THE WORK BREAKDOWN STRUCTURE IN AN ACQUISITION REFORM ENVIRONMENT

Prepared For:

COST SCHEDULE PERFORMANCE MANAGEMENT CONFERENCE

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OVERVIEW

• Background
• Acquisition Reform
• Work Breakdown Structure Definition
• Work Breakdown Structure Development Process
• Uses of Work Breakdown Structure
• Contract Business Management Overview
• GAO Review
• Issues in Work Breakdown Structure Development
• Relationship with Contractor Management System
• Summary
BACKGROUND

• MIL-STD-881 Developed to Standardized Materiel Defense Items Definitions for Planning, Coordinating and Controlling the Technical and Cost Aspects of a Program
• Reflect Importance of:
  – Technology
  – Software
  – Contractor Organization/Practices
• With Acquisition Reform, MIL-STDs no longer applicable
  – MIL-STD-881 remained essentially in effect (Kaminski Letter)
  – Implementation was still required for Program Managers
  – Contractors utilize to ensure complete and accurate reporting
• MIL-HDBK on Work Breakdown Structures replacing MIL-STD
  – Focus on Government vs. Contractor implementation
  – Follows Acquisition Process
ACQUISITION REFORM

• Implementation of Acquisition Reform includes:
  – Streamline Acquisition (Commercial Practices)
  – Use of Integrated Product Teams
  – EVMS vs. C/SCSC (Insight vs. Oversight)
  – Cost as An Independent Variable (CAIV)
  – Reduction of Government Oversight
    • SOO vs. SOW
    • Elimination of MIL-STDs and MIL-SPECs
    • Addition of Integrated Management Plans and Schedules
• The WBS Remains the Definitive Framework for Government and Industry
  Communication for Technical, Cost and Schedule Elements
WORK BREAKDOWN STRUCTURE DEFINITION

DEFINITION

• A Product Oriented Family Tree of Hardware, Software Services and Data Which Results from Systems Engineering Efforts During Development and Production of a System

• Displays and Defines the Product(s) and Relates the Elements of Work to Each Other and the End Product, and Completely Defines the Program

• Plays a Key Role in Developing/Tracking Costs; Provides a Framework for Financial Reporting

• A Work Breakdown Structure (WBS):
  – Does Not Drive a Program’s Requirements
  – Helps Identify the Interfaces Between the Government and Contractor, and Between Contractors
  – Provides the Framework for Integrating the Program Acquisition Requirements
WORK BREAKDOWN STRUCTURE
DEFINITIONS (CONT’D)

Two Types of Work Breakdown Structures:

• Program Work Breakdown Structure Encompasses Entire Program and Consists of Atleast Three Levels of the Program
  – Used by Government to Define the Contract WBS
  – Used by Contractors to Develop and Extend a Contract WBS

• Contract Work Breakdown Structure is the Approved WBS for Reporting Purposes and its Discretionary Extension by the Contractor
  – Includes All the Elements for the Products Which are Responsibility of the Contractor
  – Contract Work Statement should Provide the Reporting Requirements
**WBS LEVELS**

- **Level 1**
  - Entire System
  - Program Element, Project or Subprogram
- **Level 2**
  - Major Elements of the System
  - Top Level Aggregations of Services or Data
- **Level 3**
  - Subordinate Items to Level 2 Elements
  - Generally Common Across Similar Programs
PROGRAM WBS (EXAMPLE)

LEVEL 1

- AIRCRAFT SYSTEM

LEVEL 2

- AIR VEHICLE
- SYSTEM ENGINEERING / PROGRAM MANAGEMENT
- SYSTEM TEST AND EVALUATION
- DATA
- TRAINING

LEVEL 3

- AIR FRAME
- PROPULSION
- FIRE CONTROL
### EXPANDED PROGRAM WBS (EXAMPLE)

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### AUTOMATED SOFTWARE SYSTEM

**WORK BREAKDOWN STRUCTURE**

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## Software Extension

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| Build 1…n| CSCI 1          | CSC 1…n  
|          | CSCI 2          | CSC 1…n  
|          | CSCI 3          | CSC 1…n  
|          |                 | CSC to CSC Integration and Checkout  
|          |                 | CSC to CSC Integration and Checkout  
|          |                 | CSC to CSC Integration and Checkout  
|          | CSCI to CSCI Integration and Checkout |
# Relationship of Program WBS with Contract WBS

## Program WBS

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EVOLUTIONARY REQUIREMENTS DEFINITION

Pre-Concept

Concept Exploration

Definition & Risk Reduction

Engineering & Manufacturing Development

Production & Deployment

Operations & Support

Need Analysis Support

Technology Opportunity

Alternative Concepts

Reduced Risk Alternative

Detailed Design

Refined Final Design

Product Improvement

Specifications

Configuration Baselines

Major Technical Reviews & Audits
THE EVOLUTION OF WORK BREAKDOWN STRUCTURE

CONCEPTUAL STUDIES

PROGRAM APPROVAL

PROGRAM DEFINITION & RISK REDUCTION

DEVELOPMENT

PRODUCTION

#1 CONTRACT PRELIMINARY WBS

#2 CONTRACT PRELIMINARY WBS

OTHER CONTRACT(s) IF ANY

#1 CONTRACT WBS AND EXTENSION

#2 CONTRACT WBS AND EXTENSION

OTHER CONTRACT(s) IF ANY

APPROVED/PROPOSED PROGRAM WBS

APPROVED/UPDATED PROGRAM WBS

APPROVED PROGRAM WBS

#1 CONTRACT WBS AND EXTENSION

#2 CONTRACT WBS AND EXTENSION

OTHER CONTRACT(s) IF ANY

OTHER CONTRACT(s) IF ANY

STUDY PHASES

PROGRAM ACQUISITION PHASES
SYSTEMS ENGINEERING

• Pre-Concept
  – Need Analysis Support
  – Identifying Technology
  – Systems Engineering Intensive

• Concept Exploration
  – Mission Need Statement
  – Exploratory Trade-Off Studies
  – Preliminary System Level
    • Functions
    • Performance
  – Top Level Specifications

WBS DEVELOPMENT

• No Formal WBS Defined
CONCEPT EXPLORATION

KILL TANK

USER NEED - LEVEL 0

MOVE

DETECT

SHOOT

SYSTEM NEED - LEVEL 1
PROGRAM DEFINITION & RISK REDUCTION

SYSTEMS ENGINEERING
• Operational Requirements Document (ORD)
  – Approved Program
• System Level Performance Requirements
  – Prove Critical Technologies and Processes
  – Type “A” or “B” Specifications
• CAIV Implementation
• Preliminary Configuration Items Within a Functional Architecture
• Preparation of Statement of Objectives

WBS DEVELOPMENT
• Preparation of:
  – CCDR Plan
  – Preliminary Program WBS to Level 3
  – Schedule and Cost Estimates
• Prepare CAIV Trade-offs for each WBS element
PROGRAM DEFINITION & RISK REDUCTION

LEVEL 1

AIRCRAFT SYSTEMS

LEVEL 2

AIR VEHICLE

TRAINING

PECULIAR SUPPORT EQUIPMENT

LEVEL 3

RECEIVER

FIRE CONTROL

COMMUNICATION

EQUIPMENT

SERVICES

DEPOT
ENGINEERING & MANUFACTURING DEVELOPMENT

SYSTEMS ENGINEERING
- Updated Operational Requirements Document
- Detailed Design
  - Preliminary Design Review
  - Critical Design Review
  - Lower Level Specification
  - Product and Process/Material Specifications
- Configuration Defined
  - Specification Tree
  - Configuration Items (CI) or Computer Software Configuration Item (CSCI)
- Cost/Performance Trade-offs

WBS DEVELOPMENT
- Approved Program WBS
- Statement of Work Developed by Contractor
- Approved Contract WBS
- Extension of Contract WBS by Contractor
- Continue CAIV Trade-offs
- Cost/Schedule Performance Measurement
PRODUCTION

SYSTEMS ENGINEERING
• Produce Prime Mission Product
• Maintain Configuration Management
• Improve Performance through CAIV implementation

WBS DEVELOPMENT
• Maintain Program and Contract WBS
  – Major Modifications
  – Relationship to Process and Configuration Control
• Continue CAIV Trade-offs
• Cost/Schedule Reporting
USES OF A WORK BREAKDOWN STRUCTURE

• Technical Management
  – Provides Framework for Defining the Technical Objectives of the Program
  – Contract Statement of Work (SOW)
  – Describes What Products and Services are to be Delivered
  – An Effective SOW will Facilitate Effective Contractor Evaluation After Contract Award
  – A Standardized WBS is a Template for Constructing the SOW and the Contract Line Items (CLINs) - Streamline the Process
  – Use the WBS to Provide the Framework and Facilitate a Logical Arrangement of the SOW Elements

• Specification Tree
  – Hierarchy of Performance Requirements for Each Component Element of the System for Which Design Responsibility is Assigned
  – Specifications May Not be Written for Each Product
  – May Not Match the WBS
USES OF A WORK BREAKDOWN STRUCTURE (CONT’D)

• Configuration Management
  – Process of Managing the Technical Configuration of Items Being Developed
  – Need to Designate Which Contract Deliverables are Subject to Configuration Management Controls
    • Configuration Item (CI)
    • Computer Software Configuration Item (CSCI)
  – Framework for Designating the Configuration Items in the WBS
• Financial Management
  – WBS Assists Management in Measuring Cost and Schedule Performance
  – Products are Identified in Terms of Cost and Schedule Performance Goals
  – Serves as the Basis for Estimating and Scheduling Resource Requirements
• Cost Estimating
  – Facilitates Government to Plan, Coordinate, Control and Estimate Various Program Activities
  – Provides Common Framework for Tracking Estimated and Actual Costs
USES OF A WORK BREAKDOWN STRUCTURE
(CONT’D)

• Data Bases
  – Used for Pricing and Negotiating Contracts and Contract Changes, and for Follow-on Procurement
  – Provides Cost Data Base of Similar WBS Elements from Different Programs
    • Used to Develop Learning Curves, Regression and Other Techniques to Estimate the Cost Requirements
    • Provide Comparison to the Original Estimates
    • Assists in Bidding Future Contracts and Budgeting New Work
RELATIONSHIP TO MANAGEMENT PLAN AND SCHEDULE

- Project Control Is the First Unit of Control
  - Integrated Management Plan (IMP) Ties Contractual Work Scope With Technical Plans and Goals of the Program
- Time or Schedule Is the Second Unit of Control
  - Integrated Management Schedule (IMS) Ties Contractual Work Scope to Schedule or Milestones Goals
  - Understanding the Duration to Go From Step One to Step Two of the Work Scope the Better the Plan and the Better the Control
- Identifying Resources Is the Third Unit of Control
INTEGRATED MANAGEMENT

**Requirement**
- System Specification
  - 1000 Air Vehicle
    - 1100 Airframe
    - 1110 Wing

**WBS Elements**
- 1000 Air Vehicle
  - 1100 Airframe
    - 1110 Wing
  - 1189 Landing Gear

**SOW Task**
- 3.1 Air Vehicle (WBS 1000)
  Design, develop, produce and verify, complete air vehicles, defined as airframe propulsion, avionics and other installed equipment.

### Integrated Management Plan

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<td>1. Preliminary Design Complete</td>
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<td>Duty Cycle Defined</td>
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RELATIONSHIP OF SYSTEM DESIGN AND WBS

SPECIFICATION FLOWDOWN

SYSTEM
SYSTEM (A SPEC)

SEGMENT
(A OR B1 SPEC)

ELEMENT
(B1 SPEC)

SUBSYSTEM
(B2 SPEC)

COMPONENT
(ASSEMBLY)

SUBASSEMBLY
(DETAIL PART)

SYSTEM SPECIFICATION

SYSTEM SEGMENT SPECIFICATION

PRIME ITEM SPECIFICATION

CRITICAL ITEM SPECIFICATION

COMPONENT DESIGN REQUIREMENTS

DETAIL DRAWINGS

WBS BREAKOUT

SYSTEM

AIR VEHICLE

FIRE CONTROL

RADAR SUBSYSTEM

RECEIVER SUBSYSTEM

CIRCUIT BOARD

MCR Federal, Inc.
FINANCIAL MANAGEMENT REPORTING STRUCTURE

- **FUTURE YEAR DEFENSE PROGRAM**
- **PROGRAM FUND REQUIREMENTS**

**WBS**

- **PERFORMANCE MEASUREMENT**
  - SCHEDULE
  - COST
  - TECHNICAL

- **CONTRACT COST DATA**
  - FUNCTIONAL COSTS
  - OVERHEAD DATA
  - PROGRESS CURVES

**CSSR CPR”**

**CFSR”**

**CCDR”**

MCR Federal, Inc.
INTEGRATING PROGRAM ACQUISITION REQUIREMENTS

- Generated by Government
- Identifies Work to be Performed
- Define the System
- Define the System
- Ties System Definition with Work to be Performed
- Conforms to MIL-HDBK
- Framework for Technical, Cost, Schedule Reporting
- Identifies Contractual Requirements
- Tied to SOO/SOW or WBS
CONTRACT BUSINESS MANAGEMENT OVERVIEW

- RFPs Identify Significant “Misapplication” of Reporting Requirements
  - Timely Development of CCDR Data Plan
  - CCDRs Not Used; Go To Unknown Staff
  - WBS Changes After Contract Award
  - Drive Reporting to Too Low of Level
  - Tailoring Not Allowed
  - CLINs Cause Separate Allocation
- 50% Have WBS Implementation Problems
  - Poor Software WBS Definition
  - WBS Not oriented to Development Type Contracts
  - Conflicts Between Types of WBS Used
  - Extending WBS Below Reporting Level Requires Permission
CONTRACT BUSINESS
MANAGEMENT OVERVIEW (CONT’D)

- Program Manager Involvement
  - Key Individual in Process
  - Upfront Planning Drives Quality of Output
  - Business Planning Ownership Should Not be Diffused
- Poor Communication
  - Industry/Government Relationship
  - WBS Development Inconsistent Across Services
  - WBS Must be the Tool for Integrating the Functions and Communicating the Needs
GAO REPORT FINDINGS
May 1997

- Found contractor systems inconsistent with Government requirements for reporting
- Levels of reporting were often too low
- Disconnect between cost account and development processes
- Estimating and C/S requirements out of sync
- CCDR procedures and processes being revised
- Standardized WBS could provide consistency (but could cause problems if improperly implemented)
ISSUES IN WORK BREAKDOWN STRUCTURE DEVELOPMENT

- Element of a Program that are Not Products
- Program Phases (e.g., Production), and Types of Funds (e.g., Research, Development, Test and Evaluation)
- Rework, Retesting and Refurbishing
- Non-recurring and Recurring Classifications
- Organizational Structure (Functional vs. IPT)
- Tooling (e.g., Special Test Equipment, and Factory Support Equipment Such as: Assembly Tools, Dies Jigs, Fixtures, Handling Equipment, etc.)
- Production Acceptance Testing of R&D (Including First Article Test) and Production Units
ISSUES IN WORK BREAKDOWN STRUCTURE DEVELOPMENT

- The Integrated Management Plan (IMP) and Integrated Management Schedule (IMS) should reflect the WBS
- The IMP/IMS data contained within the CWBS framework should be reconcilable into a single IMP/IMS element.
- The WBS will serve multiple functions within the program. Design of the WBS should accommodate the requirements for:
  - Design To Cost (DTC)/Life Cycle Cost (LCC), Cost As an Independent Variable (CAIV)
  - Engineering Bill(s) of Material (EBOM), Manufacturing Bill(s) of Material (MBOM),
  - Product structure of the end items regardless of phase or funding
- Each subcontractor effort will be assigned to a single WBS element
  - Minor subcontractors (i.e., subcontractors with either little or no technical, schedule, and/or cost risk) may be grouped together under a single WBS element
COMPARISON OF CORRECT AND INCORRECT PROGRAM WBSs

**CORRECT**

**PROGRAM WBS**

**INCORRECT**

**PROGRAM WBS**

These are work efforts, not products.

These items are functional, not products (Ref. CCDR).

Nonrecurring and recurring items are not WBS elements (Ref. CCDR).

Software should be included with the hardware it supports.

These are system level tests but should be included in the Airframe WBS element.
RELATIONSHIP WITH CONTRACTOR MANAGEMENT SYSTEM

- Contractor Should Assign Management Responsibility for Technical, Schedule, and Cost Performance (Cost Account Manager)
  - Cost Management System Should Provide the Necessary Visibility of the WBS as it Interfaces with the Organization
  - At Juncture of the WBS Element and Organization Unit, Cost Accounts are Usually Established
  - Performance is Planned, Measured, Recorded and Controlled
TRANSLATION FROM FUNCTION TO PRODUCT

LEVEL 1
- FIRE CONTROL

LEVEL 2
- RADAR
- TRAINING

LEVEL 3
- RECEIVER GROUP
- ANTENNA
- RECEIVER
- SIDELOBE CANCELLER
- APPLICATIONS S/W
- MECHANICAL DESIGN
- ELECTRICAL DESIGN
- DRAFTING/ CHECKING
- COST ACCOUNT
- COST ACCOUNT

FUNCTIONAL ORGANIZATION
- COMPANY
- MANUFACTURING
- DESIGN
- ENGINEERING
- TEST

WORK PACKAGES

MCR Federal, Inc.
TRANSLATION FROM IPT TO PRODUCT

LEVEL 1
- FIRE CONTROL

LEVEL 2
- RADAR
- TRAINING

LEVEL 3
- RECEIVER GROUP
- ANTENNA

WORK PACKAGES

IPT ORGANIZATION
- IPT
- TEST IPT
- MANUFACTURING IPT
- DESIGN
- ELECTRICAL DESIGN
- DRAFTING/ CHECKING
- MECHANICAL DESIGN
- COST ACCOUNT
- SIDELOBE CANCELLER
- APPLICATIONS S/W

MCR Federal, Inc.
LINKAGE BETWEEN CONTRACTOR WBS AND CONTRACTOR MANAGEMENT SYSTEMS

LEVEL 1
- FIRE CONTROL

LEVEL 2
- RADAR
- TRAINING

LEVEL 3
- RECEIVER GROUP
- ANTENNA

LEVEL 4
- RECEIVER
- SIEDLOBE CANCELLER
- APPLICATIONS SOFTWARE

FUNCTIONAL ORGANIZATION

COMPANY
- TEST
- ENGINEERING
- FACTORY

SOFTWARE QUALITY ASSURANCE
- COST ACCOUNT

SOFTWARE ENGINEERING
- COST ACCOUNT

SW CONFIG. CONTROL
- COST ACCOUNT

WORK PACKAGES
- REQUIREMENTS ANALYSIS (Job Code)
- DESIGN (Job Code)

CODE AND TEST (Job Code)

Integration and Test (Job Code)

MCR Federal, Inc.
LINKAGE BETWEEN WORK BREAKDOWN STRUCTURE AND PROCESS-ORIENTED BREAKDOWN

LEVEL 1
- FIRE CONTROL

LEVEL 2
- RADAR
- TRAINING

LEVEL 3
- RECEIVER GROUP
- ANTENNA

PROCEDURE - ORIENTED BREAKDOWN

- DEVELOPMENT/PRODUCTION ACTIVITY OR INTEGRATED PRODUCT TEAM
  - RESOURCE INPUTS
  - DEVELOPMENT PROCESS
    - FABRICATION
    - SET-UPS
  - PRODUCTION PROCESS
    - ASSEMBLY
    - COST ACCOUNT
    - SIDELOBE CANCELLER
    - COST ACCOUNT
    - APPLICATIONS S/W
    - ELECTRICAL/ELECTRONIC FAB
    - MECHANICAL FABRICATION
    - WORK PACKAGES

MCR Federal, Inc.
SUMMARY

• Work Breakdown Structure is Product-Oriented Family Tree

• Develop program and Contract Work Breakdown Structure Based on How the System Will be Developed

• Use the Work Breakdown Structure as an Integrating Tool with the SOW, CLIN and System Design

• Acquisition Reform Provides Continued Use of WBS with IPT, CAIV, IMS, IMP, and Other Initiatives

• Extension of WBS at Too Low of Level Will Burden the Contractor Management System

• Use the WBS as a Medium for Communicating the Program Requirements