Synergy Beyond Expectations – Integrating Engineering Processes

NDIA – CMMI Technology Conference & User Group
Sally Cheung, Jim Cotterman & Dennis Laiola

November 17, 2004
Our Organization
Raytheon Fullerton Operations (RFO)

Network Centric Systems, Fullerton, CA

• Achieved CMMI SW Level 5 in December 2003

• Achieved CMMI SE Level 3 in December 2003
  CMMI SE Level 2 in 10/2002
Background – Past Achievements and 2003 Plans

2002

Achievements:
- SW-CMM Level 5 in September 2002
- CMMI SE Level 2 in October 2002

Planned:

2003

SCAMPI CMMI Class B 3rd Qtr 2003

SCAMPI Class A mid-2004
CMMI SE/SW Level 3

2004
Background – Management Changes to 2003 Plans

2002

Achievements:
- **SW-CMM Level 5** in September 2002
- **CMMI SE Level 2** in October 2002

2003

SCAMPI CMMI Class B 3rd Qtr

Management wants
SW Level 5 & SE Level 3 in 2003
- Keep up with Competitors
- Budget reduced by 18%
- Higher SW maturity level
- Shorter schedule

2004

SCAMPI Class A mid-2004
CMMI SE/SW Level 3

Faster & cheaper!

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Initial Approach
Use Existing Directive – Parallel Structures

- Controlled via PIRs by SW EPT
- Upgrade CSWP to CMMI Level 5
- Generate procedures from SE process in RFO Book 5 to fill gaps

Controlled by ECCB - reviews all engineering directive changes
Submit changes via CR to RFO CCB for review and release
Generate procedures using CSWP processes to fill gaps

Too many Change Control Boards
- Two parallel sections to tailor
- Increases tailoring effort
- Too complicated

ECCB – Engr Change Control Board
PIR – Process Improvement Request
SW EPT – Software Engr Process Team
Burning Platform - Need to Re-architect Directives

• Cannot add procedures in logical and related groupings - current organization does not support it

• Too many CCBs
  – RFO CCB - RFO Directives
  – ECCB - RFO Engineering Directives
  – SW EPT - CSWP

• Parallel approach confusing and complicating
  – Common procedures in CSWP, RFO and SE …. confusing
  – Confusing for Process Engineers & Projects
  – If directive structure is confusing, tailoring will be confusing and take extra effort

Defined alternate solutions and applied DAR process
Common Engineering Process (CEP) Architecture - Transition State

- Freeze CSWP
- Enables project tailoring

Raytheon Fullerton Operations (RFO) Directives

- Freeze Engr Sect 5 - enables project tailoring
- Continue changes to other directives via RFO CRs
- Controlled by RFO CCB

Changes to directives via PIR
- Controlled by Engineering Configuration Control Board (ECCB)
- SW EPT absorbed into ECCB

Interim Directive Build

Promote common procedures

Submit CR to move CEP to RFO when ready

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Changes to directives via PIR & controlled by ECCB
C/DM, SCM, PM, and PA Processes
Transition State - Change Flow (CMMI related changes)

Process Flow
1. REA submits CR & directive changes to ECCB Control Point
2. ECCB Control Point schedules Full ECCB
   • ECCB reviews and disposition (approve / reject)
   • ECCB Control Point provides comments back to REA for rework
3. REA incorporates comments as needed, submit to RFO Control Point
4. RFO Control Point coordinates RFO CCB review
5. RFO CCB reviews, dispositions, and comments
6. REA incorporates comments as needed, submit to RFO Control Point
7. Release approved changes to RFO directive web site

Raytheon Fullerton Operations (RFO) Directives
C/DM Book 6  SCM Book 8  PM Book 16  QA Book 19

Continue changes to other directives via RFO CRs Controlled by RFO CCB

- **Raytheon Fullerton Operations (RFO) Directives**
- **Raytheon Policy**
- **IPDS v2.2.1**
- **CEP Sect 5**
- **C/DM Sect 6**
- **SCM Sect 8**
- **PM Sect 16**
- **QA Sect 19**
- **Common Engr (CEP)**
- **Engr Work Instructions (EWI)**
- **Systems Engr (SEP)**
- **Common SW Engr (CSWP)**
- **Hardware Engr (HWP)**
- **Specialty Engr (SPP)**
- **Project Directives (SDP, SEMP, Engineering Notebooks-ENBs/SENs, etc.)**

- **Corporate**
- **RFO**
- **Engineering**
- **Project**

- **Project**
  - **IPDS Deployment Workshop**
  - **Gates, IMP/IMS**
  - • CEP policy and procedures – common across engineering disciplines
  - • Controlled by a CCB

- **CCB**
  - • CEP + discipline specific procedure & work instructions
  - • Controlled by site ECCB

- **ECCB**
  - • Detailed work instructions
  - • Controlled by project CM

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What are the CEP, EWI, SEP, CSWP, SPP and HWP?

- **RFO Section 5 Engineering (CEP)**
  - Common Engineering directives for all disciplines
  - Integrated CSWP and Systems Engineering Directives

- **Engineering Work Instructions (EWI)**
  - Common Engineering Work Instructions

- **Systems Engineering Process (SEP)**
  - Discipline specific directives for Systems Engineering

- **Common Software Process (CSWP)**
  - Discipline specific directives for Software Engineering

- **Specialty Engineering Process (SPP)**
  - Discipline specific directives for Specialty Engineering

- **Hardware Engineering Process (HWP)**
  - Discipline specific directives for Hardware Engineering
Benefits of Integrating Engineering Processes (1)

Engineering Directive Overview

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<th>Total</th>
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<th>Mod CSWP</th>
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- **Common engineering processes enabled (42 MMs savings):**
  - Decreased total number of directives from parallel structure
  - More common process than unique
  - Minimized need to create discipline specific procedures for SE and SW
  - Decreased the need to create new procedures
  - Modification of Common SW Processes is higher due to the use of pointers to the new common directives
- **Reuse of SE directives not included in above numbers**

Reduced Cost & Schedule - Met Management Goal
Benefits of Integrating Engineering Processes (2)

- **Opportunity Realized in 2003** - **savings of $259K**
  - Appraisal planning, preparation and conduct efforts have been worked jointly with good synergism
  - Joint SE/SW peer reviews of Gap analysis and joint affinitization of gaps reduced the effort of developing the Gap analysis worksheets
  - SE & SW Synergy resulted in less effort than planned for preparation of training materials due to joint training packages
  - **FUTURE**: Potential additional synergy in remaining training conduct and project plans and procedures updates

- **2004 and beyond**
  - Directive maintenance costs – 1 set of common directive rather than multiple directives for each discipline
  - Training
  - Projects plans and procedures
  - Appraisal costs
## SCAMPI Achievements

### Rating Profile - Software

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| Fully Implemented | ![Color](Fully Implemented)
| Largely Implemented | ![Color](Largely Implemented)
| Partially Implemented | ![Color](Partially Implemented)
| Not Implemented | ![Color](Not Implemented)

### Rating Profile

| PA   | GP 2.1 | GP 3.1 | GP 2.2 | GP 2.3 | GP 2.4 | GP 2.5 | GP 2.6 | GP 2.7 | GP 2.8 | GP 2.9 | GP 2.10 | SP 2.1 | SP 2.2 | SP 2.3 | SP 2.4 | SP 2.5 | SP 2.6 | SP 2.7 | SP 2.8 | SP 2.9 | SP 2.10 |
|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|---------|
| REQM |        |        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |         |         |
| PP   | 1.1    | 1.2    | 1.3    | 1.4    | 1.5    |        |        |        |        |        |         |        |        |        |        |        |        |        |        |         |         |
| PMC  | 1.1    | 1.2    | 1.3    | 1.4    | 1.5    | 1.6    | 1.7    | 1.8    | 1.9    | 1.10   | 2.1     | 2.2    | 2.3    | 2.4    | 2.5    | 2.6    | 2.7    | 2.8    | 2.9     | 3.0     |
| SAM  | 1.1    | 1.2    | 1.3    | 1.4    | 1.5    | 1.6    | 1.7    | 1.8    | 1.9    | 1.10   | 2.1     | 2.2    | 2.3    | 2.4    | 2.5    | 2.6    | 2.7    | 2.8    | 2.9     | 3.0     |
| M&A  | 1.1    | 1.2    | 1.3    | 1.4    | 1.5    | 1.6    | 1.7    | 1.8    | 1.9    | 1.10   | 2.1     | 2.2    | 2.3    | 2.4    | 2.5    | 2.6    | 2.7    | 2.8    | 2.9     | 3.0     |
| PQM  | 1.1    | 1.2    | 1.3    | 1.4    | 1.5    | 1.6    | 1.7    | 1.8    | 1.9    | 1.10   | 2.1     | 2.2    | 2.3    | 2.4    | 2.5    | 2.6    | 2.7    | 2.8    | 2.9     | 3.0     |
| CM   | 1.1    | 1.2    | 1.3    | 1.4    | 1.5    | 1.6    | 1.7    | 1.8    | 1.9    | 1.10   | 2.1     | 2.2    | 2.3    | 2.4    | 2.5    | 2.6    | 2.7    | 2.8    | 2.9     | 3.0     |
| RD   | 1.1    | 1.2    | 1.3    | 1.4    | 1.5    | 1.6    | 1.7    | 1.8    | 1.9    | 1.10   | 2.1     | 2.2    | 2.3    | 2.4    | 2.5    | 2.6    | 2.7    | 2.8    | 2.9     | 3.0     |
| TS   | 1.1    | 1.2    | 1.3    | 1.4    | 1.5    | 1.6    | 1.7    | 1.8    | 1.9    | 1.10   | 2.1     | 2.2    | 2.3    | 2.4    | 2.5    | 2.6    | 2.7    | 2.8    | 2.9     | 3.0     |
| PI   | 1.1    | 1.2    | 1.3    | 1.4    | 1.5    | 1.6    | 1.7    | 1.8    | 1.9    | 1.10   | 2.1     | 2.2    | 2.3    | 2.4    | 2.5    | 2.6    | 2.7    | 2.8    | 2.9     | 3.0     |
| VER  | 1.1    | 1.2    | 1.3    | 1.4    | 1.5    | 1.6    | 1.7    | 1.8    | 1.9    | 1.10   | 2.1     | 2.2    | 2.3    | 2.4    | 2.5    | 2.6    | 2.7    | 2.8    | 2.9     | 3.0     |
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| GSF  | 1.1    | 1.2    | 1.3    | 1.4    | 1.5    | 1.6    | 1.7    | 1.8    | 1.9    | 1.10   | 2.1     | 2.2    | 2.3    | 2.4    | 2.5    | 2.6    | 2.7    | 2.8    | 2.9     | 3.0     |
| OPD  | 1.1    | 1.2    | 1.3    | 1.4    | 1.5    | 1.6    | 1.7    | 1.8    | 1.9    | 1.10   | 2.1     | 2.2    | 2.3    | 2.4    | 2.5    | 2.6    | 2.7    | 2.8    | 2.9     | 3.0     |
| OT   | 1.1    | 1.2    | 1.3    | 1.4    | 1.5    | 1.6    | 1.7    | 1.8    | 1.9    | 1.10   | 2.1     | 2.2    | 2.3    | 2.4    | 2.5    | 2.6    | 2.7    | 2.8    | 2.9     | 3.0     |
| IPM  | 1.1    | 1.2    | 1.3    | 1.4    | 1.5    | 1.6    | 1.7    | 1.8    | 1.9    | 1.10   | 2.1     | 2.2    | 2.3    | 2.4    | 2.5    | 2.6    | 2.7    | 2.8    | 2.9     | 3.0     |
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| QPM  | 1.1    | 1.2    | 1.3    | 1.4    | 1.5    | 1.6    | 1.7    | 1.8    | 1.9    | 1.10   | 2.1     | 2.2    | 2.3    | 2.4    | 2.5    | 2.6    | 2.7    | 2.8    | 2.9     | 3.0     |
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| CAR  |        |        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |         |         |

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We did it !!!
### SCAMPI Achievements

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#### SE/SW Rating Legend

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**We exceeded our goal of CMMI SE level 3, we were so close to achieving the level 5!**

Results of leveraging from engineering disciplines with higher maturity
Enablers to an Integrated Common Engineering Directive System

- A single EPG to manage Engineering processes
- On projects, engineering leadership headed by a program engineer (PE) responsible for all engineering activities
- All engineering personnel under one Engineering Director at the site vs. separate SE, HW and SW functional organizations
- Strong sponsorship from senior management regarding the “I” in CMMI (not just engineering but enterprise level as well)
- An integrated Quality Assurance organization for all engineering activities
- SE, HW, Specialty and SW use the same process model, CMMI
- Experienced engineering process personnel, with experience on projects at the site
- Utilize EPG liaisons to projects
  - Both SE & SW (HW as required) to provide depth of knowledge and greater level of support
  - Have Team-of-Four meetings to assist process deployment & measures
Lessons Learned

• Process management needs to be normalized across Engineering
• Once started, synergy exceeded expectations, building off each previous one
• Benefit of cross-training Engineering processes
• CMMI training is crucial to success
• CMMI Appraisal experience significantly contributed to the process improvement effort
• R6s baseline was an excellent forum for team building & establishing a practical tactical approach to achieving aggressive strategic objectives