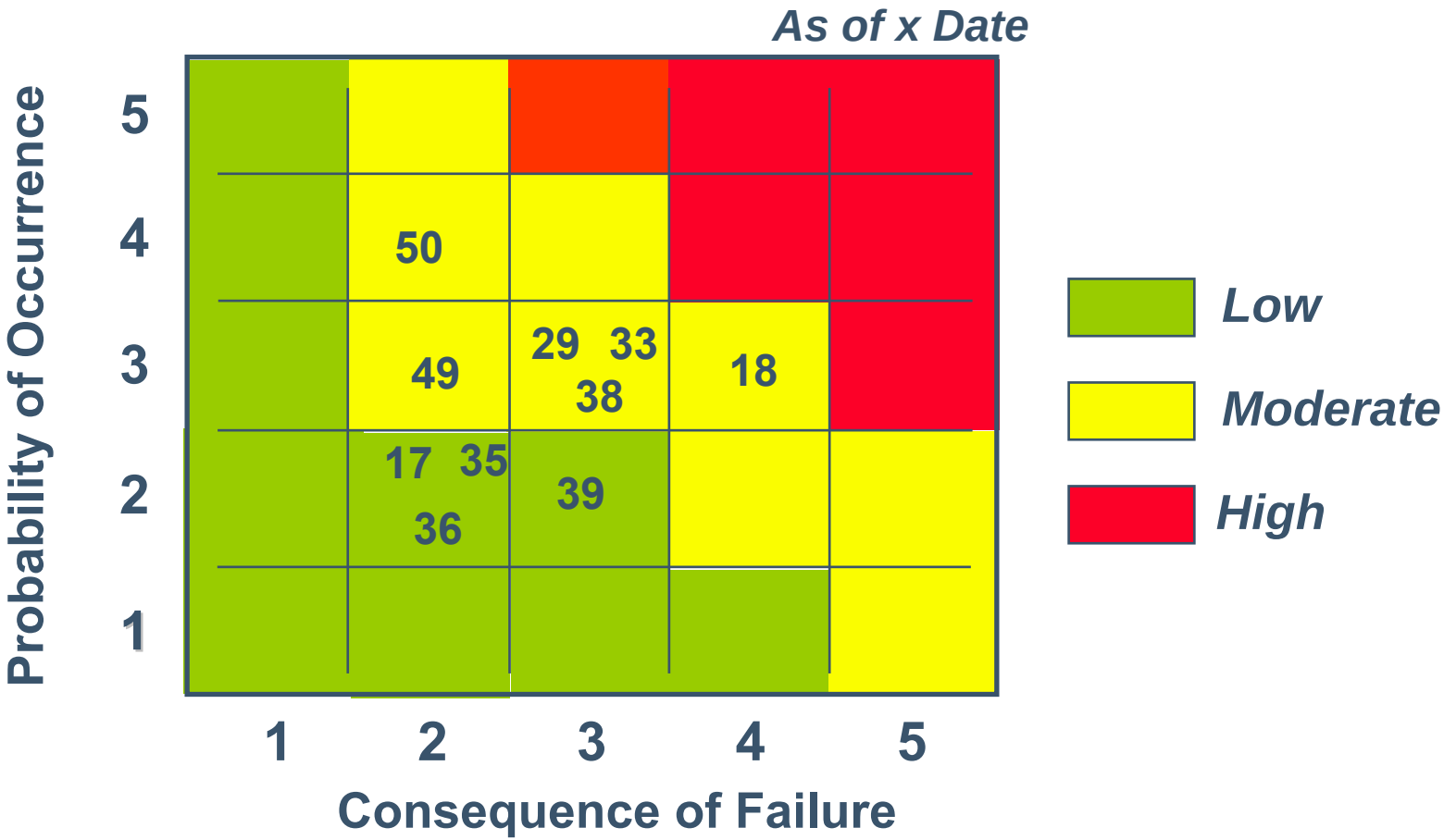
By awarding a contract, the program office invites a third party to help satisfy the customer.

When a responsibility or risk is transferred to a third party, the transferer accepts a new set of risks.

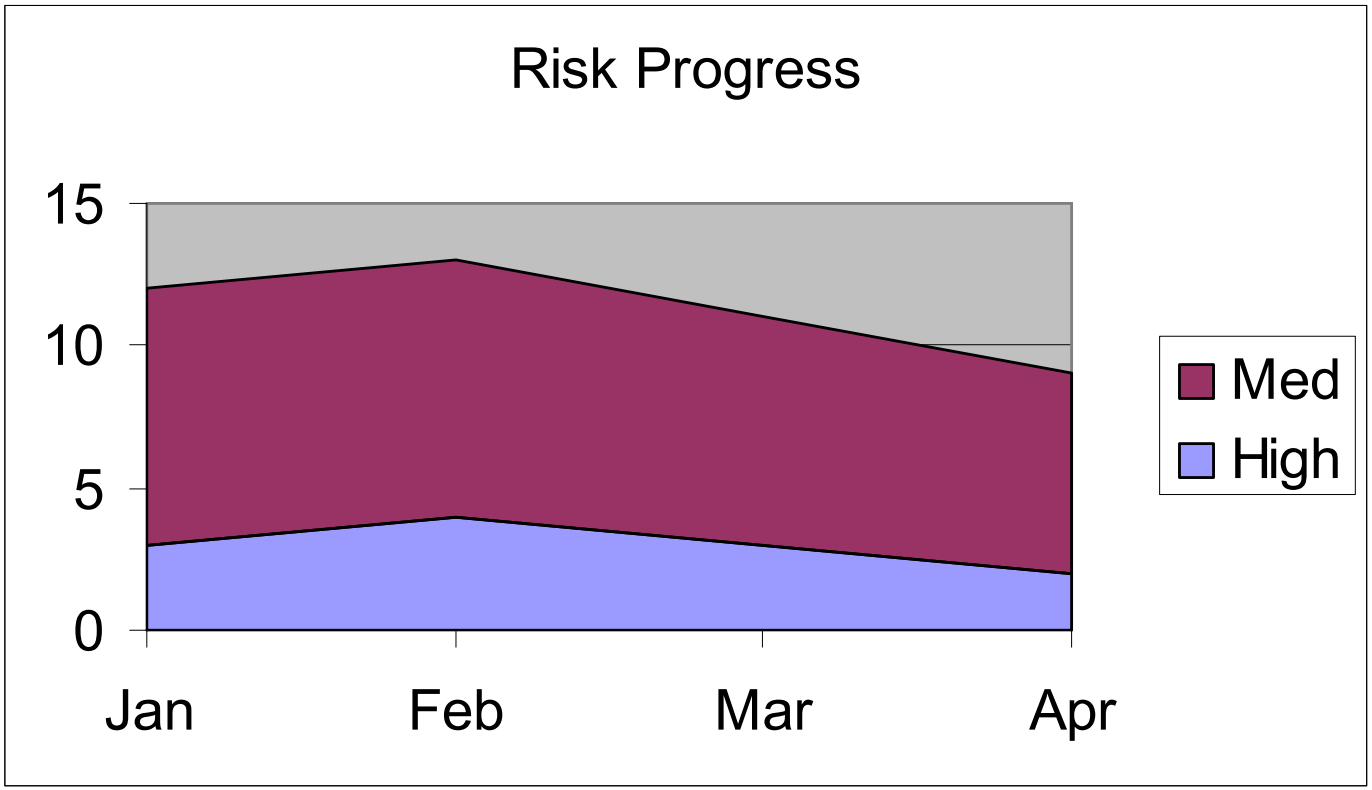
- Business domain expertise
- Financial capacity
- Project management
- Technical expertise
- Process performance
- Change management
- Relationship issues
- Other uncertainty



Sample Risk Indicator



Risk Progress Indicator Chart



Counts of #High, #Med Risks over time

Supplier Quality Assurance

Review process adherence “x” times per year.

- Monitoring supplier QA means additional cost for you and the Supplier (i.e., choose “x” wisely).

Count number of quality interventions

- Checklists
- Audits
- Inspections
- Technical Reviews

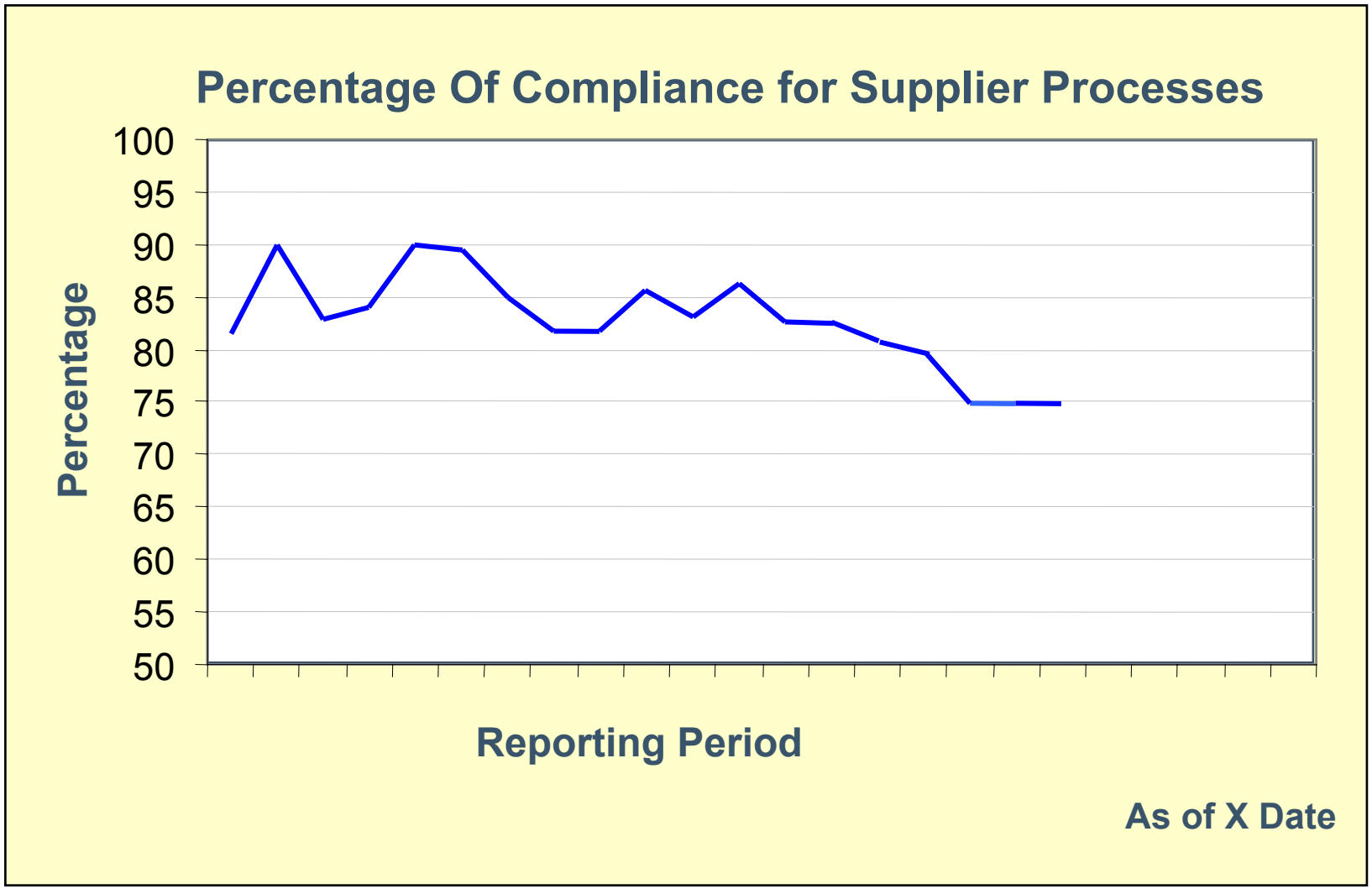
Provide process adherence assessment

- % process adherence

When you receive a QA report, request risk evaluation

- If “process x” is not properly followed, what is the potential impact?

QA Compliance Indicator



Change Management

*"… major risk is the **lack of rapid response to change** that happens in traditional project organizations where software expertise and decision authority are scattered at low management levels across various project elements. "*

Boehm, et. al. "Spiral Acquisition of Software Intensive Systems," CrossTalk, May 2004.

Communications & Change Process

Embrace Change

1. Assign a contractor contact and a government contact.
2. Conduct a walk-through of where the change will occur.
3. Document the scope of work to incorporate the change.
4. Document and agree on the assumptions regarding the additional work with all stakeholders.
5. Have the contractor submit an order of magnitude cost impact; depending on urgency of the change, government could issue a not-to-exceed cost threshold.
6. Schedule IPT meeting to approve or reject change

PM Network, May 2004 story on rebuilding the Pentagon.

Communications & Change Indicators

- Measure the cycle – from request for change to approval of change
- Notify all affected parties of change approval
- Track and ***communicate*** the completion of every change action.
- Minimize or eliminate unnecessary approvals.

Change management affects everything: deliverables, plans, and processes.

RFP Change Indicators

- How long does it take to resolve RFP Change Requests?
  - Start Date
  - Approval Date
  - Documents Updated (change + revised doc.)
  - Announced Availability
- Total Cycle Time (“Target < x calendar days”)
- Number of pages changed
- Effort or other cost to publish and distribute

Configuration Mgmt Indicators

Baseline configuration items as they pass the initial quality gate for that item type.

Count configuration items in baseline (denominator).

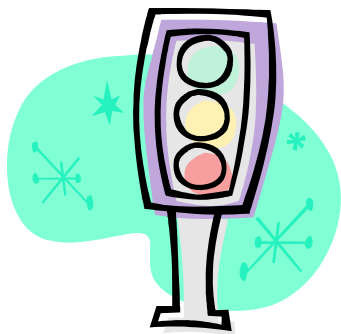
Count every ***change*** to baselined configuration item (numerator).

Show % changes by month.

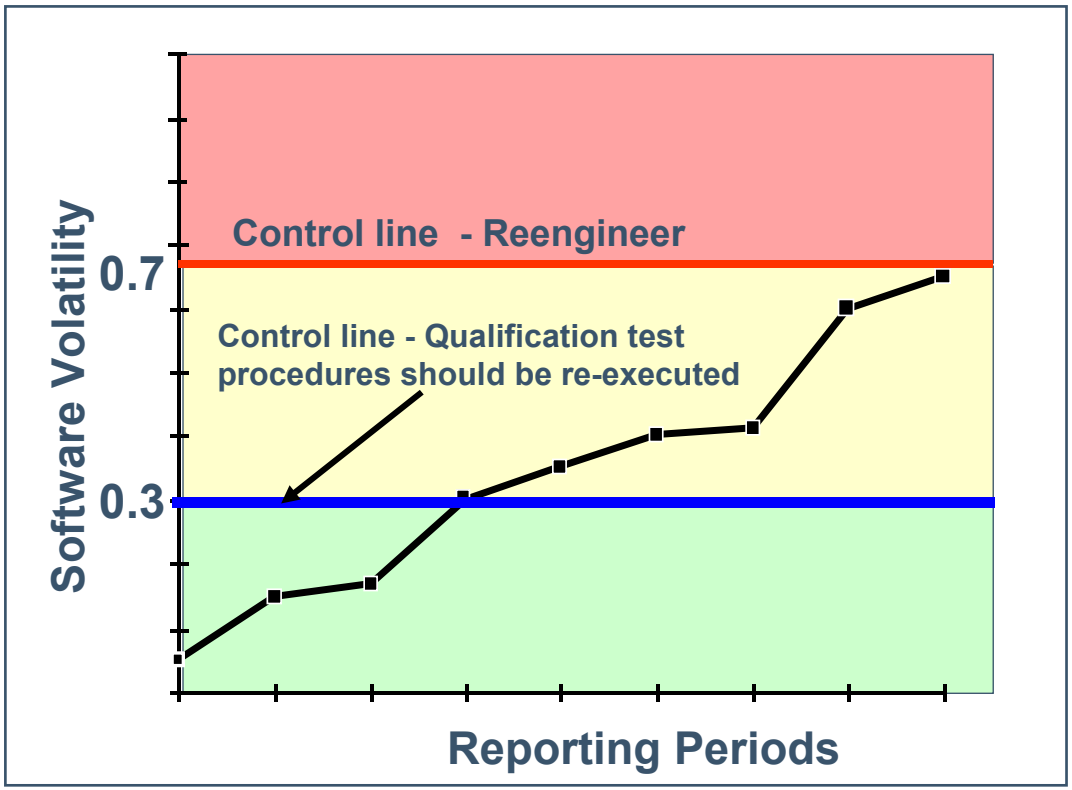
Use a stoplight indicator or gauge.

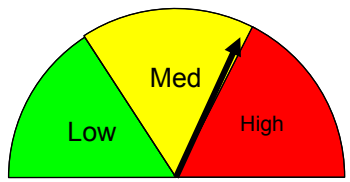
- Green < 1% per week
- Yellow > 1% and < 2% per week
- Red ≥ 2% per week

(Percentages will vary by project.)

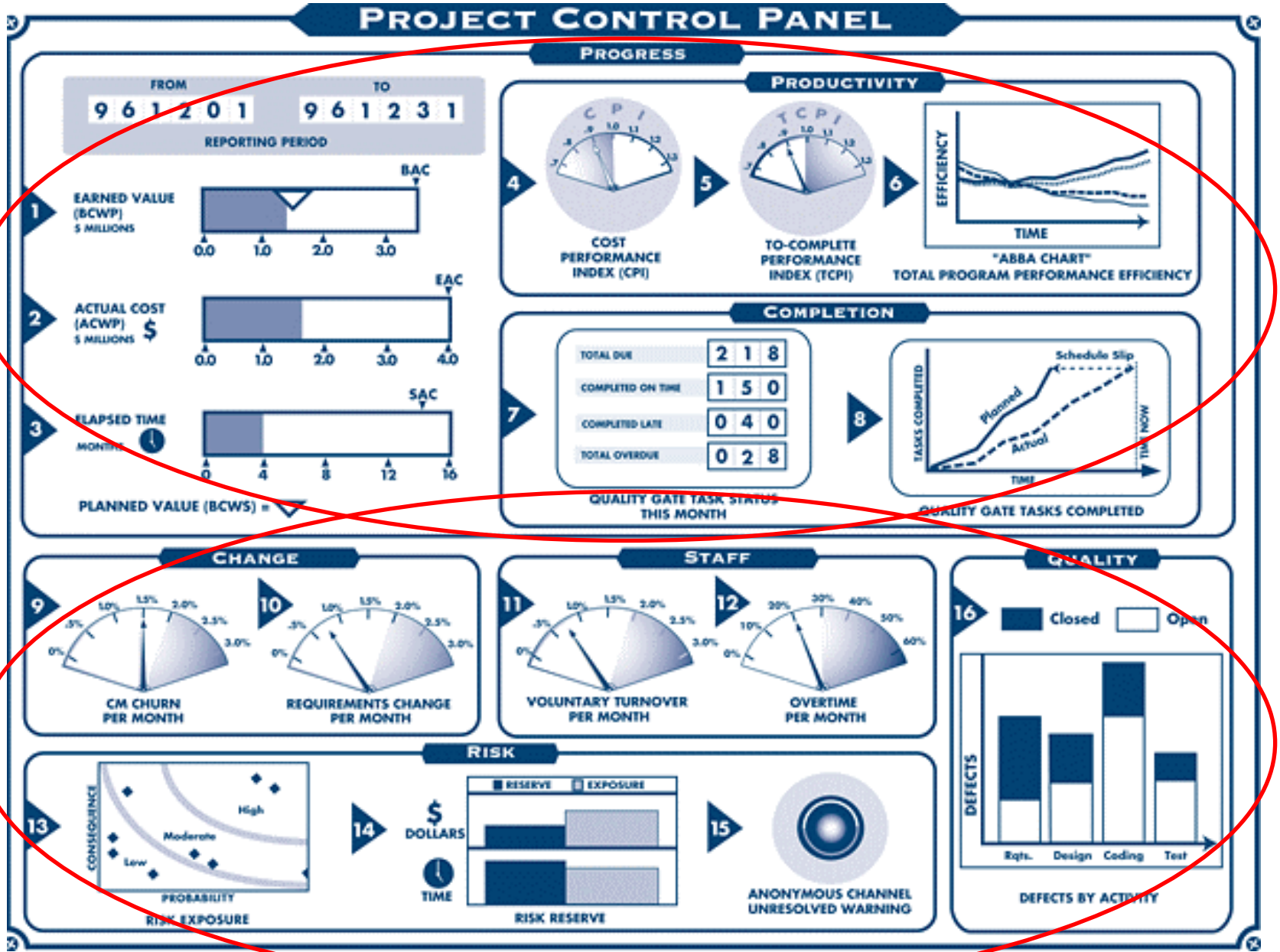


Software Volatility Indicator



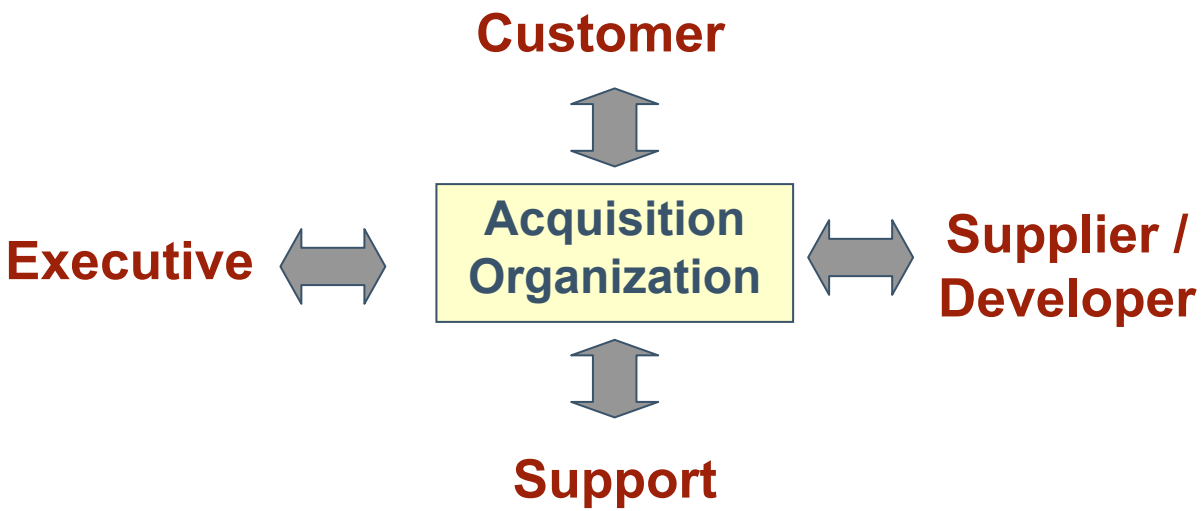


$$\text{Volatility} = \frac{\text{Number of modules changed because of a SW maint. request}}{\text{Total number of modules in a release over time}}$$



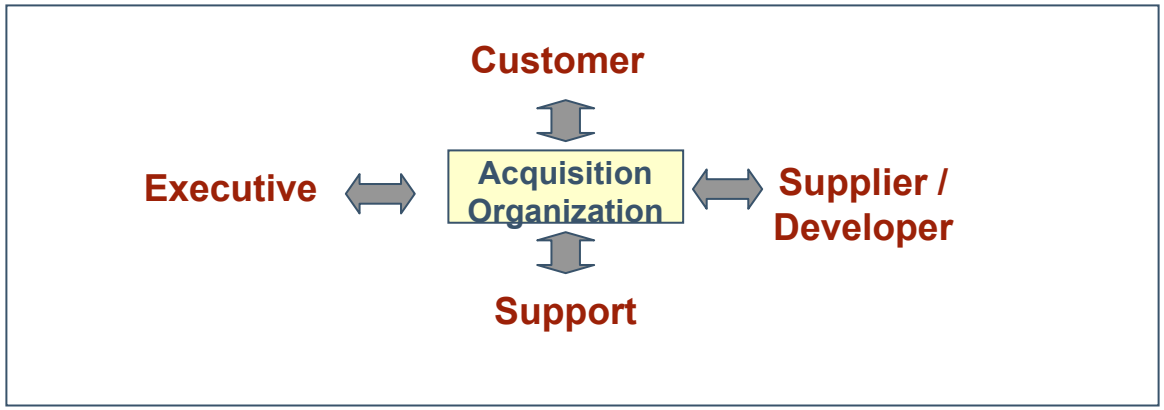
"The Program Manager's Guide to Software Acquisition Best Practices, 1997

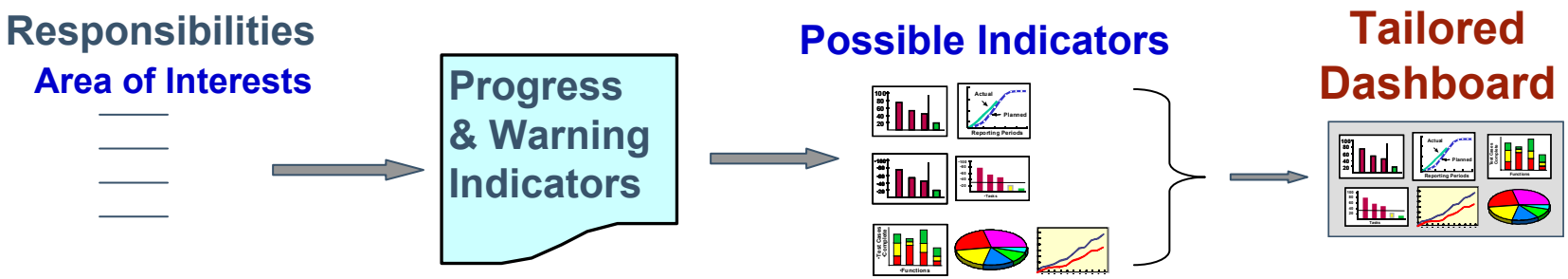
Acquisition Environment



Each role has different responsibilities and different stakeholders, thus, they each have a different viewpoint.

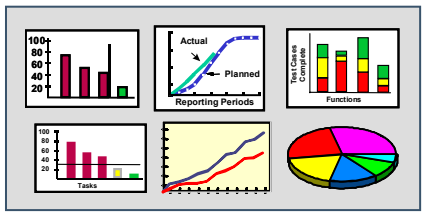
For Each Viewpoint





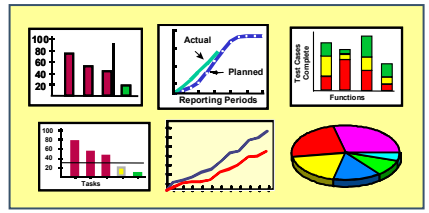
Customizing the Dashboard

Customer
Area of Interests
Tailored Dashboard



- Schedule adherence
- Quality of delivered products
- Risks
- Resources required and utilized
- Issue management

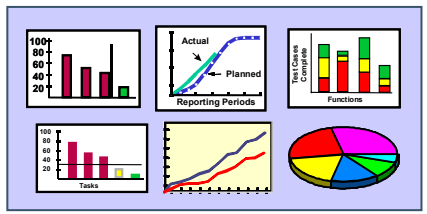
Acquirer
Area of Interests
Tailored Dashboard



- Process performance
- Product produced (Quality)
- Resources
- Risks

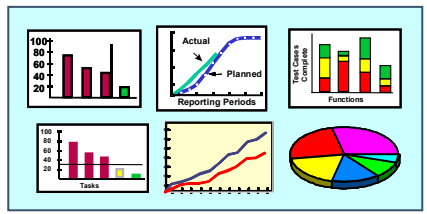
Acquisition Organization

Executive
Area of Interests
Tailored Dashboard



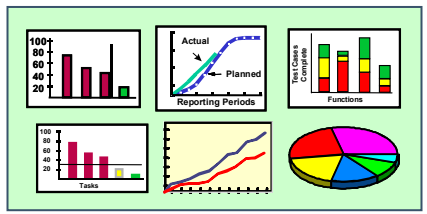
- Portfolio management
- Policy/guidance implementation
- Project management performance
- Program risk

Supplier / Developer
Area of Interests
Tailored Dashboard



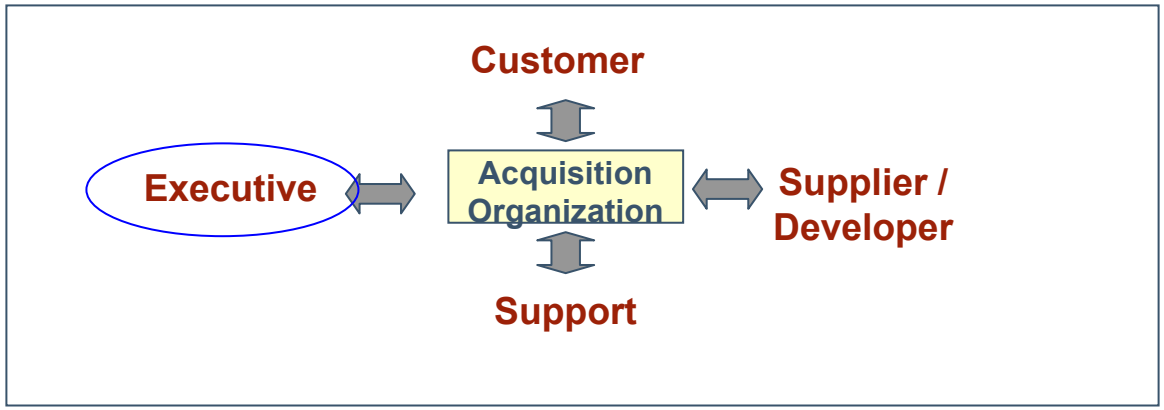
- Progress and costs
- Process used
- Quality of delivered products
- Risks
- Key Contacts
- Relationship

Support
Area of Interests
Tailored Dashboard



- Process used
- Resources required and utilized
- Relationship

Executive Role



What information needs and responsibilities do the Executives have?

Who are their Stakeholders?

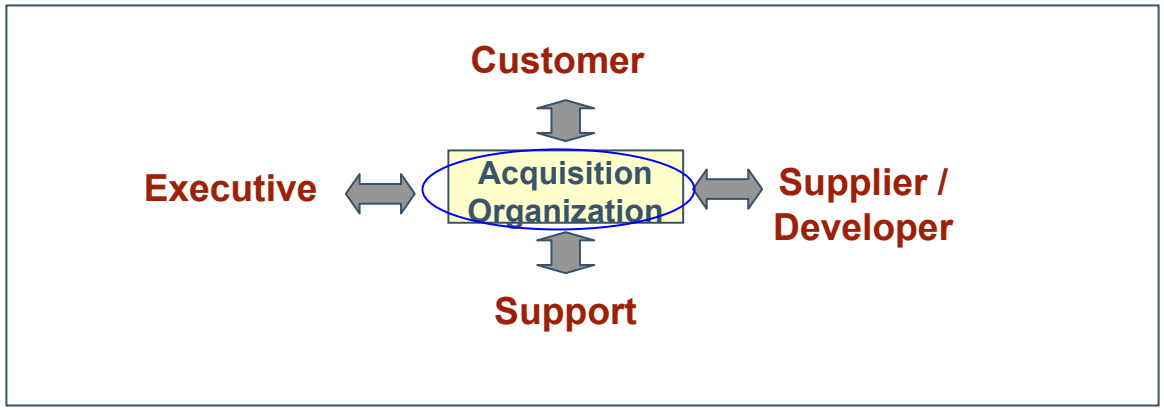
What do the Executives want to know?

Executives make commitments to customers and stakeholders about mission, schedules and costs.

Based on these commitments, they make investment decisions.

- Will the product suit the mission need?
- Will I keep my commitments to customers and stakeholders, or will I need to renegotiate?
- Is the investment sufficient or will I need to reallocate funds and resources from other projects?

Acquisition Team



What information needs and responsibilities does the Acquisition Team (not just the PM) have?

Who are their stakeholders?

Acquisition Team

The acquirer needs to watch his own processes and process improvement projects.

- What are your critical processes?
- What is your performance on critical processes?
  - Cycle time, effort, rework, productivity
  - *Rework is also an indicator of product quality*
- What process improvement efforts and internal projects are underway?
- Do your outputs/deliverables meet their intended purpose?

Acquisition Team Status

The acquisition team should be concerned about:

- Work Tasking
- Schedule dependencies with other teams
- Its contribution to project progress
  - Productivity
  - Performance
  - Rework
  - Effects of change management
- Clear communications
  - issues, action items, risks and change requests
- Morale and staffing issues.

Acquisition Team Meeting

Review the dashboard

Assessment & Discussion

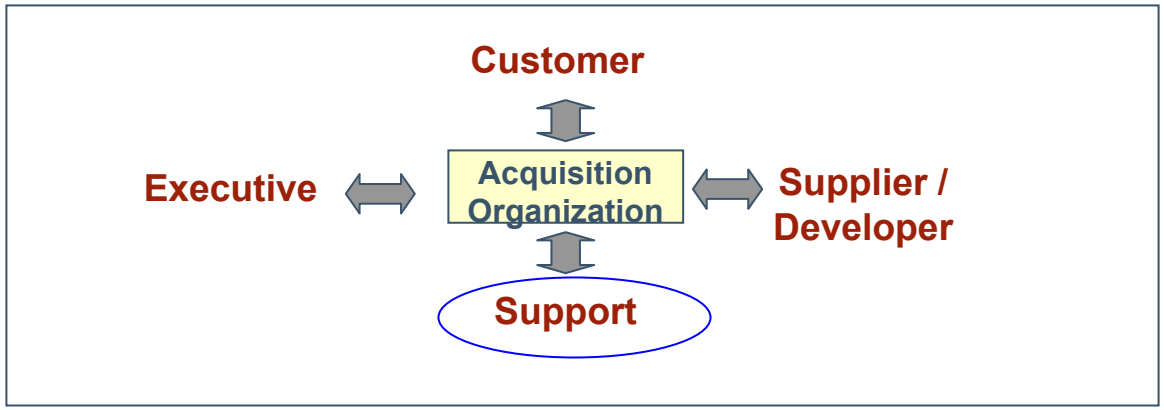
- What does the data tell us?

Near-term task assignments

Risks, Issues & Action Items

- Counts of these items provide a measure of uncertainty.

Support Team



What information needs and responsibilities does the Support Team have?

Who are their Stakeholders?

Support Team

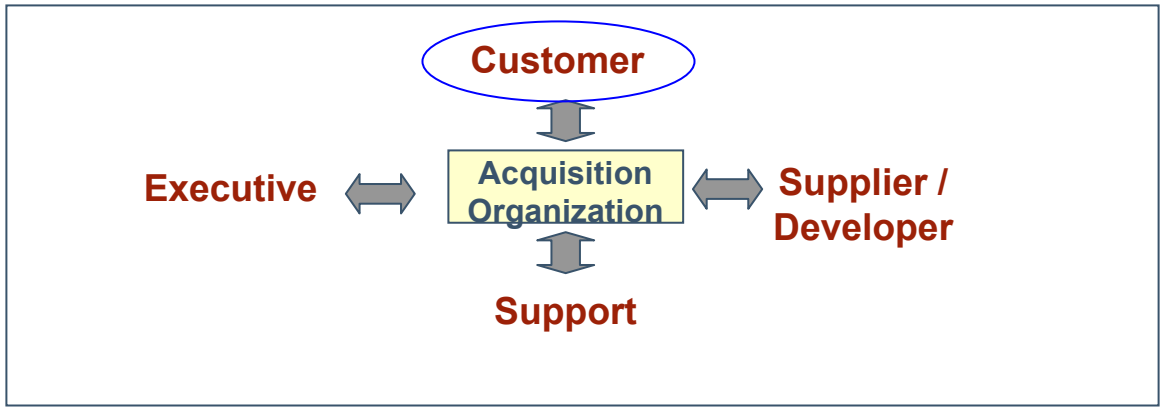
Information needs:

- Schedule adherence
  - affects resource scheduling, logistics, facility schedule
- Resources required

Progress and Warning Indicators

- Process performance
  - Reviews, integration, …(?)
- Other issues and action items
- Resources utilized vs. planned
- Risks (may be customer generated or caused)
- Do their outputs/deliverables meet their intended purpose?

Customer/User



What information needs and responsibilities does the Customer/ End User have?

Who are their Stakeholders?

Customer/User

Information needs:

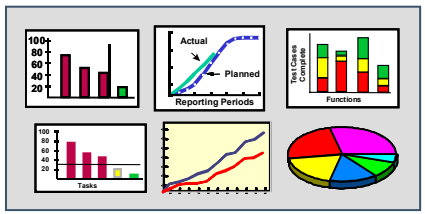
- Schedule adherence
  - affects resource scheduling, logistics, facility schedule
- Resources required
- Product quality

Progress and Warning Indicators *from* Customers

- TBD Requirements
- Other issues and action items
- Validation and review process performance
- Resources utilized vs. planned
- Risks (may be customer generated or caused)

Customer

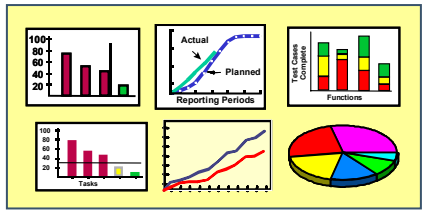
Area of Interests
Tailored Dashboard



- Schedule adherence
- Quality of delivered products
- Risks
- Resources required and utilized
- Issue management

Acquirer

Area of Interests
Tailored Dashboard

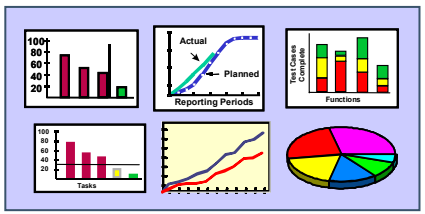


- Process performance
- Product produced (Quality)
- Resources
- Risk

Acquisition System

Executive

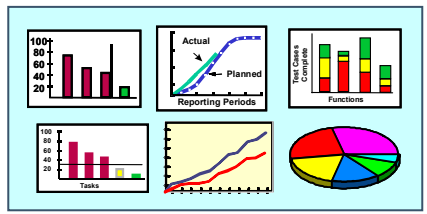
Area of Interests
Tailored Dashboard



- Portfolio management
- Policy/guidance implementation
- Project management performance

Supplier / Developer

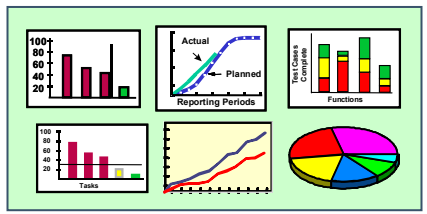
Area of Interests
Tailored Dashboard



- Progress and costs
- Process used
- Quality of delivered products
- Risks
- Key Contacts
- Relationship

Support

Area of Interests
Tailored Dashboard



- Process used
- Resources required and utilized
- Relationship