Raytheon
Space and Airborne Systems

System Engineering Cost Collection Codes at Raytheon SAS

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Presentation Purpose

- Show the current cost collection code methodology for Raytheon SAS
- Methodology for determining estimates of effort and cost

Goals of Cost Codes

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- Multiple views and perspectives of costs in order to deliver best possible value at lowest cost
- Collect costs in process views as well as product views
- Process views allow more direct productivity comparisons
  - *By program*
  - *By product*
  - *By Business*
  - *By region*
- Characterize our processes for productivity metrics
- Subdivided processes enable process improvement opportunities
- Bid along process view as well as work product view

Cost Estimation-Collection Cycle

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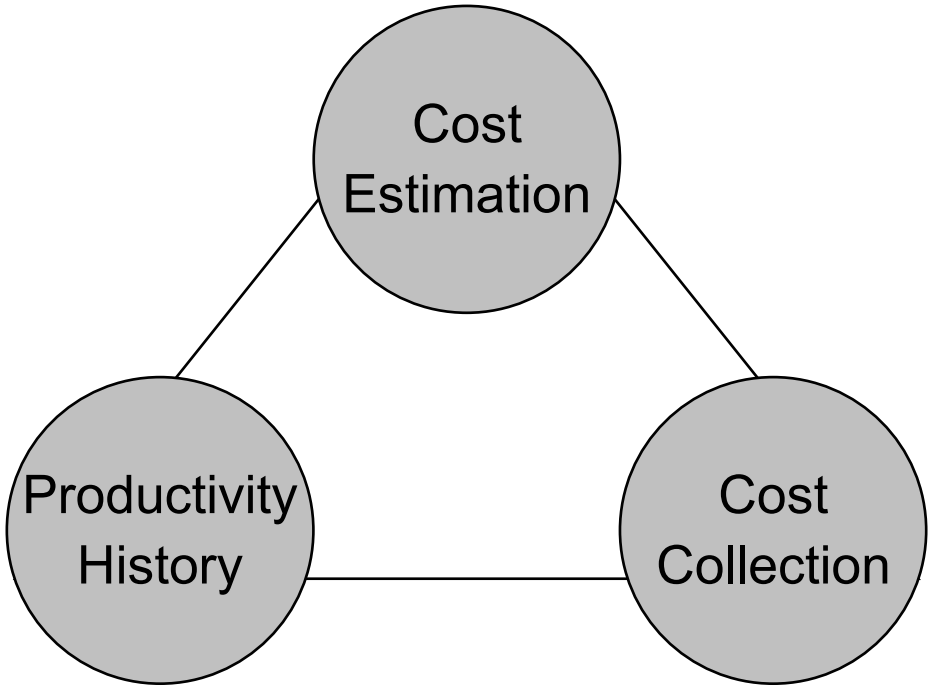

Cost Codes are the Common Denominator
- ***Throughout Program Life Cycle***
- ***Program to Program***

Raytheon IPDP Program Phases
(Integrated Product Development Process)

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Life-Cycle Phase
PROJECT PLANNING, MANAGEMENT & CONTROL
REQUIREMENTS & ARCHITECTURE DEVELOPMENT
PRODUCT DESIGN & DEVELOPMENT
SYSTEM IV&V
PRODUCTION AND DEPLOYMENT
OPERATIONS AND SUPPORT

Raytheon IPDP Program Phases: Next Level Breakdown

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Life-Cycle Phase
PROJECT PLANNING, MANAGEMENT & CONTROL
Planning
Management and Control
REQUIREMENTS & ARCHITECTURE DEVELOPMENT
System Requirements Definition
System Preliminary Design
Product Requirements Definition
Product Preliminary Design
Component Requirements Definition
PRODUCT DESIGN & DEVELOPMENT
Technical Tracking, Simulation & Modeling
Post-Architecture IV&V Planning and Preparation
Component Preliminary Design
Detail Design
Component Implementation
Component Integration and Test
SYSTEM IV&V
Product IV&V
System Integration & Acceptance Test
System Test & Evaluation
PRODUCTION AND DEPLOYMENT
Production Material
Production Assembly & Test
Production Acceptance/Demonstration
Production Pack & Ship
OPERATIONS AND SUPPORT
Requirements Analysis
Product Support

IPDP Stage Nomenclature

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Stage	Life-Cycle Phase
2	PROJECT PLANNING, MANAGEMENT & CONTROL
2-1	*Planning*
2-3	*Management and Control*
3	REQUIREMENTS & ARCHITECTURE DEVELOPMENT
3-1	*System Requirements Definition*
3-2	*System Preliminary Design*
3-3	*Product Requirements Definition*
3-4	*Product Preliminary Design*
3-5	*Component Requirements Definition*
4	PRODUCT DESIGN & DEVELOPMENT
4-1	*Technical Tracking, Simulation & Modeling*
4-2	*Post-Architecture IV&V Planning and Preparation*
4-3	*Component Preliminary Design*
4-4	*Detail Design*
4-5	*Component Implementation*
4-6	*Component Integration and Test*
5	SYSTEM IV&V
5-1	*Product IV&V*
5-2	*System Integration & Acceptance Test*
5-3	*System Test & Evaluation*
6	PRODUCTION AND DEPLOYMENT
6-1	*Production Material*
6-2	*Production Assembly & Test*
6-3	*Production Acceptance/Demonstration*
6-4	*Production Pack & Ship*
7	OPERATIONS AND SUPPORT
7-1	*Requirements Analysis*
7-2	*Product Support*

Task Descriptors

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Stage	Life-Cycle Phase	
2	PROJECT PLANNING, MANAGEMENT & CONTROL	
2-1	*Planning*	
2-3	*Management and Control*	
3	REQUIREMENTS & ARCHITECTURE DEVELOPMENT	
3-1	*System Requirements Definition*	18
3-2	*System Preliminary Design*	39
3-3	*Product Requirements Definition*	12
3-4	*Product Preliminary Design*	43
3-5	*Component Requirements Definition*	11
4	PRODUCT DESIGN & DEVELOPMENT	
4-1	*Technical Tracking, Simulation & Modeling*	
4-2	*Post-Architecture IV&V Planning and Preparation*	
4-3	*Component Preliminary Design*	
4-4	*Detail Design*	
4-5	*Component Implementation*	
4-6	*Component Integration and Test*	
5	SYSTEM IV&V	
5-1	*Product IV&V*	
5-2	*System Integration & Acceptance Test*	
5-3	*System Test & Evaluation*	
6	PRODUCTION AND DEPLOYMENT	
6-1	*Production Material*	
6-2	*Production Assembly & Test*	
6-3	*Production Acceptance/Demonstration*	
6-4	*Production Pack & Ship*	
7	OPERATIONS AND SUPPORT	
7-1	*Requirements Analysis*	
7-2	*Product Support*	

Number of Task Descriptors

Codes for Systems Eng. Column

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Stage	Life-Cycle Phase	SE
2	PROJECT PLANNING, MANAGEMENT & CONTROL	
2-1	*Planning*	X
2-3	*Management and Control*	X
3	REQUIREMENTS & ARCHITECTURE DEVELOPMENT	
3-1	*System Requirements Definition*	X
3-2	*System Preliminary Design*	X
3-3	*Product Requirements Definition*	X
3-4	*Product Preliminary Design*	X
3-5	*Component Requirements Definition*	X
4	PRODUCT DESIGN & DEVELOPMENT	
4-1	*Technical Tracking, Simulation & Modeling*	X
4-2	*Post-Architecture IV&V Planning and Preparation*	X
4-3	*Component Preliminary Design*	
4-4	*Detail Design*	
4-5	*Component Implementation*	
4-6	*Component Integration and Test*	
5	SYSTEM IV&V	
5-1	*Product IV&V*	X
5-2	*System Integration & Acceptance Test*	X
5-3	*System Test & Evaluation*	X
6	PRODUCTION AND DEPLOYMENT	
6-1	*Production Material*	X
6-2	*Production Assembly & Test*	X
6-3	*Production Acceptance/Demonstration*	X
6-4	*Production Pack & Ship*	X
7	OPERATIONS AND SUPPORT	
7-1	*Requirements Analysis*	
7-2	*Product Support*	

More Granularity: Separate RMSS

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Space and Airborne Systems

Stage	Life-Cycle Phase	SE	ILS	RMA	SHF
2	PROJECT PLANNING, MANAGEMENT & CONTROL				
2-1	*Planning*	X			
2-3	*Management and Control*	X			
3	REQUIREMENTS & ARCHITECTURE DEVELOPMENT				
3-1	*System Requirements Definition*	X			
3-2	*System Preliminary Design*	X			
3-3	*Product Requirements Definition*	X			
3-4	*Product Preliminary Design*	X			
3-5	*Component Requirements Definition*	X			
4	PRODUCT DESIGN & DEVELOPMENT				
4-1	*Technical Tracking, Simulation & Modeling*	X			
4-2	*Post-Architecture IV&V Planning and Preparation*	X			
4-3	*Component Preliminary Design*				
4-4	*Detail Design*				
4-5	*Component Implementation*				
4-6	*Component Integration and Test*				
5	SYSTEM IV&V				
5-1	*Product IV&V*	X			
5-2	*System Integration & Acceptance Test*	X			
5-3	*System Test & Evaluation*	X			
6	PRODUCTION AND DEPLOYMENT				
6-1	*Production Material*	X			
6-2	*Production Assembly & Test*	X			
6-3	*Production Acceptance/Demonstration*	X			
6-4	*Production Pack & Ship*	X			
7	OPERATIONS AND SUPPORT				
7-1	*Requirements Analysis*				
7-2	*Product Support*				

SE Systems Engineering

ILS Integrated Logistics Support (Supportability)

RMA Reliability, Maintainability, Availability

SHF Safety and Human Factors

ILS Codes

Raytheon

Space and Airborne Systems

Stage	Life-Cycle Phase	SE	ILS	RMA	SHF
2	PROJECT PLANNING, MANAGEMENT & CONTROL				
2-1	*Planning*	X	X		
2-3	*Management and Control*	X	X		
3	REQUIREMENTS & ARCHITECTURE DEVELOPMENT				
3-1	*System Requirements Definition*	X	X		
3-2	*System Preliminary Design*	X			
3-3	*Product Requirements Definition*	X			
3-4	*Product Preliminary Design*	X			
3-5	*Component Requirements Definition*	X			
4	PRODUCT DESIGN & DEVELOPMENT				
4-1	*Technical Tracking, Simulation & Modeling*	X			
4-2	*Post-Architecture IV&V Planning and Preparation*	X			
4-3	*Component Preliminary Design*				
4-4	*Detail Design*		X		
4-5	*Component Implementation*		X		
4-6	*Component Integration and Test*				
5	SYSTEM IV&V		X		
5-1	*Product IV&V*	X			
5-2	*System Integration & Acceptance Test*	X			
5-3	*System Test & Evaluation*	X			
6	PRODUCTION AND DEPLOYMENT				
6-1	*Production Material*	X			
6-2	*Production Assembly & Test*	X			
6-3	*Production Acceptance/Demonstration*	X			
6-4	*Production Pack & Ship*	X			
7	OPERATIONS AND SUPPORT				
7-1	*Requirements Analysis*		X		
7-2	*Product Support*		X		

SE Systems Engineering

ILS Integrated Logistics Support (Supportability)

RMA Reliability, Maintainability, Availability

SHF Safety and Human Factors

RMA Codes

Raytheon

Space and Airborne Systems

Stage	Life-Cycle Phase	SE	ILS	RMA	SHF
2	PROJECT PLANNING, MANAGEMENT & CONTROL				
2-1	*Planning*	X	X	X	
2-3	*Management and Control*	X	X	X	
3	REQUIREMENTS & ARCHITECTURE DEVELOPMENT			X	
3-1	*System Requirements Definition*	X	X		
3-2	*System Preliminary Design*	X			
3-3	*Product Requirements Definition*	X			
3-4	*Product Preliminary Design*	X			
3-5	*Component Requirements Definition*	X			
4	PRODUCT DESIGN & DEVELOPMENT			X	
4-1	*Technical Tracking, Simulation & Modeling*	X			
4-2	*Post-Architecture IV&V Planning and Preparation*	X			
4-3	*Component Preliminary Design*				
4-4	*Detail Design*		X		
4-5	*Component Implementation*		X		
4-6	*Component Integration and Test*				
5	SYSTEM IV&V		X	X	
5-1	*Product IV&V*	X			
5-2	*System Integration & Acceptance Test*	X			
5-3	*System Test & Evaluation*	X			
6	PRODUCTION AND DEPLOYMENT			X	
6-1	*Production Material*	X			
6-2	*Production Assembly & Test*	X			
6-3	*Production Acceptance/Demonstration*	X			
6-4	*Production Pack & Ship*	X			
7	OPERATIONS AND SUPPORT			X	
7-1	*Requirements Analysis*		X		
7-2	*Product Support*		X		

SE	Systems Engineering
ILS	Integrated Logistics Support (Supportability)
RMA	Reliability, Maintainability, Availability
SHF	Safety and Human Factors

SHF Codes Complete the Picture

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Stage	Life-Cycle Phase	SE	ILS	RMA	SHF
2	PROJECT PLANNING, MANAGEMENT & CONTROL				
2-1	*Planning*	X	X	X	X
2-3	*Management and Control*	X	X	X	X
3	REQUIREMENTS & ARCHITECTURE DEVELOPMENT			X	X
3-1	*System Requirements Definition*	X	X		
3-2	*System Preliminary Design*	X			
3-3	*Product Requirements Definition*	X			
3-4	*Product Preliminary Design*	X			
3-5	*Component Requirements Definition*	X			
4	PRODUCT DESIGN & DEVELOPMENT			X	X
4-1	*Technical Tracking, Simulation & Modeling*	X			
4-2	*Post-Architecture IV&V Planning and Preparation*	X			
4-3	*Component Preliminary Design*				
4-4	*Detail Design*		X		
4-5	*Component Implementation*		X		
4-6	*Component Integration and Test*				
5	SYSTEM IV&V		X	X	X
5-1	*Product IV&V*	X			
5-2	*System Integration & Acceptance Test*	X			
5-3	*System Test & Evaluation*	X			
6	PRODUCTION AND DEPLOYMENT			X	
6-1	*Production Material*	X			
6-2	*Production Assembly & Test*	X			
6-3	*Production Acceptance/Demonstration*	X			
6-4	*Production Pack & Ship*	X			
7	OPERATIONS AND SUPPORT			X	
7-1	*Requirements Analysis*		X		
7-2	*Product Support*		X		

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ILS Integrated Logistics Support (Supportability)

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Each Cost Code in the Database

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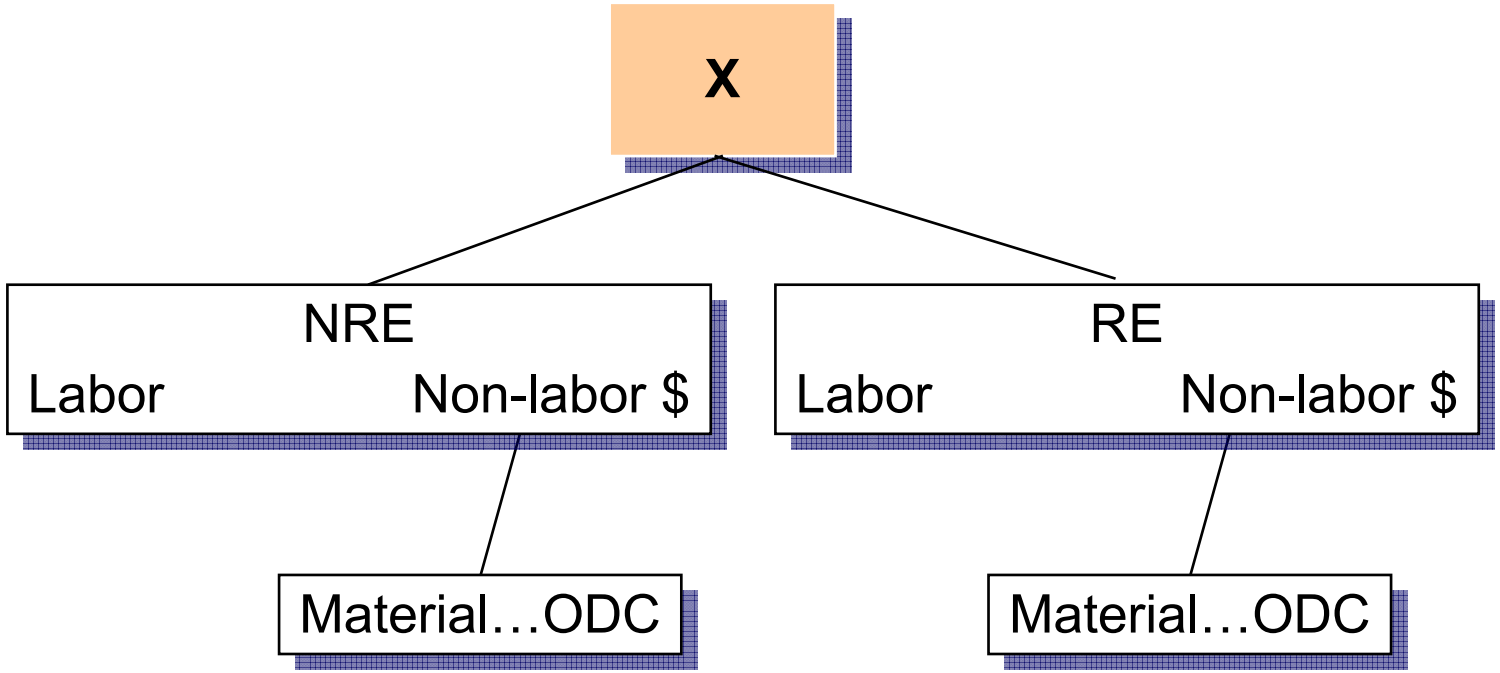

A Cost Code Can Include NRE and RE; Labor Hrs and Non-labor $

Program WBS

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- WBS is loaded into the database
- Elements of program WBS are mapped to the Codes
- Mapping is defined within the database
- Costs can now be examined in separate views
  - *WBS view*
  - *Process view (e.g., Raytheon IPDP)*
- Mapping used for both cost estimating and cost collection

Cost Estimation

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Cost Code Composition

- *Historical Actuals*
  - Actual Labor Hours
  - Actual Non-Labor $ (e.g., ODC, Material)
  - Period of Performance
  - Size Metrics (Units and Values)
  - Re-Use
  - Work Product Productivities
- *Attributes*

Actuals and attributes data are used to generate future bids

Attribute Examples

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- Systems Analyst Team Capabilities
- Systems Analyst Team Experience
- Number of Requirements
- Requirements Volatility
- Defects Found
- Defects Corrected
- Rework
- Multiple Site Development
- Security Requirements
- Contract Type
- System Platform
- Quality Assurance Level
- Effect of Schedule Slip
- Number of Configuration Items
- Number & Complexity of Interfaces
- Automated Tools Use
- Reuse

Values for each attribute are collected with each cost code

Size Estimates

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- Size estimates are made for the key metric of each code
  - *Number of requirements*
  - *Number of plans*
  - *Number of tests*
- These size estimates are multiplied by the historical work product productivity to get number of hours for a code
  - *Hours/requirement*
  - *Hours/plan*
  - *Hours/test*
- Sum together number of hours for all codes

Total hours are then compared to output of a parametric model

Summary

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- **Raytheon SAS System Engineering Cost Collection Codes**
  - ***Methodology***
  - ***Process Based***
  - ***Mapped to program WBS***
  - ***Provides multiple views by product and process***
  - ***Cost collection elements***
  - ***Work product productivities***
  - ***Sizing estimates***
  - ***Cost estimates for each code***
  - ***Sum total for bid input***

Cost Code Database Is Reducing Our Bid Turnaround Time and Providing Multiple Real Time Views of Bid As Inputs Are Entered

Contact Information

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- **Questions ?**

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