Headquarters U.S. Air Force

Integrity - Service - Excellence

Improving ERP Estimating in the Department of Defense

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June 11, 2010

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Overview

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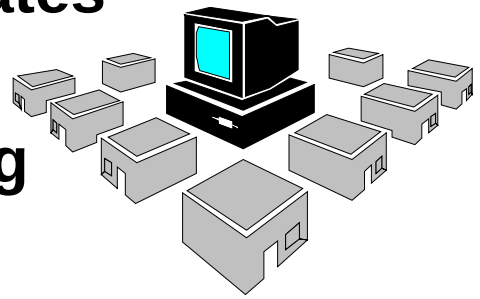
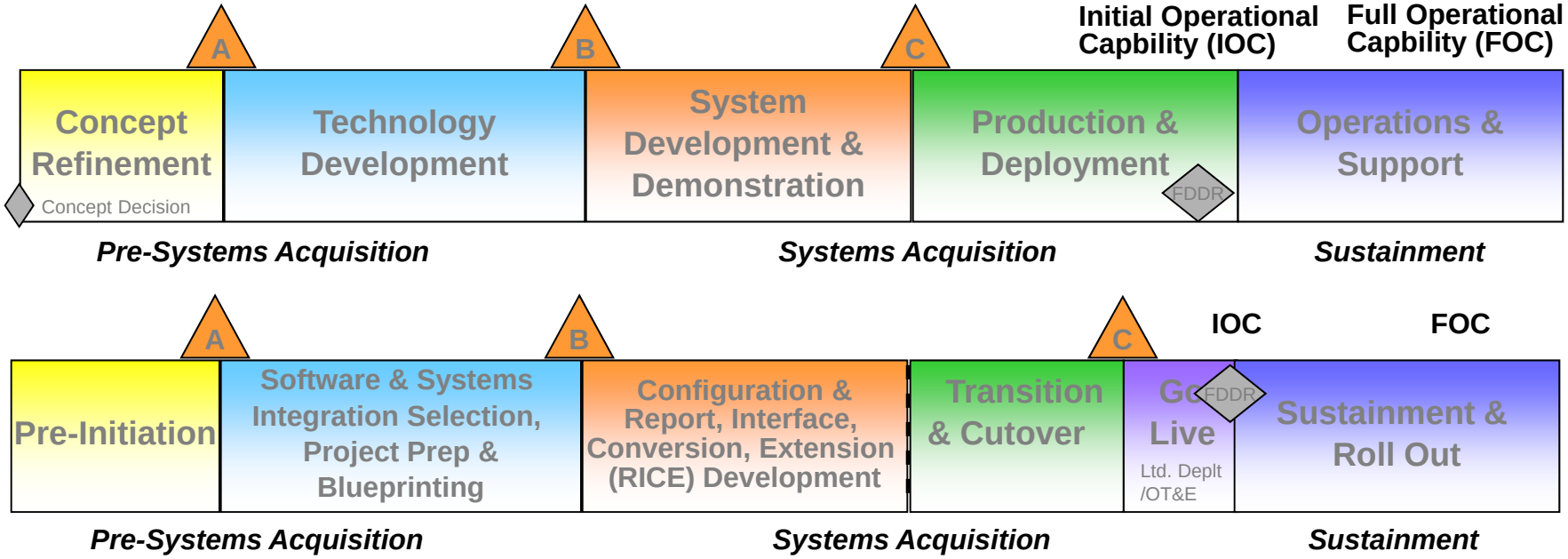
Overview: What is an ERP?

- Enterprise Resource Planning (ERP) software
- An enterprise software application that
  - Has a single, integrated database
  - Integrates multiple business functions across an organization onto a single computer system that serves everyone's needs
  - Eases the exchange of data and facilitates communication among departments
- Each module works separately performing specific data-processing
- Typically enabled by Commercial-Off-The-Shelf (COTS) Software (SW)



Overview: ERP vs. Traditional SW

- COTS vs. Custom
- Organizational design vs. System design
- Interconnected Systems vs. Standalone Systems
- Life Cycle Differences



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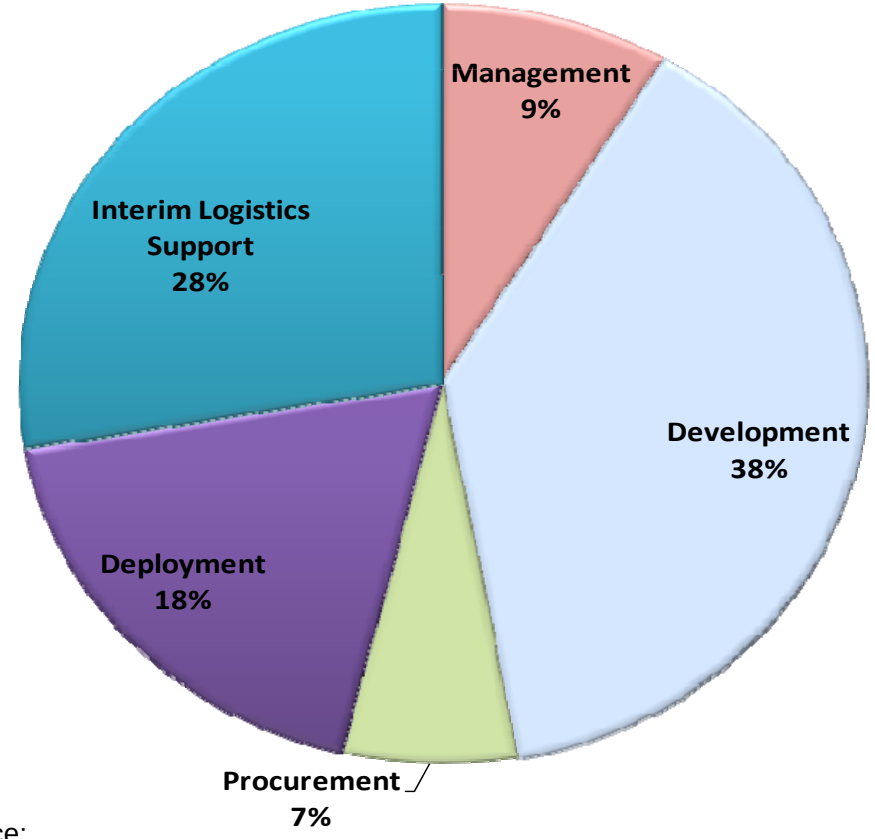
ERP Investment Cost Allocation



MIL-STD-881 AIS WBS Reference:

Management (Government Only)= Program Management (PM), Systems Engineering (SE), Change Management (CM)
Development = Prime Mission Product, Contractor SE/PM/CM, DT&E, Training Development, Data, Other
Deployment = Site Activation, User Training, Data Migration, Management/Engineering Support
Interim Logistics Support = system operations, help desk, system/database administration, deployment hardware software refresh

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Main Challenges with ERP Estimating

- Cost Body of Knowledge
  - Unfamiliar with Cost and Schedule Drivers
  - Limited ERP Cost Research
  - Few “white papers” found on cost drivers but none provide supporting data
- Policy and Guidance
  - Limited data to support Program Decision reviews and Weapon Systems Reform Act of 2009

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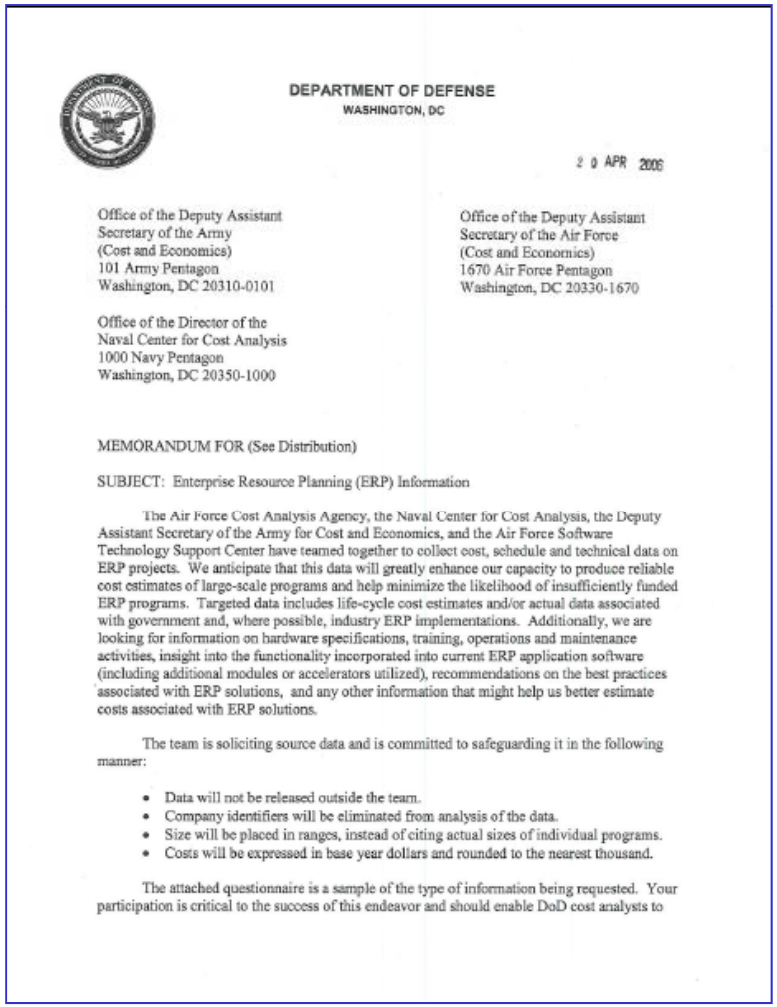
Cost Improvement Initiative



DEPARTMENT OF DEFENSE
WASHINGTON, DC

20 APR 2006

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Secretary of the Army
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101 Army Pentagon
Washington, DC 20310-0101

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Office of the Director of the
Naval Center for Cost Analysis
1000 Navy Pentagon
Washington, DC 20350-1000

MEMORANDUM FOR (See Distribution)

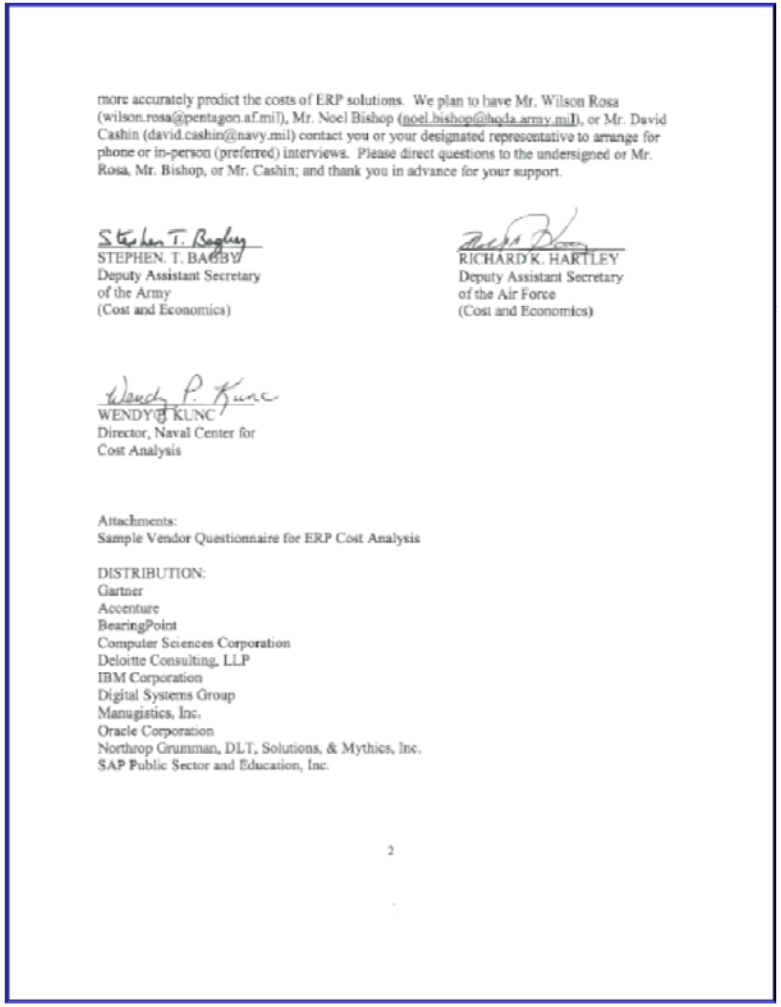
SUBJECT: Enterprise Resource Planning (ERP) Information

The Air Force Cost Analysis Agency, the Naval Center for Cost Analysis, the Deputy Assistant Secretary of the Army for Cost and Economics, and the Air Force Software Technology Support Center have teamed together to collect cost, schedule and technical data on ERP projects. We anticipate that this data will greatly enhance our capacity to produce reliable cost estimates of large-scale programs and help minimize the likelihood of insufficiently funded ERP programs. Targeted data includes life-cycle cost estimates and/or actual data associated with government and, where possible, industry ERP implementations. Additionally, we are looking for information on hardware specifications, training, operations and maintenance activities, insight into the functionality incorporated into current ERP application software (including additional modules or accelerators utilized), recommendations on the best practices associated with ERP solutions, and any other information that might help us better estimate costs associated with ERP solutions.

The team is soliciting source data and is committed to safeguarding it in the following manner:

- Data will not be released outside the team.
- Company identifiers will be eliminated from analysis of the data.
- Size will be placed in ranges, instead of citing actual sizes of individual programs.
- Costs will be expressed in base year dollars and rounded to the nearest thousand.

The attached questionnaire is a sample of the type of information being requested. Your participation is critical to the success of this endeavor and should enable DoD cost analysts to



more accurately predict the costs of ERP solutions. We plan to have Mr. Wilson Rosa (wilson.rosa@pentagon.af.mil), Mr. Noel Bishop (noel.bishop@hqda.army.mil), or Mr. David Cashin (david.cashin@navy.mil) contact you or your designated representative to arrange for phone or in-person (preferred) interviews. Please direct questions to the undersigned or Mr. Rosa, Mr. Bishop, or Mr. Cashin; and thank you in advance for your support.

STEPHEN. T. BAGBY
Deputy Assistant Secretary
of the Army
(Cost and Economics)

RICHARD K. HARTLEY
Deputy Assistant Secretary
of the Air Force
(Cost and Economics)

WENDY P. KUNC
Director, Naval Center for
Cost Analysis

Attachments:
Sample Vendor Questionnaire for ERP Cost Analysis

DISTRIBUTION:
Gartner
Accenture
BearingPoint
Computer Sciences Corporation
Deloitte Consulting, LLP
IBM Corporation
Digital Systems Group
Manugistics, Inc.
Oracle Corporation
Northrop Grumman, DLT, Solutions, & Mythics, Inc.
SAP Public Sector and Education, Inc.

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Recent Developments

- **First-Ever MIL-STD-881 Work Breakdown Structure, Data Dictionary, and Software Resource Data Report for ERP**
  - Adopted in recent Cost and Schedule Data Report Plans (CDSR) -- GFEBS, GCSS-Army, ECSS, DEAMS, GCSS-MC, and NAVY ERP
- **ERP Cost Database**
  - AFCAA in conjunction with NCCA and DASA-CE have collected empirical cost, schedule, and technical data on 18 ERP programs
- **ERP Cost Toolkit (Sep 10)**
  - Empirically-based cost estimating metrics and benchmarks
- **ERP Cost Handbook (Nov 10)**
  - Standards, guidelines and rules of thumb for estimating ERP
- **ERP Cost Risk and Uncertainty Metrics (Aug 10)**

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Acronym

AIS	Automated Information System
BY09	Base Year 2009
CM	Change Management
COOP	Continuity of Operations
COTS	Commercial Off The Shelf
DASA-CE	Deputy Assistant Secretary of the Army (Cost and Economics)
DEAMS	Defense Enterprise Accounting Management System
DISA	Defense Information Systems Agency
DT&E	Development Test and Evaluation
ECSS	Expeditionary Combat Support System
ERP	Enterprise Resource Planning
FDDR	Full Deployment Decision Review
FFRDC	Federally Funded Research and Development Center
FOC	Full Operational Capability
GCSS-Army	Global Combat Support System - Army
GCSS-MC	Global Combat Support System - Marine Corps
Go-Live	Also referred as FOC
HW	Hardware
IOC	Initial Operational Capability
MAIS	Major Automated Information System
MS	Milestone
PMP	Prime Mission Product
LRE	Latest Revised Estimate
NCCA	Naval Center for Cost Analysis

OEM	Original Equipment Manufacturer
OT&E	Operational Test & Evaluation
PM	Program Management
PMO	Program Management Office (Government)
RICE	Report, Interface, Conversion, Extension
SE	Systems Engineering
SE/PM	Systems Engineering / Program Management
SRDR	Software Resources Data Report
SW	Software
T&E	Test and Evaluation
WBS	Work Breakdown Structure

Performance Tracker

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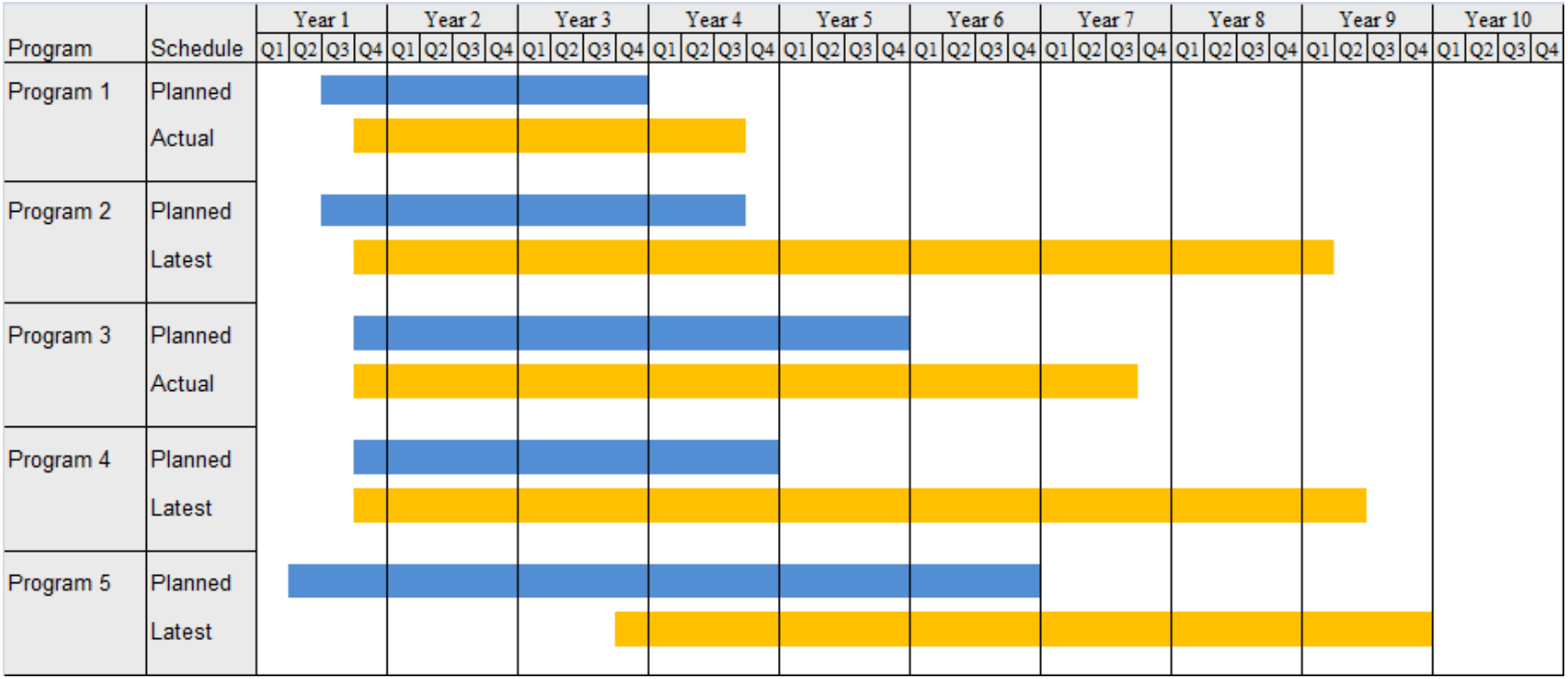
Performance Tracker – Schedule Growth

- **Actual schedule ranges between 110% and 240% of initial (Milestone B) schedule duration**
- **Extends "standing army" costs (a significant cost)**
- **5 ERP programs**



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Performance Tracker – Requirements Growth

- **Based on data from 7 ERP Programs**
- **Growth is measured as percent difference between predicted and actual number of RICE Objects**

	Projects	Mean	Median	Low	High
Growth in RICE Object Count	7	75.4%	20.0%	-13.7%	361.4%

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Performance Tracker – Cost Growth

Historic ERP Cost Growth
Actual/LRE vs. Baseline, 2000-2010

Projects	Sample Size (Number of Programs)	Low Bound	Mean	High Bound
Completed	3	8.4%	96.2%	187.8%
Ongoing*	4*	117.6%	229.5%	411.3%
Combined	7	8.4%	172.4%	411.3%

[1] **Investment Phase: Program Insertion through Go-Live**
***Historical schedule/cost growth beyond 5 year point**

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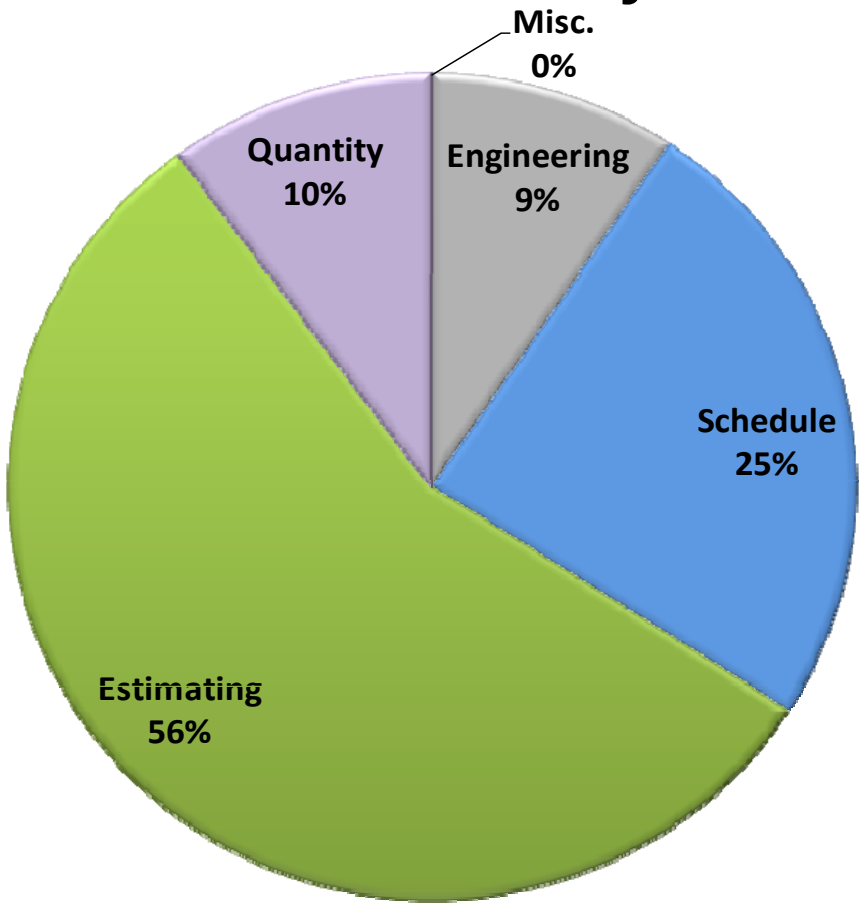
Contribution to Cost Growth

*Contribution to Cost Growth by Variance Category



*Investment Phase Only: Program Insertion through “Go-Live”

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Reasons for Cost Growth

1. **Estimation: A lack of understanding of the new technology and business environment led to the use of obsolete cost models (1980-1990s) and dubious estimating methods**
2. **Schedule: limited budgets have forced decision makers to extend the period of performance of "Level of Effort" related tasks – Civilian, Contractor, and Military FTEs**
3. **Engineering: Inexperience with Oracle/SAP Customization has led to underestimation of requirements. Difficulty changing business processes to match ERP processes**
4. **Quantity: war-fighter need has led some program offices to reassess user and implementation requirements**

Major Costs

Major Costs: Background

- The primary purpose of any metrics provided is to give the estimator insight into reasonable bounds and benchmarks for program size and cost.
- The benchmarks in this presentation should not be used for a primary estimating methodology!!!

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Major Costs:

ERP Work Breakdown Structure

WBS ID	Level 1	Level 2	Level 3	Level 4	Level 5
1.0	Automated Information System (AIS)				
1.1		Automated Information System Prime Mission Product Release/Increment X			
1.1.1			Custom Application Software 1..n		
1.1.2			Enterprise Service Element 1..n		
1.1.3			Enterprise Information System 1..n		
1.1.4			External System Interface Development 1..n		
1.1.5			System Level Integration		
1.2		System Engineering			
1.3		Program Management			
1.4		Acquisition Logistics			
1.5		System Test and Evaluation			
1.5.1			Development Test and Evaluation		
1.5.2			Operational Test and Evaluation		
1.6-1.7		Training/Data			
1.10		Operational/Site Activation			
1.10.X			Site Type 1…N		
1.10.X.1				Deployment Software and Hardware	
1.10.X.2				Site Activation	
1.10.X.3				User Training	
1.10.X.4				Data Migration	
1.10.X.5				Management/Engineering Support	
1.10.X.6				Interim Logistics Support	
1.10.X.6.1					Systems Engineering/Program Management
1.10.X.6.2					System Operations / Sustaining Engineering
1.10.X.6.3					Help Desk
1.10.X.6.4					System Database Administration
1.10.X.6.5					Deployment Hardware/Software Refresh
1.10.X.6.6					Software Maintenance,
1.10.X.6.7					Follow on Training
1.10.X.6.8-9					Accreditation / Independent Verification and Validation

Unpublished MIL-STD-881 References (Final Review Stage):
[1] Appendix TBD: Automated Information System Work Breakdown Structure and Definition
[2] APPENDIX I: COMMON ELEMENTS WORK BREAKDOWN STRUCTURE AND DEFINITIONS

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Practical Cost Metrics:
Mapped to ERP WBS

Practical Cost Metrics	ERP WBS Reference
■ Development	
■ Productivity ($/RICE)	WBS 1.1.3, 1.2-1.4 (contractor only), 1.5.1,1.6-1.7
■ Size (RICE Objects)	WBS 1.1.3, 1.2-1.4 (contractor only), 1.5.1, 1.6-1.7
■ Size (External System Interfaces)	WBS 1.1.4
■ Size (Business Processes)	WBS 1.1
■ Program Office Staff (FTE/yr or $/yr)	WBS 1.2-1.4 (government only)
■ Duration (Years)	WBS 1.2-1.4 (government only)
■ Procurement / Deployment	
■ User Count	WBS 1.10.X.1.1 (deployment Software)
■ Migrated Legacy Systems	WBS 1.10.X.4
■ Servers (UNIX and Windows Servers)	WBS 1.10.X.1.2 (deployment hardware)
■ Operating Locations	WBS 1.10.X.5
■ Training/Test Events	WBS 1.10.X.3
■ Interim Logistics Support / Operations and Sustainment	
■ PMO Staff (% Ramp-Down after FOC)	WBS 1.10.X.6.1 (WBS 2.1 after FOC)
■ Contractor Staff (% Ramp-Down after FOC)	WBS 1.10.X.6.6 (WBS 2.6 after FOC)
■ Help Desk (Users/FTE)	WBS 1.10.X.6.3 (WBS 2.3 after FOC)
■ Software License Fees ($/User)	WBS 1.10.X.6.5 (WBS 2.5 after FOC)
■ System/Database Administration Staff (FTE/Servers)	WBS 1.10.X.6.4 (WBS 2.4 after FOC)
■ Follow on Training Factor (% of User Training Cost)	WBS 1.10.X.6.7 (WBS 2.7 after FOC)

Note: Interim Logistics Support (WBS 1.10.X.6) is renamed to Operations and Support (WBS 2.X) after FOC

Major Costs

Major Cost Drivers:

Development

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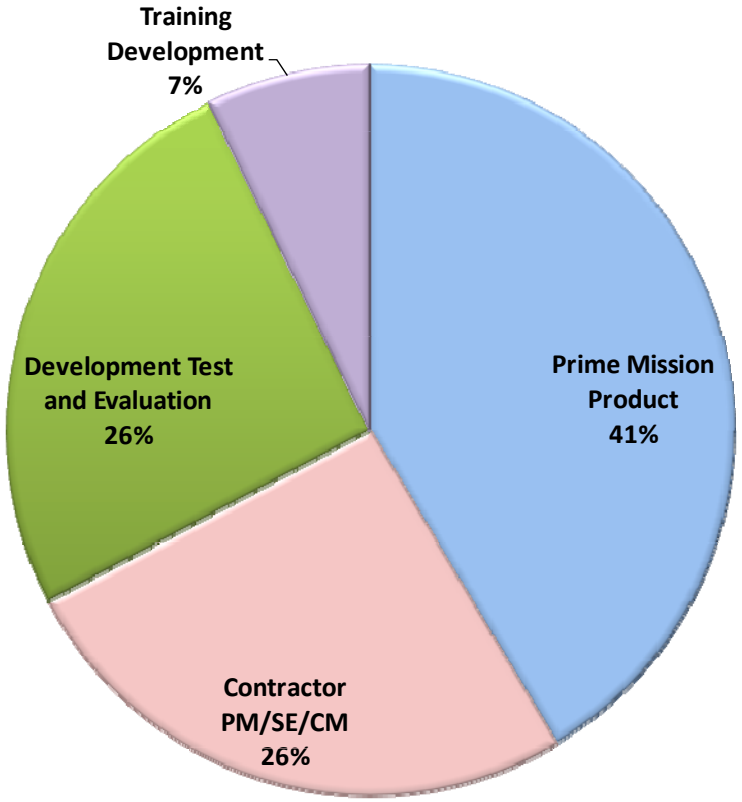
Major Costs: Development



	Average	Low	High	Stdev
Prime Mission Product	41%	25%	60%	11%
Contractor PM/SE/CM	26%	9%	51%	15%
Development Test and Evaluation	26%	9%	43%	11%
Training Development	7%	3%	16%	4%

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Major Costs: Development

- Number of RICE Objects
  - Includes Reports, Interfaces, Conversions, Extensions, Workflows, Bolt-On, and Patches
  - Standard ERP Sizing metric
- Number of Business Processes and Sub-Processes
  - Available early in the acquisition process
  - Metric for complexity and size or as a crosscheck
- Number of Requirements
  - Metric to determine size or as a crosscheck
- Number of External Interfaces
  - Metric to determine complexity and size
  - Drives complexity of ERP Development
- Training
  - Includes Training Development
  - Initial Training costs accounted for in Deployment

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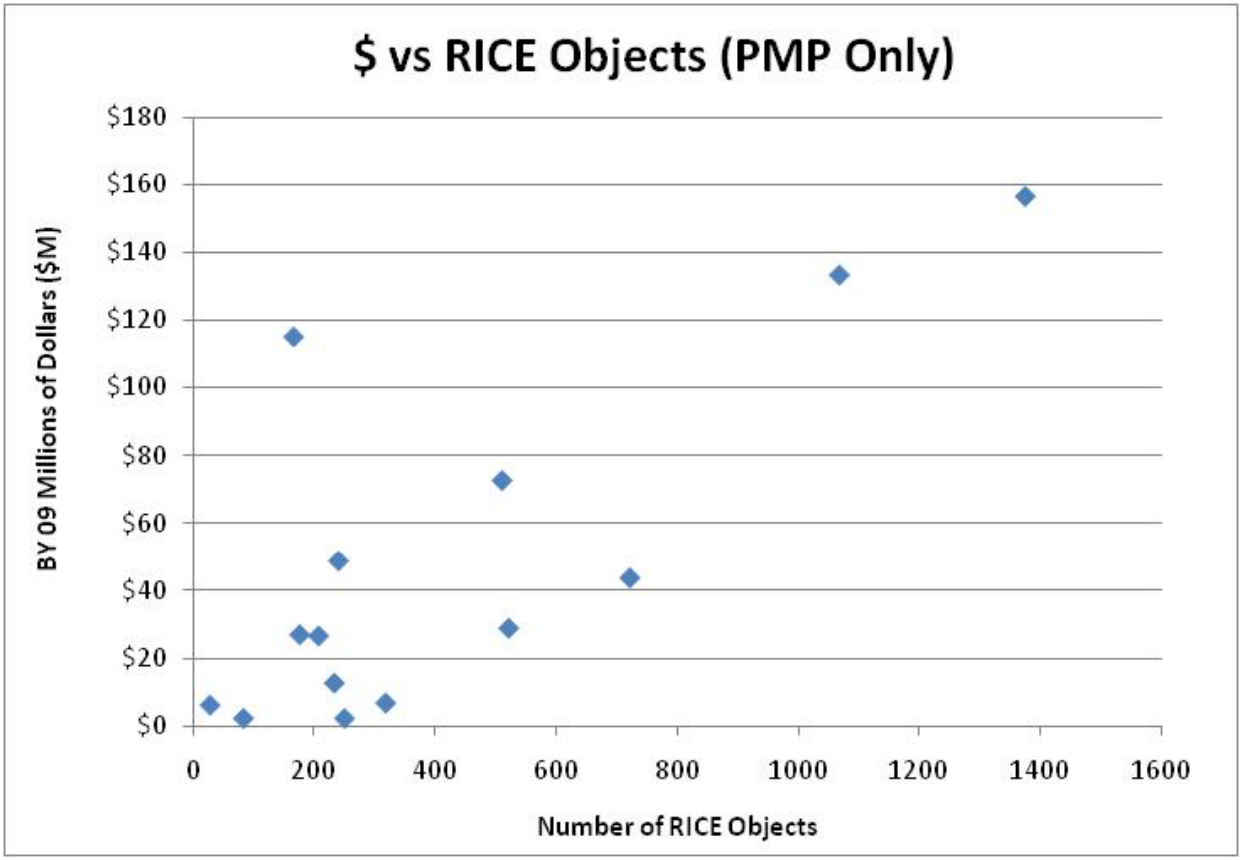
Major Costs: Development



	Mean	Median	Low	High	StDev
$ per RICE Object (PMP Only)	$143K	$120K	$9K	$690K	$170K
$ per RICE Object (Development*)	$400K	$255K	$20K	$1,318K	$377K

*Development = Prime Mission Product, Contractor SE/PM/CM, DT&E, Training Development, Data, Other

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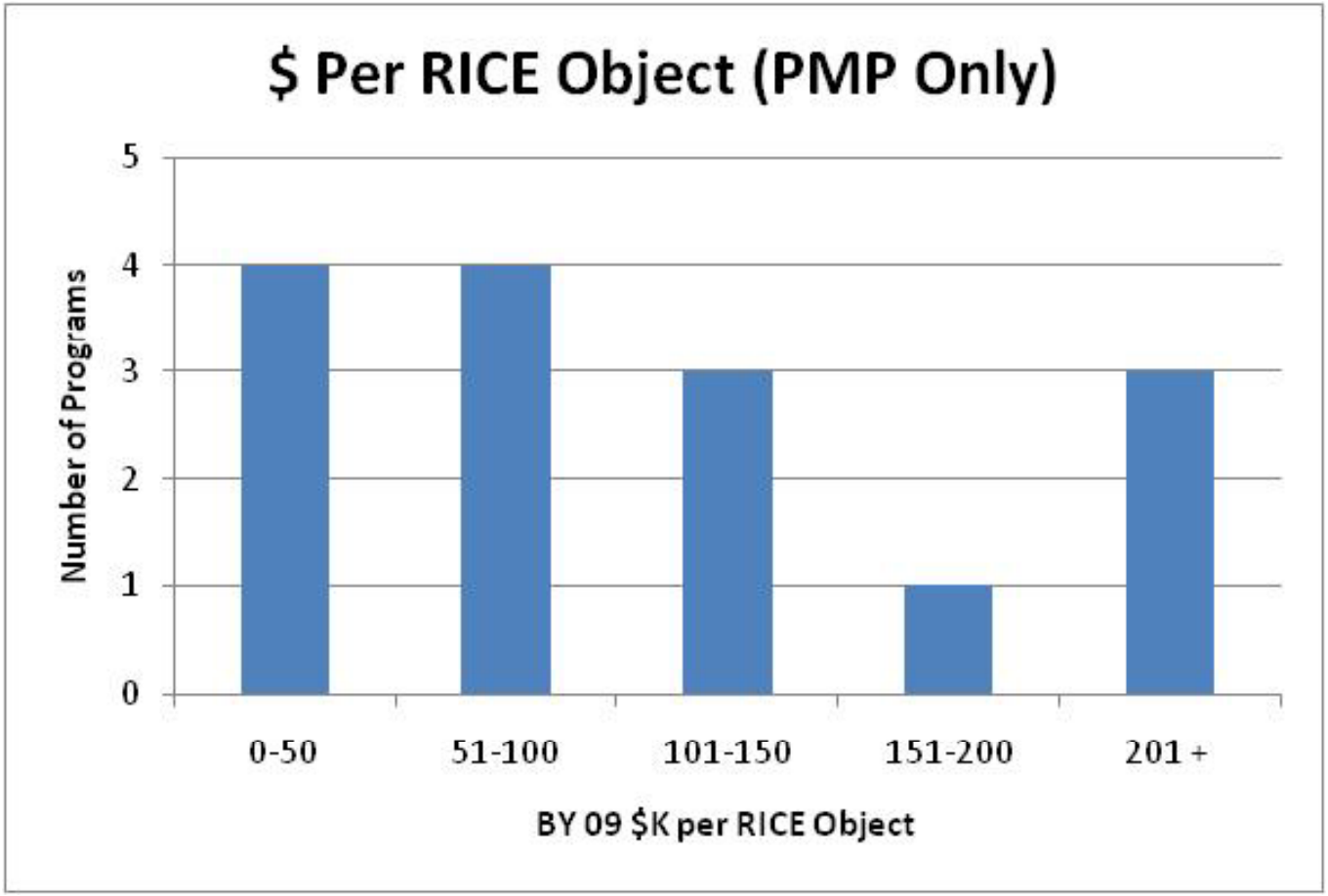
Major Costs: Development



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$ per RICE Object (PMP Only)	$143K	$120K	$9K	$690K	$170K

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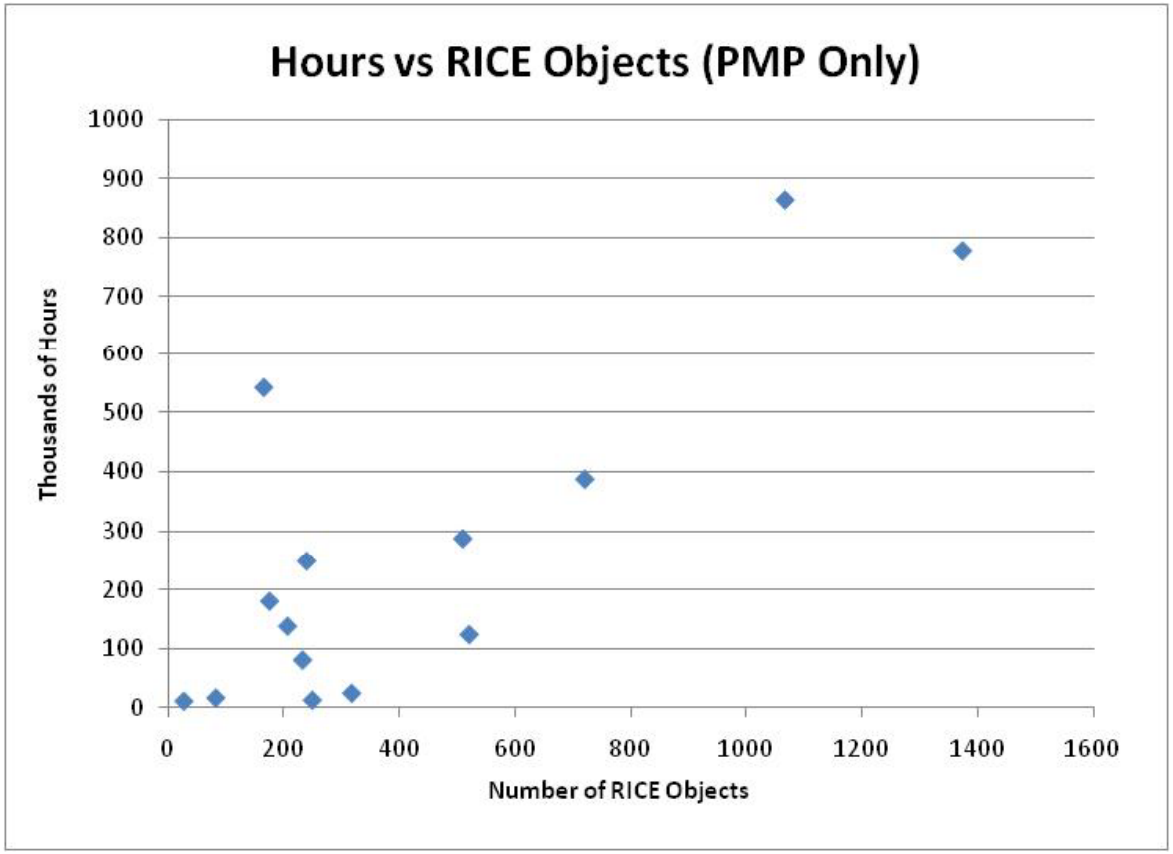
Major Costs: Development



	Mean	Median	Low	High	StDev
Hours per RICE Object (PMP Only)	700	550	50	3,250	800
Hours per RICE Object (Development*)	2,350	2,300	125	7,250	1,950

*Development = Prime Mission Product, Contractor SE/PM/CM, DT&E, Training Development, Data, Other

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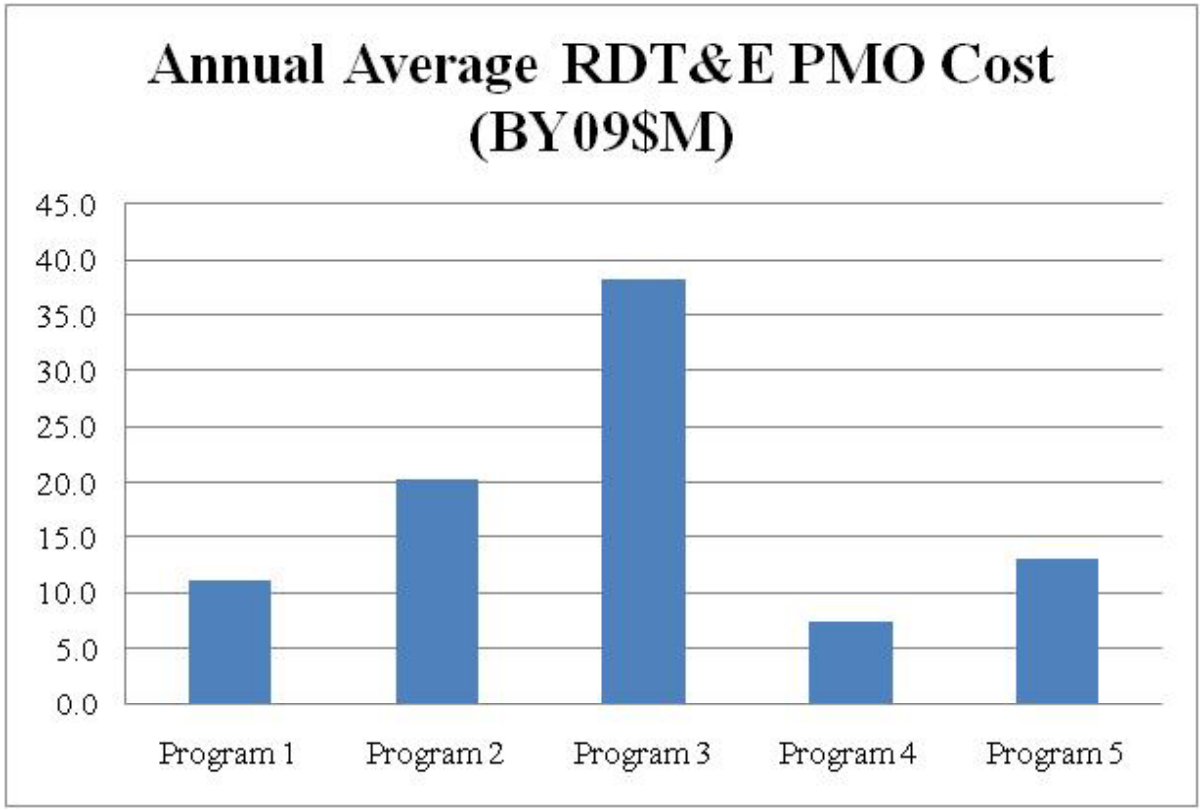
Major Costs: Development

- Government SE/PM (a.k.a PMO)
  - Combination of civilian, military, and support contractors: PM, Systems Engineering, Change Management, and Support
  - Does not include Prime Contractor SE/PM



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Major Costs: Development

SIZE METRICS	Small ERP Programs			Medium ERP Programs			Large ERP Programs		
	Sample	Defined Range	Average	Sample	Defined Range	Average	Sample	Defined Range	Average
Number of RICE Objects	4	0-200	114	7	201-600	325	3	601+	1050
Number of Business Processes	3	0-30	18	4	31-60	49	3	61+	155
Number of Business Sub-Processes	3	0-200	129	3	201-400	341	2	401+	580
Number of Requirements	2	0-750	385	6	751-3,000	1,288	4	3,001+	6,800
Number of External Interfaces	4	0-10	6	3	11-25	18	3	26+	39
Number of Migrated Legacy Systems	2	0-30	9	1	31-100	65	2	101+	190

Major Costs:

Procurement and Deployment

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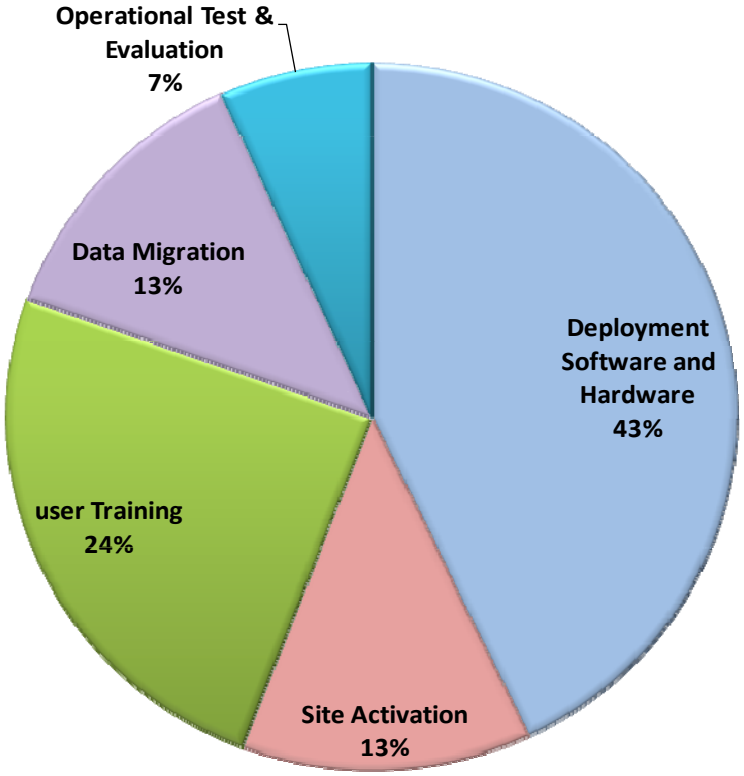
Major Costs: Procurement/Deployment



	Average	Low	High	Stdev
Deployment Software and Hardware	43%	9%	64%	30%
Site Activation	13%	9%	16%	4%
User Training	25%	15%	41%	15%
Data Migration	13%	3%	31%	16%
Operational Test & Evaluation	7%	3%	11%	4%

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Major Costs: Procurement/Deployment

- Procurement/Deployment includes: HW purchases, HW upgrades, COTS SW, User Licenses, Rollout, Initial Training, OT&E and applicable change management
  - Includes Data Migration / Cleansing if migration is done on-site
  - Should not include Hardware Refresh (but frequently does)
- User License Data
  - http://www.oracle.com/corporate/pricing/technology-price-list.pdf
  - http://www.oracle.com/corporate/pricing/sig.pdf
  - http://www.sap.com/solutions/licensingmodel/index.epx
- Discounts from the OEM (from Supply Management Office or other resources) are frequently available and may be applicable to license refresh rates in O&S

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Major Costs: Procurement/Deployment

- User Count
  - Includes Users and SW Maintainers
  - Useful to calculate COTS licenses, servers, storage space, and size
- Migrated Legacy Systems provide insight into complexity and scope of the ERP, and is especially helpful in estimating data conversion, data cleansing, and data migration
- Servers
  - Useful to calculate storage space and amount of data transfers anticipated

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Major Costs: Procurement/Deployment

- **Operating Locations are a cost driver for ERPs, specifically for Deployment labor, Deployment schedule, training, site activation costs, and travel costs.** *Note: Due to lack of consistent reporting and varying definitions of "Locations", they were not included in this set of metrics*
  - **Could mean central server locations (including COOP)**
  - **Could mean bases (or other equivalent) where the ERP is used (Preferred)**
- **Site Activation**
  - **Varies by program and number of operating locations**
  - **Typically does not require much HW, but is labor-intensive**
- **OT&E**
  - **Data is incomplete or not broken out to specify OT&E**

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Major Costs: Procurement/Deployment

	Small ERP Programs			Medium ERP Programs			Large ERP Programs		
SIZE METRICS	Sample	Defined Range	Average	Sample	Defined Range	Average	Sample	Defined Range	Average
Number of RICE Objects	4	0-200	114	7	201-600	325	3	601+	1,050
Number of External Interfaces	4	0-10	6	3	11-25	18	3	26+	39
User Count	6	0-5,000	1,890	4	5,001-15,000	10,800	2	15,001+	62,000
Number of Servers	3	0-50	16	1	51-300	150	2	301+	486

Major Costs:

Operations and Sustainment

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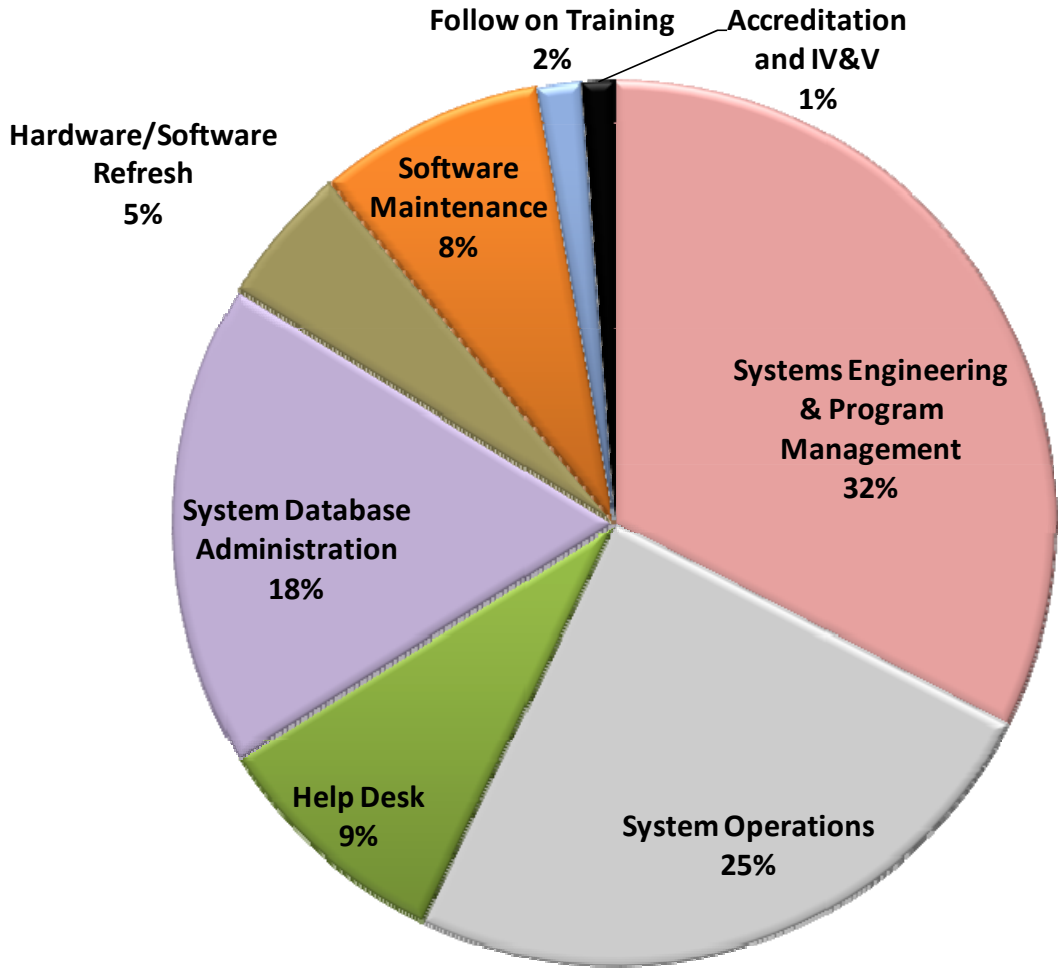
Major Costs: O&S



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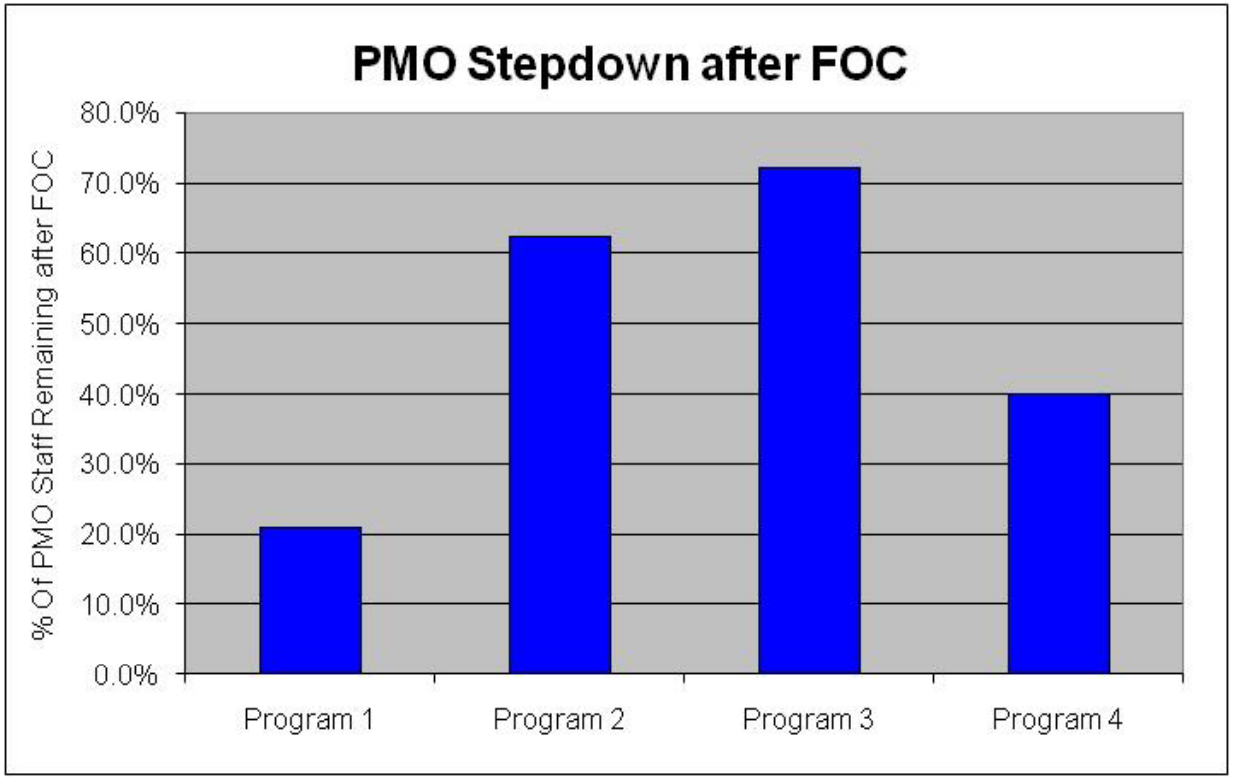
Major Costs: O&S

- Government SE/PM Staffing Ramp-Down (Post-FOC)
  - Average of 4 programs is around 50%
  - The two programs that kept a higher percentage of staff post-FOC had higher RICE Object counts



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Major Costs: O&S

- Recurring COTS License Fees
  - Typically represented as an annual cost based on a percentage (around 20% – 30% annually) of the initial purchase cost
- Initial Purchase Cost price lists
  - http://www.oracle.com/corporate/pricing/technology-price-list.pdf
  - http://www.oracle.com/corporate/pricing/sig.pdf
  - http://www.sap.com/solutions/licensingmodel/index.epx
- Discounts on Initial Purchase of COTS may be applicable to license refresh rates in O&S

Summary

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Summary

- Schedule growth drives a large portion of cost growth
  - Some of the largest costs in the program are PMO/FMO and System Integrator staffing ("Standing Army" costs)
  - Schedule growth has relatively small effect on PMP cost, but the "standing army" must be kept, greatly increasing the below-the-line costs
- RICE is a reasonable estimator, if uncertainty is included
  - Very wide variations around the mean
- The bulk of the costs are in Development and Deployment; Procurement plays a small role
- DISA / Mega-Center / Database Maintenance costs figure primarily in O&S, and make up a substantial portion of O&S costs
- O&S Metrics are evolving as ERPs enter that life cycle phase and generate data

Questions?