Enterprise Process Integration within the Space and Airborne Systems Business Area of Raytheon

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November 16, 2005
Setting the Stage

- Raytheon is an industry leader in defense and government electronics, space, information technology, technical services, and business aviation and special mission aircraft.
  - The company is divided into seven major business units

- Space and Airborne Systems (SAS) is one of the seven business units that make up Raytheon
  - Conglomeration of programs from various legacy defense companies such as Hughes Aircraft, Texas Instruments and Raytheon Company
  - 2004 Revenue of $4.1 Billion
  - 13,000 employees
  - 4 geographic locations
    - El Segundo, CA
    - Goleta, CA
    - Texas
    - Mississippi
Setting the Stage

Each location had their own set of processes, process improvement initiatives and goals

- El Segundo had been previously assessed at CMMI Level 3 for Systems and Software Engineering
- Texas had been previously assessed at CMMI Level 5 for Software Engineering and CMMI Level 3 for Systems Engineering

At the beginning of 2004, there were three sets of processes being developed and maintained within SAS

- Separate process groups working independently
  - Site specific
  - Discipline specific
Case for Action

- Increasing business need to share work between geographic locations
- Discipline-specific processes existed for Systems, Software, and Hardware Engineering
  - Across the sites we found we had separate but similar processes
  - As Hardware Engineering started down the process improvement journey, we realized many of the same processes would be needed
- Multiple CMMI appraisals would be needed and were planned due to the varying processes and goals
The Goal

- In July 2004, Jack Kelble, SAS President, made the strategic decision to integrate development processes across SAS
  - El Segundo already had a process architecture called the Enterprise Management System (EMS)
  - Only the El Segundo processes were integrated into this architecture

- Goal was to achieve CMMI Level 5 for Systems and Software Engineering and CMMI Level 3 for Hardware Engineering in 2005
  - As part of this goal, all engineering development processes were to be merged and integrated into EMS
  - In addition, one CMMI Class A appraisal was to be conducted for the entire SAS organization
Plan of Attack

• Execute this enterprise process integration effort like a program
• Determine an approach that would allow SAS to integrate processes across the entire organization in a very short period of time
• Develop a proposal describing how to accomplish the goal and identifying what resources would be required

• Pull the “best of the best” processes from across SAS to form the SAS standard process
• Create discipline-independent processes whenever feasible

Look for better solutions!
Plan of Attack

• Organize several teams to develop the plan to integrate the processes across the enterprise
  – Core Proposal Team
  – Numerous Mini-Teams
  – Management Review Team

• Create a unified Enterprise Process Group (EPG) for all sites and disciplines
  – Ensure representation from all sites on all teams and throughout the EPG Leadership Team
  – Reduce process improvement effort by maintaining only one set of processes and conducting a unified appraisal
Core Proposal Team

- Membership
  - Key process leaders from each site

- Responsibilities
  - Provide the overall roadmap for the proposal
  - Identify complete list of existing processes
  - Develop initial recommended list of discipline-independent processes
  - Divide the process list into numerous mini-teams by topic
  - Determine common terminology to be used for the SAS Directives
    - Procedure versus Directive
    - Work Instruction versus Procedure
  - Secure resources to work mini-team reviews
  - Establish process for mini-teams to review processes
  - Review recommendations and estimates generated by the mini-teams
  - Roll-up estimates and present plan to management
SAS Directive Structure

- **Policy**: Directive and establishes the commitment that cannot be tailored.
- **Bulletins**: Used to augment policy for a short time or for frequently changing needs.
- **Procedures**: Directive and may not be tailored. Contain detail on “What to do”.
- **Work Instructions**: Directive and may be tailored. Contain detail on “How to do”.
- **Enablers**: Not directive. Enablers are provided to support implementation of Procedures and Work Instructions.
  - Enablers are samples, templates, checklists, etc. for what should be considered when performing a task.
Mini-Teams

• Membership
  – Subject Matter Experts from each site for the various process areas
  – Multi-site representation was key to the success of the mini-teams

• Responsibilities
  – Meet (virtually) with the representatives from each site to review the existing processes
  – Develop a recommendation on the path forward for the specific process area
    • Keep one site’s existing process as is
    • Merge existing processes from all sites
    • Eliminate the process
    • Elevate the process to be discipline-independent
  – Generate detailed Basis of Estimate (BOE) to document the effort required to accomplish the recommendation of the team
Example Mini-Team

• One mini-team was assigned the Peer Review Process
  – Subject Matter Experts on the existing processes were identified

• Current State
  – SE Peer Review Directive and Procedure in Texas
  – SW Peer Review PRG and Procedure in Texas
  – Separate SE and SW Peer Review Work Instructions in El Segundo
  – Five enablers in Texas and three enablers in El Segundo
  – HW did not yet have a Peer Review process at either site
  – Defect Logger Tool (Access database) used in Texas and Integrated Project Reporting Tool (Excel spreadsheet) used in El Segundo

• Recommendation
  – Form one discipline-independent Peer Review process
    • Common definition of a defect and common set of codes for defect classification (type, reason and priority)
    • Common program phases for defect containment
    • Create an alternative, less formal process for Desk Checks
  – Deploy the Defect Logger Tool to all geographic locations
Management Review

- Membership
  - SAS President and VP of Engineering
    - Approve the budget for the plan
  - Functional line management
    - Approve the technical approach

- Responsibilities
  - Review and approve the plan presented by the Core Proposal Team
  - SAS President and VP of Engineering reviewed the budget and ability of the plan to meet the goal
  - Functional line management reviewed the recommendations of the mini-teams to ensure they were aligned with the recommendations
Proposed Changes

The Space and Airborne Systems (SAS) Enterprise Management System (EMS) is a company-wide Product Development (PD) tool used to document and maintain the processes for the development of the company's products. This EMS was designed to be convenient and easy to use, allowing users to access the information they need without having to navigate through multiple layers of menus. The EMS was also designed to be flexible enough to accommodate the needs of different projects and disciplines. The changes proposed to the EMS are intended to improve its usability and effectiveness, and to align it more closely with the company's overall business goals.

The changes proposed to the EMS include:

- Baseline:
  - 0 changes proposed

- Add:
  - 32 changes proposed

- Delete:
  - 20 changes proposed

- Modify*:
  - 59 changes proposed

* A document can be "modified" more than once e.g., driven by IPDP stage or discipline related.
A key goal of our process merger effort was to replace discipline-specific processes with discipline-independent ones wherever possible.

- Discipline-independent processes are referred to as “common” processes.

Benefits include:

- Reduces the number of processes to maintain.
- Facilitates common execution of process across all disciplines.
- Allows integrated teams to talk the same language.
Discipline-Independent Processes

- Process Tailoring
  - Describes how programs will perform tailoring, including both discipline-independent and discipline-specific processes

- Program Planning
  - Created a process, called the Program Management Plan, for the program-level planning elements
  - Kept discipline-specific processes for details of planning requirements by discipline
    - Systems Engineering Management Plan
    - Hardware Development Plan
    - Software Development Plan

- Standardized on a 3-phase tailoring and planning approach for all disciplines
Discipline-Independent Processes

- **Project Measurement & Analysis**
  - Used to help the program establish their metrics plan

- **Team of X**
  - This is an interactive meeting between program personnel and line management to review program metrics, status, issues, processes

- **Integrated Management Review**
  - This is a periodic review with higher level management that can involve more than one discipline
Discipline-Independent Processes

• Structured Decision Making
  – Process for making formal decisions that could have a significant impact to the program

• Risk and Opportunity Management
  – Describes how to identify, categorize and manage risks and opportunities for all disciplines

• Work Product Management and Stakeholder Involvement
  – One matrix that lists the program’s work products, level of control for each, stakeholder involvement for each and designates which work products must be reviewed using the Peer Review process

• Cost Estimation
  – Originally thought to be disciple-specific, but later determined it could be discipline-independent
  – Still under development, but a new version to be piloted soon
Discipline-Independent Processes

- **Project Teaming**
  - Describes the establishment of integrated product teams

- **Peer Review and Desk Check**
  - Peer Review process meets the requirements of the CMMI model
  - Desk Check process is a less formal process that can be used

- **Gate Reviews**
  - This is an independent review of the program at major phase transitions

- **Objective Evaluation**
  - Process and product audits by independent evaluators
The plan of attack included unifying the various process groups across the business into a single Enterprise Process Group (EPG)

- The new structure was referred to as the OneSAS EPG to make it obvious that we were unifying the process groups and the processes into one
- Created a logo for the enterprise process integration effort

The OneSAS EPG would include representation from all disciplines and sites and would be responsible for executing the process merger plan

- A distributed team makes coordination and communication more difficult
- The OneSAS EPG meets weekly via teleconference and Sametime
- Meet face-to-face for all planning activities and once a month as a leadership team
OneSAS EPG Organization

- Implemented an Integrated Product Team (IPT) structure for process development and a Cross Product Team (CPT) structure for activities that cut across all IPTs.

**Process Integration Technical Directors:** Robert Gonzalez and John Peyton

**Linda Kovar,** Program Manager

**Enterprise Management System CPT**
- Alcantar
  - HDW IPT
    - Martin Heer
  - SYS IPT
    - Bosworth Perkowsk
  - SW IPT
    - Seigler Chacon
  - PM IPT
    - Probst
  - CM/DM IPT
    - Brantley
  - SCM IPT
    - Holt
  - QA IPT
    - O’Berry

**Appraisal Coordination CPT**
- De Cicco

**Measurement and Analysis CPT**
- Luke

**Learning CPT**
- Adams

**Process Improvement Rollout CPT**
- Raymond

**IPCCB**
- Making sure processes are consistent across disciplines, across programs and with the architecture EMS/IPDS. Address issues related to process compliance within CMMI interpretations.

**Appraisal Coordination CPT**
- Making sure data archiving and repositories are consistent across disciplines, across programs and with the architecture EMS/IPDS. Planning and collecting artifacts for appraisals.

**Process Integration Technical Directors:**
- Robert Gonzalez and John Peyton

**Process Integration Technical Directors:**
- Making sure the training program is consistent across SAS organizations.

**Process Integration Technical Directors:**
- Making sure process rollouts are consistent across disciplines, across programs. Coordinate with IPT leads for deploying the processes. Program Contact Coordination using the Team of X.
OneSAS EPG ConOps

• Developed concept of operations (ConOps) for the IPTs and CPTs to define the interactions between them
  – One generic ConOps for the discipline IPTs
  – Five specific ConOps for each of the CPTs

• In addition, the following ConOps were needed for specific tasks
  – Top-level EPG
  – Process Definition
  – Process Support
  – Integrated Process Change Control Board Change Process
  – Enterprise Management System Website
  – Process Improvement Roll-out
  – Artifact/Data Collection
  – Artifact Gap Closure
- Created a chart showing the inputs and outputs from the EPG to describe the services offered by the EPG

**OneSAS EPG Services**

- EMS Directives and Tools
- EMS Status of Changes
- Communications (EPG Activities)
- PAL (Lessons Learned, Best Practices, Examples)
- Piloting
- PIR Communication & Package
- Training Plans
- Disposition of Training Request
- Enterprise Objective Evaluation Reports
- Appraisal Program Support
- Appraisal Results
- Verified Artifacts & Corrective Action Guidance
- Org Measurement Plan
- Process Capability & Outliers
- Non-Appraisal Program Support

**Inputs to EPG**

- CR
- Process Improvement Ideas
- Tailoring Reports
- Lessons Learned
- Request for New Process Training Course
- Request for Process Training - IDP
- Appraisal Artifacts
- SAS Business Goals
- Metrics
- Request for Non-Appraisal Program Support

**Outputs from EPG**

- EMS
- PIRs
- Learning
- Appraisals
- Metrics & Analysis
- Services for Hire
Did it Work?

• The OneSAS EPG team was formed and worked very well together
  – Representation from each site and monthly face-to-face meetings were keys to our success

• All the discipline-independent processes discussed previously are released and are being used with the exception of Cost Estimation
  – Late decision to make Cost Estimation discipline-independent

• SAS Achieved CMMI Level 3 for Systems, Software and Hardware Engineering in August of 2005
  – This multi-site, multi-disciplined appraisal was the largest in scope for any business in Raytheon
  – It was the first CMMI appraisal to include Hardware