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

Linda Kovar

and

Deana Seigler

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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**

Goleta, CA

El Segundo, CA
– SAS HQ

Dallas, McKinney, and Plano, TX

Forest, MS
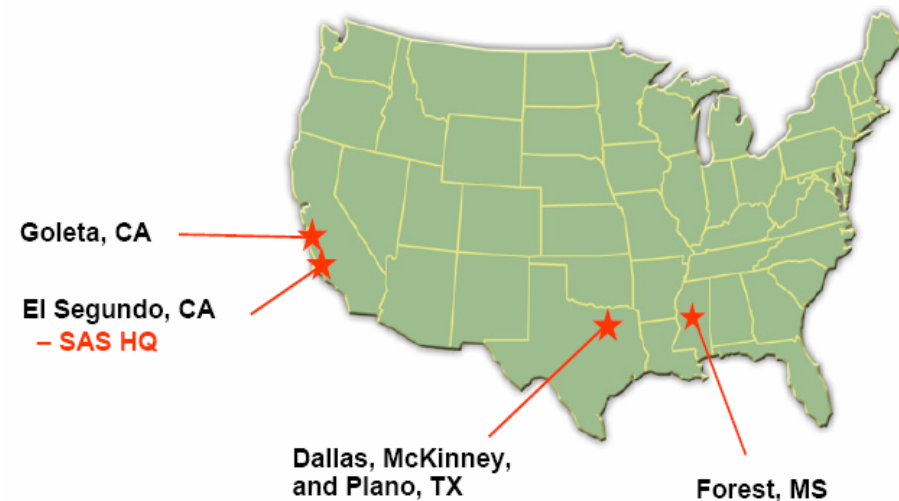
Setting the Stage

- **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

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- 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

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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**

- **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**

Look for better solutions!

- **Pull the "best of the best" processes from across SAS to form the SAS standard process**
- **Create discipline-independent processes whenever feasible**

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.**

Policy

Bulletins

Procedures

Work Instructions

Enablers

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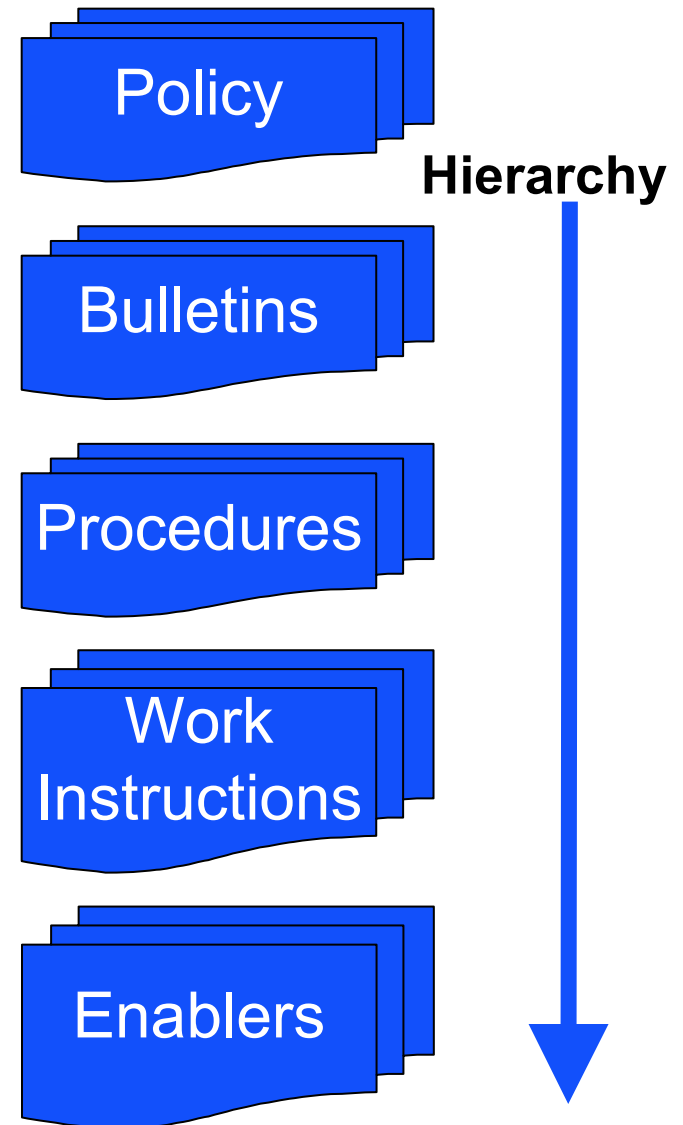
- **Membership**
  - **Subject Matter Experts from each site for the various process areas**
  - **Multi-site representation was key to the success of the mini-teams**

- **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**

- **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
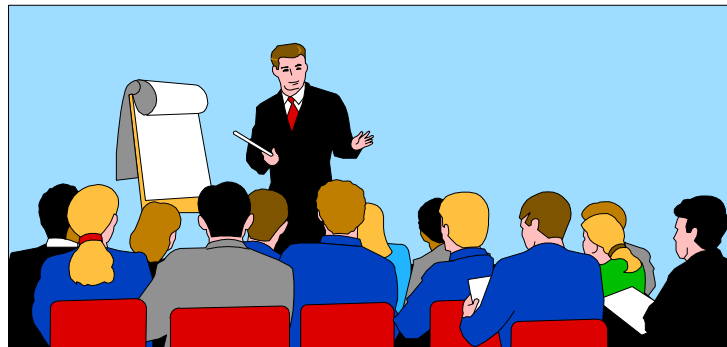 - Deploy the Defect Logger Tool to all geographic locations

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**

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Proposed Changes

Process Documents	EMS Baseline	One SAS		
		Add	Delete	Modify*
Policies	1	0	0	0
Procedures	13	3	0	26
Work Instructions	95	32	20	59
Enablers	81	101	9	39

* A document can be "modified" more than once eg. Driven by IPDP stage or discipline related

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Discipline-Independent Processes

- **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**
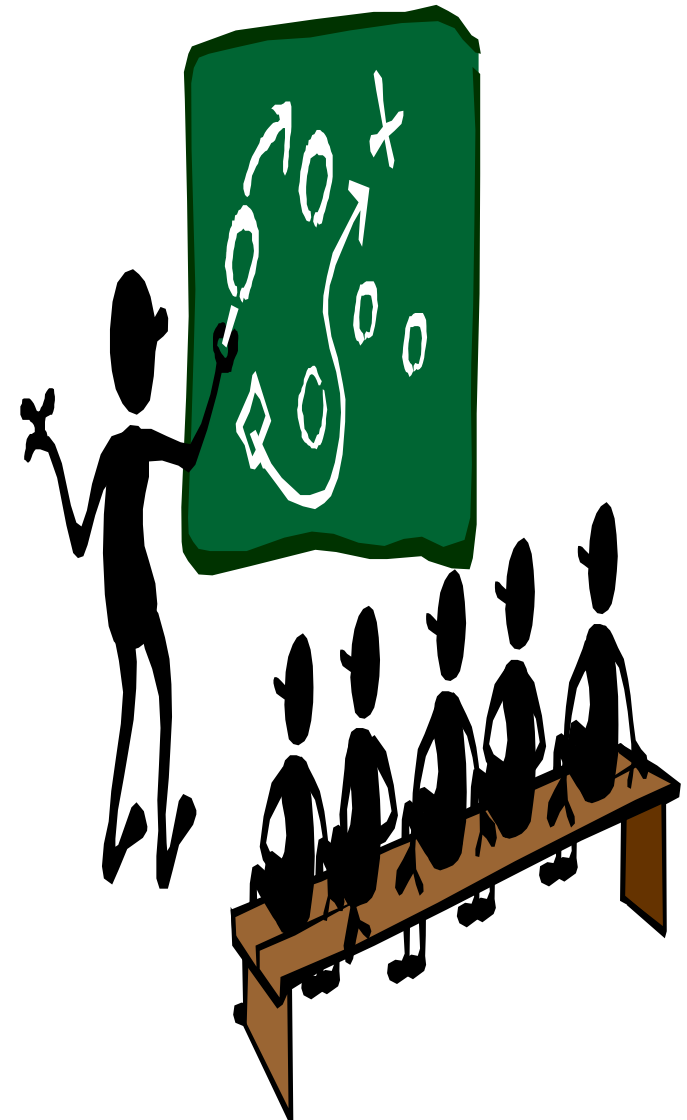
Discipline-Independent Processes

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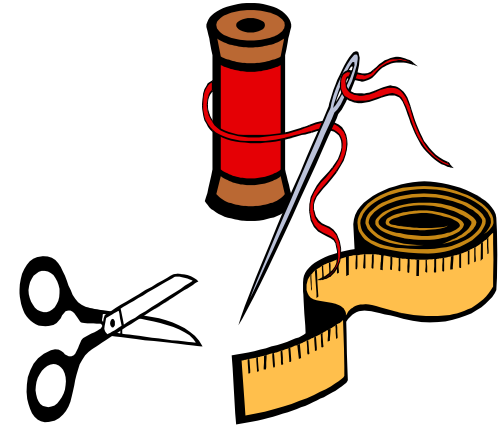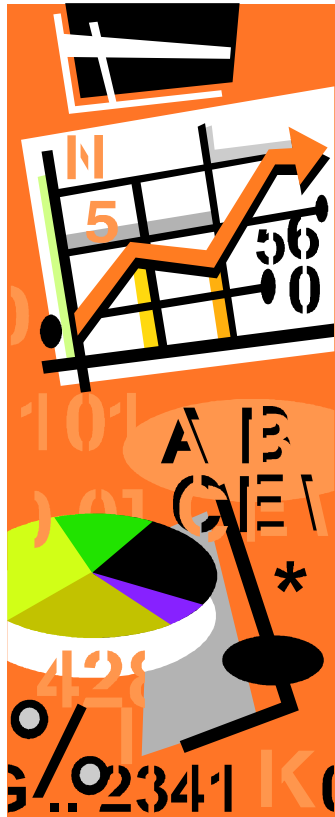
- **Project Measurement & Analysis**
  - Used to help the program establish their metrics plan

- **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

OneSAS EPG

- **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.

EPG

Linda Kovar, Program Manager

Process Integration Technical Directors: Robert Gonzalez and John Peyton

HDW IPT	SYS IPT	SW IPT	PM IPT	CM/DM IPT	SCM IPT	QA IPT
Martin	Bosworth	Seigler	Probst	Brantley	Holt	O'Berry
Heer	Perkowski	Chacon				

Enterprise Management System CPT — Alcantar — 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 — De Cicco
Making sure data archiving and repositories are consistent across disciplines, across programs and with the architecture EMS/IPDS. Planning and collecting artifacts for appraisals

Measurement and Analysis CPT — Luke
Coordinating consistent metrics across SAS. Keeping track of business needs and translating those to action-metrics.

Learning CPT — Adams
Making sure the training program is consistent across SAS organizations

Process Improvement Rollout CPT — Raymond — PIR
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..

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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**

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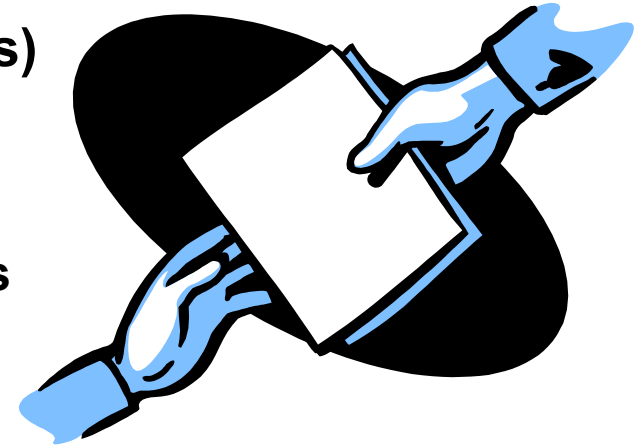
- Created a chart showing the inputs and outputs from the EPG to describe the services offered by the EPG

EPG

CR → | EMS → EMS Directives and Tools

Process Improvement Ideas → EMS → EMS Status of Changes

Tailoring Reports → | Communications (EPG Activities)

Lessons Learned → | PAL (Lessons Learned, Best Practices, Examples) Piloting

EMS

PIRs → PIR Communication & Package

Request for New Process Training Course → **Learning** → Training Plans

Request for Process Training - IDP → | Disposition of Training Request

Appraisals → Enterprise Objective Evaluation Reports

Appraisal Artifacts → | Appraisal Program Support

| Appraisal Results

| Verified Artifacts & Corrective Action Guidance

SAS Business Goals → **Metrics & Analysis** → Org Measurement Plan

Metrics → | Process Capability & Outliers

Request for Non-Appraisal Program Support → **Services for Hire** → Non-Appraisal Program Support

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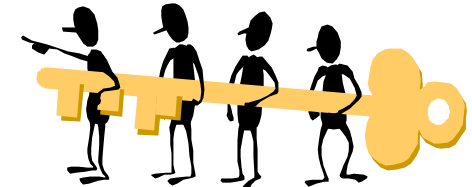
- **All the discipline-independent processes discussed previously are released and are being used with the exception of Cost Estimation**
  - Late decision to make Cost Estimation discipline-independent

- **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

CMMI

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The Center for Systems Management completed a CMMI® based appraisal on August 30, 2005, in accordance with the Software Engineering Institute's SCAMPI℠, V1.1: Method Definition Document and it was determined that

Raytheon – Space and Airborne Systems

exhibited the characteristics of

SEI Level 3 Process Maturity
in Systems, Software and Hardware Engineering

as defined by the SEI CMMI® Version 1.1
SE/SW Staged Representation.

Albert J. Truesdale
SEI Authorized Lead Appraiser
The Center for Systems Management

CSM THE CENTER FOR SYSTEMS MANAGEMENT