Raytheon
Space and Airborne Systems

System Engineering Cost Collection Codes at Raytheon SAS

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Raytheon Space and Airborne Systems

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Presentation Purpose

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- 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 or business unit*
  - *By region*
- Characterize our processes for productivity metrics
- Subdivide processes to enable process improvement opportunities
- Bid along process view as well as work product view

Cost Estimation-Collection Cycle

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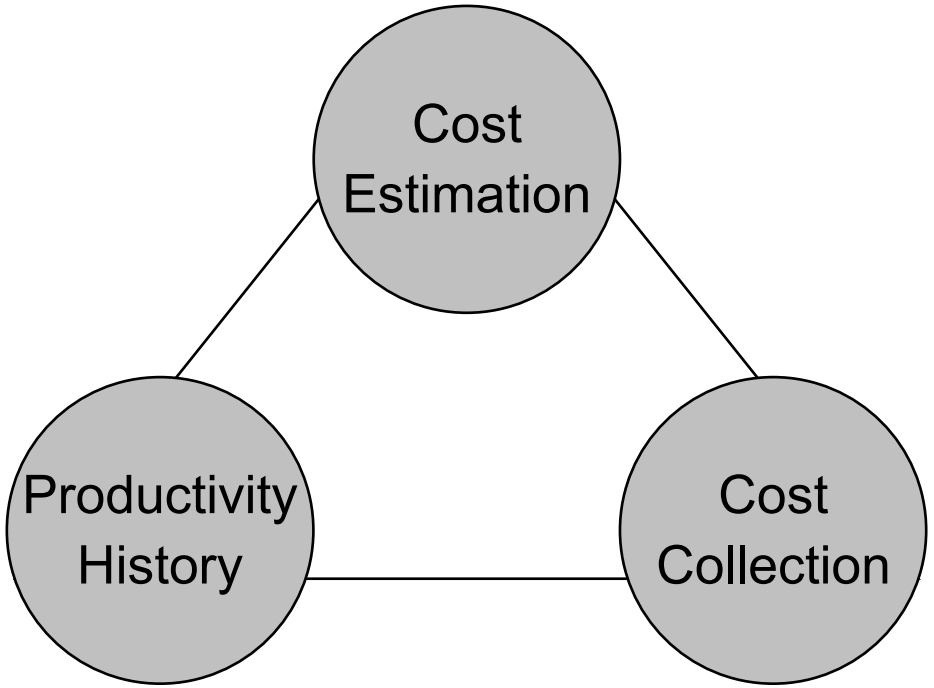

Cost Codes are the Common Denominator

- ***Throughout program life cycle***
- ***Across all programs***
- ***Across all product lines***

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

Task Descriptors

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Life-Cycle Phase	
PROJECT PLANNING, MANAGEMENT & CONTROL	
Planning	
Management and Control	
REQUIREMENTS & ARCHITECTURE DEVELOPMENT	
System Requirements Definition	18
System Preliminary Design	39
Product Requirements Definition	12
Product Preliminary Design	43
Component Requirements Definition	11
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	

Number of Task Descriptors

Codes for Systems Eng. Column

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

More Granularity: Separate RMSS

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

SE Systems Engineering

ILS Integrated Logistics Support (Supportability)

RMA Reliability, Maintainability, Availability

SHF Safety and Human Factors

ILS Codes

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

SE Systems Engineering

ILS Integrated Logistics Support (Supportability)

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RMA Codes

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

SE	Systems Engineering
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Each Cost Code in the Database

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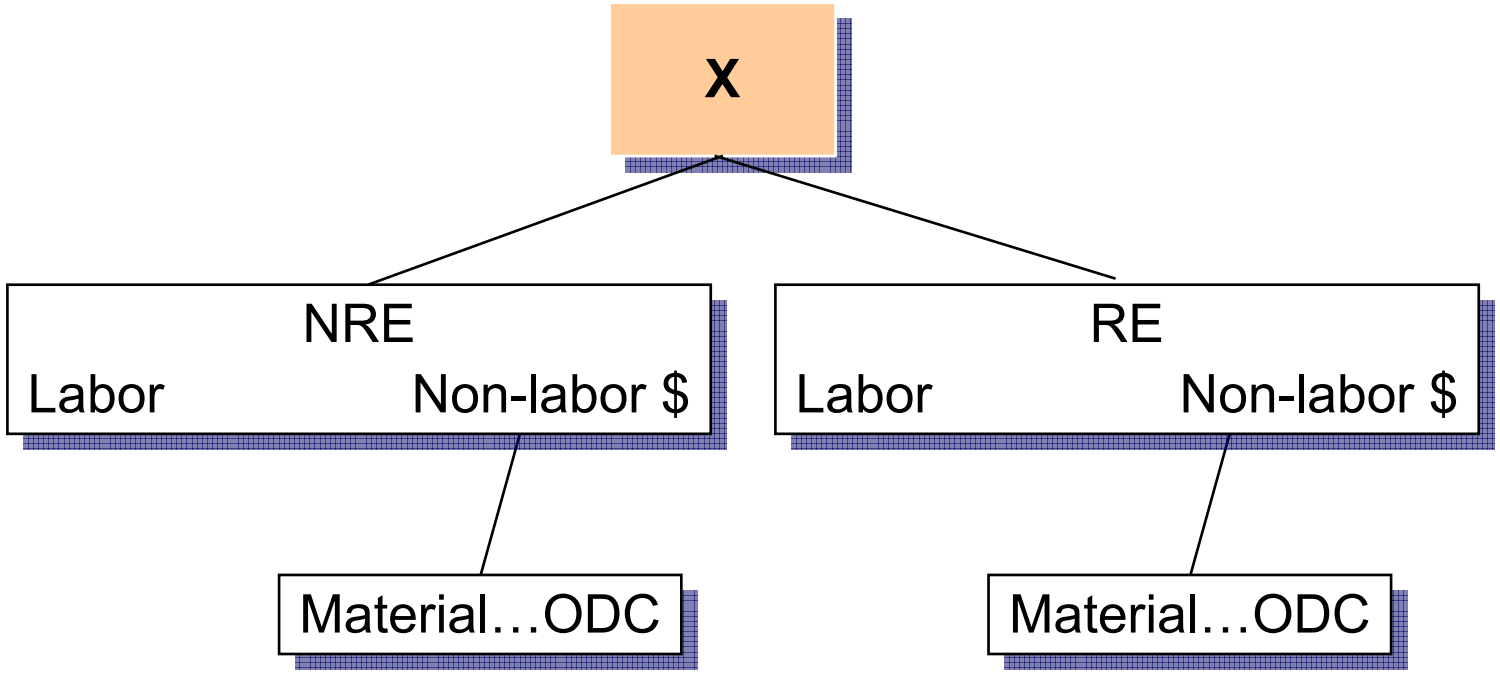

A Cost Code Can Include NRE and RE; Labor Hrs and Non-labor $

Program WBS

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- WBS is loaded into the database
- Elements of program WBS are mapped to the Cost 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, Travel)
  - 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
- Contract Type
- System Platform
- Effect of Schedule Slip
- Number of Configuration Items
- Number & Complexity of Interfaces
- Automated Tools Use
- Reuse
- Security Requirements

Values for attributes 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 another model, such as the output from 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***
  - ***Compare total to another model for reasonableness***

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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