Interfaced vs. Integrated Process

BAE Systems
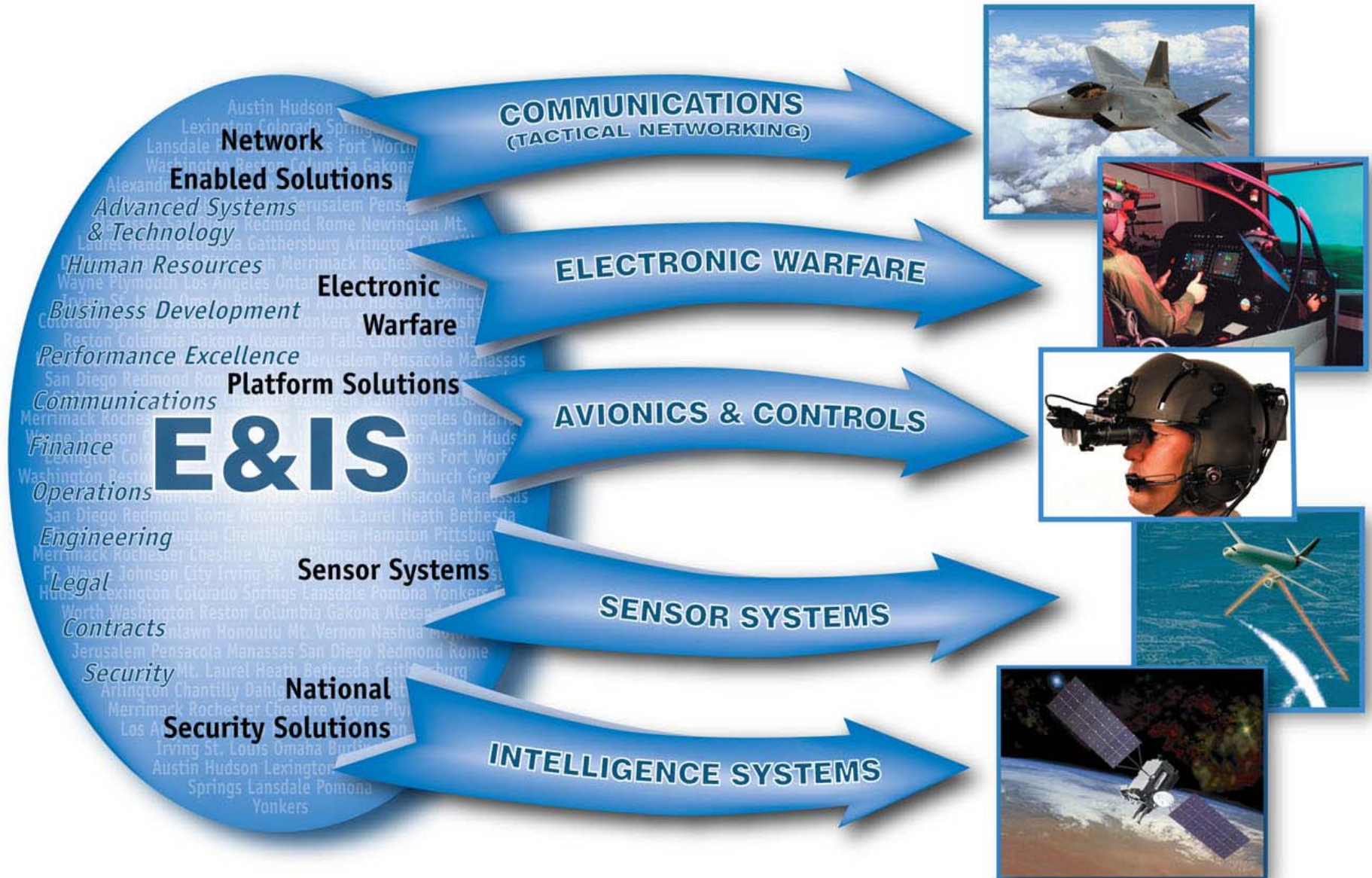
Electronics and Integrated Solutions Operating Group

Nashua, New Hampshire

USA

- –Organization Overview
- –Process Improvement Approach
- –Resulting Process Architecture
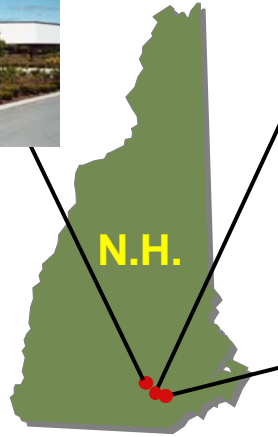- –Process Improvement Results
- –Conclusions

BAE SYSTEMS

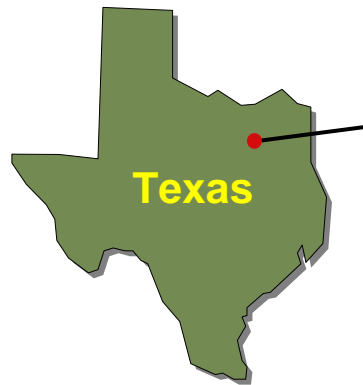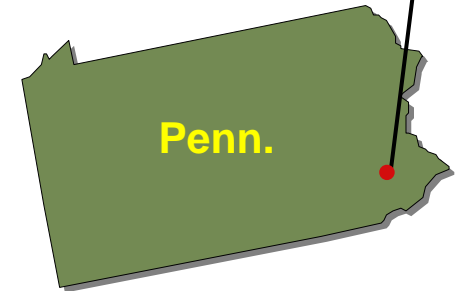Calif.

Merrimack

Nashua

Lansdale

N.H.

Penn.

Hudson

Pomona

Texas

N.Y.

Fort Worth

Yonkers

BAE SYSTEMS

Mojave

Austin

Manassas

Jerusalem (Rokar)

Calif.

Texas

N.H.

Va.

Mass.

Israel
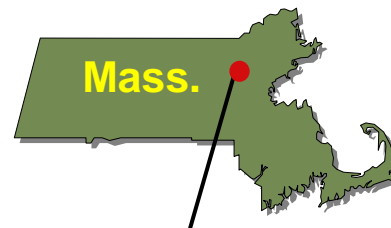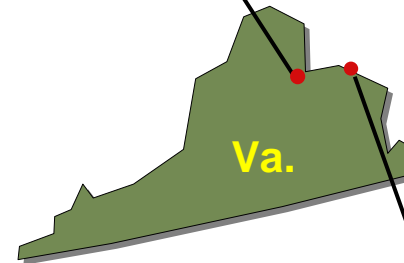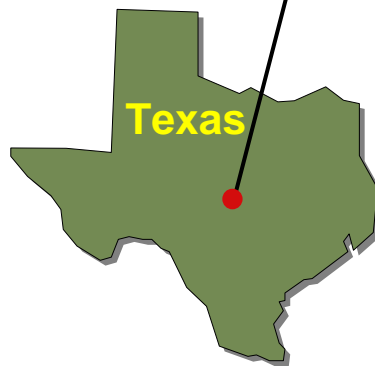
Merrimack

Nashua

Lexington

Washington, D.C.

Process Improvement Time Line

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BAE SYSTEMS Lifecycle Management

CMMI® Released by SEI

PMBOK® Focus Introduced

Customer Requirements for CMMI® Level appearing in RFPs

} External Drivers

Software Process Assessed at SW CMM® Level 4 (9/01) Previous appraisals at Level 3 (94, 98, 00)

System Engineering Process at EIA-731 L2+ going for L3

Other Engineering Processes well defined & followed

Program Management Process Defined, Inconsistently Followed

IPDP Effort Begins

5 Opportunities for Improvement (OFI) assigned to IPDP

IPDP Identifies Solutions to 14 Program Operating Model (POM) Issues for Leadership Ratification

Update SW process to SW-CMM Level 5

System Engineering Process Assessed at EIA-731 L3 (10/02)

IPDP Management Process Pilots March-June

Implement IPDP Technical Processes for System Engineering and Software Engineering

Deploy IPDP V1.0 (9/03)

All Key Projects have transition Plans by 12/03

Form Enterprise Process Group (EPG) 7/03

Start new Projects using IPDP

Full CMMI SE/SW/IPPD/SS based Assessment of Process at Level 4 via Class B appraisal (10/04)

Implement Corrective actions from Class B appraisal

CMMI SE/SW Class A appraisal at Level 3 (4/05)

Implement process improvements to enhance usability

Expand Level 4 and 5 behaviors from Software to Systems

**2001**   **2002**   **2003**   **2004**   **2005**

CMM and CMMI are registered trademarks of Carnegie Mellon University
PMBOK is a registered trademark of the Program Management Institute

- Current Process Improvement Activities began in 2002 designed to
  - Address project performance issues identified in 2001
  - Take the capability of the process to the next level
- Leverage the best practices in place
  - Within the local organization
  - Within sister organizations in BAE Systems
- Basis for process improvement
  - Capability Maturity Model Integrated (CMMI SE/SW/IPPD/SS v1.1) and
  - The tenets of the Program Management Institute; Program Management Body of Knowledge

– Process improvement activity to be organized as a project
  – Defined budget
  – Formally planned
  – Representation from all disciplines
    - Engineering, Project Management and support disciplines
– Use a full system engineering approach to developing the process
  – Requirements analysis and definition
  – System Design
  – Implementation
  – Integration
  – Pilot (verification)
  – Deployment
– Early decision needed on how to document the enhanced process
  – Knit existing processes together into an **INTERFACED** process or
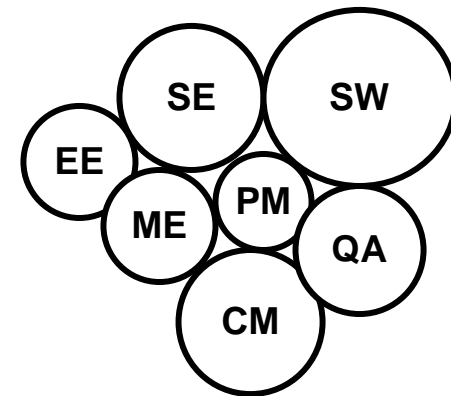 – Develop a single **INTEGRATED** process

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## Non-Integrated Process

Interfaced Process
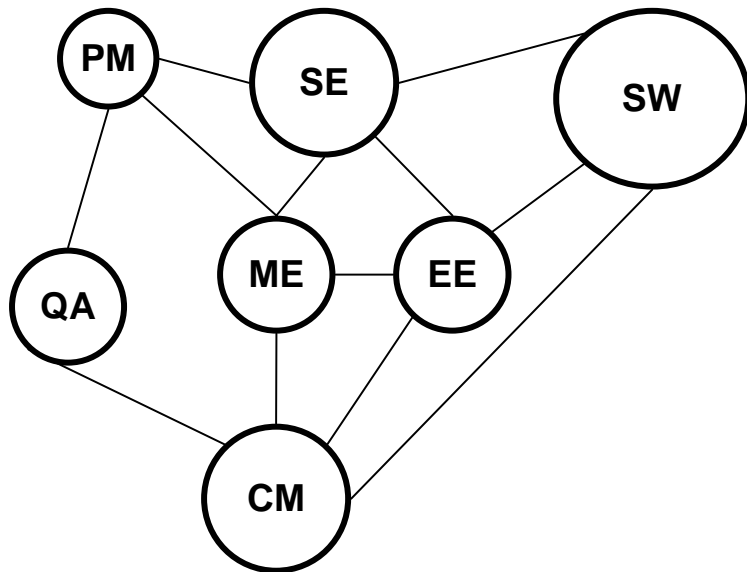
- Each function defines its own process to its own understanding of needs

- Each function does similar things in different ways

- Communication, sharing of product and information is along narrow defined paths

- Collaboration is adhoc to non-existent

- Add defined Interfaces and interactions into each functional process (touch points)

- Each function defines its own process to a <u>common understanding</u> of needs

- Each function does similar things in <u>compatible</u> ways

- Communication, sharing and collaboration are built into each functional process set.

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Integrated Process
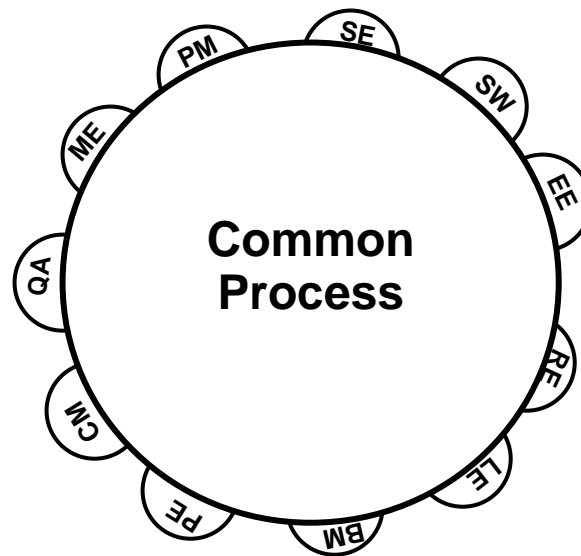
- <u>Common</u> process for all functions with extensions as necessary
- Each function does similar things in the <u>same</u> way
- Communications, sharing and collaboration are a natural outcome of working to the <u>same</u> process
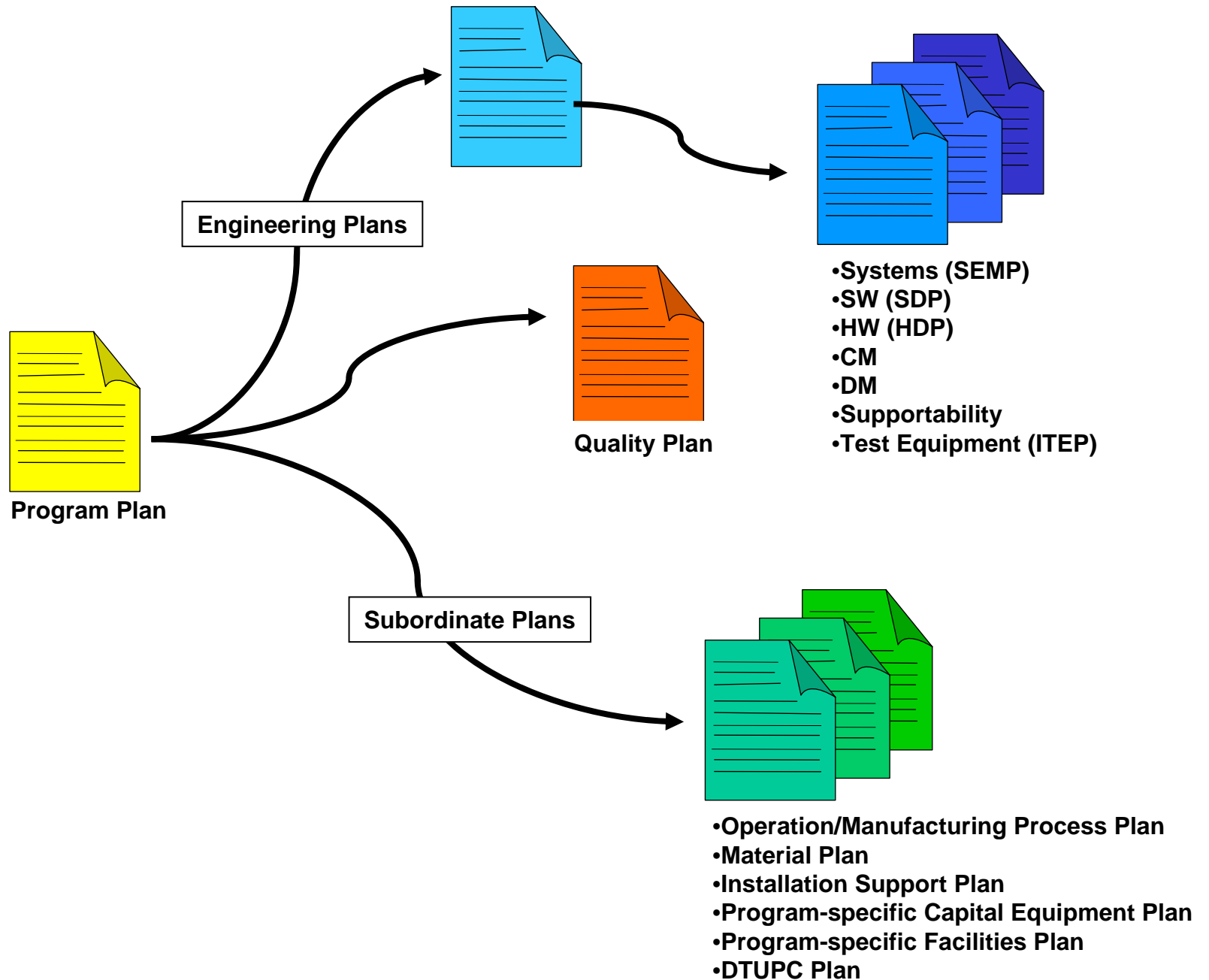
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Interfaced Process	Integrated Process

Interfaced Process

- Pros
  - Less overall work
  - Discipline processes to be executed are documented all together
  - Level of detail of process can be adapted to the maturity of a discipline
  - Infrastructure to support the processes is already in place
- Cons
  - No clear owner of integrated behavior
  - Total volume of process is greater
  - More cost and effort to maintain
  - Difficult to keep all parts of the process in alignment

Integrated Process

- Pros
  - Single clear owner of integrated behavior associated with the process
  - Easier to maintain
    - Single place to make changes
    - Smaller overall process description
  - Less infrastructure require to support the process
  - Forms the basis of a more extensible process architecture
- Cons
  - Requires more work to develop and deploy
  - Requires more stakeholder involvement in reviewing and agreeing to the process

Selecting the Approach:
Analyze Pre-Integration Program Plan Hierarchy

Engineering Plans

Program Plan

Quality Plan

- Systems (SEMP)
- SW (SDP)
- HW (HDP)
- CM
- DM
- Supportability
- Test Equipment (ITEP)

Subordinate Plans

- Operation/Manufacturing Process Plan
- Material Plan
- Installation Support Plan
- Program-specific Capital Equipment Plan
- Program-specific Facilities Plan
- DTUPC Plan

Selecting the Approach:
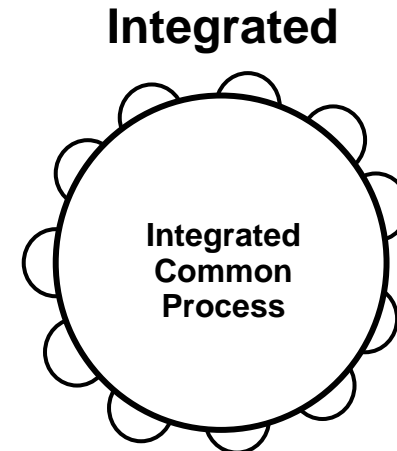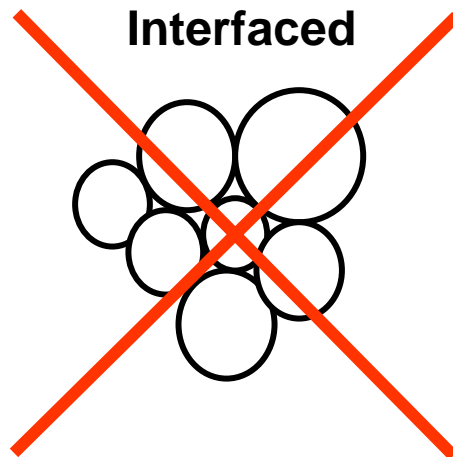# Analysis of Plans

- Plans were structured as stand-alone documents
  - Not hierarchical
  - Many common attributes
  - No consistency
- Plans were functionally oriented
- Some plans contained process descriptions that were duplicated from project to project
- Templates for plans existed
  - Checklists were not value added or non-existent
  - Content not consistent across projects or within projects

Planning Elements	CMMI	LCM	MDP	Project	System	Software	PSEP	CM	Quality	HW	Support	DM
Project Scope												
Description/Overview		x		x				x	x	x		
Charter	x											
Purpose/Mission/Objective's	x	x	x	x					x			x
Benefits and Enablers		x		x			x					
Goals				x								x
Success Criteria		x		x								
Vision	x	x	x	x			x					x
Customer Requirements and Assumptions			x	x								
Constraints	x				x	x				x		
Assumptions	x											
Work Products												
Work Product Control Table	x				x	x				x		
Baseline Control Table					x							
Technical Baseline												
Product Content					x				x	x		
Decision Analysis and Resolution (Trade Studies)	x				x							
Verification/Validation	x				x	x	x		x			
Process												
Lifecycle	x			x								
Project Defined Process	x				x	x			x	x		
PE Tailoring Matrix					x	x			x	x		
Project Unique Process	x			x	x				x			
Process Appraisal & Audit Process	x							x	x			
Schedule												
Project Schedule and CP Analysis			x	x								
Integrated Master Schedule	x	x	x	x				x				
Major Milestones	x	x										
Detailed Schedule				x				x	x	x	x	
WBS												
WBS Matrix	x		x	x								
WBS Dictionary	x			x								
Cost												
WBS/Program Organization Labor Matrix				x								
Labor Budget by WBS over Life of Project	x			x				x	x			
Supplier and Material Dollar Budgets			x	x								
Earned Value Techniques				x								
Other Direct Cost Dollar Budget (by type)				x								
Rationalization of Budgets to Contract Dollars			x	x								
Labor Budget by CAM (work packages)				x								
Dollar Expenditure Plan Over Life of Contract				x								
Organization												
OBS	x			x			x	x	x	x	x	x
Roles and Responsibilities	x			x				x	x	x	x	x
Interfaces/Coordination							x			x	x	
Resources												
Key Resources			x							x		
Facilities	x		x		x					x	x	
Staffing				x	x	x		x	x	x	x	
Training/Specialty Knowledge and Skills	x				x	x			x	x	x	
GFE/GFS	x		x	x					x	x	x	
Reuse	x			x								
Development Environment	x				x	x			x	x		
Capital Equipment			x							x		
Verification Equipment	x											
Stakeholders												
Related IRAD							x					
Stakeholder Involvement/Commitments	x				x		x		x			
Between Process Phases							x					
Conflict/Issue Resolution	x						x					
Supplier Agreements	x	x	x	x	x	x	x		x	x		
Product Assurance	x		x						x			
Information Management												
Data Item Submittal/Management												x

Elements are More Common Than Unique!

Developed a matrix of plans and common elements

Interfaced
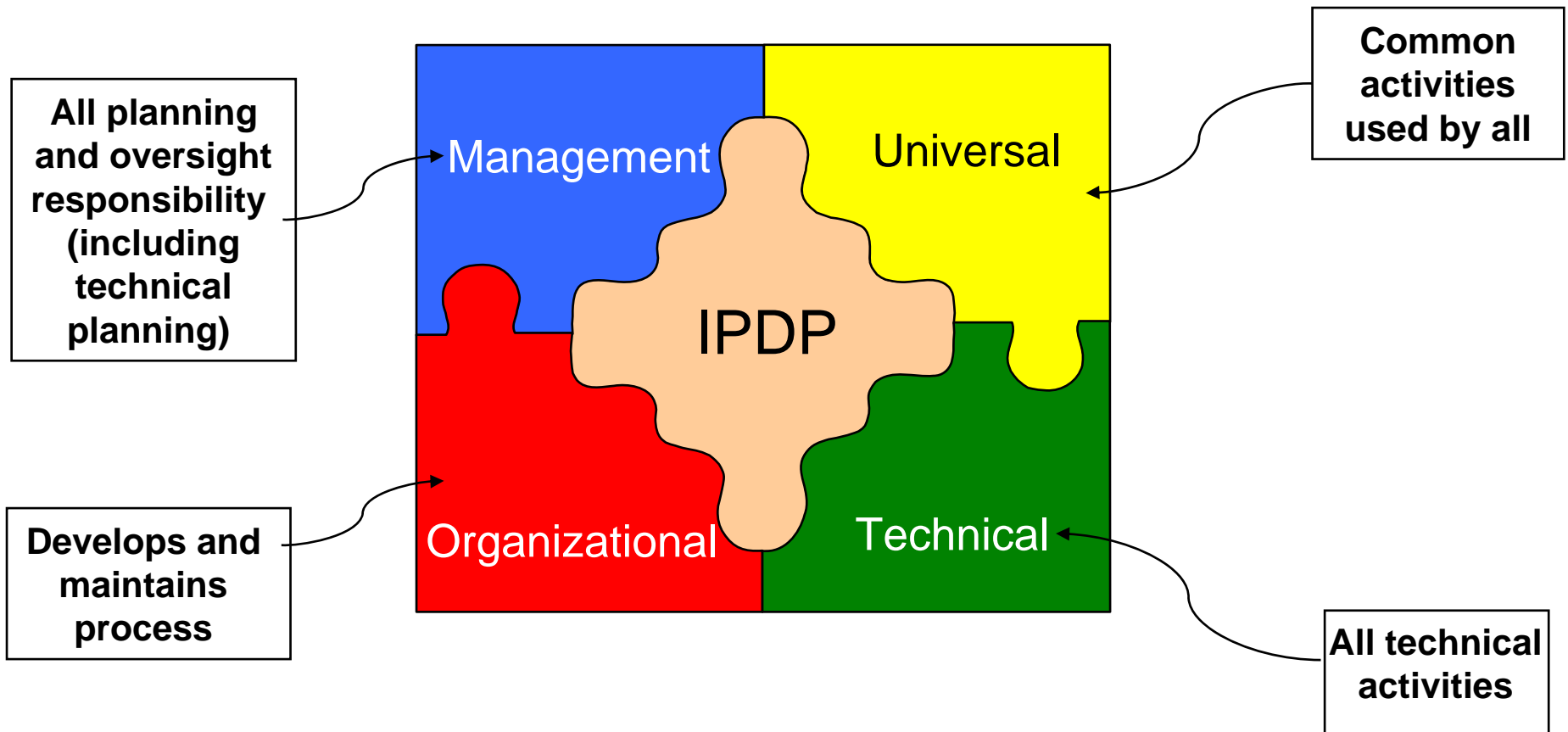
Integrated

Integrated Common Process

- Our analysis of **Interfaced vs. Integrated** set our direction toward an integrated process
- Our analysis of existing project plans and processes served as an **early validation** that an Integrated process was possible and the correct approach

- We needed to establish a process architecture that supported an integrated approach
  - Common procedure level descriptions
  - With natural, transparent extensions to support discipline needs

A Good Process Architecture is the Key to a Successful Integrated Process

– Use the CMMI subpractices as discrete requirements
– Add requirements from other governing process frameworks not included in CMMI
  – ISO 9001-2000 (AS9100)
  – Program Management Institute Body of Knowledge (PMBOK)
  – BAE Systems Life Cycle Management
– Develop specific requirements to describe how projects will operate
  – Called Program Operating Models (POMs)
  – Reviewed and agreed to by all functions and all levels of management
    - Approved by organization leadership
  – Examples:
    - Structure projects as Integrated Product Teams (IPTs)
    - How to staff and de-staff projects
    - Expansion of Configuration and Data Management into Information Management

Single Database Created to Capture All Requirements

BAE SYSTEMS

All planning and oversight responsibility (including technical planning)

Management

Universal

Common activities used by all

IPDP

Organizational

Technical

Develops and maintains process

All technical activities

Requirements were Allocated to One of Four Zones

Each Zone has Process Elements

Management Zone

Corrective Action

Manager Assigned

Plan

Charter

Requirements

Plan Project or Project Element

Estimate Project or Project Element

Monitor & Control Project or Project Element

Close Project or Project Element

Manage Risk & Opportunity
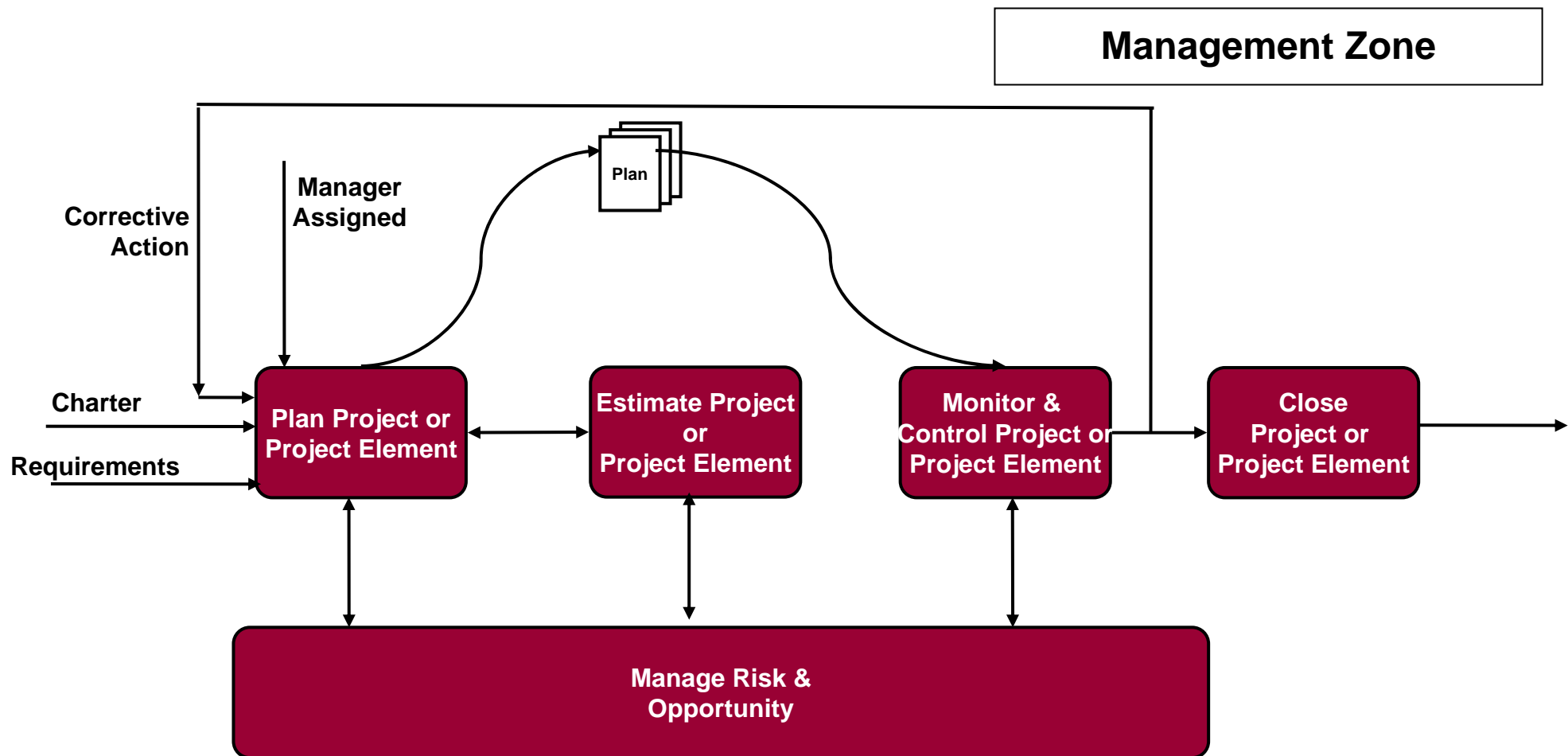
Requirements Grouped into Process Elements

Practices

– One or more per process element

– Contains

- Inputs & outputs

- Entry & exit criteria

- Flow diagram

- Steps to be performed
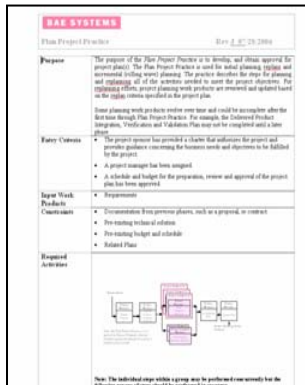
Review Lists

– At least one for each work product referenced by the practices

– May be discipline specific

– Contain rules for the development and review of the work product

- Required rules

- Expected rules

- Project specific rules

Templates

– For work products that require specific formatting or

– To provide the user with a starting point

Practices, Review Lists and Templates Form the Process Building Blocks

Overall IPDP Architecture

Overarching documents, such as

BAE Systems Policies & Life Cycle Management

Top-level policy

MDP

IPDP Framework

Required

IPDP Policies

Concept of Operations for IPDP

(Rules to apply IPDP customization, Roles, Definitions, Program Operating Models, etc.)

Practices Review Lists (some templates)

Actions to be taken, criteria for completion, formatting aids

Templates, Handbooks, Training and Other Guidance Material

Increasing Level of Detail
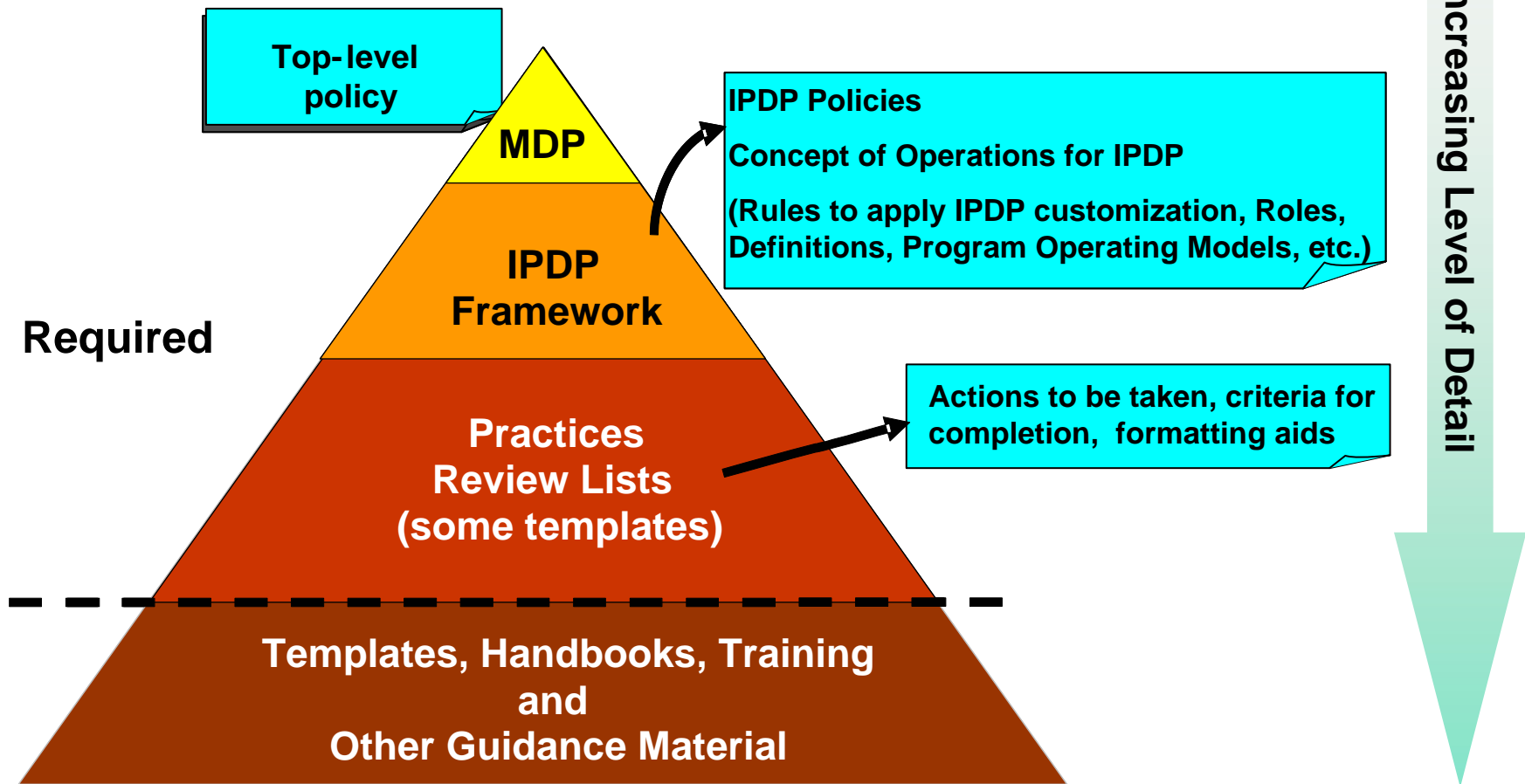
– Practices are written at a high level
  – Common to all disciplines
  – Describe what has to be done
  – Describe how to the level of consistency and commonality needed
– Overall process is work product centered
  – Each work product has a review list
    - Describes the elements that must exist in a quality, compliant work product
  – Allows each discipline to have unique review lists to support their needs
    - Example:
      - Common Size Effort Review List
      - Size Effort Review List - Software
      - Size Effort Review List – Mechanical
      - Size Effort Review List – Electrical
      - etc…
  – Work products can be
    - Used to scale (tailor) the implemented process. For example:
      - A table style work product can define the frequency of meetings and events
      - A table style work product can define the level of stakeholder involvement
    - Shared and reused between different documents on the project
    - Used to keep larger documents living (up to date)

Examples of Planning Work Products

- Templates and review lists ensure consistency and facilitate development of each planning element

- Review lists at each level of planning hierarchy define required elements and content

Project or Project Element Plan

Project Scope
— Description
— Objectives/Requirements
— Shared Vision
— Key Success Criteria
— Enablers
— Cost and Schedule Targets
— Major Milestones and Events
— Assumptions

Organization
— IPT Structure
— Roles and Responsibilities
— Operating Procedures

Schedule
— Integrated Schedule
— IMS/IMP
— Critical Path Analysis

Budget
— Labor
— Material and Suppliers
— ODC

WBS
— WBS
— Dictionary

Suppliers
— Material Plan
— Supplier SOWs
— Supplier Management Plan
— Supplier Agreements

Process
— Lifecycle
— Defined Process
— Monitor and Control Reviews

Resources
— Staffing Plan
— Knowledge, Skills and Training
— Facilities
— Equipment/Tools
— Capital Equipment

Work Products
— Control and Approval Matrix

Technical Baseline
— Product Structure
— IV&V Approach
— Make/Buy Trades

Key Performance Indicators
— Progress
— Quality and Process
— Technical

Risk and Opportunities
— Risk and Opportunity Parameters
— Risk and Opportunity Review Board

Stakeholders
— Roles and Responsibilities
— Involvement Plan
— Commitments
— Communications

Information Management
— Change Control Board

Product Assurance
— Assessments

Examples of Practices, Review Lists and Templates

Plan requires published Specification

1. **Practice lays out the steps**

2. **Review List provides the rules and are specific to a work product**

3. **Template aids in formatting**

Integrated Product Development Process

Engineering

Program Management

Operations

IPDP

Common Processes

Shared Objectives

Coordinated Activities

Unique Project Plans
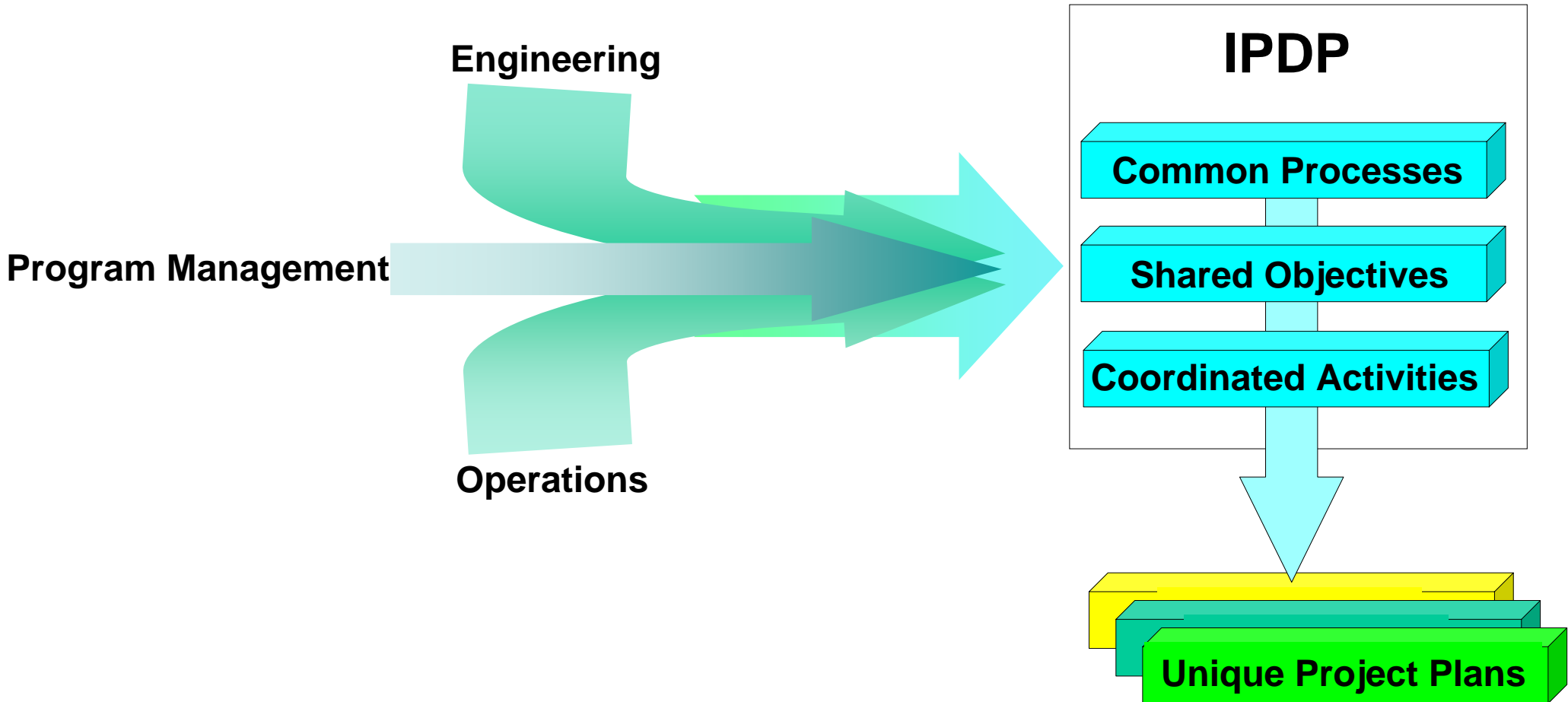
Integrates the Major Functions on Development Projects

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- A full implementation of the CMMI SE/SW/IPPD/SS v1.1 model
  - Includes practices through Level 5
- Adds definition and implementation to Lifecycle Management framework
- Incorporates best practices from
  - Other BAE Systems business units
  - Industry sources
  - Program Management Institute Body of Knowledge (PMBOK)
- Addresses identified project performance issues
- Supports different project types and customer communities
- A fully integrated process definition
  - One approach used at multiple levels for
    - Management – planning and monitor & control
    - Requirements, Design, Integration and Test
- The process was appraised using a Class B appraisal in October '04 up to and including Level 4
  - Project corrective actions from that appraisal were closed by February '05
  - Organization corrective actions were closed by December '05
- CMMI SE/SW model used for successful Class A appraisal at Level 3 in April '05
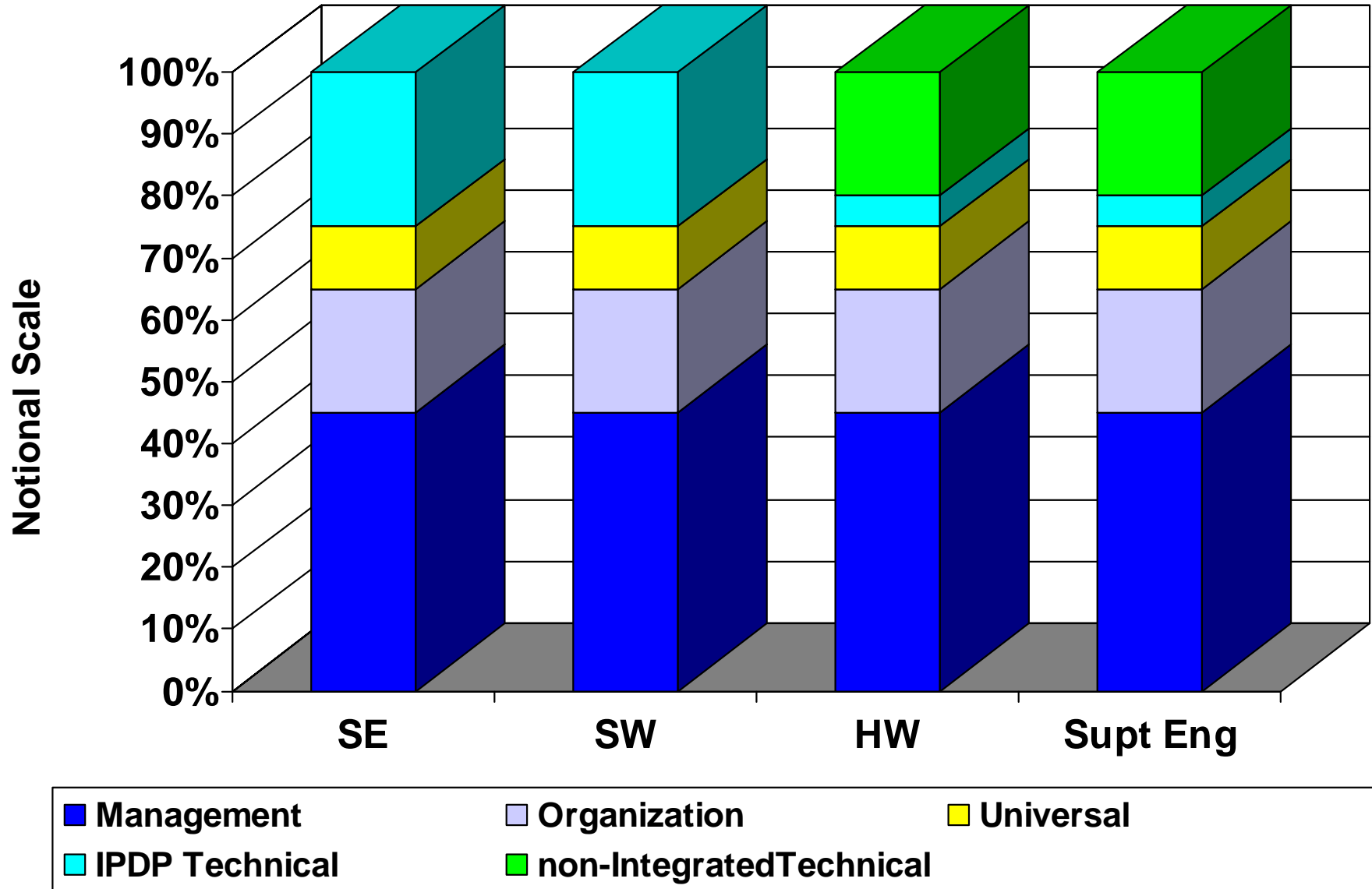 - Process included IPPD aspects but process areas and goals were not assessed

BAE SYSTEMS

Notional Scale
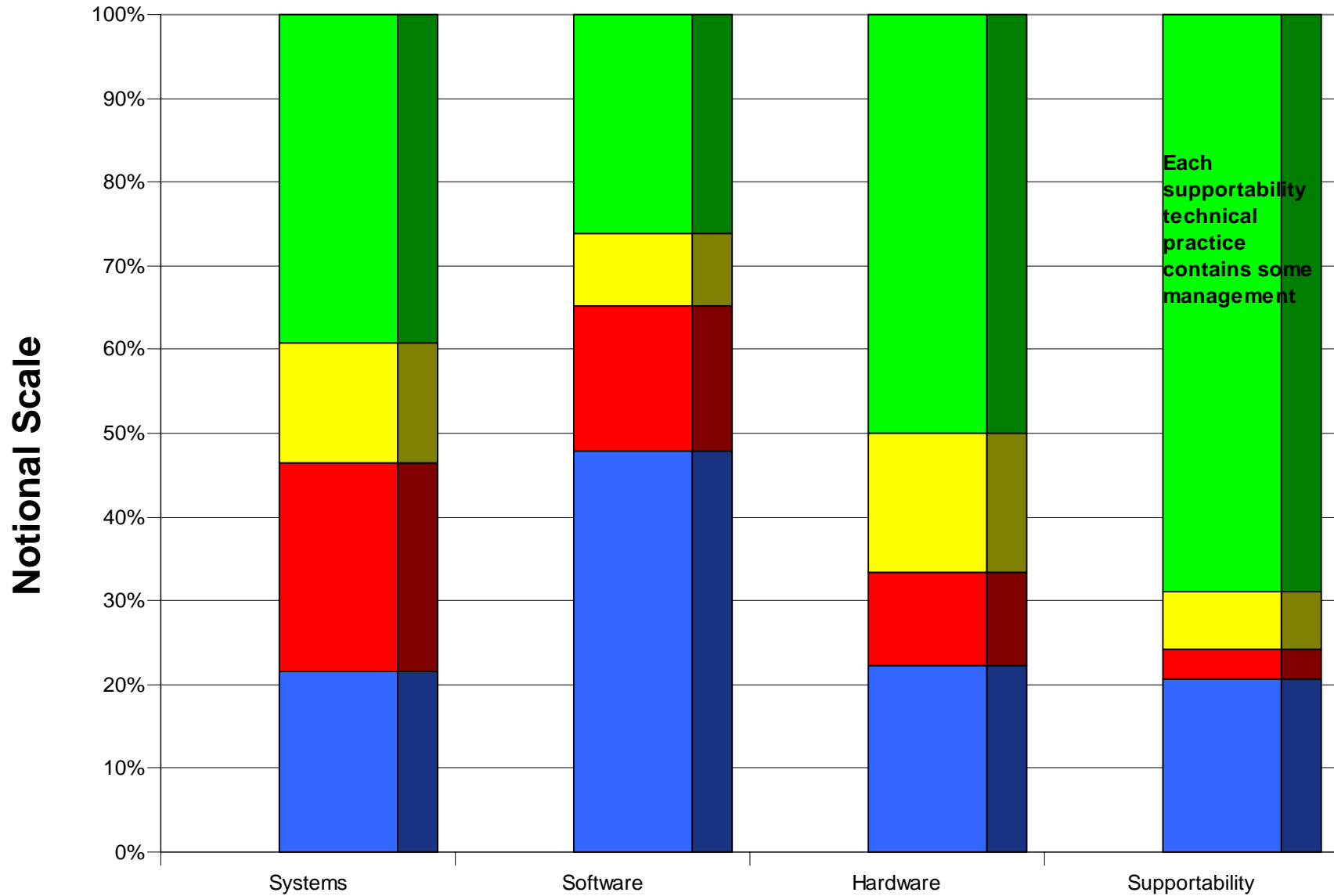
Each supportability technical practice contains some management

■ Management ■ Organization ■ Universal ■ Technical

This is a breakout of Practices only. Guidebooks, templates and review lists are not included.

Systems   Software   Hardware   Supportability

IPDP Notional Breakout of Technical Processes

BAE SYSTEMS

BAE SYSTEMS

– We created an **Integrated** process that is
  – Easy to maintain
  – Supports multiple project types and customer communities
  – Has been successfully deployed
– A highly extensible, well documented process architecture
  – Allows new processes to be added in a simple easy way
  – Resists changes that create a Plate of Spaghetti process
– A comprehensive process requirements database
  – Documents how each process requirement is implemented
  – Makes it easy to understand the impact of any purposed change to the process
  – Makes it easy to understand the impact of any change to the requirements
– Lessons learned
  – Heavy stakeholder involvement is needed early and often in the process development activity
  – Maintaining buy-in by the disciplines without all the attributes of ownership is difficult
  – All requirements need to be captured, not just unique requirements

- **Questions**

- **Comments**

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