NATO OTAN

North Atlantic Treaty Organization

NATO Independent Cost Estimating & Capability Portfolio Analysis

Naval Center for Cost Analysis

Brian Flynn

DoDCAS 2008

Contents

- Introduction
- Background
  - NATO
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  - Brochure
  - ICEs
  - Portfolio Analysis

Introduction

- OSD CAIG vision
  - Improve cost estimating in the international defense community
    - 2004 start
- Follow-on to previous efforts
  - Generic Life Cycle Cost Breakdown Structure (GCBS)

NATO/OTAN

Organisation du Traite de l'Atlantique Nord

"The Parties of NATO agree that an armed attack against one or more of them … shall be considered an attack against them all."

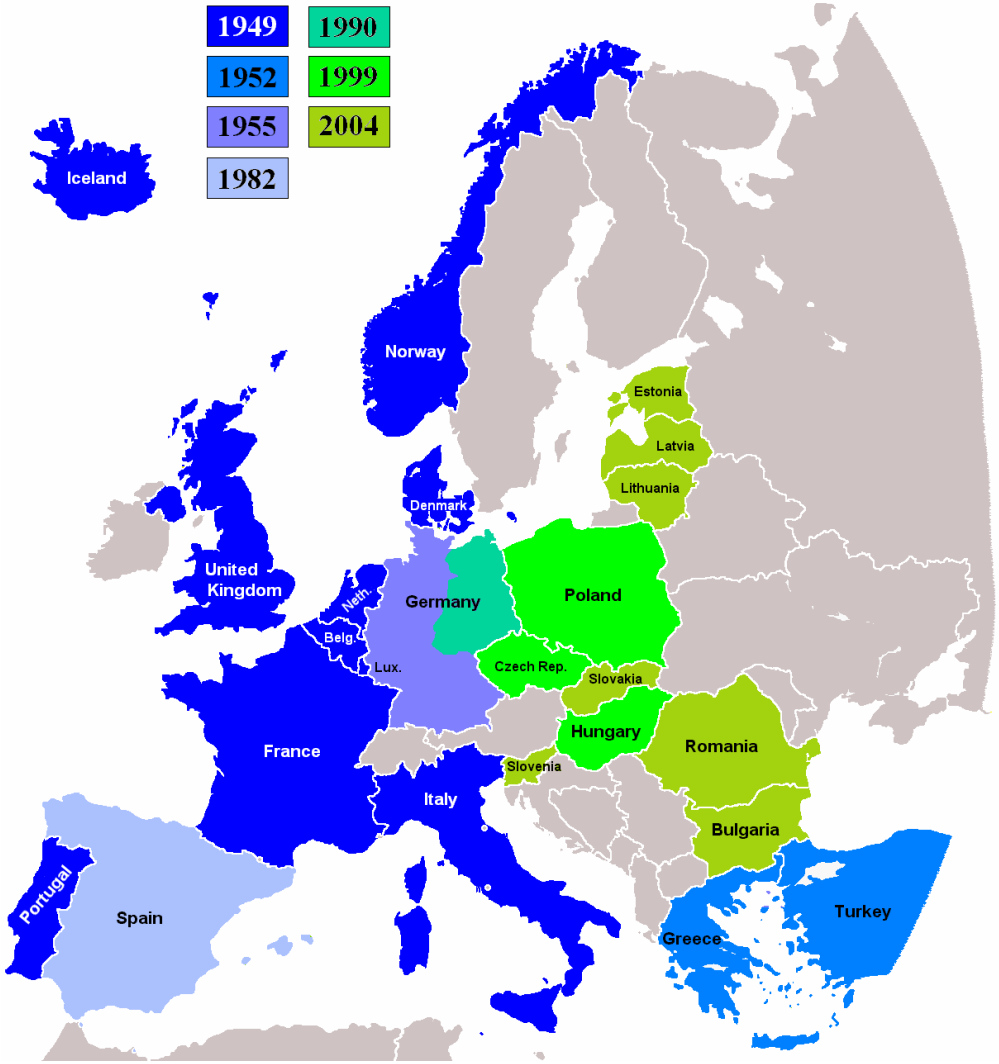
NATO Membership

- Belgium
- Bulgaria
- Canada
- The Czech Republic
- Denmark
- Estonia
- France
- Germany
- Greece
- Hungary
- Iceland
- Italy
- Latvia
- Lithuania
- Luxembourg
- The Netherlands
- Norway
- Poland
- Portugal
- România
- Slovakia
- Slovenia
- Spain
- Turkey
- United Kingdom
- United States

NATO Expansion

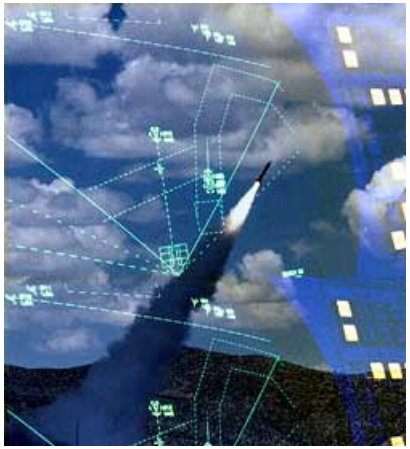
Military Highlights

- 1954 … Soviet Union tries to join
- 1994 … first military action; Bosnia
- 1999 … Kosovo War; Yugoslavian leader Slobodan Milosevic captured
- 2003 … NATO takes command of the International Security Assistance Force (ISAF) in Afghanistan

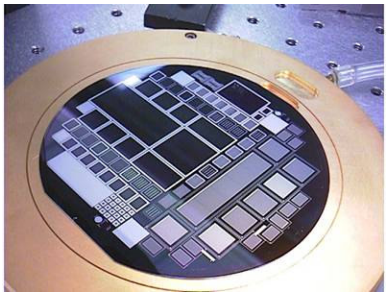


NATO Research

- Task group on cost analysis created and approved by NATO's Research and Technology Organization
- Mission of RTO



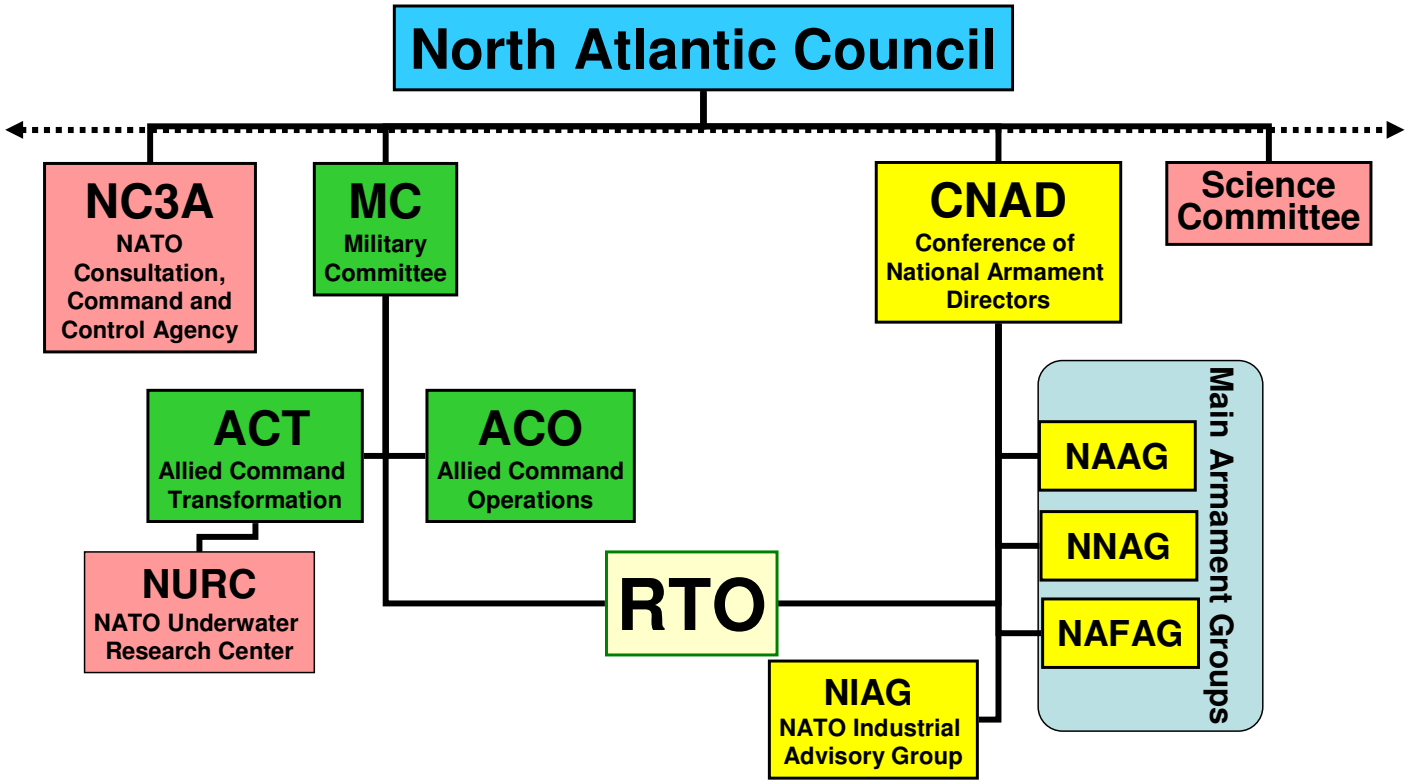
"To support the development and effective use of national defence R&T and thus to maintain a technological lead within the Alliance;

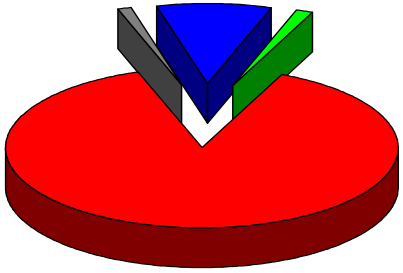


To meet the military needs of the Alliance;

To provide advice to NATO and national decision makers.

RTO Role





Research and Technology Board (57)

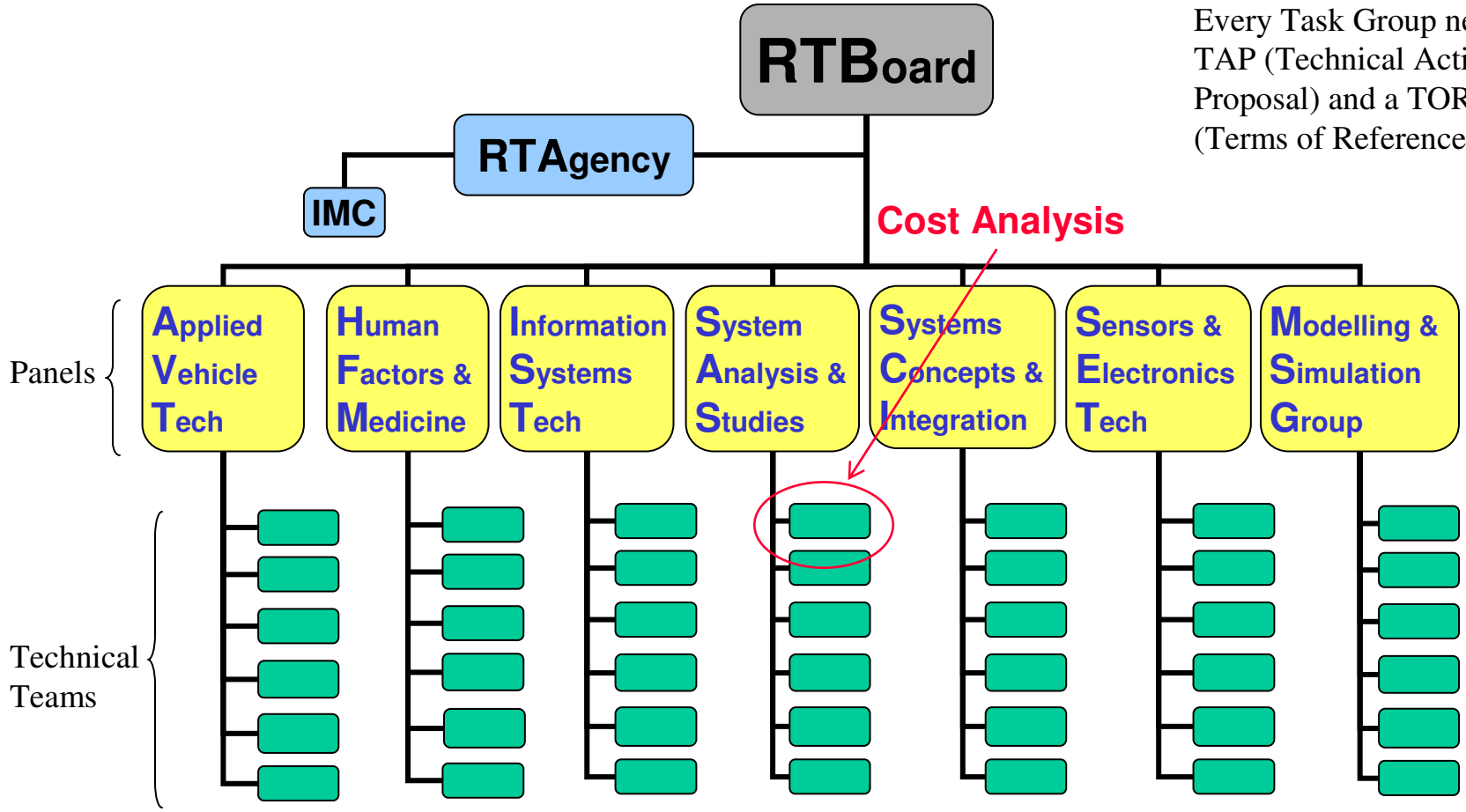
Panel Members (373)

Scientists and Engineers (3,500)

RTA Headquarters (61)

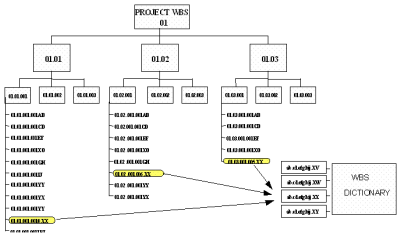
Task Groups

Every Task Group needs a TAP (Technical Activity Proposal) and a TOR (Terms of Reference)



SAS-054, -069, -076

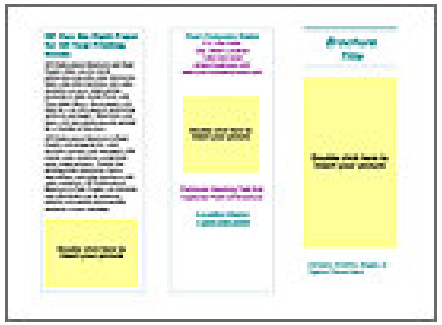
Cost Analysis



SAS-028; Cost Breakdown Structure for NATO

2003

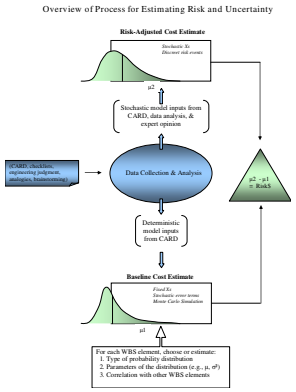
Current



SAS-069; Brochure of best practices.

Lead: Mr. Marcel Smit

NATO
Cost Analysis
Improvement



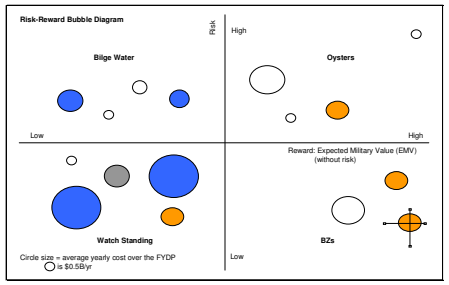
2004 to 2006

SAS-054; Methods and Models for Life Cycle Costing.

Lead: Mr. Marcel Smit

AC/327 Working Group on Life-Cycle Costs

Future



SAS-076; ICEs and Portfolio Analysis

Lead: Brian Flynn

SAS-054

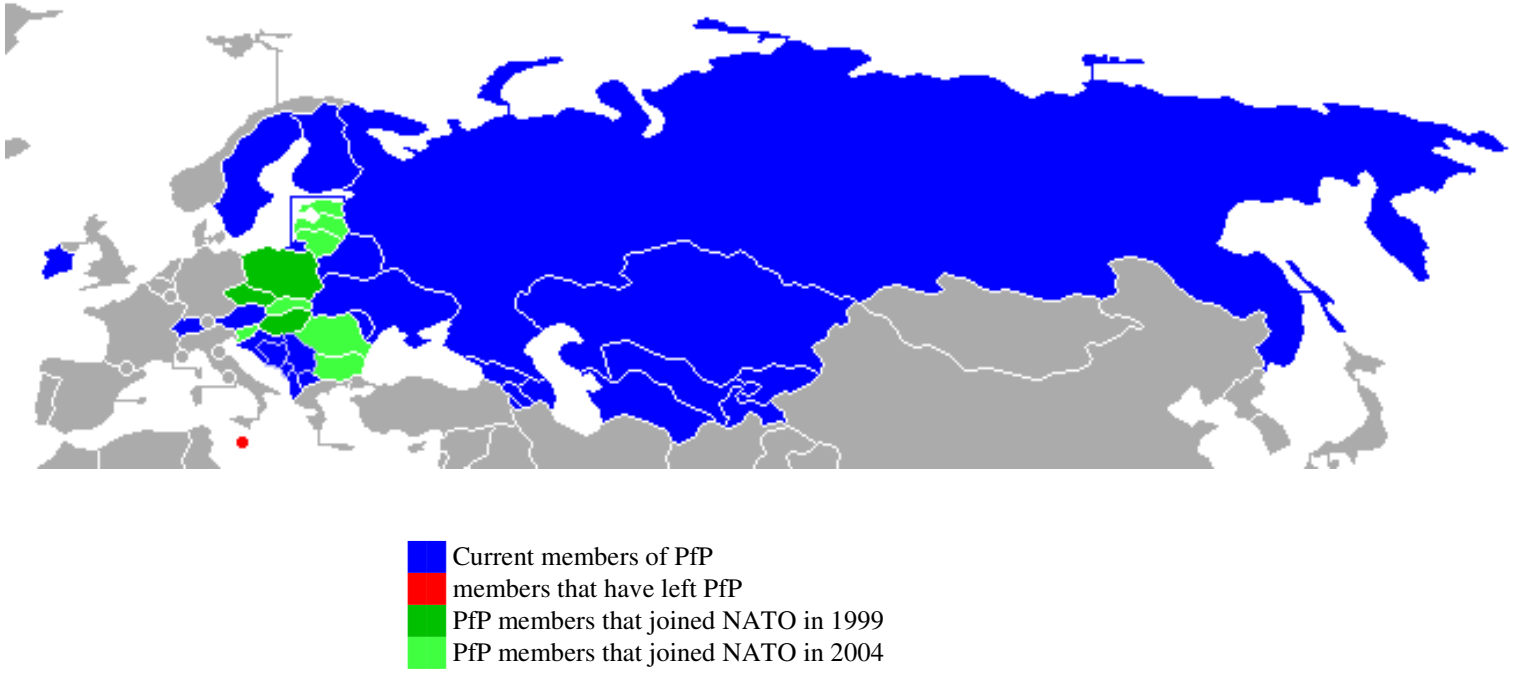
- Membership
  - NATO and Partnership for Peace (PfP) nations invited
  - Participants
    - Denmark, Germany, Norway, Switzerland (PfP), United Kingdom, France, The Netherlands, Sweden (PfP), Turkey, United States, OCCAR
  - Observers
    - Belgium, Italy, Greece, Georgia (PfP)

Manages seven European armaments programs

Organisation conjointe de coopération en matière d'armement

SAS-054

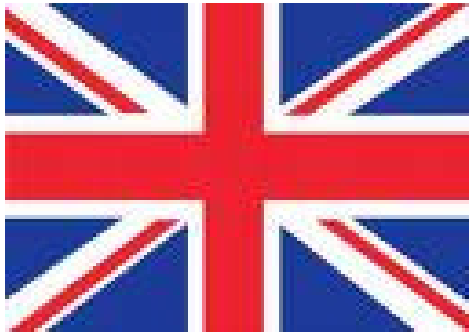
- Partnership for Peace alliance aims to create trust between NATO and other European states and the former Soviet Union
  - Created in 1994
  - 23 members



SAS-054

- Objectives
  - Understand NATO and PfP nations' methods and models for cost analysis
  - Promulgate best practices within NATO's Phased Armaments Programming System (PAPS)

Lead: Mr. Marcel Smit, The Netherlands

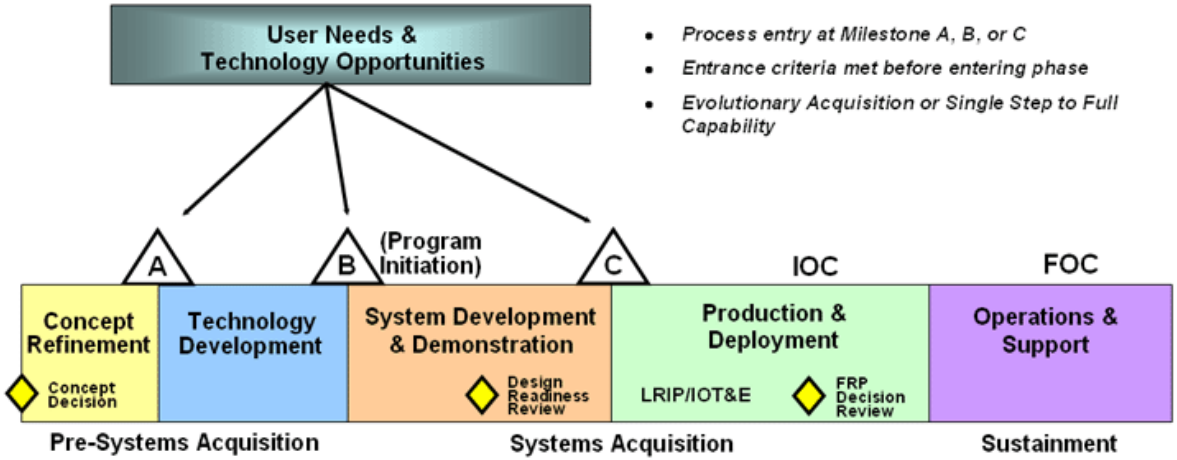


Executive Secretary (Chief of Staff): Mr. Arthur Griffiths, United Kingdom

SAS-054

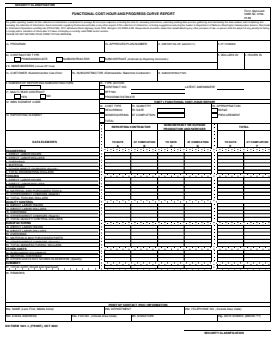
- Method
  - Each nation asked to map its acquisition process into PAPS
  - Then, *best practices* in cost analysis identified for each phase
  - U.S. mapping:

PAPS PHASES in LIFE CYCLE							
1	2	3	4	5	6	7	8
Mission need evaluation phase	Pre-feasibility phase	Feasibility phase	Project definition phase	Design and Development phase	Production phase	In-service phase	Disposal phase
Pre System Acquisition				System Acquisition		Sustainment	
Concept Refinement		Technology Development		System Develop. & Demonstration	Production & Deployment	Operations & Support	Included in O&S



Findings

- Data Collection
  - Critical but difficult for all nations
  - Availability of data often defines what methods and models can be applied



- Methods and Models
  - Standard estimation tools like OLS are common

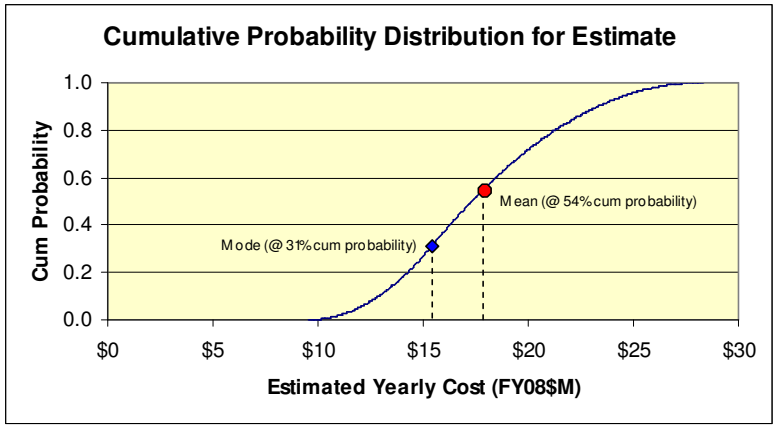
Models		Mission need	Pre-feasibility	Feasibility	Project Definition	Design & Developm.	Production	In-service	Disengage-ment
Optimization	In-house		○						
	Commercial				○	◒	◒	◒	◒
Simulation	In-house			○	◒	◒	◒	◒	◒
	Commercial	○		○	○	○	◒	◒	◒
Calculation / Estimating	In-house	●	●	●	●	●	●	●	●
	Commercial	◒	●	●	●	●	●	◒	◒
Decision Support	In-house	◒	○						
	Commercial	◒							○

Legend

blank	*No nation*
○	*1 nation*
◒	*2-3 nations*
●	*>3 nations*

Findings

- Risk and Uncertainty
  - Life cycle cost estimates are *widely* regarded as probability distributions
    - Point estimate merely one observation
  - Sensitivity analysis and use of SMEs common



Risk		Mission need	Pre-feasibility	Feasibility	Project Definition	Design & Developm.	Production	In-service	Disengage-ment
Methods	Expert opinion	●	●	●	●	●	●	●	●
	Monte Carlo simulation	◒	◒	◒	◒	●	◒	◒	◒
	Sensitivity analysis	●	●	●	●	●	●	●	●
Models for risk analysis	In-house	●	●	●	●	●	●	●	●
	Commercial	●	●	●	●	●	◒	◒	◒
Models for uncertainty analysis	In-house	●	●	●	●	●	●	●	●
	Commercial	●	●	●	●	●	●	●	●

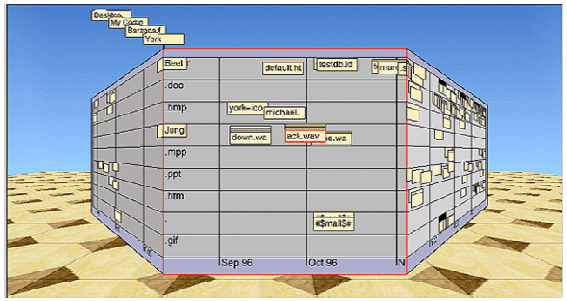
Legend		
	blank	*No nation*
	○	*1 nation*
	◒	*2-3 nations*
	●	*>3 nations*

Findings

- Presentation of Results
  - Little standardization within or between nations
  - Essential to convey the "right" information cogently

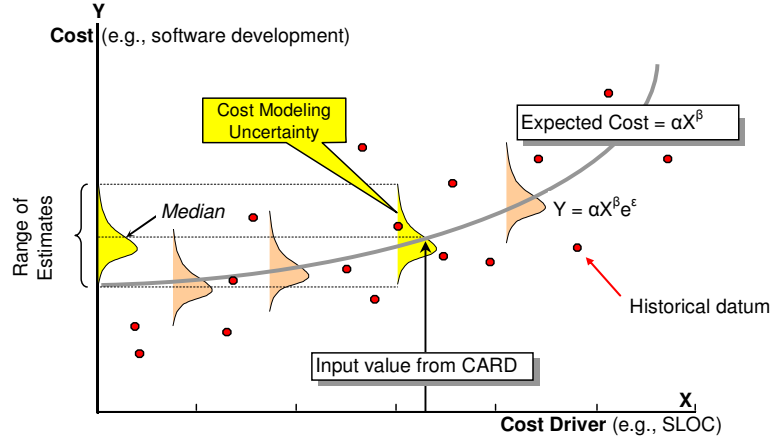
"the basic problem," from PARC

- Exchange of Information
  - Significant barriers
  - Difficulty in accessing each others' websites and databases



Recommendations

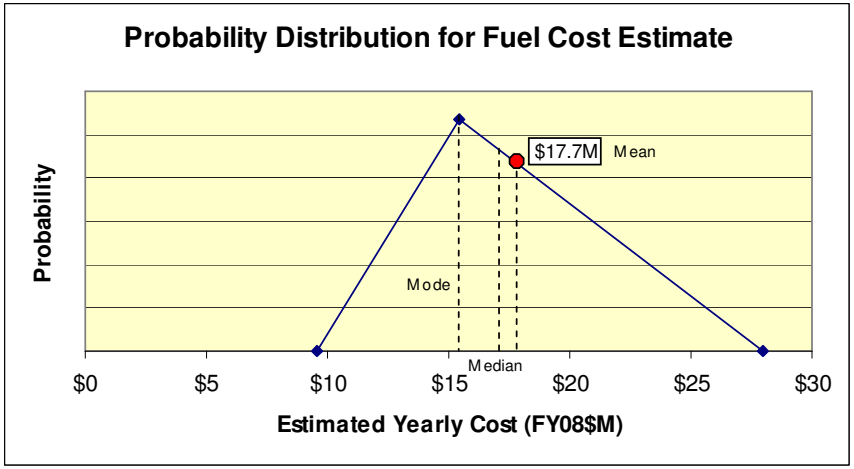
- Life cycle cost estimates should:
  - Be fully documented
  - Be prepared by experienced personnel
  - Include an affordability analysis
  - Use cross-checks
- Life cycle cost models should:
  - Be validated by a recognized testing process
- Data collection efforts should:
  - Focus on cost, programmatic, technical, and performance information
    - Within the entire NATO/PfP community
    - To improve the accuracy, visibility, and availability of data *useful to all*



Breakdown barriers on information access

Recommendations

- Risk and uncertainty analysis should be based on one or more generally accepted techniques such as
  - Sensitivity analysis
  - Monte Carlo simulation
  - Garvey's scenario-based analysis
  - U.K.'s risk registers
- Risk and uncertainty analysis should start early
  - With analytical justification of values
  - Don't leave to the 11th hour

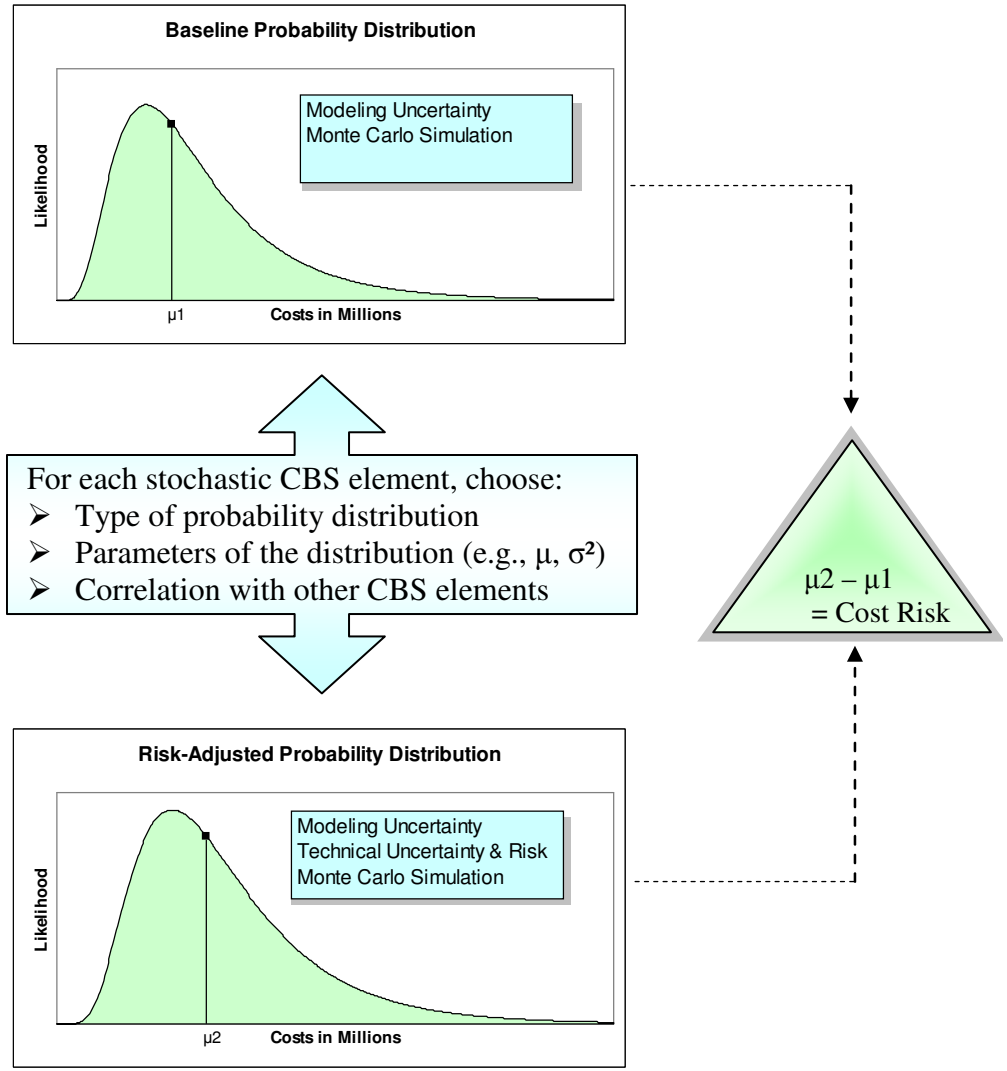


Parameter	Low	Baseline (Mode)	High
Fuel Price			
Per gallon			
OPTEMPO			
Fuel Consumption			
Gallons per day			
State 1			
State 2			
State 3			

Develop early, *with* each point estimate

Recommendations

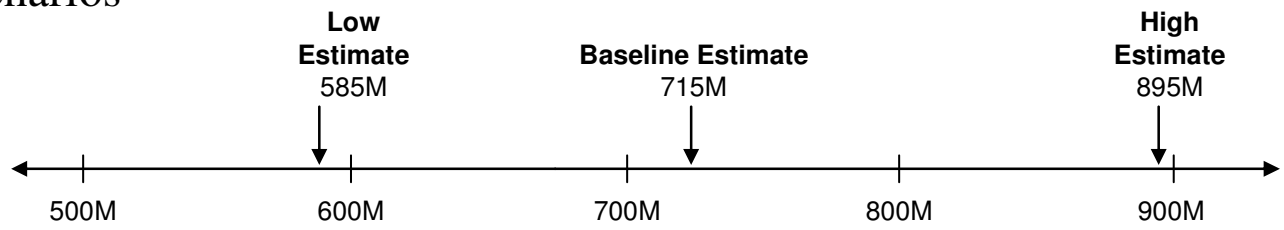
- Conduct Monte Carlo simulation along these lines
  - Generate a baseline estimate that reflects uncertainty
    - "Noise" or variance in estimating relationships
  - Then include risk
  - Delta between the means is *cost risk*



See work of Mr. Tim Anderson and AFCAA's CRUH for more details

Recommendations

- Convey to decision makers the *essential* fact that cost estimates are *stochastic*
  - List assumptions or describe scenarios



> Low-end historical cost growth factor of -18%	> Baseline estimate	> Historical cost growth factor of 25%

Cost Growth Factor, Sensitivity Analysis, or Risk Register from the UK

> 40th percentile estimate using Monte Carlo simulation	> Mean estimate using Monte Carlo simulation	> 80th percentile estimate using Monte Carlo simulation

Risk and Uncertainty Analysis Using Monte Carlo Simulation

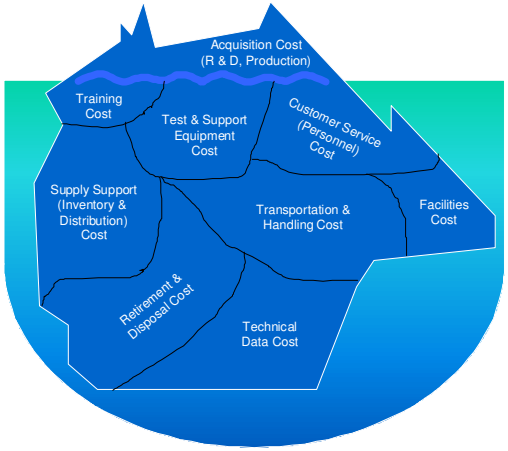
> X month schedule > 80% learning curve > 65% commonality with predecesor > Business base strong > No inflation	> Y month schedule > 85% learning curve > 60% commonality with predecesor > Business base solid > Moderate inflation	> Z month schedule > 90% learning curve > 20% commonality with predecesor > Business base weak > Accelerating inflation rate

Underlying Assumptions or Scenarios

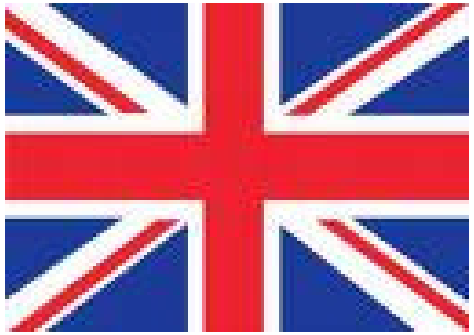
Display a range of estimates

SAS-069

- Code of Practice for Life Cycle Costing
  - Describes best practices for all phases of the life cycle
    - Examples
    - Handy booklet
  - End date: Sep 2008



Lead: Mr. Marcel Smit, The Netherlands



Executive Secretary (Chief of Staff): Mr. Arthur Griffiths, United Kingdom

SAS-076

- NATO Independent Cost Estimating and Capability Portfolio Analysis
  - New effort
    - Start: June 2008
    - End: June 2011
  - ICEs
    - Proof of concept for SAS-054 guideline
  - Role of cost estimating in capability portfolio analysis

Lead: The United States

SAS-076

- Candidate ICEs
  - Ex-post testing
    - One or more systems where a CARD/MDAL is available
      - Test against actuals
  - New systems
    - To support decision making

A400M

SAS-076

- Capability portfolio analysis
  - Best practices
  - Two or three international conferences
    - Subject matter experts from each nation
      - E.g., Joint Staff, USD(AT&L), SOCOM HQ in the U.S.
  - Emphasis on role played by life cycle cost analysis

Decision Support Center, Naval War College

"In defense planning, capability is defined as the enduring ability to generate a desired operational outcome or effect, and is relative to the threat, physical environment, and contributions of coalition partners." [Through Life Capability Management Conference, London, 2007]

NATO Forces

- Long-term goal of NATO cost-analysis activities
  - Engender more informed resource decision making within the Alliance to support coalition warfighters

NATO forces in Afghanistan

Backup

SAS-076

- Examples of *initial* efforts in executing capability portfolio analysis
  - NCCA's pilot in mine warfare
  - Joint staff example

MCM Portfolio

Strategic Assets

National Reconnaissance Office - Satellites
National Geospatial-Intelligence Agency - Digital maps
Defense Intelligence Agency - Human intelligence
Air Force B-52s and strike aircraft
Navy P-3s

Dedicated Navy Assets

Surface

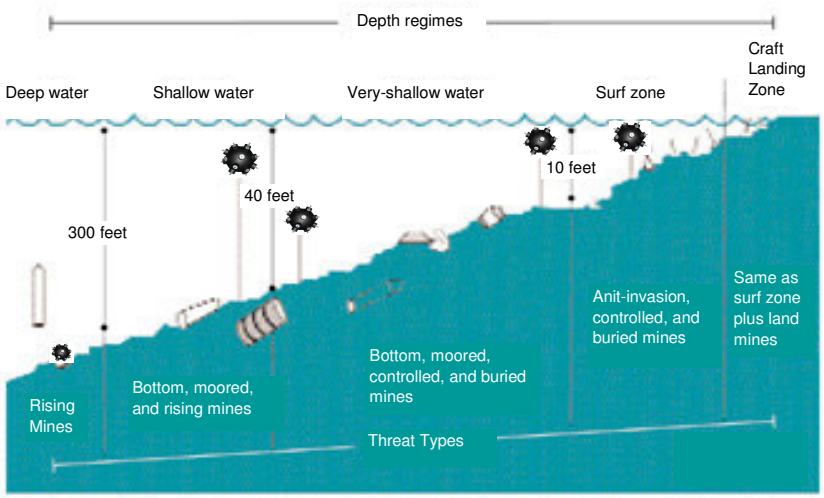
Two classes
MCM-1 Class
MHC-51 Class
Command ship (High Speed Vessel *Swift*)
Systems such as SQQ-32, -32 (HFWB), SLQ-37, and SLQ-38

Airborne

20 MH-53E Sea Dragons (multi-purpose)
-- Systems such as
AQS-14, AQS-20,
AQS-20A, AQS-24
Mk-103 to Mk-106

Undersea

Explosive Ordance Disposal (EOD)
Divers
Marine mammals



Organic Navy Assets

Surface
Littoral Combat Ship
-- Unmanned Surface Vehicle (USV) with influence sweep
-- Vertical Take-off Unmanned Aerial Vehicle with COBRA
-- MH-60S (see below)
-- Remote Minehunting System
-- NSCT-1 with SCULPIN

Airborne
MH-60S Knighthawk with
-- Underwater towed array (AQS-20A)
-- Airborne Laser Mine Detection System
-- Airborne Mine Neutralization System
-- Rapid Airborne Mine Clearance System
-- Organic Airborne & Surface Influence Sweep

Undersea
-- UUVs; MRUUV

Command
-- Systems such as SYQ-13 & MEDAL

Assault
-- Systems such as ABV & JDAM

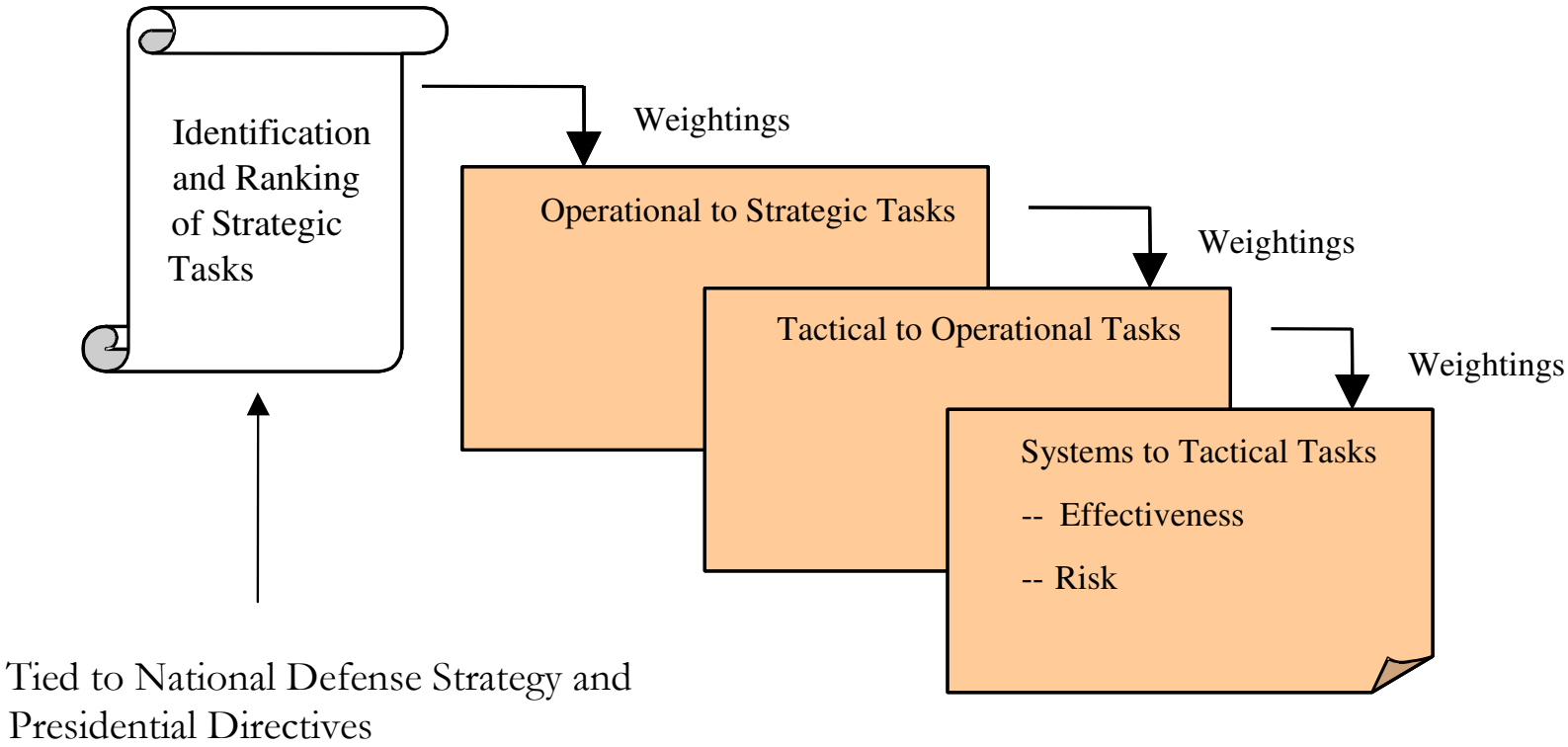
Research and Development Program

DARPA
ONR - Future Naval Capability
Naval Surface Weapons Center - Carderock and Panama City

} Basic & applied research; technology demonstration

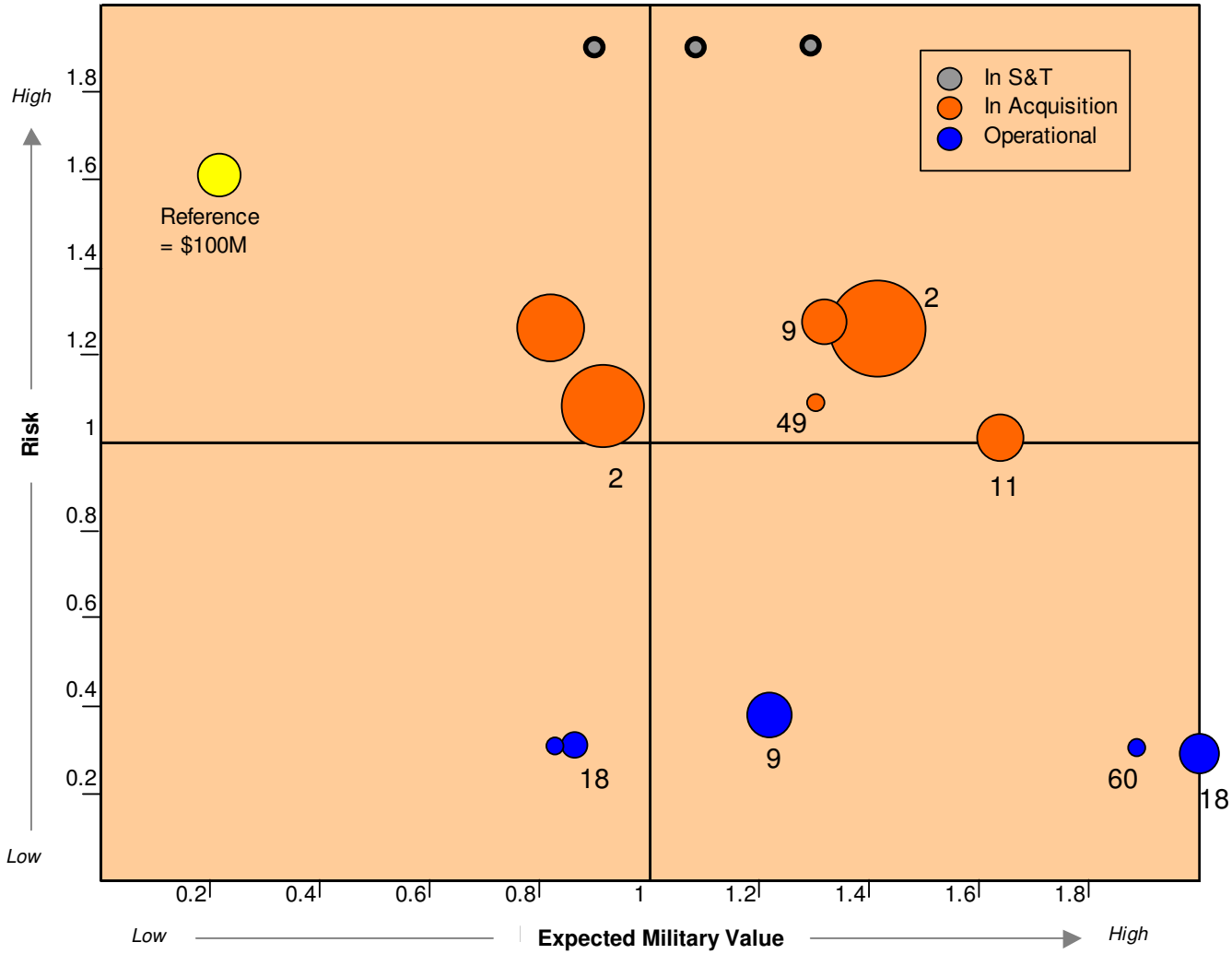
Design of Scoring

- Strategy-to-systems model for MCM assets



Value of Systems

Detection, Localization, Classification, and Identification of Sea Mines



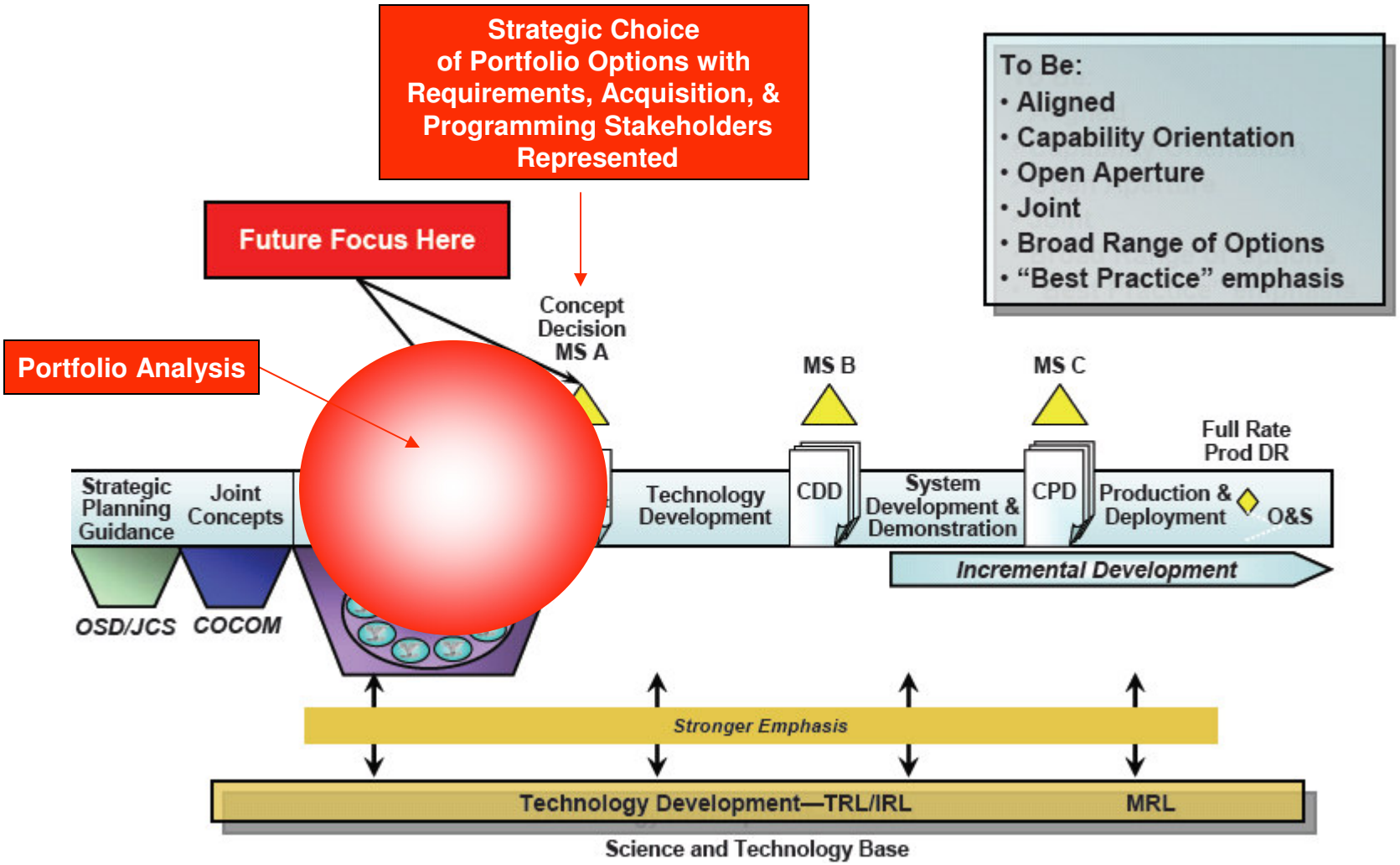
Numbers shown are sample ROIs

ROI = Military Value/Cost

Each bubble captures development and procurement costs over the FYDP + ten years' O&S cost (in FY06$)

Note: ROI is shown only for systems with complete cost data

Concept Decision: (To-Be)



Notional Example

- Next two slides were briefed to DEPSECDEF, Vice Chairman JCS, and other members of the DAWG
- Based on required capabilities to support a notional MCO or stability operation

Unclassified, hypothetical scoring

Notional Example

Example Capabilities: Operational Plan Assessment (What & How Much)

		B	C	D	E	F	G
1		Enter effect prioritizations in this row (High Importance- H, Important- I, Low Importance- L)					
2	Enter JCA prioritizations in this column (High Importance- H, Important- I, Low Importance- L)	**TIER 1 JCA /** **Tier 2 JCA**	Effect 1 AQ and Affiliates are denied safe havens, freedom of movement and funding to establish new footholds (H)	Effect 2 Friendly nations defeat terrorist threats within their borders (I)	Effect 3 Terrorists cannot acquire or employ WMD/E (I)	Effect 4 COCOM is able to recover and eliminate uncontrolled WMD/E materials and maintain the capacity to conduct consequence management in the AOR (I)	Effect 5 Terrorist organizations are unable to conduct attacks against U.S. homeland and interests (H)
3	I	**JOINT ACCESS & ACCESS DENIAL**					
4	H	Contigency Basing	X	X	X	X	X
5	L	Counter Operational Mobility					
6	L	Forcible Entry					
7	I	Freedom of Navigation	X			X	
8	H	LOC Protection	X			X	
9	L	Seabasing					
10	I	**JOINT AIR OPERATIONS**					
11	L	Air Interdiction					
12	L	Offensive Counterair Ops					
13	L	Strategic Attack	X		X		X
14	L	Tactical Air Support	X	X		X	X
15	H	**JOINT BATTLESPACE AWARENESS**					
16	H	Analysis & Production	X	X	X		X
17	H	Dissemination & Integration	X	X	X		X
18	H	Evaluation & Feedback	X	X	X	X	X
19	H	Observation & Collection	X	X	X	X	X
20	H	Planning & Direction	X	X	X	X	X
21	H	Processing & Exploitation	X	X	X		X

X Sufficiency

X Gap

X Overage

Notional Example

Example Implementation / Execution: Who and How (Tasks & Activities) Solution Trades

Capability Provider	Tactical Aircraft	Inventory
Navy	F/A-18E/F	558
Air Force	F-15A/B/C/D	197
Air Force	F-15E	138
Air Force	F-16	414
Air Force	F-22A	38

- Exploring the solution space:
  - Evaluate On-Hand Capability
  - Evaluate alternatives to fill gap:
    - Increase current capability- buy more airframes
    - Substitute alternatives
    - Change DOT_LPF
    - Accept Risk
  - Present decision makers with options in terms of risk and resources
  - Execute a decision

(Notional Example addressing a Joint Air Operations, Tactical Air Gap)