Assessing Enterprise Resource Planning (ERP) Cost, Schedule and Size Growth

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Outline

- Introduction
- ERP Overview
- Data Analysis Approach
- Data Demographics
- Cost Growth
- Schedule Growth
- Cost Benchmarks
- Schedule Benchmarks
- Conclusion

Problem Statement

- Program Office estimates of Enterprise Resource Planning (ERP) implementation costs and schedules are inaccurate, despite increased oversight
- All major DoD ERP deployed programs experienced cost growth
- All major DoD ERP deployed programs experienced schedule delays

As of Dec. 2016, DoD has invested more than $16B in their deployed nine ERP programs!

Purpose of Study

- Analyze performance of nine (9) ERP programs in terms of cost and schedule growth at each Authority to Proceed (ATP) event

- Establish cost and schedule benchmarks to crosscheck early estimates, such as Business Case Analysis and/or Special Studies

Overview

What is ERP?

Enterprise Resource Planning (ERP) systems are typically **commercial software systems** that **integrate** an organization's **core business functions** around a **unified data base.**

ERP definition, in terms of cost characteristics, is related to the **scope and integration of multiple business systems/processes**

If a program is not labeled an ERP, it still may be one

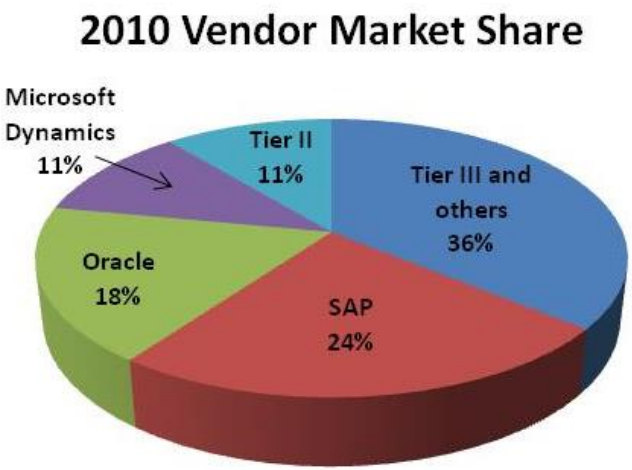
How is ERP implemented?

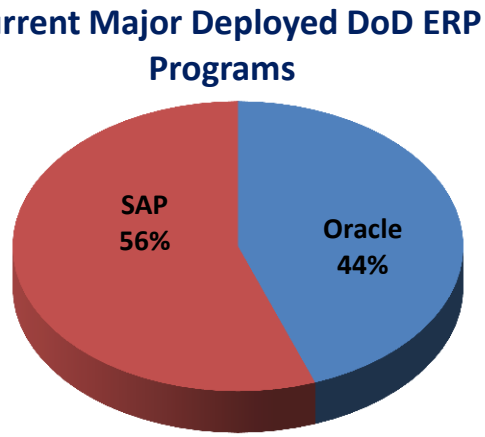
Business processes are automated via an integrated COTS software application:

Microsoft Dynamics

SAP

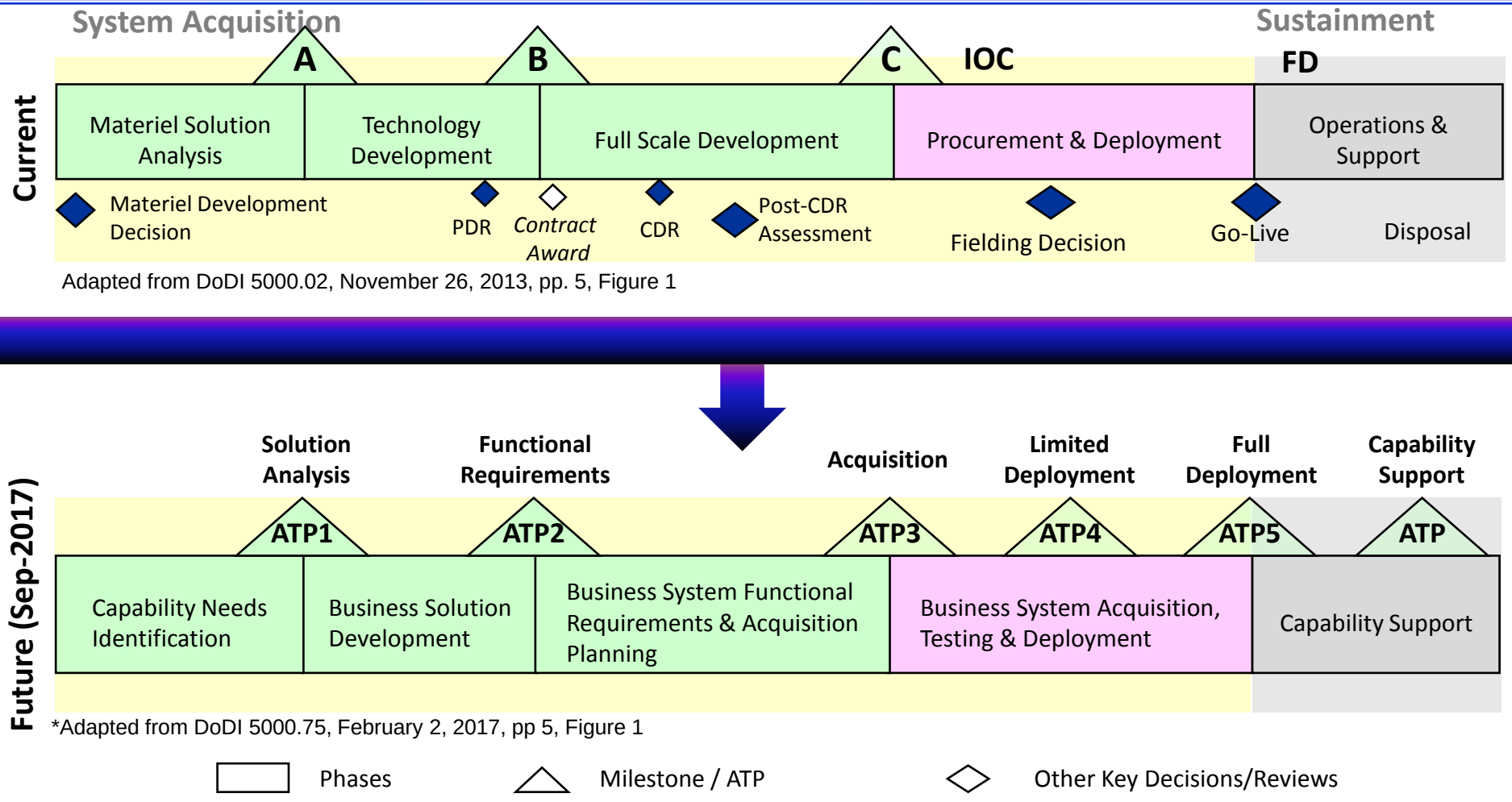
ORACLE





Integration is typically done by a 3rd Party Vendor

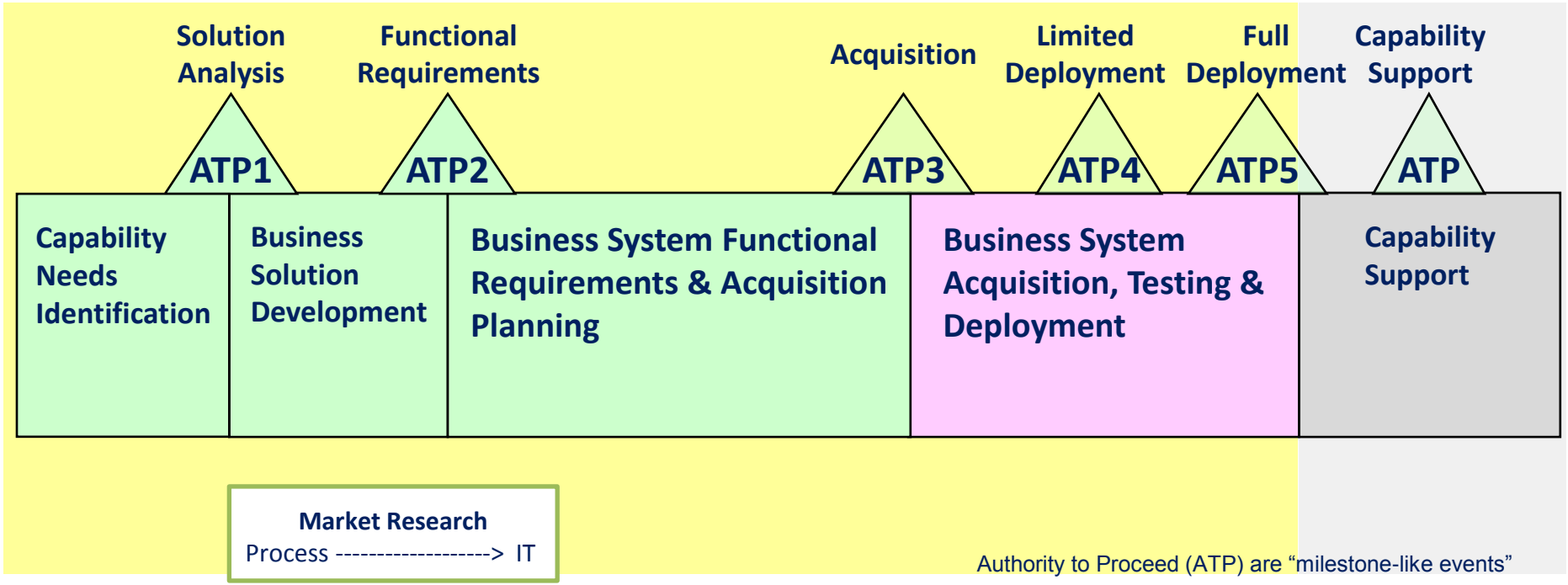
DoD Acquisition Cycle Current vs Future*



New Defense Business System (DBS) Acquisition Cycle uses the Authority to Proceed (ATP) decision points roughly equivalent to Milestones in the previous DODI release

PDR = Preliminary Design Review; CDR = Critical Design Review; IOC = Initial Operational Capability; FD = Full Deployment;

Business Capability Acquisition Cycle (Future)*

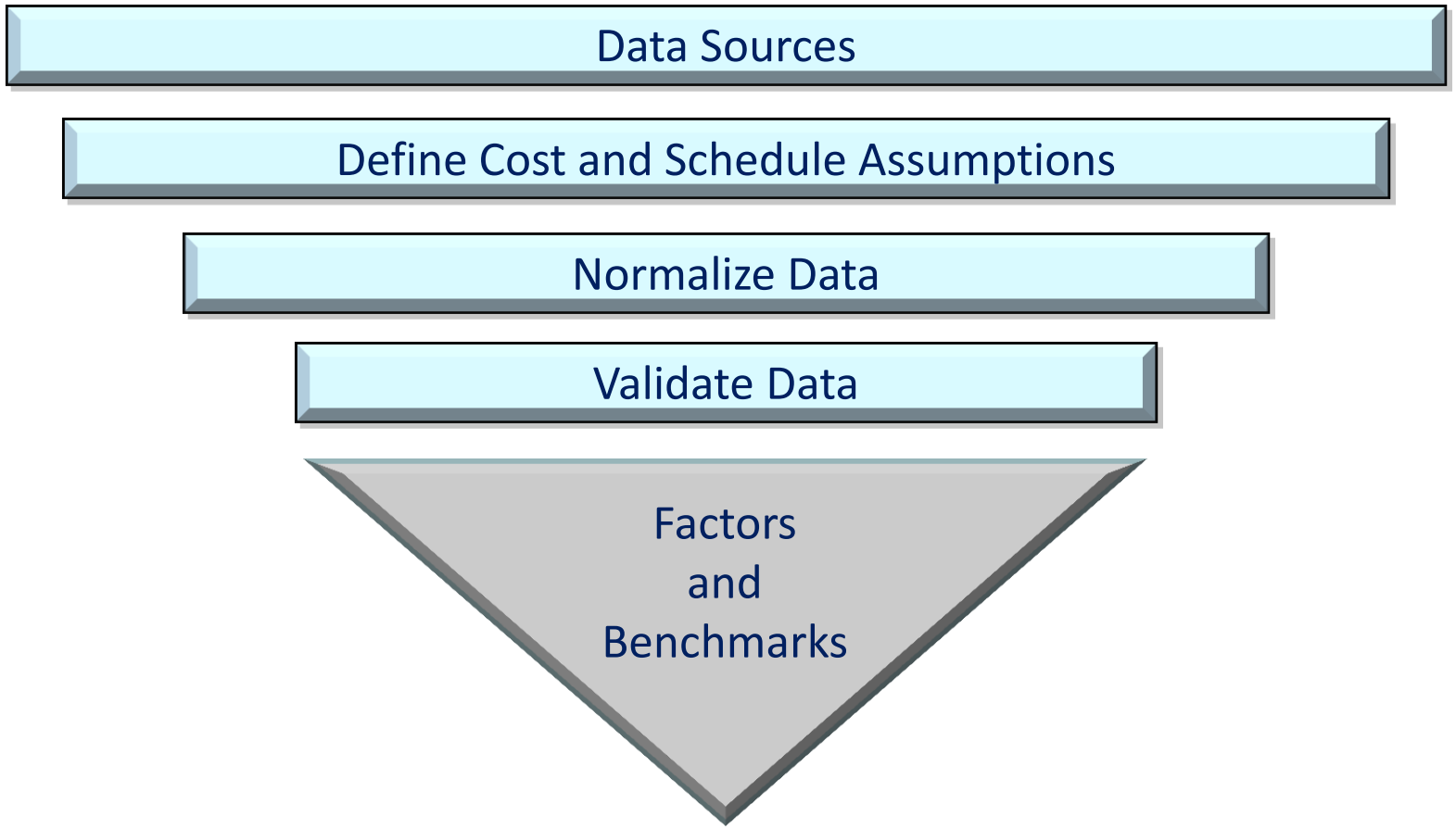


*Adapted from DoDI 5000.75, February 2, 2017, pp 5, Figure 1

Data Analysis Approach

Data Analysis Process Flow

- **Dataset normalized to "account for sizing units, application complexity, and content so they are consistent for comparisons" (source: GAO)**



Data Sources

Cost, Schedule, and Technical Data from Authoritative Sources:

Cost	Approved Cost Estimate Final Cost Model
Schedule	MAIS Annual Report (MAR) MAIS Quarterly Report
Technical	Cost Analysis Requirements Document (CARD) Software Resources Data Report (SRDR)

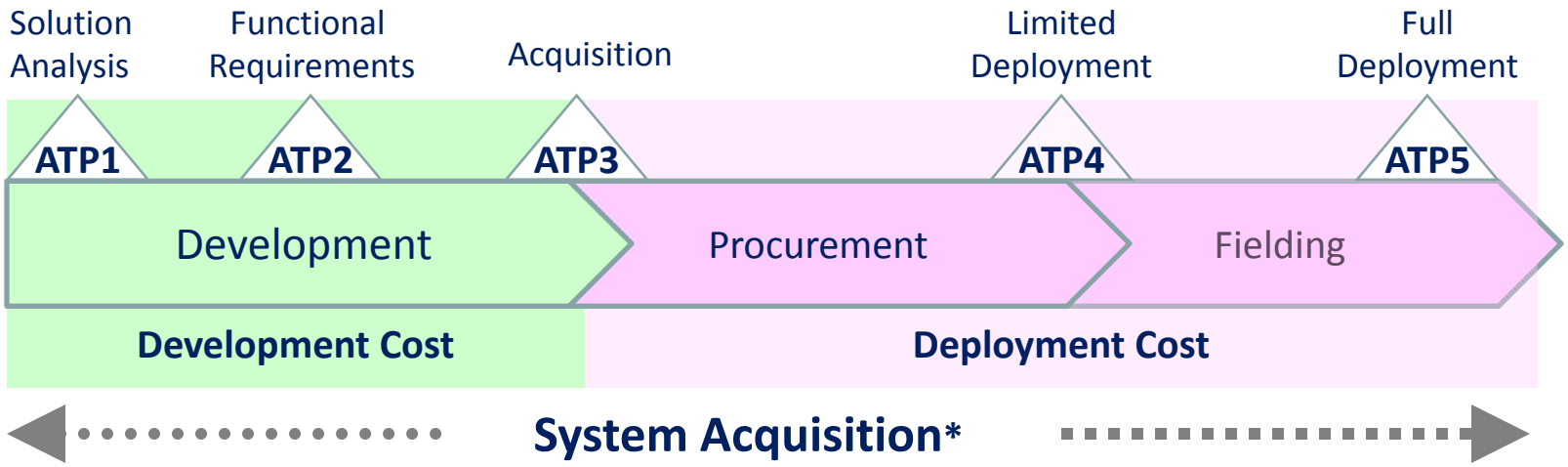
http://dcarc.cape.osd.mil/Default.aspx

DAMIR

http://www.acq.osd.mil/damir/

Data analysis is based on nine ERP deployed programs

Cost Assumptions



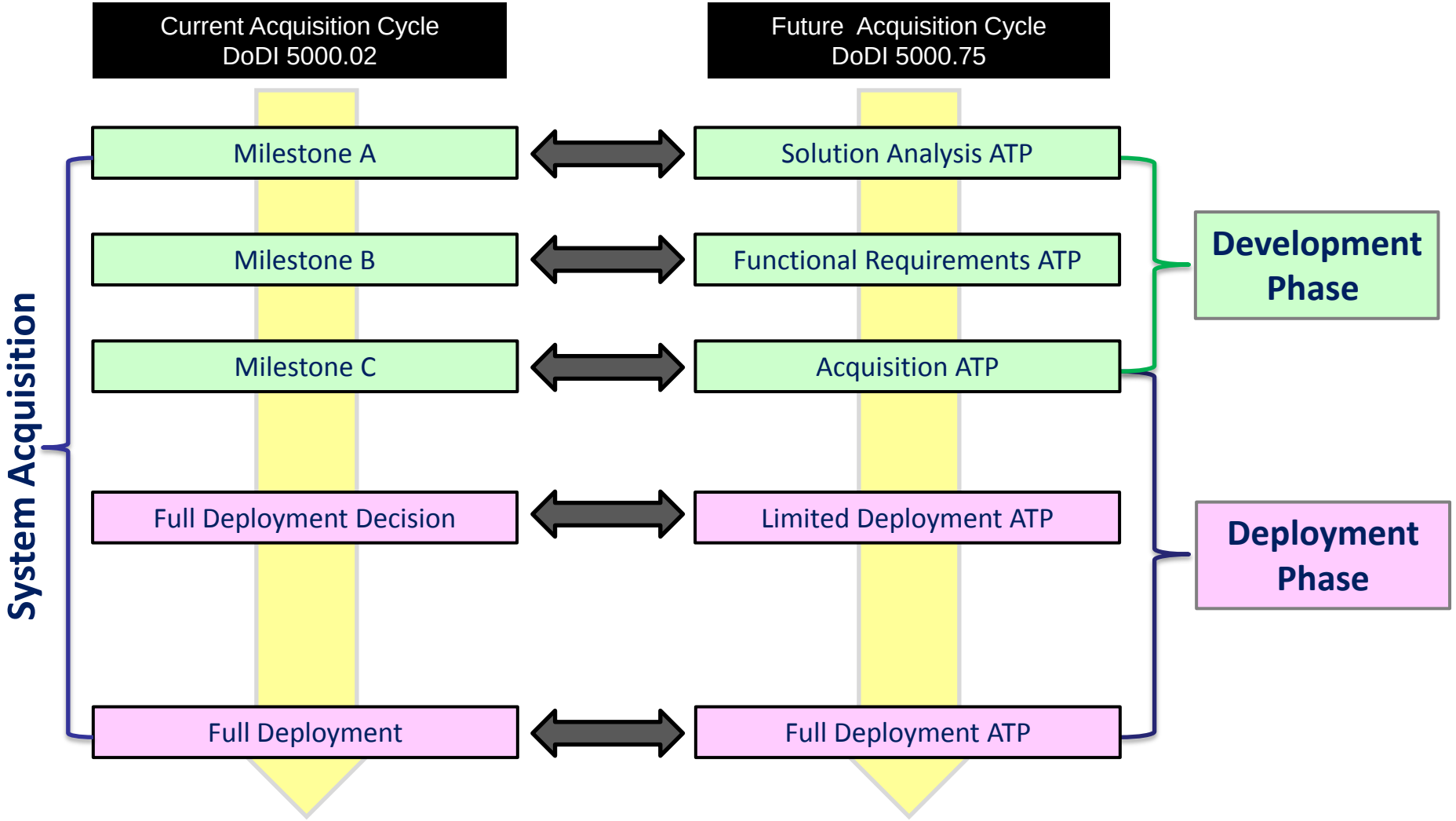
* Acquisition includes all associated costs from Solution Analysis ATP throughout Full Deployment ATP

Cost Elements*	Design/ Configuration/Customization Program Management Systems Engineering Change Management Training Development Development Test & Evaluation	Deployment Software Licenses Deployment Hardware Procurement	User Training Site Installation/Activation Data Conversion Execution Cut-over Interim Sustainment Operational Test & Evaluation
Assumptions	Cost in Base Year 2016 Dollars	Cost in Base Year 2016 Dollars	Cost in Base Year 2016 Dollars

*Adapted from MIL-STD-881D Appendix K (unpublished draft as of March 6, 2017)

Authority to Proceed (ATP) are “milestone-like events”

Schedule Assumptions
Current vs. Future Acquisition Process

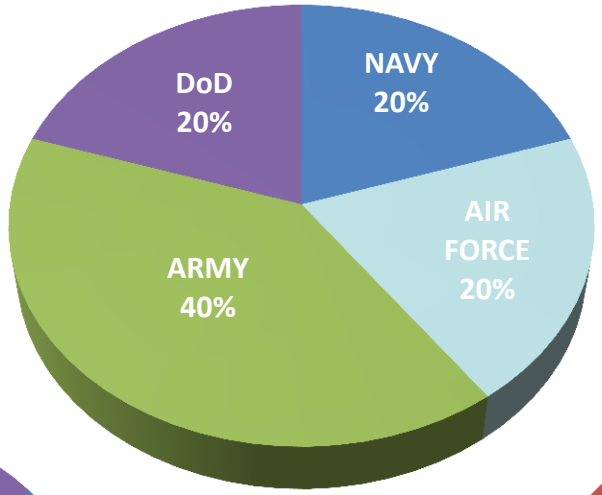


ATP = Authority to Proceed

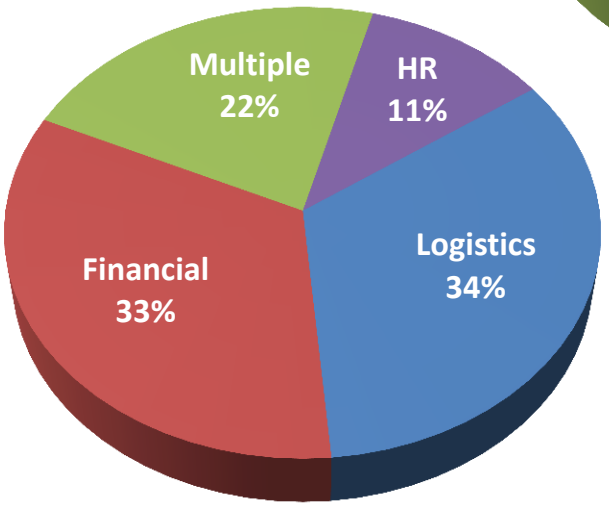
Data Demographics

Project Characteristics

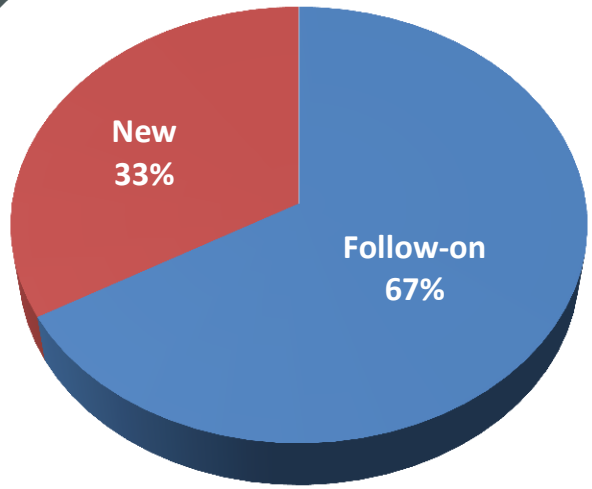
DoD Component



Functional Area

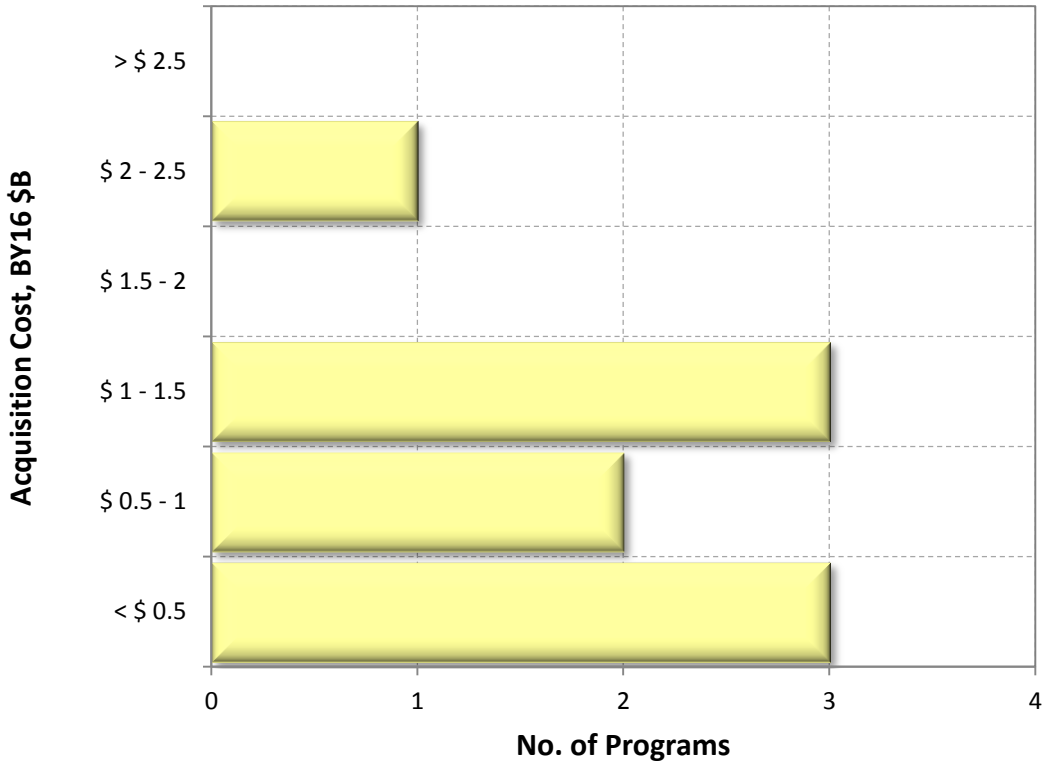


Program Heritage



✓ Analysis based on 9 deployed ERP programs

Acquisition Cost at FD (BY16 $B)

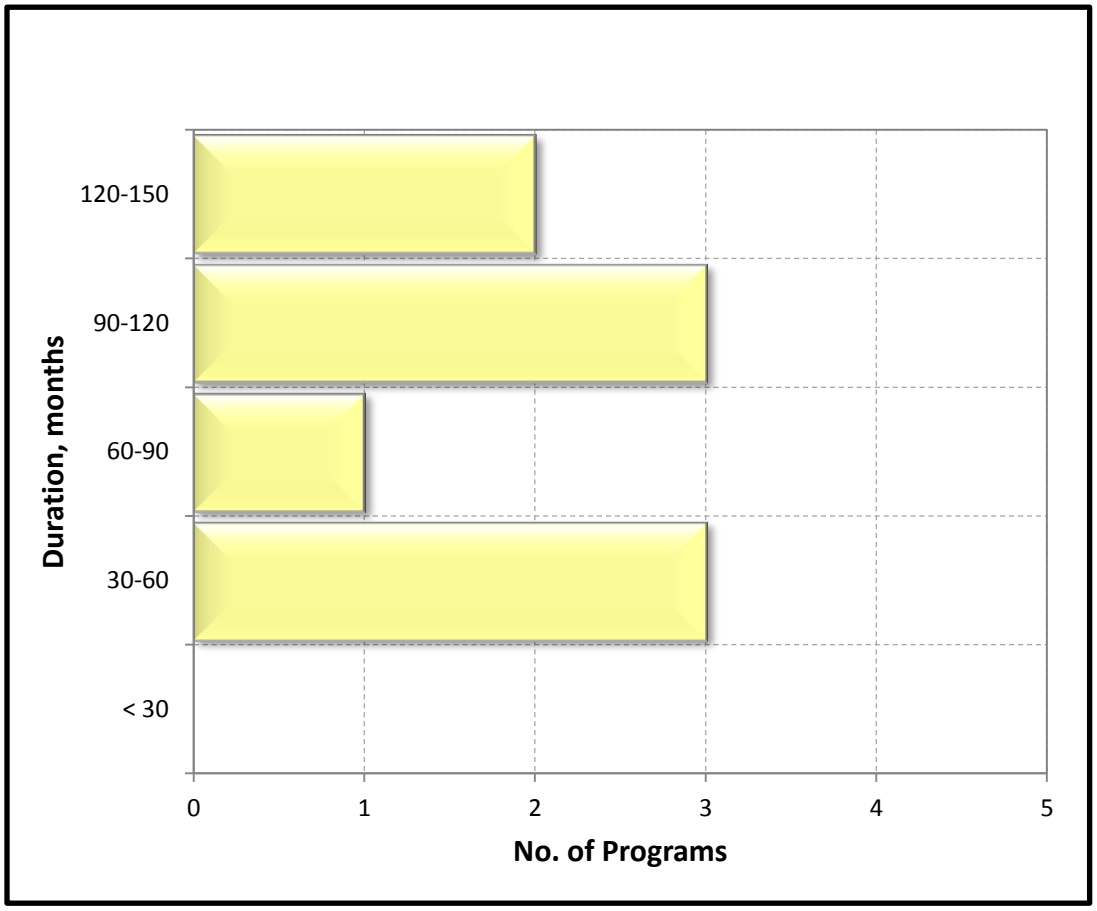


- Acquisition cost includes development, procurement, and fielding costs.
- All programs experienced Acquisition cost growth from Solution Analysis ATP to Full Deployment

An average ERP acquisition costs approximately $0.9 billion, with 70% of the programs ranging between $0.6 B and $1.9 B

FD = Full Deployment Authority to Proceed (ATP)

Acquisition Schedule at FD

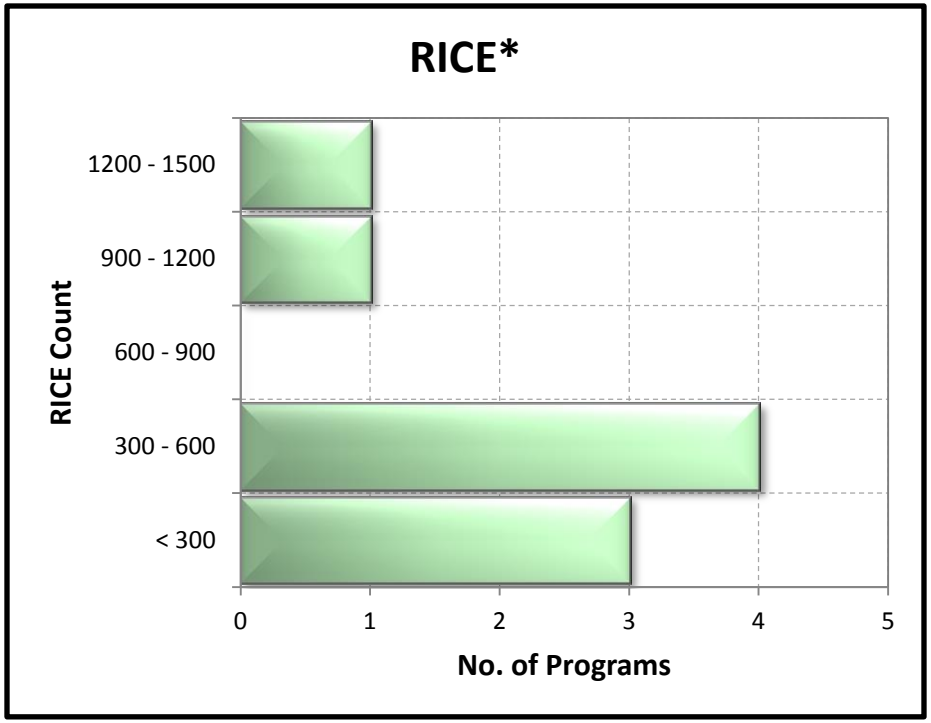


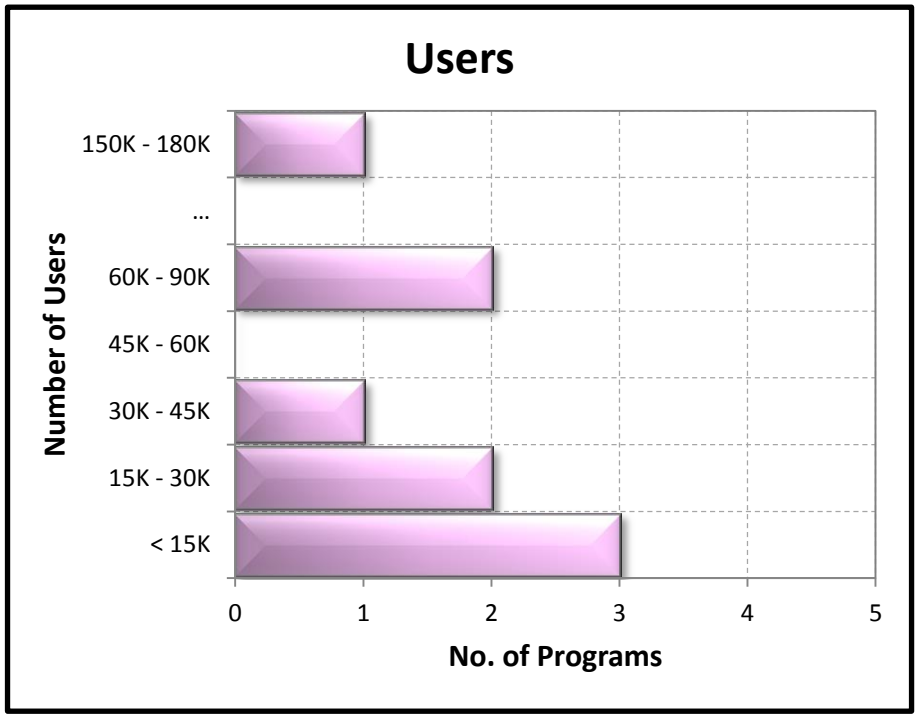
- 80% of programs between 50 and 115 months
- Median Acquisition Duration: 98 months
- Median Development Duration: 39 months
- Median Deployment Duration: 53 months

~60% of programs experienced critical breach for time
(failure to meet Limited Deployment ATP within five years of Solution Analysis ATP)

FD = Full Deployment Authority to Proceed (ATP)

Technical Requirements at FD



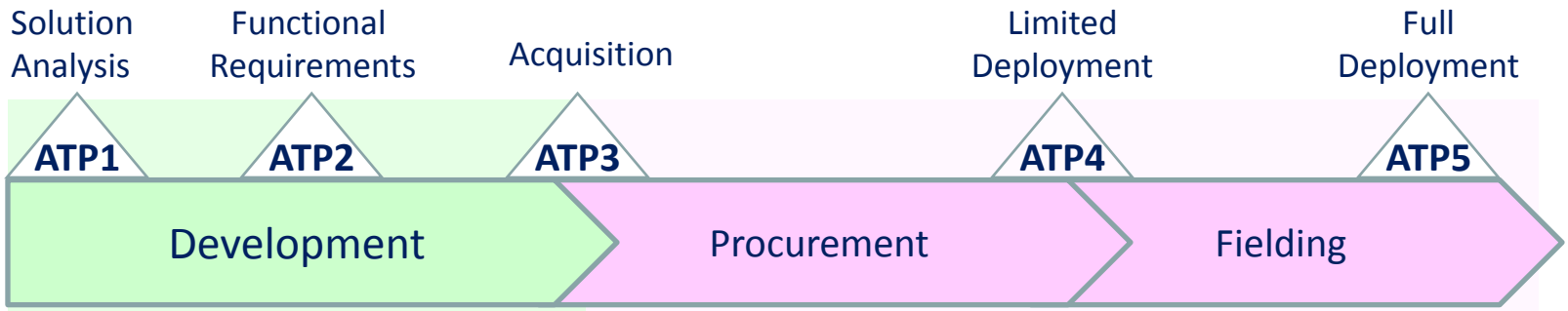


- RICE Counts median: 413
- User Estimates median: 26,600

RICE: Reports, Interfaces, Conversions, Extensions
Majority of Deployed ERP systems have fewer than 40,000 Users

Cost Growth

Cost Growth Overview



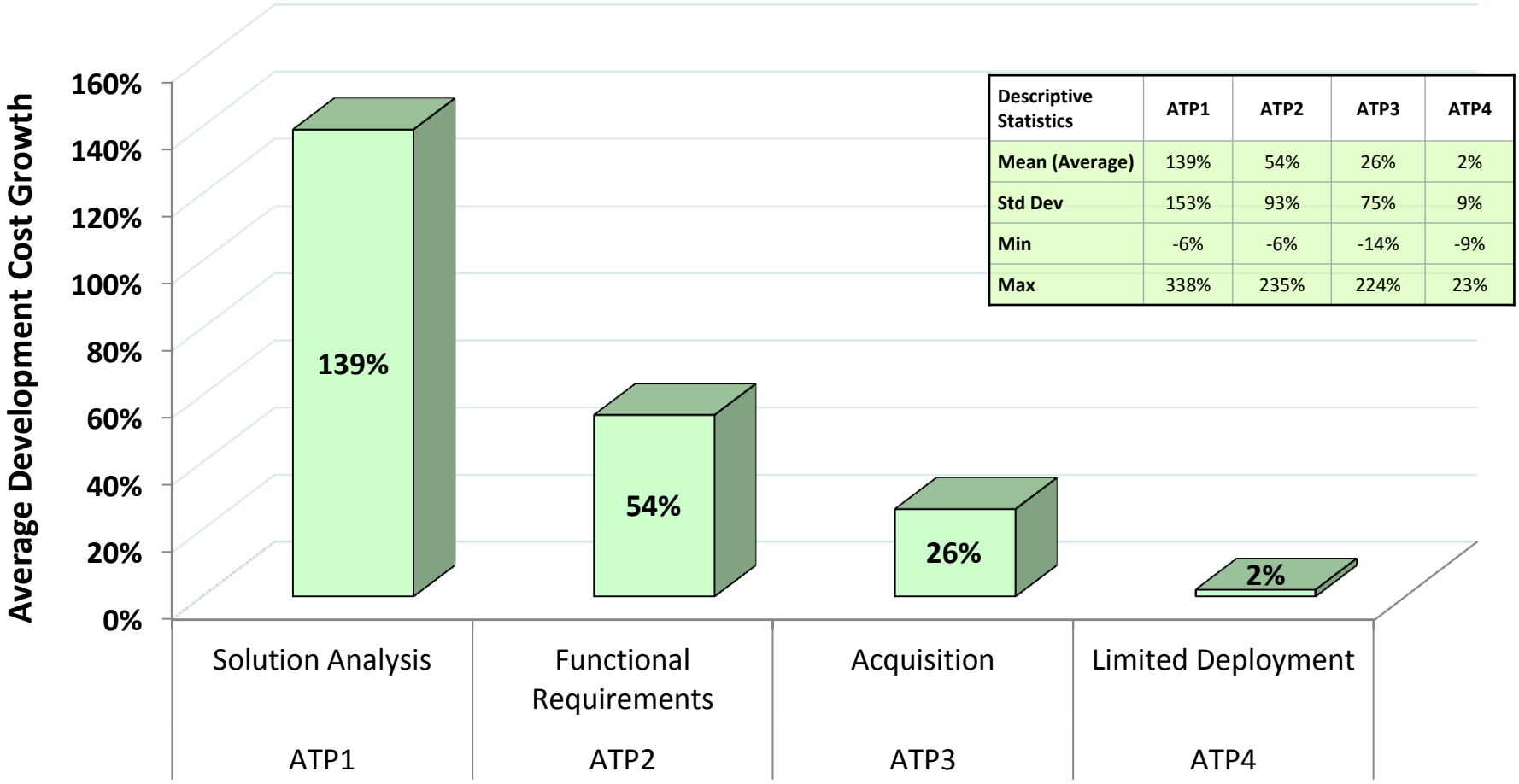
Milestones			
Activities			
Cost Group	**Development**	**Deployment**	
Cost Elements included	ERP Configuration/Customization Program Management Systems Engineering Change Management Training Development Development Test & Evaluation	Deployment Software Licenses Deployment Hardware Procurement	User Training Site Installation/Activation Data Conversion Execution Cut-over Interim Sustainment Operational Test & Evaluation
Key Metric:	Development Cost Growth	Procurement Cost Growth	Fielding Cost Growth

Usefulness

Use as secondary method to adjust point estimate for cost growth

Use descriptive statistics (as last resort) for defining cost risk/uncertainty bounds

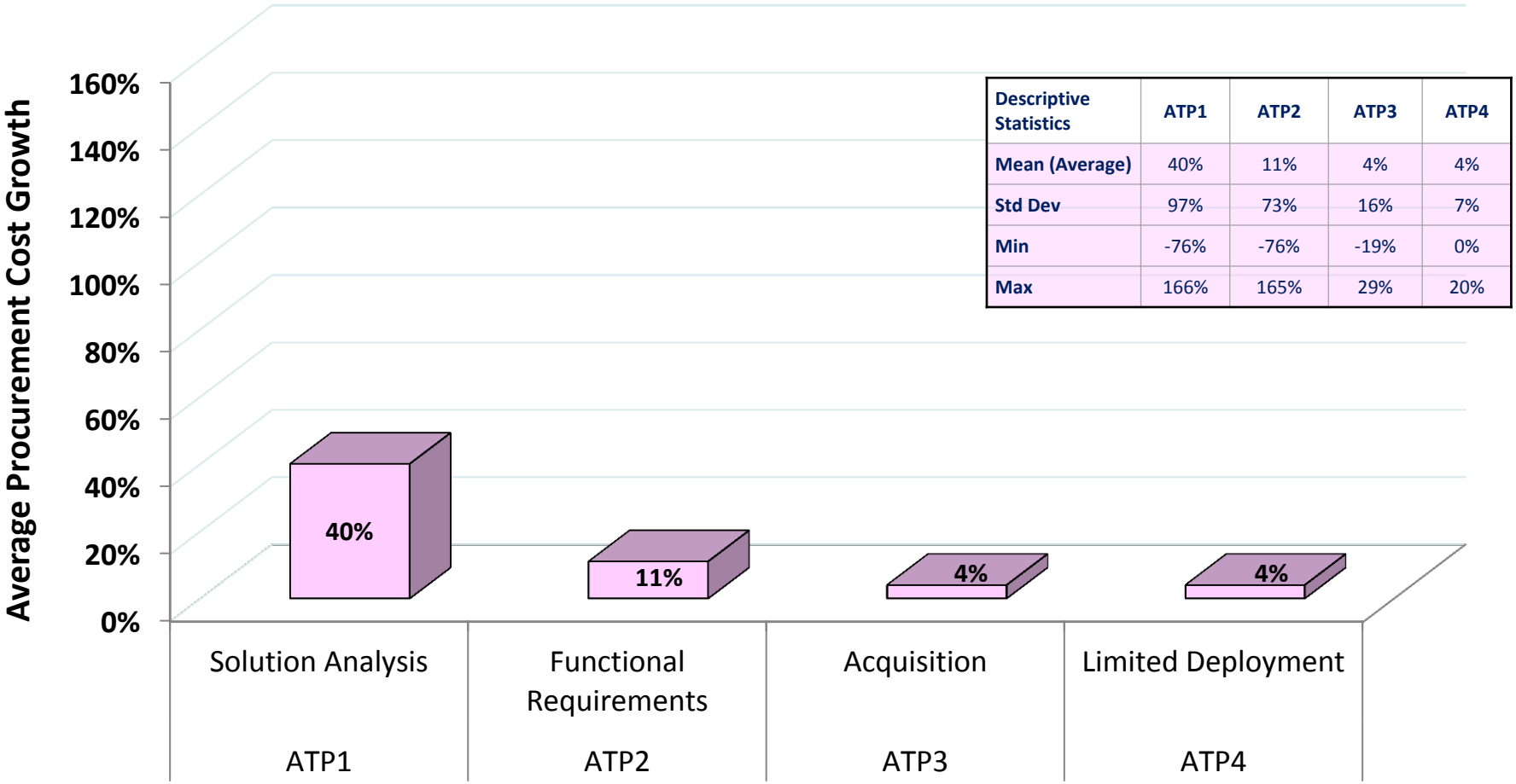
Development Cost Growth (Planned to Actual at each ATP)



Descriptive Statistics	ATP1	ATP2	ATP3	ATP4
Mean (Average)	139%	54%	26%	2%
Std Dev	153%	93%	75%	9%
Min	-6%	-6%	-14%	-9%
Max	338%	235%	224%	23%

- Cost growth in ATP1 and ATP2 was primarily driven by schedule delays
- Delays were triggered by ERP software customization, including scope creep and re-work
- Schedule delays extend the “standing-Army” personnel, up to 50% of total development cost

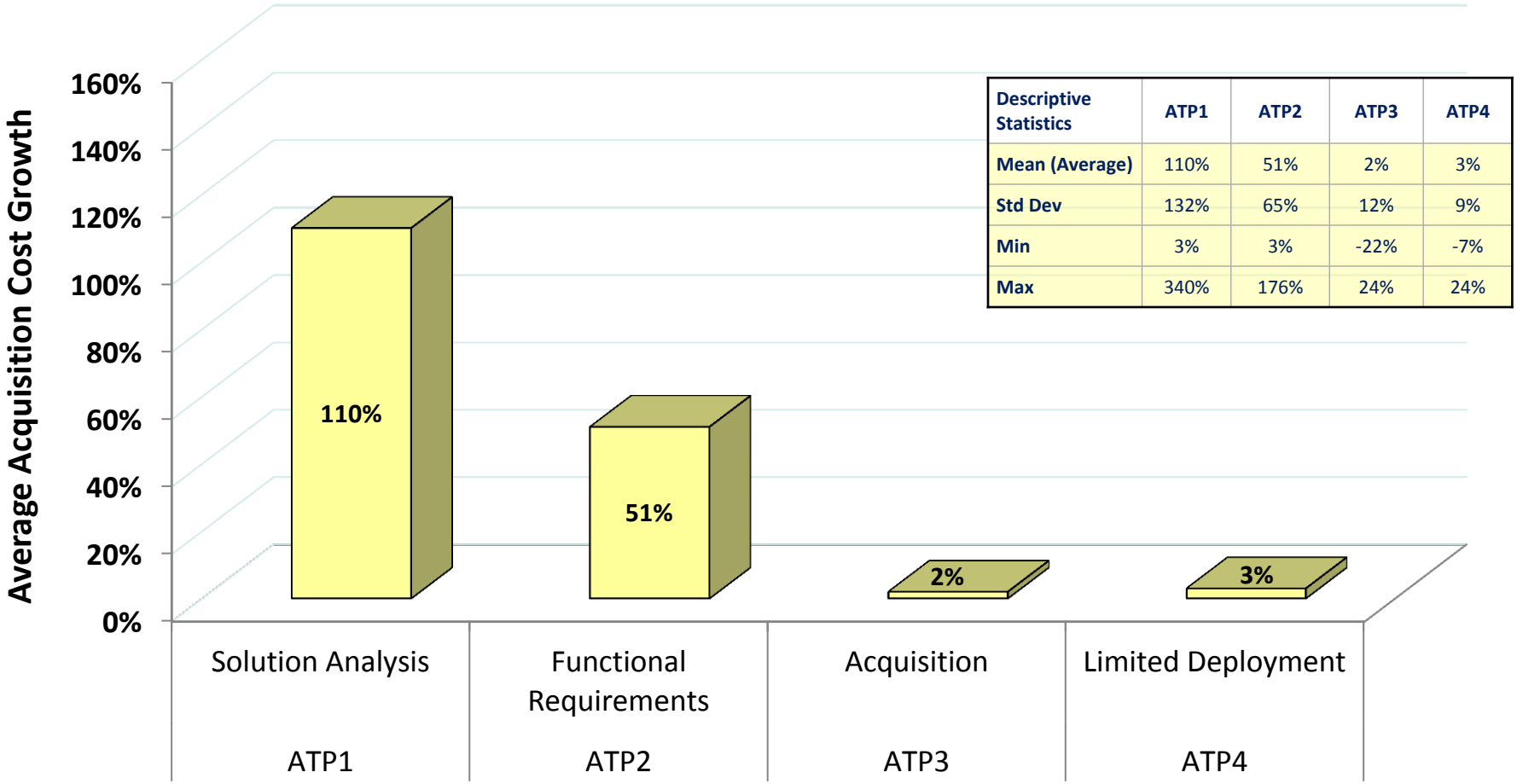
Procurement Cost Growth (Planned to Actual at each ATP)



Descriptive Statistics	ATP1	ATP2	ATP3	ATP4
Mean (Average)	40%	11%	4%	4%
Std Dev	97%	73%	16%	7%
Min	-76%	-76%	-19%	0%
Max	166%	165%	29%	20%

Lower procurement cost volatility due to stable user counts and negotiated license fees

Acquisition Cost Growth (Planned to Actual at each ATP)



Descriptive Statistics	ATP1	ATP2	ATP3	ATP4
Mean (Average)	110%	51%	2%	3%
Std Dev	132%	65%	12%	9%
Min	3%	3%	-22%	-7%
Max	340%	176%	24%	24%

Acquisition Cost includes Development, Procurement and Fielding costs

Reasons for Cost Growth

1. Failure to implement Business Process Reengineering (BPR) best practices: Difficult to change business processes / culture to exploit ERP strengths.

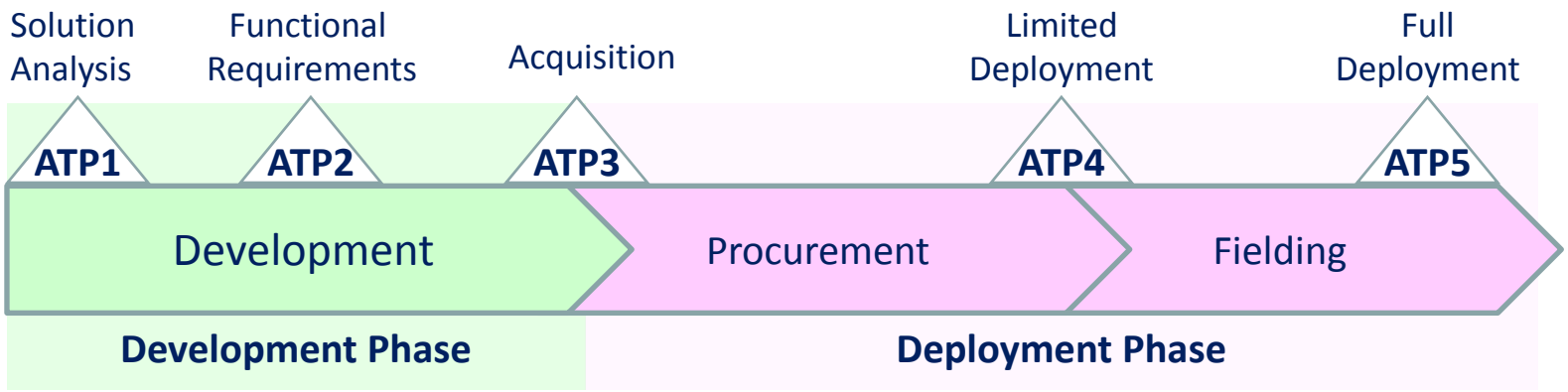
2. Engineering: Inexperience with Oracle/SAP customization and configuration led to scope and requirements growth.

3. Estimation: Optimistic acquisition planning contributed to underestimation of both effort and duration at Solution Analysis ATP.

4. Schedule: Limited budgets forced delays and extended fixed staffing cost; not meeting user expectations generated unanticipated rework.

Schedule Growth

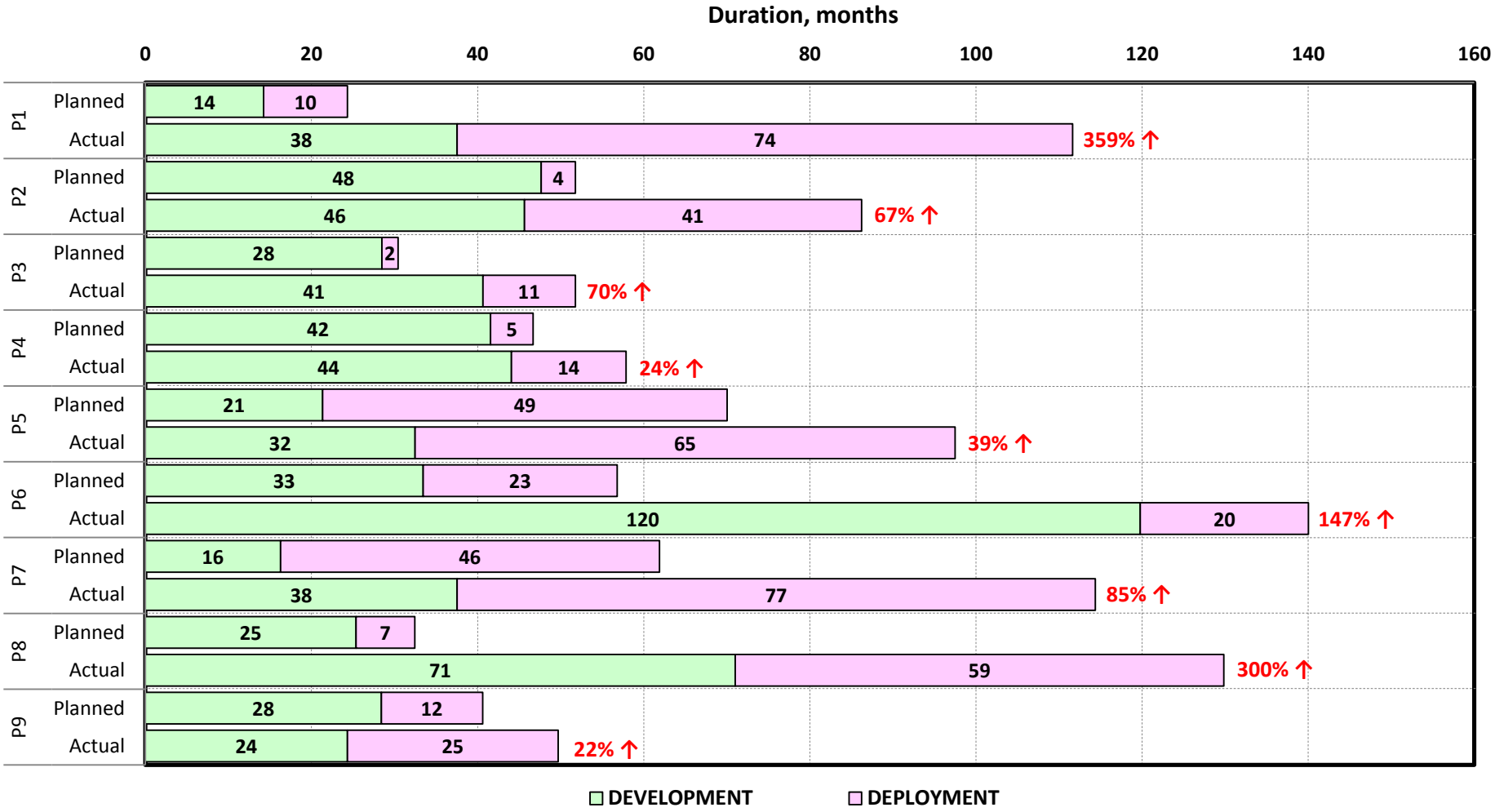
Schedule Growth Overview



Key Schedule metrics:	Program Length (in months)	Program Length (in months)
What does this measure?	Actual vs Planned Duration (at ATP1 or ATP2)	Actual vs Planned Duration (at ATP4 or ATP5)
Usefulness	**To adjust deployment duration using the schedule growth factors** **For defining schedule risk/uncertainty bound**	

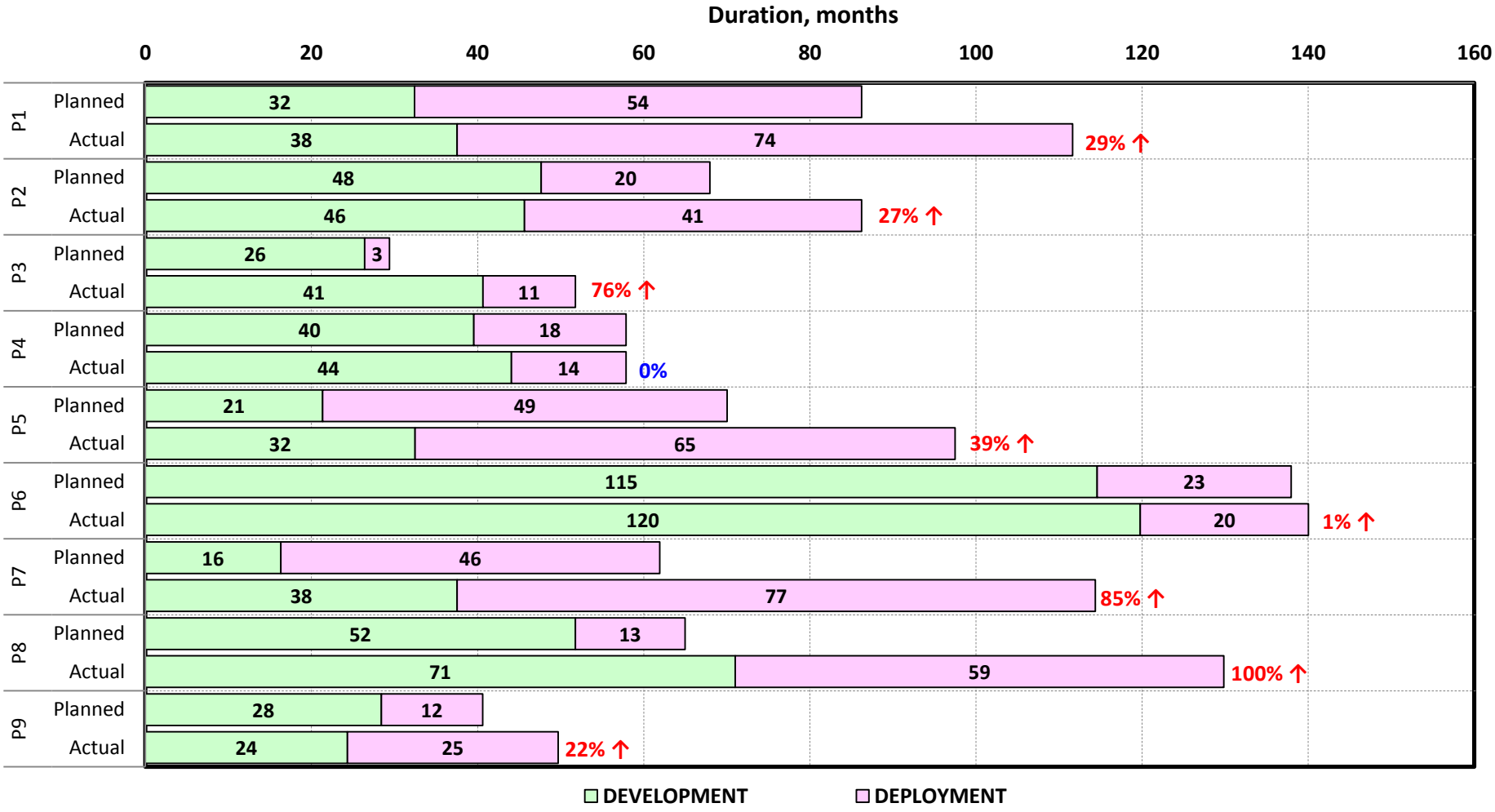
ERP Program Duration at Solution Analysis ATP

(Actual vs Planned Schedule)



Deployed ERP programs have slipped an average of 47 months from the original schedule, ranging between 9 to 97 months

ERP Program Duration at Functional Requirements ATP (Actual vs Planned Schedule)



At Functional Requirements ATP, deployed ERP programs experienced an average of 25 months schedule slip. Schedule slip is lower than at Solution Analysis ATP as scope is better defined/identified.

Reasons for Schedule Growth

1. Premature fielding: Failing to meet user expectations generated unanticipated rework.

2. Developmental Testing: Significant system deficiencies to fix before fielding.

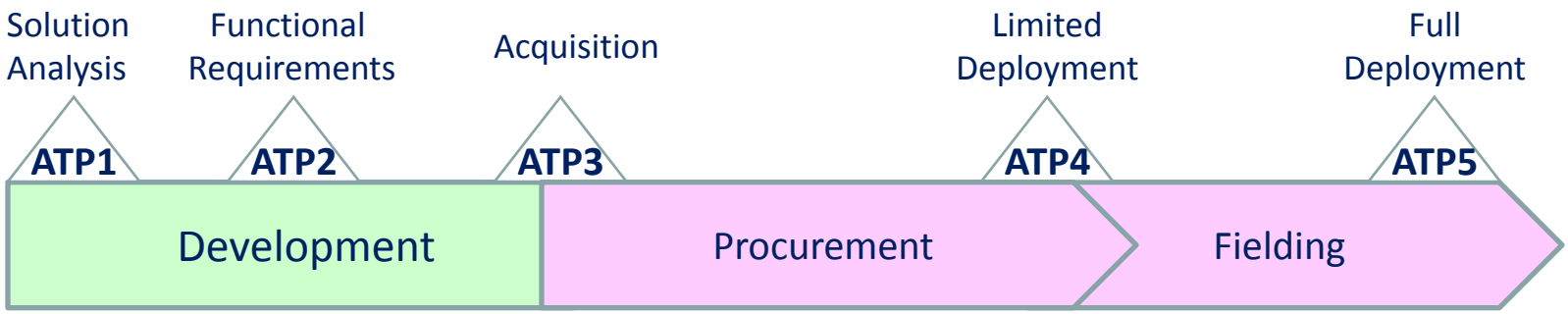
3. Engineering: Inexperience with Oracle/SAP Configuration and Customization led to underestimation of delivery timeline. Difficulty changing business processes to exploit ERP.

4. Quantity: War-fighter needs led some program offices to reassess user and implementation requirements.

5. Schedule Uncertainty Analysis: Recommended now, but in the past, Program Office's optimistic schedule was a ground rule.

Cost Benchmarks

Cost Factors Overview

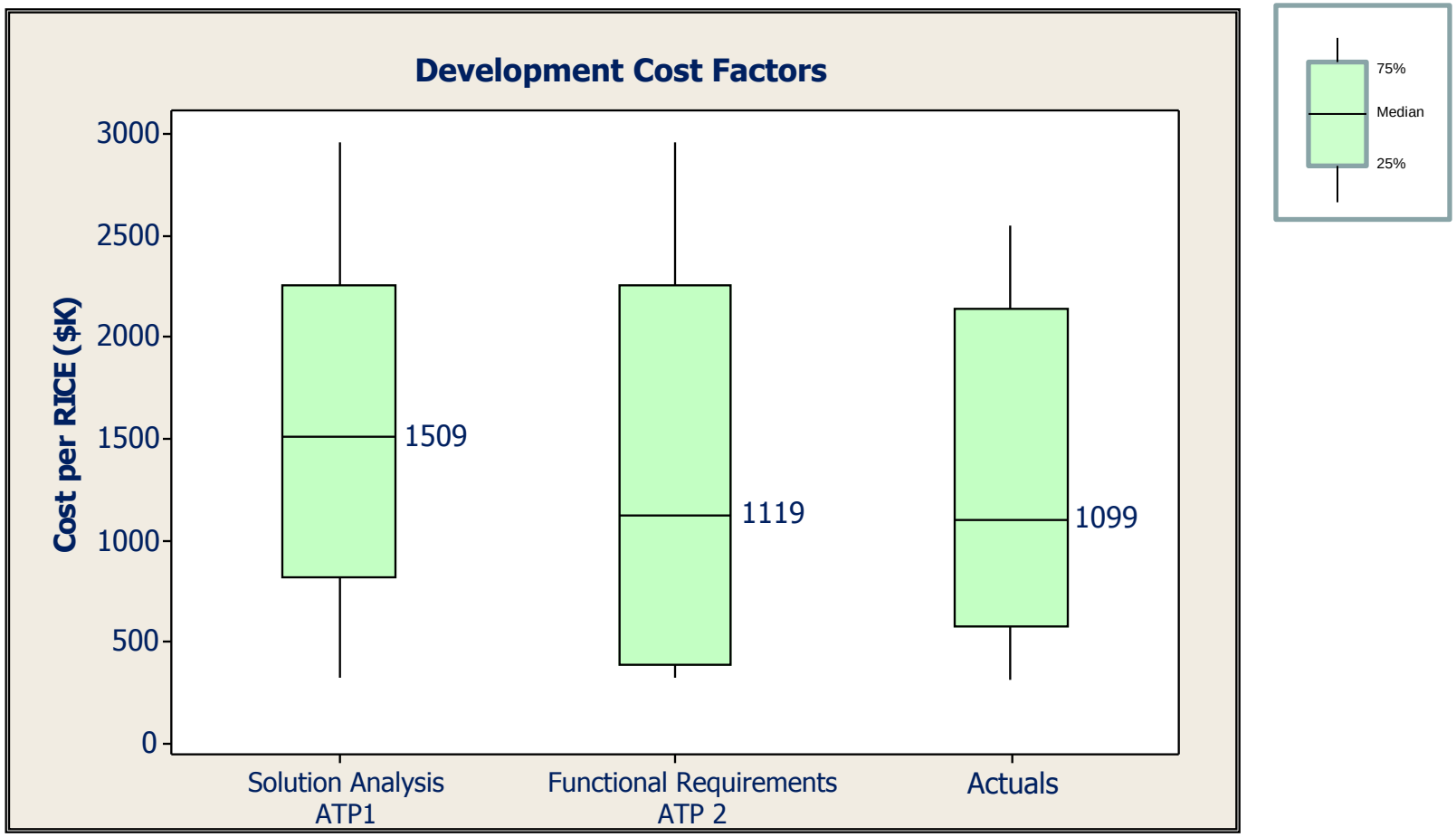


Activities			
Cost Elements	Design/ Configuration/Customization Program Management Systems Engineering Change Management Training Development Development Test & Evaluation	Deployment Software Licenses Deployment Hardware Procurement	User Training Site Installation/Activation Data Conversion Execution Cut-over Interim Sustainment Operational Test & Evaluation
Key Cost metrics:	Development Cost per RICE* Development Cost per Requirement	Procurement Cost per User	Fielding Cost per User
What this measures?	Volume of development work units addressed by a number of either RICE or requirement	IT Hardware and Software License Costs addressed by a number of users	Volume of deployment & fielding work units addressed by a number of users
Rationale for metric	Interfaces and requirements often available at Solution Analysis ATP RICE often available at Functional Requirements ATP	Number of users are available at early ATP and tends to be stable throughout life cycle	Number of users are available at early ATP and tends to be stable throughout life cycle

Authority to Proceed (ATP) are “milestone-like events”

*RICE = reports, interfaces, conversions, and extensions of software objects

Development Cost per RICE

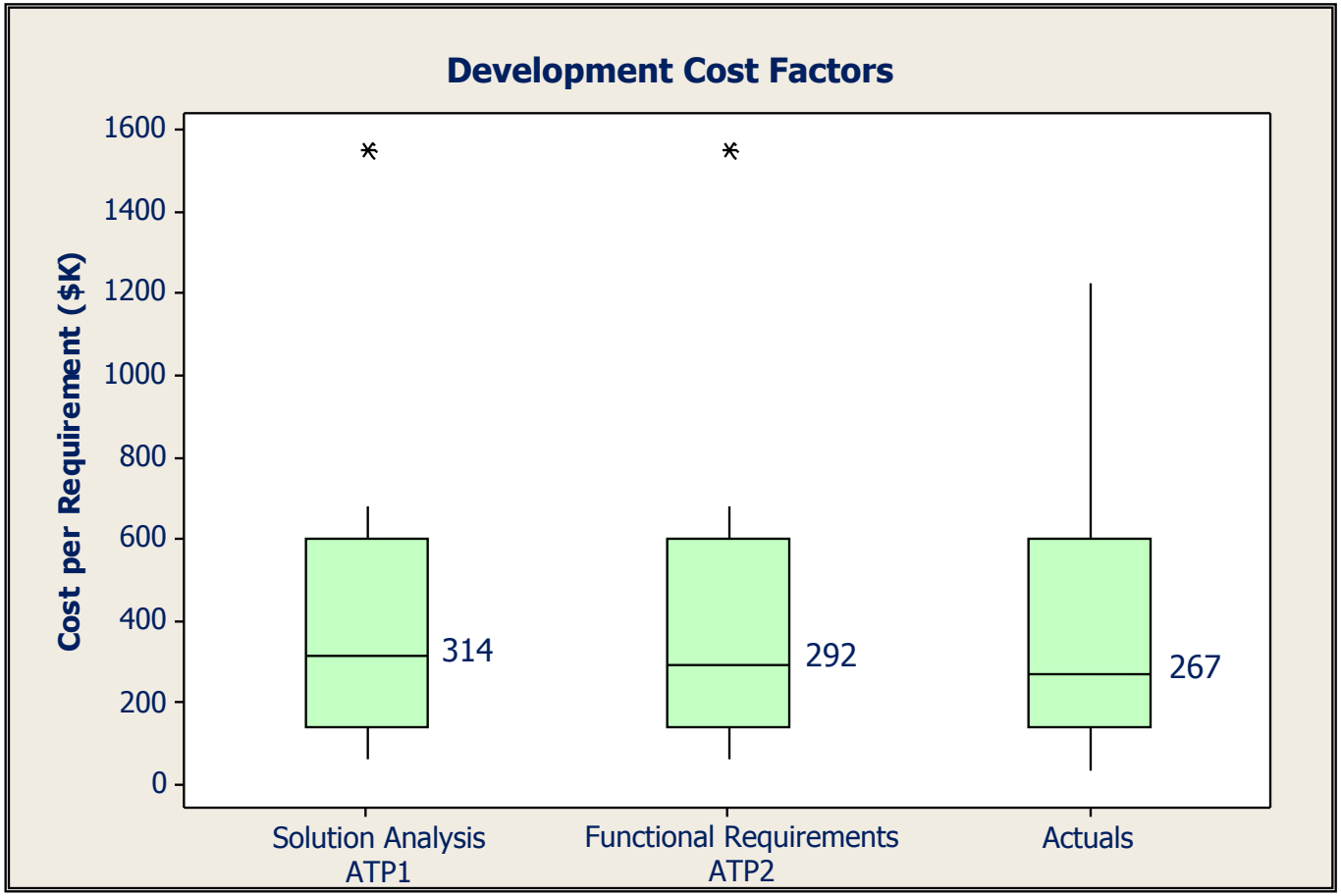


Formula:

$$Development\ Cost\ Factor\ = \frac{(Cost)_{FD}}{(RICE)_{ATP1}} \quad \frac{(Cost)_{FD}}{(RICE)_{ATP2}} \quad \frac{(Cost)_{FD}}{(RICE)_{FD}}$$

$COST_{FD}$ = Actual Development Cost at FD; $RICE_{ATP1}$ = Estimated RICE at ATP1; $RICE_{ATP2}$ = Estimated RICE at ATP2; $RICE_{FD}$ = Actual RICE at FD

Development Cost per Requirement

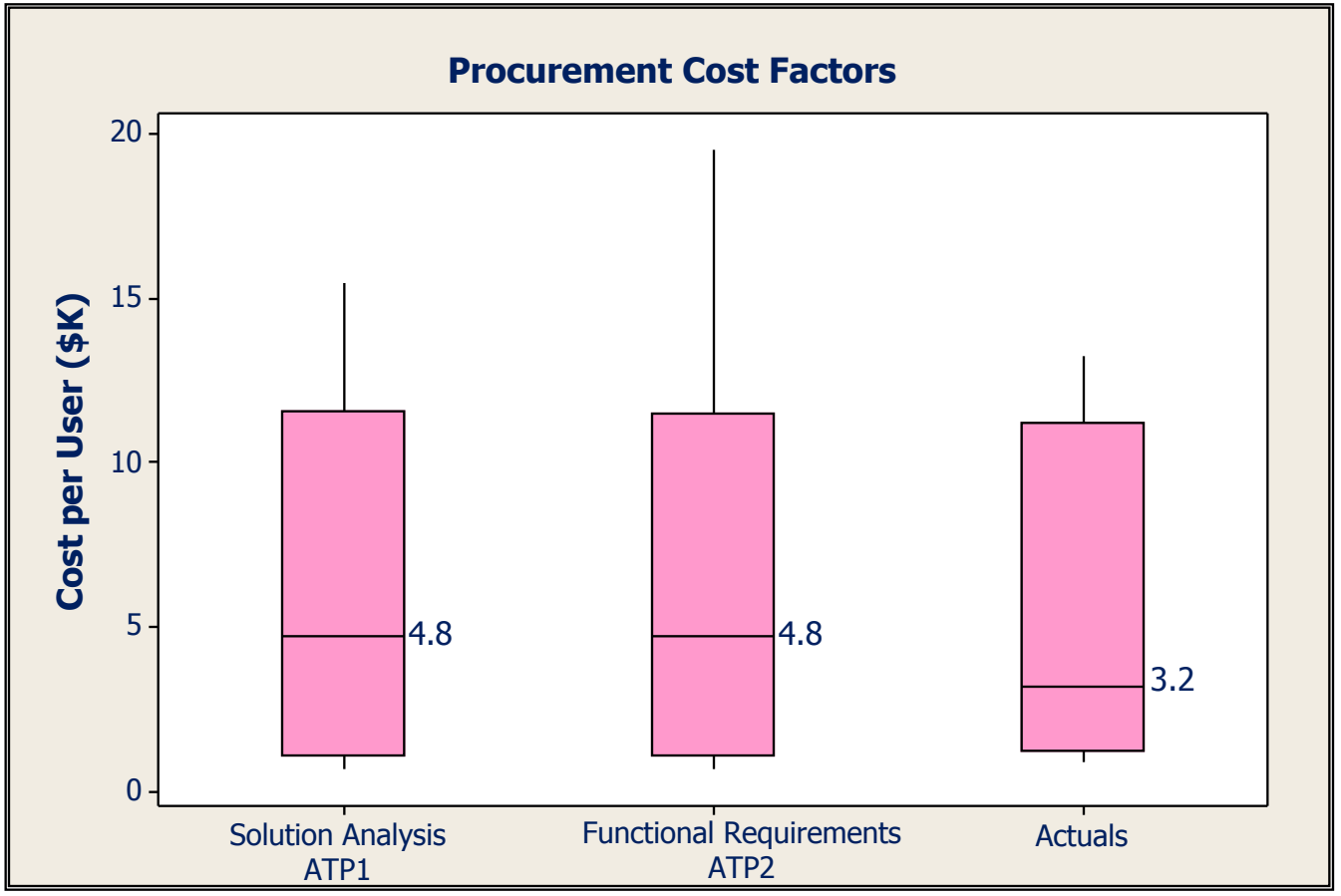


Formula:

$$Development\ Cost\ Factor\ = \quad \frac{(Cost)_{FD}}{(REQ)_{ATP1}} \qquad \frac{(Cost)_{FD}}{(REQ)_{ATP2}} \qquad \frac{(Cost)_{FD}}{(REQ)_{FD}}$$

$COST_{FD}$ = Actual Development Cost at FD; REQ_{ATP1} = Estimated Requirements at ATP1; REQ_{ATP2} = Estimated Requirements at APT2; REQ_{FD} = Actual Requirements at FD

Procurement Cost per User



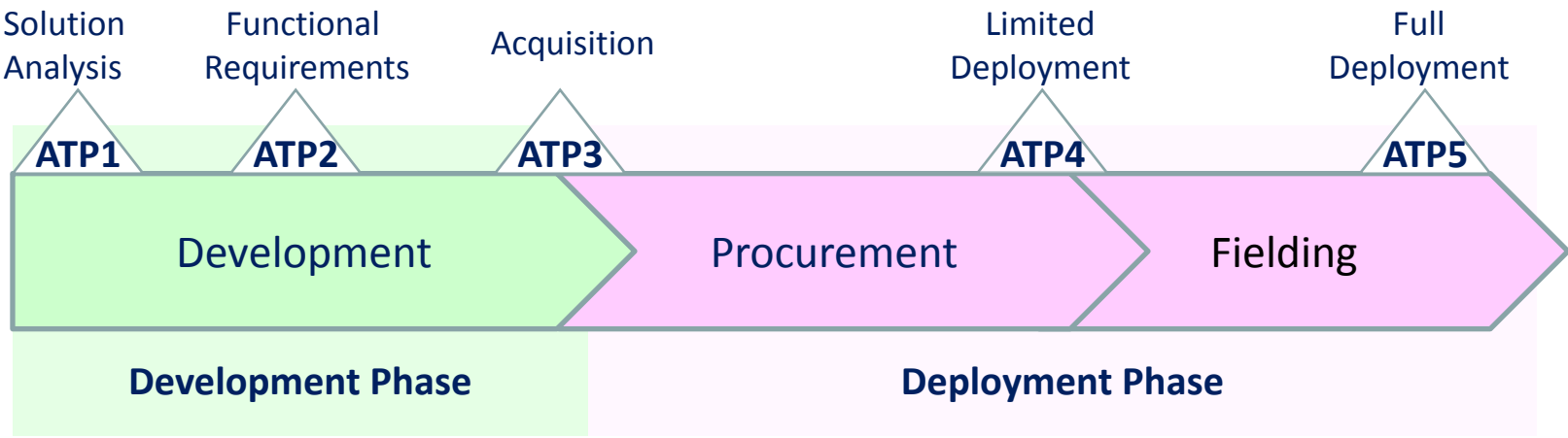
Formula:

$$Procurement\ Cost\ Factor\ = \quad \frac{(Cost)_{FD}}{(User)_{ATP1}} \qquad \frac{(Cost)_{FD}}{(User)_{ATP2}} \qquad \frac{(Cost)_{FD}}{(User)_{FD}}$$

$COST_{FD}$ = Actual Procurement Cost at FD; $USER_{ATP1}$ = Estimated users at ATP2; $USER_{ATP2}$ = Estimated users at ATP2; $USER_{FD}$ = Actual users at Full Deployment

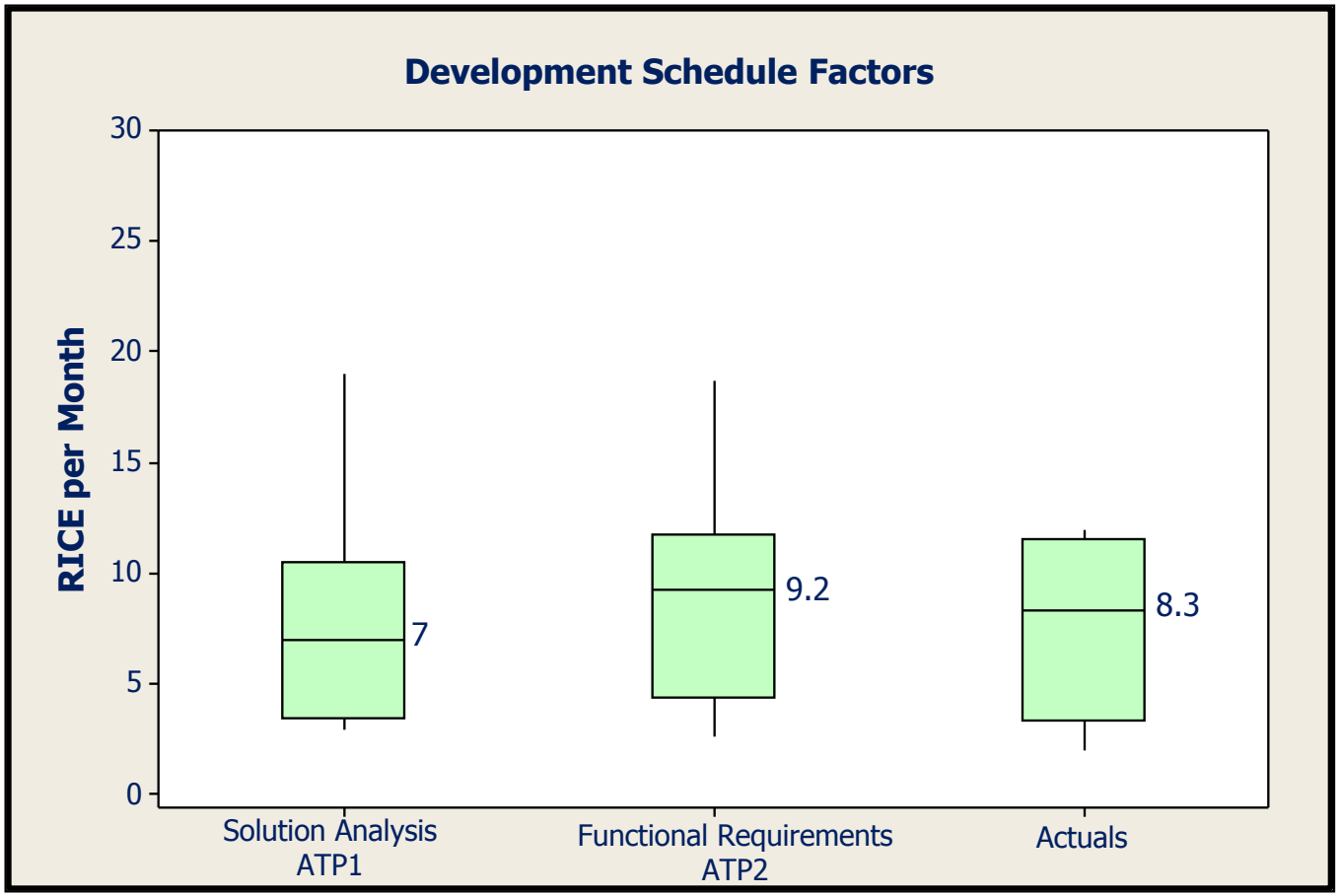
Schedule Benchmarks

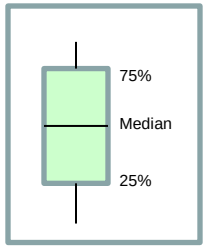
Schedule Factors Overview



Key Schedule metrics:	RICE per Month Requirements per Month	Users per Month
What this measures?	Development phase duration using number of RICE or requirements	Deployment phase duration based on the number of users
Rationale for metric	Interfaces and requirements often available at Solution Analysis ATP RICE often available at Functional requirements ATP	Number of users often available at Solution Analysis ATP Percent change in user count is very low throughout FD

RICE per Development Months



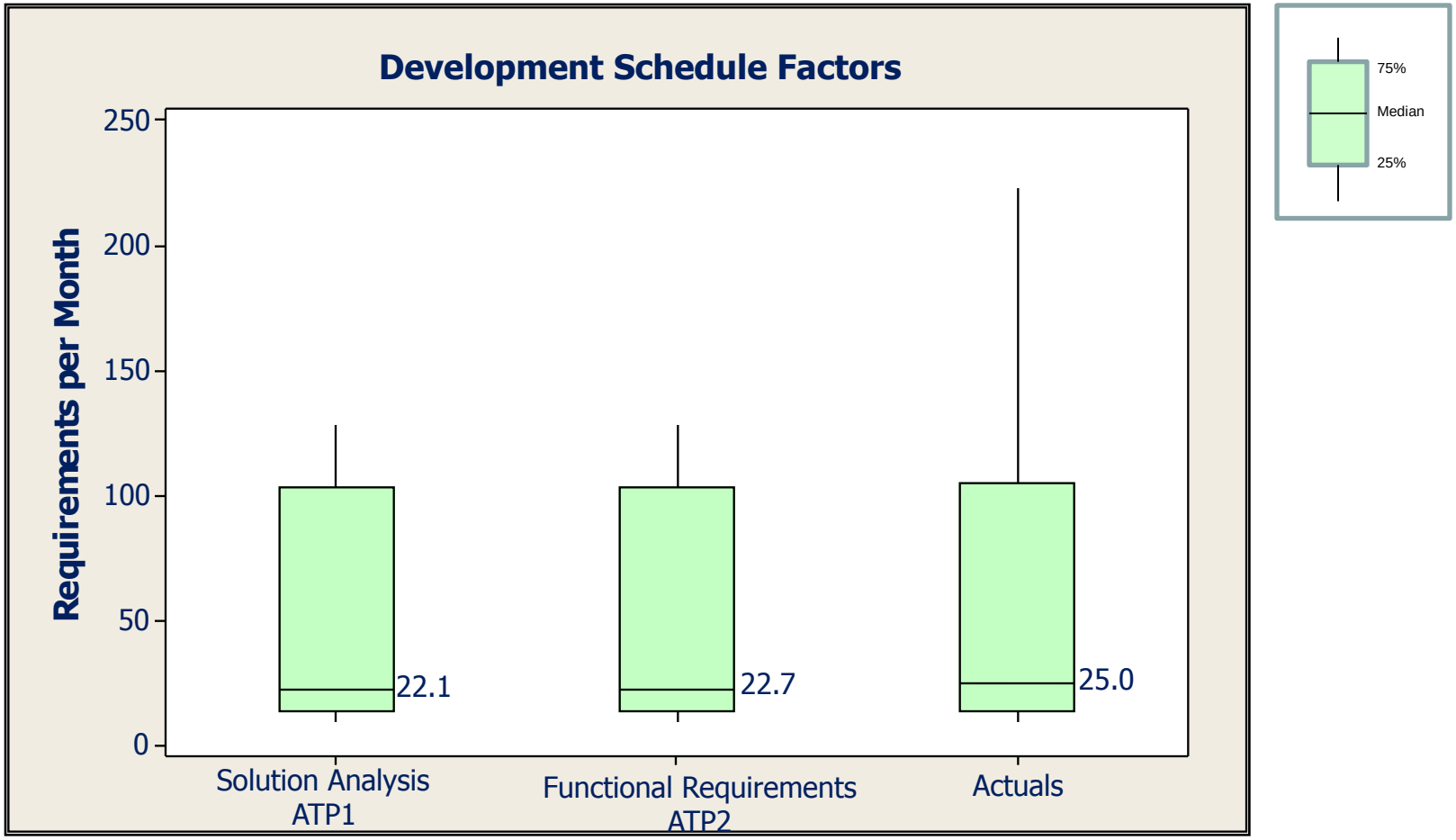


Formula:

$$Development\ Schedule\ Factor\ = \frac{(RICE)_{ATP1}}{(Month)_{FD}} \quad \frac{(RICE)_{ATP2}}{(Month)_{FD}} \quad \frac{(RICE)_{FD}}{(Month)_{FD}}$$

$MONTH_{FD}$ = Actual Development Duration at FD; $RICE_{ATP1}$ = Estimated RICE at ATP1; $RICE_{ATP2}$ = Estimated RICE at ATP2; $RICE_{FD}$ = Actual RICE at Full Deployment

Requirements per Development Months

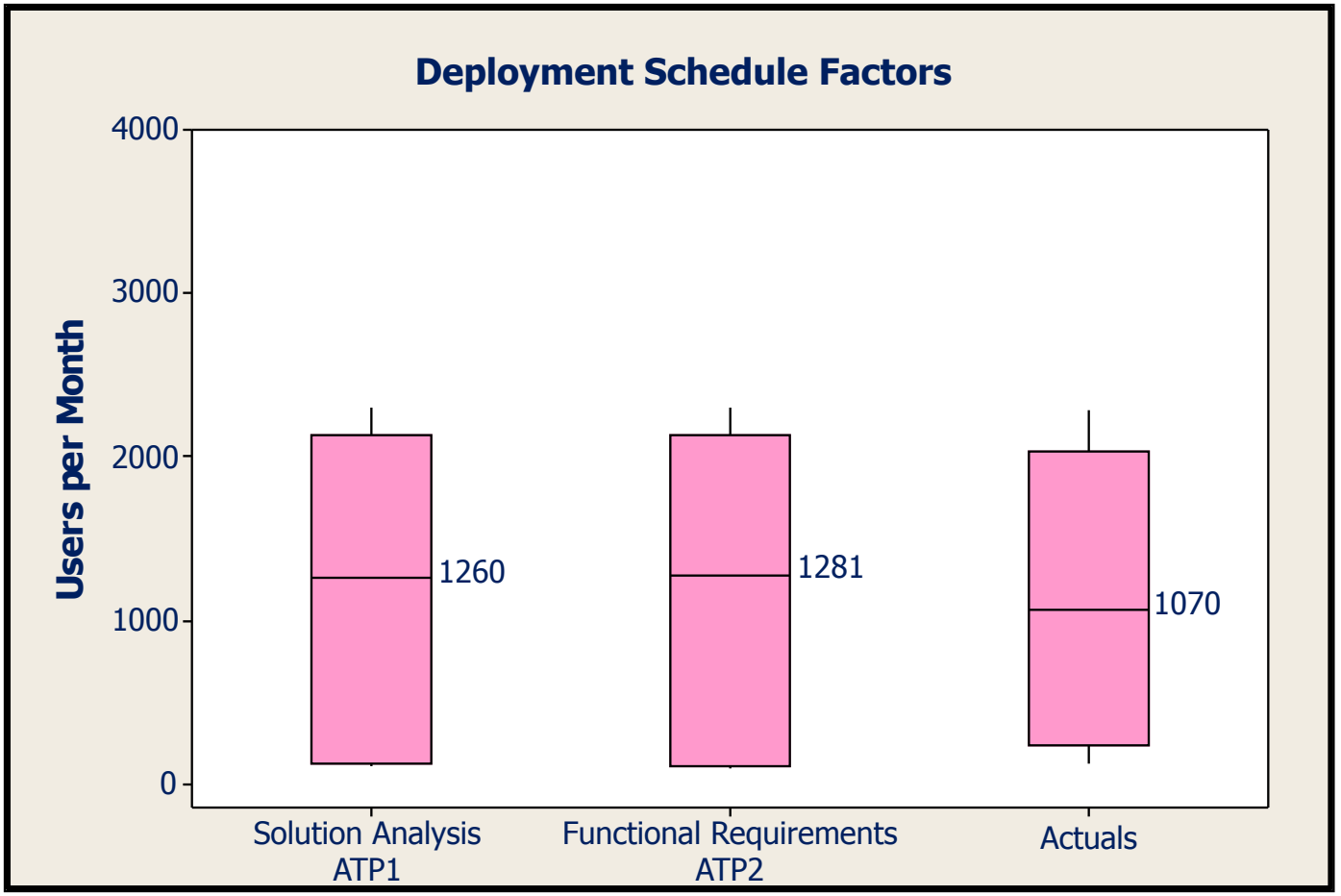


Formula:

$$Development\ Schedule\ Factor = \frac{(REQ)_{ATP1}}{(Month)_{FD}} \quad \frac{(REQ)_{ATP2}}{(Month)_{FD}} \quad \frac{(REQ)_{FD}}{(Month)_{FD}}$$

$MONTH_{FD}$ = Actual Development Duration at FD; REQ_{ATP1} = Estimated requirements at ATP1; REQ_{ATP2} = Estimated requirements at ATP2; REQ_{FD} = Actual requirements at FD

Users per Deployment Months



Formula:

$$Deployment\ Schedule\ Factor = \frac{(USER)_{ATP1}}{(Month)_{FD}} \quad \frac{(USER)_{ATP2}}{(Month)_{FD}} \quad \frac{(USER)_{FD}}{(Month)_{FD}}$$

$MONTH_{FD}$ = Actual Deployment Duration at FD; $USER_{ATP1}$ = Estimated users at ATP1; $USER_{ATP2}$ = Estimated users at ATP2; $USER_{FD}$ = Actual requirements at FD

Conclusion

Primary Findings

- All major deployed ERP programs in DoD experienced cost and schedule growth from initial estimates
  - Actual data suggests cost and duration are always underestimated at ATP1 and ATP2
- Cost and schedule overruns were each over 100% from Solution Analysis ATP
- Most ERP programs exceeded five years guideline to limited deployment
- Deployment Schedule overruns were greater than Development overruns

Lessons Learned

- Adjust your point estimate for growth, as all ERP programs have exceeded original estimates, account for the uncertainty
- Add growth according to the program's maturity
- Cost factors should be developed using initial size estimates to minimize estimating error and account for growth
- Cost analysts should add uncertainty to schedule as it is the primary contributor to cost overruns

QUESTIONS?

Thank you for your attention