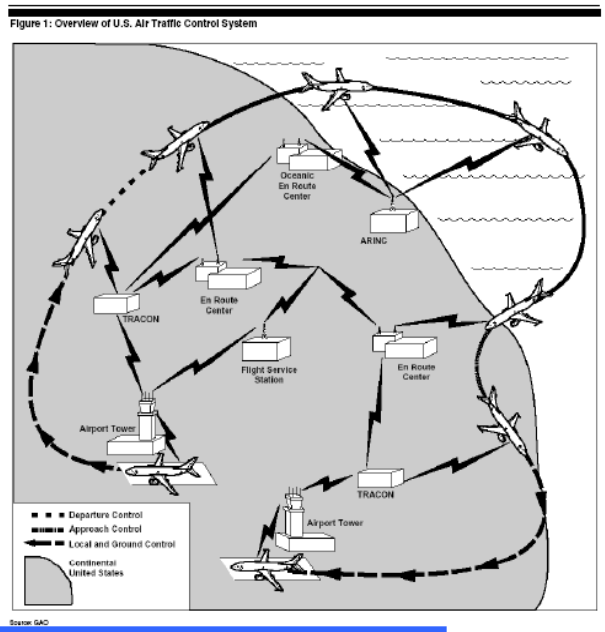
Achieving Acquisition Excellence - Making It Happen Effectively

Support Systems Associates, Inc. 800 Park Drive Warner Robins, GA 31088

"Achieving Acquisition Excellence via Effective Systems Engineering."
26 – 29 October 2009 San Diego, CA

29 October 2009



James E. Jones

Commitment to Excellence – Enabling acquisition organizations to achieve acquisition excellence

Content

- Objectives
- A Software Acquisition Journey
- Software Acquisition Challenges
- Key Acquisition Elements
  - The Contract
  - The Acquisition Environment
  - Requirements Management
  - Risk Management
  - Technical Performance Assessments
  - Software Test Evaluation
  - Performance Measurements
- Summary

Objectives

- Illustrate how effective Software Engineering Advisory and Assistance Services enable acquisition organizations to achieve acquisition excellence
- Provide Key Acquisition Elements for enabling acquisition excellence
  - The Contract, The Acquisition Environment, Requirements Management, Risk Management, Technical Performance Assessment, Software Test Evaluation, and Performance Measurements
- Provide detailed Practical Examples from major military and federal programs

Knowledge of failure helps lead to success

A Software Acquisition Journey

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Programs	Roles
C-130 AMP ***Software Engineering Advisory and Assistance Services*** ***- 8 years***	***Integrated Product Teams Support*** **Systems Integration Facility (SIF)** **Operational Flight Program (OFP) Software** **Systems Requirements, Design & Test**
C-130J Hercules ***Software Subcontract Management*** ***- 4 years***	***Supplier Manager*** **Review and approve SDRL items** **Monitor supplier activities** **Witness acceptance testing** **Coordinate with FAA DER**
FAA NAS Plan Programs ***Software Engineering Advisory and Assistance Services*** ***– 10 years***	**System Development Manager (AAS)** **SPO Software Lead (TDWR)** **Software Subject Matter Expert (e.g., VSCS, MLS[1], RCE[1], NADIN II, MCCP/MCC[2])** 1 Terminated for Default: Deposed by AT&T (RCE), GAO Audit (MLS) 2 Terminated for Convenience

Plus a foundation of 19-years Software Development and Process Improvement
United States Patents #4451702, #4479034

Examples of FAA NAS Programs

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Advanced Automation System (*AAS*) ***Cornerstone of the NAS Plan***	° 1984, $276.7 million Competitive Design Phase Contract – *IBM Federal Systems* and *Hughes Aircraft* ° 1988, $3.6 billion Fixed-Price, – *IBM Federal Systems* Statement of Work ° Replace computer hardware and software at ATC facilities-Airport Towers, Terminal Facilities, and En-Route Centers, 99.99999% Reliability.
Microwave Landing System (*MLS*)	° 1984, $90.6 million Fixed-Price First Production – *Hazeltine Corporation* System Overview ° Landing aid to enable planes to fly a wide variety of approach paths to airport runways.
Radio Control Equipment (*RCE*)	° 1986, Fixed-Price Contract (DTFA01-86-C-00034) - *AT&T Company Federal Systems Advanced Technologies* System Overview ° Provides pilots communications links with air traffic controllers.

Examples of FAA NAS Programs

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Voice Switching and Control System (VSCS) Upgrade

- 1992-Contract Award-$1.3 billion, *Harris Corporation*

System Overview

- Allows air traffic controllers to communicate with pilots and other air traffic controllers at 23 Air Route Traffic Control Centers (ARTCC)
- Independent distributed processors and voice switches, fault-tolerant databases, redundant high-speed bus interconnections, operational availability – 0.9999999

Terminal Doppler Weather Radar (TDWR)

- 1988, Firm Fixed-Price Incentive contract – *Raytheon Systems Company*

Develop, produce, and install 47 TDWR at 45 airport sites

System Overview

- Detects and reports hazardous weather in and around airport terminal approach and departure zones
- Identifies and warns air traffic controllers of low altitude wind shear hazards caused by micro-burst and gust fronts
- Reports on precipitation intensities
- Provides early warning of wind shifts

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Software Acquisition Challenges

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Why is Software Acquisition a Challenge?

- Studies have shown that ***technical performance, cost, and schedule risks*** are inherent in delivering quality software products within cost and schedule constraints [GAO 1999]
- 75% of all large scale software systems fail
  - [Software's Chronic Crisis, W Wyat Gibbs, 1994]
- Design constraints make software acquisition and development mission critical
  - **Examples of design constraints**
    - Application domain (real-time embedded systems of systems),
    - Software size
    - Complexity, Throughput/Timing
    - High-integrity
    - Reliability
    - Safety-critical

The Software Crisis Is Still With Us!

Software Acquisition Challenges

Why is Software Acquisition a Challenge?

- Software size is the critical factor in determining cost, schedule, and effort [Jones 2004] [Jones 1999]
  - Software size typically driven by the supplier's agreement terms –
    - Contract vehicle (Fixed-Price, Cost-Reimbursement)
    - Statement of work
    - Deliverables (Contract Data Requirements List-CDRL)
    - Technical requirements (safety-critical)
    - Supplier's software development capability/maturity
- Software Acquisition Team – Inability to recognize quality work

"Acquirers must recognize quality work before they can require and accept it"

----Watts Humphrey, 2009

Examples of Acquisition Problems

- Cost and Schedule Overruns
- Software Performance Issues
  - Underestimate software size and complexity
- Lack of Software Acquisition Capability Maturity
  - Ability to specify software contractual requirements
    - Functional and Non-Functional
  - Unable to recognize product quality
  - Lack of software expertise in acquisition, project management, and the application domain

Examples of Acquisition Problems

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FAA NAS Programs

o AAS	o Inadequate requirement baseline control o Cost and Schedule Overruns o Restructured in 1994 **– contract cost increased from $3.6 billion to $7.6 billion**
o NADIN II	o Cost and Schedule Overruns
o MCCP/MMC	o ***Termination for Convenience***
o MLS	o ***Termination for Default***
o RCE	o ***Termination for Default (DOT BCA No. 2479) (FAR 52.249-8)***

Success in Acquisition

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FAA NAS Programs

- TDWR[1]
  - Delivered First Production Unit ***six months early***
  - Received IEEE Computer Society award
  - Operational at 45 Airports
  - 1991, software process evaluated a SEI CMM® Level 3

® CMM registered in the U.S. Patent and Trademark Office by Carnegie Mellon University

Acquirer and supplier capability / maturity levels matched

- VSCS Upgrade
  - Production completed
  - 100% on-time system delivery of all 23 systems
  - FAA Contractor of the Year Award
  - Human Factors Engineering Society Award

1 *Successful Acquisition of FAA Terminal Doppler Weather Radar*, Third Annual Conference on the Acquisition of Software-Intensive Systems (Experience Track, 26 January 2004). [Jones 2004-1]
http://www.sei.cmu.edu/programs/acquisition-support/conf/2004-presentations/jones.pdf

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The Contract

- Contract Administration
- Contract Types
  - Fixed-Price
  - Cost-Reimbursable
- Contact Data
  - Statement of Work (SOW)/Statement of Objective (SOO)
  - Contract Data Requirements List (CDRL)
  - System Specification
  - Data Rights

The Contract is the foundation for acquisition success

Contract Administration

- The **Contract** is a mutually binding legal relationship obligating the seller (supplier) to furnish products or services and the buyer (acquirer) to pay for them.
- **Acquisition management** involves obtaining products or services through a contractual agreement.
- **Contractual authority** – delegated to an Administrative Contracting Officer (ACO)/procuring contracting officer (PCO)

The **acquirer** specifies
- What the system requires
- When the system is needed
- How the system will be accepted

Concerns
- cost
- schedule
- technical

The **supplier** determines
- How the system will be produced
- The resources required (examples)
  - people, equipment
  - facilities

The degree of interaction depends on the nature of the development effort and the type of contract

Contract Types

- Basic Compensation Schemes used in Contracts
  - ***Fixed-Price***
    - Acquirer pays the supplier a fixed sum
    - The supplier assumes the risk
    - Profit is a direct function of supplier's ability to deliver the product or service
  - ***Cost-Reimbursement***
    - Acquirer agrees to reimburse the supplier's allowable costs plus profit
    - The risk is shared

The degree of acquirer/supplier relationship depends upon the contract type

Contract Data

- Why have Contract Data?
  - Contract vehicle must clearly express a vision of the final product and the development effort
  - Software acquisition issues must be addressed in the Request-For-Proposal (RFP) via contract data
- Key *Software-Related* Contract Data in the RFP
  - Statement of Work (SOW)/Statement of Objective (SOO)
  - Contract Data Requirements List (CDRL) Items
  - System Specification
  - Data Rights

Success of an acquisition is directly linked to the quality of the RFP --- (Army 2007)

SOW/SOO

- What is the Statement Of Work (SOW) / Statement Of Objectives (SOO)?
  - Basis for communicating acquirer requirements to the supplier
    - SOW defines specific tasks
    - SOO defines objectives
  - Primary document for translating management requirements into contractual tasks / objectives
  - Sufficient detail must be provided to allow the supplier to scope the effort, cost it, and provide a responsive technical solution
  - Tasking information must be defined for the preparation of deliverable data (artifact)
    - Each tasking statement reference applicable ***Contract Data Requirements List*** (CDRL) item which will be delivered by that task.

SOW/SOO

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- Examples of Key Software Tasking
  - ***Software development process***
  - ***Software management***
  - ***Software engineering*** – software requirements analysis, preliminary design, detailed design, code and unit test, integration, and formal qualification testing
  - ***Software tools and environment***
  - ***Risk management***
  - ***Technical reviews*** – *Software Specification Review (SSR), Preliminary Design Review (PDR), Critical Design Review (CDR), and Test Readiness Review (TRR)*
  - ***Technical Interchange Meetings***
  - ***In Process Reviews***

The SOW/SOO must not tell the supplier how to do the required work
The SOW/SOO must not specify selection of major software components

Contract Data Requirements List (CDRL)

- Software Data (artifacts)
  - ***Absolutely essential*** for managing the development process
  - A natural by-product of the development effort to capture results of each activity
- Contract Data Requirements List (CDRL) Items
  - Primary vehicle for acquiring software data
  - A list of authorized data requirements for a specific procurement that forms a part of the contract.
  - Defense Federal Acquisition Regulation Supplement (DFARS) ***Subpart 215.470 Estimated Data Prices*** requires a CDRL (DD Form 1423) when delivery of data is required
  - CDRL items must be referenced in the Statement of Work (SOW) describing the development effort
  - Language must be consistent with the SOW

Key CDRL Item Requirements

Block	Description
4	Authority (Data acquisition Documentation No.) Data Item Description (DID[1]) – Defines format and content preparation instructions for data product generated by task requirements ***Assist-Quick Search*** used to access the current DID 1 Should be tailored to meet contract requirements (Block 16)
5	Contract Reference - Reference Statement of Work paragraphs
6	Requiring Office – Organization have primary responsibility for reviewing the data and recommending acceptance/rejection of the data
8	Approval Code - (A) Approved by the Contracting Officer Should specify approval at each milestones (e.g., SSR, PDR, CDR, etc.)
10, 11, 12, 13	Delivery Requirements Should be associated with milestones (e.g., SSR, PDR, CDR, etc.) - 30 days prior to the milestone

CDRL Lessons Learned

- Software CDRL items **should** be delivered prior to the technical reviews to allow significant time to enable:
  - Acquirer to perform a detailed review
  - Supplier to disposition the review comments
  - Acquirer to provide feedback to supplier disposition
- Technical review **should** include review of supplier disposition and feedback
- Software CDRL items **should** be prepared by the software team
  - Reviewed by all applicable distribution addressee organization
  - Approved by either the appropriate Chief Engineer, Program Manager or Data Requirements Review Board

CDRL Lessons Learned

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- Typical Software CDRL Items
  - **SOFTWARE REQUIREMENTS SPECIFICATION (SRS) –*DI-IPSC-81433A***
    - *Describes the behavior of the software to be developed and methods to be used to ensure each requirement has been met*
    - *Basis for the design and qualification*
    - **Interface Requirements Specification (IRS) – DI-IPSC-81434A may be appendix to SRS**
  - **SOFTWARE DESIGN DESCRIPTION (SDD) – *DI-IPSC-81435A***
    - *Describes the design and detailed design needed to implement the software*
    - **Interface Design Description (IDD)-DI-IPSC-81436A, may be appendix to SDD**
    - **Database Design Description (DBDD)-DI-IPSC-81437A, may be appendix to SDD**
      - *Describes the data base design and elements (content and format)*
  - **Software Test Plan (STP) – *DI-IPSC-81438A***
    - *Describes plans for qualification testing, test environment, identify tests to be performed, and schedule*
  - **Software Test Description (STD) –*DI-IPSC-81439A***
    - *Describes the test preparation, test cases, and test procedures to be used to perform the qualification testing*
    - **Enables the acquirer to access the adequacy of the qualification testing**
  - **Software Test Results (STR) – *DI-IPSC-81440A***
    - *A record of the qualification testing*
    - **Enables the acquirer to access the testing and its results**
  - **Software Version Description (SVD) – *DI-IPSC-81442A***
    - ***Identifies and describes a software version (“as-built” software)***

System Specification

What is the System Specification?

- Establish top-level technical performance, design, development, integration, and verification requirements
- Examples of requirement statements
  - All software related to operation in civil airspace **shall** be modified or developed in accordance with the requirements of RTCA DO-178B or equivalent level of safety
  - All newly developed software **shall** be written in a higher order language (HOL)
  - Meteorological algorithms **shall** be implemented in high order language (HOL)
  - Use of commercial software **shall** be approved by the FAA

Data Rights

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- Data Rights
  - Enable the use, maintenance, and replication of the software data
- Data Rights Categories
  - **Unlimited rights** - right to use, modify, reproduce, release, in whole or in part, in any manner and for any purpose whatsoever, and to have or authorize others to do so. Software developed exclusively with acquirer funds.
  - **Acquirer Purpose rights** - rights to use, modify, reproduce, release, within the acquirer's organization/company without restriction. Software development with mixed acquirer and supplier funding.
  - **Restricted data rights** apply only to noncommercial computer software and mean that the acquirer's rights are as set forth in a Restricted Rights Notice. Supplier funds all development .

Secretary of the Air Force Memo - Data Rights and Acquisition Strategy (3 May 06) - directing the acquisition of technical data and associated rights to be addressed specifically in all Acquisition Strategy Plans, reviews, and associated planning documents for Acquisition Categories (ACAT) programs – software intensive systems and subsequent source selections.

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The Acquisition Environment

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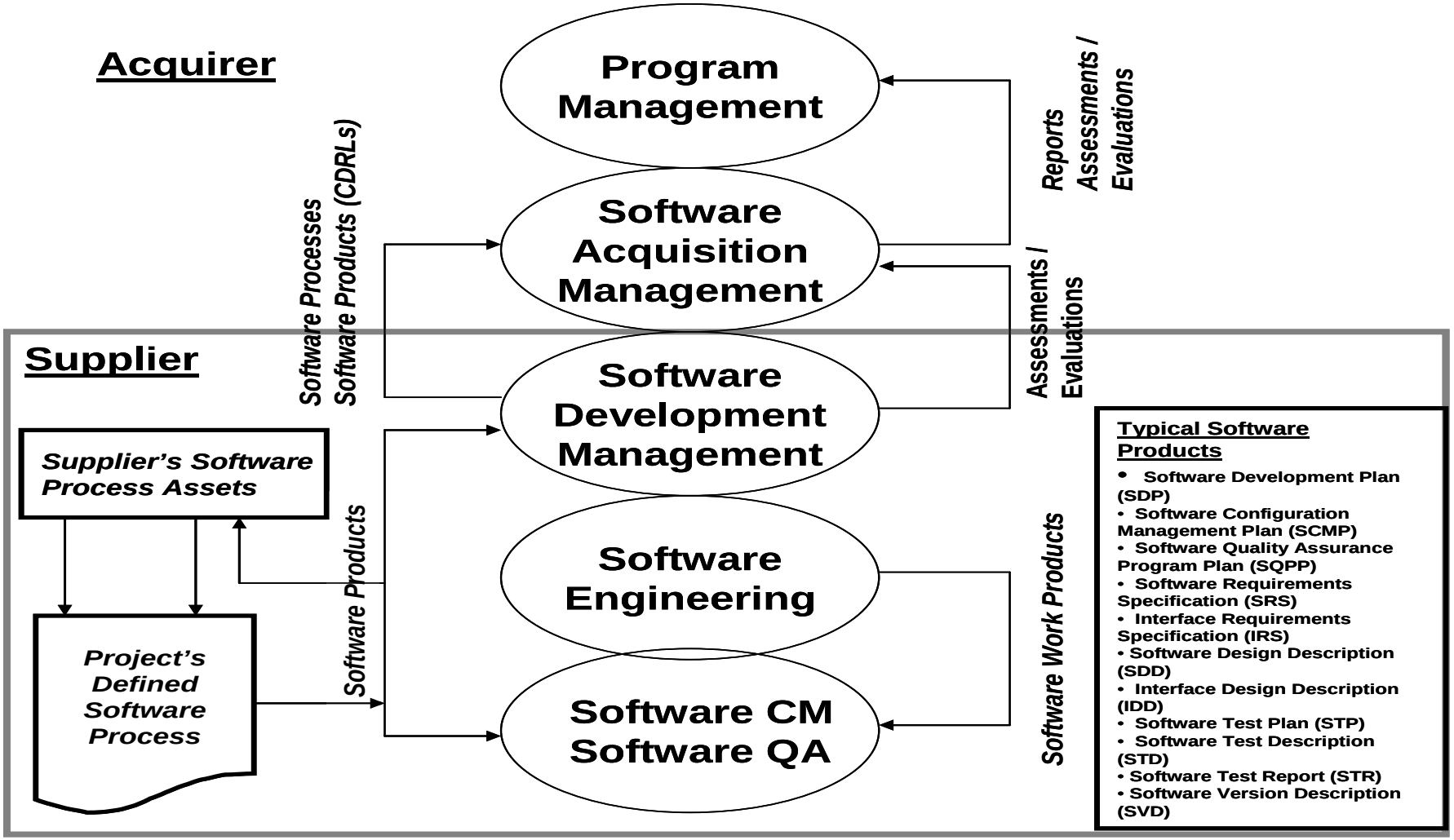

Best Practices: Better Matching of Needs and Resources, will lead to Better Weapon Systems Outcomes…GAO 2001

Acquirer

- Acquirer Capability Maturity
  - Software acquisition team must have software expertise in application domain, acquisition, process, project management, engineering, and safety, as needed
  - A software lead must be designated to be responsible for establishment and managing the software acquisition activities
  - The software acquisition team must have adequate resources and funding to perform the acquisition activities
  - The software acquisition team must be trained (Examples)
    - *Software Acquisition Management*
    - *Application domain (Radar, Communications Systems, etc)*
    - *Processes, Procedures, Standards being used*
    - *Technologies, Tools, Methodology being used*

"Acquirers must recognize quality work before they can require and accept it"

----Watts Humphrey

Example of FAA AAS SPO System Development

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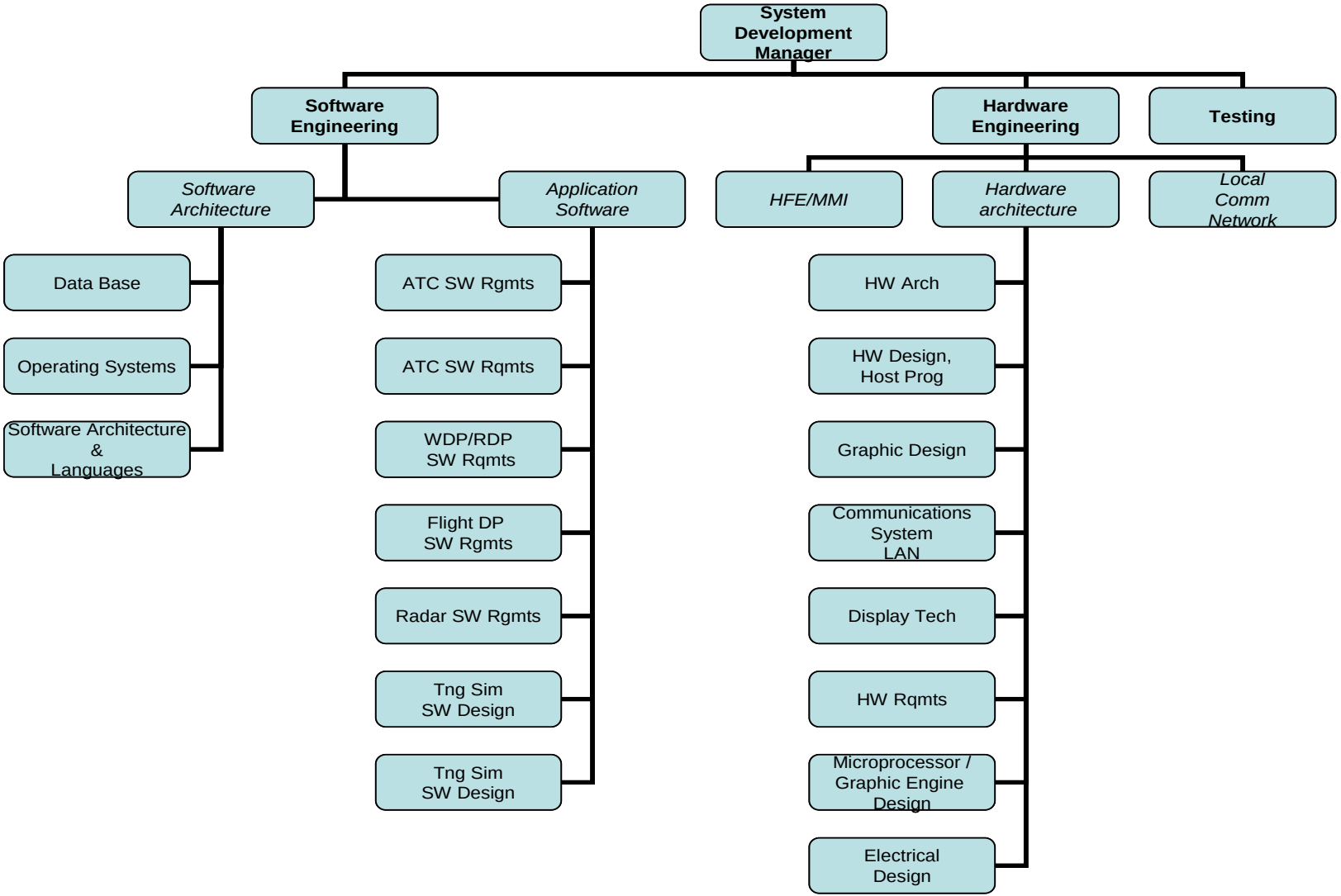

Supplier

- Supplier Capability Maturity
  - A set of software process assets must be established and maintained
  - The project must develop a defined software process by tailoring the organization's standard processes
  - Software plans (**software development plan (SDP), software configuration management plan, and software quality assurance plan**) must be documented and institutionalized
  - The SDP must provide the acquirer with:
    - Insight into the processes, procedures, and desk instructions
    - Tools and methods used
  - Development environment must be augmented by management practices
    - Measuring and monitoring progress
    - Judging the quality of the software
    - Validating the deliverable
    - Conducting technical reviews and in-process reviews

Typical Software Process Definition

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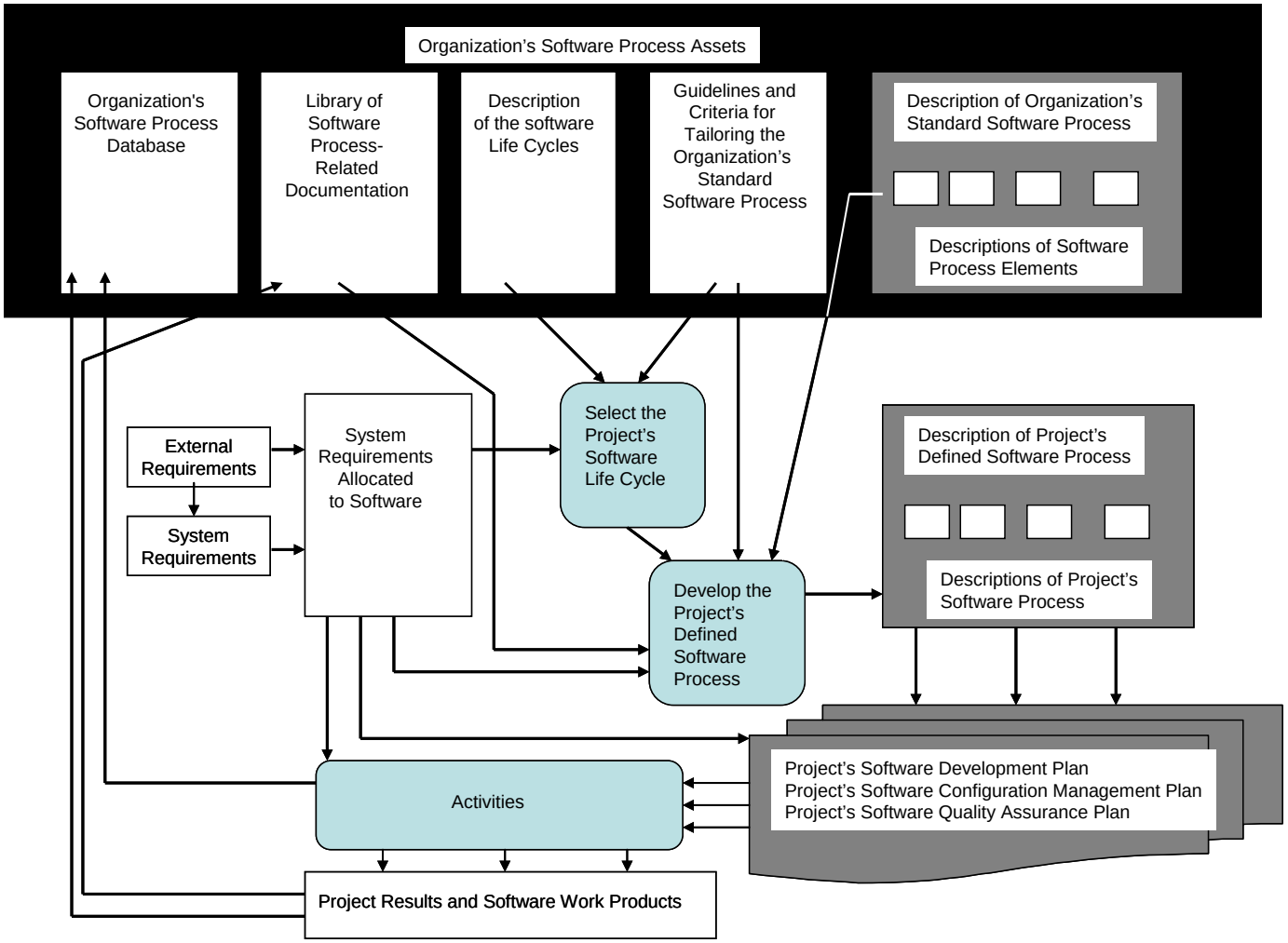

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Requirements Management

- Requirements change for variety of reasons
  - Additional requirements are derived or changes made to the existing requirements
- ***Requirements Management*** involves establishing and maintaining bidirectional traceability of requirements, design, source code, and test to ensure the right product is being built
- Bidirectional traceability is required by CDRL item DID
- Bidirectional traceability is essential for Safety Critical
- Supplier must manage changes and identify any inconsistencies
- Supplier must track measures of requirements volatility

Requirements management is fundamental to a controlled and disciplined engineering design process [CMMI 2006]

Bidirectional Traceability

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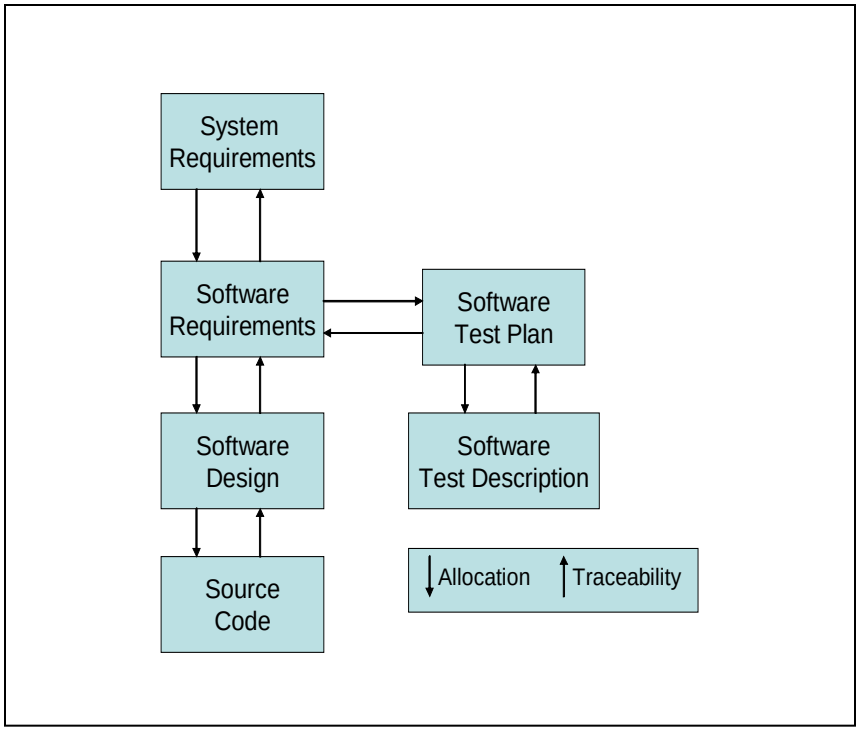
- Required by the CDRL item DID
- Allocation ensures the right products been built
- Reduce effort required to determine change impact
- Traceability ensures the evolving product is not expanding the scope
- Should be Documented in a requirements database
  - DOORS®, RTM



Bidirectional traceability

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Risk Management

- Why Manage Risks?
  - Risk is like fire: if controlled it will help you; if uncontrolled it will rise up and destroy you…
    - Theodore Roosevelt
  - ***Technical performance***, ***cost***, and ***schedule*** risks are inherent in software intensive systems development [GAO 1999]
  - One key obstacle is the inability to see cost and schedule issues as symptoms of unforeseen problems
    - Software size growth, requirements growth, complexity, ability to perform
  - Air Force expects the acquisition communities to address ***Risk Management*** throughout the life cycle of the acquisition program [DoD 2004]
    - Continuously identify and manage risks
    - Ensure the risks, impact, and mitigation plans are appropriately addressed during program reviews.
  - ***Risk Management*** is a process element of the 10 Life cycle Processes of Operational Safety Suitability and Effectiveness [AFMC 63-1201]
    - 1) Risk Management Planning, 2) Risk Identification, 3) Risk Assessment, 4) Identification of Risk Options, 5) Decision Analysis, 6) Implementation, and 7) Risk Monitoring

Risk Management

- Managing Risks
  - Establish a Risk Management Model to define a systematic process
  - Establish consistent Risk Statement to allow recognition of the impact or consequence
  - Establish a Risk Information System for identifying, analyzing, planning, tracking, and controlling risk.
  - Risk Information System should include - storage media, the procedures, and the tools for accessing the risk system

Example of Risk Management Model ---[Van Scoy 1992],

Tools
- **MITRE**
  - Risk Matrix
  - Risk Management Toolkit
- **AFMC [AMC 2007]**
  - Probability of Program Success (PoPS)

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Technical Performance Assessment

- How to Reduce the Risks, Increase the Reliability and Quality, and Ensure Compliance with Requirements
  - Software work products (artifacts) are ***absolutely*** essential for managing the development process
  - Gaining adequate visibility into the supplies' process, plans, and software products is key to technical performance assessments
- Technical Performance Assessment provide:
  - **Visibility** into the process, quality and reliability of the software products.
  - Feedback to improve the software process
  - Ensures compliance with requirements
  - Key technical performance assessments
    - ***Process***
    - ***Progress***
    - ***Software Product***

Acquirers must recognize quality work before they can require and accept it

----Watts Humphrey, 2009

Technical Performance Assessment

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- **Process Assessment** - Ensure software management, engineering, configuration management, and quality assurance activities compliance with contractual requirements and supplier's defined software process and plans

Process Assessment key focus is "what is done and the product being built"

- Examples of Software Plans
  - Software Development Plan (SDP)
  - Software Configuration Management Plan (SCMP)
  - Software Quality Assurance Plan (SQAP)

The Contract must provide mechanism to gain access to process and plans

Technical Performance Assessment

- Progress Assessment conducted to determine what is done
  - Contract SOW must specify Technical Reviews and Design Reviews to be held to determine progress, status, surface issues, and provide feedback. Examples:
    - **Technical Reviews (Examples)**
      - Program Management Review
      - Program Configuration Control Boards
      - Technical Interchange Meeting
      - In-Process
    - **Design Reviews** – used as quality gates (progress and quality)
      - (e.g., *Software Specification Review (SSR), Preliminary Design Review (PDR), Critical Design Review (CDR), etc)*
  - Supplier must conduct informal reviews such as Peer Reviews in accordance with supplier's defined process
  - Acquirer must participate in Technical Reviews and Design Reviews to
    - Gain visibility into the progress and status
    - Discuss issues/candidate risks
    - Provide feedback

Software Products Assessment

- Supplier must evaluate CDRL items prior to delivery and place under configuration control
- Supplier should deliver CDRL items prior to the technical review to allow significant time for detailed review and disposition of review comments
  - CDRL delivery and review comments disposition must be the entrance criteria for the technical review
- Acquirer must establish a CDRL review process
- Acquirer must complete the review within an agreed upon time after receipt of the CDRL items

Software Product Assessment

- Acquirer typical review process
  - Evaluation CDRL using evaluation criteria
  - Evaluation criteria examples
    - Compliance with DID format and content
    - Completeness (e.g., missing requirements, testing, interfaces, etc.)
    - Traceability (e.g., test traced to requirements, etc.)
    - Consistency with upper level documents
    - Internal consistency
    - Ambiguity of requirements (understandable, testable?)
    - Conflicting requirements
    - Test coverage of requirements
    - Appropriate analysis, design, and coding techniques used
  - Provide discrepancies and recommendations to supplier
  - Conduct meeting with supplier to disposition supplier responses.

Practical Examples

- FAA NAS (TDWR) Contract
  - 16 CDRL Items specified by the SOW
  - Submittal (preliminary and final) linked to design review (e.g., SSR, PDR, etc)
  - Acquirer approval within 30-calendar days
- Raytheon
  - 45 Total CDRL Items delivered
- TDWR Software IPT
  - Over 4300 Review Items Discrepancies approved

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Software Test Evaluation

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What is Software Testing?

- Software development involves a series of activities in which opportunities for human induced defects are enormous
  - 46% - 60% of all software defects originate in the software requirements analysis phase [Endves 1975] [Voges 1979]
- **Software Testing** is the quality assurance technique used to evaluate the "as-built" software product to ensure the probability of failure due to latent defects is low enough for acceptance
- Software testing typically consists of three levels of testing
  - *Unit Testing*, *Integration*, and *Formal Qualification Testing*

Software testing represents the ultimate evaluation of the software requirements, design, and coding activities [Jones 1993-1]

Software testing can make the software product more reliable and usable [Musa 1987] [Dunn1984]

Software Test Evaluation

- What is required in the Contract?
  - Unit Testing, Integration, and Formal Qualification Testing (FQT) activities and artifacts must be documented in the supplier's defined software process and the Software Development Plan
  - FQT activities and artifacts must be specified in the SOW Examples
    - Planning – **Software Test Plan** (CDRL item)
    - Test Description – **Software Test Description** (CDRL item)
      - Test Cases and Test Procedures
    - Test Results – **Software Test Report** (CDRL item)
  - Test Readiness Review (TRR) must be held prior to FQT execution to determine readiness
  - Software test artifact must be delivered at designated quality gates (i.e., PDR, CDR, TRR, and Product Release)
- Acquirer and Supplier's Software Quality Assurance must witness all FQT execution

Software Test Evaluation

- Problem Reporting/Tracking
  - Supplier process must be institutionalized to:
    - Document problems identified during FQT and to track the problems to ensure closure
    - Determine the severity of all problems detected
    - Control changes to the software products under configuration control
    - Analyze the changes to determine impact to the work product, related work product, and schedule
    - Analyze the problem closure to determine the impact to the software release milestone

Change control system should be used to determine the aspects of process improvement and effectiveness of previous activities

Typical Problem Report Life Cycle

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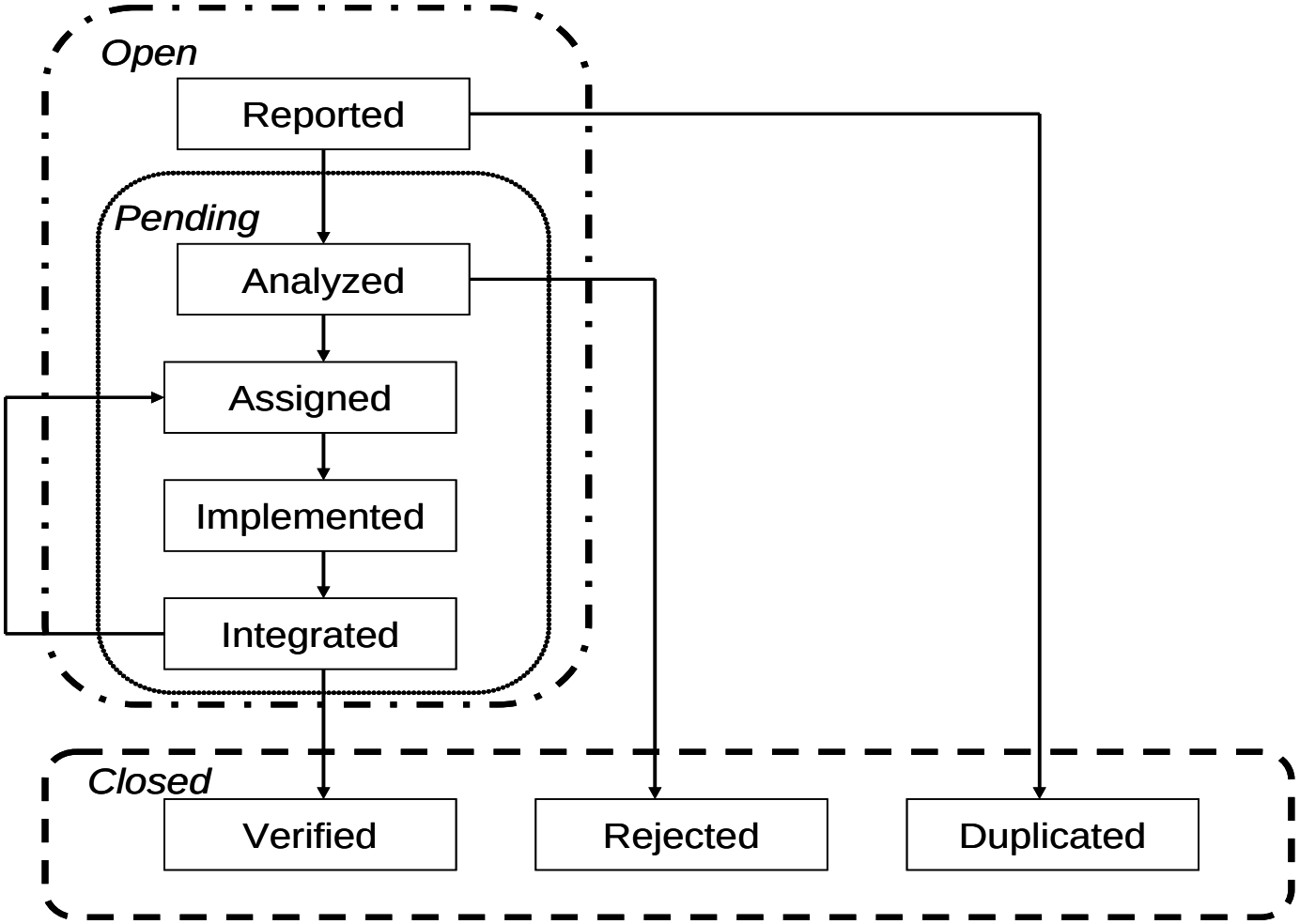

Software Test Evaluation

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How much testing is enough?

- Complete test coverage is generally not possible [Jones 1993-1]
- ***Test Case*** design methodology must be documented
- Acquirer and supplier must mutually agree on completion criteria Examples
  - Completion of a number of test runs with no open priority 1 and 2 severity problems
- Acquirer and supplier should establish a failure intensive objective (FIO) using a software reliability growth model: Examples
  - Time-Between-Failure Models
  - Error-Count Model

Acquirer and supplier face a difficult decision when to release the software product
Complete test coverage is generally not possible…[Jones 1993-1]

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  - Risk Management
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  - Software Test Evaluation
  - Performance Measurements
- Summary

Performance Measurement

Why Measure Performance?

- Software development is ***often out-of-control***. *You cannot control what you cannot measure*…[DeMarco 1982]
- **Performance Measurement** is key to managing and producing quality software and is an essential element of software process improvement [Humphrey 1989]
- National Defense Acquisition Act Section 804-2003 mandate
  - *Metrics for performance measurement and continual process improvement*

How to Measure Performance?

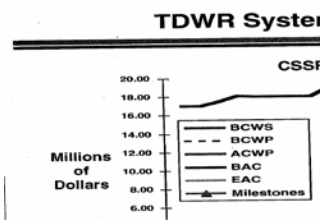
- *Software Measures* **should** be captured to document actual-versus-plan and to identify problems
- Software Measures **should** be selected that are directly measurable to evaluate progress and identify significant predictors [Jones 2004]
- Software Measures **should** be selected to provide insight into four key acquisition areas:
  - ***Process*** – insight into the software development process and how it is working
  - ***Product*** - insight into the quality of the product (frequency of requirement changes, number of problems, review comments)
  - ***Project*** - schedule attainment, CDRL delivery
  - ***Productivity*** - rate at which the work is progressing

Performance Measurement

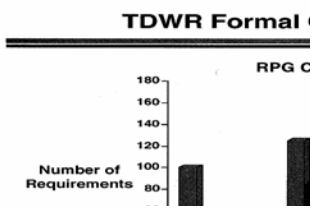
- How to use Software Measures?
  - Provide overview of development progress
  - Early-warning for detecting process and quality issues
  - Provide feedback to refine the process and contribute to positive control
- Typical software measures
  - ***Software size***
  - ***Cost/Schedule deviation***
  - ***Schedule progress***
  - ***Activity progress***
  - ***Requirements stability***
  - ***Resource tilization***
  - ***Documentation (Artifact) review item discrepancies***

Examples of Performance Measures

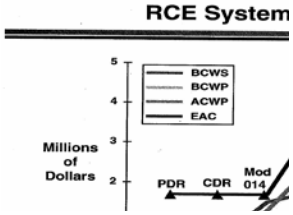
Support Systems Associates, Inc. 800 Park Drive Warner Robins, GA 31088



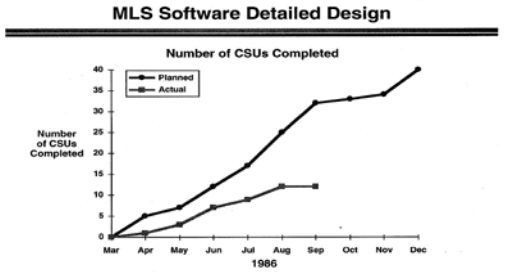
Cost/Schedule Deviation

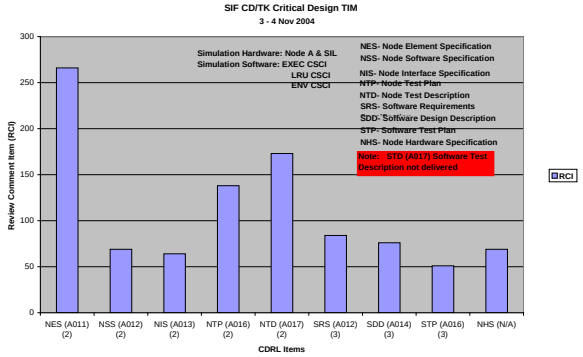


FQT Progress

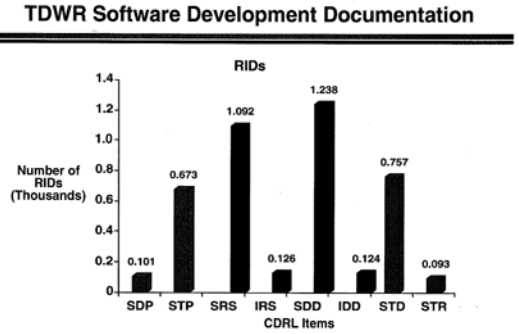


Development Progress





Document Review Item Discrepancies



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Summary

Achieving acquisition excellence…

- Receiving quality software delivered on time
  - THE CONTRACT ***must*** specify what is required
  - THE ACQUISITION TEAM ***must*** have the acquisition capability maturity to perform
    - **"Acquirers must recognize quality work before they can require and accept it"** ----Watts Humphrey, 2009
    - **The acquirer can negatively impact the supplier**
  - RISK MANAGEMENT ***must*** be performed to control the inherent performance, cost, and schedule risks
  - PERFORMANCE MEASUREMENTS ***must*** be performed to control the development activities

Summary

- Reducing the risks, increasing the reliability, and quality
  - TECHNICAL PERFORMANCE ASSESSMENTS ***must*** be performed to gain insight into the process and product quality
    - **Identify discrepancies in the process and products**
    - **Provide feedback to disposition of discrepancies**
    - **Vehicle for process improvement**
  - SOFTWARE TEST EVALUATION ***must*** be performed to ensure the “as-built” software product meets software requirements
  - REQUIREMENT MANAGEMENT ***must*** be performed to ensure the right product is being built at each phase throughout the lifecycle

Summary

- Improvements in Software Acquisition
  - Public Law 107-314 Section 804 of the National Defense Authorization Act, released in December 2002 [Section 804-2003]
  - Clinger-Cohen Act: Initiatives such as Software Assurance and Open Architecture
  - The best practice model Capability Maturity Model® Integration (CMMI®) for Acquisition
  - The White House, Memorandum for the Heads of Executive Departments and Agencies, ***Government Contracting***, 4 Mar 09
    - [http://www.whitehouse.gov/the_press_office/Memorandum-for-the-Heads-of-Executive-Departments-and-Agencies-Subject-Government-Contracting/]

Questions ?

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Commitment to Excellence – Enabling acquisition organizations to achieve acquisition excellence

Selected Publications and Presentations

- *Software Acquisition Management Practical Experience*, Systems & Software Technology Conference, 22 April 2009
- *Process Improvement in a Small Company*, Proceedings of the First International Research Workshop for Process Improvement in Small Setting, October 25
- *Successful Acquisition of FAA Terminal Doppler Weather Radar*, Third Annual Conference on the Acquisition of Software-Intensive Systems, 26 January 2004
- *Mission Success: Estimating Software Projects*, The International Society of Parametric Analysts, 26th Annual Conference, May 10, 2004
- *Estimating Software Size, Cost, and Schedule: Mission Success Through Life Cycle Process*, 1999 Joint ISPA/SCEA Conference, 1999
- *Conforming to ISO 9001: A Mission Success Solution to Product Development,* Lockheed Martin Management and Data Systems, 1997
- *Software Metrics Effectiveness in Software Acquisition Management*, 38th Air Traffic Control Association Fall Conference, 1993
- *Software Testing: Methods and Techniques*, 38th Air Traffic Control Association Fall Conference, 1993
- *Software Acquisition Management: Managing The Acquisition of Computer Software Using DoD-STD-2167A*, 37th Annual Air Traffic Control Association Conference Proceeding, November 1992

Acronyms

AAS	Advanced Automated System
ACAT	Acquisition Category
AMP	Avionics Modernization Program
ATC	Air Traffic Control
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CIP	Capital Investment Plan
CNS/ATM	Communications/Navigation Surveillance / Air Traffic Management
CO	Contracting Officer
COTS	Commercial Off-The-Shelf
CPAF	Cost-Plus Award Fee
CSCI	Computer Software Configuration Item
CY	Calendar Year
DCI	Document Comment Item
DER	Designated Engineering Representative
DFARS	Defense Federal Acquisition Regulation Supplement
DID	Data Item Description
DoD	Department of Defense
DOORS	Dynamic Object-Oriented Requirements Systems
ECP	Engineering Change Proposal
EMD	Engineering, Manufacturing and Development
FAA	Federal Aviation Administration
FFP	Firm Fixed-Price
FFPI	Firm Fixed-Price Incentive

FQT	Formal Qualification Testing
IDD	Interface Design Description
IRS	Interface Requirements Specification
MP	Mission Processor
NAS	National Airspace System
OFP	Operational Flight Program
OFP	Operational Flight Program
PCO	Procuring Contracting Officer
PDR	Preliminary Design Review
SCM	Software Configuration Management
SDD	Software Design Description
SOF	Special Operations Forces
SOO	Statement of Objective
SOW	Statement of Work
SPO	System Program Office
SQA	Software Quality Assurance
SRS	Software Requirements Specification
SSR	Software Specification Review
STD	Software Test Description
STP	Software Test Plan
STR	Software Test Report
SVD	Software Version Description
TRR	Test Readiness Review