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- With Acquisition Reform, MIL-STDs no longer applicable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)

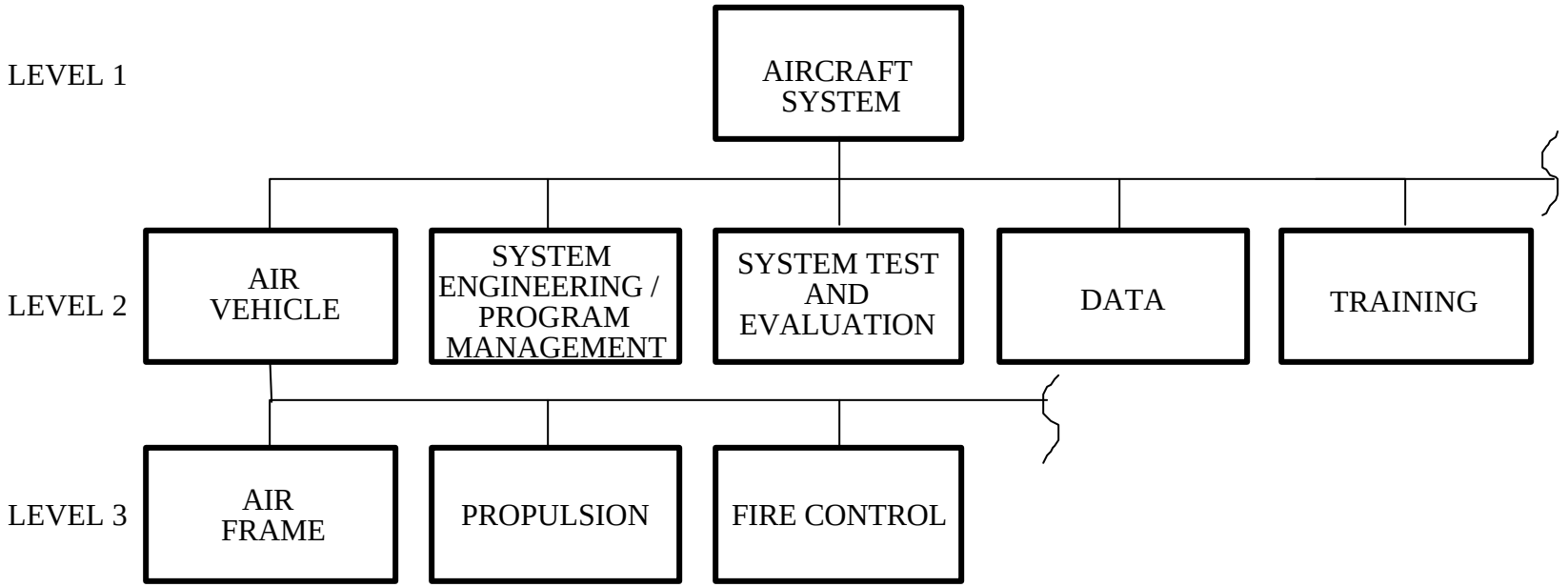
Two Types of Work Breakdown Structures:

- 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)



EXPANDED PROGRAM WBS (EXAMPLE)

PROGRAM WBS

1	2	3	4	5
FX AIRCRAFT				
	AIR VEHICLE			
		AIRFRAME		
		PROPULSION (SK-PW-52D)		
		COMMUNICATIONS/IDENTIFICATION		
		NAVIGATION/GUIDANCE		
		FIRE CONTROL		
			RADAR	
				RECEIVER
				TRANSMITTER
				ANTENNA
				RADAR APPLICATIONS S/W (TO CSCI LEVEL)
				RADAR SYSTEM S/W (TO CSCI LEVEL)
				RADAR INTEG., ASSEMBLY, TEST AND CHKOUT
		AUTOMATIC FLIGHT CONTROL		
		CENTRAL COMPUTER		
		ELECTRONIC WARFARE		
		WEAPON DELIVERY EQUIPMENT		
		ARMAMENT		
	SYSTEM TEST AND EVALUATION			
		DEVELOPMENT TEST AND EVALUATION		
		OPERATIONAL TEST AND EVALUATION		
		MOCKUPS		
		TEST AND EVALUATION SUPPORT		
		TEST FACILITIES		
	SYSTEMS ENGINEERING/PROGRAM MANAGEMENT			
		SYSTEMS ENGINEERING		
		PROGRAM MANAGEMENT		
		INTEGRATED LOGISTIC SUPPORT		
	PECULIAR SUPPORT EQUIPMENT			
		TEST AND MEASUREMENT EQUIPMENT		
		SUPPORT AND HANDLING EQUIPMENT		
	COMMON SUPPORT EQUIPMENT			
	TRAINING			
		MAINTENANCE TRAINERS		
		AIRCREW TRAINING DEVICE		
		TRAINING COURSE MATERIALS		
	DATA			
		TECHNICAL PUBLICATIONS		
		ENGINEERING DATA		
		MANAGEMENT DATA		
		SUPPORT DATA		
		DATA DEPOSITORY		
	OPERATIONAL/SITE ACTIVATION			
		CONTRACTOR TECHNICAL SUPPORT		
	INITIAL SPARES AND REPAIR PARTS			

AUTOMATED SOFTWARE SYSTEM WORK BREAKDOWN STRUCTURE

LEVEL 1	LEVEL 2	LEVEL 3
Electronic/Automated Software System	Prime Mission Product (PMP)	Electronic Subystem 1 ..n (Specify Names) PMP Applications Software PMP System Software PMP Integration, Assembly, Test and Checkout
	Platform Integration	
	System Engineering/Program Management	
	System Test and Evaluation	Development Test and Evaluation Operational Test and Evaluation Mock-ups Test and Evaluation Support Test Facilities
	Training	Equipment Services Facilities
	Data	Technical Publications Engineering Data Management Data Support Data Data Depository

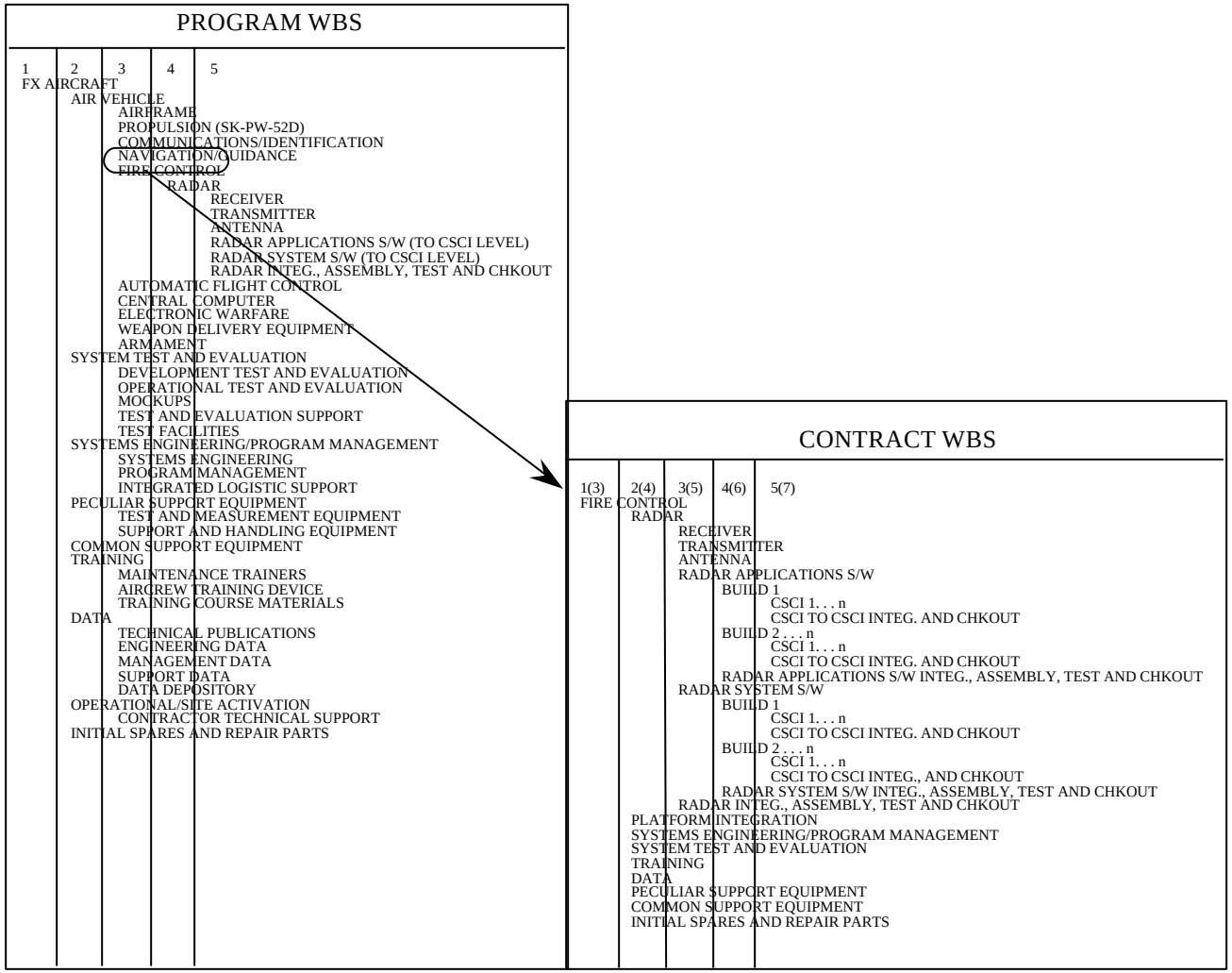
AUTOMATED SOFTWARE SYSTEM
WORK BREAKDOWN STRUCTURE (CONT'D)

LEVEL 1	LEVEL 2	LEVEL 3
	Peculiar Support Equipment	Test and Measurement Equipment Support and Handling Equipment
	Common Support Equipment	Test and Measurement Equipment Support and Handling Equipment
	Operational/Site Activation	System Assembly, Installation and Checkout on Site Contractor Technical Support Site Construction Site/Ship/Vehicle Conversion
	Industrial Facilities	Construction/Conversion/Expansion Equipment Acquisition or Modernization Maintenance (Industrial Facilities)
	Initial Spares and Repair Parts	

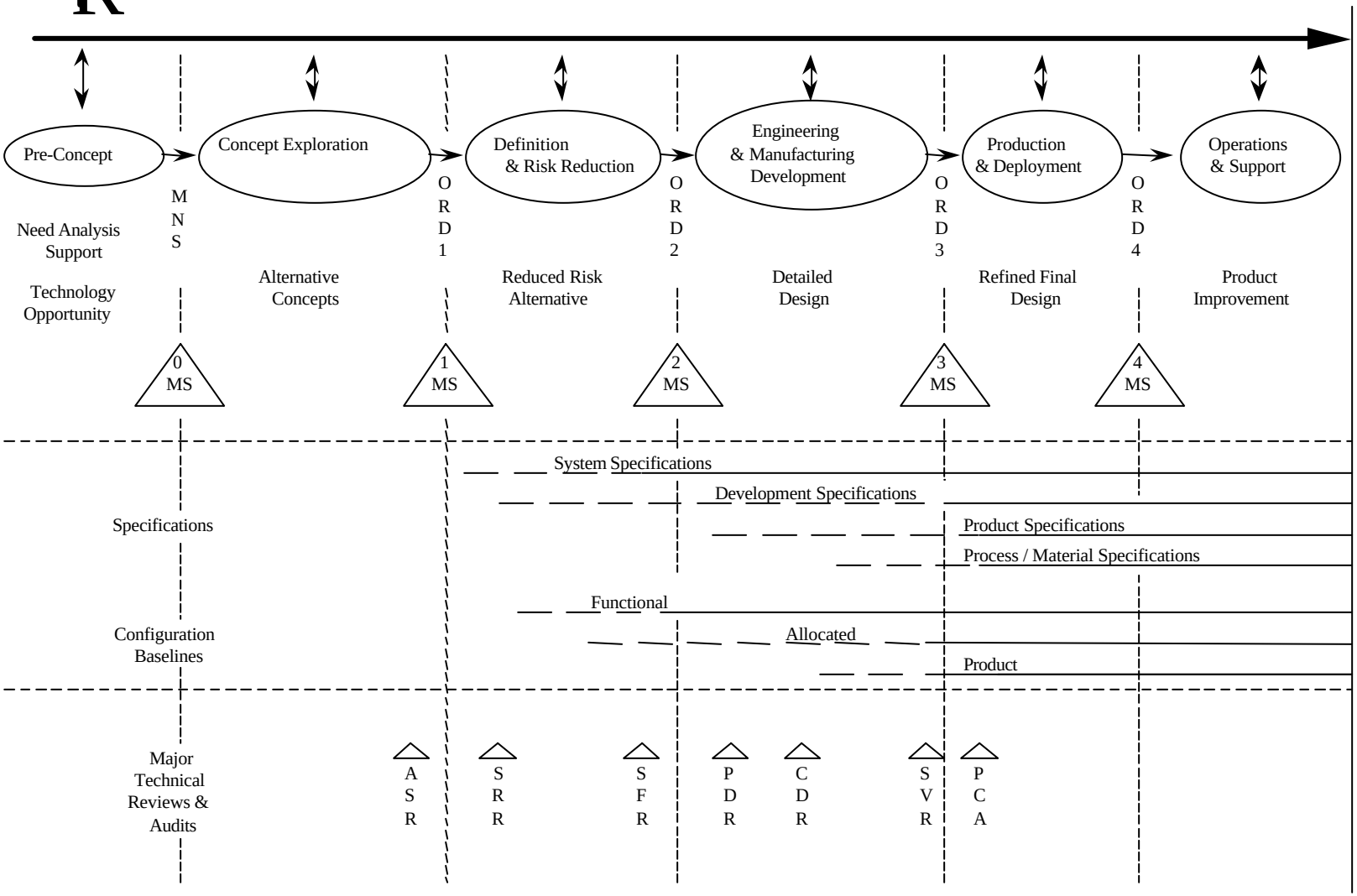
AUTOMATED SOFTWARE SYSTEM
WORK BREAKDOWN STRUCTURE (CONT'D)
Software Extension

LEVEL 4	LEVEL 5	LEVEL 6
Build 1…n	CSCI 1	CSC 1…n CSC to CSC Integration and Checkout
	CSCI 2	CSC 1…n CSC to CSC Integration and Checkout
	CSCI 3	CSC 1…n CSC to CSC Integration and Checkout
	CSCI to CSCI Integration and Checkout	

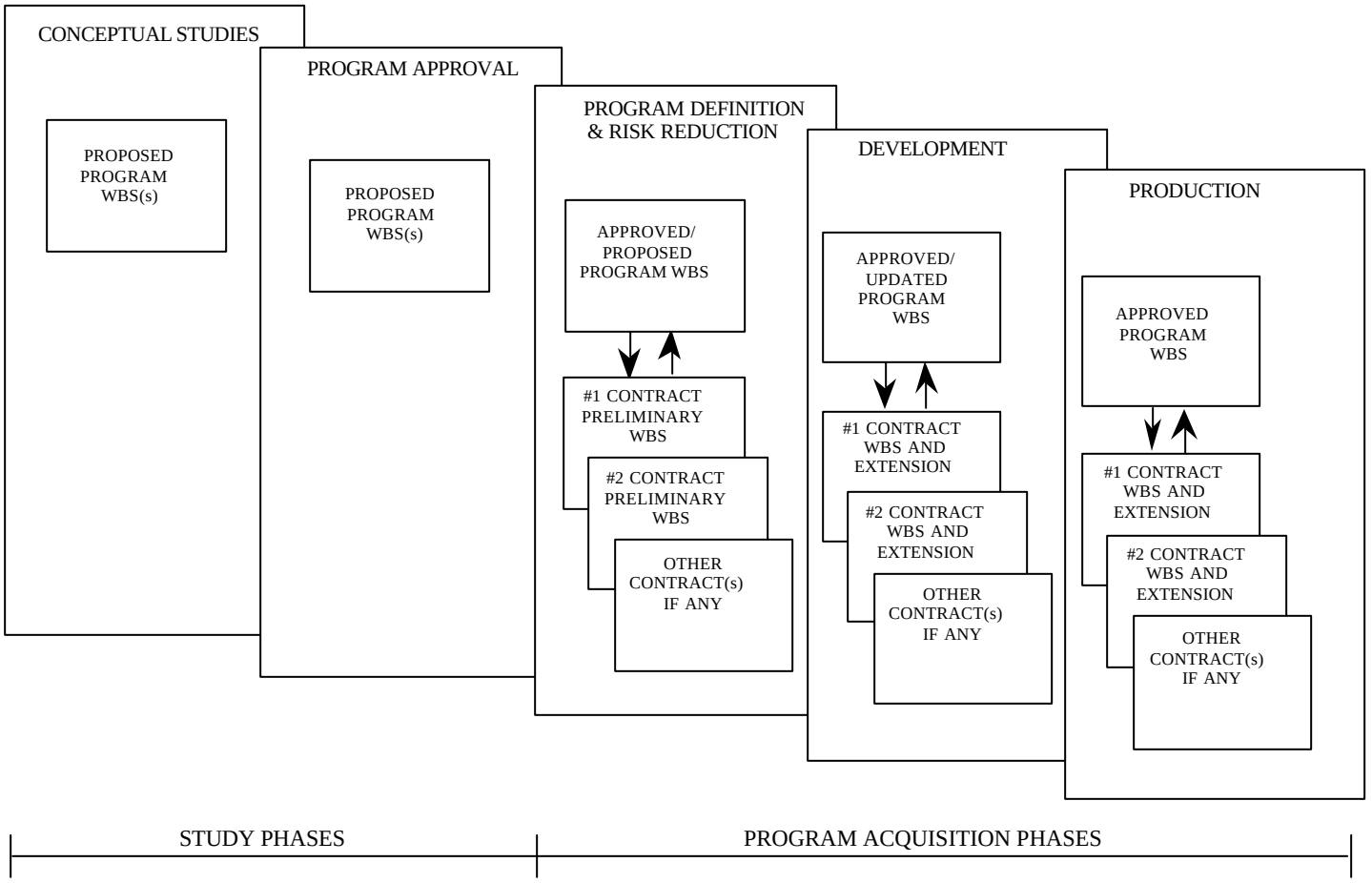
RELATIONSHIP OF PROGRAM WBS WITH CONTRACT WBS



EVOLUTIONARY REQUIREMENTS DEFINITION



THE EVOLUTION OF WORK BREAKDOWN STRUCTURE



SYSTEMS DEVELOPMENT
Mission Need and Analysis

MCR

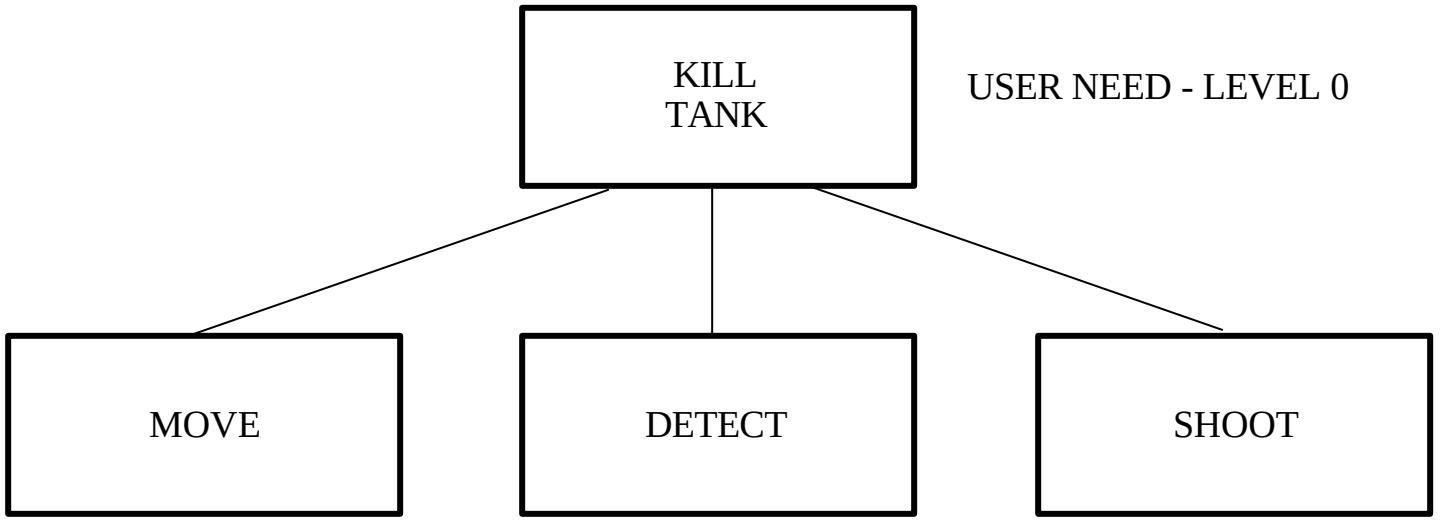
SYSTEMS ENGINEERING

- 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



PROGRAM DEFINTION & RISK REDUCTION

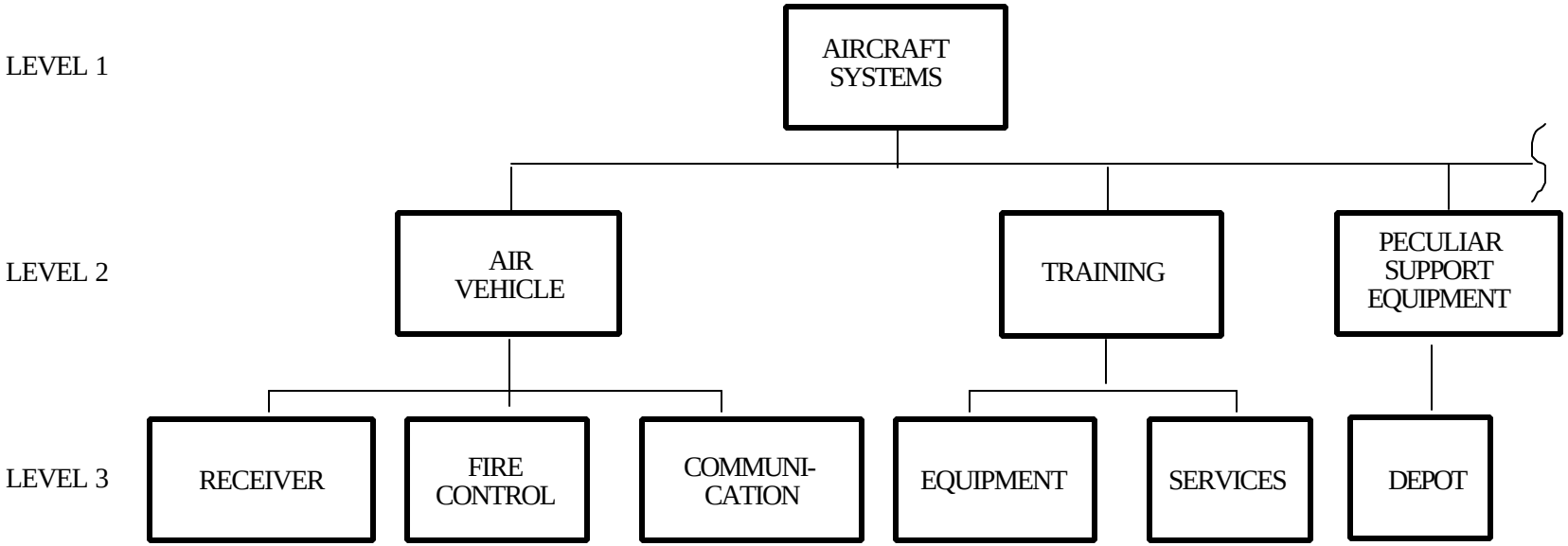
SYSTEMS ENGINEERING

- 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



ENGINEERING & MANUFACTURING DEVELOPMENT

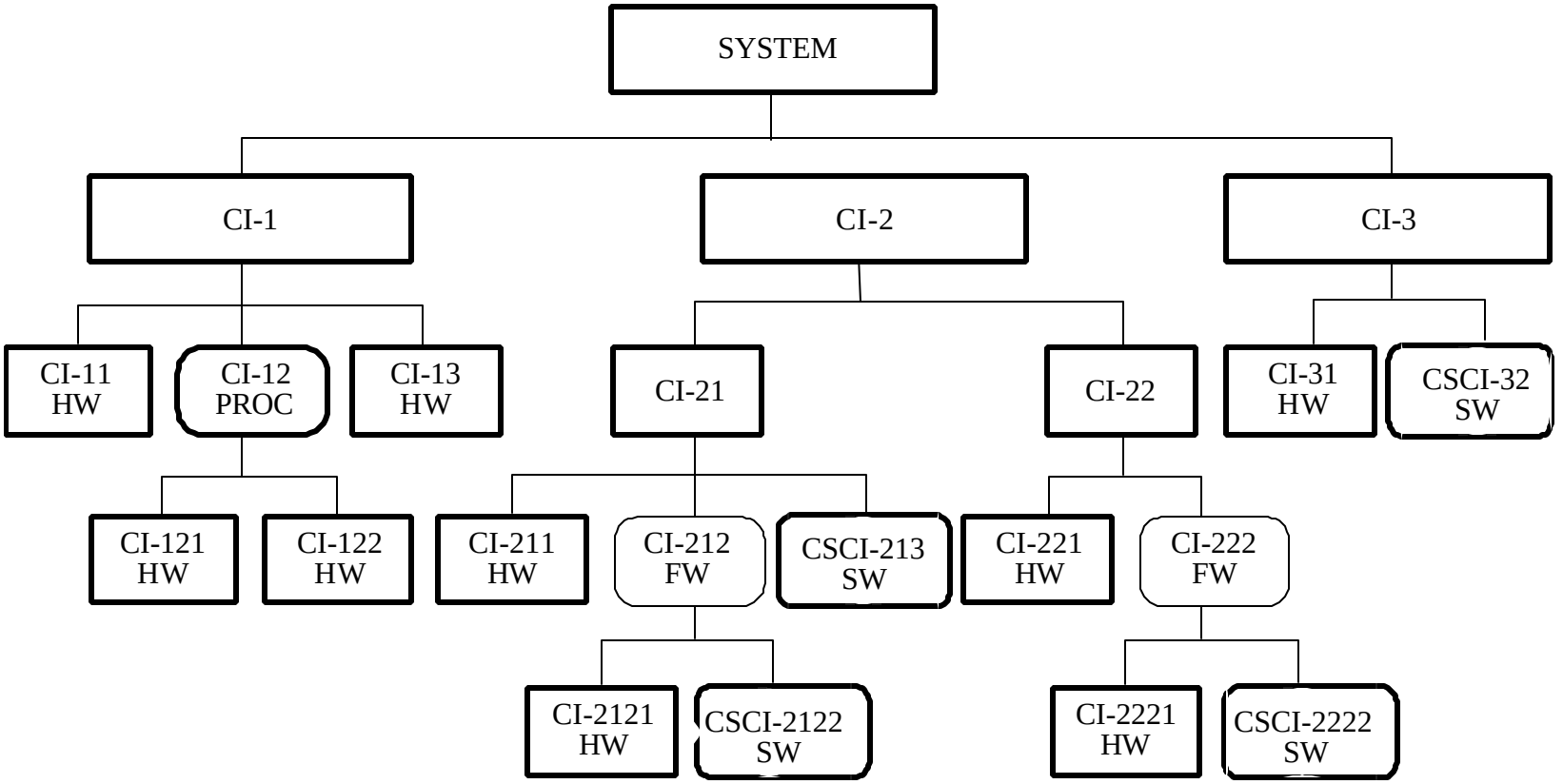
SYSTEMS ENGINEERING

- 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

SYSTEM CONFIGURATION



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
  - Together with Contract SOW and Product Specification, Aids in Establishing a Specification Tree, Defining Configuration Items, and Planning Support Tasks
  - 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

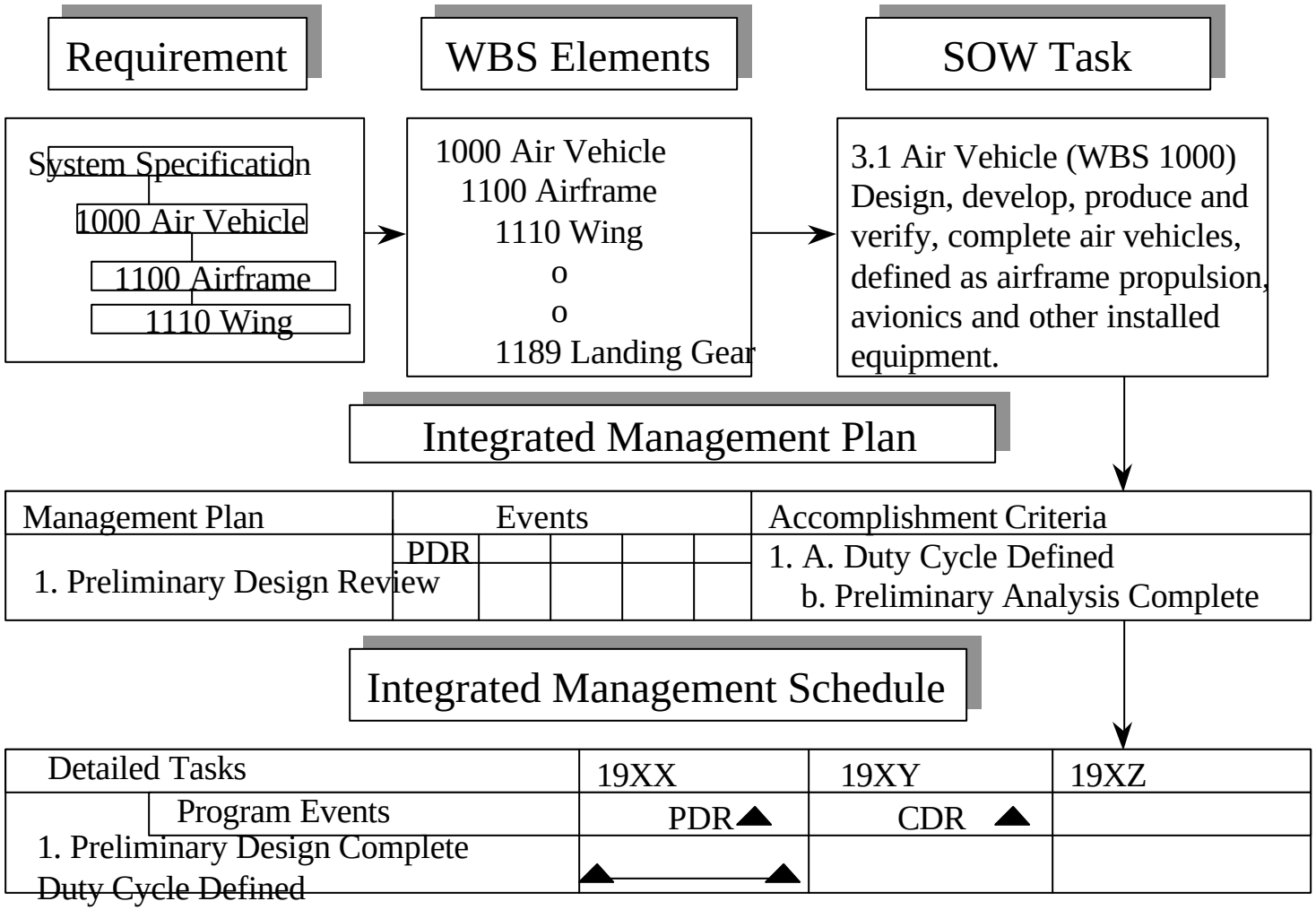
USES OF A WORK BREAKDOWN STRUCTURE (CONT'D)

- 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

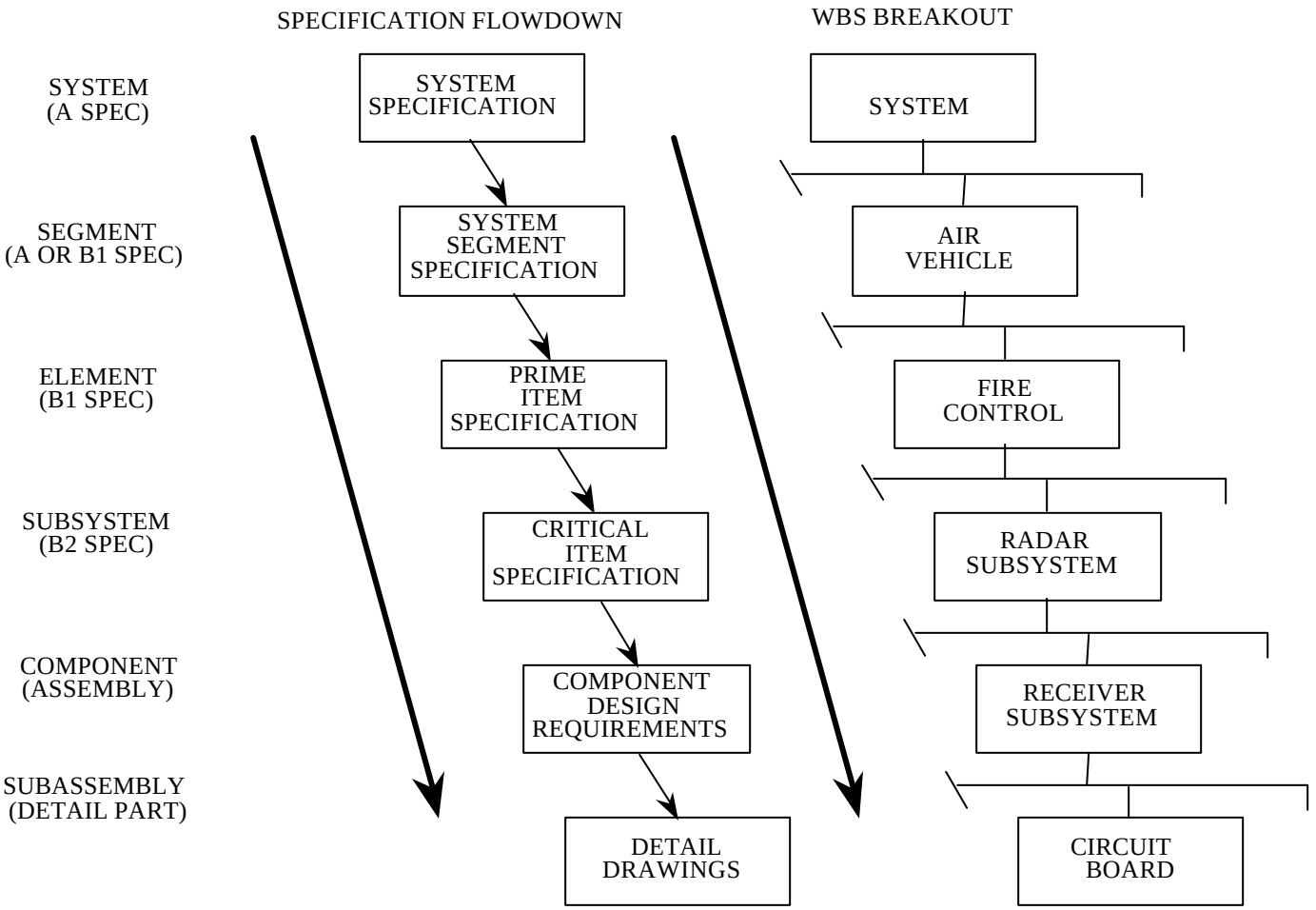
RELATIONSHIP TO MANAGEMENT PLAN AND SCHEDULE

- 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
  - Identifying Materials, People and Tools to the Work Scope Definition Will Determine How Well the Project Is Utilizing Resources and How Performance Is Measured.

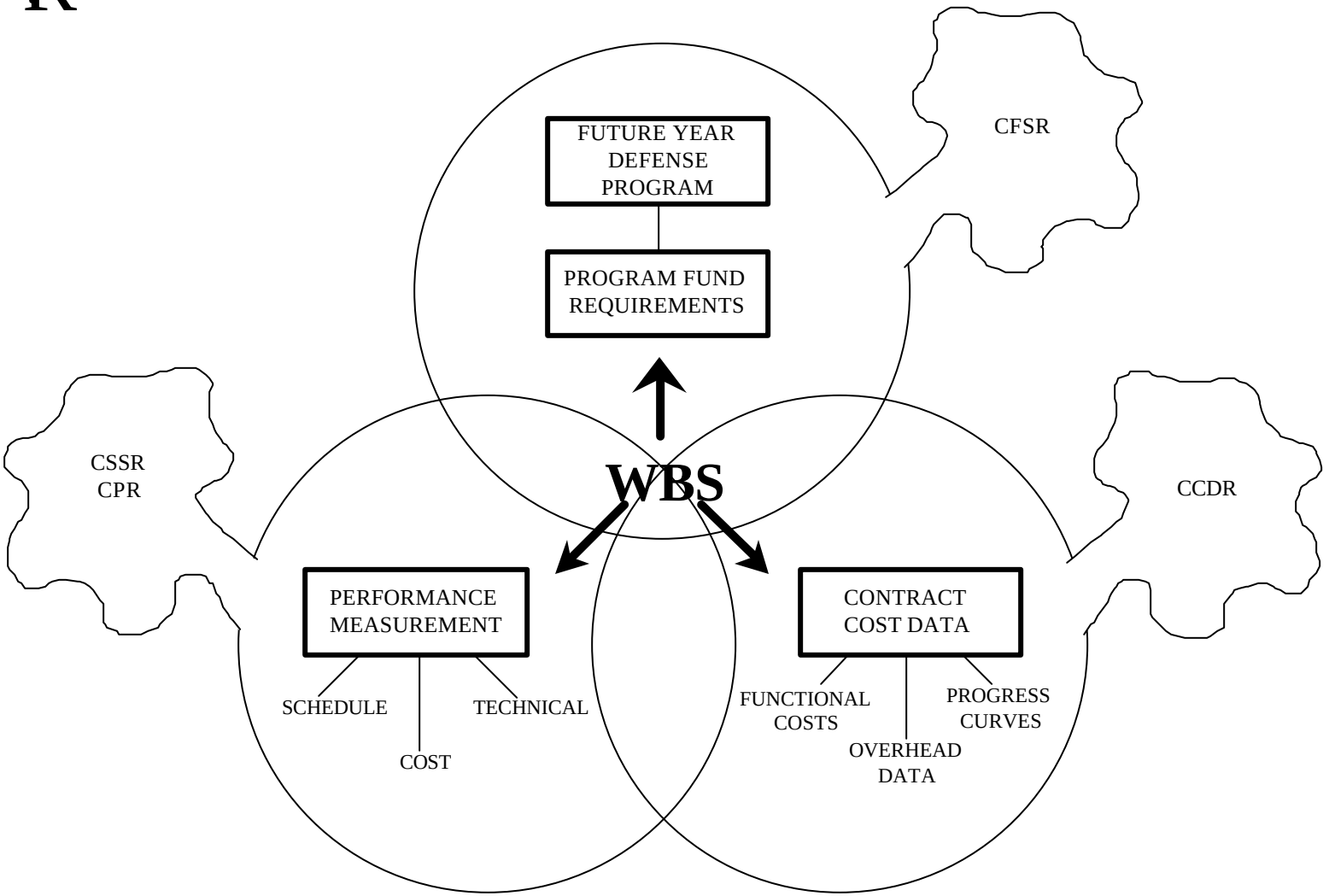
INTEGRATED MANAGEMENT



RELATIONSHIP OF SYSTEM DESIGN AND WBS



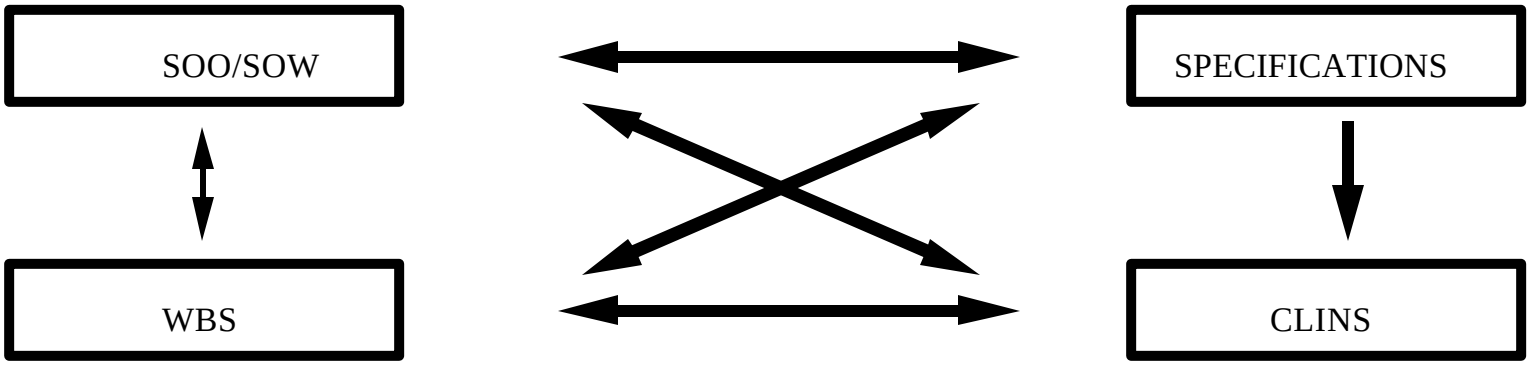
FINANCIAL MANAGEMENT REPORTING STRUCTURE



INTEGRATING PROGRAM ACQUISITION REQUIREMENTS

- Generated by Government
- Identifies Work to be Performed

- 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 REPORTFINDINGS
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

1	2	3	4
FX AIRCRAFT			
	AIR VEHICLE		
		AIRFRAME	
			WING
			FUSELAGE
			EMPENNAGE
			FLIGHT CONTROLS SUBSYSTEM
			HYDRAULIC SYSTEM
			ENVIRONMENTAL CONTROL
			CREW STATION SYSTEM
			LANDING AND ARRESTING GEAR SYSTEM
			INTEG., ASSEMBLY, TEST AND CHKOUT
		PROPULSION (SK-PW-52D)	
		COMMUNICATIONS/IDENTIFICATION	
			RADIO SYSTEM
			DATA LINK
			COMMUNICATIONS SYSTEM SOFTWARE
		NAVIGATION/GUIDANCE	
		FIRE CONTROL	
			RADAR
			COMPUTER
			CONTROLS AND DISPLAYS
			SYSTEM SOFTWARE
		AUTOMATIC FLIGHT CONTROL	
		CENTRAL COMPUTER	
			COMPUTER
			SYSTEM SOFTWARE
		ELECTRONIC WARFARE	
		WEAPON DELIVERY EQUIPMENT	
		ARMAMENT	
	SYSTEM TEST AND EVALUATION		
		DEVELOPMENT TEST AND EVALUATION	
			WIND TUNNEL ARTICLES AND TEST
			STATIC ARTICLES AND TEST
			FATIGUE ARTICLES AND TEST
			CONTRACTOR FLIGHT TESTS
		OPERATIONAL TEST AND EVALUATION	
		MOCKUPS	
		TEST AND EVALUATION SUPPORT	
		TEST FACILITIES	
	SYSTEMS ENGINEERING/PROGRAM MANAGEMENT		
		SYSTEMS ENGINEERING	
		PROGRAM MANAGEMENT	
		INTEGRATED LOGISTIC SUPPORT	
	PECULIAR SUPPORT EQUIPMENT		
		TEST AND MEASUREMENT EQUIPMENT	
		SUPPORT AND HANDLING EQUIPMENT	
	COMMON SUPPORT EQUIPMENT		
	TRAINING		
		MAINTENANCE TRAINERS	
		AIRCREW TRAINING DEVICE	
		TRAINING COURSE MATERIALS	
	DATA		
		TECHNICAL PUBLICATIONS	
		ENGINEERING DATA	
		MANAGEMENT DATA	
		SUPPORT DATA	
		DATA DEPOSITORY	
	OPERATIONAL/SITE ACTIVATION		
		CONTRACTOR TECHNICAL SUPPORT	
	INITIAL SPARES AND REPAIR PARTS		

INCORRECT

PROGRAM WBS

1	2	3	4	5
FX AIRCRAFT				
	AIR VEHICLE			
		AIRFRAME		
			DESIGN ENGINEERING	
			FABRICATION	
			ASSEMBLY	
		PROPULSION (SK-PW-52D)		
		COMMUNICATIONS/IDENTIFICATION		
			MANUFACTURING	
			ENGINEERING	
			QUALITY ASSURANCE	
			MATERIAL	
		NAVIGATION/GUIDANCE		
		FIRE CONTROL		
			NONRECURRING	
			RECURRING	
		AUTOMATIC FLIGHT CONTROL		
		CENTRAL COMPUTER		
		ELECTRONIC WARFARE		
		WEAPON DELIVERY EQUIPMENT		
		ARMAMENT		
		SOFTWARE		
			COMMUNICATIONS/IDENTIFICATION SOFTWARE	
			FIRE CONTROL SOFTWARE	
			NAVIGATION/GUIDANCE SOFTWARE	
			AUTOMATIC FLIGHT CONTROL SOFTWARE	
			CENTRAL COMPUTER SOFTWARE	
			ELECTRONIC WARFARE SOFTWARE	
	SYSTEM TEST AND EVALUATION			
		PRODUCTION ACCEPTANCE TEST		
		FIRST ARTICLE TEST		
		DEVELOPMENT TEST AND EVALUATION		
		OPERATIONAL TEST AND EVALUATION		
		MOCKUPS		
		TEST AND EVALUATION SUPPORT		
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		SUPPORT DATA		
		DATA DEPOSITORY		
	OPERATIONAL/SITE ACTIVATION			
		CONTRACTOR TECHNICAL SUPPORT		
	INITIAL SPARES AND REPAIR PARTS			

WRONG
These are work efforts, not products

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

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

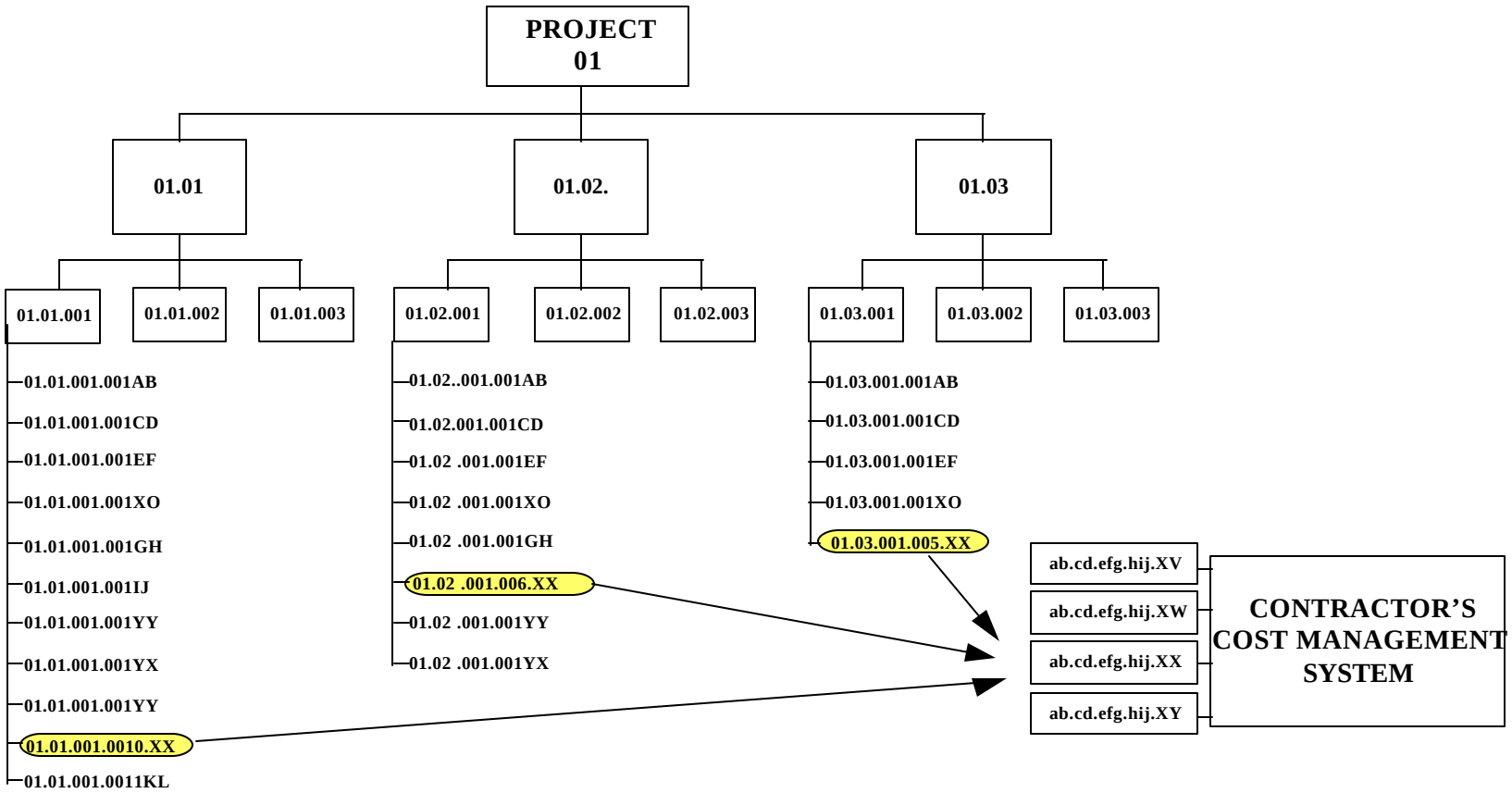
WRONG
Software should be included with the hardware it supports.

WRONG
These are system level tests but should be included in the Airframe WBS element.

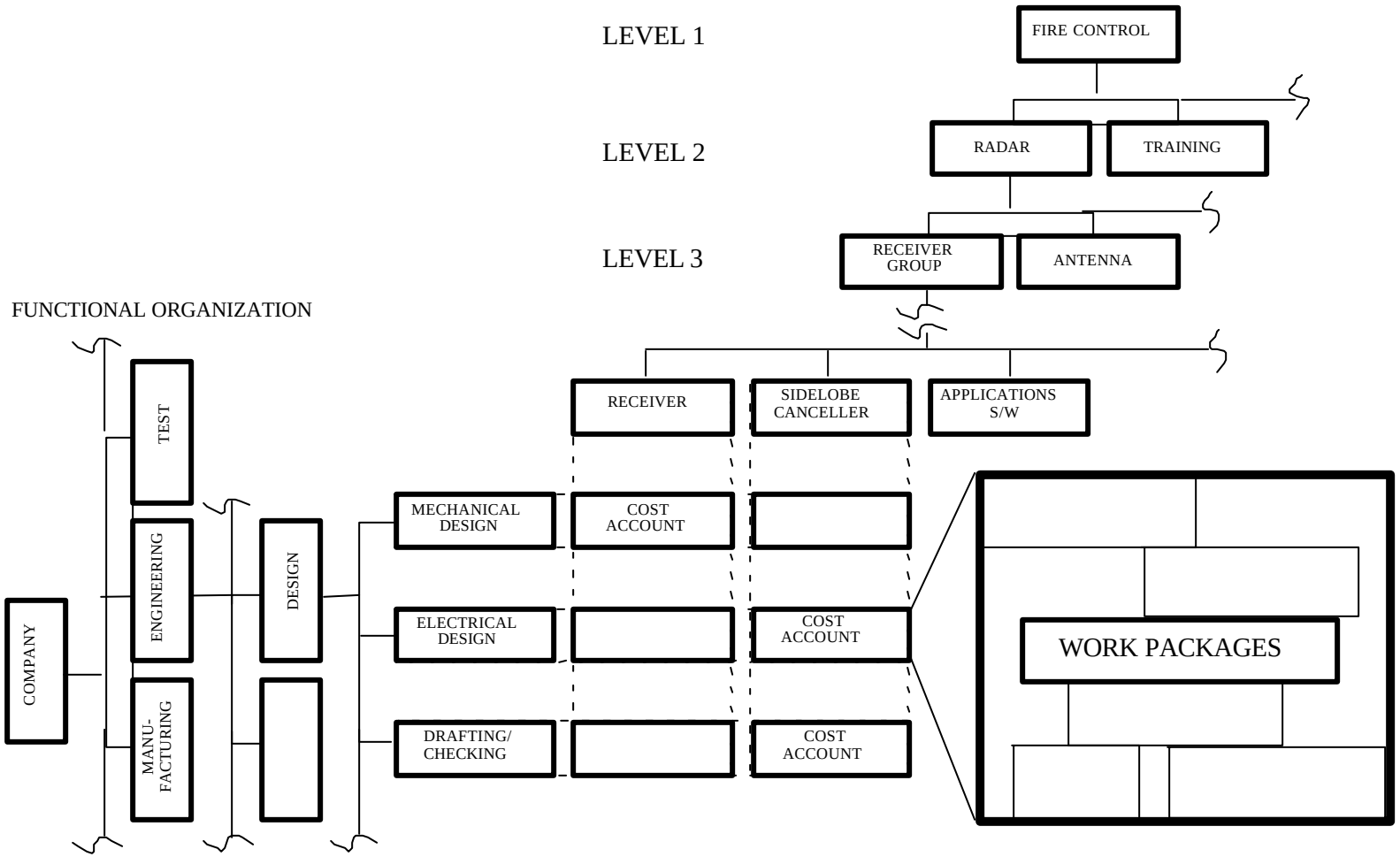
RELATIONSHIP WITH CONTRACTOR MANAGEMENT SYSTEM

- 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

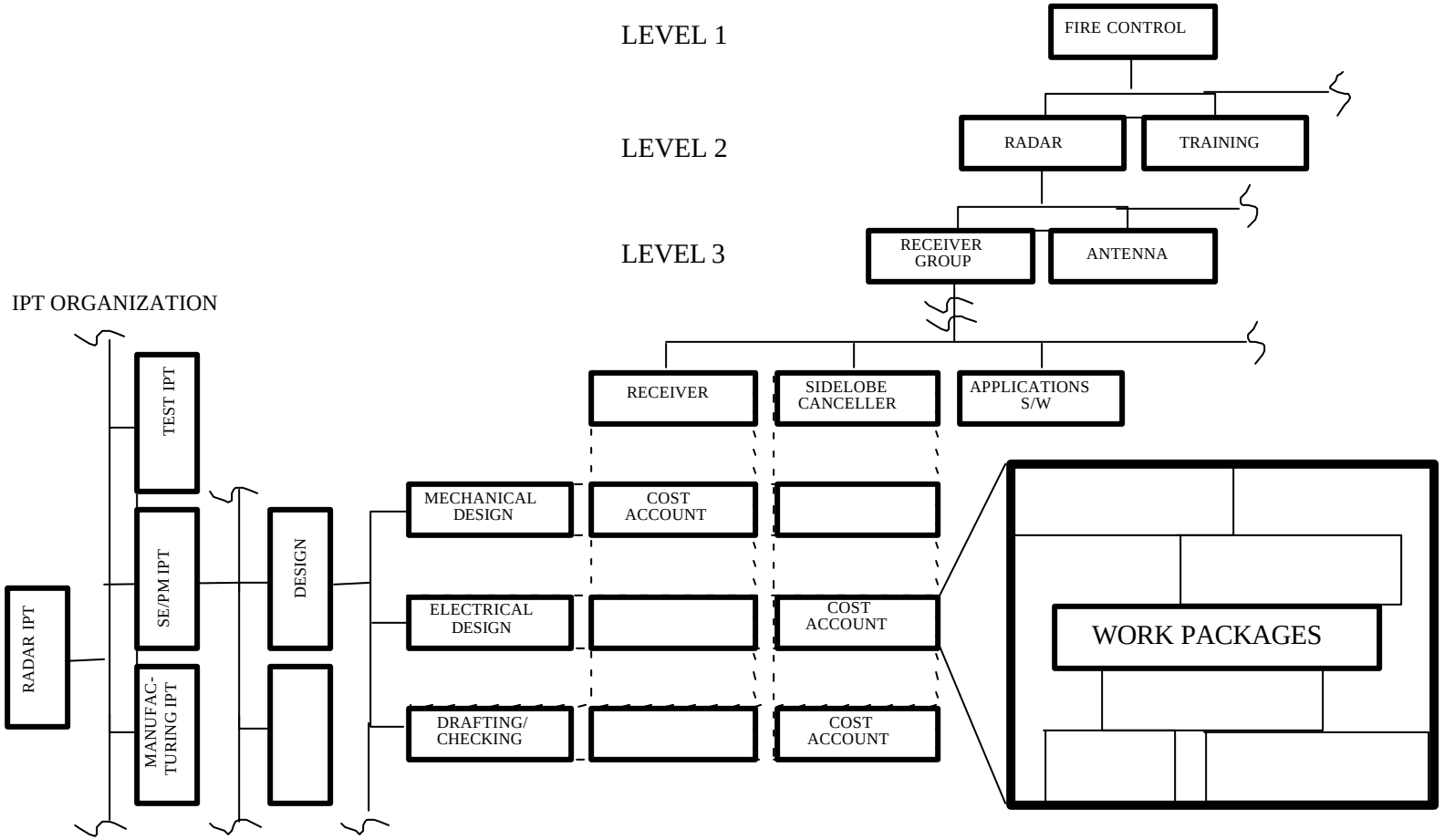
COST MANAGEMENT SYSTEM



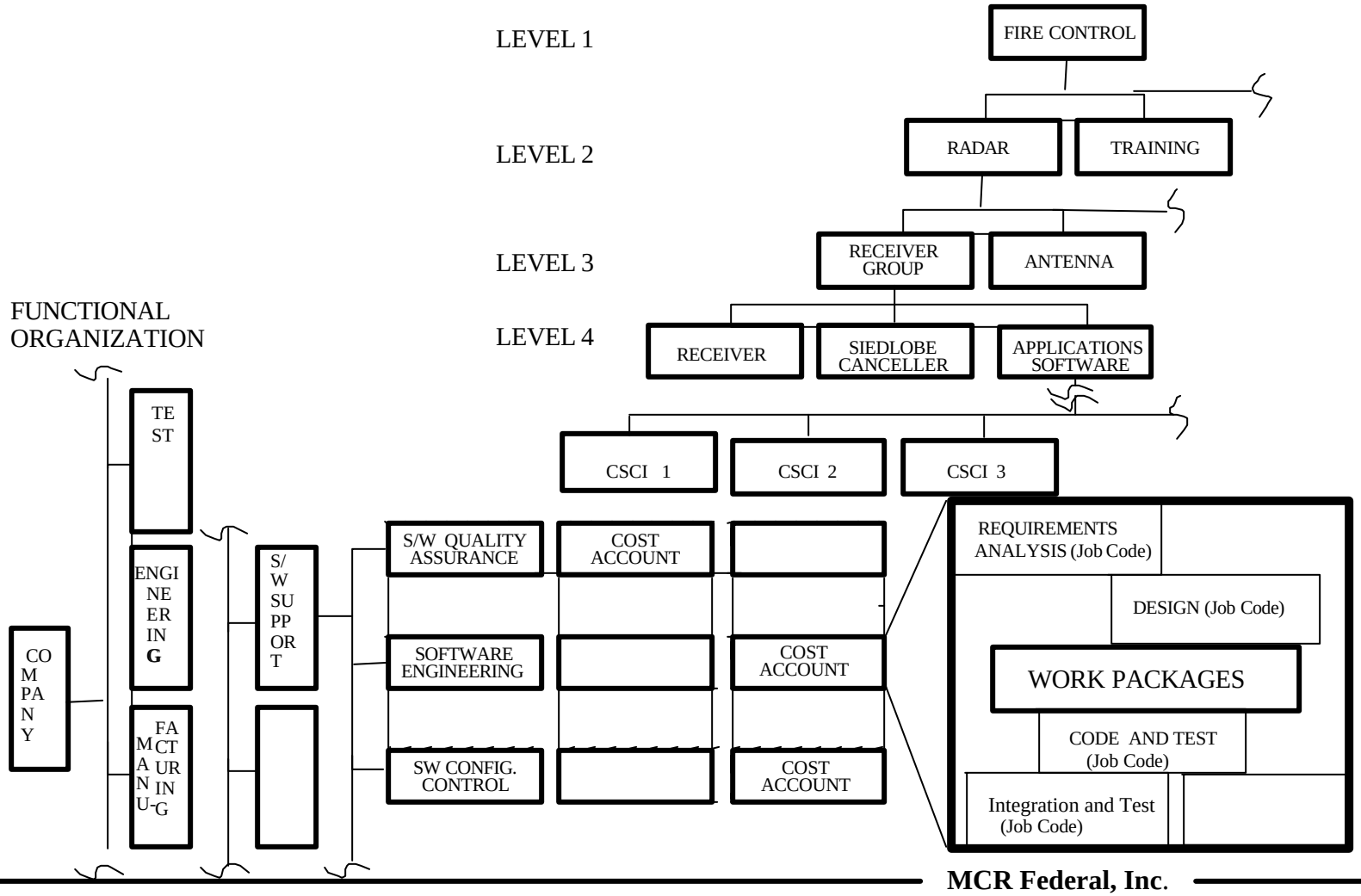
TRANSLATION FROM FUNCTION TO PRODUCT



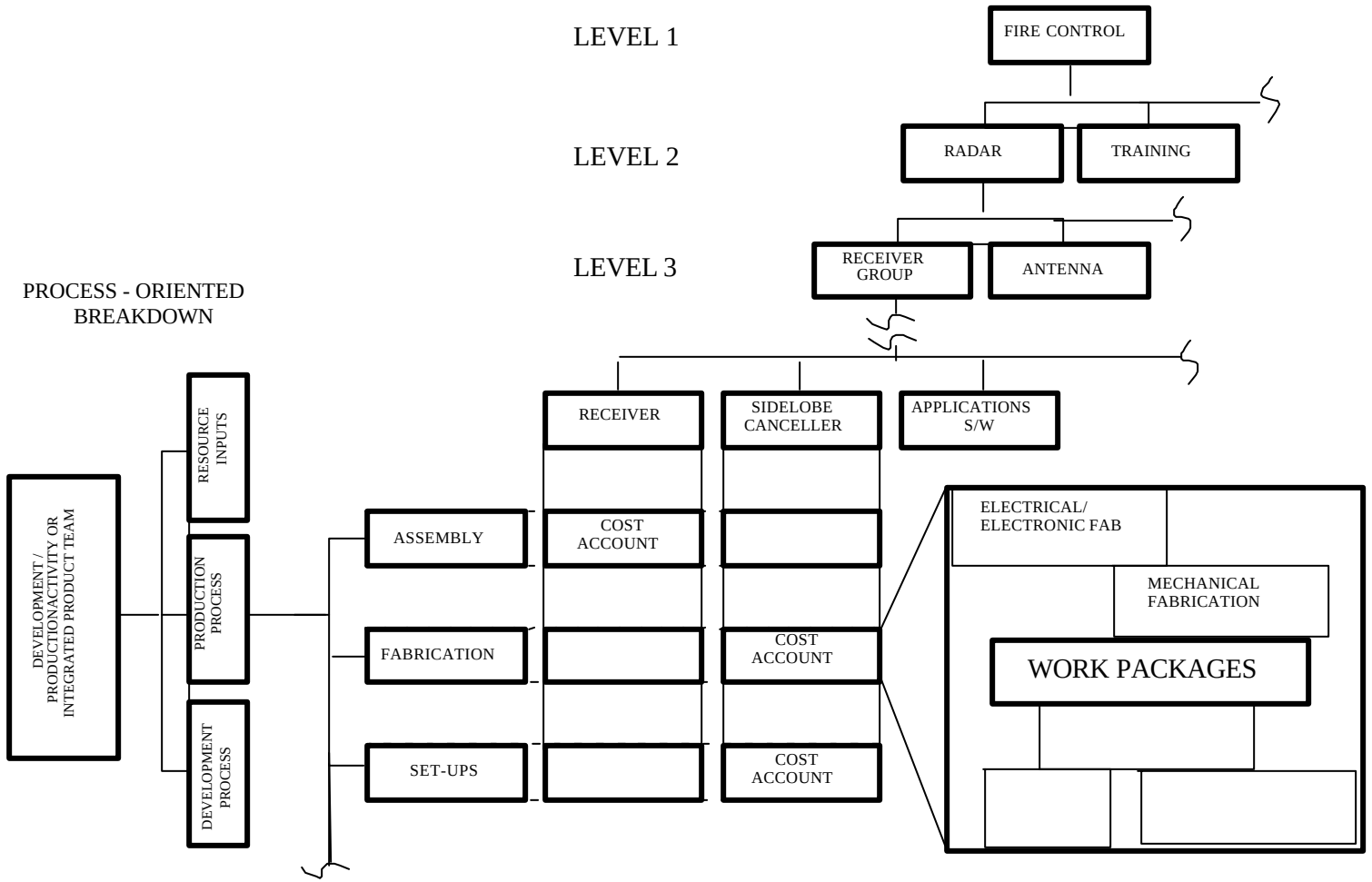
TRANSLATION FROM IPT TO PRODUCT



LINKAGE BETWEEN CONTRACTOR WBS AND CONTRACTOR MANAGEMENT SYSTEMS



LINKAGE BETWEEN WORK BREAKDOWN STRUCTURE AND PROCESS-ORIENTED BREAKDOWN



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