AV-8B Integrated Earned Value Management System

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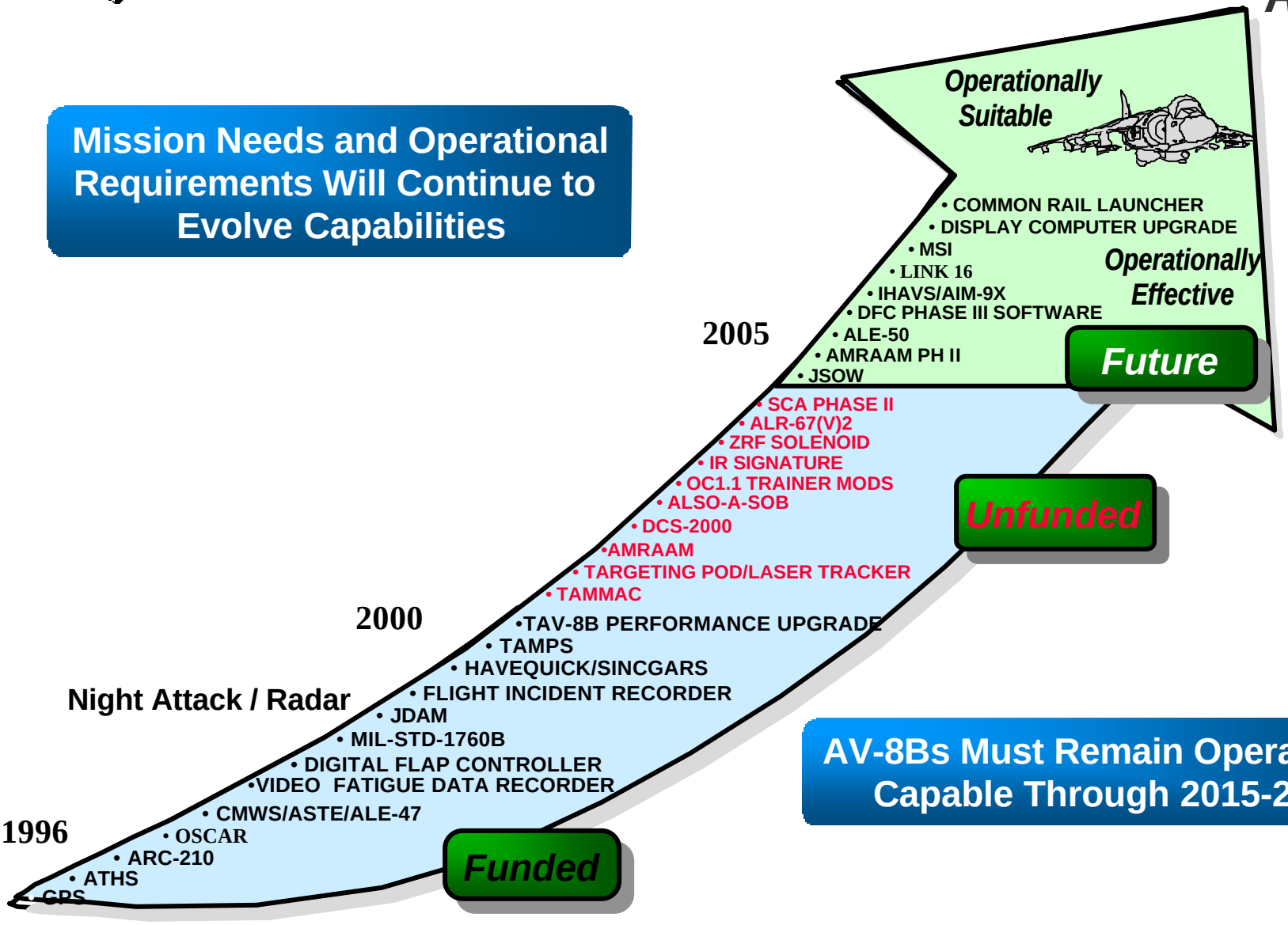
Brief Contents

- OSCAR Overview
- NAWC-WD/Boeing EVMS Overview
- Bringing it all together - The IBR
- Conclusions

AV-8B Operational Requirements

AV-8B

Mission Needs and Operational Requirements Will Continue to Evolve Capabilities



AV-8Bs Must Remain Operationally Capable Through 2015-2020+

0765-004

Vers1 DLB/MJZ

Avionics Upgrades for Legacy Aircraft

- Legacy aircraft such as the Harrier are forced to remain operational well beyond their projected service life
- Modernization of existing avionics
  - Practical means of extending Harrier's service life
  - Leverage commercial technologies

Challenges of Avionics Modernization

- **Existing avionics computational capabilities**
  - **Existing architectures are incompatible with available commercial technologies**
  - **Limited computation throughput**
  - **Input/output bandwidth limitations**
- **Commercial technology advancements**
  - **Military application of these technologies is hampered by acquisition process**
  - **Legacy systems have tightly coupled hardware, software and support equipment which make upgrades difficult**
  - **Commercial technology changes rapidly**
    - **Replacement of obsolete commercial parts may be a problem as they become obsolete much faster**

System Engineering Approach

- **Overall system engineering approach is key to using open architectures for legacy upgrades**
  - **Plan to incrementally upgrade avionics suite as time and funding allow**
  - **Engineer immediate upgrade requirements**
  - **Design to allow for changes in the future**

What is an Open System Approach?

- Product performance and life cycle support drive engineering decisions
- Modular system design isolates the effect of component upgrades
- Use of commercial, widely used interface standards
- Buy rather than develop system components

Open Systems Benefits

- State-of-the art systems
- Systems fielded faster
- Easier technology insertion
- Increased vendor competition
- Reduced life cycle costs
- Better performance

Open Systems Risks

- Government has less control over outcomes - Government is a consumer vice a designer.
- Open systems products may not provide the optimum design for modules, components, subsystems, and short-term solutions
- Building an open system takes time for:
  - Market Analysis
  - Prototyping
  - Standards selection
- Open systems Interface Standards extensions may cause problems later on in the system life cycle

Open System Core Avionics Requirement

- Replace the existing AYK-14 Mission Computer configuration with PMA-209's Advanced Mission Computer
- Redesign and code the existing Mission Computer and Stores Management Computer functionality using:
  - Open Systems Architecture
  - Object-oriented Analysis and Design Methodology
  - C++ Programming Language
  - Commercial Software Development Tools

NAWC-WD/Boeing Integrated EVMS Overview

- System Engineering Support Contract
  - Cost Plus Award Fee Contract
  - Contract specifies earned value and schedule data CDRLs
    - Planning Data (Time phased budget data)
    - Status Data
    - VARs
- Common WBS and WBS Dictionary
- BCR between organizations

Block Upgrade Milestone Schedule

Potential Block Upgrades

Requirements | *Design & Development*

OAG
- STRs
- ORDs
- SORs
- OIs
- Fund Plan
- Schedule

SCRB
- Compiled SORs
- Master Schedule
- Funding Plan
- SOPR

EA
- SOPR
- Appr. FRSs
- POD
- Prel. Build Plan
- SDP
- Risk Mgmt Plan

PIR
- Top-level PVI
- Appr. FRD
- Appr. POD
- Appr. SDP
- Prel. Build Plan
- PMP

SRR
- Control Accounts
- RAM
- CAAs
- PUP

IBR
- Proposed SOF
- (WSRD)
- ASAP?
- DAG?

SDR
- Preliminary Drawing
- Sub System Specs
- Prelim FRD (SOF)
- Detailed Build Plan
- Test Plan
- Assets Identified

PDR

CDR
- Appr. Build Plan
- Appr. FRD(SOF)
- Final PVI
- Appr. Drawings

Development & Verification

Iterations 1 thru N

PEER REVIEWS

TWD Development

IKO | **Detail Reqmts** | **SW Architecture** | IPR | **SW Construction** | **Desktop Test** | **Integration Test** | IFRR | **DT Flight Test**

- Metrics Report
- Technical Issues
- Risk Identification & Assessment

- Detailed Build Plan
- DT Integration Test Plan (Lab & Grnd)
- DT Flight Test Plan
- Revised SDP

- HW Qual
- Cockpit/Lab RFF
- Flight Clearances
- Grnd Test Results
- Boeing OK to Fly
- EMC SOF Test

Validation | *Op Test* | *Fleet Use*

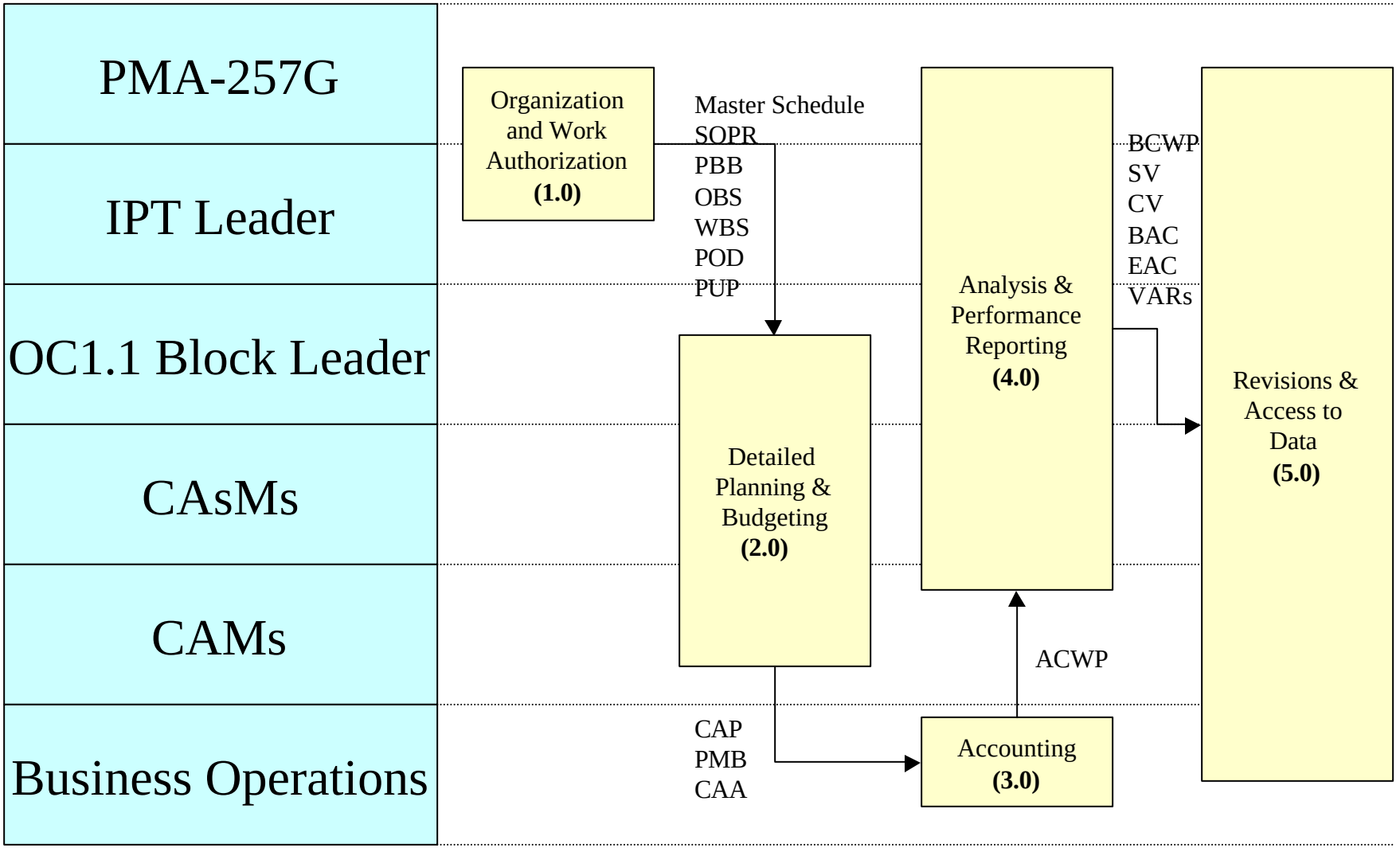
VRR | OTRR | RR

- S/W Source under CM Gold
- PRI 1/ 2 SARs Corrected
- Draft FRD(SOL)
- V&V Procedures
- All PRs converted to SARs

- Complete FRD
- Redline Pubs
- Signed Off Temp
- No PR 1 or 2 STRs or SARs
- Flight Clearances
- List of Open SARs/STRs
- OTRR checklist

- Brief Pk Complete
- Flight Clearance
- PUBS
- Prelim OT Report
- Install Plan
- SW Media

EVMS Process Overview



IPT Organization

- NAVAIR
- CHINA LAKE
- BOEING
- * CAM

OSCAR IPT Lead
NAVAIR

OSCAR Product Co-Leaders
NAWC-WD PM
Boeing PM

Business Ops
NAWC-WD BM
Boeing BM

Contracts & Pricing
PCO
Boeing CO

OC1.1 Block Managers
NAWC-WD *
Boeing *

OC1.2 Block Managers
NAWC-WD *
Boeing *

Software
- MSC
- WMC/ACP
- MSS
- SEE
- STF
- AIC S/W Test

Avionics Suppliers
- MSC H/W
- WMC H/W
- SCP H/W & S/W
- DC S/W
- Radar S/W
- ACNIP S/W
- AIC Auto Test Procedures
- Supplier Management

Integration/Analysis/Test
- Integration
- Analysis
- E3
- AIC Integration Test
- Weapon Integration

Airframe Design
- Armament
- Crew Station
- Electrical Functional
- Electrical Integration
- ECS
- Forward Fuselage
- Manuf. Support
- Prod. Support

Airworthiness
- Flight Test Clearances

Data Mgmt
- Supplier Data

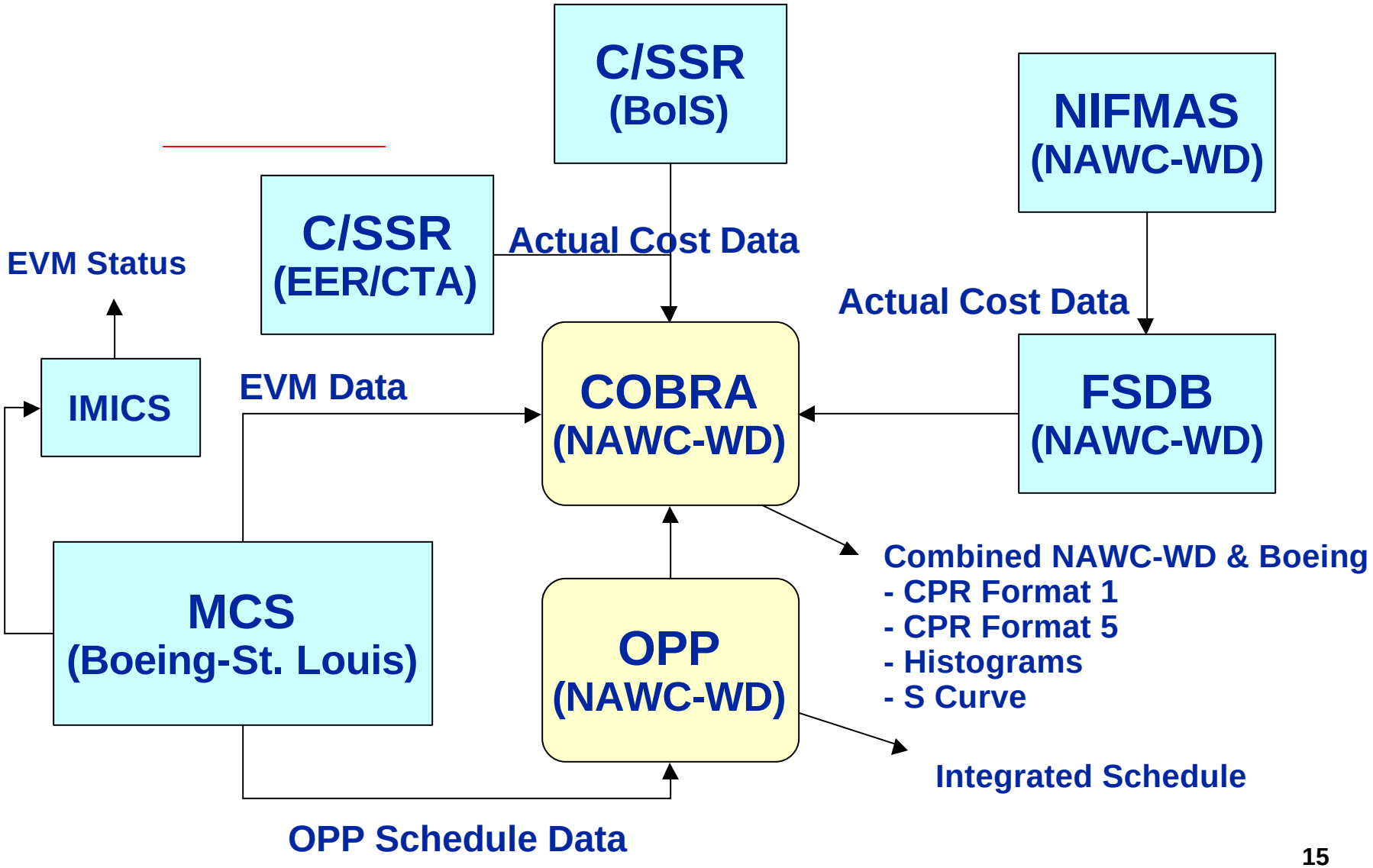
Flight Test & Eval
- Weapons Integration
- Test Eng & Planning
- Data Collect/Reduce
- DT Flight Ops
- OT Flight Ops

Logistics
Bruce Herbert *
- Technical Publications
  - Preliminary Pubs for DT/OT
  - Interim Pubs for OTRR
- Retrofit Technical Directives
  - Reman
  - Radar
  - Night Attack
- Provisioning/Spares
  - Interim Support Item List
  - Design Change Notices
- LSA/MP
  - LSEP
  - SAP
  - 1388 2B LSAR
- CTFD's
- Loaders

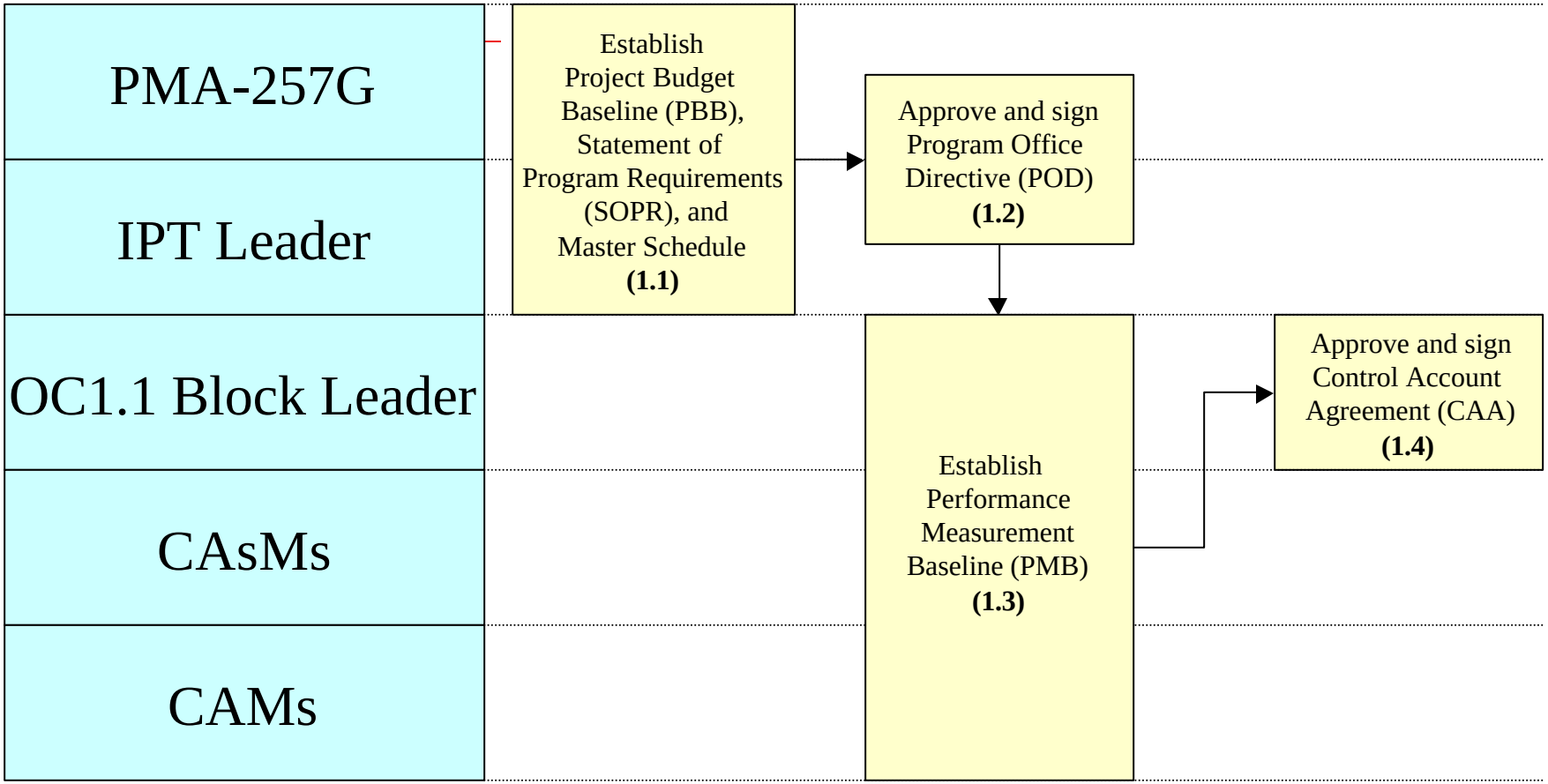
Allen Larsen *

Support Teams
- HQA/SQA
- SM&P
- Reliability
- Maintainability
- Testability/Verticality
- Safety
- Configuration Mgmt
- Test Facility Maintenance

EVMS Integration Overview



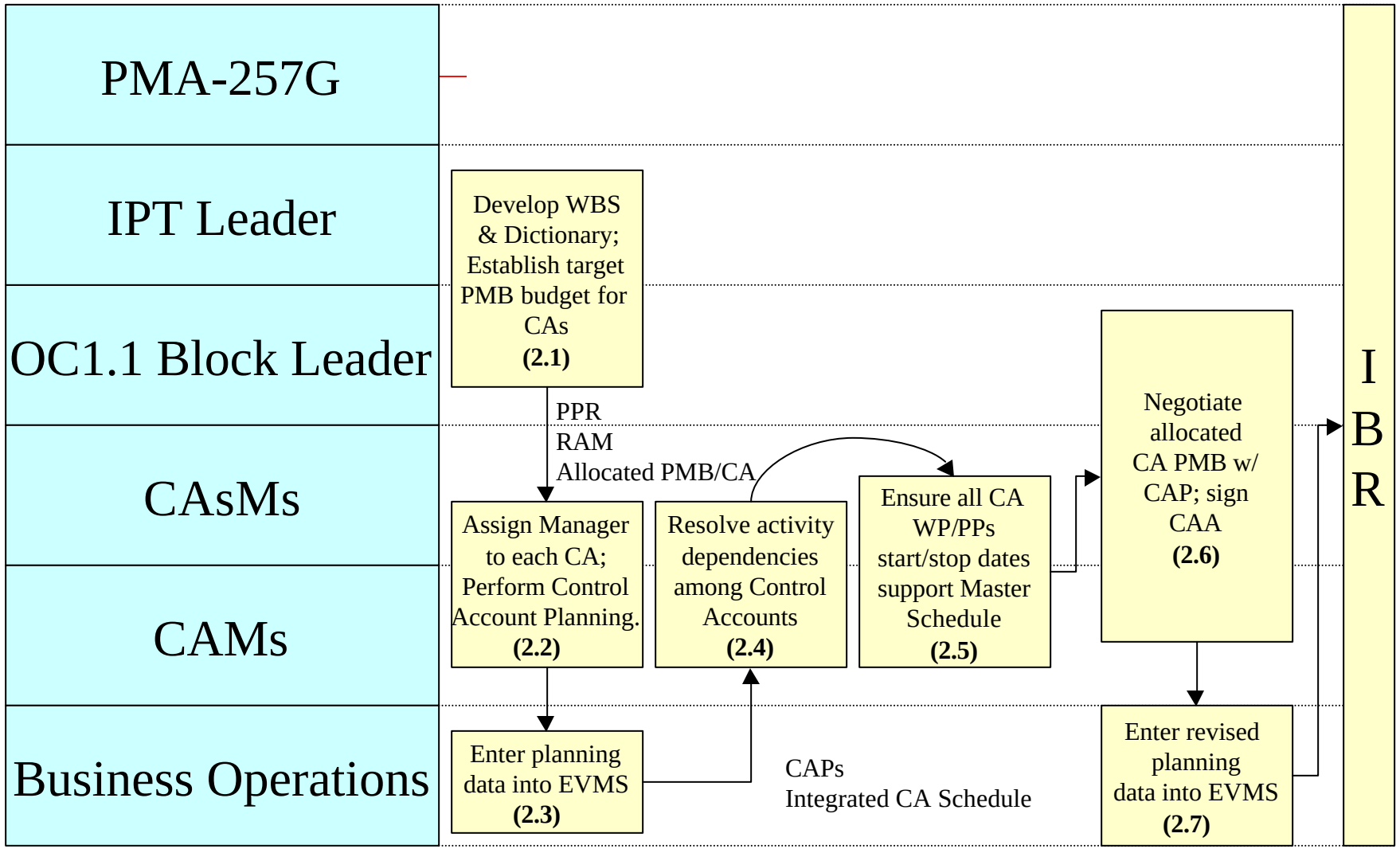
Work Authorization Process



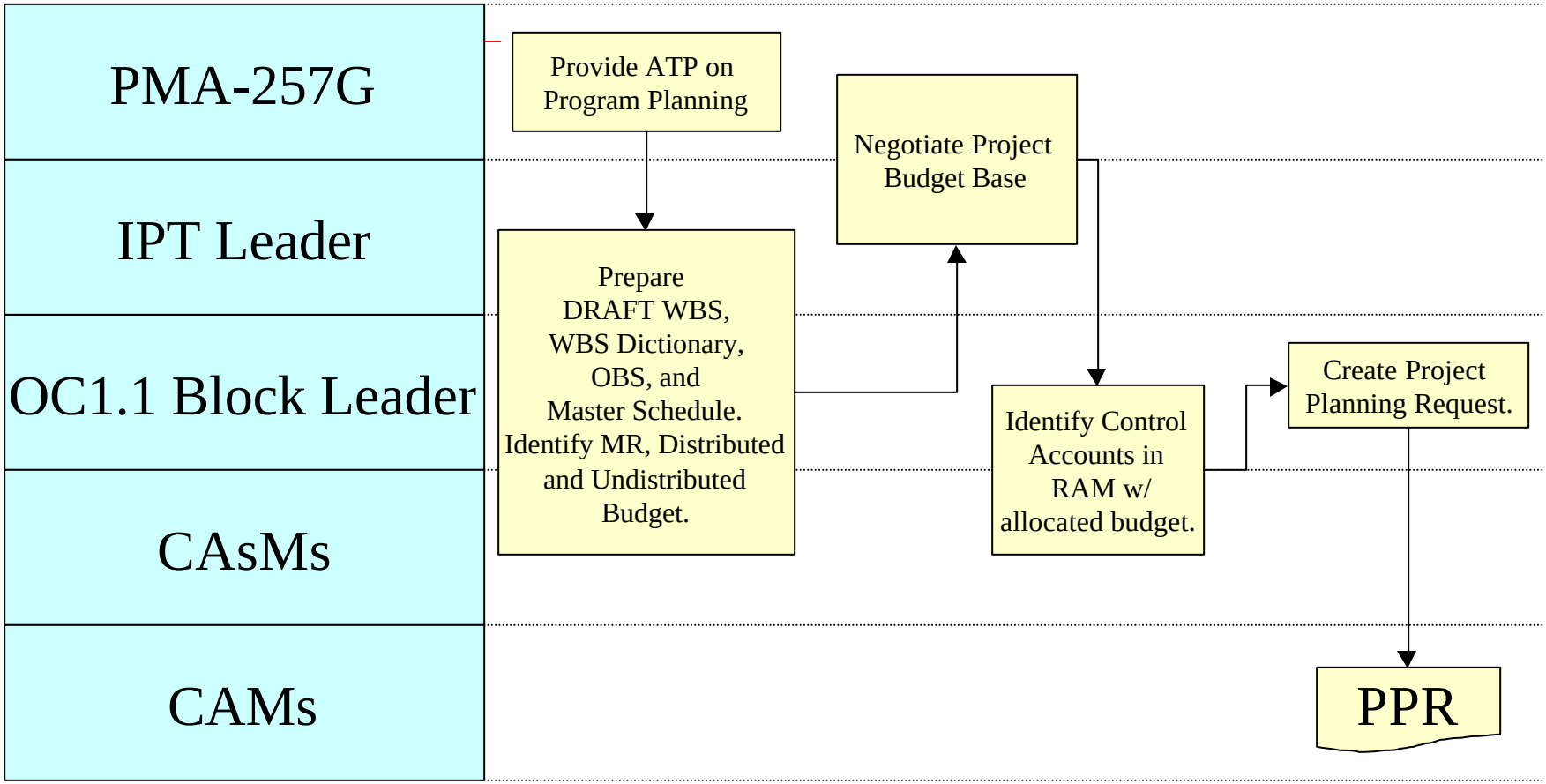
Program Office Directive Contents

- Statement of Program Requirements (SOPR)
- Master Program Schedule
- Summary Program WBS Funding Plan
- Identification of Funding Sources
- Boeing Cost Plus Award Fee Contract Variance Analysis Threshold
  - ↗$100,000 or more and 10% of Sub-CLIN BAC

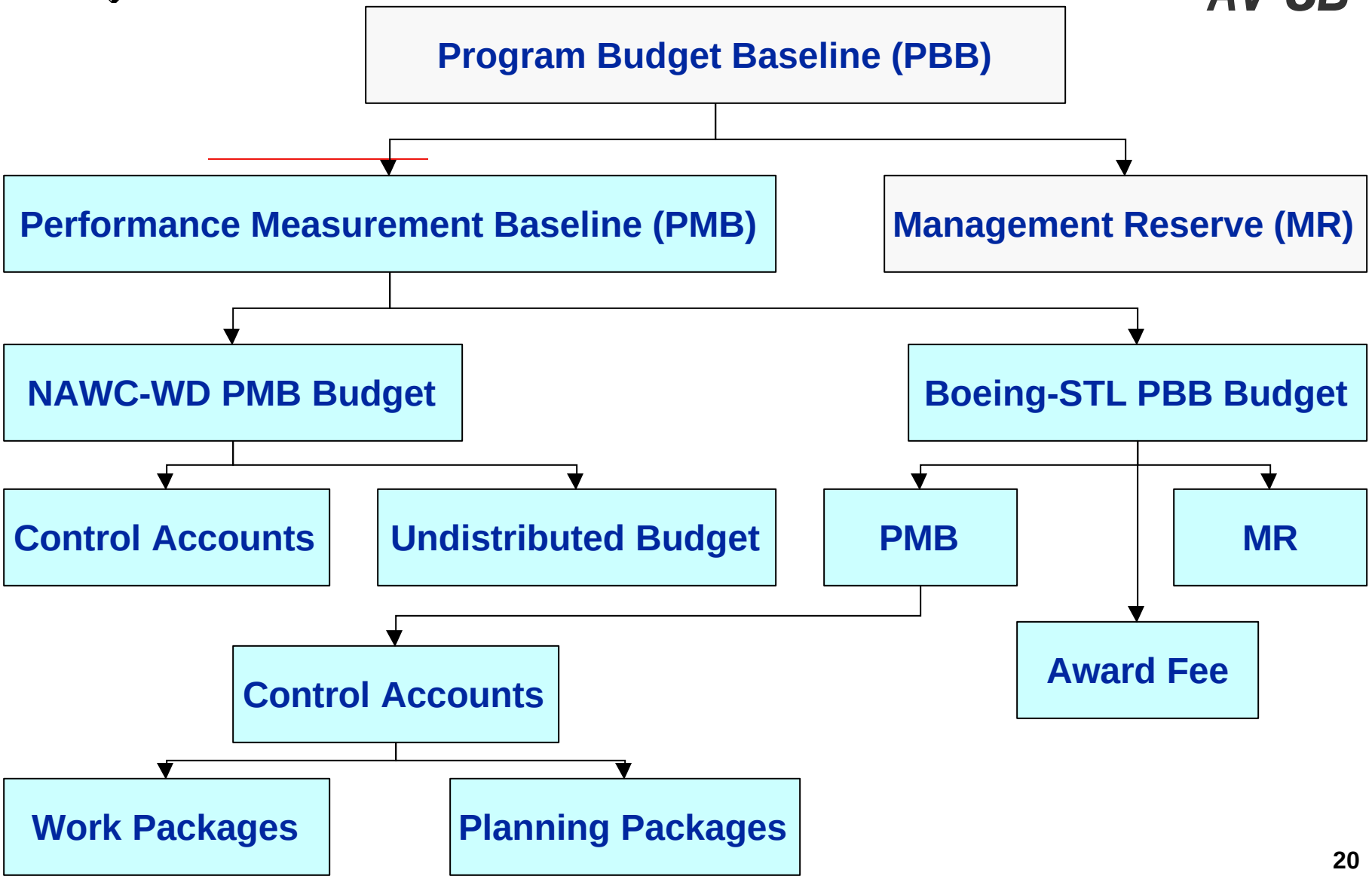
Detailed Planning & Budgeting



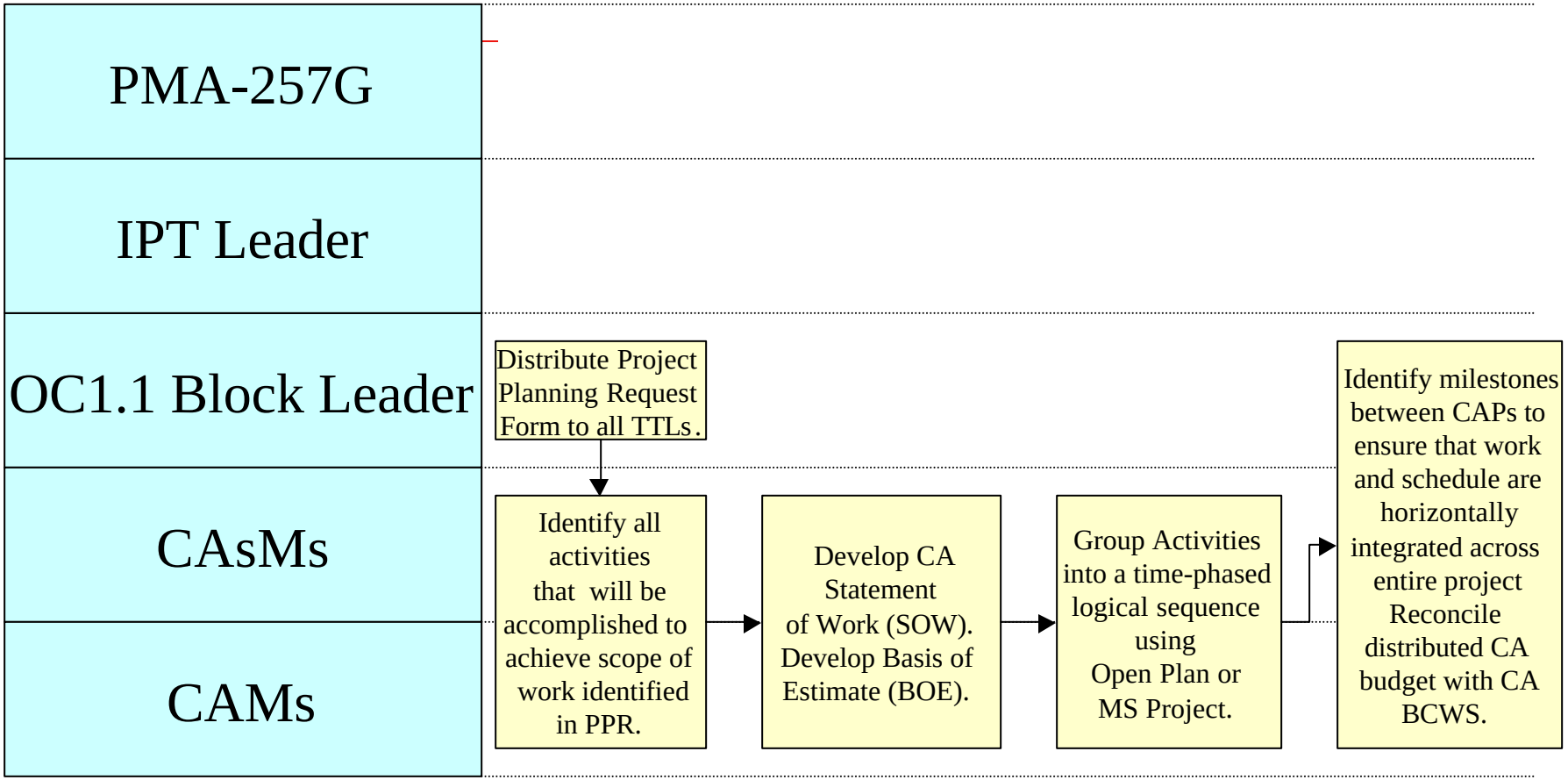
Establish Project Budget Base



OMNI OC1.1 PBB Distribution



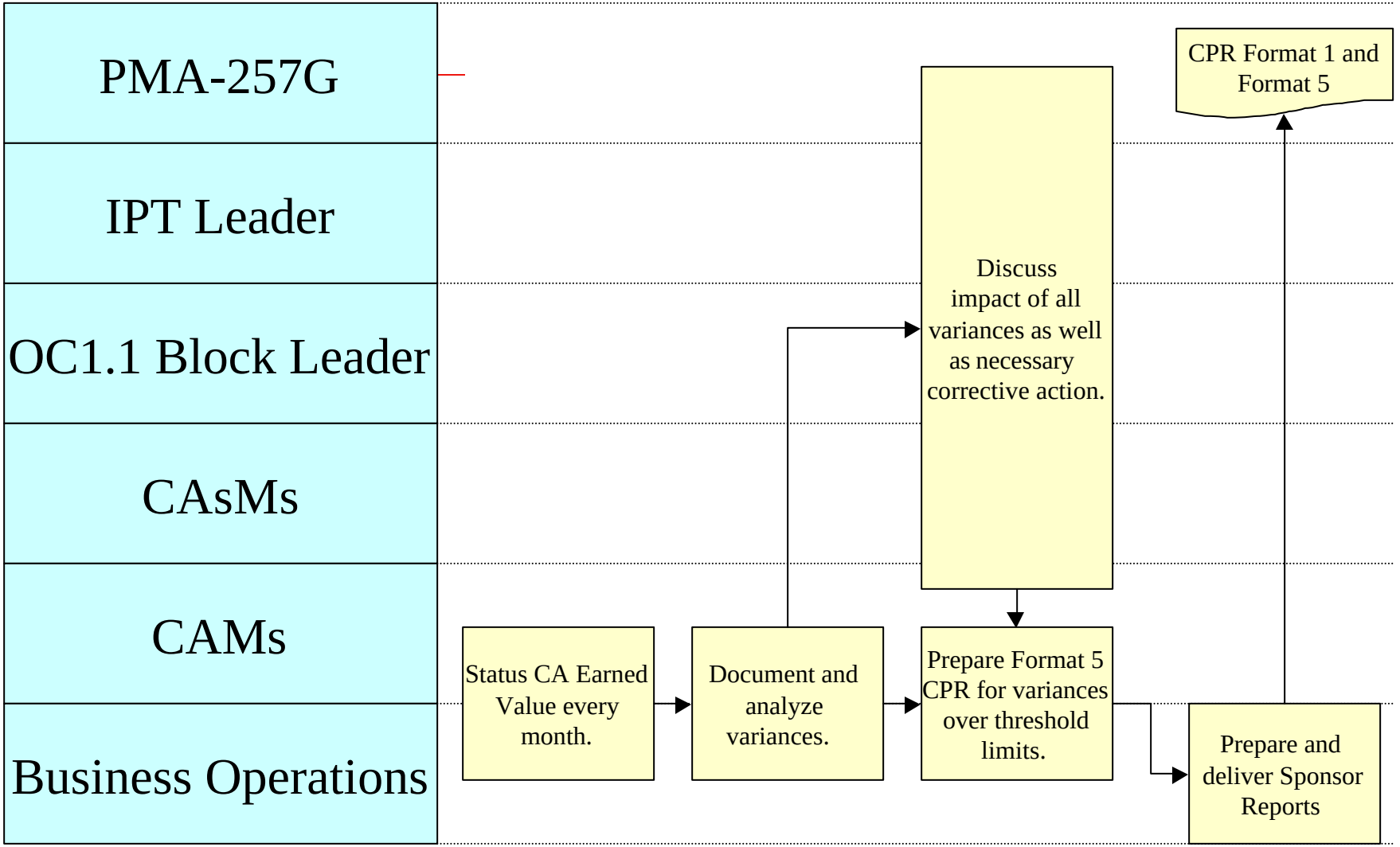
Develop Control Accounts



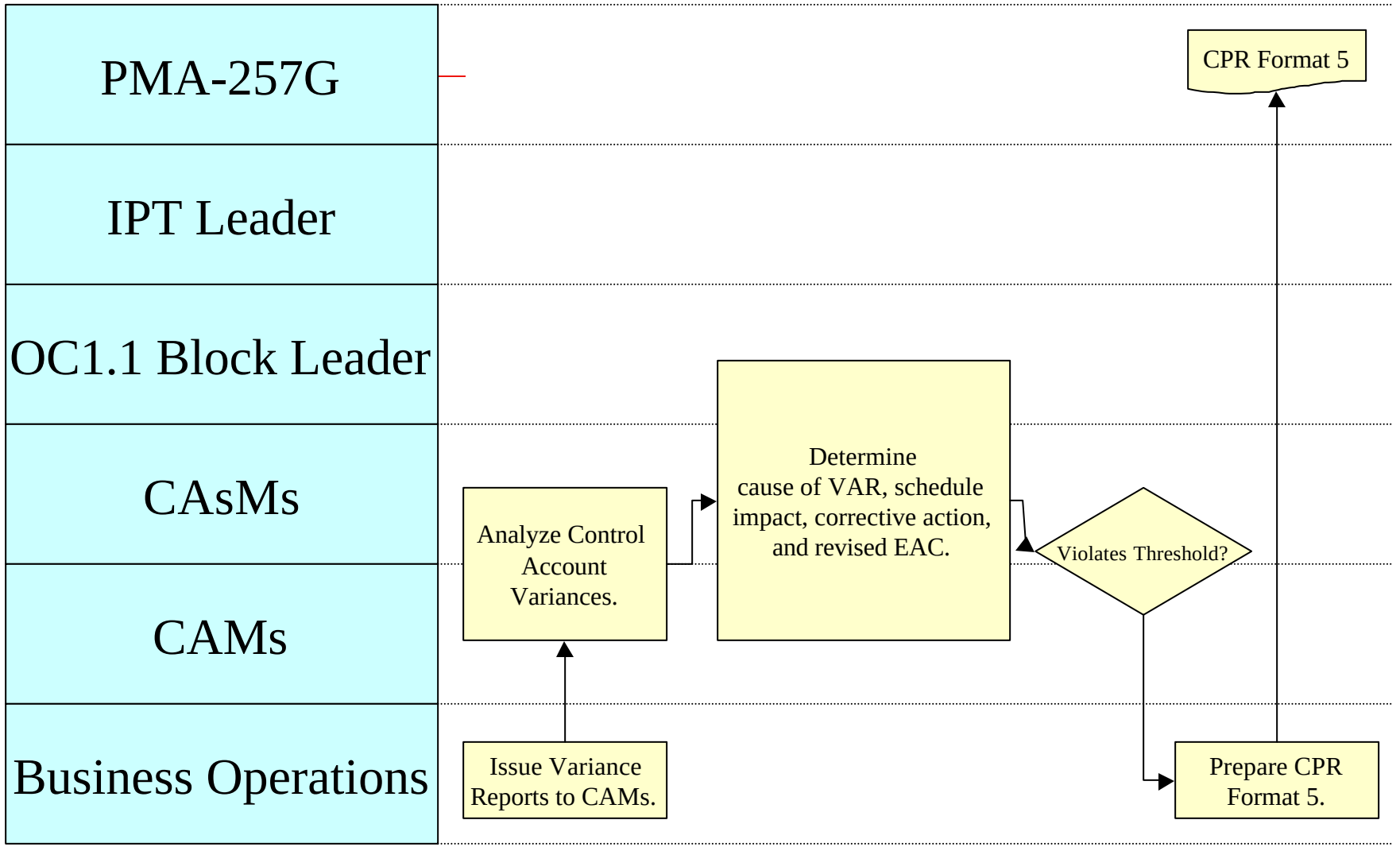
Control Account Contents

- Statement of Work
- JON
- Schedule
- Authorized Budget
- Time Phased Budget
- Earned Value Measurement Techniques
- Work Packages/Planning Packages
- Activity Schedule

Project Performance Analysis



Document and Analyze Variances



Program Unique Publication

- **PUP contents describe:**
  - Tools and methods program will use to accomplish Earned Value Management
  - Deviations from the minimum requirements stated in the NAVAIR EVM System Description Document Version 1.1
  - Aspects of a program's EVMS that is not fully compliant with DOD 5000.2-R criteria
  - Work Breakdown Structure coding instructions
  - Reconciliation of accounting data (ACWP)

Bringing it all together

an

Integrated Baseline Review (IBR)

April 19-21, 1999

OMNI OC1.1 IBR Expectations

- Provide the IPT with sufficient insight to effectively evaluate
  - ↗the contents of the integrated EVMS
    - technical
    - budget
    - schedule
  - ↗EVMS products
  - ↗EVMS architecture
  - ↗EVMS tools

IBR Entrance Criteria

- EVMS used for 2-3 months
- EVMS has generated CPR for 2-3 months
- PUP approved and signed
- PBB established
- POD approved and signed
- CAM Notebooks created

IBR Entrance Criteria Cont...

- Approved SOPR
- Approved Master Program Schedule
- Integrated NAWC-WD/Boeing WBS
- Integrated NAWC-WD/Boeing WBS Dictionary
- IBR Brief

IBR Team

- Led by Program Office IPT Leader
- Team members included:
  - Program office technical specialists
  - NAVAIR EVM Specialists (supplemented by contractor support)
  - OSD - Mr. Van Kinny
  - DCMC - DPRO St. Louis
- IBR held at Boeing's facility in St. Louis
  (NAWC-WD CAMs came to Boeing)

IBR Results

- IBR Team consisted of 14 Technical & EVM Analyst
- Interviewed 23 CAMs
  - ↗16 of 17 Boeing CAMs
  - ↗7 of 10 NAWC-WD CAMs
- Generated Concern Reports
- NAVAIR will track concerns to resolution
- Review was completed in a cooperative & productive environment

Strengths

- First time Integrated EVMS has been accomplished between Contractor & Government Facility
- NAWC-WD & Boeing have established a baseline for performance measurement
- System interfaces functioning well
- Good CAM knowledge and management of tasks

Strengths cont...

- Earned Value metrics for software development
- Management commitment to EVM
  - ↗Boeing EVM experience has been beneficial
  - ↗NAWC-WD has made significant progress
- Leadership - CAMs and support staff were open & candid
- “CAM bakes” demonstrate use of EV data

Concerns

- Aggressive software productivity assumptions
  - ↗(~~Issue resolved~~)
- Establish and manage a critical path schedule
- Create a process to transfer scope & budget between NAWC-WD & Boeing
- Amount of LOE in combined Control Accounts may distort performance measurement

IBR Summary

- IBR expectations achieved
- Performance measurement baseline captures cost, schedule and technical content of the project
- IBR review team identified pertinent issues that will improve the EVM system & data quality
- Project teams hard work, dedication, and commitment to the EVM implementation led to the success of the IBR

Conclusions

EVM Implementation Conclusions

- **Journey towards establishing EVMS was valuable**
  - ↗Discussions among Task Team Leaders
  - ↗Discussions between Boeing and NAWC-WD
  - ↗Recognized activity dependencies between all organizations
  - ↗EVMS provides baseline for budget, scope of work and schedule
  - ↗Tool to manage requirements changes
- **EVMS provided a means for a cultural change in engineering management at AV-8B**

EVM Implementation Conclusions Cont...

- Tools and Boeing interface has worked
- Provides process for meaningful dialogue between product team and program team
- EVMS requires a lot of education for all team members
- Need to assess workload for EVMS administration overhead

Conclusions

- EVM has provided significant improvement in visibility of budget and work scope
- The IBR is a critical part of preparing to execute a program
- Program office has a powerful tool to focus management attention