

**Awarded
Best Paper
on**



Acquisition Reform - 1998 Joint Conference, Toronto, Canada*

A Related paper won Best Paper at ISPA SCEA 1999 Joint Conference - San Antonio, TX

Total Ownership Cost (TOC) & Cost As an Independent Variable (CAIV) and their Relationship to Target Costing

**TOC/CAIV Workshop 99-3
4 November 1999
R. L. Coleman**

Outline

- **CAIV & TOC descriptions and characteristics**
- **DoN*'s (et al) TOC & CAIV policies**
- **DoN Initiatives**
- **CAIV and Target Cost (TC)**
- **TOC & CAIV tools**
- **Related short subjects**
- **Conclusion**

***Department of the Navy**



FAQs We Will Answer

Including some questions you didn't even know to ask

- **TOC & CAIV** *
- What is the difference?
- What are the relationships?
- How do they relate to *other* topics in acquisition?
- **TOC Costs**
- What costs must we include?
- How can we determine them?
- **CAIV practices and tools**
- Where can we go to flesh them out?
- And what are the proven tools? Says who?
- **What are the roles of Government and Industry?**

CAIV & TOC Policy and Background

- **USD Memo of 19 Jul 95: “Policy on Cost-Performance Trades”**
- **USD Memo of 4 Dec 95 “Cost As an Independent Variable”**
- **DoDD 5000.1 and DoDI 5000.2-R (Ch-3)**
- **USD(A&T) Memo TOC Pilot Programs dated 13 April 98**
- **SECNAV Memo CAIV Policy Guidance dated 16 April 98**
- **ASN(RD&A) Memo Implementation of TOC Baselines in the DoN dated 5 May 98**
- **SAF/AQ memo “Implementing CAIV” dated 12 March 1997**
- **OUSD(A&T) Memo of 13 Nov 98, “Definitions of TOC, LCC, and the Responsibilities of PMs”**

Details of references are in Backup

TOC & CAIV ... how do they relate, differ?

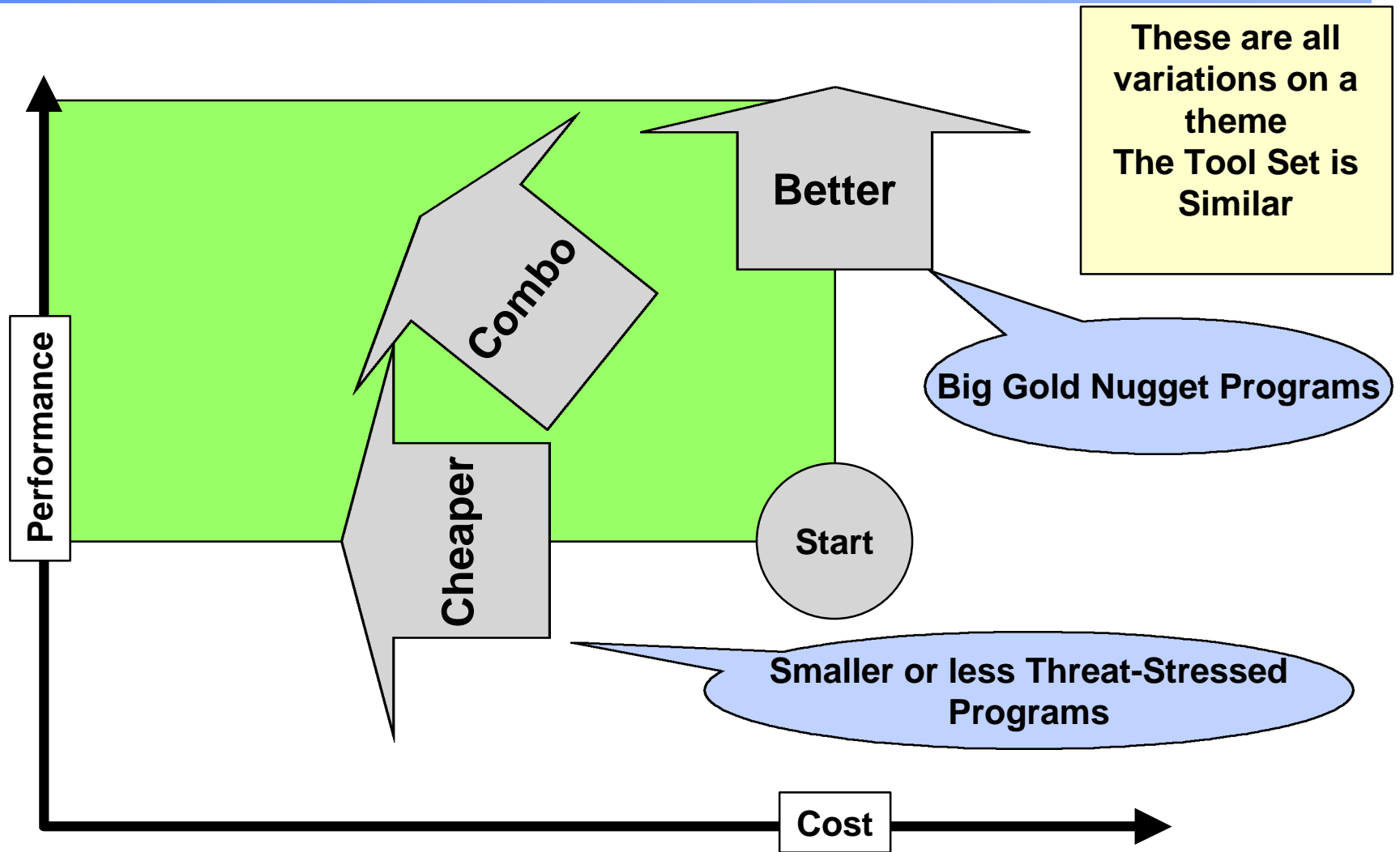
- ***CAIV is a process - a way to reduce costs***
- ***TOC is a domain - a set of costs to be reduced***
- ***TOC Reduction* is a program - a set of processes***
 - ***TOC Reduction seeks to change:***
 - ***What we acquire, usually addressed by CAIV***
 - ***How we acquire or operate a system, addressed in a number of ways, in order to reduce cost***

***“CAIV is a verb,
TOC is a noun!”***

- Bob Jones, NSWCD

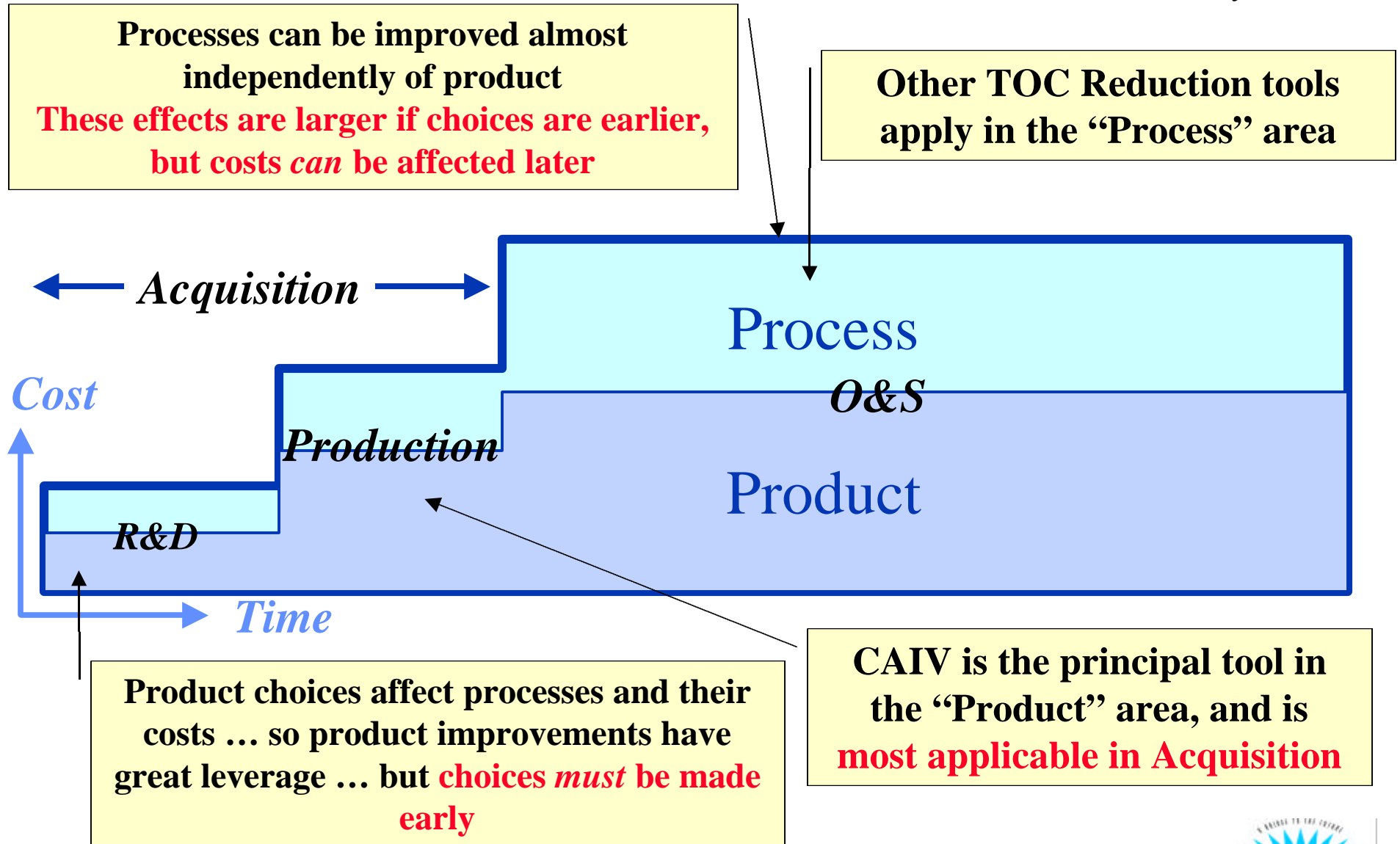
***Also Called “Reducing TOC (R-TOC)”**

The Full Spectrum of CAIV



Product, Process, TOC, CAIV & The Life Cycle

Not to scale ... it's only a cartoon!



DoD TOC Definition

DoD TOC is the sum of all financial resources necessary to organize, equip, sustain and operate military forces sufficient to meet national goals in compliance with all laws, all policies applicable to DoD, all standards in effect for readiness, safety, and quality of life, and all other official measures of performance for DoD and its Components. DoD TOC is comprised of costs to research, develop, acquire, own, operate, and dispose of weapon and support systems, other equipment and real property, the costs to recruit, retain, separate and otherwise support military and civilian personnel, and all other costs of business operations of the DoD.

This is a new, *revised* definition

-OUSD(A&T) Memo of 13 Nov 98, “Definitions of TOC, LCC, and the Responsibilities of PMs”

Life Cycle Cost Definition

Defense Systems TOC is defined as Life Cycle Cost (LCC). LCC (per DoD 5000.4M) includes not only acquisition program direct costs, but also the indirect costs attributable to the acquisition program (i.e., costs that would not occur if the program did not exist). For example, indirect costs would include the infrastructure that plans, manages, and executes a program over its full life and common support items and systems.

This is an old, *revitalized* definition

-OUSD(A&T) Memo of 13 Nov 98, “Definitions of TOC, LCC, and the Responsibilities of PMs”

DTC vs. CAIV and TOC¹

CAIV

- **Starts before Acquisition**
- LCC²
- CPIPT with Gov't & Ktr
- Maximum incentives
- Requirement & Performance-based trades
- Freedom from MILSPECs
- Empowered IPTs
- Continual cost reduction

DTC

- **Starts during acquisition**
- AUPC
- Contractor
- No incentives to do trades
- Limited trades within fixed requirements
- MILSPECs & Standards
- Hierarchical management
- Cost tracking & containment

¹ Adapted from a briefing to BMDO CAIV Workshop of 12 Feb 1998 by Dr. S. Pallas

² Formerly TOC.

New Initiatives

- **There are two kinds of new initiatives:**
 - **“New Ideas”**: Revolutionary or near-revolutionary concepts unlike anything before them
 - Mass Production
 - Lean Production (the Toyota Production System)
 - Statistical Process Control
 - **“Best Practices”**: Ideas, known “to all in part, and to some in full,” fleshed out and given a catchy name
 - TQM
 - IPTs
- **CAIV & TOC*** are part “Best Practice” and part “New Idea”

*The term TOC is used to mean both TOC and TOC Reduction, for brevity, in DoD, and here



CAIV & TOC as Best Practices

- **None of these are new ideas:**
 - **Only buying what you can afford**
 - **Capping costs**
 - **Reducing *all* costs, incurred or influenced**
 - **Trading off some capabilities to reduce cost, while maintaining “Key Performance Parameters”**
 - **Incentivizing cost reduction**
- **Every past PM did some of these to some degree**
 - **The best did them to the greatest degree**
 - **The CAIV & TOC initiatives seek to increase participation in these practices**

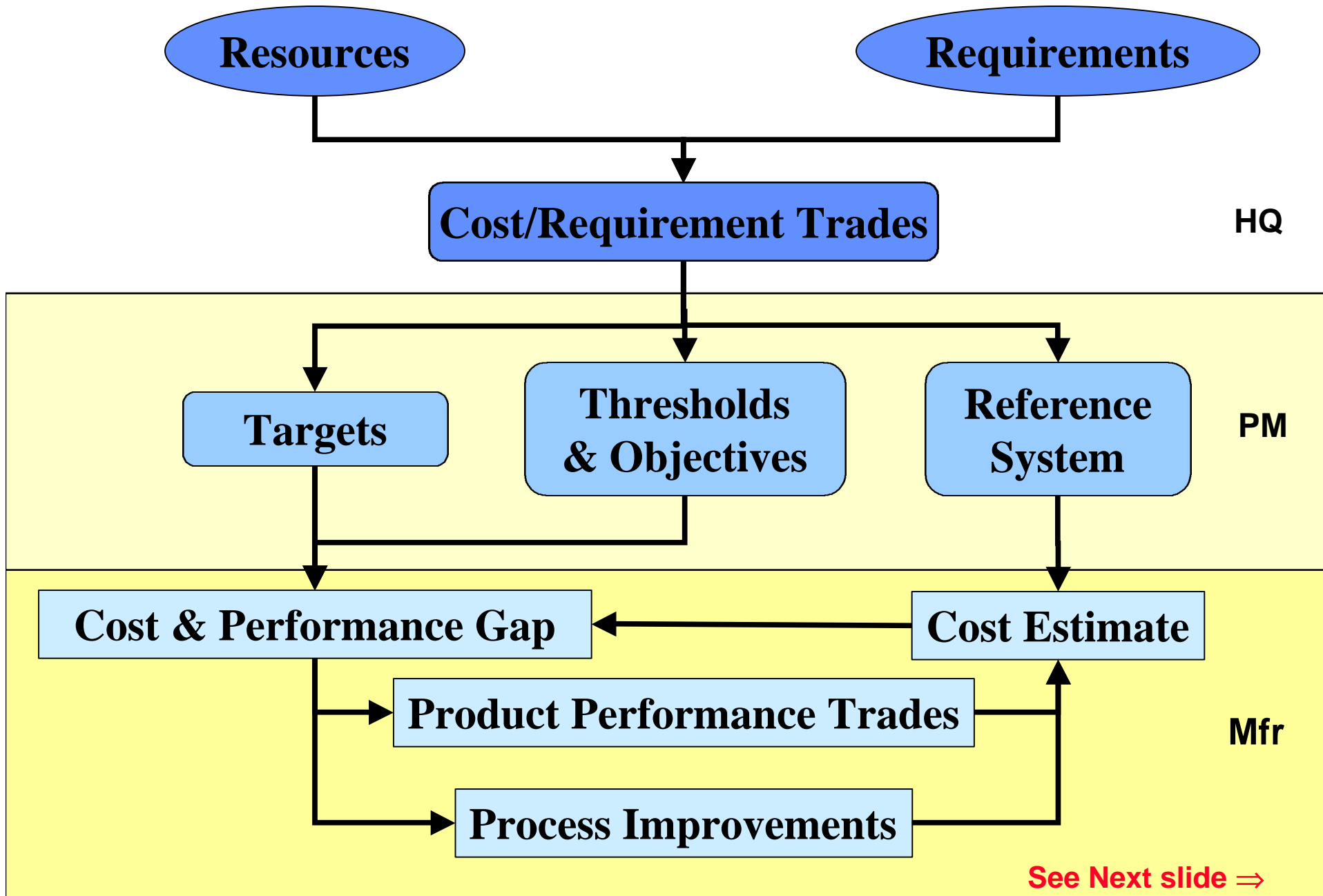
CAIV & TOC as New Ideas

- **CAIV has a dramatic effect on the requirements process**
 - Requirement generation must now include consideration of costs
 - Early and continuous user involvement in cost/performance trades
- **Programs have the flexibility to exceed spending caps in Acquisition if TOC reductions can be shown (e.g., AAV transmission)**
 - Note that recouping these savings can be problematical
 - There is a DoN TOC Reduction Gainsharing Incentives IPT in process, formulating a new policy

A Few CAIV Process Slides

The CAIV Process

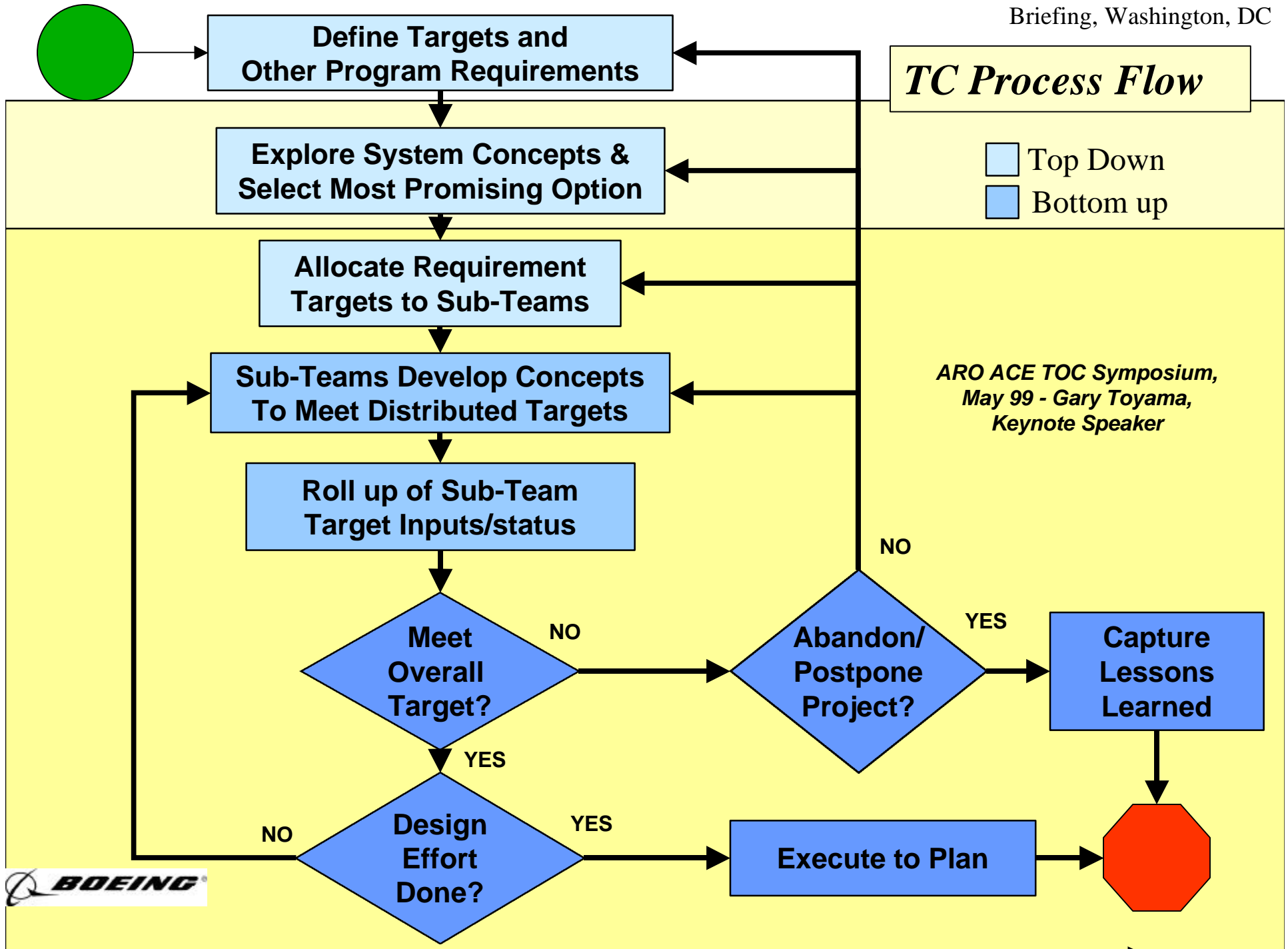
Briefing, Washington, DC



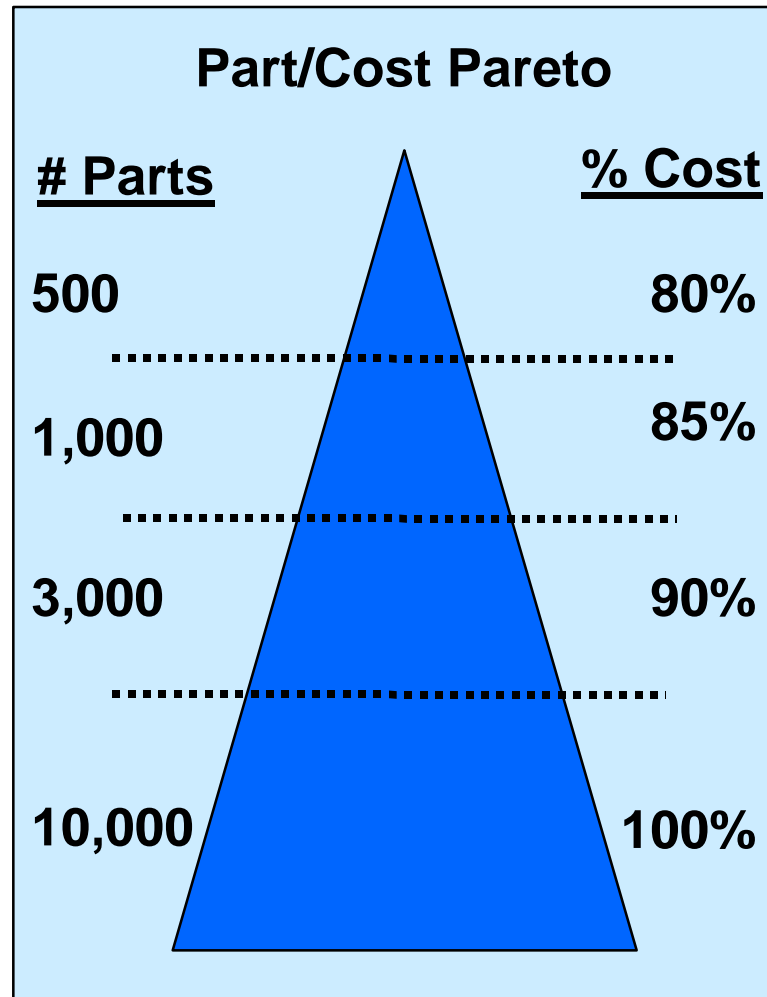
TC Process Flow

□ Top Down
■ Bottom up

*ARO ACE TOC Symposium,
May 99 - Gary Toyama,
Keynote Speaker*



Target Costing/Part Number Targets



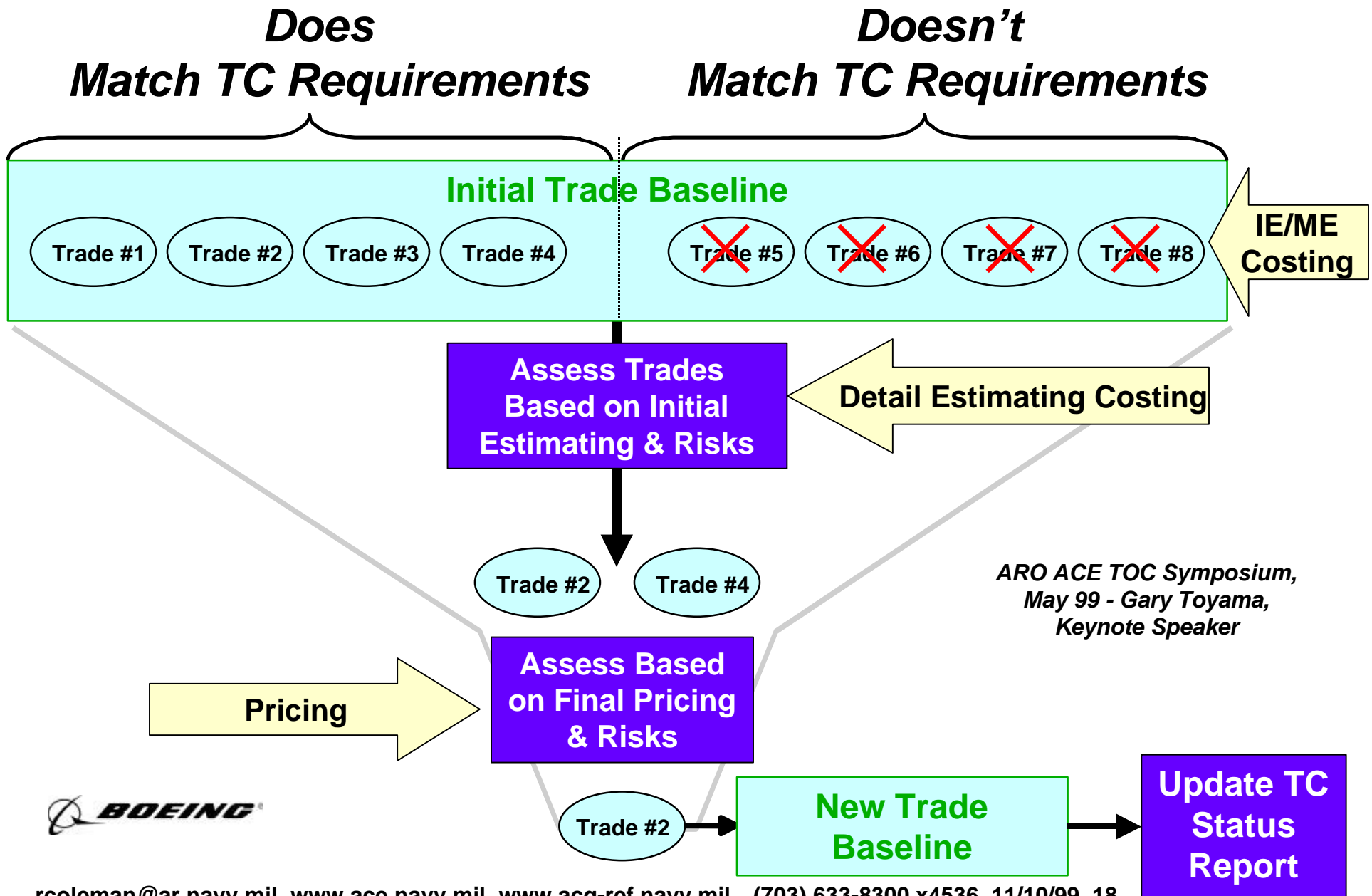
*ARO ACE TOC Symposium,
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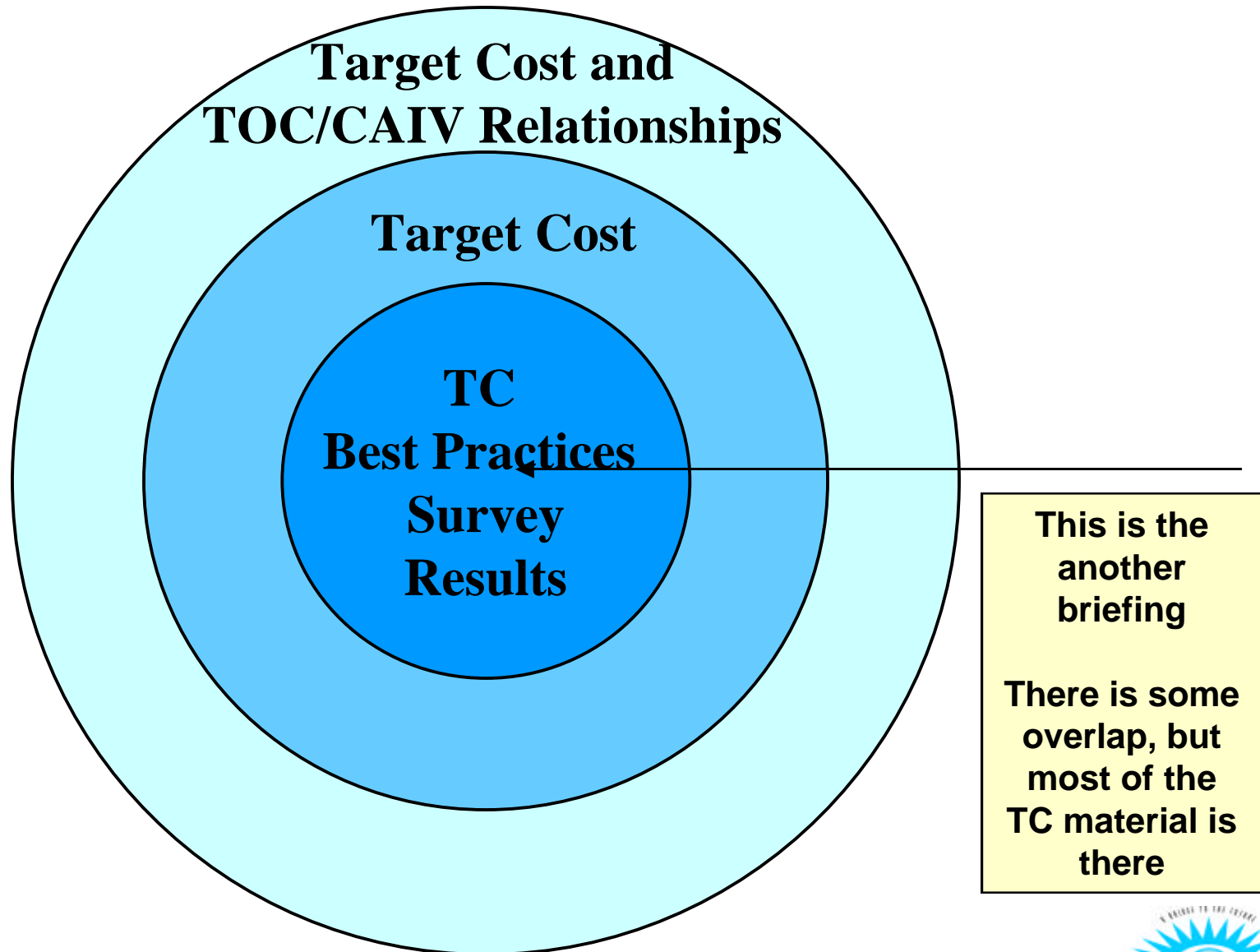
Focus On The Few Parts That Drive Overall Cost



Different Costing for Different Roles



Peeling the *Target Cost and CAIV* Onion



CAIV Compared to Target Cost or

*“Where Should I Look to Flesh Out CAIV and TOC
Methods and Practices?”*

CAIV in Context of Industry's Methods

- CAIV was born at the same time that U. S. industry was discovering a Japanese practice called Target Costing (TC)
- The Consortium for Advanced Manufacturing - International¹ (CAM-I) timeline for their definitive book *“Target Costing - The Next Frontier in Strategic Cost Management”*:

- TC Focus Group formed: **Dec '93**
- Book begun: **Summer '94**
- Book published: **Sept '95**

Bibliography analysis shows articles as follows:

87	88	89	90	91	92	93	94	95
1		11		11	11	1111	11111	11

- The OSD timeline for the CAIV policy:
 - Workshop convened: **Summer '94**
 - Promulgated: **Fall '95**

¹ See <http://www.cam-i.org/>





Key Elements of TC vs. CAIV & TOC

- Target costing is a system of profit planning and cost management that is:

<u>Target Costing*</u>	<u>CAIV</u>
– Price led	<i>Affordability determination</i>
– Customer focused	<i>Meeting the warfighters' needs</i>
– Design centered	<i>Design trade intensive</i>
– Cross functional	<i>IPTs are key</i>
– Life-cycle oriented	<i>LCC</i>
– Value-chain based	<i>Implicit</i>

“*Target Costing - The Next Frontier in Strategic Cost Management”

DoN CAIV, TOC and Target Costing

- **DoN CAIV differs from Target Costing¹ in that the cost which is selected as the Target Cost comes from Affordability Analysis² rather than Market Analysis, and in the expansion to TOC**
- **CAIV and TOC address issues that differentiate the Service from the civilian consumer, and which result in a (senior?) partnership with industry:**
 - **Explicitly chooses key performance parameters long before fielding with only an educated guess at emerging technology**
 - **“Commits” to the product sight unseen (progressively and inexorably)**
 - **Funds the entire life cycle wholly and directly**
 - **Bears all sunk costs**
 - **Bears virtually all risk**
 - **Buys ~all units**
 - **Must *budget and account for indirect costs***

1 “CAIV & TOC and their Relationship to Target Costing”, R. Coleman, 1998, 2nd International Congress on Target Costing

2 Other services place a reduced emphasis on formal Affordability Determination as a part of CAIV.

Target Costing Applicability

- **CAIV is stratified into Gov't and industry activities**
 - Together, these yield a good analogy to TC
- **Understanding TC may give us better understanding of “the thinking behind the thinking” of CAIV**
- **TC may be something we would like our manufacturers to do, since:**
 - TC is analogous to CAIV, and reinforces it
 - Private industry is already in the process of adoption of TC
 - Private industry can borrow from mature Japanese and German TC practices and literature
 - Considerable literature and guidance are provided by *CAM-I*

Government and Industry Roles in CAIV¹

Government

- **Determines resources and mission needs**
- **Sets Target Costs & KPPs using trades**
- **Insight**
- **Insight**
- **Insight**
- **Revises targets at each phase**

Industry

- **Little-to-no role**
- **Assists in trade analysis**
- **Develops metrics & provisions for program management**
- **Identifies initial cost & cost reduction opportunities**
- **Designs and produces system**
- **Assists in trade analysis**



1 Briefer's opinion



Differences Between CAIV & TC Implementation

- Among the main problems cited by TC implementers are culture change and training
- TC usually starts on a small project then spreads to the rest of the company
 - Boeing *Scandinavian Belly Loader* \$100K, 3 mo., 25 people - spread by stages to \$Bs, 2-3 yr. projects, 10K people
 - Continental Teves *ABS* ~\$200M - then spread to \$2.4B
 - CASE Corp. *XT Skid Steer*
 - Rocketdyne started with the *RS 27*, and moved to the *RS 68*
- CAIV went much faster
 - Mandated in Fall '95
 - Flagship programs reported in July '96
 - Effective for all programs in '96
 - CAIV was top down, with no actual example programs, tools, or expertise
- TOC Reduction has been added
 - Mandated Winter of '98
 - Large programs (ACAT I & II) report Dec '98
 - Remaining programs report July '99
- Our challenge is arguably much greater

Target Cost (and thus CAIV) In Practice



CAIV vs. Target Cost in Practice

- **Differences in “demographics” of CAIV vs. TC practitioners**
 - Longer average product development times (question 4)
 - Had fewer competitors (12g)
 - Relied more on skilled labor (12n)
 - Had worse cooperation among divisions within the company (14a)
 - Had more participation by Product Planners, less by Ops & Mfrg
- **Differences in practice of CAIV vs. TC practitioners**
 - Did more Value Engineering (9f)
 - Did *less* Reverse Engineering (9g)
 - Had more supplier involvement (13 a, b, c)
 - Had better dealer support (14c)
 - Found it *more* important to beat the competitor's price (16c)

**Aerospace & Defense Target Cost Adopters, compared to non-Aerospace & Defense Adopters in the
1998 CAM-I Target Costing Best Practices Survey
All differences were statistically significant**

Does Target Cost Do the Job?

Is it on the *scale* that CAIV & TOC
need to be?

Does it yield the same types of *benefits*
as CAIV & TOC?



TC Results

Briefings, CAM-I 2nd Annual International
Target Cost Conference, October 1998

- Is the result from TC of the order of magnitude needed for CAIV & TOC? Some examples:
 - **Japanese TC:**
 - Up to **13-17%** continuing annual cost reduction
 - **Rocketdyne RS-68**
 - **50%** Production Unit Cost reduction
 - **65%** non-recurring cost reduction
 - **60%** time to market reduction
 - **Boeing Scandanavian Belly loader**
 - **72%** cost reduction
 - **Boeing 757-300**
 - **43%** cost reduction

Answer: It is on the scale needed





Benefits of TC

CAM-I Target Cost Best Practices Study
Dr. S. Ansari

- C** • Increased overall profitability
- C** • Reduced manufacturing costs
- C** • Reduced the costs of new products before manufacturing
- C** • Met or exceeded customer expectations for our products
- C** • Reduced the cost of purchased materials
- C** • Resulted in product features and functions that customers value
- C** • Developed a more profitable product mix
- N** • Decreased the number of design changes after production begins
- C** • Reduced the time required for new product introduction

Listed from most achieved to least achieved

Time

Answer: It *does* yield the desired *benefits*



Is Target Cost = CAIV & TOC?

- It looks like a duck ...
- It quacks like a duck ...

... it's a duck

CAIV & TOC

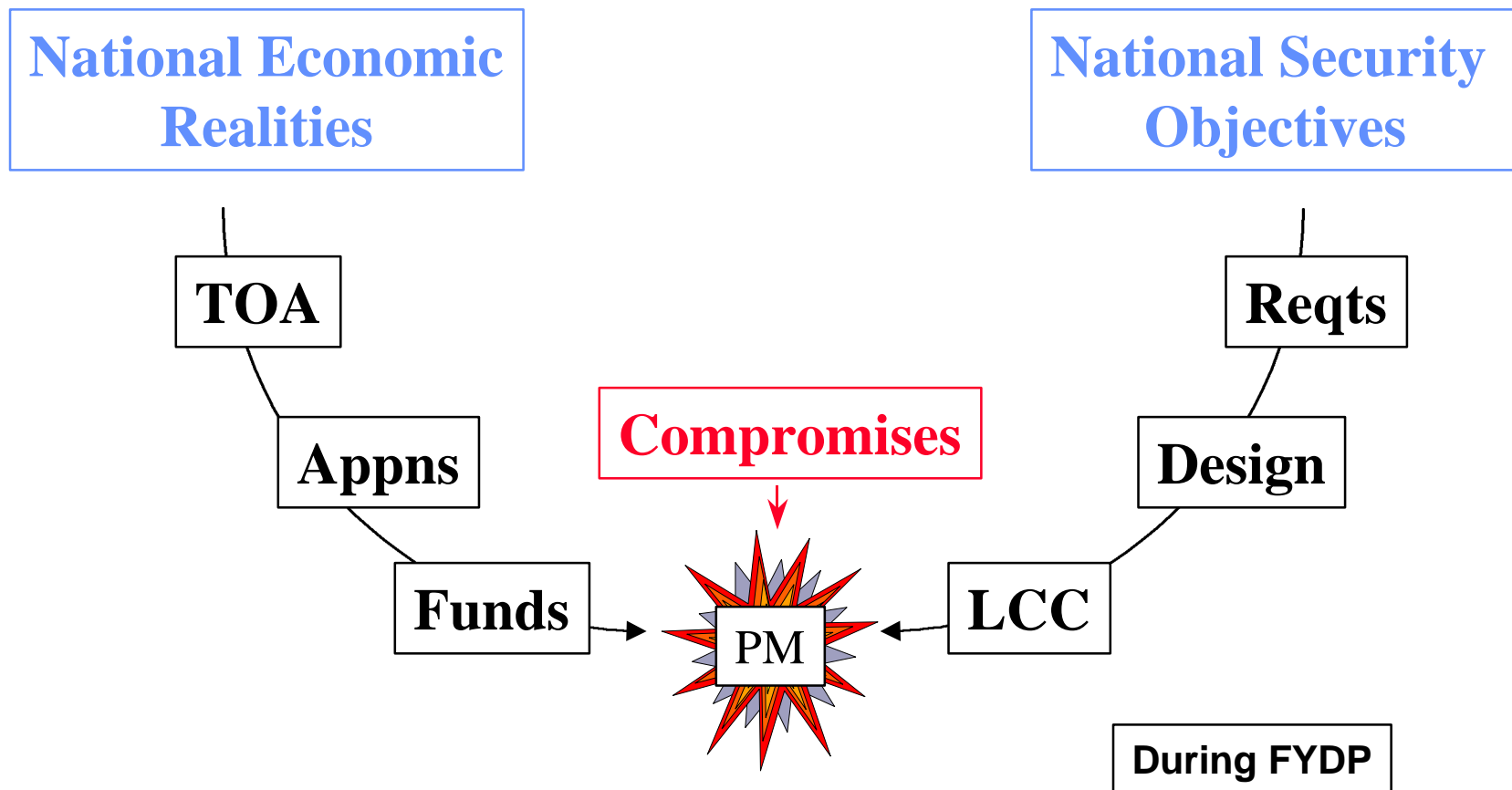
The Change in The Decision Point¹

- The key point of CAIV is to agree upon a target cost (cost objective), based on affordability considerations, which will shift the decision point
- Discussion in the past involved funds :
“required” vs. “budgeted”
 - Funds usually converged at the expense of other programs, or,
 - Coming late in the game, limitations dictated bad design choices, loss of features, quantity cuts or all three.
- Discussion should involve designs :
“unconstrained” vs. “affordable”
 - Which can converge in time for optimal trade-off.
- This is a shift in both time and space ...

¹ “A Framework for Costing in a CAIV Environment” (Coleman, Mannarelli), DoDCAS 1996

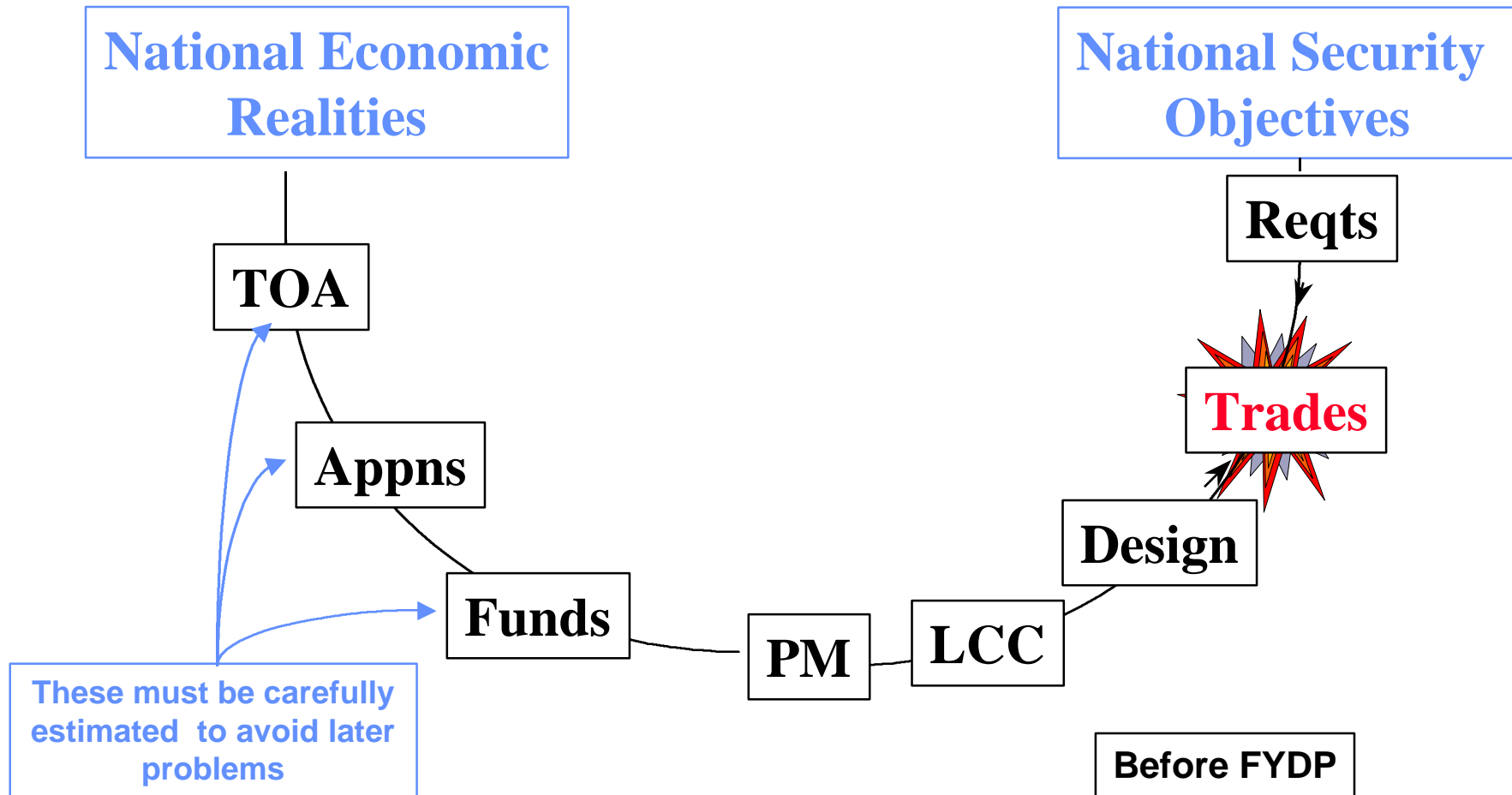


Old Paradigm¹

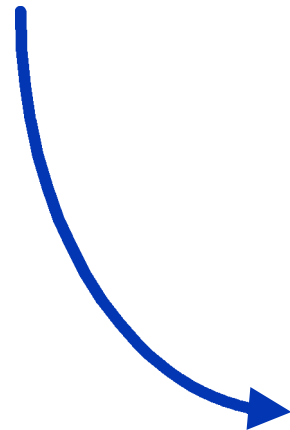
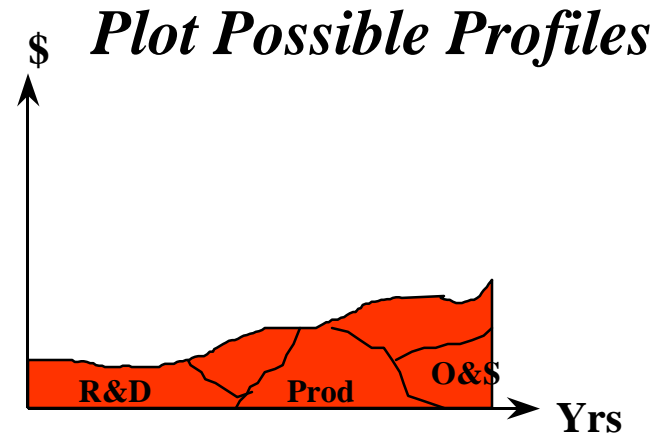
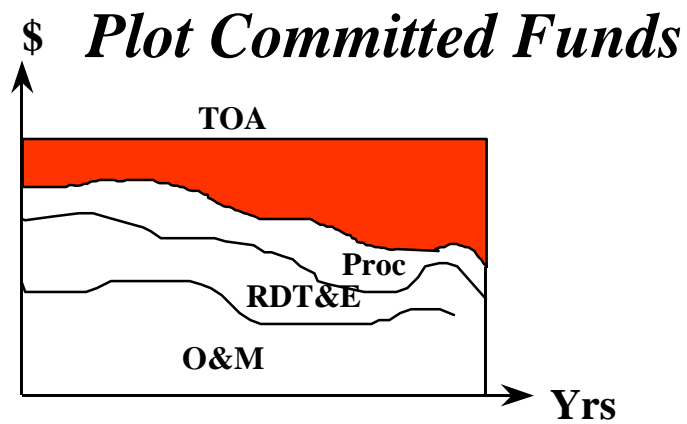


New Paradigm¹

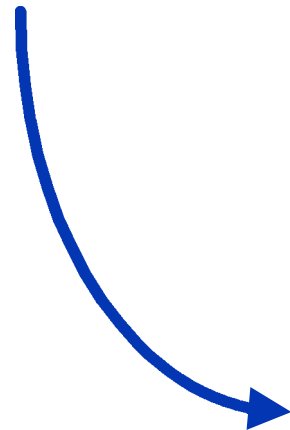
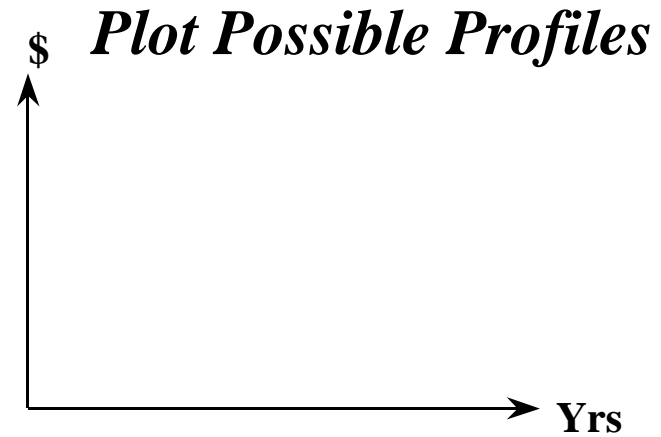
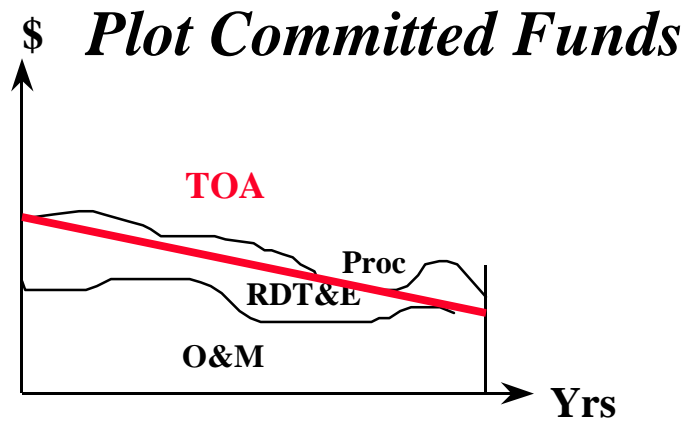
Affordability shall be assessed at each MS decision point beginning with program initiation
- DoD 5000-2-R Sect 2.5 Ch-3



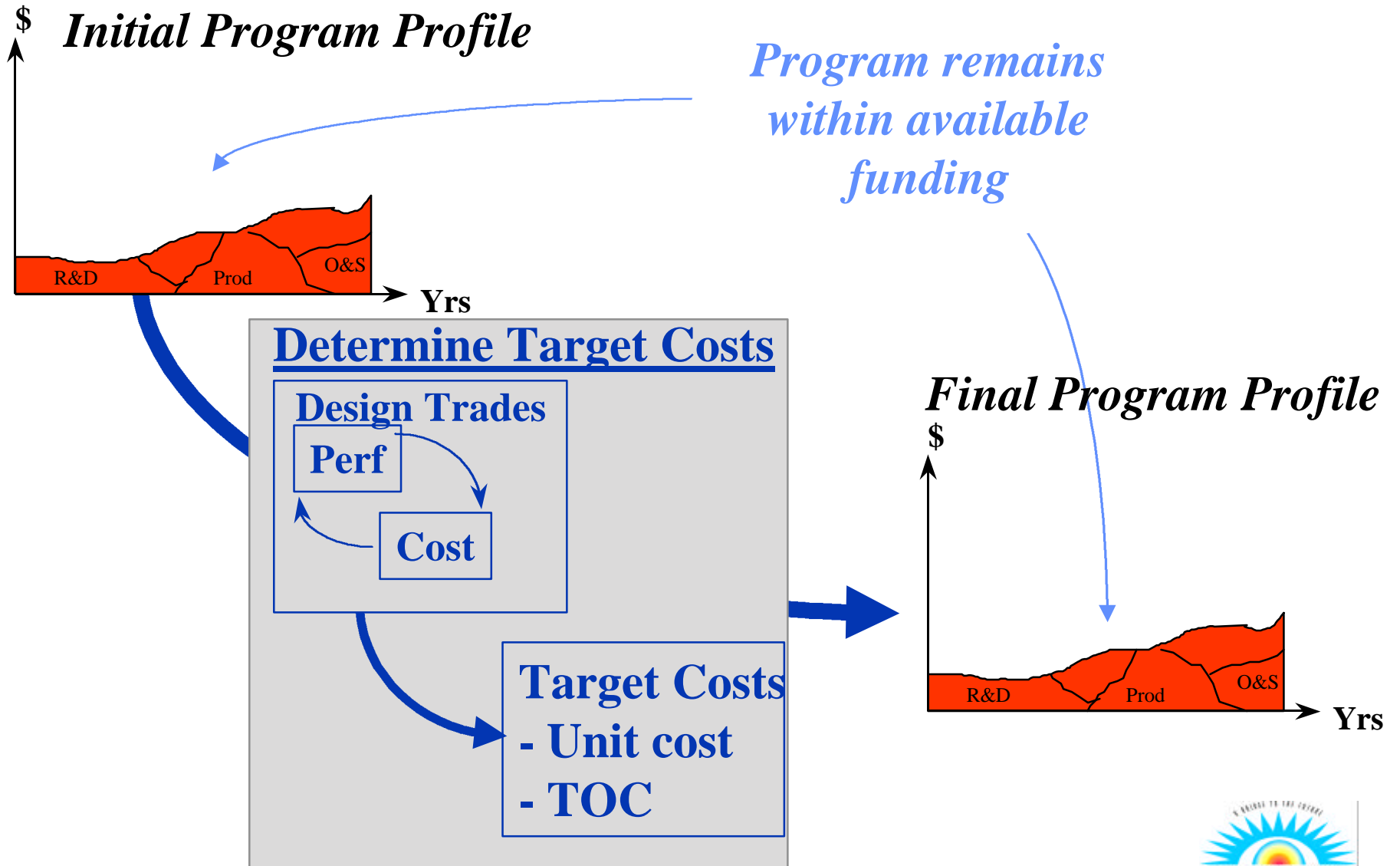
Determine Affordability



Determine Affordability - The Current DoD Reality



Determine Target Cost and Program Profile



TOC Within the DoN*

- **OSD is establishing TOC Pilot Programs**
- **The DoN TOC reduction initiative requires reduction of “the cost of ownership of current and future systems in order to identify funds which can be used to support the recapitalization and modernization of the Navy.” To this end, establish a formal TOC Reduction plan**
- **Establish cost baseline**
 - **Identify cost drivers**
 - **Develop specific reduction initiatives**
 - **Develop metrics**
 - **Report progress at regularly scheduled metrics briefs**
 - **Every ACAT Program will:**
 - **Revise current approved APB**
 - **Establish TOC Objective and Threshold**
 - **Submit TOC Reduction Plan & APB Revision to MDA:**
 - **ACAT I/II NLT Dec ‘98**
 - **ACAT III/IV NLT Jun ‘99**

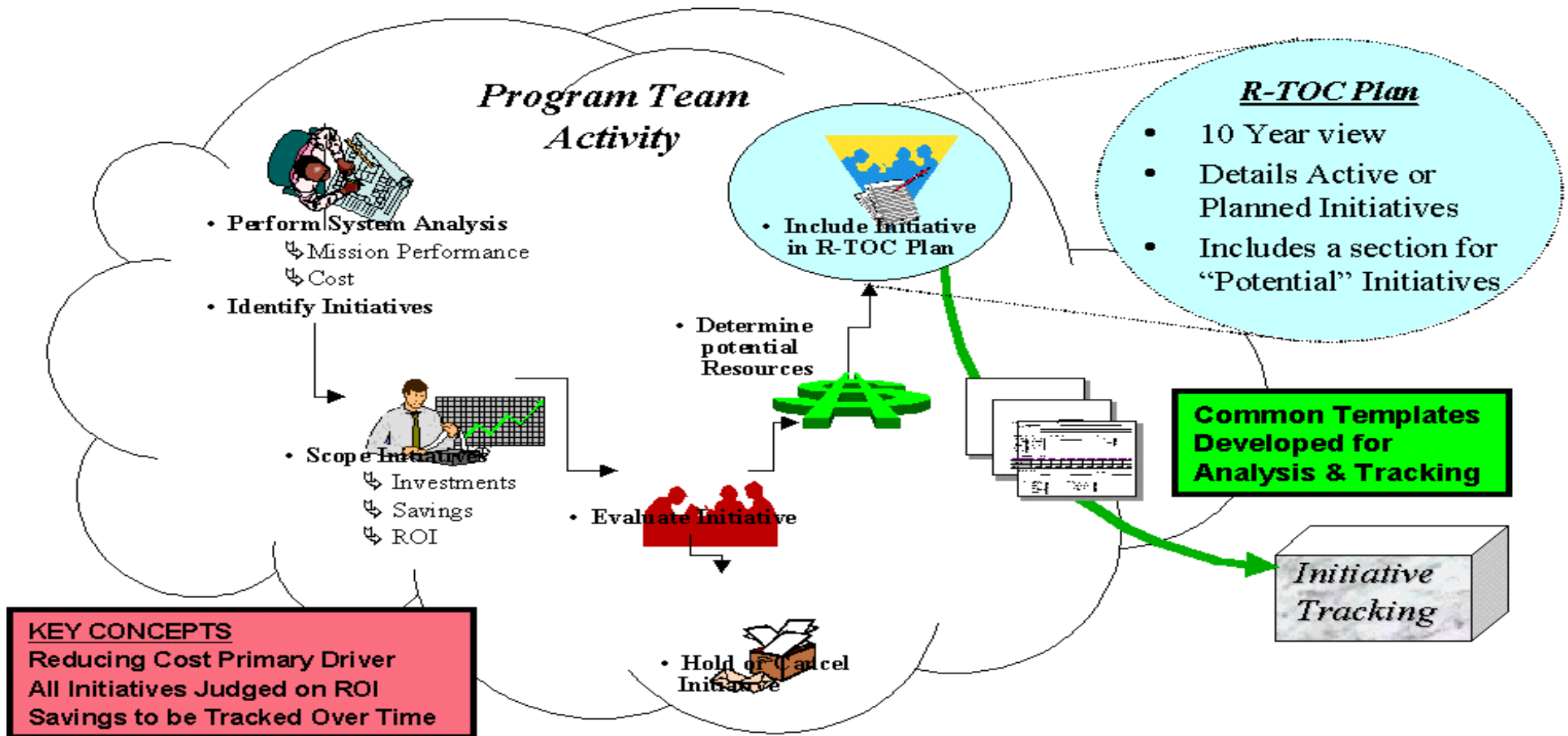
*ASN(RD&A) Memo Implementation of TOC Baselines in the DoN of 26 Mar 98



DoN R-TOC Pilot Programs

1. **Aviation Support Equipment**
2. **H-60 Series Helicopter**
3. **Standoff Land Attack Missile -Expanded Response (SLAM-ER)**
4. **AEGIS Weapon System**
5. **EA-6B**
6. **AN/BQQ-10 Acoustic Rapid COTS Insertion**
7. **Meteorological and Oceanographic Systems (METOC)**
8. **Airborne Mine Counter Measures**
9. **Advanced Amphibious Assault Vehicle (AAAV)**
10. **CVN-68 Class Carrier, RIPP-IT**

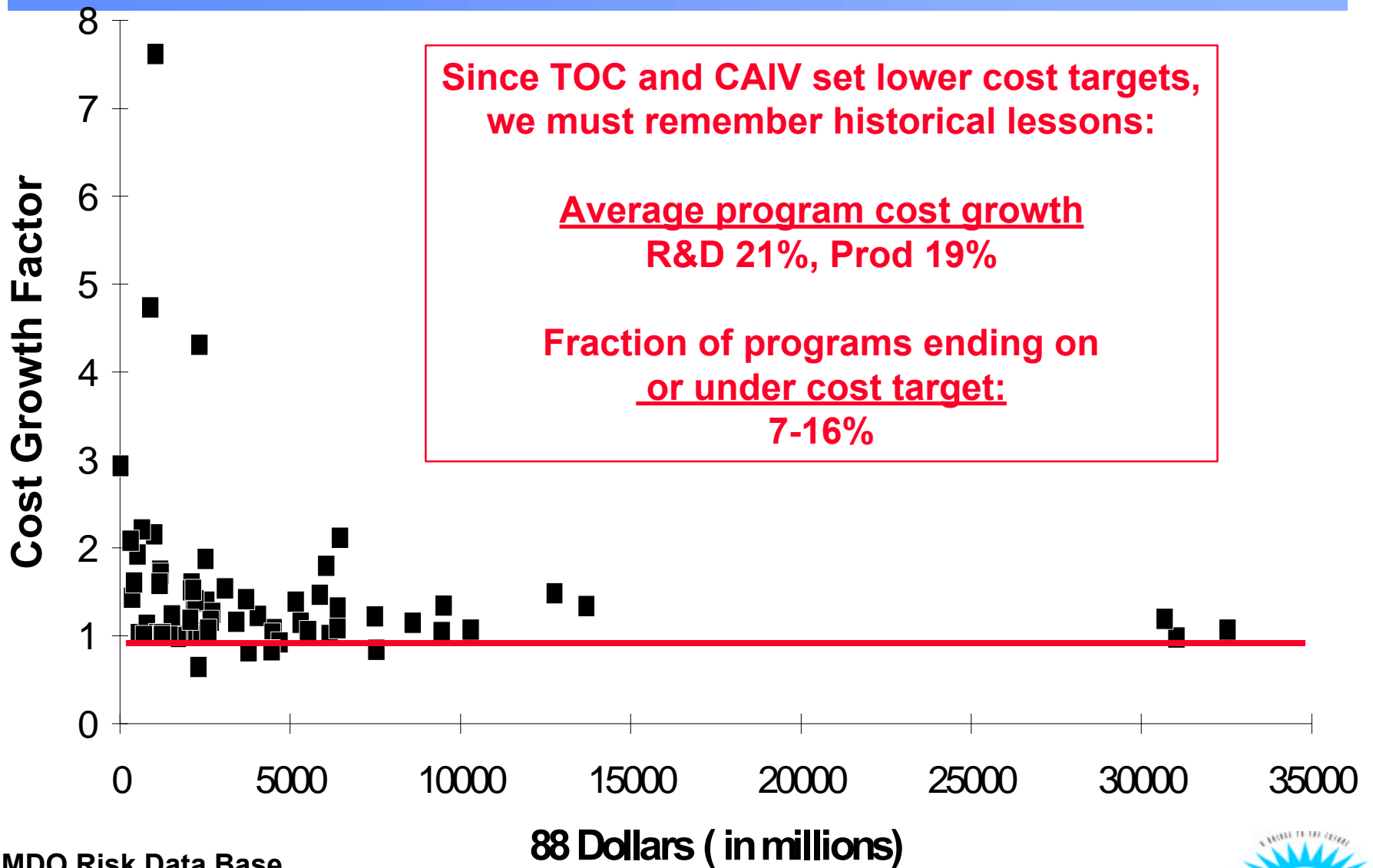
R-TOC PLANNING PROCESS



TOC Challenges (Editorial comment)

- **Programs are directed to manage to TOC, reduce TOC, and trade to TOC, but**
 - TOC databases essentially do not exist, though the services are striving to broaden their data, particularly in O&S
 - TOC is often confused with LCC, though it is broader, including formerly indirect, and hitherto ignored costs
 - The DoN formerly omitted indirect costs from LCC, whereas OSD always included indirect costs.
 - Definitions were recently adjusted to achieve alignment
 - TOC is often erroneously reduced still further down to O&S costs, due to the term “Ownership”
 - LCC also often confused with O&S cost
- **What should you do, if you cannot capture all of TOC?**
 - At a bare minimum, trades and decisions must strive to include the effects of all knowable costs which fluctuate as a result of the trade-off candidates.

TOC & CAIV Challenges: Historical¹ Cost Growth



1 BMDO Risk Data Base



TOC & CAIV Tools

Tools from Industry



Target Costing Tools [1]

- | | | | | |
|---|---|---|--|--|
| S | C | ↑ | <ul style="list-style-type: none"> • Cross-functional teams (IPTs) for problem solving <ul style="list-style-type: none"> – Single most used tool – Correlated with all other tools | Listed from <i>most used</i>
to <i>least used</i> |
| S | C | | <ul style="list-style-type: none"> • Multi-year product & profit planning | |
| S | C | | <ul style="list-style-type: none"> • DTC (cost objectives, goals, and thresholds throughout) | |
| S | C | | <ul style="list-style-type: none"> • DFMA (optimize interactions) | |
| S | C | | <ul style="list-style-type: none"> • Continuous Improvement activities (<i>Kaizen</i>) | |
| S | C | | <ul style="list-style-type: none"> • TQM | Used significantly more by
Aerospace & Defense |
| S | C | | <ul style="list-style-type: none"> • Benchmarking | |
| S | C | | <ul style="list-style-type: none"> • Value Engineering¹ (includes performance trades) | |
| S | C | | <ul style="list-style-type: none"> • Competitor cost analysis | |
| S | C | | <ul style="list-style-type: none"> • QFD (document and understand requirements) | |



Adopters use all 13 tools more!

1 OMB Circ. A131





Target Costing Tools [2]

- Certain tools *did not* show significant differences between Adopters and Non-Adopters, nor were they correlated strongly with other tools:
 - Activity-Based Costing/Management (ABC/ABM)
 - Cost tables
 - Tear down analysis/Reverse engineering
- Integrated Data Environment (IDE) was *not asked* on the survey
- No correlation between tools and maturity

Used significantly less by
Aerospace & Defense





TC Tool Use in Aerospace & Defense



- Cross functional teams for problem solving
- Multi-year product and profit planning
- Design to cost*
- Total Quality Management Systems
- Continuous improvement activities (Kaizen)
- Design for manufacture and assembly
- Value Engineering *
- Benchmarking
- Quality Function Deployment
- Competitor cost analysis

Listed from most to least used

CAM-I Target Cost Best Practices Study
Dr. S. Ansari

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- Tools Not Used Significantly More By TC Adopters**
- Activity-based costing/management
 - Cost tables
 - Tear down analysis/reverse engineering **

* significantly more than non-A&D Adopters

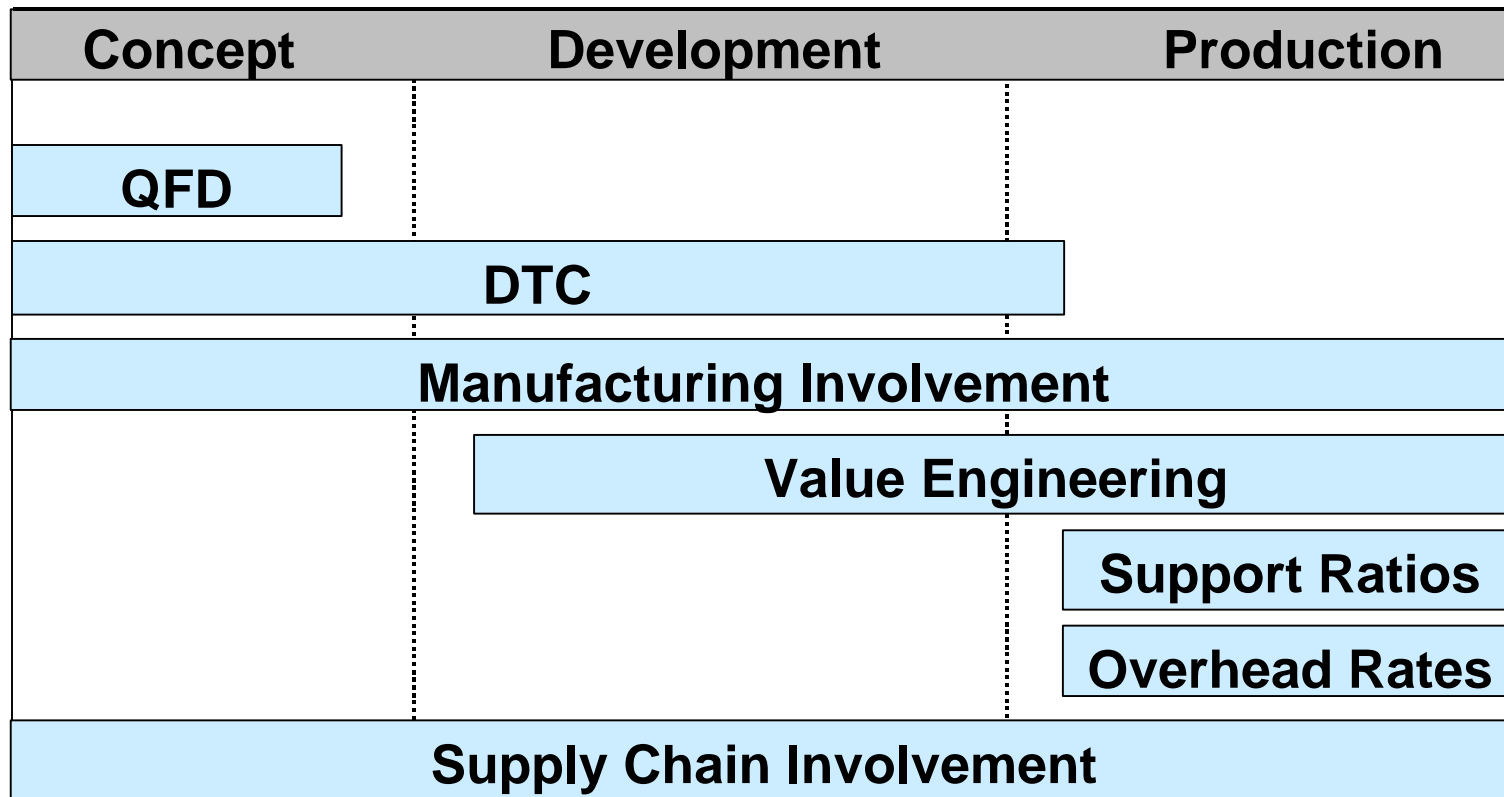
** significantly less than non-A&D Adopters



Tool Families for Target Costing

	IPTs	Prod Prof	QFD	Bench-mark	Kaizen	DTC	VE	DFMA	TQM	Comp Cost
Design										
Quality										
Value										
Market										

How TC Tools Apply by Program Phase



Small Programs

- ACAT III/IV roughly 200 people or less
- CAM-I survey analysis, 500 people or less
- Lower market share, less pressure on profit margins, lower barriers to enter market (12adf)
- Shorter product development times (4)
- Greater willingness to experiment with new ideas (10a)
- More pressing problems (18c)
- Estimate Distribution/Logistics costs more (7d)
- Less likely to reduce profit margin, more likely to reduce reliability/longevity (27bd)
- Increased role of suppliers in design (29b)
- More targets for purchased parts (34b)

All other findings are the same

TC Tools - Definitions

- **Design to cost (DTC)**: A method to ensure that product designs meet a stated cost objective. Cost is addressed on a continuing basis as part of product or process design. The technique embodies early establishment of realistic but difficult cost objectives, goals, and thresholds and then manages the design until it converges on these objectives.
- **Design for manufacture and assembly (DFMA)**: A simultaneous engineering process that optimizes the relationship between materials, manufacturing technology, assembly process, functionality, and economics. It seeks to ease manufacture and assembly of parts or eliminate parts.

TC Tools - Definitions

- **Value engineering**: A systematic method of evaluating the functions of a product to determine whether they can be provided at a lower cost without sacrificing the features, performance, reliability, usability, and recyclability of the product. Generally used at the design stage of a product to improve customer value and reduce costs before production has begun. Required¹ to be used in the Federal Gov't.
- **Quality function deployment (QFD)**: A structured matrix approach to documenting and understanding customer requirements and translating them into technical design characteristics for each stage of product development and production.

1 Circular No. A-131 "Federal agencies shall use VE as a management tool, where appropriate, to ensure realistic budgets, identify and remove nonessential capital and operating costs, and improve and maintain optimum quality of program and acquisition functions.

Tools from DoD

Including:

Tools developed by DoD with broader applicability
Discussions tailored to DoD

Affordability Determination

- **Earlier in the brief, we saw how CAIV has created a paradigm shift**
- **We recognized a need to predict budgets from National Economic Realities**
- **An example of an Affordability Determination model is the CIBA model (Commodity Investment Balance Assessment), which is being installed in the Navy ACE**

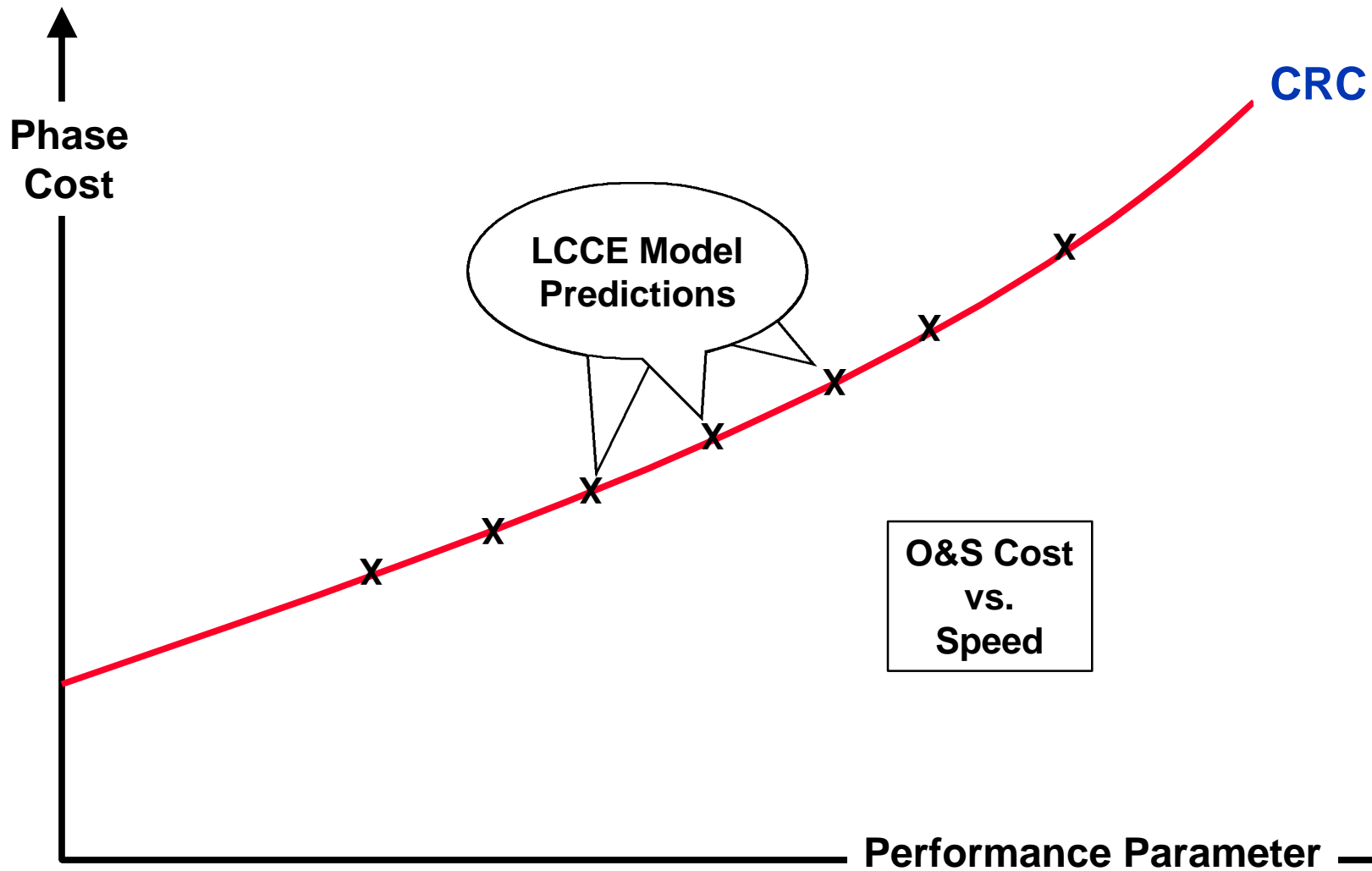
Trade Basics

Cost Response Curves¹ (CRCs)

- **Relate total or phase costs to some specific attribute or decision variable**
- **Developed from cost estimating models**
 - Yield costs that the cost model would, but are portable & easy to use
 - Must very nearly replicate cost model output to be usable
- **Portray, one variable at a time, the effect of changing variables.**
 - Allow decision makers and non-cost analysts to experiment with operational parameters, with costs that remain faithful to the underlying cost model

¹ “*Cost Response Curves - Their generation, their use in IPTs, Analyses of Alternatives, and Budgets*”, DoDCAS ‘96, K. J. Allison, K. E. Crum, R. L. Coleman, R. G. Klion

Cost Response Curves



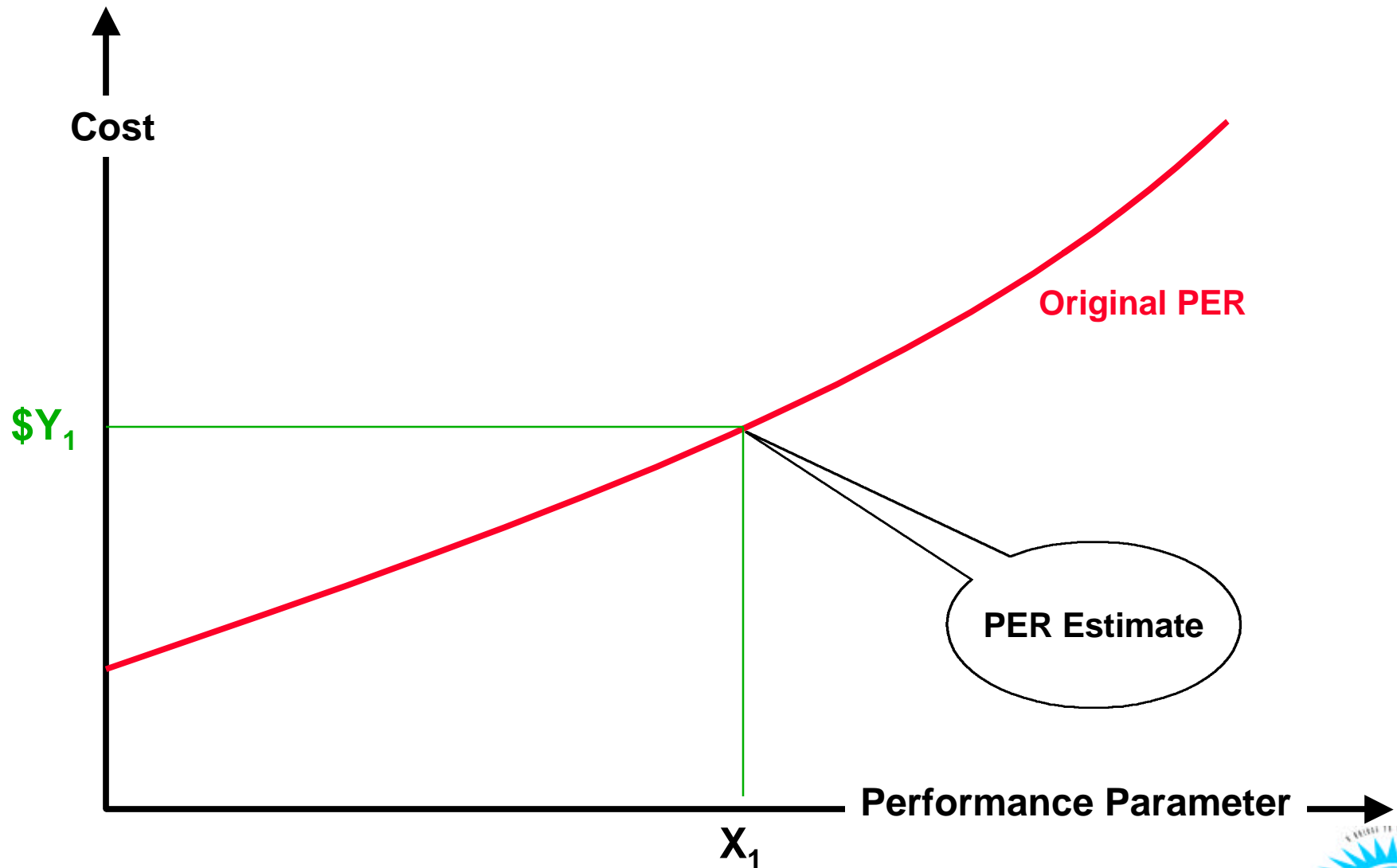
Performance Estimating Relationships¹ (PERs)

- **PERs are needed to conduct meaningful trades**
 - **But performance parameters not are often found in cost estimates**
- **Most cost estimates contain Cost Estimating Relationships (CERs) based on weight and other parameters formerly pre-eminent in Design**
 - **These were desired in the past, since weight is often the best known parameter a design, especially in any granularity**
- **Some CERs with useful parameters were considered, but rejected since they gave less accurate predictions**
 - **These equations must be re-discovered and brought into use**
- **Cost estimators and designers must make a conscious effort to shift their focus to more useful parameters**
- **If PERs are not good enough predictors, they can be “calibrated”**
 - **Re-set the y intercept to pass through a point predicted by a better CER**
 - **Use the PER to predict best departure slopes from a best starting point**
 - **Re-calibrate periodically as deemed necessary**

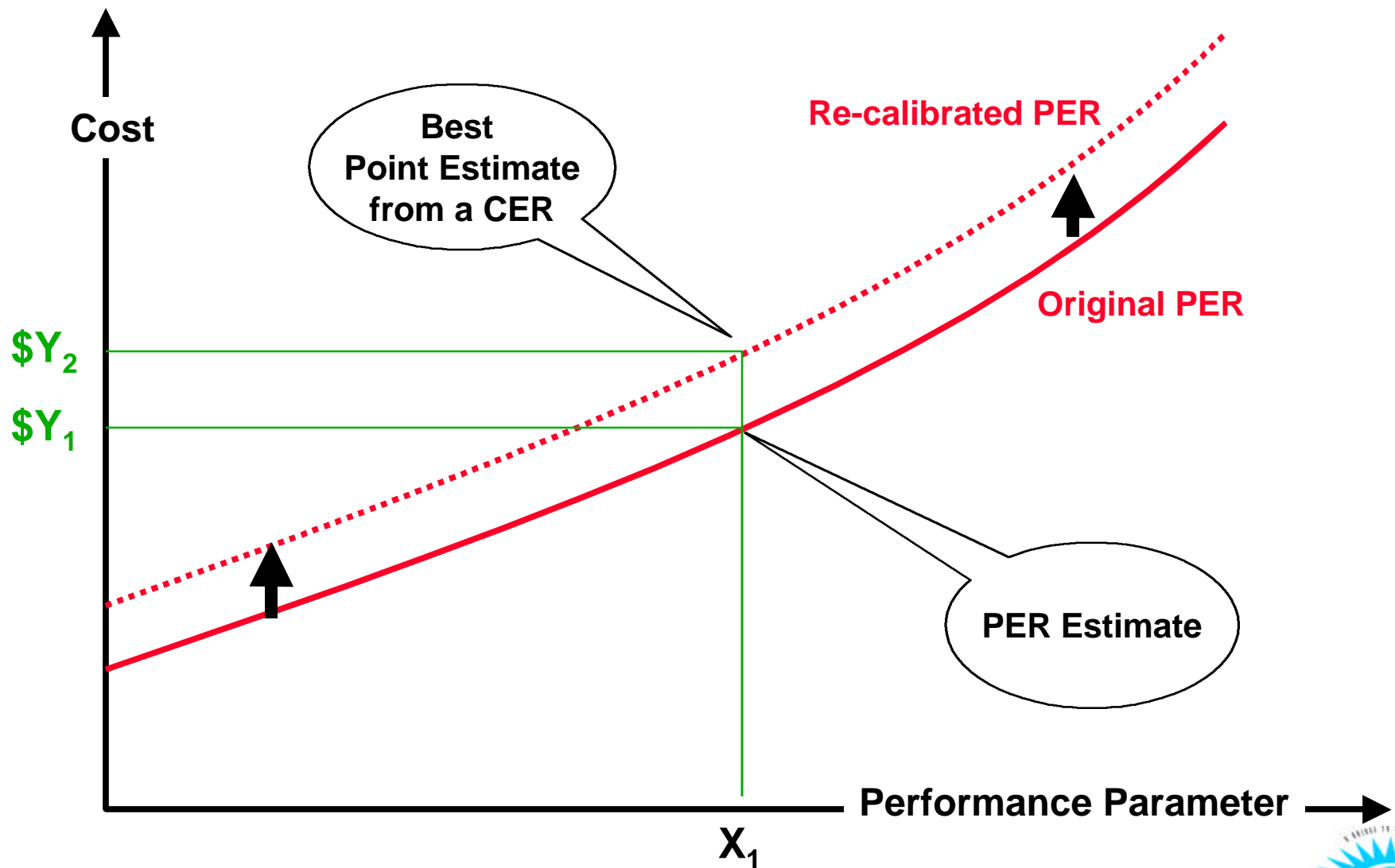
¹ “A Framework for Costing in a CAIV Environment” Coleman, Mannarelli, DoDCAS ‘96



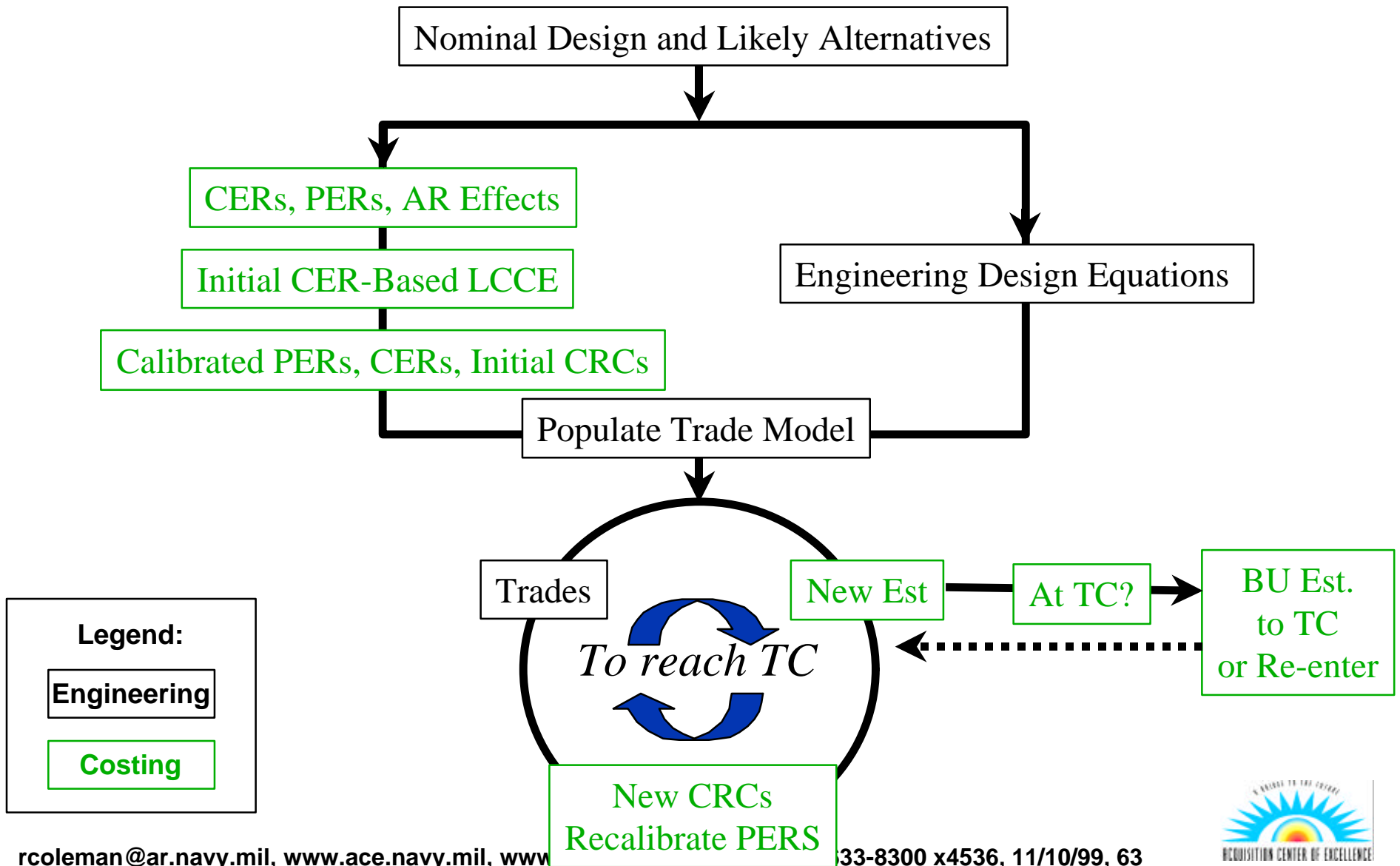
Calibrating PERs



Calibrating PERs



Design, Cost & CAIV Process



Systems Dynamics

- **Systems Dynamics can show the “give-and-take” of the system, and will allow easy visualization of the reaction of the system to changes in parameters**
- **The devil is in the details - population of SD models is challenging, but do-able**
 - **No other modeling approach will give the dynamic reactions in a what-if way**
- **Several SD cost models are being deployed in the ACE:**
 - **DDI’s SNAP Model**
 - **NCCA’s OSCAM Model**

OSCAM Model Overview

- **Standardized, yet flexible approach to estimating/analyzing O&S costs and availability**
 - **OSCAM(Ship) for new & in-service ships**
 - **OSCAM(Systems) for new & in-service ship systems**
 - **There is an Aviation model planned, but it will take over a year**
 - **No USMC model as yet planned**
- **Developed jointly by NCCA, UK MoD and HVR Consulting Services Ltd.**

www.ncca.navy.mil



Activity-Based Costing (ABC)

- TOC Reduction Cost involves all costs
- One method helpful for this is ABC, which assigns costs to the activities by which they are incurred
- The *CAM-I* survey showed that ABC is **not common** in manufacturing, and is **not** a signature tool of Target Cost ... this contradicts early U. S. thought on Target Cost, and needs further study
 - Thus ABC may not be practicable for CAIV
 - ABC is, though, a powerful cost reduction tool for¹
 - Reducing overhead
 - Reducing costs of “processes”
 - “Right sourcing” especially in comparing Gov’t and private comparisons
 - Product line rationalization

1 Briefer’s opinion



Commercial-Off-The-Shelf (COTS) Insertion

- **COTS use has been mandated to the maximum extent possible by DOD 5000.2-R. This gives rise to several problems:**
 - **Determining viable substitutes**
 - **Cost trade-offs**
 - **Determining the supportable lifetime for COTS**
 - **Including COTS refresh points in the Life Cycle Cost Estimate**
- **A model developed by NSWC Crane will be used in the ACE**

Other Applicable Tools

- **Navy VAMOSC¹ for O&S² Data**
 - A data base that tracks ~all direct O&S costs over time
 - ~All ships, ~all A/C, some systems
 - 5 USMC vehicles, in 17 variants
- **OARS³**
 - On line access to Ship's 3-M data
- **COMET¹ for Total Cost of a Sailor**
 - Tracks many indirect costs
 - No USMC data in the output
- **Contractor Logistics Support (being both studied by a Navy IPT, and widely implemented)**
- **Turbo-Spec⁴ & Turbo-Streamliner⁴ for Source Selection**

1 www.ncca.navy.mil

2 USAF is shifting to a TOC-based VAMOSC, called AFTOC

3 www.oars.navsea.navy.mil

4 www.acq-ref.navy.mil



EVM and CAIV

- Remember these words culled from DoD and Navy policies:
 - An unavoidable consequence of setting aggressive, realistic cost objectives is an increase in risk.
 - [Set] aggressive, achievable cost objectives
 - Manage achievement of these objectives
 - Develop plans, metrics and provisions for managing program execution
 - Instituting and implementing an effective risk management plan
 - Defining and measuring meaningful metrics
- *Since* - risk is now higher, *then* - EVM is now more important
- The near-real-time nature of EVM and increased insight will bring about unexpected rewards in contract execution

<http://www.acq.osd.mil/pm/>



Initial Efforts in Linking EVM & Performance

- **Three programs are working with OUSD(A&T)* in an initial effort to develop a way to link cost and schedule with technical performance**
- **They will essentially associate WBS elements that affect performance with the performance being achieved ... then cost and schedule performance will foretell technical performance**
- **The programs are:**
 - **H-1 Navy**
 - **EA-6B Navy**
 - **WAAS FAA**

***Phonecon with Mr. Reed White, OUSD(A&T)**



Open Systems Architecture

- **OSD emphasizes Open Systems**
 - “... Commercial items that use open standards as their primary interface standards.”
 - Multiple suppliers
 - Commercially-supported practices, products, specs & standards
 - Select on performance, cost, industry acceptance, long term availability & supportability and upgrade potential
 - See the Open Systems Joint Task Force
<http://www.acq.osd.mil/osjtf/>

Editorial: Open systems are often thought to be confined to support equipment, electronics & computers, but the concepts are much broader, and are being applied in many DoD systems

IPTs and IDEs

- **IPTs are essential to Trades**
 - **Correct IPT construction is key** to enable trades
 - Unbalanced representation of disciplines was the most common problem found by *CAM-I*
 - **IPTs are the single most common, and most correlated tool** according to the *CAM-I* TC survey
 - They are the forum for cooperation among disciplines
 - Formerly, disciplines operated by sequential hand-off of pro forma documents (e.g., CARDS)
 - Now, disciplines must operate in concert, and have shared competencies in order for trades to work
see:<http://www.acq.osd.mil/ar/text/tipt.htm>
- **Integrated Data Environments & Smart Product Models are key players in CAIV and TOC Reduction**
 - They let IPTs see actions and interactions, and share views
 - They assist in Configuration Management
 - They show status and progress continuously

Related Subjects

Incentives

Definition

Incentives are rewards, consequences, or processes that motivate individuals or organizations to act in a desired way. They may include:

- Monetary benefits or penalties that accrue to a program, organization, or individual
- Positive or negative recognition for a program, organization, or individual
- Enhanced or diminished security for a program, organization, or individual
- Other tangible benefits for individuals (time off, education, promotion)
- Other tangible benefits for programs or organizations (office space, events, ADP resources)

Incentives Possibilities

Individual and Team Monetary	Organizational Monetary
<ol style="list-style-type: none"> 1. Broadbanding 2. Premium Pay Position 3. Government Monetary Awards 4. Individual and Team Gainsharing 5. Performance Bonuses Allocated to PM Office 6. Merit Point System 	<ol style="list-style-type: none"> 7. Organizational Gainsharing 8. Investment Money for Reliability Improvements
Industry Monetary	Non-Monetary (All)
<ol style="list-style-type: none"> 9. Use of TOC Reduction Incentives in Gov. Contracts 10. Past Performance Credits 	<ol style="list-style-type: none"> 11. Choice of Assignments or Opportunity for Growth 12. Non-Monetary, Public Recognition



Performance Based Specs & Standards*

- **Objective**
 - **Move *from*:** “how-to” detailed specs
 - **Move *to*:** “outcome-oriented” specs
- **Benefit**
 - **Lower costs**
 - **Capture emerging technology**
 - **Enable a “best value” trade space**

*<http://www.acq-ref.navy.mil/specright/index.html>

Performance Based Specs & Standards - Issues

- **Cost:**
 - Conversion to Mil-Prf ~ **\$31K/spec**
- **Pace:**
 - DoD processed less than **300 Mil-Prfs in 2 years**
- **Quality:**
 - Poor quality endemic
- **Impact:**
 - TOC/CAIV and Best Value AR initiatives constrained by lack of adequate performance-based requirements (i.e., flexibility, trade-space)

Conclusion

- **What can a PM take from CAIV & TOC? How should it be implemented?**
 - TOC & CAIV are issue that are **helpful** if implemented, **harmful** if ignored
 - You must *walk the walk*, but remember to *talk the talk*
 - CAIV is a disciplined approach to what you are hopefully doing anyway
- **Metrics will become particularly important to manage programs**
- **Incentives will become important to cause pushing of the envelope**
- **Risk is a much bigger issue than formerly**
 - Risk will rise, since cost goals are now to be more aggressive, and risk was already present
- **There are technical issues to consider:**
 - **Linkage:** To do trades, performance and cost must be linked
 - **Non-comensurability:** How to trade cost vs. performance
 - **Risk:** Risk should be considered in trades

Backup





The TC Starting Point

- Where do Target Cost practitioners start?
 - “*Tabula rasa*” (blank slate) ... start from zero?
 - “Business As Usual” ... start from current practice?
 - In other words, must we start from a “blank sheet of paper” to shift paradigms and drive out costs?
- *CAM-I* says¹:
 - “...the cost gap ... is the difference between the allowable cost and the current or initial estimated cost ... the initial cost is the **preliminary estimate of a product’s cost, assuming existing work structures, technology and processes. No change in production technology, methods, or distribution channels is assumed** ...current cost (in Japan, the drifting cost) drifts toward the allowable cost through successive design iterations.”

“1 Target Costing - The Next Frontier in
Strategic Cost Management”





Example Starting Points

- **Chrysler**
 - Bottom-up costs, based on a reference vehicle
 - Used an existing vehicle as a reference
- **Boeing**
 - Found that an evolving target is acceptable
 - Targets may start out easier, and evolve to be harder
 - Only uses TC on Non Recurring
- **Caterpillar**
 - Starts with an existing vehicle
 - Adjust with known differences
 - Gets deltas vs. target
 - Designs out costs

DoN Success Stories



DoN Success Stories*

- **Acquisition reform initiatives:**
 - **Standardization/Commonality**
 - **Elimination of Standards and Specifications**
 - **COTS/NDI (Non-Developmental Items)**
 - **Logistics**
- **CAIV initiatives:**
 - **Setting and adhering to cost goals**
 - **Trades by the government/PM**
 - **Performance specs allowing optimal solutions (i.e., trades by the contractor)**
 - **The ACE is planning a survey of CAIV practices this fall**

*Adapted from ARO home page, www.acq-ref.navy.mil/



Standardization/Commonality Successes

- **DDG-51**
 - fastener standardization
 - estimated savings = \$1.1M per ship
- **F/A-18 C/D & E/F**
 - 90% common avionics between C/D and E/F
 - estimated savings = \$500K per aircraft
- **TRIDENT Strategic Weapon Systems**
 - 2 navigation suites replaced by one common suite
 - estimated total life cycle savings = \$500M+
- **V-22 OSPREY**
 - designed using 100% digital product definition, allowing for accurate part production at all locations
 - reduced fastener count by 34%
 - reduced error change and rework drawings by 85%
 - reduced composite material scrap by 74%

Elimination of Standards and Specs Successes

Program	Original # of Specs and Stds	Reduced # of Specs and Stds
AAAV	75	7
LHD GPS Interface Unit	118	10
CEC	45	11
AH-1W Integrated Weapon System	99	4
Generic Acoustics Stimulation System	64	14
AN/WSC-6 SHF Sattellite Communications Terminal	65	5
JSOW	1500+	4
JTUAV Maneuver Program		1
SLAM ER	104	54
E-2C Mission Computer Upgrade	81	1
Photonics Mast	129	34
ASTECS	105	35
Standard Missile	457	22

COTS*/NDI Successes

- **AEGIS Weapon System**
 - COTS CPUs = reduced ship AUC
- **AN/SQS-53A Sonar**
 - ruggedized COTS = reduced LCC, weight, spares and downtime
- **AN/UYQ-70**
 - COTS = reduced development cost and timeline
- **Fixed Surveillance Systems**
 - COTS = operational performance and decreased maintenance costs
- **Joint Maritime Communications System (JMCOMS)**
 - NDI = reduced weight, reduced cost and increased reliability

***Notes:**

**The “C” in COTS stands for commercial, not cheap
COTS is largely a computer/electronics issue**

COTS/NDI Successes (cont'd)

- **Scaleable High Performance LAN (SHPL)**
 - **COTS = \$10-\$15M in RDT&E savings**
- **MIDS**
 - **Commercial standards (VME, SEM-E) = cost effective technology insertion**
- **Launched Expendable Acoustic Device (LEAD)**
 - **NDI = instantly compatible w/ U.S. and allied navy launchers**
- **New Attack Submarine (NSSN) C3I**
 - **COTS = economical upgrades to retain margin of superiority in the future**

Logistics Successes

- **Cruise Missile Command and Control Program**
 - **Traditional Navy distribution system could not meet the unique requirements of COTS/NDI equipment**
 - **Navy distribution system replaced by FEDEX:**
 - **reduced transit time to ships from 32 to 6.5 days**
 - **reduced piece part count from a range of 237 and a depth of 535 to a Pack Up Kit of 40 piece parts**
 - **overall FEDEX logistics system cost avoidance of \$12.68M to date**

CAIV Successes*

- **Fixed Surveillance System**
 - **IUSS Sites consolidated from 14 to 5 reduced personnel 50%**
- **CEC**
 - **System specification replaced with performance specification**
- **MIDS F-15 Data Link**
 - **Not to Exceed Production Cost = \$150K**
 - **Incentivized up-time vice repairs**
- **AIM-9X**
 - **procurement price commitment curve reduced production T1**
 - **Using award fee to in EMD, award fee in Prod, share ratio on AUPC, warranty in O&S to drive RM&A**
 - **Most successful incentive is 0/100 share ratio for being under AUPC**

***Note: These are “CAIV-like” savings.**

ACE Experience With CAIV & TOC

- Presented papers and served on a speaker panel at the 1996 DoD Cost Analysis Symposium in a CAIV workshop “*CAIV... How Do We Actualize It?*”
 - *CAIV - The First Step* (Roberts, Coleman)
 - *A Framework for Costing in a CAIV Environment* (Coleman, Mannarelli)
 - *Cost Response Curves* (Allison, Horan, Klion, Coleman)
- “*A Framework for Costing in a CAIV Environment*” (Coleman, Mannarelli) - 1996 Modeling and Simulation Symposium of the American Society of Naval Engineers
- “*An Initial Strategy for CAIV within the Department of the Navy*” (Roberts, Coleman, Gupta, Blackburn) - 1997 SCEA National Conference
- “*Implementation of an initial CAIV and TOC Process in the Navy’s ACE*” (Coleman, Gupta, Blackburn, St. Louis) - 1998 SCEA/ISPA Joint International Conference. **Awarded “*Best Paper on Acquisition Reform*”**
- “*CAIV in the Navy’s ACE, and it’s Relationship to Earned Value Management*” (Coleman) - 1998 Performance Management Association International Conference and the 10th Annual International Integrated Program Management Conference

ACE Experience With CAIV & TOC

- Presented “*CAIV & TOC and their Relationship to Target Costing*” (Coleman) - 1998 2nd International Congress on Target Costing (CAM-I)
- Presenting “*Processes for Reducting Total Ownership Cost: CAIV and Target Costing*” accepted for the 1999 SCEA/ISPA Joint International Conference.
- *CAM-I Target Costing Best Practices Study Report, Feb 99, Statisticians*
- Wrote ARO Newsletter article on TOC
- Implementing CAIV and TOC in the ACE
 - Developed an Affordability and Investment Balance Model (CIBA)
 - Conducting a continuing series of 2-day ACE CAIV/TOC Workshops on policies and tools
 - Presented briefs on CAIV & TOC implementation to dozens of DoD and DoN agencies & offices

CAIV Policy

- **USD Memo of 19 July 95: “Policy on Cost-Performance Trades”**
- **USD Memo of 4 Dec 1995 “Cost As an Independent Variable,” emphasizes:**
 - **Stability**
 - **Affordability**
 - **Minimized budgets allowing more programs/greater quantities**
- **DoDD 5000.1 and DoDI 5000.2-R (Ch-3) emphasize:**
 - **Aggressive, achievable cost objectives**
 - **Manage achievement of these objectives**
 - **Balance mission needs with projected out-year resources**
 - **take into account anticipated process improvements in both DoD & defense industries**
 - **Set requirements at outset & refine at each MS using CAIV-based cost-schedule-performance trades**
 - **Conduct cost-schedule-performance trades before an acquisition approach is finalized, reassess at each MS**

CAIV Policy (cont'd)

- **Additional guidance has been issued on the related fields of TOC & CAIV. These will be discussed later in the briefing:**
 - **SECNAV Memo CAIV Policy Guidance dated 16 April 98**
 - **USD(A&T) Memo TOC Pilot Programs dated 13 April 98**
 - **ASN(RD&A) Memo Implementation of TOC Baselines in the DoN dated 5 May 98**
 - **SAF/AQ memo “Implementing CAIV” dated 12 March 1997**

DoN CAIV Tenets¹

- **CAIV is a DoN methodology for reducing Total Ownership Cost (TOC)**
 - **CAIV entails setting aggressive, realistic cost objectives and managing those objectives while meeting warfighters' requirements.**
 - **TOC includes defense systems life cycle costs, which include all the costs directly associated with research, development, procurement, operations, logistics support, and disposal.**
 - **TOC also includes the indirect, linked costs that are associated with the total supporting infrastructure that plans, manages, and execute a defense system over its full life, and the cost of required common support items and systems that are incurred because of introduction of that defense system.**

¹ SECNAV Memo CAIV Policy Guidance dated 16 April 98



DoN CAIV Tenets (Cont'd)

- **CAIV embraces the following fundamental, iterative actions over the life cycle to optimize warfighting capability within affordability constraints and to promote program stability:**
 - 1. Establish mission area resource allocations for each resource sponsor community.**
 - 2. Determine operational requirements to meet mission needs.**
 - 3. Estimate total life cycle costs to satisfy requirements.**
 - 4. Project long-range availability of resources in all affected appropriations based on resource sponsor priorities.**
 - 5. Assess cost, schedule and performance relationships.**
 - 6. Establish aggressive target costs.**
 - 7. Identify cost reduction opportunities and tradeoffs to meet aggressive targets.**
 - 8. Develop plans, metrics and provisions for managing program execution.**

Gov't
Lead

Ktr
Lead

DoN CAIV Tenets (Cont'd)

- **CAIV is a top-down, bottom-up, continuous, and comprehensive process that facilitates decisions to influence TOC while still meeting the warfighters' needs.**
- **Limited resource availability drives the TOC Target.**
 - **Fiscal constraint is a reality that all stakeholders in the DoN must recognize. Based on the determination of resource availability, a TOC cost target must be set for the system.**

DoN CAIV Tenets (Cont'd)

- **CAIV employs a hierarchy of cost reduction activities, expanding the potential trade space. The recommended priority for cost reduction is:**
 - (1) Processes, activities and technology choices.**
 - (2) Requirements which do not directly contribute to warfighters' needs.**
 - (3) Trade-offs that reduce cost while still meeting all operational requirements.**
 - (4) Cost-performance trade-offs of user requirements resulting in a breach of the approved operational requirement threshold are only to be accomplished as a last resort, with the agreement of the MDA and CNO/CMC.**

Gov't
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DoN CAIV Tenets (Cont'd)

- **CAIV recognizes that carefully structured contracting incentives can offer great leverage in achieving CAIV objectives.**
- **CAIV requires risk management.**
 - **An unavoidable consequence of setting aggressive, realistic cost objectives is an increase in risk.**
 - **Effective implementation and management of CAIV, and the minimization of resultant risk , is achieved by:**
 - **Risk analysis**
 - **Instituting and implementing an effective risk management plan,**
 - **Defining and measuring meaningful metrics**
 - **Establishing incentives**
 - **Utilizing the knowledge and experience of the DoN organization**

DoN CAIV Tenets (Cont'd)

- **CAIV is a cradle-to-grave process**
 - **For new systems, CAIV should be implemented during the requirements generation phase.**
 - **For fielded systems, CAIV should be initiated and refined where practical.**








Other Tenets and Policies

- **Trades are within the purview of the PM between the Objective and Threshold values. Outside these values, they are the purview of the MDA - DoD 5000.2 Ch-3.**
- **SAF/AQ Policy emphasizes:**
 - **Place cost on an equal footing with performance and schedule**
 - **Search for “best value” solutions, not “greatest performance” or “lowest cost”**
 - **CAIV is not setting arbitrary costs and sticking to them**
 - **CAIV is intelligently finding performance cliffs and adjusting performance to suit cost concerns**
 - **Minimize KPPs to maximize trade space (flexibility)**
 - **CAIV integrates the warfighter, developer, acquirer and sustainer into a life-cycle focused team**



Model Applicability

- **Slides shown earlier in the brief will now be annotated to show where the tools discussed might apply**

CAIV Policy

- **USD memo of 4 Dec 1995 directs “Cost As an Independent Variable,” emphasizing:**
 - **Stability** 
 - **Affordability**
 - **Minimized budgets allowing more programs/greater quantities**
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QFD

CIBA

DS

TC

VE

ABC

EVM

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