Effectiveness of Competitive Prototyping and Preliminary Design Review Prior to Milestone B

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Cyclic Use of Prototyping

- Pre - WW II

- "Fly-Before-Buy"

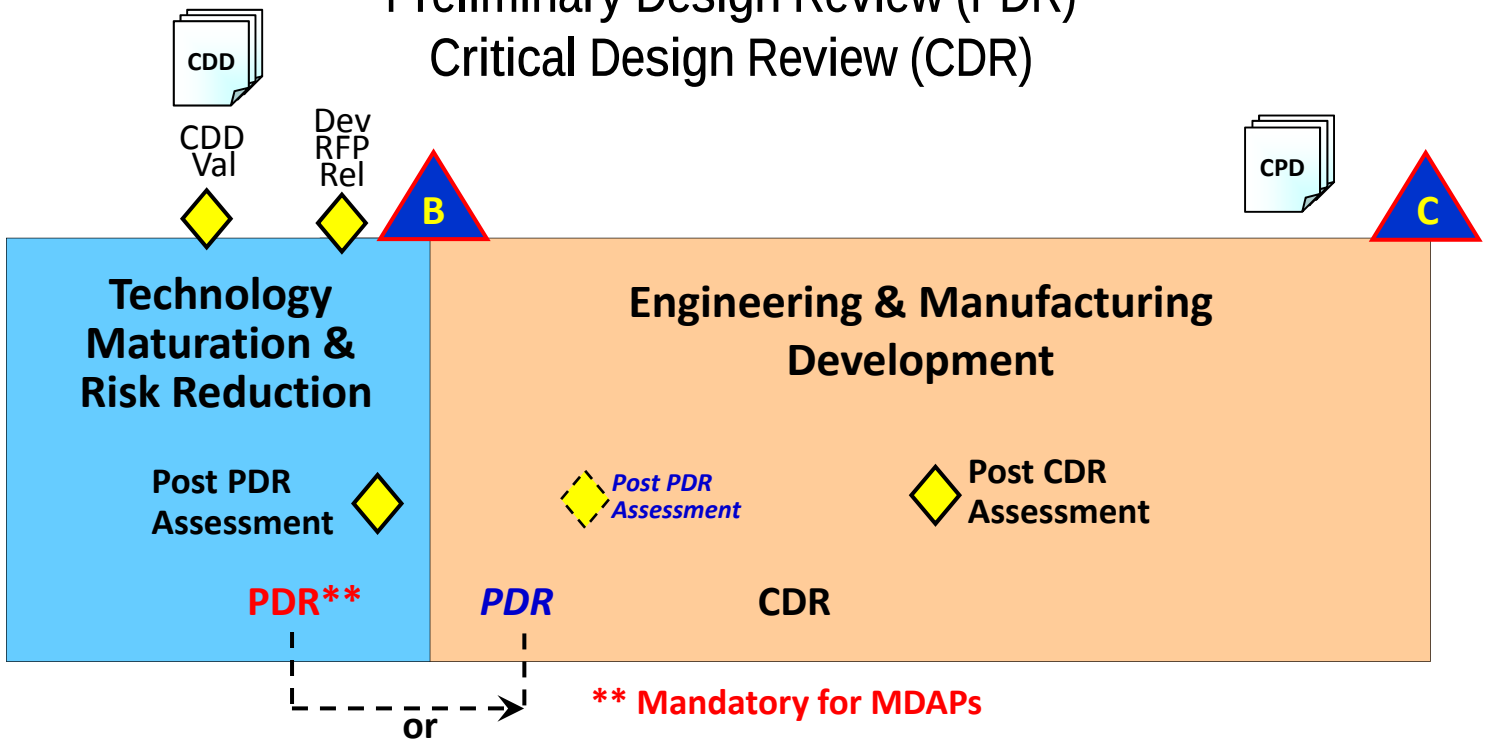
- Packard Commission

Weapons System Acquisition Reform Act of 2009 and Prototyping

- Competitive prototyping of *systems or critical subsystems* before Milestone B approval
- If competitive prototyping is waived by MDA, a prototype must still be produced before MS B

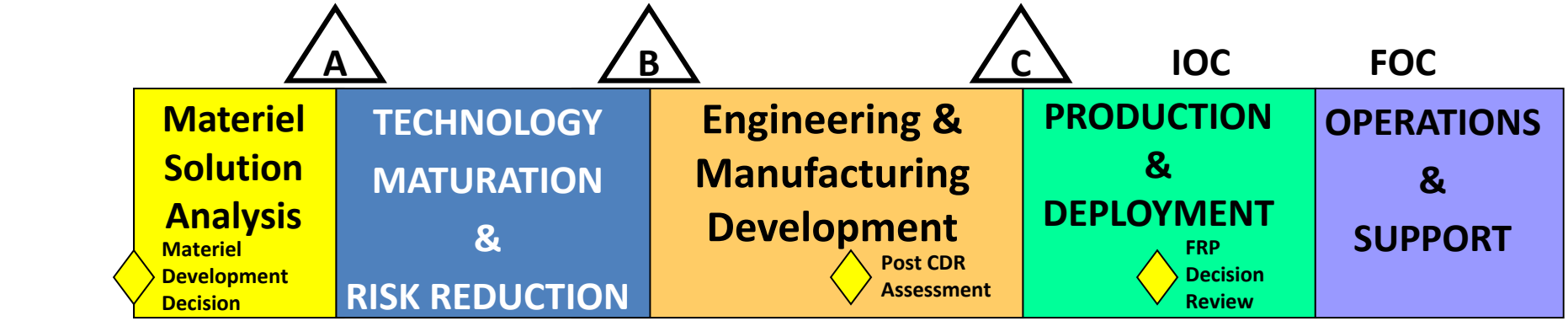
Defense **Acquisition** Management System 2013

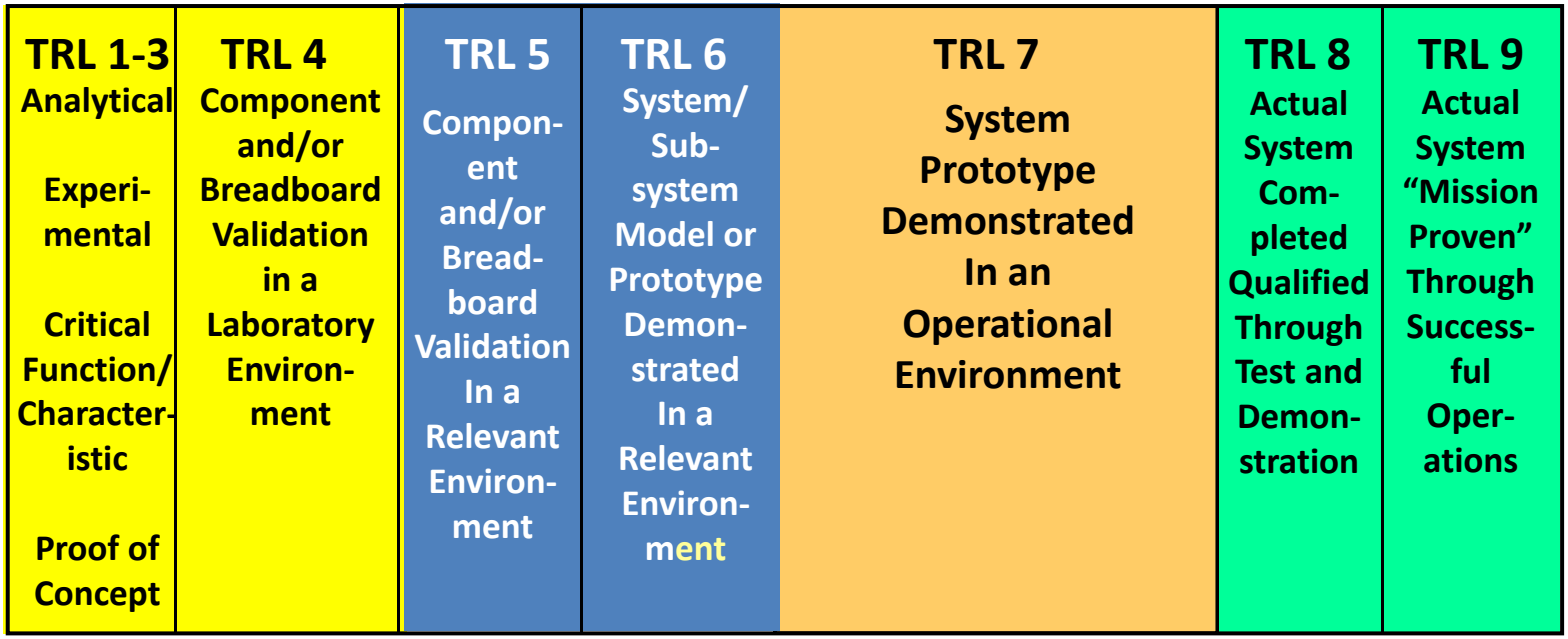
Preliminary Design Review (PDR)
Critical Design Review (CDR)



PDR Before Milestone B	PDR After Milestone B
• Planned for in Acquisition Strategy • PDR Report provided to MDA at MS B • Includes recommended requirements trades resulting from prototyping and critical technology demonstrations • Mandatory for MDAPs and DASD(SE) participates	• Planned for in Acquisition Strategy • PDR Report provided to MDA prior to Post PDR Assessment • Reflects requirements trades • At Post PDR Assessment, MDA considers PDR report; determines action(s) required to achieve APB objectives and issues ADM

Technology and Manufacturing Readiness Levels





Technology Readiness Levels

Defense Acquisition Guidebook para. 10.5.2

Section 2366b of Title 10, United States Code, requires certification that the technology in the program has been "demonstrated in a relevant environment" prior to Milestone B. (This is interpreted as TRL 6.)

Joint Lightweight Tactical Vehicle (JLTV)

USA / USMC	**BAE Systems**	**AM General/GDLS**	**Lockheed Martin**
Contract Type	Various	Various	CPFF
TD Contract Costs	$62.9 M	$61.3 M	$53.4 M
Requirements	CDD, 15 March 2012		
TMRR Phase	27 months		
Prelim Design Rev	June - July 2009		
TRL (at MS B)	5 (underbody) / TD protoypes built on assembly line		

Littoral Combat Ship (LCS)

USN	General Dynamics	Lockheed Martin
Contract Type	FPI	FPI
TD Contract Costs	$575 M	$537 M
Requirements	validated CDD, June 2008; 10 KPPs	
TMRR Phase	72 months	
Preliminary Design Review	July 2003 (prior to MS A)	
TRL (at MS B)	? (integration w/mission packages) / 9 (seaframe)	

Small Diameter Bomb (SDB) II

USAF / USN	**Boeing / Lockheed**	**Raytheon**
Contract Type	CPFF	CPFF
TD Contract Costs	$161.4 M	$161.4 M
Requirements	validated CDD, June 2009; 5 KPPs	
TMRR Phase	42 months	
Critical Design Rev	within 6 months of MS B (June 2010)	
TRL (at MS B)	6 (Program Office Estimates)	

Research Issue

Determine if DoD Instruction 5000.02 policies for Major Defense Acquisition Programs (MDAPs) relating to competitive prototyping, technology readiness, and Preliminary Design Review (PDR) prior to Milestone (MS) B are having the desired effect on program outcomes.

Research questions:

1. Does the knowledge from competitive prototyping and a PDR conducted prior to MS B result in better decisions relative to requirements, design, and resources?

2. What are the effects of the competitive prototyping, technology readiness, and PDR policies on program costs and program schedules?

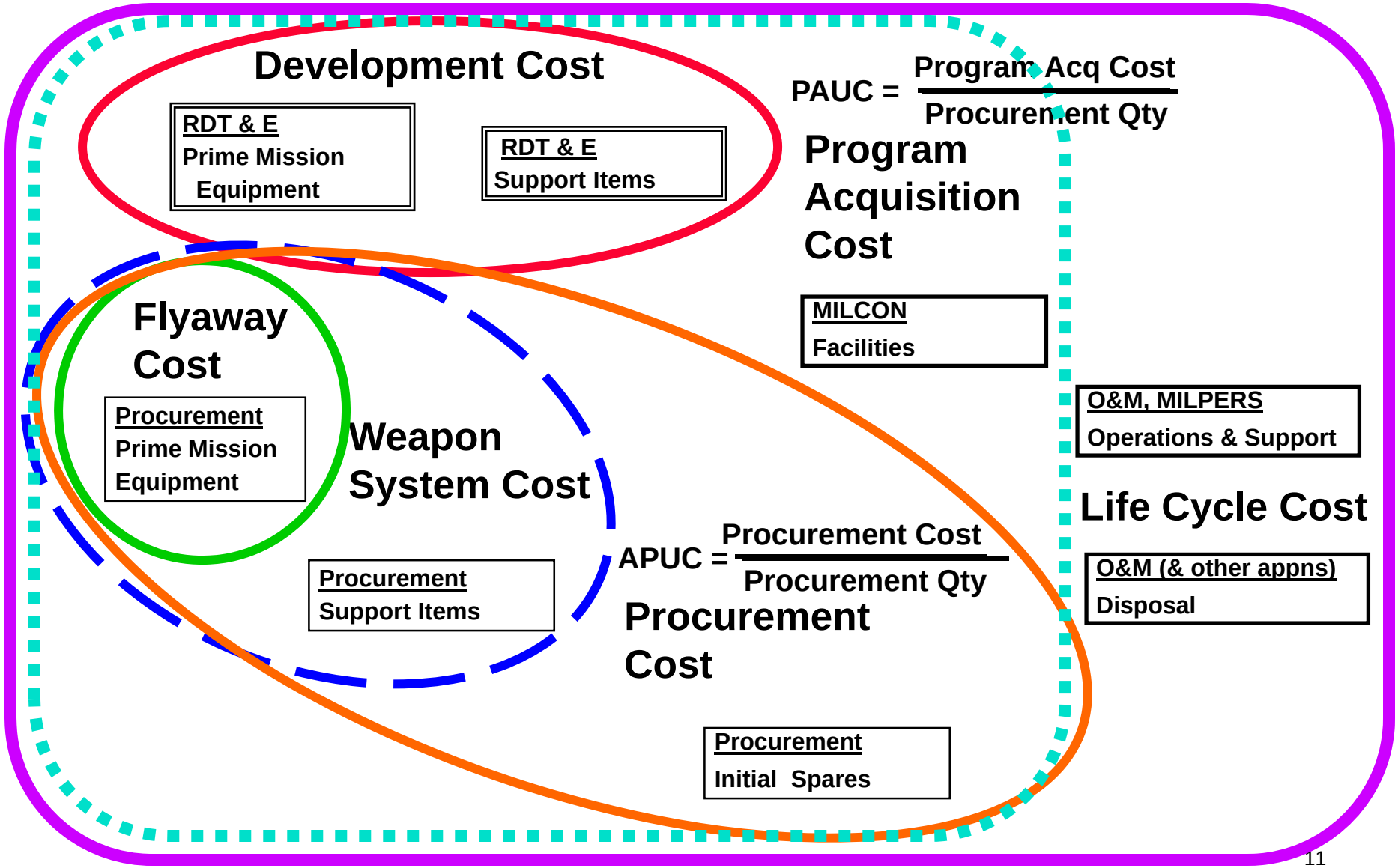
Research Methodology

- *Cost growth* was determined by comparing the original Program Acquisition Unit Cost (PAUC) with the current PAUC estimate, calculated to the same base-year dollars, as reported in the Unit Cost Report (UCR) of the annual Selected Acquisition Reports (SARs) for 2011 and 2012

- Annual SARs also identify if programs have suffered an *Acquisition Program Baseline (APB) threshold schedule breach*

- Government Accountability Office (GAO) survey data was used to identify programs that have demonstrated technology maturity on prototypes in a relevant environment (Technology Readiness Level 6) and have conducted a preliminary design review prior to Milestone B

Life Cycle Cost Composition



Research Methodology

- Descriptive statistics are used to analyze cost growth (percent change to date in PAUC) and schedule breaches for the MDAPs that *have conducted competitive prototyping and PDR activities*.

- Similar descriptive statistics are used to analyze *the balance of the MDAPs* included in a particular annual SAR submission.

- The percentage of programs that have negative cost growth (negative percent change to date in PAUC) from each population is compared. The population with the highest number of negative cost growth programs is preferred.

- The percentage of programs that suffered an APB schedule thres-hold breach from each population is compared. The population with the lowest percent of schedule breaches is preferred.

Research Results

PAUC Cost Growth Results. Based upon data from the 2011 and 2012 SAR, programs that demonstrated technology maturity on prototypes in a relevant environment (TRL 6) and conducted a preliminary design review prior to Milestone B *were more often to show negative PAUC cost growth.*

This result was seen in all DoD Components.

Research Results

Table 2. Programs Costing Less, Selected Acquisition Report, December 31, 2011

Component	Programs w/Prototypes & PDR			Balance of Programs		
	Programs Costing Less	Total Programs	Percent	Programs Costing Less	Total Programs	Percent
Army	6	7	86	3	12	25
Navy	7	15	47	6	20	30
Air Force	5	10	50	4	15	27
Def Agency	1	1	100	2	9	22
Total	**19**	**33**	**57**	**15**	**56**	**27**

Table 3. Programs Costing Less, Selected Acquisition Report, December 31, 2012

Component	Programs w/Prototypes & PDR			Balance of Programs		
	Programs Costing Less	Total Programs	Percent	Programs Costing Less	Total Programs	Percent
Army	5	8	62	4	12	33
Navy	8	18	44	4	20	20
Air Force	3	8	38	6	17	35
Def Agency	0	0	0	4	5	80
Total	**16**	**34**	**47**	**18**	**54**	**33**

Research Results

Schedule Threshold Breach Results. Based upon data from the 2011 and 2012 SAR, programs that demonstrated technology maturity on prototypes in a relevant environment (TRL 6) and conducted a preliminary design review prior to Milestone B *did not suffer fewer APB schedule threshold breaches*.

This result was seen in all DoD Components except the Air Force.

Research Results

Table 4. Program Schedule Breach, Selected Acquisition Report, December 31, 2011

Component	Programs w/Prototypes & PDR			Balance of Programs		
	Programs w/Schedule Breach	Total Programs	Percent	Programs w/Schedule Breach	Total Programs	Percent
Army	2	7	28	2	12	17
Navy	4	15	27	5	20	25
Air Force	4	10	40	6	15	40
Def Agency	1	1	100	4	9	44
Total	**11**	**33**	**33**	**17**	**56**	**30**

Table 5. Program Schedule Breach, Selected Acquisition Report, December 31, 2012

Component	Programs w/Prototypes & PDR			Balance of Programs		
	Programs w/Schedule Breach	Total Programs	Percent	Programs w/Schedule Breach	Total Programs	Percent
Army	3	8	38	4	12	33
Navy	6	18	33	3	20	15
Air Force	2	8	25	7	17	41
Def Agency	0	0	0	0	5	0
Total	**11**	**34**	**30**	**14**	**54**	**26**

Future Research

- To remove some of the uncertainty in the cost growth metric, compare PAUC based upon the original cost estimate with actual PAUC. Actual PAUC can be determined from contracts found in the Defense Cost and Resource Center (DCARC) database.

- To remove some of the uncertainty in the schedule slippage metric, compare the original schedule estimate with actual schedule performance data. Actual schedule performance data for this comparison should be available in the DCARC database or Defense Acquisition Management Information Retrieval (DAMIR).

- Finally, the challenge in using cost growth and schedule slippage metrics is to tie them back to the use of competitive prototyping (to reveal technology readiness) and the use of an early PDR. The knowledge from these activities and how that knowledge is applied will tell us whether these policies have had an effect. To that end, more detailed surveys, such as those conducted annually on selected weapon systems by the GAO, will aid in helping establish the cause-effect relationship between policy and program outcomes.