Mission Assurance of Software Suppliers – A Partnership Between Software Supplier Managers and Quality Engineering

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Network Centric Systems

Agenda

- Introduction

- Why Are We Here?

- CMMI Gap Analysis With MSI Focus

- Addressing The Gaps

- Integration Of SSM and QE

- Lessons Learned and Future Steps

**Mission Assurance of Software Suppliers –
A Partnership Between Software Supplier Managers and
Quality Engineering**

Introduction – At a Glance

- A global technology leader in:
  - Defense, government and commercial electronics
  - Space
  - Information technology
  - Technical services
  - Business and special mission aircraft
- 2005 sales: $21.9 billion
- 80,000 employees worldwide
- Headquarters: Waltham, Massachusetts, USA
  - http://www.raytheon.com
  - Common stock ticker symbol: RTN

Partners in customer success

Introduction – Business Areas

Missile Defense

Intelligence, Surveillance and Reconnaissance

Precision Engagement

Homeland Security

Network Centric Systems
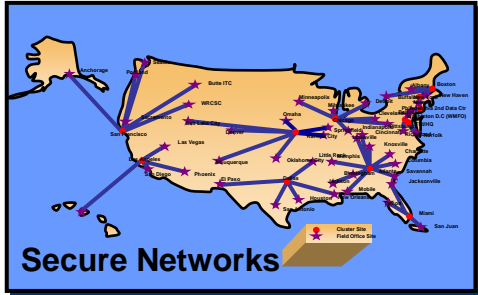

Command & Control Systems

Secure Networks

Missile Systems

Vision Systems

Air Traffic Management

Integrated Communications

Combat Systems

Superior mission integration for communication and information dominance
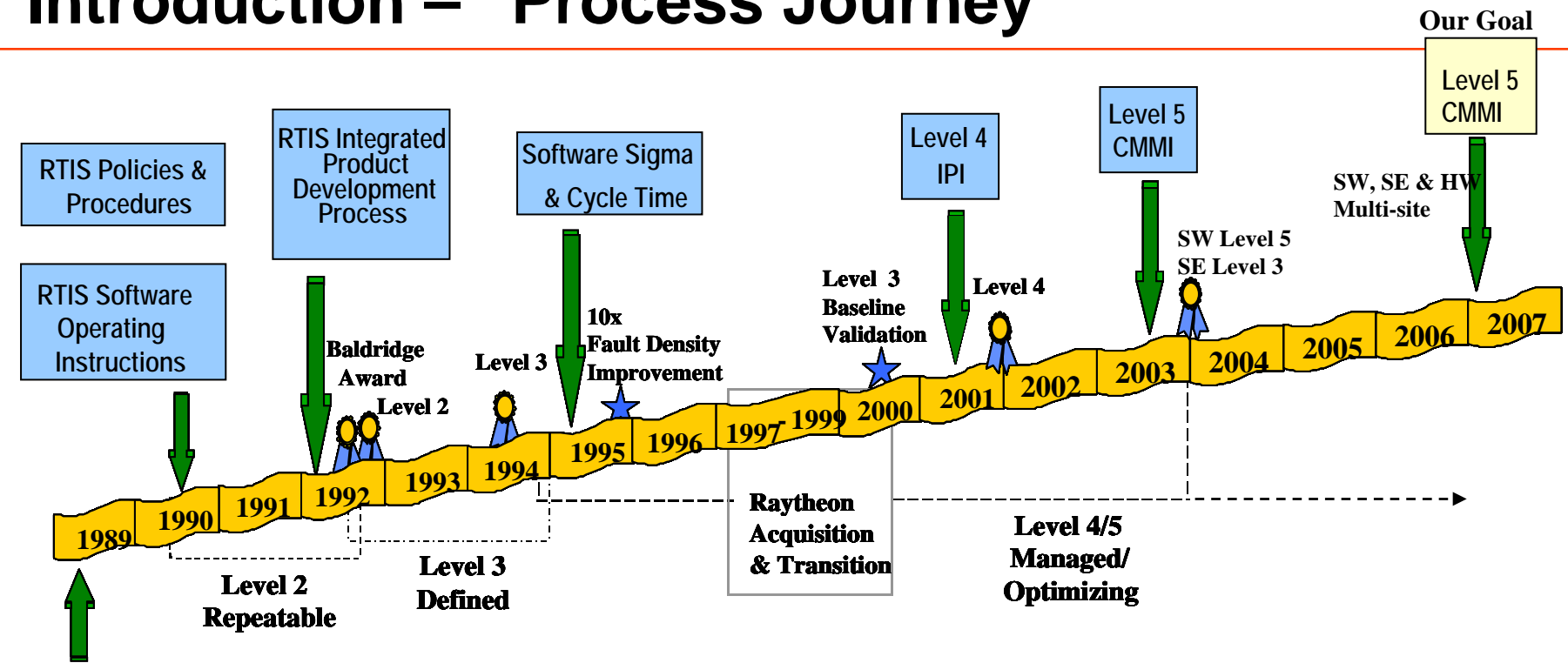
Raytheon's Global Presence
Serving Customers Around the World

- 🔴 Raytheon International, Inc. business development offices
- 🟢 Raytheon International, Inc. business development headquarters
- 🟡 Raytheon Systems Limited
- ○ Raytheon Australia
- 🟣 Raytheon Canada
- 🔵 Thales Raytheon Systems

Introduction – "Process Journey"

A long history of process excellence

Why Are We Here? – The Burning Platform

- Our business is evolving from a system developer to a Mission Systems Integrator (MSI)

- > 70% of what we deliver comes from suppliers

- The role of supplier management must evolve

- In this presentation, Software Supplier Managers (SSMs) and Quality Engineers (QEs) are being highlighted to address this evolution

CMMI Behavior/Skills Analysis With MSI Focus

Raytheon

- CMMI-SE/SW/IPPD/SS V1.1 analysis of model used to identify behavior/skill gaps

Key Behavior/Skills	Noted in CMMI	Required for MSI Success	
		SSM role	QE role
Knowledge of regulations and practices associated with handling suppliers	Supplier Agreement Management	Major	Major
Acquisition planning and preparation	Supplier Agreement Management	Moderate	Minor
COTS products acquisition	Supplier Agreement Management	Major	Major
Supplier Evaluation and Selection	Supplier Agreement Management	Major	Minor
Negotiation and conflict resolution	Supplier Agreement Management	Major	Minor
Supplier Management	Supplier Agreement Management	Major	Major
Testing and Transition of acquired products	Supplier Agreement Management	Major	Major
Receiving, storing, using, and maintaining acquired products	Supplier Agreement Management	Moderate	Major

Legend: Major = Key Role
Moderate = Need knowledge
Minor = Support Role

MSI Success depends on trained skills & knowledge
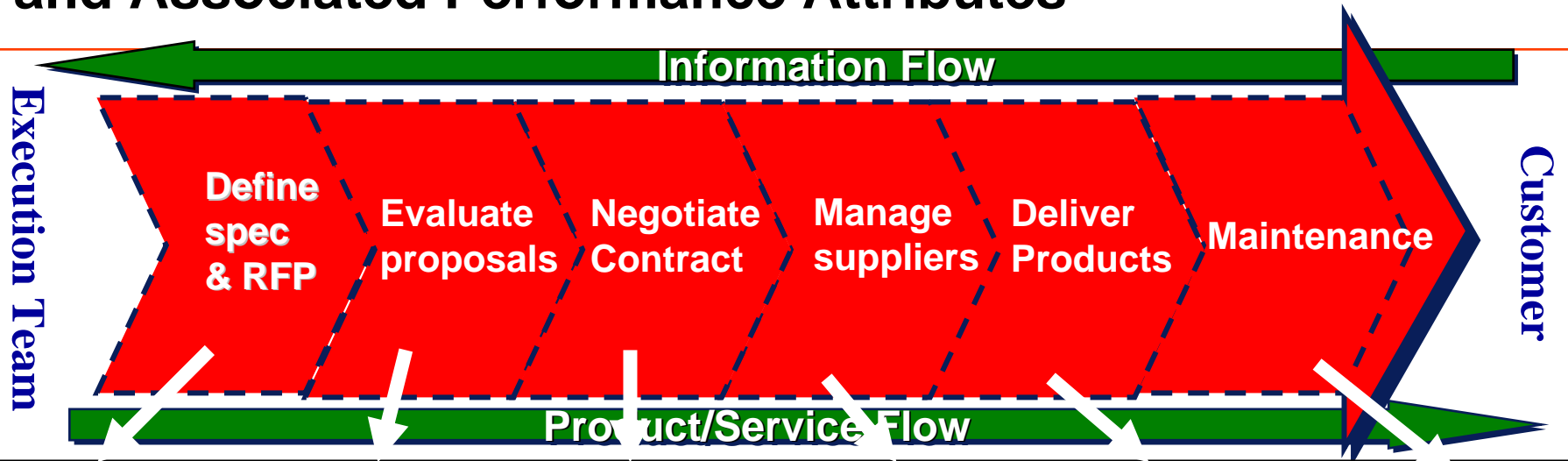
CMMI Gap Analysis With MSI Focus

- CMMI-SE/SW/IPPD/SS V1.1 analysis of model used to identify behavior/skill gaps

Key Behavior/Skills	Noted in CMMI	Required for MSI Success	
		SSM role	QE role
Application Domain	Process and Product Quality Assurance	Moderate	Major
Customer Relations	Process and Product Quality Assurance	Major	Major
Process descriptions, standards, procedures, and methods for the project	Process and Product Quality Assurance	Major	Major
Quality assurance objectives, process descriptions, standards, procedures, methods, and tools	Process and Product Quality Assurance	Moderate	Major
Identifying potential sources for candidate products to be acquired	Integrated Supplier Management	N/A	N/A
Acquisition feasibility and product life-cycle costs analysis	Integrated Supplier Management	Support	N/A
Evaluating supplier work products	Integrated Supplier Management	Major	Support
Monitoring supplier processes	Integrated Supplier Management	Major	Major

Gap Closure Process

- Develop SSM value stream and identify performance attributes

- Identify available training courses to supplement performance gaps

- Develop program specific training model to address needed skills

- On-the-job training with senior practitioners

Value Stream of SW Supplier Excellence and Associated Performance Attributes

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Information Flow

Execution Team → **Customer**

Define spec & RFP | **Evaluate proposals** | **Negotiate Contract** | **Manage suppliers** | **Deliver Products** | **Maintenance**

Product/Service Flow

Requirements (PCD)	Cost Estimation	Establish Scope	Process	Formal Qualification	ECP
SoS Architecture	Schedule Impact	Funding Constraints	Lifecycles	Transition	SCR
Process Capability	Risks/Opportunities (R&O)	Risks	Metrics	Receive and integrate role	Enhancement
SOW	Technical Evaluation	CAIV	Technical Reviews		Proposal & White paper Evaluation
Contract		Negotiation Strategy	R & O		P3I
			Supplier Performance		
			Knowledge Elicitation		
			Communication		
			SDRL Evaluation		
			Reqts Trade		
			Change Management		

Example of Value Stream Step One Performance Attributes

Define Spec & RFP

Performance Attributes	Standards of Excellence	Source of skills
Requirements (PCD)	Comprehend system requirements and integrate CONOPS strategy to capture applicable software performance requirements.	Domain experience OJT Mission Use Cases (SME) SE Class – Reqts Allocation
SoS Architecture	Understand the key customer/program quality factors to guide tradeoffs.	ATAM, JTA-A SEI Certified Architect training SE Class on Architecture
Process Capability	Understand parent process requirements.	OJT, OCD, FCS SDP DOORS Training
SOW	Comprehend the contents of statement of work	OJT
Contract	Comprehend the contents of the contract & establish evaluation criteria.	OJT

Specific standards of excellence associated with each performance attributes

Example of Program Training Model

Training Classes

Engineering Disciplines

IMS (Open Plan)	Source Selection		NCS PL Cert. Training	GS IPT			GS IPT (SW)				
	SSAC Training	SSET Training		DOORS	Cost Reimb. Contract Training	Ethics in the Procure. Process	Software Devl Plan Orientation	Configuration Mgmt.	Software Process Training	Intro to UML Modeling	Product Evaluations
O			NR	R	R	RC					
N/A			NR	R	R						
N/A			NR	R	R						
R		RC	R	R	R	RC					
N/A			NR	R	R						
N/A			NR	R	R						
N/A			NR	R	R		R	R	R		R
N/A			NR	R	R						
N/A			NR	R	R						
R	RC	RC	R	R	RC	RC					
N/A			NR	R	R	RC	RC	R	RC		R
		R	NR	R	R	R					
N/A			NR	RC	R	R					
R	RC		R	R	R	RC					
N/A			NR	R	R	RC					
N/A		R	NR	RC	R	R					
N/A		RC	NR	R	R						
N/A			NR	R	R	RC	RC	R	R		R
N/A			NR	R	R	R					
N/A			NR	R	R	R					
R			NR	R	R						
N/A			NR	R	R						
N/A			NR	R	R						
N/A			NR	R	R		R	R	R		R
N/A			NR	R	R		R	R	R		R
N/A			NR	R	R						

Specific training classes for those engineering disciplines to perform the tasks at hand.

Training courses to supplement performance gaps

Addressing The Gaps by On-The-Job-Training

- Mentor under a senior practitioner

- Shadow a senior SSM on different meetings and activities

- Familiarize the processes and procedures through self-learning

- Begin with lesser responsibility on a smaller supplier

- Increase responsibility with demonstrated performance

Mentoring and Hands-on experience to address gaps

Integration Of SSM and QE

- Advantages of a Integrated Team
  - Different perspectives of supplier activities
  - Review of critical metrics
  - Participation at reviews
  - Review of documents to ensure requirements compliance

- Performance Multiplier of an Integrated Team
  - SSM focus on cost, schedule, and technical performance
  - QE focus on process compliance through audits and surveillance checks

Integrated team provides the best combination of supplier management
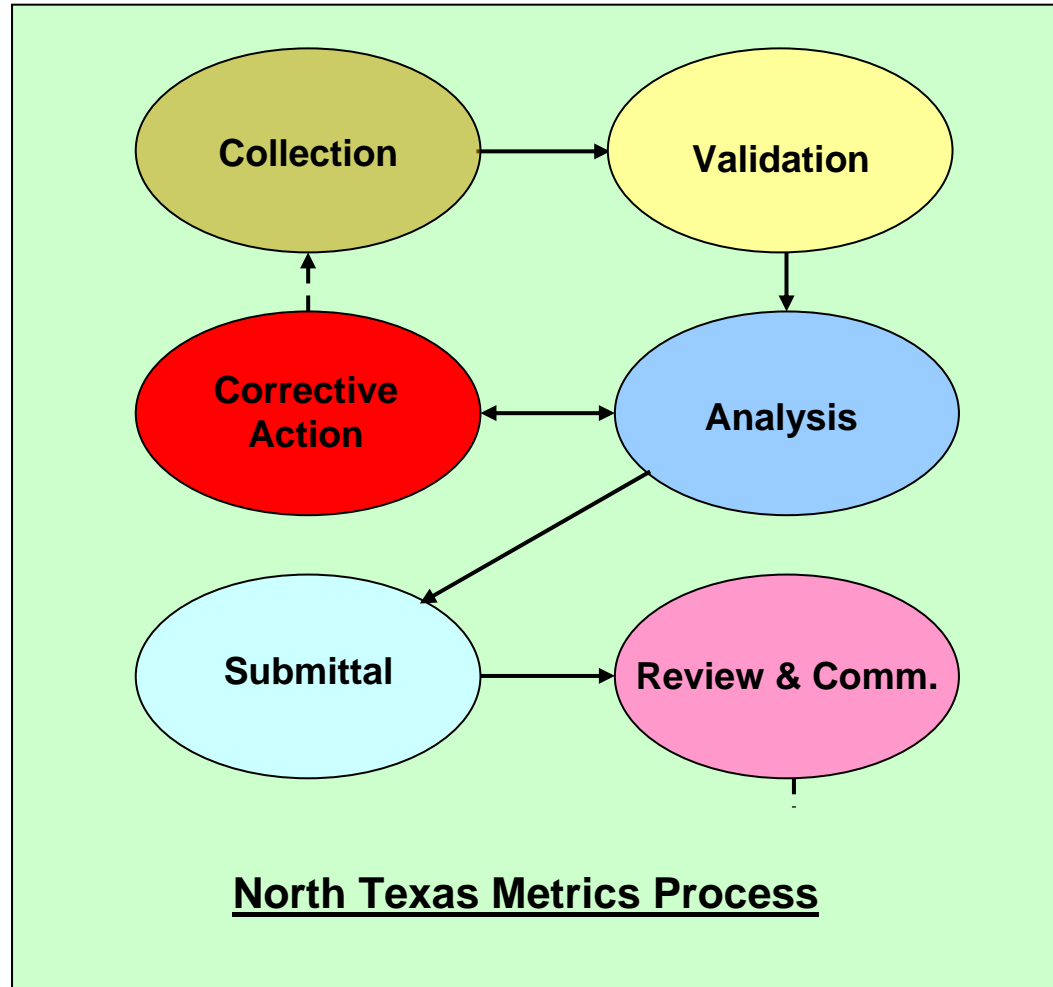
Monitoring of Supplier activities

C	Green	Compliant	C
FO	Yellow	Open findings with acceptable plan	FO
FC	Yellow	Findings closed	FC
N	Red	Unacceptable resolution plan or 30 days past due	N
P	Purple	Planned audit	P
R	Blue	Rescheduled audit	R
U	Gray	Not audited	U
W	Orange	Process audit still in work	W

Data as of: **1/28/2006**

Process Audit Area	Supplier/ LSI SDP	FCS SDP	Previous Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Latest Status
Software Project Management			2005													
-Recording rationale	4.8	4.8		U	U	U	U	U	U	U	U	U	U	U	U	U
-Access for Acquirer Review	4.9	4.9		U	U	U	U	U	U	U	U	U	U	U	U	U
-Software Cost & Schedule Estimation	5.1	5.1	FC	U	U	U	U	U	U	U	U	U	U	U	U	FC
-Software Measurements	5.2	5.2	FO	U	U	U	U	U	U	U	U	U	U	U	U	FO
-Group Coordination & Communication	5.3	5.3		U	U	U	U	U	U	U	U	U	U	U	U	U
-Software Training	5.4	5.4	FO	U	U	U	U	U	U	U	U	U	U	U	U	FO
-Software Risk Management	5.5	5.5	N	U	U	U	U	U	U	U	U	U	U	U	U	N
-Software Subcontractor Management	5.6	5.6		U	U	U	U	U	U	U	U	U	U	U	U	U
-Software Configuration Management	5.7	5.7		P	U	U	U	U	U	U	U	U	U	U	U	P
-Software Product Evaluation	5.8	5.8		U	P	U	U	U	U	U	U	U	U	U	U	P
-Software Quality Assurance	5.9	5.9		U	U	U	U	U	U	U	U	U	U	U	U	U
-Defect Management	5.10	5.10		U	U	U	U	U	U	U	U	U	U	U	U	U
-Software Development Environment	6.3	6.3		U	U	U	U	U	U	U	U	U	U	U	U	U
-Software Process Management	7	7		U	U	U	U	U	U	U	U	U	U	U	U	U

Example of an audit plan to ensure process compliance

Audit plan to ensure comprehensive coverage of process compliance

Software Metrics Analysis Process

North Texas Metrics Process

Collection → Validation → Analysis

Corrective Action ↔ Analysis

Analysis → Submittal → Review & Comm.

Corrective Action → Collection

Metrics Analysis to monitor and track performance

LCA Review Criteria

| Review 0% Criteria | 0% 4.0 System Requirements | 0% 5.0 Software Architecture | 0% 6.0 Views & Patterns | 0% 7.0 Life-Cycle Plan | 0% 8.0 Feasibility Rationale |

NEW

EXAMPLE

| 0% | **6.0** | **Views & Patterns** | MAJOR ARTIFACT **SADD** |

| R | **6.1** | **Use Case View** | **TECHNICAL** |

Score

5		6.1.1	Are the use cases in the use case view consistent with the logical view sequence diagrams?
5		6.1.2	Does the use case view cover key behaviors?
5		6.1.3	Is this view complete with respect to the suppliers completeness criteria as documented in the supplier tailoring of the GSS SADD Appendix C? (Use Case Diagrams and Use Case Text)
20		6.1.4	Are the supplier use cases consistent with the GSI use cases as document in the GSS Operational Concept Document?

General Comments:

| R | **6.2** | **Logical View** | **TECHNICAL** |

Score

20		6.2.1	Are the top-level subsystems and classes defined?
5		6.2.2	Are the relationships among the top-level subsystems and classes described?
5		6.2.3	Is the control architecture captured (in terms of state machines for individual classes/objects, and via an Object Communication Model or the equivalent)?
5		6.2.4	Are the internal interfaces, as captured in the interaction diagrams, described? e.g., this message contains Time of Day.
5		6.2.5	Are the external interfaces on the Supplier Sequence Diagrams consistent with the CEEU/CREU IRS?
5		6.2.6	Are the logical view diagrams internally consistent with one another?
5		6.2.7	Are safety and mission critical classes clearly marked?
5		6.2.8	Are the Supplier Sequence Diagrams (e.g., those presented at the Software Architecture Evaluation, and more) consistent with the GSS System Model Segment threads?
20		6.2.9	Is the mapping between the GSS SADD Logical view elements (Aggregate Software Elements) and the Supplier Logical view elements clear (subsystems, classes)?

General

Review Tool to consistently capture reviewers' feedback

Audits and Document Review

Document Review Tool

List of document reviewer

Electronic collaboration system to ensure timely completion of document reviews with the right reviewers

Lessons Learned

- There is a massive amount of information and data required to manage multiple suppliers and appropriate tools are critical

- Performing supplier management in an MSI role is not the same as simply scaling up the support roles of a "traditional" developer program

- Importance and cost of communication and coordination

Lessons Learned - Continued

- Lessons learned are captured by stages to enable continuous improvement

- Review Tools are mandatory to save time and be consistent

- Working with a diverse team with different culture and in different geographic locations is a challenge

Summary

- The roles of SSM and QE have evolved over time to better assess and address supplier management

- Evolution not as a "scale up" from a development program, but to include new activities and interactions

- In addition to SSM and QE, other disciplines contribute to supplier management such as supply chain, contracts, etc. to make up the full supplier management team

- Feedback SSM training needs to organization for gap closure

- Re-evaluate against the CMMI model to ensure that all elements are appropriately addressed

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Questions