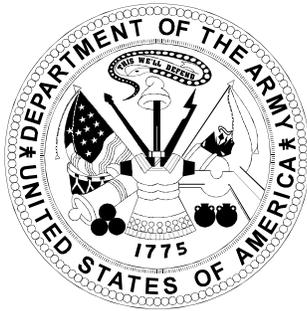


---

# JOINT CAMPAIGN ANALYSIS

## BOOK I – STUDENT TEXT



This publication contains copyright material and may not be further reproduced without permission of the copyright holder.

---

**NAVAL POSTGRADUATE SCHOOL**  
**Operations Research Department**  
**Monterey, California 93943**  
**6 December 1999**

# JOINT CAMPAIGN ANALYSIS

## TABLE OF CONTENTS

	<u>TOPIC</u>	<u>PAGE</u>
<b>PART I</b>	Table of Contents	i
	Preface	iii
	Acknowledgments	v
	Selected Brevities	vi
	Points to Remember	ix
		<b><u>READINGS</u></b>
<b>Section 1</b>	<b>Defining Campaigns/Operational Warfare</b>	
	a. (1) A Circulation Model	
	(2) The Simple Campaign Analysis Model	
	b. A Definition of Campaign Analysis (CA)	
	c. (1) Strategic-Operational-Tactical Warfighting Links	Appendix
	(2) Naval Littoral Center of Gravity and Joint Campaign Analysis	A1, A2, A3
<b>Section 2</b>	<b>Two applications of the simple model</b>	
	a. A Modern Application of the Circulation Model	A
	b. An Air-Ground Campaign	B
<b>Section 3</b>	<b>How CA was used for planning Major War</b>	
	a. A Submarine-on-Submarine Campaign	C
	b. Analysis by Wargaming: American Naval Planning 1919-1941	D
	c. Major Fleet Escort Study (1967)	
<b>Section 4</b>	<b>Contemporary CA for MRCs, LRCs, and LICs</b>	
	a. Discussion of Metric and Methodology	
	b. 1993 Surface Combatant Battle Force Level Study with Metric and Methodology	
	c. Fundamentals of Campaign Analysis in MTWs	
<b>Section 5</b>	<b>Contemporary CA (continued)</b>	
	a. The Gulf War – Lessons Learned; Issues for Campaign Analysis	E
	b. History vs Wargames & Simulations (Benchmarks)	F
<b>Section 6</b>	<b>Air-land campaign modeling</b>	
	a. Air Ops in Desert Shield/Desert Storm	G
	b. The Combat Simulation of Desert Storm	H
	c. A “Littoral Supremacy Ship” Design	I

## MIDTERM EXAMINATION

<b>Section 7</b>	<b>Air-land campaign analysis</b>	
	a. Modern Campaign Techniques: Graphing	J
	b. A Comparison of Land, Sea, and Littoral Campaigns	K, L
	c. Game Theory and Military Decision	M

<b>Section 8</b>	<b>MiniStudy. Student assignments in teams</b>	
	Methodology for Analysis and Presentation	TBA

<b>PART II</b>	<b>APPENDIX A1.</b> Joint Pub 5-00.1 Extract “Design of Campaigns:	
	<b>APPENDIX A2.</b> Towards Understanding Military Strategy – Lykke, June 1989	
	<b>APPENDIX A3.</b> Battle of Britain – Karl Klee, 1965	
	<b>APPENDIX B.</b> Derivation of the Expressions for $\bar{X}$ and $\sigma_X$ of Lesson 1a	
	<b>APPENDIX C.</b> Lanchester’s Equations	

**PART III READINGS<sup>1</sup>**



- A. Conner, Ehlers & Marshall: “Countering Short Range Ballistic Missiles,” 1992
- B. Ravid: “Defense Before or After Bomb-release Line,” 1989
- C. Young: “Setting Goals for a Submarine Campaign,” 1985
- D. Vlahos: “Wargaming: An Enforcer of Strategic Realities,” 1987
- E. CSIS: “Gulf War: Military Lessons Learned,” July 1991
- F. USACAA: “Historical Characteristics of Combat for Wargames [BENCHMARKS],” 1988
- G. Case, Hines & Satchwell: “Analysis of Air Ops During Desert Shield/Desert Storm,” 1992
- H. Appleget, Jeff: “The Combat Simulation of Desert Storm,” 1995
- I. Hall: “A Littoral Supremacy Ship,” point paper of Oct 1993
- J. Arquilla & Fredricksen, “‘Graphing’ and Optimal Grand Strategy”
- K. Bubke, “Clausewitz and Naval Warfare”
- L. Hughes, “Naval Maneuver Warfare”
- M. Ravid: “Military Decision, Game Theory and Intelligence: An Anecdote,” 1989

---

<sup>1</sup> Some of the readings already condensed into the lesson plans.

# PREFACE

## I. INTRODUCTION

This course was originally developed in 1980 while I was in the Chair of Applied Systems Analysis at the Naval Postgraduate School. It was based on campaign analyses typical among Navy Pentagon planners and CINC staffs. As one project, students were required to report on and evaluate individual classified studies in the library for each other. As these studies faded in relevance there were few replacements, because in the early 1980s the Navy closed down its campaign analysis machinery for a decade. But decision-makers hungered for some sort of appraisals. Strategic war gaming was substituted and is still a prominent, overworked tool for campaign and force level planning. The lost art of campaign analysis was revived in the 1990s, but often over-emphasizes high fidelity or comprehensive simulation.

This course emphasizes analytical models and “nesting” data and models within a hierarchy. In the course the lower level models and inputs often can be assumed away as having been provided by tactical or logistical analyses and techniques learned in other NPS courses. The need to understand input-output relationships (“if-then statements”) can then be taught, along with the ability to communicate these relationships to a decision maker clearly.

Before the Navy's maritime strategy was formalized, the navy campaign to support a NATO war against the Soviet Union and parallel operations in the Pacific were both implicit. The written maritime strategy sharpened the campaign-level construct and the shape of the “600-ship navy” gave it benchmarks of mission and force composition. At about the same time, however, the effects of the Goldwater-Nichols Act affected the Navy's charter, created new complications, and entailed an understanding of sister-services' analytical methods. “Jointness” became a watchword and led to new forms of analysis. With the help of Professor Sam Parry, Army and Air Force material was added, and the name was changed to “Joint Campaign Analysis.”

But the seminal event was the collapse of the Soviet Union. That reshaped the substance, and sometimes the tools, of campaign analysis just as dramatically as it reshaped the substance and strategy of the American armed forces. Starting in 1990 the course was reoriented to deal with the analysis of campaigns of unpredictable character, against various and unexpected foes. The analysis watchwords became flexibility and fast-reaction.

As was true of JCS, Army, Navy, and Air Force campaign analyses, in the early 1990s, course emphasis was on major theater wars, supported and sustained by naval forces. Then the course altered again when all Special Operations students began to take Joint Campaign Analysis in 1995. The campaign analysis tools for special operations are, to put it mildly, rudimentary. However, the course now has a broader perspective to look at campaigns across the spectrum of conflict scale and intensity.

## II. THE COURSE

For the first six weeks a wide variety of approaches to campaigns is covered. Each major section introduces the students to operations research techniques applied to campaigns.

At midterm the students are formed into small teams to conduct a mini-study. Each team's final product is a briefing of a fast reaction ("overnight") analysis of a very broad problem that a high level decision maker must deal with "tomorrow." The briefings are presented as a team would deliver an analysis in the JCS Tank or the CNO Conference Room. Taking four weeks in all, the students draw on the course topics and previous courses to plan the problem, gather the inputs, conduct their analyses, and report their conclusions in a 40-minute briefing. All students hear and critique all briefings.

The final examination is an individual paper on some aspect of a mini-study, extending, revising, or challenging it in quantitative detail, using the same or an alternative analytical form. Since some student teams are assigned to analyze plans and courses of action for opposing sides, the students learn the extent to which similar and conflicting results and conclusions will emerge and must reflect on the causes of the differences.

Wayne P. Hughes, Jr.  
Captain USN (Retired)  
Senior Lecturer  
Department of Operations Research

24 November, 1999

## **ACKNOWLEDGEMENTS**

There being no standard body of literature in campaign analysis from which to draw, this course takes advantage of the high standards met by NPS students who have taken the course in the past. Each successive class has affected the content and raised the bar to some degree.

Each of the authors cited and read is owed lasting gratitude, for by and large the works used are enduring and durable. In the mid 1990's LCDR Eric Godat organized my many notes compiled over fifteen years and assembled them in a unified text. Some fine tuning, clarifications, and addition of new material ensued. In 1999 Captain and Senior Lecturer George Conner taught the course in my absence and suggested other changes including the removal of obsolescent material.

This edition was smoothed by LT Marc Schweighofer. He influenced its final form by applying a student's viewpoint to clarify many points. Therese Bilodeau once again was the careful technical editor.

## SELECTED BREVITIES

AA	antiaircraft
ACE	Allied Command Europe
AFSC	Armed Forces Staff College
BLT	Battalion Landing Team
BofB	Battle of Britain
C <sup>2</sup>	command and control
C <sup>3</sup>	command, control, and communications
CAP	crisis action procedures
CCF	Chinese Communist Forces
CDR	commander
CG	commanding general
CG-#	hull number of a guided missile cruiser
CGSC	Command and General Staff College
CINC	Commander in Chief
CINCEUR	Commander in Chief, Europe
CINCPAC	Commander in Chief, Pacific
CINCPOA	Commander in Chief, Pacific Ocean Areas
CINCSOUTH	Commander in Chief, Southern Command
CINCUSNAVEUR	Commander in Chief, United States Navy, Europe
CJCS	Chairman, Joint Chief of Staff
CMG	Cavalry-Mechanized Group
COA	course of action
COMNAVSURFPAC	Commander, Naval Surface Forces Pacific (LANT = Atlantic)
COMUSMACV	Commander of the U.S. Military Assistance Command, Vietnam
CTF	Commander, Task Force
CVN-#	hull number for a nuclear-powered carrier
DD-##	hull number for a general purpose destroyer
DDG-##	hull number for a guided missile destroyer
DEFCON	defense condition
DJCO	Department of Joint and Combined Operations
DMZ	demilitarized zone
DOS	Department of State
DOD	Department of Defense
DTG	date-time group
EUSA	Eighth United States Army
FFG-##	hull number of a guided missile frigate
FM	field manual

FMFLANT	Fleet Marine Force Atlantic
FMFPAC	Fleet Marine Force Pacific
GTA	(German) Guards Tank Army
GTC	(German) Guards Tank Corps
HQ	headquarters
ICTZ	I Corps Tactical Zone
IDAD	internal defense and development
IJN	Imperial Japanese Navy (abolished 1945)
IR	Iran
IQ	Iraq
J5	Strategic Plans and Policy Directorate
JCS	Joint Chiefs of Staff
JMNA	Joint Military Net Assessment
JMSDF	Japanese Maritime Self Defense Force (established 1952)
JOPEs	Joint Operation Planning & Execution System
JOPS	Joint Operations Planning System
JSPS	Joint Strategic Planning System
JTF	joint task force
KMA	Korean Military Academy
LATAM	Latin America; Latin American
LCAC	Amphibious air cushioned landing craft
LCC	Command & Control ship
LIB	Light Infantry Brigade
LIC	low intensity conflict
LIC-PD	Low Intensity Conflict-Proponencies Directorate
LPD-##	hull number of dock landing ship (carries LCACs)
LSS	Littoral Supremacy Ship
MAAG	Military Assistance Advisory Group
MAF	Marine Amphibious Force
MAGTF	Marine Air Ground Task Force
MAU	Marine Amphibious Unit
MCM	mine countermeasures ship
NATO	North Atlantic Treaty Organization
NCA	National Command Authorities
NK	North Korea
NKPA	North Korean People's Army
NSC	National Security Council
NWC	Naval War College

OKH	Oberkommando der Heeres (German Army Headquarters)
OKW	Oberkommando der Wehrmacht (German Armed Forces Headquarters):
OPCON	operational control
OPLAN	operation plan in complete format
OPORD	operation order
OTC	officer in tactical command
PDF	Panamanian Defense Force
PRC	People's Republic of China
RAF	Royal Air Force
RDJTF	Rapid Deployment Joint Task Force
ROK	Republic of Korea
SACEUR	Supreme Allied Commander Europe
SASM	Special Assistant for Security Matters
SOLIC	special operations low intensity conflict
SOUTHCOM	U.S. Southern Command
SWPA	Southwest Pacific Area
TPFDD	Time-Phased Force & Deployment Data
UN	United Nations
UNAAF	Unified Action Armed Forces
USA	United States Army
USAF	United States Air Force
USAFPOA	United States Army Forces, Pacific Ocean Area
USCENTCOM	United States Central Command
USCINCEUR	United States Commander in Chief, Europe
USCINCSO	United States Commander-in-Chief, Southern Command
USFK	United States Forces, Korea
USMC	United States Marine Corps
USPACOM	United States Pacific Command
USSOUTHCOM	United States Southern Command

**Major Fleet Locations**

**HQ**

US 2nd Fleet	Atlantic Ocean	Norfolk, Virginia
US 3rd Fleet	Eastern Pacific/Alaskan Gulf	San Diego, California
US 5th Fleet	Persian Gulf/Southwest Asia	Riyadh, Saudi Arabia
US 6th Fleet	Mediterranean	Haifa, Israel
US 7th Fleet	Western Pacific/Southeast Asia	Yokosuka, Japan

**Major Army Locations**

US Forces - Europe  
US Forces - Korea

## POINTS TO REMEMBER

1. The definition of Campaign Analysis (CA)
2. The 1/3, 1/3, 1/3 rule of analysis
3. Every model product is merely an IF-THEN statement.
4. In every model there are two “IF’s”: [MODEL] + [INPUTS] = [RESULTS].
5. Look for the knee of the curve, as a *measure* of decreasing marginal returns.
6. The ALL PURPOSE EFFECTIVENESS MODEL has two knees
  - Case A: A Force-on-Force examination
  - Case B: A fixed enemy force: buy-in and saturation points
7. In CA, the concept of Artful Simplicity, due to the endlessness of the variables. The question is, is it Naive Simplicity or Sophisticated Simplicity? Choose the right factors vis-a-vis the decision to be made.
8. The difference in CA styles between Army and Navy.
9. In a campaign, distinguish between
  - A. Sequential, e.g., Battle fleet actions: Force-on-Force, few and far between, brief, intense attrition
  - B. Cumulative, e.g., Antishipping actions: Predator-prey, many and continuous, long term attrition results
10. In the decade of the 1980s, the USN shut down its analytical campaign machine and conducted war games only.
11. War gaming is a blunt instrument for analysis.
12. The First Law of Systems Analysis
13. The partitions of naval functions:

	SAFEGUARD	DELIVER
	ATTACK	DEFEND

What? Goods and Services in/from the sea
14. Soviet (or major power) = a “threat” environment  
MTW/SSC/LIC environment = a “risks & opportunities” environment
15. The Gulf War is best studied in terms of Combat Potential and Combat Power with results that include Suppression, Demoralization, and Domination as well as Attrition.
16. All-purpose models always fail.

# LESSON 1a (1)

## A Circulation Model

**Background:** This simple campaign model was developed by CDR Jack Hall in 1969. The purpose is to illustrate statistical uncertainty in determining force effectiveness in a campaign. This model represents a simple circulation concept. Here, a series of submarine patrols is postulated. The model determines the survivability of a force of submarines in a series of attacks on an opposing force's merchant marine. This model could also postulate Special Operation Forces attacking a series of specialized objectives and surviving.

### Points to Remember:

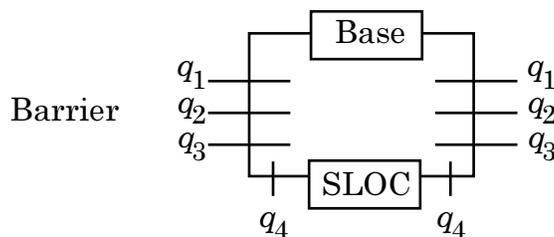
- (3) Every model product is merely an IF-THEN statement.
- (5) Look for the knee of the curve, as a *measure* of decreasing marginal returns.
- (7) In CA, the concept of Artful Simplicity, due to the endlessness of the variables. The question is, is it Naive Simplicity or Sophisticated Simplicity? Choose the right factors vis-à-vis the decision to be made.

### Questions to Ask:

- 1. Why must independence be required in such a simple model?

**Model 1.** Assume that Figure 1a.1 applies. A submarine leaves a base for a patrol on the enemy SLOC (sea lines of communication). The submarine must pass four barriers to the attack area. Each attack barrier has a probability of kill associated with the submarine as it attempts to pass the barrier. The submarine survives barrier  $i$  with  $1 - p_{ki}$  equal to  $q_i$ .

Each barrier survival is independent of the other barrier.



**FIGURE 1a.1**

The aggregate survival for a half-patrol is the product  $q$ .  
 $q_1q_2q_3q_4 = q$ . Thus  $q$  is the half patrol survivability.

Equations from Model 1

Let  $X$  be the number of successful submarine attacks in the SLOC.

$$P[X = 0] = 1 - q \quad \text{note also} \quad P[X \geq 1] = 1 - P[X = 0] = 1 - (1 - q) = q$$

$$P[X = 1] = q(1 - q^2)$$

(Survives with probability  $q$ , makes attack, then is killed: survival probability to base is  $q^2$ , non-survival probability is  $1 - q^2$ .)

Alternatively, a submarine is killed with probability  $1 - q$  and also killed with conditional probability  $1 - q$  given  $q$ , so total probability of a submarine killed =  $1 - q + (1 - q)q = (1 - q^2)$

$$P[X = 2] = q^3(1 - q^2)$$

$$P[X = n] = q^{2n-1}(1 - q^2) \quad \text{Probability Mass Function}$$

$$P[X \leq n] = 1 - q + \sum_{i=1}^n q^{2i-1}(1 - q^2) \quad \text{Probability Distn Function}$$

$$\left\{ \begin{array}{l} \text{Mean} \\ \text{Average} \end{array} \right\} \text{ of R. V. } E[X] = \bar{X} = q(1 - q^2)^{-1}$$

$$\text{Standard deviation of } X = \sigma_X = (1 - q^2)^{-1} (q^3 - q^2 + q)^{\frac{1}{2}}$$

(The derivations of mean and standard deviation are in Appendix B.)

Homework:

$$\text{If } q = .9 \quad \bar{X} = \quad \sigma =$$

$$\text{If } q = .7 \quad \bar{X} = \quad \sigma =$$

## LESSON 1a (2)

### The Simple Campaign Analysis Model

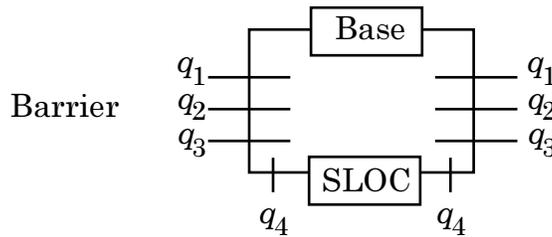
**Background:** This lesson continues to expand Model 2 of the circulation model.

**Questions to Ask:**

1. Why use a normal distribution of the random variable  $Y$ ?
2. What are the three kinds of uncertainty to deal with in this analysis?
3. What conditions might lead to  $p_i$  that were not statistically independent?
4. How would this model change if submarines started at the SLOC (on station)?

**Model 2.**

Expand the simple model with the following definitions:  
(R.V. stands for random variable.)



**FIGURE 1a.2**

Model 2 Definitions:  $M$  hits per patrol (not sinkings) (treated as parameter)  
 $N$  submarines (parameter)  
 $X$  successful patrols (THE R.V.)  
 $q$   $P$ [sub survives] (parameter or R.V.)

For  $N$  submarines the number of ships hit by all is the new R.V.

Since the number of successful patrols carried out by the  $i^{\text{th}}$  submarine is  $X_i$ , then define  $Y$  as:

$$Y = \sum_{i=1}^N MX_i \quad \text{the total number of ships hit by the } N \text{ submarines.}$$

If  $N$ , the number of submarines, is large, then the distribution of  $Y$  should approach a normal distribution, whence

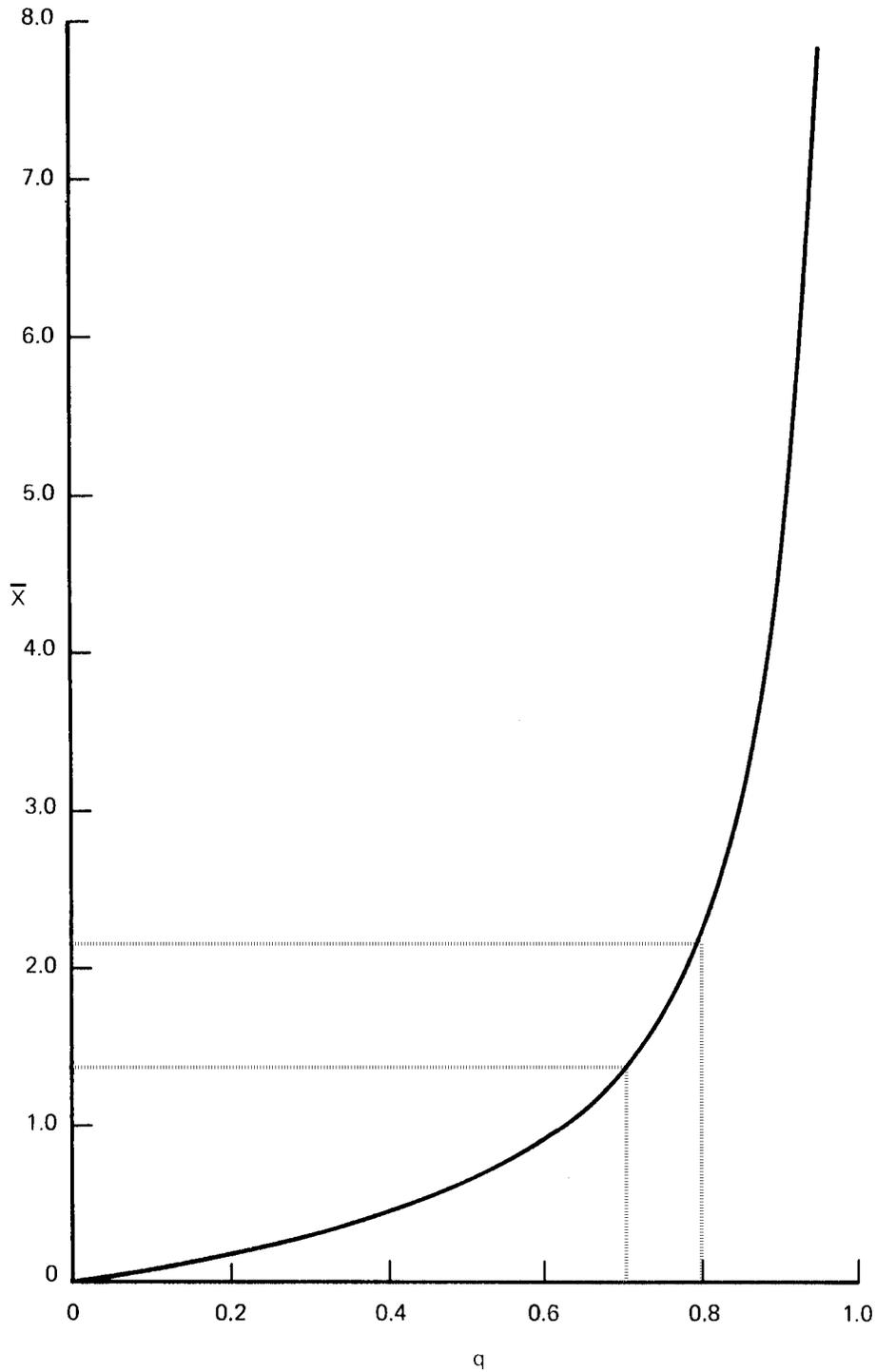
$$f_Y(y) = \frac{1}{\sigma_Y \sqrt{2\pi}} e^{-\frac{(y-\bar{Y})^2}{2\sigma_Y^2}} \quad f_Y(y) = N(\bar{Y}, \sigma_Y).$$

For such a normal random variable, the mean and standard deviation of  $Y$  are

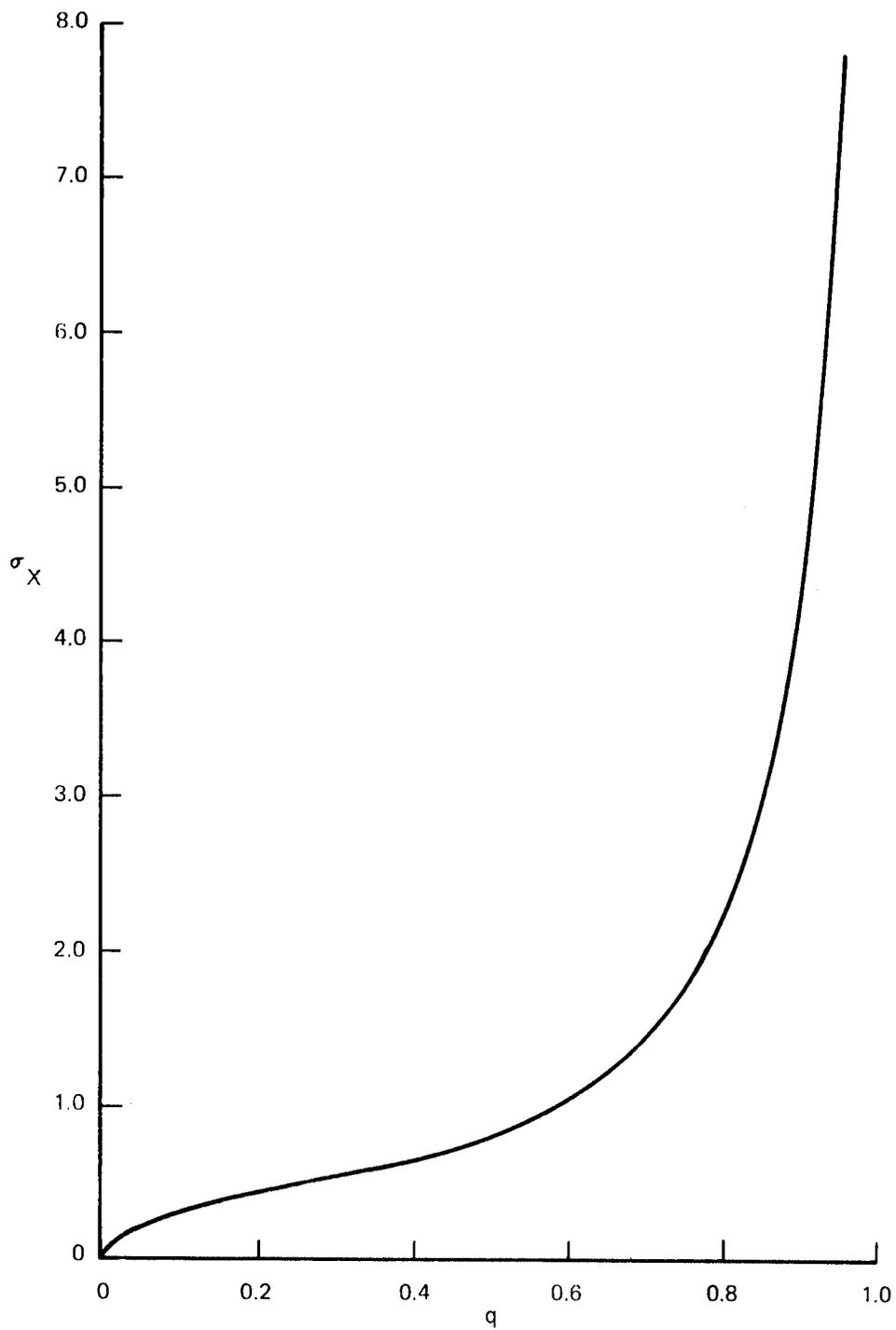
$$\bar{Y} = MN\bar{X} \quad \sigma_Y = M\sqrt{N}\sigma_X.$$

It can be seen that graphs of  $\bar{Y}$  and  $\sigma_Y$  would be proportional to the graphs of  $\bar{X}$  and  $\sigma_X$  given in Figures 1a.3 and 1a.4 (attached). Appendix B provides a table by use of which (once  $q$ ,  $M$  and  $N$  are given) the probability that  $Y$  lies in any specified interval may be found.

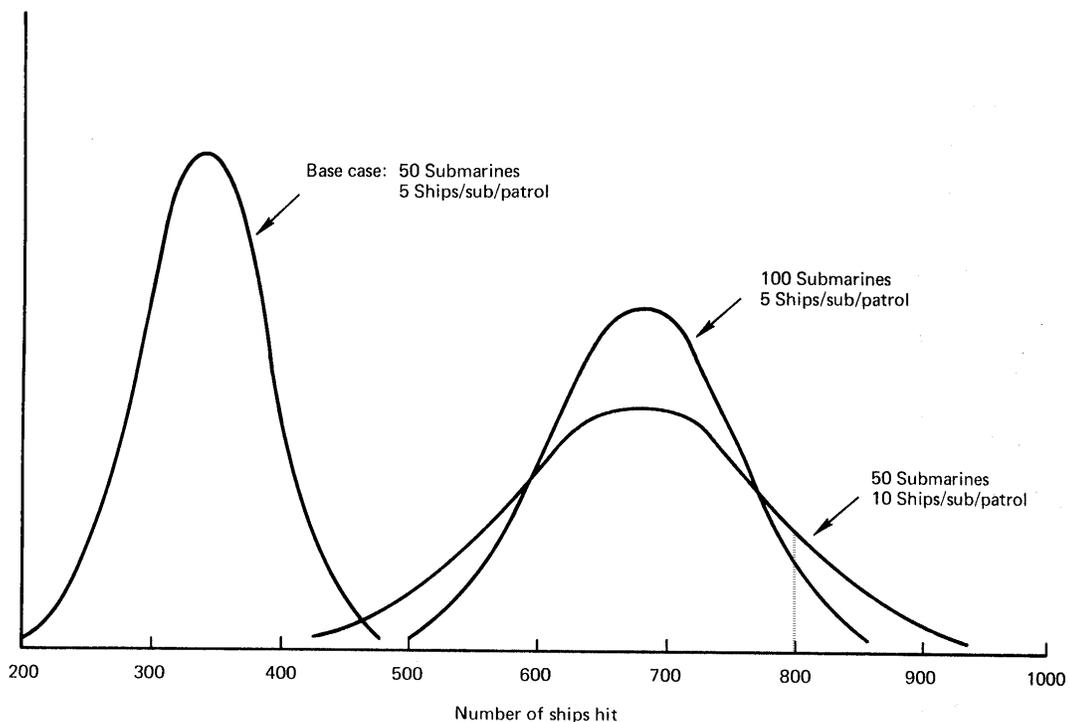
- Observe in Figure 1a.3 a sharp rise (knee) around  $q = .7$
- Conclusion: combine  $p$ 's to give  $\geq .3$  (value of several  $p$ 's)
- Also note greater effect of  $N$  on  $\bar{Y}$  than  $\sigma_Y$ . See Figure 1a.5. Suppose we want to sink 800 ships.  $M$  is more sensitive to an off-average result than  $N$ . If so, go for weapon quality instead of more submarines (a result contrary to Lanchester). This is because  $q$  is treated as a probability and  $M$  as a parameter. In fact,  $M$  also ought to be treated as a probability.
- Other modeling complications
  - (1) Repeated attacks by a sub are needed to achieve  $M$ .
  - (2) Different  $M$ 's and  $q$ 's for different subs (e.g. different classes of submarines are more survivable than others).
  - (3) Some subs would be on station prior to hostilities. What would the distribution be concerning this case? See Appendix B-4.



**FIGURE 1a.3:  $\bar{X}$  (average number of successful patrols per submarine) as a function of  $q$  ("half patrol" survival probability)**



**FIGURE 1a.4.**  $\sigma_X$  (Standard deviation of the number of successful patrols per submarine) as a function of  $q$  (“half-patrol” survival probability)



**FIGURE 1a.5. Changes in the distribution of losses: effect of doubling number of submarines compared with effect of doubling number of ships hit per submarine per successful patrol**

## DISCUSSION OF THE RESULTS

The statistical uncertainty described by this model is the simplest of the three types of uncertainty encountered in actual ASW problems. The worst uncertainties revolve about human choices. In the case of antishipping campaigns the most important of these is, what part of his force will the attacker choose to concentrate against the shipping? The value of  $N$  deals with this uncertainty. The next worst uncertainties concern the performance of the attacker's and defender's weapons systems. The values for  $M$  and  $q$  deal with this type of uncertainty. When  $N$ ,  $q$ , and  $M$  are specified, what remains is the purely statistical uncertainty inherent in a random process describable by probability distributions. It is surprising that a number of ASW studies have tried to deal in detail with some of the large uncertainties described above, but have passed up the chance to say something about the relatively simple matter of statistical uncertainty.

Figures 1a.3 and 1a.4 illustrate the most significant result. That is the existence of an extremely sharp rise in both the mean losses and the spread in the losses, for values of  $q$  greater than about 0.7. Knowledge of this kind of behavior – so easy to highlight with a simple model, so easy to miss or obscure with a complicated one – is very valuable. The obvious conclusion, assuming (as seems very likely) that the same general result would apply in the actual situation, is that ASW forces to defend shipping should be hedged so

as to provide very high assurance that average “half-patrol” survival probability will not be greater than about 0.7.

Another useful piece of information comes directly from the equations

$$\bar{Y} = MN\bar{X}$$

$$\sigma_Y = M\sqrt{N}\sigma_X.$$

One would expect the average total losses,  $\bar{Y}$ , to be proportional to both the number of submarines,  $N$ , and their effectiveness as measured by the number of ships hit per submarine per successful patrol,  $M$ . That is what the first equation shows. It is not so obvious, however, that the spread of the losses depends more strongly on  $M$  than on  $N$ , as shown by the second equation. Doubling of  $M$  will lead to the same average loss as doubling of  $N$ , but in doing so will place greater weight of probability on higher losses. (Figure 1a.5 illustrates this point.) It follows that anything the attacker can do to increase his score for a successful screen penetration (e.g., better fire control, more rapid reloading of tubes, better torpedoes) is very dangerous for the defender, whereas if the defender can take measures to reduce  $M$  by some fraction, he is probably better off than he would be if he reduced the number of submarines by the same fraction.

#### **SUMMARY:**

1. The Variable is  $q$ . It could have been  $M$  ( $N$  is unreasonable). The deviation  $\sigma$  would spread if  $q$  and  $M$  were both random variables.
2. Usually there are several attacks required to obtain  $M$ . This scenario assumes only one attack period per patrol.
3. Some submarines could be on station at the war’s onset. Let them all be inside the screen (i.e. 1 free attack). How would this change the solution for  $X$ ?
4. Look again at Figure 1a.5: the probability that 800 ships or more are lost is higher with respect to increasing the number of ships sunk/patrol than increasing the number of subs.

To illustrate, imagine yourself as Admiral Doenitz speaking to Hitler in 1936. You must ask Hitler for a program buy of submarines. Based on a simple campaign analysis, you state a need for 350 submarines to sink 600,000 to 800,000 tons per month. Your chancellor, Hitler, replies ‘OK, we don’t expect to go to war until 1945.’ Based on this estimate, your pre-war building campaign begins. A “program buy” is scaled for production from 1936-1945.

However, reviewing history, the war starts in 1939. Only 56 subs were on hand at the time of hostilities with the allies. Now the submarine buildup must compete with resources dedicated to the German Army as dictated by the German General Staff. As history records, the fall of France provided the needed bases and raw materials to continue the German submarine buildup.

## LESSON 1b

### A Definition of Campaign Analysis (CA)

**Background:** This lesson defines and discusses campaign analysis. Campaign analysis is a true mix of the art of war, strategic planning, and tactical knowledge. The following materials will help students conceptualize the factors required in a campaign planning and analysis.

#### Points to Remember:

- (1) The definition of Campaign Analysis (CA)
- (3) Every model product is merely an IF-THEN statement.
- (4) In every model there are two “IF’s”: [MODEL] + [INPUTS] = [RESULTS]

#### I. It’s Not Whether But How!

Campaign analysis will be done both pre-war and during a war. Some examples are:

- A. Admiral Doenitz calculated he required Uboat sinkings of 600,000 to 800,000 tons/mo. to win. A pretty fair number... Where did it come from?
- B. Campaigns against Japan were planned in the 1920s-1940s-wargaming. A later lesson will deal with this subject. However, questions like these arose:
  1. With a 5:3 capital ship advantage over the Japanese Navy, could the U.S. sail west and save the Philippines immediately after a Japanese attack?
  2. With a slow advance because of shortages in logistics – would we get there in time?
  3. What changes if the Philippines’ defense fails?

The campaign analysis yielded valuable insights in determining force levels.

- C. Are we making campaign plans to **end** the next war against another type of Iraq? We ought to be!!  
In short, DON’T GET IN WAR WITHOUT A CAMPAIGN PLAN TO GET OUT.  
Define our objective clearly and know roughly how to obtain it.

#### II. Our definition of campaign analysis:

- Study of Conflict between
- heterogeneous Forces in
- a Series of Encounters over time in
- a Wide Geographic Area.

### III. CA is Tidy Statements about Untidy Phenomena

Untidy phenomena can be described in such areas as:

- A. Weapon accuracy against fixed and moving targets
  - Tactical positioning and rotation
  - A/C Fuel-ordnance loading
  - Enemy mentality
  - State of training
  - Availability of forces
  - Sensor effectiveness in securing “battlefield awareness”
- B. We try to build artificially neat models (“Transparent” model is the jargon of today.)
  - Clear cause-effect
  - Well defined inputs
  - Covers the vital variables and omits the others.
- C. *Different from an **engineering approach***. Everything fitting into place, smooth surfaces. Operations analysis deals with messy problems, unavailable data, and streams of choices by both sides.
- D. Campaign analysis is the most difficult operations analysis.

### IV. CA models are usually of two types. They are:

#### **Force-on-Force** versus **Predator-Prey**

Some models are treated as one sided – e.g. Hall, Ravid

Some models are two-sided hunter-evader, emphasizing search – Young

In short, the force-on-force model can be considered a “typhoon”, a battle with great intensity and short duration, whereas the predator-prey model is like a “monsoon”, always present and seemingly endless. The figures on the next page depict the differences.



## VI. CA Methods

This is the model aspect of Campaign Analysis. There are several types of models.

INPUTS

+ → PROCESS → RESULTS

MODEL

### A. White Paper

Like Hawking in *Short History of Time* – no equations are present but the description is based on many computations.

### B. Mathematical Statements– analytic equations either simple or complex.

### C. “Closed” Simulation – a programmer’s “delight” with many pitfalls.

### D. War Game [Man-in-the-loop] – this helps a decision maker solidify what he wants.

### E. Field Experiment – realism produced but costly to replicate.

A, B, C, D, E all may be used to reinforce each other in combinations of “all of the above”.

“All of the above” means a certain integration of the different types. But realize these may be:

1. Integrated horizontally (several forms in competition)
2. Integrated vertically (hierarchical with feedback)

## VII. Requirements for Success

### A. Five Study Inputs

There are five inputs to the analytical process. [These are necessary and sufficient.]



- Scenario
- Blue Force Distribution  
(by function, position, dynamics)  
(what officers do best, so often overdone)
- Green Force Distribution  
(by function, position, dynamics)  
(from Intelligence and “enemy” team who think Green)

- Blue Force Capabilities  
(weapon, sensor, C2, and movement)  
(big danger is to use overoptimistic test results)
- Green Force Capabilities  
(weapon, sensor, C2, and movement)  
(from technical Intelligence community)

To be successful, the campaign analysis process needs the following:



- A well-defined problem (a good decision orientation)
- A competent decision maker (the boss you want to work for will be closely involved)
- Skillful analysts (Modelers, Not Models)
- Satisfactory Inputs (never say ‘good’ or ‘sound’. That’s a hope, but best estimators – like intuition that mate with the model).

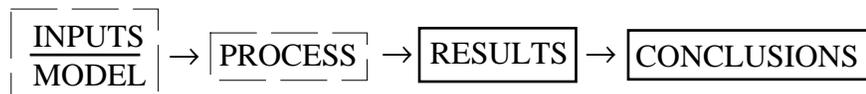
#### B. Six Study Outputs

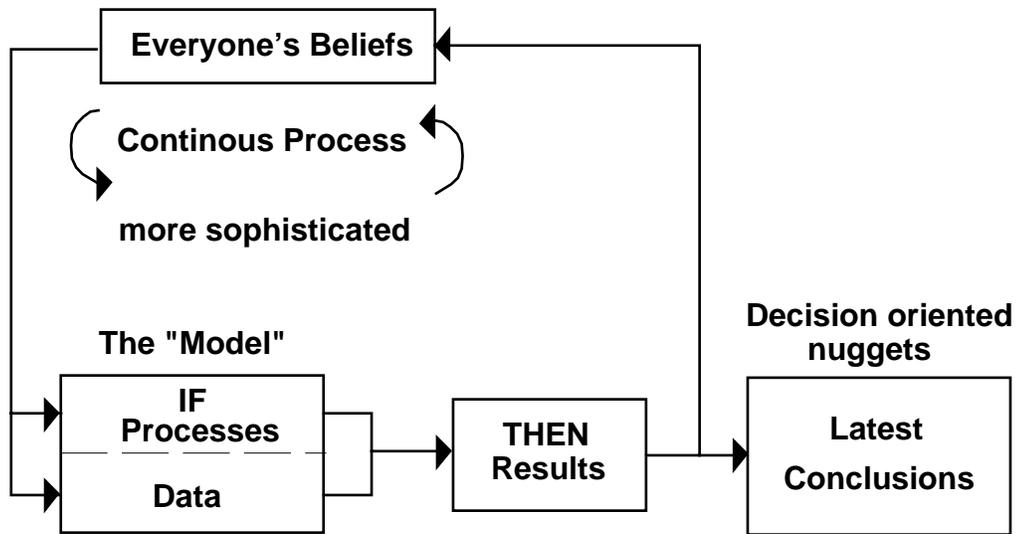
[These are neither inevitable nor sufficient.]



- Patterns of Activity
- Focused Debate
- Synthesized Information [Is it Knowledge?!]
- Informed, Quantitative, Specific — and Incomplete — Advice
- Side Benefits
- “Predictions” don’t appear...

#### VIII. The Study Process



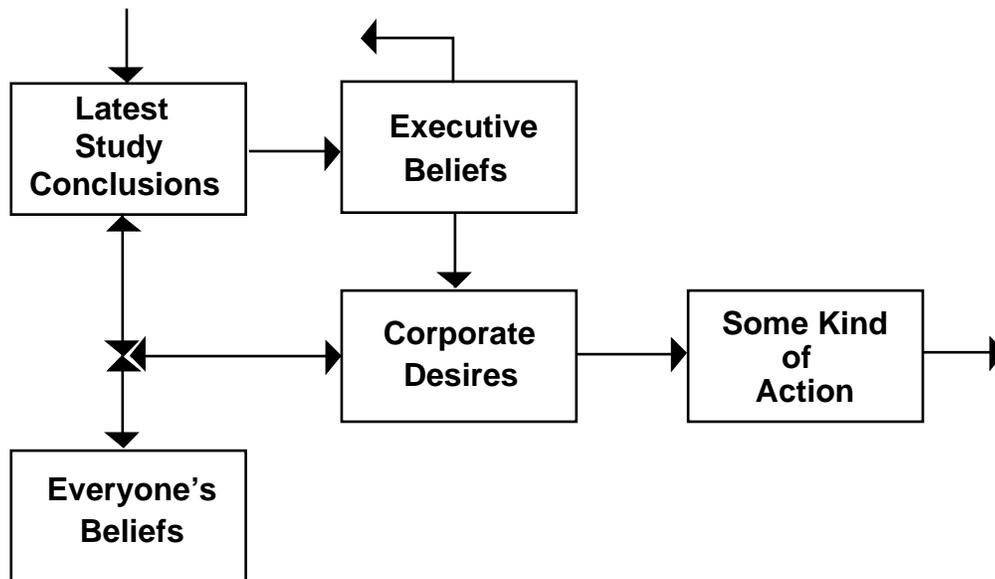


Example for Class Discussion: MFE (Major Fleet Escort study)

A supplement on endurance considered numbers of nuclear powered escorts for carriers – DXGN with CVN; 3 for 5

### IX. The Decision Process

As in any large organization, there is a decision process compounded at each level.



The bottom line of your analysis is summed up in these four words:

RESULTS – CONCLUSIONS – RECOMMENDATIONS – DECISION

## LESSON 1c (1)

### Strategic-Operational-Tactical Warfighting Links

**Ref:** Appendix A1. Joint Pub 5-00.1 Extract “Design of Campaigns”  
Appendix A2. Towards Understanding Military Strategy – Lykke  
Appendix A3. Battle of Britain – Karl Klee, 1965

**Background:** This lesson is based on understanding a nation’s security strategy and the tools necessary to implement this strategy.

#### Points to Remember:

- (1) The definition of Campaign Analysis (CA)
- (11) War gaming is a blunt instrument for analysis.
- (15) The Gulf War is best studied in terms of Combat Potential and Combat Power with results that include Suppression, Demoralization, and Domination as well as Attrition.

#### Questions to Ask:

1. What is the National Security Strategy (NSS)? What are the instruments of national power?
2. What are the links between the National Security Strategy and Campaigns (Operational Warfare)?
3. What are the ends, ways and means of strategy and campaigns?
4. What are the patterns of interwar periods in the future?

**I. National Strategy.** There are several elements of national power. These are political, economic, psychological (societal) and armed forces. These guide military strategy.

There are two types of military strategy:

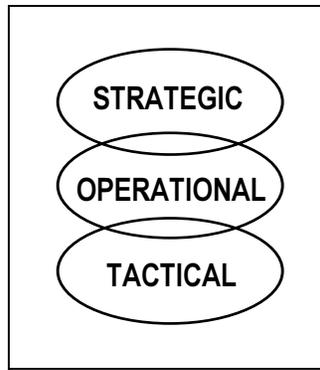
1. force development which influences future strategy,
2. operational-based on current capabilities.

**II. The Levels of Warfare.** What are the levels of warfare as we know it? There are three levels.

Refer to Figure 1c.1. This is the picture of Strategic, Operational, and Tactical levels of war. Operational warfare is campaign level warfare. Analysis at this level of warfare ties in strategy and tactics.

Each level interacts with the one directly above it.

There is one key tactical battle that may influence the strategic situation.



**FIGURE 1c.1**

A. Strategic level of war (NCA, JCS)

1. At this level of warfare, a mesh of political and military objectives occurs. The Clausewitz trinity applies here – a great leader, commander, and will of the people form the backbone of this strategic level. There are the ends, ways, and means.
  - a) Ends – military objective – governed by political objective
  - b) Ways – method of applying force, a course of action (COA)
  - c) Means – resources of military
2. A series of campaigns will mesh the operating forces to strategy.

B. Campaign or operational level of war (CINC)

The movements of forces

A theater commander determines how much combat potential to put where.

The series of tactical battles

C. Tactical level of war – single battle (CJTF, CTF)

Combat power and leadership determine outcome.

**III. Understanding strategy using the instruments of national power.** The instruments of national power are those policies a nation may choose to affect another nation. An example is JCS strategy – the art and science of employing the armed forces of a nation to secure objective of national policy. It may be the actual application or threat of armed forces.

Strategy may be thought of using the ends, ways, and means

$$\begin{array}{l}
 \text{Strategy} = \text{Ends} \quad - \text{Objectives} \\
 \quad \quad \quad + \\
 \quad \quad \quad \text{Ways} \quad - \text{Courses of Action} \\
 \quad \quad \quad + \\
 \quad \quad \quad \text{Means} \quad - \text{Instruments}
 \end{array}
 \left. \vphantom{\begin{array}{l} \text{Strategy} = \text{Ends} \quad - \text{Objectives} \\ \quad \quad \quad + \\ \quad \quad \quad \text{Ways} \quad - \text{Courses of Action} \\ \quad \quad \quad + \\ \quad \quad \quad \text{Means} \quad - \text{Instruments} \end{array}} \right\} \text{Not just military but economic, political}$$

Take for example the Desert Shield/Desert Storm events of 1990/1991.

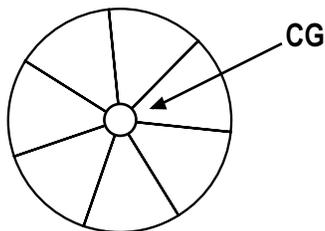
	<b>MILITARY</b>	<b>POLITICAL</b>	<b>ECONOMIC</b>
<b>ENDS</b>	Defeats Iraqi forces Republican Guards	Get Iraq out	Disrupt domestic economy
<b>WAYS</b>	Logistics chain to support action –	Do not recognize. Build coalition. Deploy army.	Trade embargoes
<b>MEANS</b>	Destroy Iraqi mil forces in action, tactical COA of forces	Embassy staff recalled, diplomatic ties severed	Restrict air flights, maritime interception operations (MIO)

#### IV. The U.S. current method of warfare

- A. Joint, rapidly deployed, campaigns – why joint? Because of 1983 Grenada problems, technology impact on weapon systems.  
The Persian Gulf war was really one large campaign with sub-elements of air side, ground side, littoral side. These are called the phasing of the campaign.
- B. What elements are the key to the U.S. method? What are the tie-ins to strategy from the ends, ways, and means concept?
  1. Geography, technology, pace of events
    - a) The Navy has relied on technology to control its geography of water.  
Navy End – strategic control of oceans; Naval End – control of oceans and Marine power projection  
Navy Way – offensive tactics; high tech fleet; Naval Way – high tech/missile LCACS, one or two stage systems  
Navy Means – type commanders and fleet commanders; Naval Means – Navy and Marine CDC (Combat Development Center), Naval Doctrine Command
    - b) Army in past relied on forward deployed geography with oceans as the buffer to protect CONUS. Now the Army has reverted to the rapid deployable forces using the USAF for troops, sealift for their equipment.

#### V. Center of gravity (CG) concept

Clausewitz described the center of gravity as the hub of power and movement. One could easily see how he was relating a wheel hub to illustrate his point. Once the hub of the wheel fails, it all falls apart and disintegrates.



In campaign analysis, identification of the center of gravity is key to developing the campaign plan. Properly defined, the study of a center of gravity of an opposing force will yield a weakness.

To affect the center of gravity the planner must define what is the decisive point, how to approach the lines of operation, and calculate the culminating point. Examples are

1. Decisive points – enemy location, activity, or unit
2. Lines of operation – directional orientation of force to the enemy
  - exterior lines – greater logistics – usually an attacker’s problem
  - interior lines – greater mobility – usually a defender’s problem
3. Culminating point – the strength of the attacker is overextended. The attacker is then vulnerable to counterattack by the defender because the offensive momentum is lost.

**VI. Post War Events** – these events typically define the “interwar” periods. The following is a pattern of events that recur between major wars.

	Between WWI and WWII (beginning in 1919)	Between Desert Storm and ? (beginning in 1991)
Victorious Peace – Drawdown of Services	1919-23	1991-
Consolidation of Revolution Forces	1922 – Soviet Union in full power	1991 - 1992 – Soviet Union collapse
Economic trading blocks	1920s – Roaring Twenties	1992 – NAFTA
Great economic depression – resulting instability, new governments	1929 - 1933	19??
Remilitarization period	1933 - 1936	20??
Heated diplomatic efforts	1938 - 1940	20??
Regional conflict into total war	1939	201?

## LESSON 1c (2)

### Naval Littoral Center of Gravity and Joint Campaign Analysis

**Background:** This material is based on Appendix A and War College publications. The purpose is to understand basic applications of the “art of war” at a campaign level.

In planning a campaign, the culminating points, center of gravity, and lines of operation are three central concepts to success. Attacking the center of gravity is key to getting an enemy to capitulate in your campaign plan. The center of gravity exists at all three levels of warfare (strategic, operational/campaign, and tactical). There are ends, ways and means of each warfare level to accomplish a plan of attack on the center of gravity. Additionally, identifying your vulnerability, lines of operation, and center of gravity may lead you to planning the proper course of action.

Navy littoral centers of gravity are difficult to grasp. However, look to examples of blue water cases then shift to the littoral region. The cases presented are Japanese offensive naval air campaign in the Pacific, German U-boat campaign, and the Falklands War.

#### Points to Remember:

- (9) In a campaign, distinguish between
- A. Sequential, e.g., Battle fleet actions: Force-on-Force, few and far between, brief, intense attrition
  - B. Cumulative, e.g., Antishipping actions: Predator-prey, many and continuous, long term attrition results

#### Questions to Ask:

1. In each of the cases below, why are the centers of gravity so difficult to regain, once lost by the favored side?
2. Why is each center of gravity “the hub and center of all movement”?
3. Does losing a center of gravity necessitate a change in strategy?

#### Case 1 Japan

The Japanese attack the Pacific Fleet at Pearl Harbor. They identify the center of gravity of the main fleet as the battleships, and especially, aircraft carriers. In one tactical attack, the Japanese prove what was the new capital ship and commence an offensive naval air campaign (a series of tactical air attacks). This campaign dominates opposing nation fleets for six months and supports land campaigns.

The Battle of Midway culminates the Japanese offensive naval air campaign. The loss of pilot experience and four capital ships exhausts the Japanese effort for any further offensive. Both the pilots and the aircraft carriers are centers of gravity.

## **Case 2 Germany**

The Germans realize the key to maintaining their continental gains is to keep Great Britain from industrial production and build-up of allied forces. The U-boats are a campaign to keep the war material and personnel off of the British Isles. The series of tactical attacks in the campaign are the wolfpacks attacking the convoys and individual predator/ prey attacks. The allies' center of gravity is the merchant ships.

The Germans' centers of gravity are U-boat production and transit through the Bay of Biscay to reach the North Atlantic convoy routes. The allies try to prevent merchant losses by eliminating the U-boats enroute to patrol stations. The American hunter-killer groups and American/British maritime patrols are the countermeasure to the U-boats. Secondly, convoys in huge numbers (upwards to 70 ships) with strong protection (surface escorts, ASW aircraft, and pouncer groups) prevent U-boat wolf packs in the patrol area from effectively stopping the flow of material and personnel.

Note the opposite result in the Pacific theater. The Japanese only traveled in small convoys (8 to 9 ships) with little ASW protection. The American submarine force attacked this center of gravity successfully.

## **Case 3 The Falklands War**

Here is a modern case of naval littoral warfare. The British fleet center of gravity is vulnerability to air attack. Argentine aircraft operating/staging through the Falkland Islands' Stanley air field will be decisive. Neutralizing the airfield forces the Argentinian aircraft to come from the mainland 400 nm further away. This stretches the operational limit of the Argentine air force.

A key campaign center of gravity is the British logistical capacity in the theater. The Argentinians cause difficulty when they hit the ATLANTIC CONVEYER with cruise missiles. Loss of ATLANTIC CONVEYER causes material loss critical to the British tactical effort in the land phase.

The Argentine Navy center of gravity is weak ASW detection and protection. The British submarine threat restricts the fleet to port after the *General Belgrano* (ex-USS *Phoenix* WWII cruiser) sinks. The Argentinians rely on land based air to counter the British fleet. Electronic warfare and surveillance are key to early detection as a counter measure by British forces.

## Conclusions

Viewing the naval littoral problem, factors to consider in identifying the center of gravity are:

- logistic constraints
- command and control of forces
- surveillance and identification
- combat capabilities of opposing force and his ability to sustain either land threat, sea threat or information threat
- identification and implementation of counter measure force
- risk imposed to blue water fleet forces operating in littoral area
- jointness of integrated Army and Air Force units.

In summary, a Campaign Analysis or operational level of war center of gravity depends on wise location of combat *potential* (fighting forces) and the ability to sustain the combat forces over time. Delivery of combat *power* (activated from combat potential on scene) is the force-on-force issue and a tactical center of gravity.

## LESSON 2a

### A Modern Application of the Circulation Model

**Ref:** Reading A, Conner, Ehlers & Marshall, “Quantifying Counterforce and Active Defense in Countering Theater Ballistic Missiles”

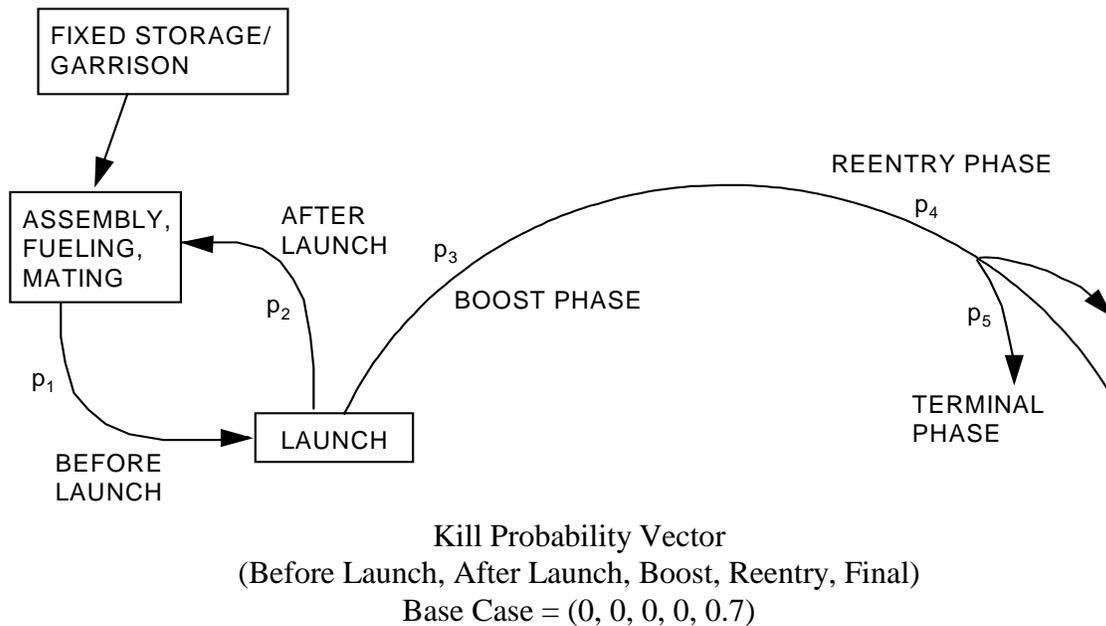
**Background.** CAPT George Conner, USNR (Ret.), former Chair of Tactical Analysis at NPS, convinced Distinguished Professor Kneale Marshall of the Operations Research Department to investigate searching for SCUD missiles. This research started in 1993 and focuses on a circulation model from ASW search techniques. The problem description: What methods of ASW analysis may apply to finding SCUD or other tactical ballistic missile launch sites? That is just like the probability of finding it in an “ocean of land”. Similar to ASW, if you can find your targets, you can attack them. You win by superior search of finding the “archer”. You cannot win in the long term with an active defense of shooting down “arrows” of the archer.

#### Points to Remember:

(4) In every model there are two “IF’s”: [MODEL] + [INPUTS] = [RESULTS].

#### Questions to Ask:

1. Do we need attack operations to solve the TMD problem?
2. Are attack operations too hard?
3. How can we achieve successful attack ops?
4. Are we using the “best” MOE?



**FIGURE 2a.1. Schematic of Theater Ballistic Missile Operations**

The basic model assumes a probability of kill for each phase. Just as in the circulation model in Lesson 1a, the missile survives with probability  $q_i = 1 - P_{Ki}$  for each separate event. This is illustrated in Figure 2a.2. The critical assumptions for this anti-TBM model are:

- (1)
- (2)
- (a)
- (b)

A summary of the problem from a different view the survivability of a missile target is:

Definitions:

- $W_{BL}$  = numbers of weapons used against launchers before launch (BL)
- $W_{AL}$  = numbers of weapons used against launchers after launch (BL)
- $m$  = number of missiles per launcher
- $n$  = number of warheads per missile
- $q_i$  = missile survivability of phase  $i$
- $X$  = number of missiles launched from a given launcher
- $Y$  = number of missiles surviving  $q_3$  and  $q_4$
- $Z$  = number of warheads coming from the  $i^{\text{th}}$  missile
- $H$  = surviving warheads

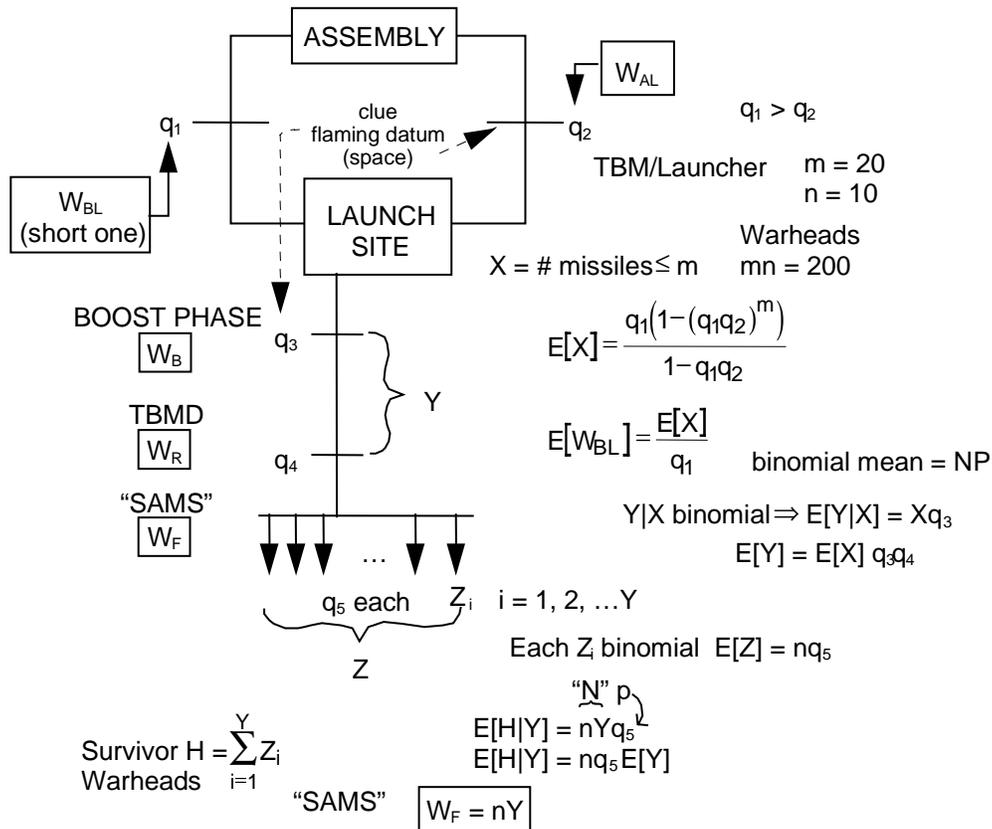


FIGURE 2a.2

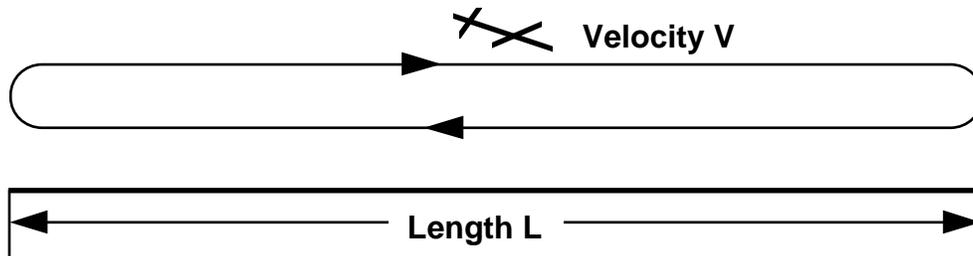
**Ia.** The object is to get the SCUD missiles en route from the assembly area before launch phase.

The kill probability table listed below is a base case with 1 warhead. This current method is viable as a method to defeat SCUD missiles. Just by having some counterforce operations, there is a dramatic improvement in the expected numbers of hard kill weapons needed for defense. The table below illustrates the point.

KILL PROBABILITY VECTOR	EXPECTED # OF WEAPONS PER LAUNCHER					EFFECTIVE WARHEADS KILLED/ WEAPON	EXPECTED # OF LEAKERS
	ATTACK OPS		BOOST PHASE	THAAD	PATRIOT		
	BL	AL					
(0,0,0,0,0.7) - BC	0	0	0	0	20	0.70	6.0
(0,0,0,0.2,0.7)	0	0	0	20	16	0.42	4.8
(0,0,0.2,0,0.7)	0	0	20	0	16	0.42	4.8
(0,0.2,0,0,0.7)	0	4.95	0	0	4.95	1.88	1.4
(0.2,0,0,0,0.7)	4.95	0	0	0	3.95	2.11	1.2

**Ib.** What about searching along roads, searching over TELs? The approach is listed below.

### Searching Along Roads Using Overhead Assets



TEL is assumed to appear at random in both time and location, and remain exposed for a time T.

Define: Coverage factor  $C = VT/L$ , the fraction of the road overflown by the search vehicle during the time a TEL is exposed.

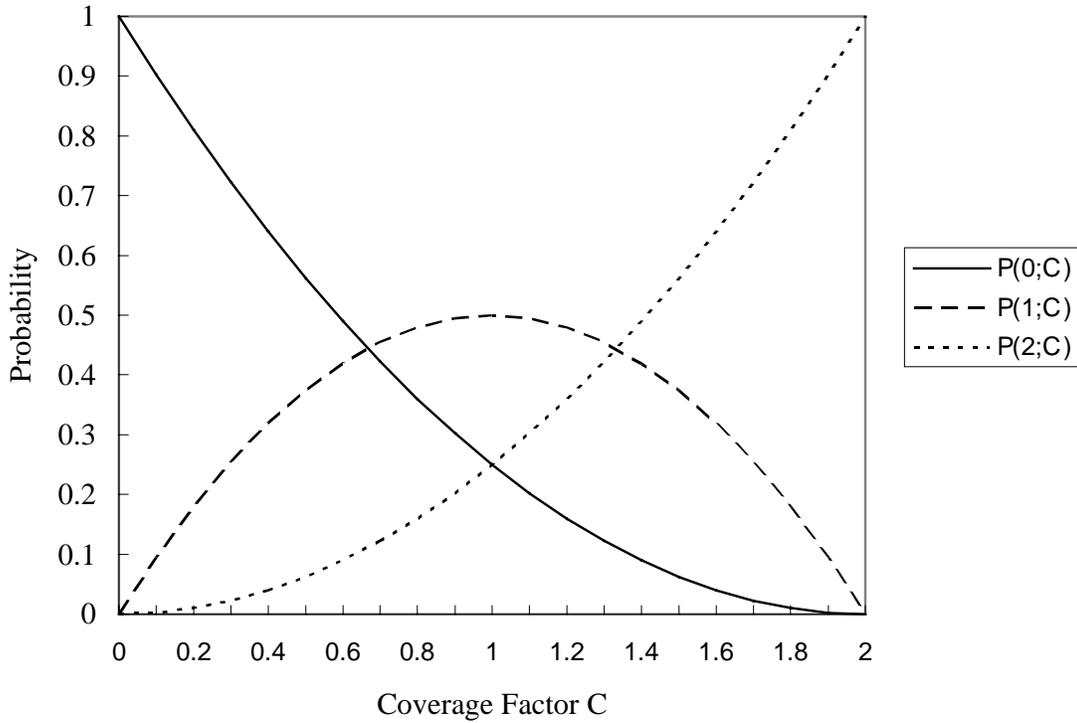
$$P(n; C) = \Pr\{\text{searcher flies over TEL } n \text{ times, given } C\}$$

For  $0 \leq C \leq 2$

$$P(0; C) = 1 - C + C^2/4$$

$$P(1; C) = C - C^2/2$$

$$P(2; C) = C^2/4$$



**FIGURE 2a.3. Distribution of the Number of Times a TEL is Overflowed**

To detect the TEL, the seeker must (1) fly over it while it is exposed and  
 (2) detect it while flying over it.

**Tradeoffs**

- The higher the altitude, the less likely the searcher is to identify an object correctly.
- The faster the searcher, the larger the coverage factor, but the lower the probability of detecting the TEL on a single over-flight.

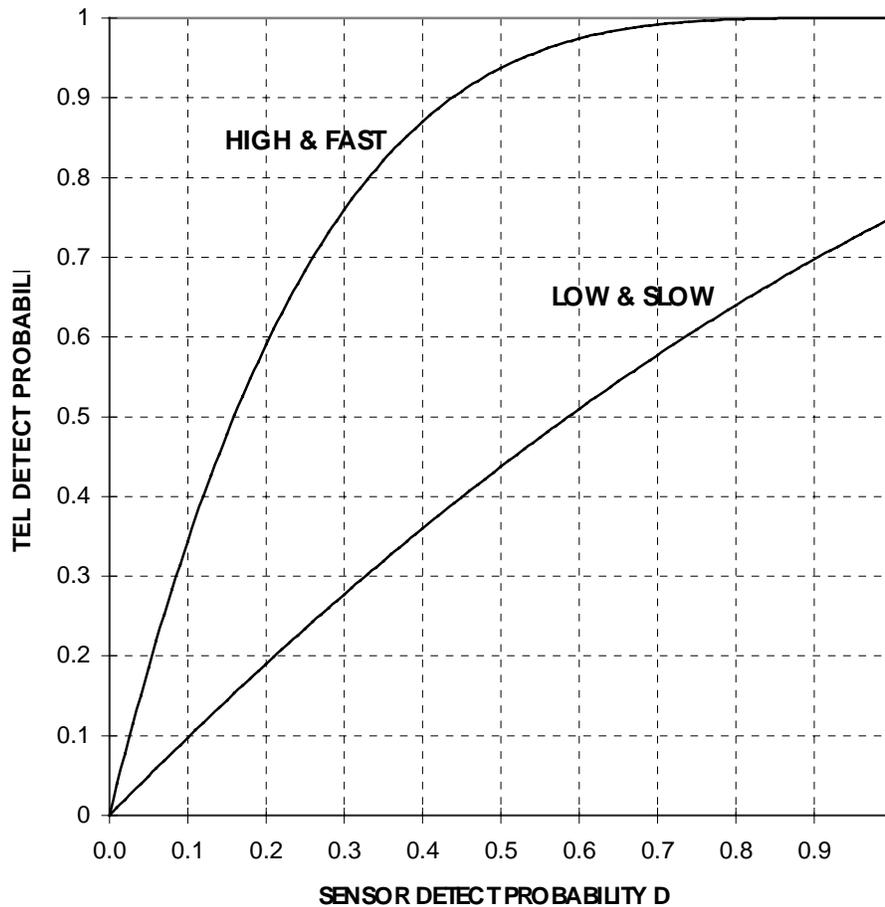
Comparison of search platform operating at:

- (A) 3000 feet and 100 mph — low & slow (L&S)
- (B) 20,000 feet and 400 mph — high & fast (H&F)

Road length L = 50 miles

TEL exposure time T = 30 minutes

Let D be the probability of sensor correct detection and identification on a single over-flight.



**FIGURE 2a.4. Comparing High & Fast with Low & Slow**

First begin with negative search theory. Where it is not currently feasible. There is a trade-off between searching high and fast or low and slow. See Figure 2a.4. Each with a different probability of detection. Use break-even analysis to choose the measure. Use this to find programming/budget decisions.

**II.** There is also a launcher circulation model. This model assumes a campaign approach. The key is to increase cycle times to defeat the launch cycle. Delay of this cycle weakens the enemy. It is hidden campaign not obvious to those who always believe in “hard kill” options.

From launcher circulation model:

$$E[L] = \frac{(1 - p_1) \left( 1 - ((1 - p_1)(1 - p_2))^m \right)}{(1 + ((1 - p_1)(1 - p_2)))}$$

This is the expected number of launches to occur where

$$m = \min \left\{ \bar{m}, \left\lceil \frac{T}{T_C} \right\rceil + 1 \right\}$$

Campaign length  $T = 72$  hours

Maximum missiles per launcher  $m = 15$

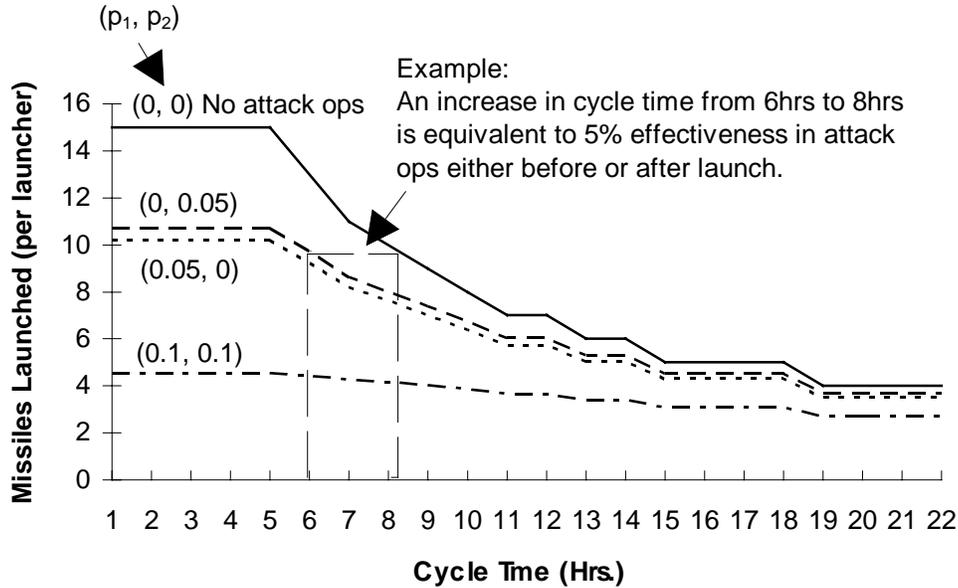


FIGURE 2a.5. Effect of Cycle Time on Expected Number of Missiles Launched

### III. Conclusions and Support Functions for the Problem

- Attack ops are a necessary integral part of a layered system.
- Attack ops can reduce # of missiles launched dramatically (both sides).
- Suppression effects of attack ops can be measured by changes in launcher cycle times, and can be as important as TEL kill in short duration conflicts.
- Attack ops can prevent salvos by disrupting coordinated launch times, thus making active defense more feasible.
- More exercises or controlled experiments to compare H&F with L&S to develop empirical data base.
- Use phasing aspects of ASW procedures to model TMD and develop tactics, techniques and procedures:

**IV.** Comparing the Navy ASW problem to the Army TMD description yields interesting comparisons.

<u>Navy ASW</u>	<u>Army TMD</u>
Cueing	Decide
Search	Detect
Localization	Detect
Classification	Confirm
Attack	Deliver

## LESSON 2b

### An Air-Ground Campaign

**Ref:** Reading B; Ravid, "Defense Before or After Bomb Release Line," *Operations Research*, Vol. 37, No. 5, Sept-Oct 1989, p. 700-715.

**Background.** Itzhak Ravid worked at the Center for Military Analyses in Israel. This is equivalent to the Army's Concepts Analysis Agency (CAA) or the Center for Naval Analyses (CNA). In this paper, several models compare modes of air defense.

This is a thorough paper which applies in a short or long war. It is a *campaign* because a *series* of tactical attacks are involved for the duration of the war (length unknown) against one or more target sites. In short, this is "A piece of analytical art."

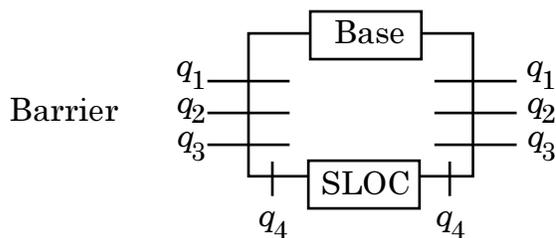
#### Points to Remember:

- (3) Every model product is merely an IF-THEN statement.
- (4) In every model there are two "IF's": [MODEL] + [INPUTS] = [RESULTS]

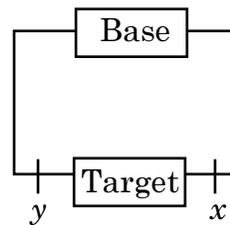
#### Questions to Ask:

1. Why is defense before or after bomb-release line important for a series?
2. What defense is a "privilege of the rich"?
3. Which defense will U.S. air strike planners face in Third World situations?

I. Note the similarity between the circulation model and this concept.



**FIGURE 1a.1**



**FIGURE 2b.1**

Instead of submarine avoidance we have CAP and SAM avoidance for an attacking aircraft. These aircraft must pass through air defenses up to the target entry point or face air defenses after target exit point.

In Figure 2b.1 let  $y$  be the equal to survival rate before the target, and  $x$  be the survival rate after the target. Thus attrition BEFORE BRL (Bomb Release Line) is  $1 - y$  and attrition AFTER BRL is  $1 - x$ .

Let  $R_y =$  Expected number of attacks BEFORE BRL

$$R_y = y + y^2 \dots = y(1 + y + y^2 \dots)$$

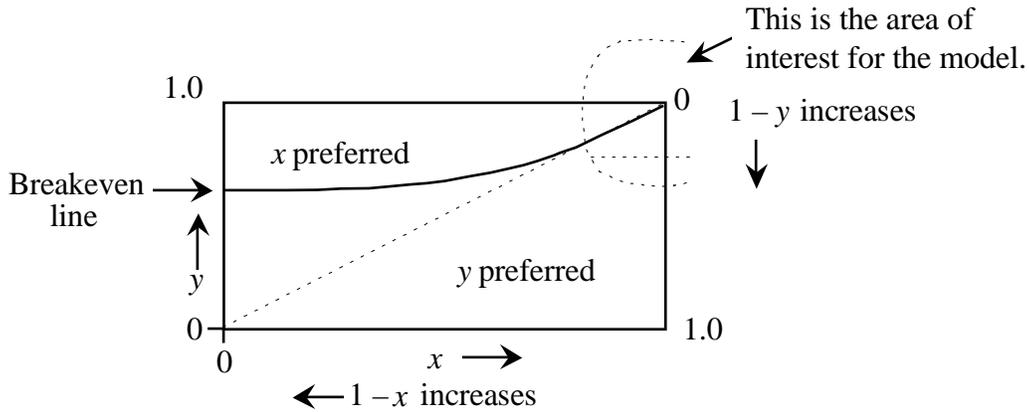
$R_x =$  Expected number of attacks AFTER BRL

$$R_x = 1 + x + x^2 + \dots$$

$R_y$  and  $R_x$  converge to

$$R_y = \frac{y}{1-y} \qquad R_x = \frac{1}{1-x}$$

At the preference breakpoint,  $\frac{y}{1-y} = \frac{1}{1-x}$ . The solution is  $y = \frac{1}{2-x}$ .



**FIGURE 2b.2**

- 1.3 Remember that a *realistic estimate* of Air Defense weapon  $P_K$  is low. Recall in the Marshall et al. paper (Lesson 2a). This tends to make the upper right corner the region of interest in Figure 2b.2. Usually  $P_K$  is overestimated. This is true everywhere. (This is true of TLAM-C.)

## II. Variations and Highlights of the Models.

2.2 Finite number of attacks. Differentiate the equation. Get an initial slope for  $x = 1$ ,  $y = 1$ .

2.3 Add SAMs or CAP — relatively speaking, before BRL is more expedient.

Quantitatively, how much?

[Analogy to homework. Let  $c$  be the killer,  $y$  be suppressor. Same as Offensive + Defensive ASW.]

2.4 Time value of attack:

Depreciate the value of attacks after #1.

Same form as 2.3. Two defense constituents.

2.5 Breakpoint (attacker quits)  $R_y = \frac{y}{1-y}$   $R_x = \frac{1}{1-x}$

An amount  $b$  is the amount of force an attacker decides he can afford to lose. This is *independent* of choosing.

2.6 Suppression

$y$  Before: “Noise” deters pilot effectiveness in delivery.

$x$  After: Higher  $P_K$  does deter bomb effectiveness too.

Adherence rates  $a_x$  and  $a_y^*$

The important thing is to have some AAW. An example is the motor vessels in World War II. AAW guns or merchants were not adding to the Allied aircraft kills of attacking Germans. The first response was to remove the guns. However, it was revealed that attacking German aircraft were more ineffective because of the motor vessels AA batteries’ flak. German pilots were more cautious and less effective even though not hit directly.

Suppression or “noise” before the attacker delivers the weapon on target is useful.

2.7 Saturation (used to be important for SAMs).

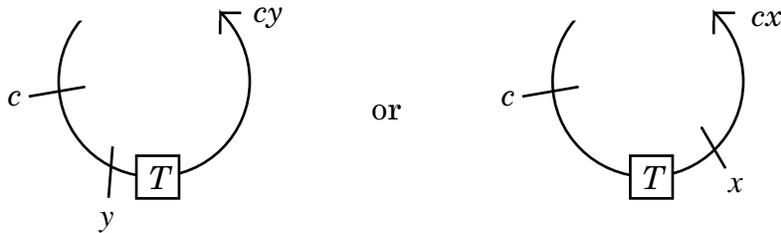
2.8 Different target values.

Complex, but can still be solved without simulation.

3.3 Defenses are the targets — this is an implied Naval model. (Critical here is to understand the differences in the Army and Navy models.)

Early attacks reduce attrition of late attacks. This is workable but use another model.

MOEs min  $R$  like  $\mu/s$



**FIGURE 2b.3**

CASE A:  $\overbrace{cx=.8}^{c=1 \ x=.8}$  Find  $y$  at Breakeven point.

$$\text{Break even at } y = \frac{1}{2-.8} = \frac{1}{1.2} = .833. \text{ Breakeven } cy = .833$$

CASE B:  $cx = .8$  but  $c = x = \sqrt{.8} = .894$

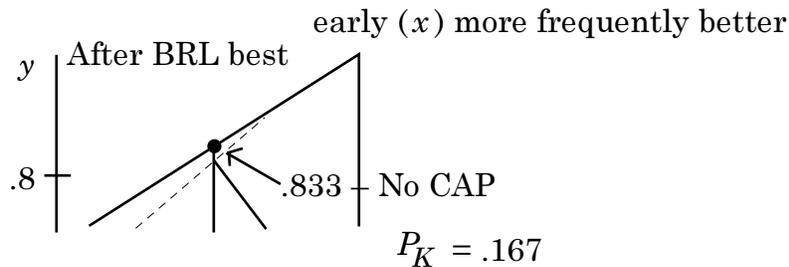
$$y = \frac{1}{1+.894-.8} = \frac{1}{1.094} = .914$$

$$\text{Breakeven } cy = .894 (.914) = .817$$

COMPARE A No CAP:  $(1 - cy) = .167$

B With CAP:  $(1 - cy) = .183$

Early effect of  $c$  (case B) makes putting AAW after BRL relatively more advantageous. Kill advantage of  $y$  has to be relatively greater.



**FIGURE 2b.4**

### III. Attrition in an air campaign based on historical WWII data bomber mission attrition rate

The table below shows the probability of survival versus missions of B-17 crews in World War II. Each mission is independent of the previous mission.

**TABLE 2b.1**  
Attrition Fraction of Force per Mission

		.02	.05	.10	
# missions	10	.82	.60	.35	}
	25	.60	.28	.07	

probability of survival

The tolerable attrition per mission was 2%. For highly motivated crews 5% may be sustainable for a short term. Beyond that no force could survive in a prolonged series. An example is the deep strike of a ball-bearing plant during WWII. A total of 15% of bombers were lost and the mission considered a complete failure.

**Summary.** One MOE is  $R$ , number of attack waves in attacker lifetime. Others?

What is the value of the target?

Goal  $\min R$ ,  $\min R/L$ ,  $\min (R - ?)$  for ?

## LESSON 3a

### A Submarine-on-Submarine Campaign

**Ref:** Reading C; Young, “Setting Goals for a Submarine Campaign”  
Appendix D, “Lanchester Equations”

**Background:** This series investigates CA from a force-on-force perspective. There are two major changes from the modern circulation model. Circulation models are event-stepped. Any estimate of time duration must be made separate from the model. The submarine campaign model described here by Young is a time-stepped scenario. Second, this is a force-on-force model, in which the losses to both sides affect the result and are computed.

#### Points to Remember:

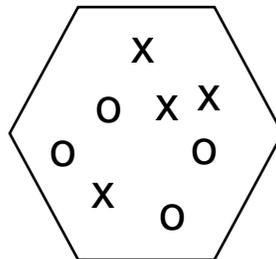
- (14) Soviet (a major power) = a “threat” environment  
MTW/SSC environment = a “risks & opportunities” environment

#### Questions to Ask:

1. Why are exchange ratios considered important for campaigns?
2. What are the major considerations used in time dependent models versus event driven models?
3. Which form of “Lanchester law” is derived by Young? Why does that form make logical sense?

#### Issue

Take a large geographical area where opposing forces are represented below.



**FIGURE 3a.1**

Soviet subs outnumber U.S. subs by ~3 to 1 and the Soviets are continuing to build at nearly three times the rate of the U.S.

Thus, a highly favorable exchange ratio is essential.

Soviet R & D and construction is eroding a potentially favorable exchange ratio – more or better U.S. subs are needed. (The author doesn't mention other ASW methods that could be developed and exploited to offset the Soviet advantage because only U.S. subs were able to operate far forward in support of the old maritime strategy of the 1980s.)

Considerations: sub hulls, machinery, sensors, weapons, tactics, and **duration of submarine campaign**. The desired duration of the sub campaign is driven by the achieved rate of engagement and influences the size of the U.S. submarine force.

### Engagement Rate

Goals must be established (i.e., depletion of enemy submarine force by a given percentage within a certain period of time). The implications of such goals for force level requirements can then be developed with the aid of a deterministic attrition model.

The engagement rate is proportional to the product of the numbers of friendly and enemy subs present. Therefore the ER will decrease as sub numbers decrease due to attrition.

### The Measures of Effectiveness (MOE)

The assumptions:

$X$  SSN's against  $Y$  enemy subs in an ocean theater of a given size,  $X$  is less than  $Y$ .

Describe the operational capability of an SSN by:

- 1) its effective search rate ( $m^2/\text{hr}$ ) (weighted by probability of an outcome)
- 2) the exchange ratio ( $E$ ),  $E > 1$ .

#### MOE #1

Excess number of potential kills ( $K$ )

$$K = EX - Y$$

$K$  is inversely proportional to the time required to reduce the enemy to the desired level.

#### MOE #2

How long to reduce the  $Y$  force of submarines to  $Y'$ ? This  $Y'$  is a fraction of  $Y$ . Adds the "effective search rate". In Young's example SSN's can detect and bring Soviet subs to battle at a rate of  $150 m^2/\text{hr}$ .

Requires the development of a time-dependent attrition model. See the Henry Young paper for its development. Eq (16) is the key equation.

Results of Analysis: With 25 U.S. SSN's, 34 days are required to reduce Soviet force to 1/3 its original size with a loss of 12 U.S. SSN's.

If instead of 25, only 20 U.S. SSN's, then 50 days are required. Now  $K = (4 \times 20) - 75 = 5$ .

### **Observations**

Main Point: Even with a favorable exchange ratio, the number of friendly subs is important to reduce enemy subs within a required period of time.

Attrition Level: The duration of the sub campaign is highly sensitive to the amount by which the enemy force is to be reduced. In the above example, an enemy force of 100 subs can be reduced to:

40 in 17 days

25 in 34 days

15 in 53 days

5 in 125 days

Scaling Rules: If the number of friendly and enemy subs is multiplied by a scaling factor, the time to reduce the enemy level by the same fraction is divided by this factor.

The duration of a campaign varies inversely with the SSN effective search rate.

Campaign durations increase linearly with the area of the theater.

### **Force Sizing Exercise** (see pages 7-10 of Reading C)

The degree of attrition and duration of sub campaign must be specified in order to compute the SSN force requirement.

Soviet submarine forces must be allocated among several ocean theaters of operation and the size of the theaters specified.

### **Soviet Allocation Example:**

- 360 operational Soviet subs
- 60 not in fighting condition on eve of war
- 25 diesel subs assigned to Baltic and Black Seas and don't participate
- 175 assigned to Northern Fleet
- 100 assigned to Pacific Fleet

Suppose the Northern Fleet has three zones of responsibility:

- 1) Near Zone: Arctic home waters
- 2) Mid Zone: girdling Europe in East Atlantic and Med.
- 3) Far Zone: along U.S. East Coast

Suppose the Pacific Fleet has two zones of responsibility:

- 1) Near Zone: home waters and areas in West Pacific
- 2) Far Zone: along U.S. West Coast

Allocate subs in each zone per Table 3a.1 and assume area within each zone that subs will be in (around NATO naval facilities and surface groups) is 1.5 million square nautical miles.

**SSN Requirements:**

Assume an SSN search effectiveness is 150 nautical miles squared/hr in every theater.

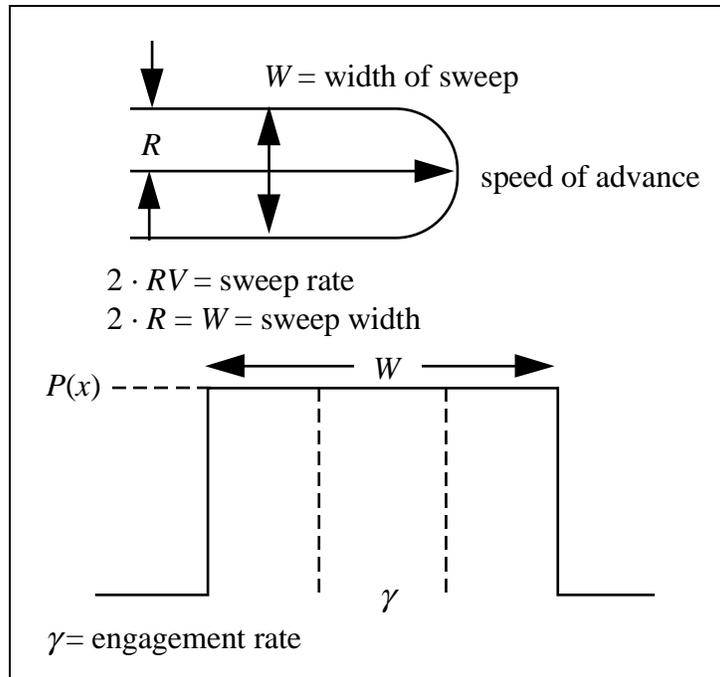
Table 3a.2: required number of friendly SSN's assigned to each area to reduce Soviet force levels by 80% in 60 days:

**Implications**

- 1) A substantial number of extra SSN's must be assigned to achieve an adequate rate of engagement.
- 2) The smaller the enemy force is, the more extra SSN's need to be assigned to an area to achieve an adequate engagement ratio.
- 3) The higher the ER (exchange ratio), the smaller the total force required but the advantage of a higher ER is offset by the need for maintaining a high engagement rate.
- 4) Number of SSN's required for a 30 day campaign:

<u>ER</u>	<u>force level</u>
5 : 1	192
4 : 1	199
3 : 1	233

Doubling the effective search rate doubles the engagement rate and results in the desired reduction in 30 days (1/2 the original time). A general sweep width model will help to describe this in Figure 3a.2.



**FIGURE 3a.2. General Sweep Model**

## LESSON 3b

### Analysis by Wargaming American Naval Planning 1919-1941

**Ref:** Reading D; Vlahos, “Wargaming: An Enforcer of Strategic Realities,” *Naval War College Review*, 1986, pp. 7-22.

**Background.** Mike Vlahos wrote this article in 1985-1986. Many years before he wrote a history of wargaming at the Naval War College during the years between WWI and WWII called “Blue Sword.” This extract describes what campaign analysts learned between the world wars. Their “tool” was wargaming at strategic and tactical levels. Wargaming was really the major tool available for analysis in the 1920s and 1930s.

Wargaming is a major CA tool but has serious limits. One big limitation is that replay and reproducibility are limited. Another is uncertainty about cause-and-effect relationships: one is seldom sure what caused the game’s salient results. Finally, wargames take large blocks of playing time and are manpower intensive. However, wargaming does have training value. It also injects the fog of war when properly done as well as the friction of war when humans participate.

#### Points to Remember:

- (10) The USN shut down its analytical campaign machine in the 1980s and conducted war games only.
- (11) War gaming is a blunt instrument for analysis.
- (15) The Gulf War is best studied in terms of Combat Potential and Combat Power with results that include Suppression, Demoralization, and Domination as well as Attrition. A campaign deals with the movement of combat potential.
- (16) All-purpose models always fail.

#### Questions to Ask:

1. What drives historians to mark phases of interwar periods?
2. Do some lessons of history never change? How do you study military history to learn these constants of war?
3. Relate the dangers of simulation wargames today to the lessons of manual war games in the 1920s – 30s. What is the critical issue?

## The Background of NWC Newport post-WWI

First place yourself in the shoes of an analyst in 1919. The first question you must ask is “Who is the enemy?” There were various scenarios depending on the country. (Colors noted country.) At the time, the following country colors were used.

Great Britain	– red	Soviets	– purple
Japan	– orange	Germany	– black
Italy	– silver		

For the U.S. Navy, Japan was regarded the most likely naval threat, but Great Britain had a navy that rivaled ours in size so was often used as the most severe test.

By the Washington Naval Disarmament Treaty of 1922, the Japanese navy was limited to 5:3 inferiority in capital ships (battleships, battlecruisers, and aircraft carriers). The Japanese wanted parity and resented their inferiority. Being a major regional power was the goal of a new industrialized Japan, and their campaign problem was how to defeat the U.S. (or British) although outnumbered. Their campaign plan was to whittle down the U.S. fleet by air attacks, night attack by destroyers with torpedoes, and submarine attacks, so their battleline could fight ours on even terms or better.

Some key events

- 1919 Versailles Treaty decided the partition of Pacific islands, and Japan received German possessions in the Pacific: the Marshalls and Carolines
- 1922 The Washington Naval Treaty: 5:3 Fleet limitations. This was the U.S.: Japan capital ship ratio. But this did not limit cruisers, destroyers, and submarines.

### I. The Stages of Naval Wargaming between WWI and WWII

Vlahos says there were three distinct phases in the evolution of strategic planning of the Pacific campaign – classified as

Phase	Period	Naval View
I Far East Short War	1919-1928	Naive – a climatic Mahanian Battle
II Middle Phase	1929-1935	Complicated – expect 1-3 yrs war
III Late Phase	1935-1941	Sophisticated – expect 3-5 yrs war

#### A. PHASE I: A Naive View (1919-1928)

The U.S. view during Phase I.

The Navy would protect the Philippines in a Mahanian-style battle. This Mahanian battle would be similar to a modern Manila Bay victory of Dewey or a Pacific “Jutland”. The method – compel a decisive fleet action.

What were the results of these games? The wargaming outcomes were the U.S. would lose a few ships, wipe out the Japanese fleet, and then move to save the Philippines unimpeded.

What did the early analysis miss? Japan's strategic *geographic* position negotiated in the 1925 treaty and its Navy *modernization* in cruisers, destroyers and submarines, and in weapons (deploy the 24" torpedo) and tactics (especially night fighting).

- The terms of the 1925 treaty did not allow U.S. fortification of the Pacific possessions.
- The Japanese fleet modernized other than battleships (e.g., long lance torpedo, cruisers, destroyers).
- The need for us to mass the fleet, which would take time. In fact, what would be needed was a huge expeditionary force. U.S. analysts did not have the full Japanese view. The Japanese view consisted of three strategies:

1. Surprise on the fleet
2. Whittle down the U.S. fleet through subs & destroyers & aircraft
3. Hit & run tactics to avoid the Mahanian battle line at first.

This had an equally big effect on the American planners.

## **B. PHASE II: A Complication of Logistics (1928-1935)**

An American "Trafalgar" was finally recognized as unrealistic. Planners realized the Japanese would not fight the way Americans expected.

The major problem: What if the Philippines are lost and have to be regained? The loss of the Philippines was never considered in Phase I. The loss of the Philippines complicated the problem. An entire force needed mobilization. Mobilization meant more supplies.

The new complication: Logistics. This became part of the wargame. Note 80% of CA is logistics-oriented, sustaining the force, or combat *potential*, that can win a series of battles.

The final answer became War Plan Orange. Joint Operations became the normal planning method. This recast the entire campaign because we would have to mobilize and transport much of the Army. This led to a new series of games with logistics planning as part of gaming.

The wargaming outcomes: Floating logistics forces/bases were needed. This enforced the thought of a long, expensive campaign. In reality, by 1944, an entire floating logistics armada was supported in the Pacific Atolls. This required building a combat logistics force (CLF).

Amphibious assaults against severe opposition would be necessary to seize the islands. Additionally, realization of escort "jeep" carriers were needed. A supporting carrier air arm for Army/Marine close air support in retaking islands became necessary.

### C. PHASE III: A Sophisticated View (1935-1941)

After factoring logistics, planners saw a long war, hence the need to take it all the way to the Japanese homeland. This meant the next war was going to be a big war. The war duration would be 3-5 years.

Coalition wars were wargamed with strategic national security objectives (NSA planning). Japanese fleet destruction became subordinate to destroying enemy capacity to make war. The campaign goals would end with war termination and *complete, unconditional surrender* of Japan.

War termination could be accomplished by two major methods. The first method – blockade and shipping destruction; or strategic aerial bombing and destruction of homeland. These were the major methods to defeat Japan besides fleet-on-fleet engagements and island land campaigns.

**II. Epilogue:** There were 318 war games in the interwar years. Of those 318, 136 were campaign level analysis with a total of 127 against Japan. It took a long time to assimilate the lessons of the game in the interwar period.

Wargaming forces the study of logistics.

Wargaming helped shape conventional forces at the time.

Wargaming, in short:

- allows Navy’s potential strategic force to be judged in quantitative terms (ships lost, ships needed) without huge operational expense;
- trains decision makers for wartime execution.

### III. Combat Potential vs Combat Power

A major point to take away from the Vlahos paper is the difference between Combat Potential and Combat Power from the pre-World War II analyst’s view. A major shift in campaign planning occurred in Phase II. This involved developing amphibious doctrine and the necessary logistical structure to support the assaults, the study of combat power in force-on-force. The Pacific campaigns in WWII also needed to study *the stationing* of sufficient combat potential to deliver the needed combat power to the critical area (the center of gravity).

This idea stems from the physicist’s view of potential energy vs kinetic energy. Potential energy is the energy in waiting, ready to go. Kinetic energy is the energy in motion that does work (force). The *combat potential* is the source and *combat power* is the force.

Refer back to Lesson 1c page 4 (Topic VI). In the new post “Cold War” era, are we building the right combat potential for future combat power applications? What is the new shift in planning to anticipate? Is the space dimension the equivalent to the amphibious doctrine development of the 1930s?

## LESSON 3c

### Major Fleet Escort Study (1967)

**Ref:** None

**Background:** This study confronted a basic dilemma of analysts: determining a ship's characteristics requires detailed analysis, but determining force levels requires broad, campaign analysis. The ship design you choose affects the numbers you require and can afford.

This study remains useful today, some 30 years after the initial study. It resulted in the decision to build a total of 31 Spruance class destroyers, a platform that remains an integral part of U.S. maritime strategy.

Also observe the difference between a requirement analysis versus a capabilities analysis. Capabilities analysis estimates how well we can do now against enemy current capabilities, where the requirements analysis estimates what future capabilities are needed to deal with potential enemies.

Force level requirements are hard to define if it is an unknown enemy. Projecting out 10-15 years beyond the current time frame is difficult. Government upheavals and new alliances may radically alter a balance of power and change requirements. The threat to a country's military may increase due to technological breakthroughs.

This study resulted in the "new" Spruance class destroyer. Looking back yields insightful practicalities about funding new systems. It is instructive to the driving factors for the choice of Spruance class design vs what transpired later. CAPT Hughes, as a commander on the OPNAV staff, contributed to this study in the ASW group.

#### **Points to Remember:**

(5) Look for the knee of the curve, as a *measure* of decreasing marginal returns.

(6) The ALL PURPOSE EFFECTIVENESS MODEL has two knees

Case A: A Force-on-Force examination

Case B: A fixed enemy force: buy-in and saturation points

(12) The First Law of Systems Analysis

#### **Questions to Ask:**

1. What is the criterion of "efficient" number of escorts and how is it determined?
2. What aspects of the MFE will apply now to future "system buys"?

#### **I. Some Aspects of Systems Analysis**

1. First Law of Systems Analysis

2. Cost effectiveness  $E/\$ = \begin{cases} \text{Maximize effectiveness for equal cost forces.} \\ \text{or} \\ \text{Least cost system for equal effectiveness.} \end{cases}$

3. Another criterion is  $\begin{cases} \text{Maximum effectiveness within a cost ceiling.} \\ \text{or} \\ \text{Least cost system that meets an effectiveness threshold.} \end{cases}$

4. The basic formula for Life Cycle costing a new system is (ignoring discounting):

$$\begin{array}{ccccccc} \$ & = & \text{R\&D} & + & \text{P} & + & [\text{number to buy}] \times [\text{years of service}] \\ & & \uparrow & & \uparrow & & \uparrow \\ & & \text{one-time learning} & & \text{economics} & & \\ & & \text{cost} & & \text{curve} & & \text{of scale} \end{array}$$

R&D = development cost

P = procurement cost

## II. MFE Study

- Aims (1) Determine characteristics of next generation ASW and AAW escorts.  
 (2) Determine force levels of those escorts.

### Components

- Concept & Scenario
  - C-E Methodology
  - Missions & Deployments
  - AAW, ASW, NGFS, and surface warfare
  - Vulnerability (of *all* platforms)
  - Costs (of *all* platforms)
  - Electronic warfare (counter-C<sup>3</sup>I)
  - Manning details
  - Propulsion
  - Logistic capability
  - Detailed costs
- } left to DX team

### Scenario

This was the typical NATO planning scenario of the period (circa 1966).

- I. General, non-nuclear, 90-day war in Europe and N.E. Asia
  - a. The war could go nuclear within 30 days, but a 90-day period was “allowed.”
  - b. The peculiarity of 90 days and the notion of carrier combat days.
- II. Secondary holding action in S.E. Asia, with:
  - Unrestricted Submarine Warfare
  - Full Mobilization

- III. Use of general purpose U.S. Naval Forces as programmed for the mid 1970s (except for escorts to be determined). Use of escorts with service life remaining.
- IV. Carrier task forces:  
North Atlantic, Med, North Pacific, S.E. Asia
- V. Unrep forces in support
- VI. Amphib assault operations
- VII. Convoying military and non-military shipping

### **MFE Missions**

These were the stated mission capabilities needed for an escort. (Most defense systems have a statement Required Operational Capabilities (ROC) & Projected Operational Environment (POE)).

- I. Primary
  - a. Detection & destruction of aircraft
  - b. Detection & destruction of missions (air, ground, or submarine launched)
  - c. Detection & destruction of submarines
  - d. Destruction of surface ships
  - e. Gunfire/missile support of amphib assault & land forces
  - f. Air control
- II. Collateral
  - a. SAR
  - b. Picket
  - c. PIRAZ (tracking and identification of aircraft)
  - d. Blockade & Quarantine
  - e. Surveillance
  - f. Minelaying
  - g. Trailing
  - h. Flagship

### **III. The Following is a Summary of the Study.**

**Study Title:** Major Fleet Escort Study, OPNAV, 1967. Originally classified SECRET.

**Study Objective:** To make concurrent recommendations about both the characteristics and force levels of AAW and ASW major fleet escorts (MFEs), based on cost-effectiveness criteria.

**MOE:** The marginal value of each candidate AAW or ASW MFE in protecting a High Value Unit (CV, Amphibious group, Support group (URG), etc.), based on the ship's 10-year [!] systems costs. After the preferred MFE ship is determined, add MFE-type combatants to the existing escort force level until the marginal cost of escorted forces saved

by another new MFE is less than the cost of the new MFE itself. (“Existing” force is the escorts remaining after obsolescent World war II DDs are retired).

**Models, Inputs, and Assumptions:** All MFE candidates and ships/cargoes escorted are costed. The effectiveness of each additional MFE is determined in a standard tactical engagement model. This is done for a single engagement (one SSN or one raid of a regiment of bombers, for instance). The aggregate threats to each escorted force come from a single campaign model, which determines the location and employment of each U.S. force in support of existing war plans world-wide, and the number, sequence and location of all air, surface, and submarine attacks against each U.S. force. Then variations in attack schedules and tactical capabilities on both sides are introduced, for different sonar, radar and geographical environments. Proximity of land was ignored except in the Mediterranean.

**Appropriateness:** Although necessarily stylized, the models, inputs and assumptions were evidently well considered and appropriate to the study objectives. However, the methodology required a tremendous amount of work to assemble the inputs, work out the attack schedules, and develop the tactical effectiveness curves, despite some evidence of clever streamlining.

**Major Results:** The results were quite clear despite the study’s intricate methodology, or perhaps because of it: the marginal cost-effectiveness criterion, which is essentially the method described in the Appendix of Hitch and McKean’s *The Economics of Defense in the Nuclear Age*, clarified and unified the presentation of the very large number of variables and their interrelationships. The conclusions were specific as to force level requirements, and the recommendations were sufficiently detailed, along with supporting rationale, for the AAW and ASW ship characteristics. The “AAW” MFE, predictably, was a dual capable AAW/ASW design. The “ASW” ship, less predictably in 1967, was to carry strong point defenses and multi-purpose helicopters. An interesting recommendation was that the AAW ships be “single enders,” because the number of escorts per escorted force was driven by ASW requirements, and in concept AAW systems were added to the already required ASW ships until the escorting force achieved AAW sufficiency, by the cost-effectiveness criterion. For various reasons, including the assumption that ASW escorts would use only active sonar, the rationale for single-enders turned out to be a mistake.

**Evaluation:** The study team had the difficult task of simultaneously looking at individual ship characteristics and the AAW and ASW force levels with those characteristics to procure and operate; and at the same time, to determine the best mix of AAW and ASW MFEs. The study achieved this multi-faceted objective in a persuasive fashion by intelligent application of the marginal effectiveness criterion. A study strength was the sensitivity analysis to show the effects on force size of various important uncertainties. Despite the relative *insensitivity* of force levels to any particular uncertainty, there was enough variation to spawn constructive debate on the final force level, based on acceptable risk.

**Impact:** As to ship characteristics, the study was the basis for the DD-963 class’ characteristics. The study was less successful for AAW ships. The number of escorts it derived for each escorted force (e.g., 5-7 for CVBGs) endured for more than a decade, and

the MFE Study levels were not satisfactorily replaced until the “Surface Combatant Force Level Study” of 1994, done by APL for N-86. Sufficient time has passed to observe the DD-963 class’s strengths and weaknesses. I evaluate the MFE Study recommendations as sound where adopted and sensible even when not adopted at the time. The force level recommendations are also well supported, and while never met, were very influential.

**GENERAL CHARACTERISTICS AND COSTS OF CANDIDATE ESCORT SHIPS**

	DX-1 1 screw	DX-2 <sup>a</sup>	DXG-1 1 SAM system	DXG-2
Displacement (fully loaded) (tons)	3950	6000	6250	7450
Maximum sustained speed (knots)	27	30	30	30
Range (n.m./knots)	4500/20	4500/20	4500/20	4500/20
Weapons	BPDMS 1-5” L.W. ASROC MK32	BPDMS 1-5” L.W. ASROC MK32	1 TARTAR D 1-5” L.W. ASROC MK32	2 TARTAR D 1-5” L.W. ASROC MK32
Sensors	Surface Radar 2D Air Radar — SQS-26	Surface Radar 2D Air Radar — SQS-26	Surface Radar 2D Air Radar 3D Air Radar SQS-26	Surface Radar 2D Air Radar 3D Air Radar SQS-26
Other	Helo Facility	Helo Facility	—	—
Average cost of conventional steamships (600 psi) in modernized yard (\$ millions)/Number procured	\$24.9/40	\$31.5 <sup>b</sup> /40	\$42.6 <sup>b</sup> /40	\$55.4/20
Annual operating cost (\$ millions)	2.8	3.2	4.4	5.0
Enlisted complement	194	216	225	244

<sup>a</sup> Costs are for 20 DXG-1 and 40 DX-2 built with common hulls in one modernized yard.

<sup>b</sup> Configuration derived in study provides additional 7” gun 175-MM or 5-inch L.W. gun on DX-2.

## MAJOR FLEET ESCORT FORCE LEVEL STUDY IMPLEMENTATION

	DX (1967) Recommended	DD963 Built (1975 - 80)
Displacement (Full Load)	5,800	7,800
Procurement Cost	\$45M	\$80M (\$250M)
Guns	2 5"/54 LW	2 5"/54 LW
ASW Sensor (no VDS)	SQS-26 or SQQ-23	SQS-26 (VDS planned & canx)
Manning	216	296
Speed	30 kts	33 kts
Propulsion	2 screws	2 screws & Gas Turbine
BPDMS	Needed Now!	Added Much Later
LAMPS	Needed	1 SH-3 or 2 LAMPS
Endurance	4500NM @ 20 kts PLUS...	6,000 @ 20 kts total

### STUDY CONCLUSIONS

1. The efficient escort force level ranges from 242 to 340.
2. Total number of escorts is determined by ASW.
3. 107 to 125 should be SAM equipped; remainder with basic point defense.
4. Sensitivity tests indicate this range covers almost all interesting excursions from base case ASW. (because drives total #)
5. Trade-off between shipbuilding & modernization programs.
6. Construction program should begin now (1967).

#### Also:

1. Single-ender missile ship preferable to double-ender.
2. BPDMS should be provided on DXs based on cost effectiveness.
3. DX and DXG combined formations reduce overall required AAW missile ships.
4. Decoys and ECM are economically attractive.
5. SQS-26 superior to SQQ-23 for first 3 escort ships in group.
6. Long ASW range weapon needed to exploit sonar range potential. (more impact and with TACTAS)

7. 5"/54/.w. gun preferable to 5"/54 rapid fire.
8. LAMPS hangar and flight deck is needed.
9. Fleet capable (30 kt) DX-2's needed for CVA ASW. DE/DX-1 fill all other needs.
10. Current DE inventory fills needs for DX-1's.

**OBSERVATIONS: STUDY CONCEPT VS FINAL DESIGN OF DD963**

1. The cost became 100% over original cost.
2. Personnel. There was a growth in number of personnel. Because expected full automation was not realized, the school house could not produce fully trained graduates. OJT still needed to complement the ships' specific peculiarities. Also, because IMAS at dockside did not assist as much as hoped.
3. The Litton design which changed from steam to gas turbines revolutionized the thinking toward Navy propulsion systems.

## LESSON 4a

### Discussion of Metric and Methodology

**Ref:** None

**Background:** Lessons 4a to 4d give the view of campaign analysis in recent literature and explores current trends. To explain current trends, recent articles projecting contemporary campaigns are discussed.

#### Points to Remember:

(5) Look for the knee of the curve, as a *measure* of decreasing marginal returns.

(6) The ALL PURPOSE EFFECTIVENESS MODEL has two knees

Case A: A Force-on-Force examination

Case B: A fixed enemy force: buy-in and saturation points

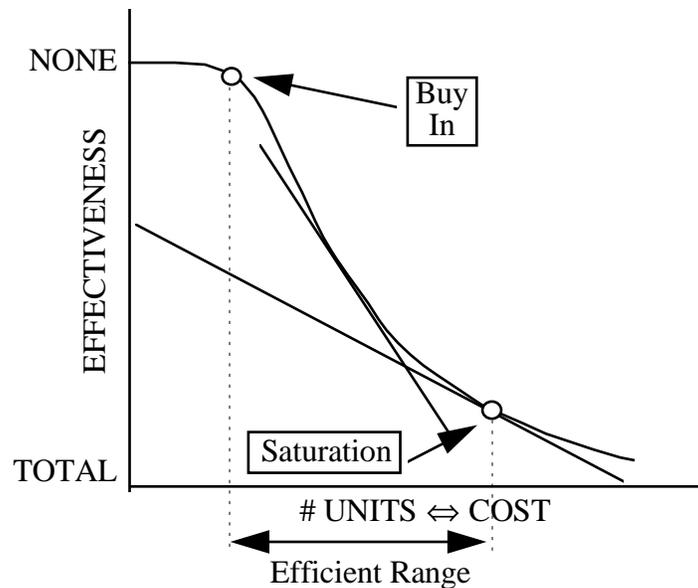
(12) The First Law of Systems Analysis

#### Questions to Ask:

1. What is sufficient versus efficient?

#### Excerpt from the Surface Combatant Force Level Study (SCFLS).

The standard of “sufficiency” employed in this study recalls another criterion of “efficiency” that was the basis for surface combatant force level and mix in one of the most successful in house studies undertaken by OPNAV, the *Major Fleet Escort Study* of 1967. The study served as the basis for surface combatant force levels in DoD for many years. In it the *efficient* number of surface combatants was the number for which the cost of adding more protection was less than the cost of procuring more of the productive forces, carriers or amphibious ships, for example. Under this economic criterion there were, in effect, two significant points in the relevant escort effectiveness curves at the time. See Figure 4a.1. The first could be called a buy-in point: the number of major fleet escorts that started to perform their assigned function by forming a critical mass. The second is the point of diminished returns: the point when the task force is saturated with capability and the marginal gain from adding another escort was small toward preventing further losses to the protected force. The shape of the curves looked like logistics curves, but their derivation was tied to force-on-force analysis. The efficient point would lie between the buy-in and saturation points.



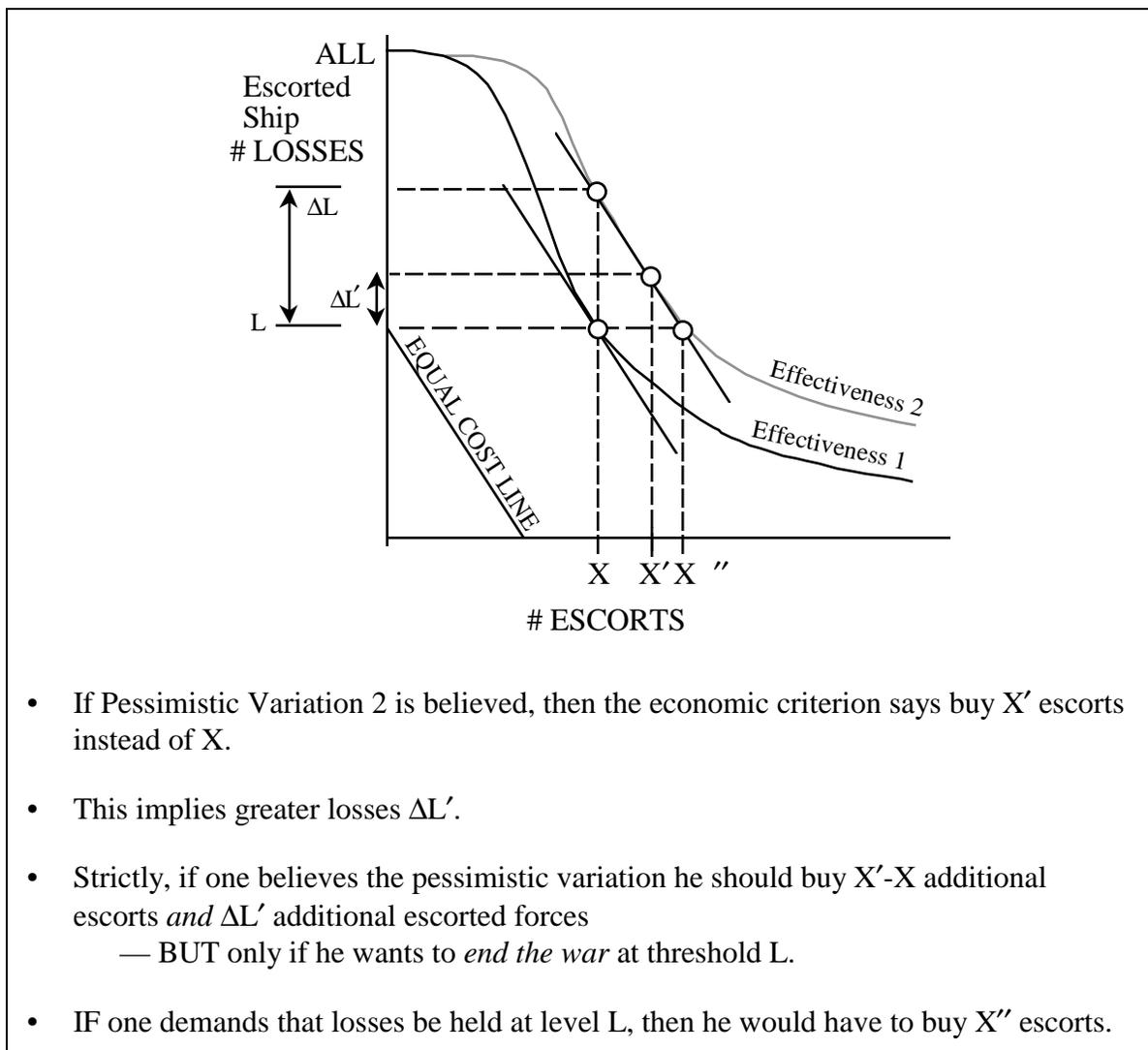
**FIGURE 4a.1**

In this study, for several reasons *sufficiency* is adopted as more appropriate to present circumstances.

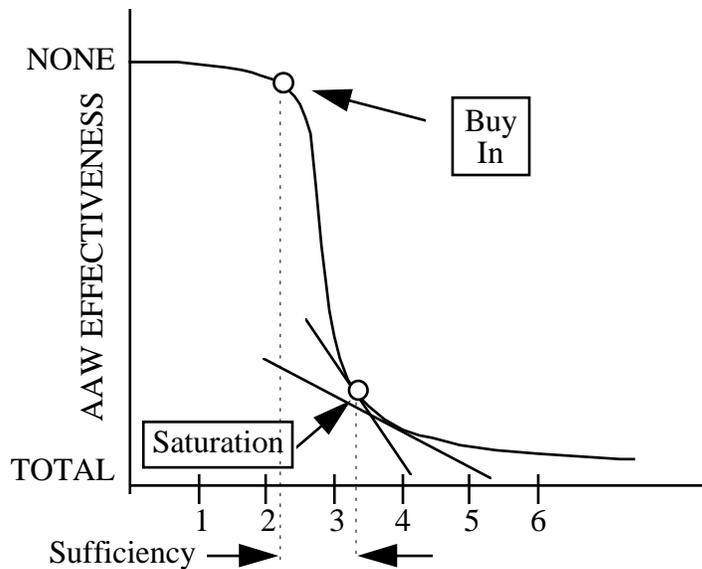
- First and most important, inspection of the results in this study will reveal that the AAW/ASMD “logistics curve” is steep and very like a step-function. See Figure 4a.3. The buy-in point and the saturation point in many or most instances consists of the same number of surface combatants. Operationally speaking, there are either severe gaps in surface combatant coverage which the enemy can exploit or there are none. Thus, there is *rarely a difference between the efficient number and the sufficient number* of surface combatants.
- Second, the modern surface combatant does more than escort other “productive” forces like CVs, LHAs and AOE’s. In many instances it is itself the productive unit, performing its own task, such as missile delivery or picket, while conducting its own defense. Sufficiency here means the ability to continue to perform the task over time in spite of enemy attacks.
- Third, the standard of acceptable losses is, in current DoD planning, thought to be a stringent one. While a no loss criterion is absurd (and not that of this study), a criterion that tolerates a 20 or 30% probability of hit of one or more ships in a task force is commonly viewed as unacceptable. Sufficiency means a small risk when forces are alert, employed with tactical acumen, and not handicapped by severe constraints of Rules of Engagement (ROE).
- Fourth, the standard of sufficiency in each task force is consonant *with sound naval practice to base plans on enemy capability*, not on his intentions. Every campaign analysis which distributes the enemy order of battle in a specific schedule of attacks is an assumption of intentions. Sometimes, as in the *Major Fleet Escort Study*, a campaign

analysis cannot avoid presumptive schedules of enemy attacks. See Figure 4a.2 for an example when the results of a series of attacks are aggregated in a campaign. An advantage of using the standard of sufficiency is that it avoids having to examine and assert specific enemy intentions about which force will be attacked and when.

- Fifth and last, the economic criterion, while useful, has its limitations. Some of these are obvious, but an example will illustrate. In the *Major Fleet Escort Study* it was never cost effective in monetary terms to protect *commercial* shipping (non-military goods). By the criterion of economic sufficiency it was always better to purchase an extra quantity of goods and merchant ships than it was to escort commercial convoys. The true value and utility of safe, convoyed delivery in wartime could not even be approximated by a dollar measure.



**FIGURE 4a.2. Variations of the Cost-Effectiveness Criterion Curve**



**FIGURE 4a.3**

For these several reasons the Surface Combatant Battle Force Level (SCFL) Study adopted sufficiency as the proper measure of surface combatant achievement, rather than efficiency.

The methodology employed in this study envisions that the enemy can, in principle, mount any type of attack within his capabilities against any U.S. task force, but not against every task force. It does not adopt the artificial campaign mechanism of scheduling attacks, measuring losses on both sides, and constructing “killer-victim scoreboards” as the measurement of results. The enemy is not constrained to one pattern of attack even when in the analytical sense he was able to discern (by some criterion based on exchange ratios) and employ his “best” pattern. Nor do we have any basis, except by assertion, of knowing what exchange ratio to label a success. If success means very limited losses to us and heavy losses to him, then success equates to the same standard of sufficiency we have adopted in this study.

While the methodology concedes the enemy a range of attack alternatives, it does not give him a blank check. The analysis constrains his choices realistically. As the campaign progresses, offensive actions by U.S. forces will destroy his submarines in port, aircraft on the ground and surface-launched missiles. Cover and deception will reduce his choices, while winning the Space and Electronic War will deny him knowledge for full scale attacks. In the study, enemy attacks are appropriate to the geography, time-distance relationships, probable intelligence and surviving order of battle.

By establishing task forces strong enough (“sufficient”) to withstand attacks of different types we obviate the need for a killer-victim scoreboard. We do not need to make assertions about the unmeasurable rate at which enemy capabilities are reduced, either by our attacks on him or his attacks on us. Nor do we have to sum up our aggregate losses, of either surface combatants or our other forces. In principle, we need not do the sum

because of our analytical standard of sufficiency requires enough forces so that our aggregate losses will be small, tolerable, and not so large as to jeopardize the execution of any task by any task force at any stage of the operation. In practice, the standard of sufficiency of the defense works out to be the ability to take away everything but the analytically measurable “leakers.” A realistic way to use the study results is to review the specific losses computed by task force and phase and make some judgments as to whether these might, in the aggregate, interfere with some phase of the campaign. A wise interpretation of the results is that even with analytically sufficient forces some slack should be cut in anticipation that the execution of some tasks will be bungled. This means either that there should be a cushion not only in surface combatants but all naval forces or that as a matter of policy we should set our national sights at a lower level than for this stringent scenario, which is, after all, only an analytical artifact.

In this study the expected penetrating ordnance (fractional missiles or torpedoes) is measured for an attack on *any* task force, but it is inappropriate to sum losses on either side because the enemy cannot conduct an attack on *every* task force since he does not have enough attackers. But by knowing (in the analytical sense) that *any* attack will be defeated we obviate the need to tabulate aggregate losses on either side. The standard of sufficiency offers assurance that no sequence of attacks will saturate or erode a task force’s capability over time; analytically it stands as a rock against all waves breaking against it. Analytically the enemy may send his waves against one or every task force rock and when his energy is spent, the rocks will still stand. This is the principle of sufficiency; if pressed too closely it will fail in the formal sense. An aggregation of many attacks will break down even our “sufficient” defense. Sufficient defense is not perfect defense. To so scrutinize the results is a self-deceiving exaggeration of the power of campaign analysis. Such scrutiny is not necessary to take advantage of the study’s analytic power.

*Explicitly, as the study product we derive not the losses suffered in the course of the campaign, but the number of surface combatants both by task and in the aggregate which will limit our losses to an acceptable level from the beginning to the end of it.*

We establish sufficiency first for a notional combatant, then we show the limited extent to which other existing but less capable destroyers and frigates may be substituted to deal with the threat of 2001.

We then examine other mission and threat variations and show the robustness in general of the analytical criterion of sufficiency; that is, we show how over a wide set of variations the sufficient (and efficient) numbers of surface combatants change very little if at all.

## LESSON 4b

### 1993 Surface Combatant Battle Force Level Study (SCFLS) with Metric and Methodology

**Ref:** None (lesson accompanied by in-class presentation)

**Background:** This expansion of the metric and methodology explains the backdrop of the 1993 study. In this study, a mission area needing quantitative numbers is demonstrated.

**Points to Remember:**

- (6) The ALL PURPOSE EFFECTIVENESS MODEL has two knees
  - Case A: A Force-on-Force examination
  - Case B: A fixed enemy force: buy-in and saturation points

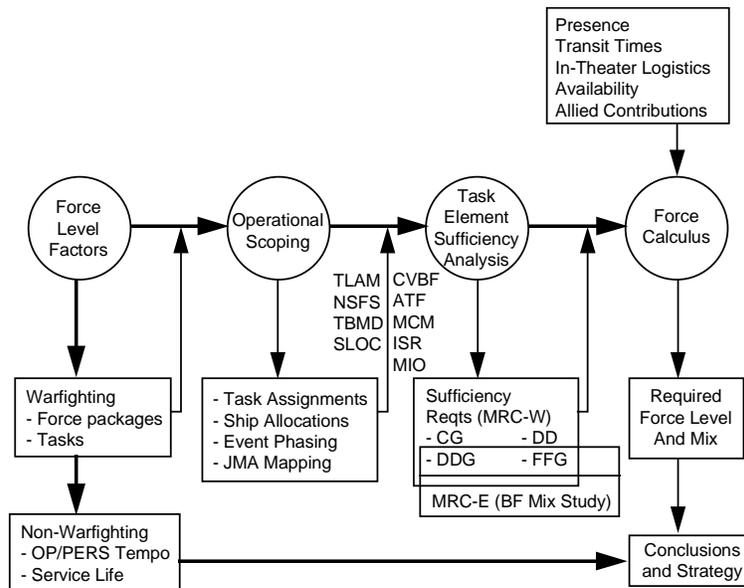
(12) The First Law of Systems Analysis

**Questions to Ask:**

1. What is sufficient versus efficient?
2. Why is the study using more ships in each scenario than practical reality allows?

Figure 4b.1 shows the elements of the study and how they are assembled into a campaign analysis. Many or most depend on previous tactical policy, and deployment modeling and results.

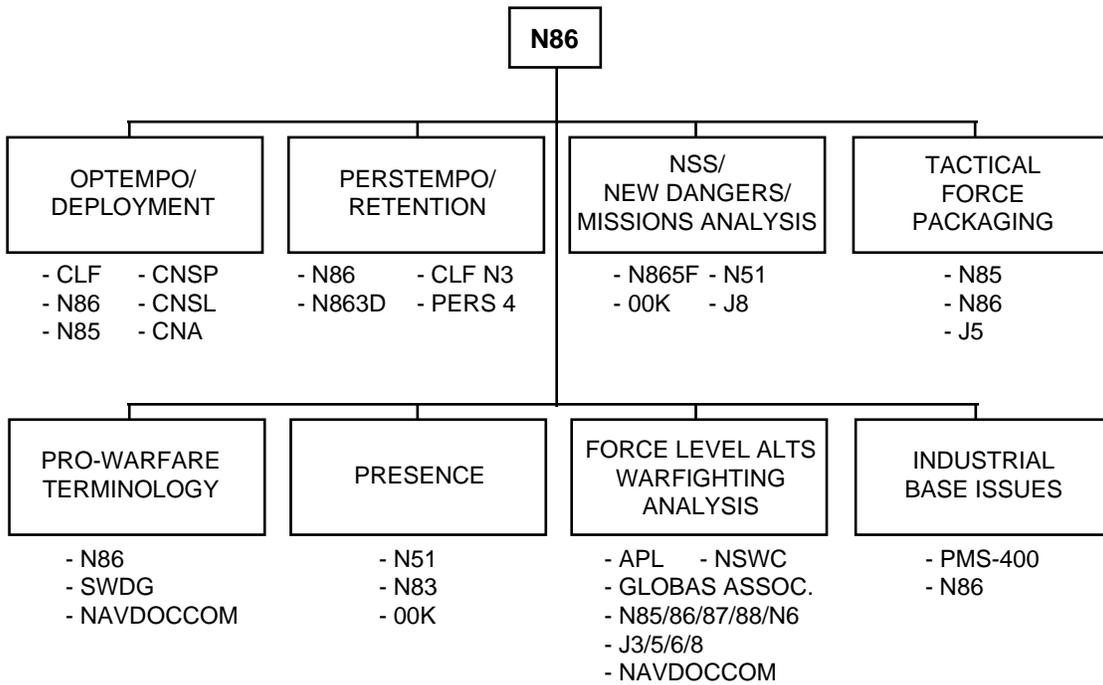
**I.** The 1993 Surface Combatant Battle Force Level Study started with the following considerations.



**FIGURE 4b.1**

Figure 4b.2 shows the organizations contributing to the study. Some contributed

- Scenario and missions
- Blue and Green deployments
- Blue and Green tactical capabilities
- Presence calculations and response times of forces during naval buildup
- Discussion of issues outside of the CA proper, such as effects on industrial base issues and personnel retention.



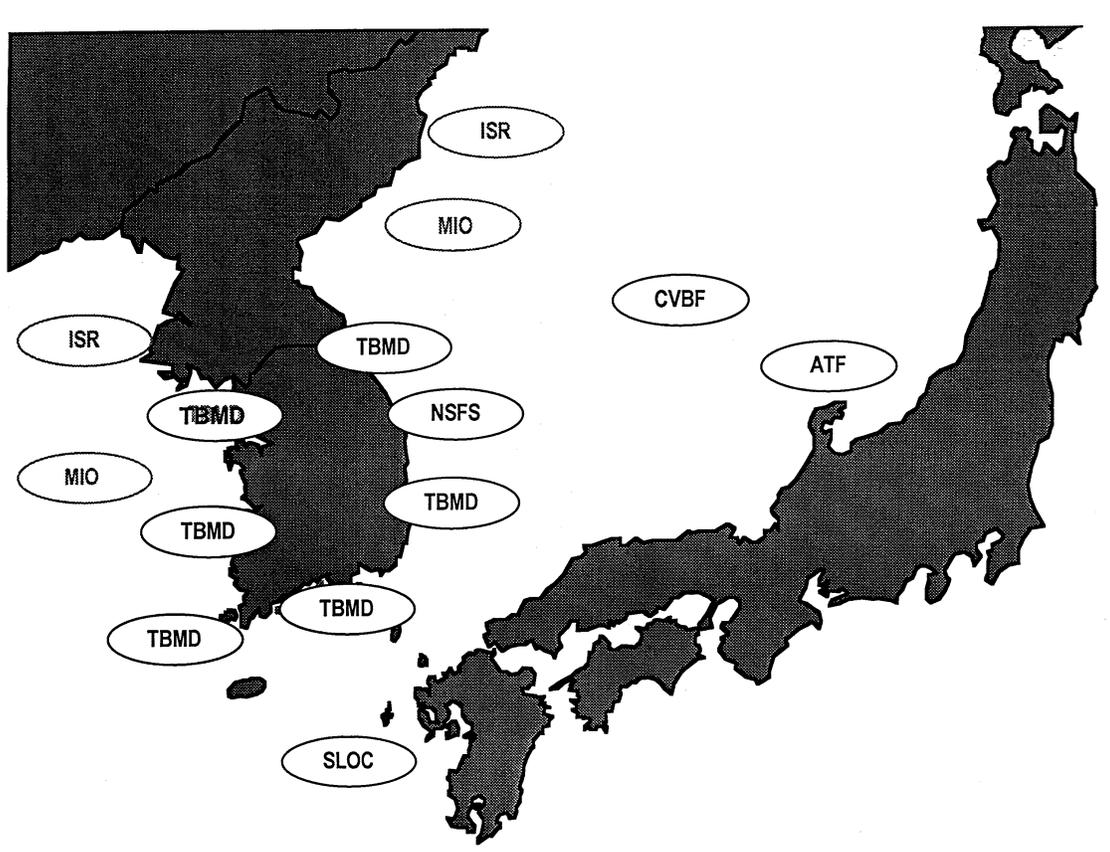
**FIGURE 4b.2. Surface Combatant Force Level Study**

On the next page, Figure 4b.3 and Table 4b.1 show Mission Bubbles and the tasks by Surface Combatants within a mission.

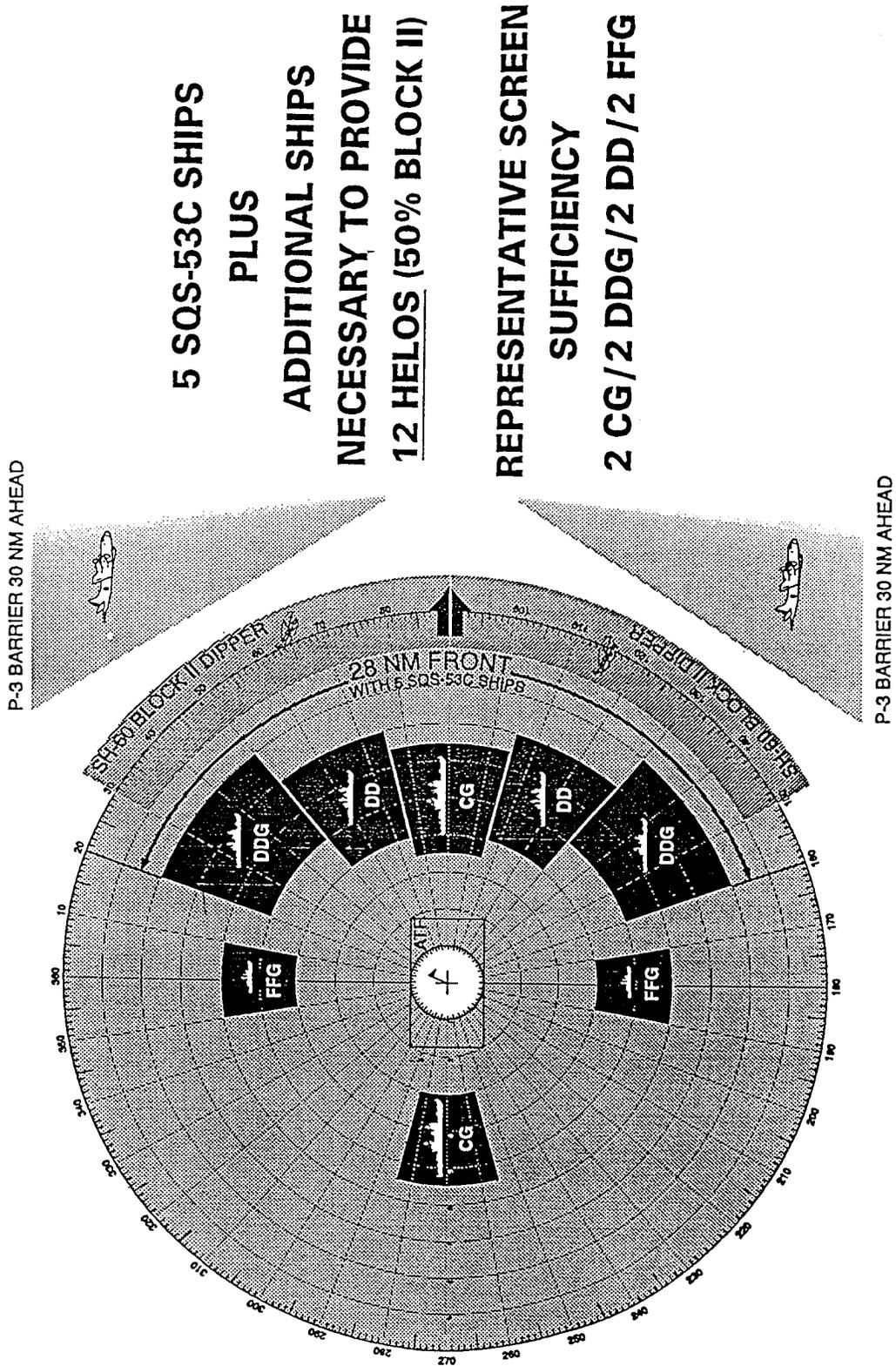
- One or more SCs are required to perform the tasks at each mission location according to the sufficiency criterion.
- There are a series of these deployment plots representing the sequenced phases of the campaign.
- Figure 4b.4 shows how a tactical warfare mission may shape up for any mission location of the campaign. Here ASW forces are considered for protection of an amphibious task force.

**Table 4b.1. Multi-Mission Tasking**

CAMPAIGN CONTRIBUTIONS				BATTLE SPACE DOMINANCE		
TASK ELEMENT	TBMD	NSFS	STRIKE	SURFACE	AIR	UNDERSEA
TBMD	X		X	X	X	X
NSFS		X	X	X	X	X
CVBF			X	X	X	X
ATF			X	X	X	X
SLOC			X	X	X	X
MIO	ANALYZED OFF-LINE					
ISR	ANALYZED OFF-LINE					



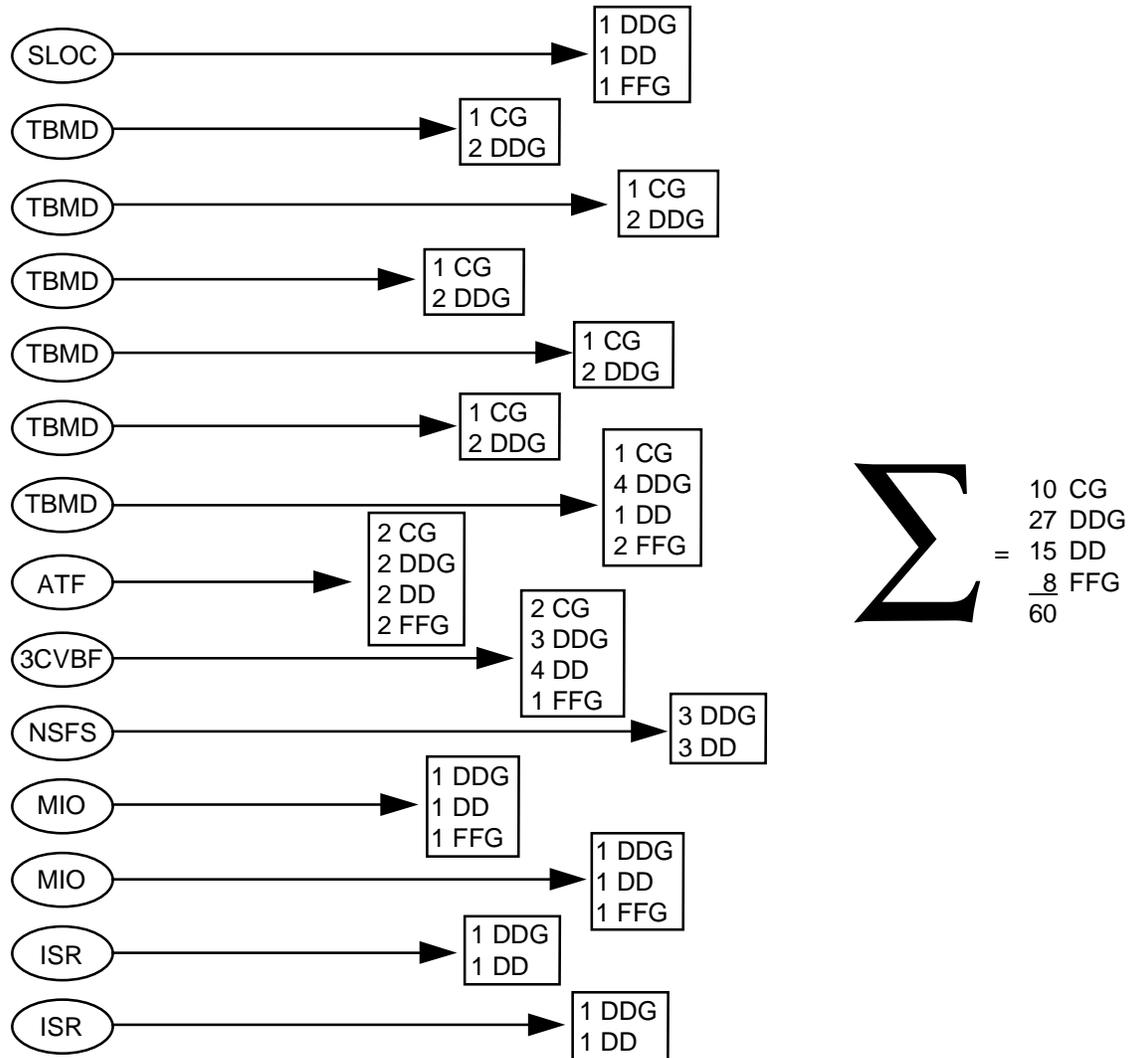
**FIGURE 4b.3. Tasks and Geography**



**FIGURE 4b.4. ASW Sufficiency ATF "A" Screen**

Figure 4b.5 depicts the result of the task analysis at each location in terms of notional forces required.

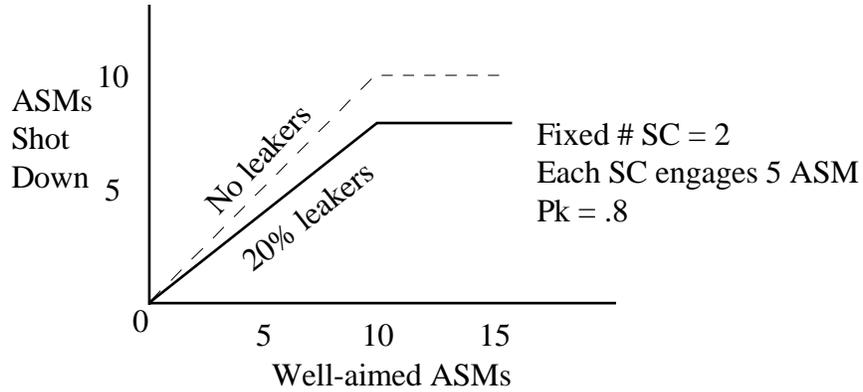
- This figure depicts the requirement/bubble and total forces on station at time C+12.



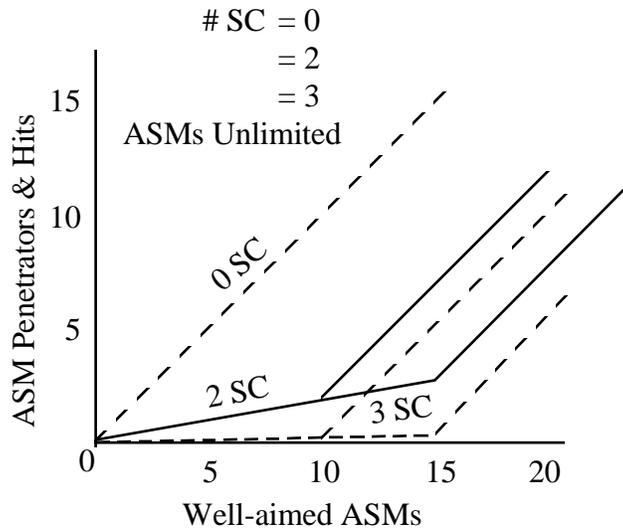
**FIGURE 4b.5.**  
**Nominal Sufficient Forces Against Campaign Tasks on Day C+12**

## II. An Excursion to the Tactical Level of Warfare TBMD.

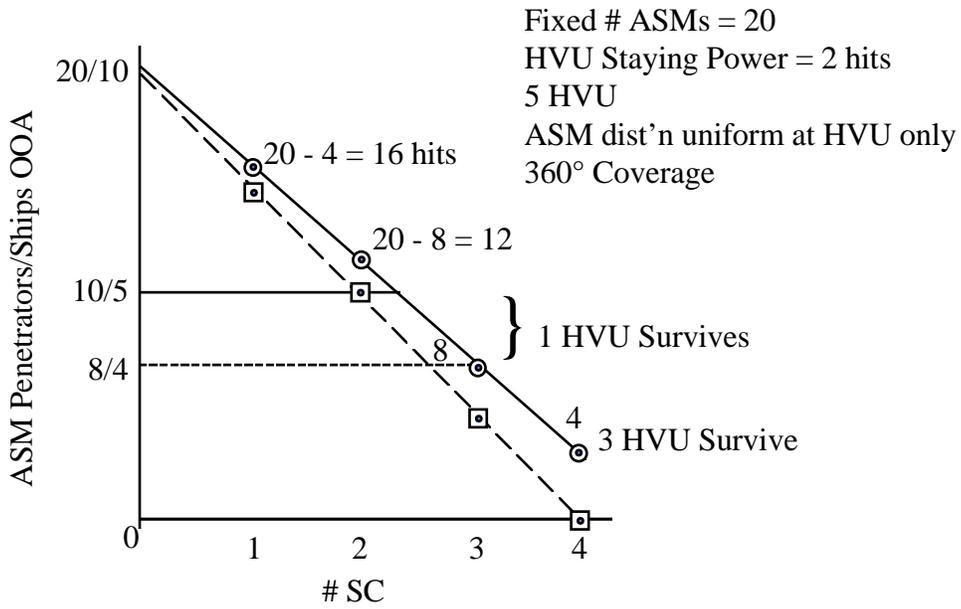
This example shows how one mission area (such as AAW) may be analyzed to provide a baseline number of ships for a given mission area. Each mission area analyzed provides a number to the overall  $\Sigma$  seen in Figure 4b.5.



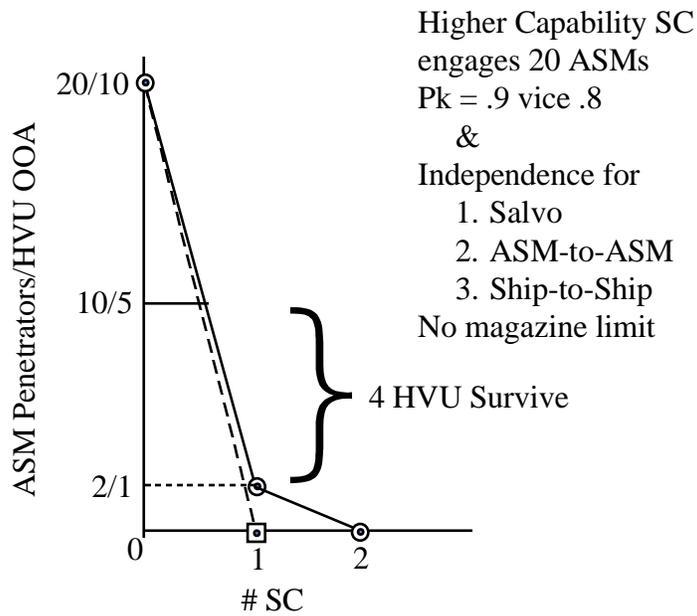
**FIGURE 4b.6**



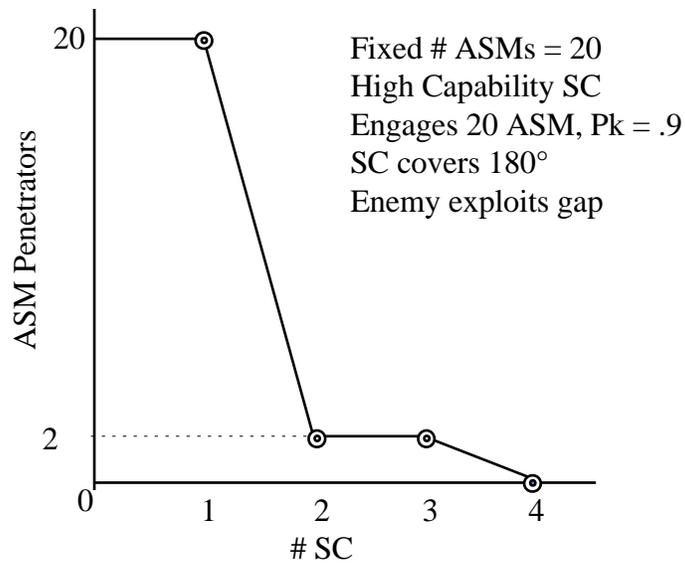
**FIGURE 4b.7. A tactical (1 engagement) perspective  
Variable # SC  
ASM Penetrators vs Size of ASM Attack**



**FIGURE 4b.8. ASM Penetrators vs # SCs for Fixed # ASMs**



**FIGURE 4b.9. ASM Penetrators vs More Capable SCs**



**FIGURE 4b.10. ASM Penetrators vs # SCs When One SC Covers 180°**

## LESSON 4c

### Fundamentals of Campaign Analysis in MRCs

**Ref:** None

**Background:** This article was written in preparation for the 1993 Surface Combatant Study. In it, some fundamentals of analysis were discussed relevant to campaign level warfare.

#### Points to Remember:

- (6) The ALL PURPOSE EFFECTIVENESS MODEL has two knees
  - Case A: A Force-on-Force examination
  - Case B: A fixed enemy force: buy-in and saturation points
- (13) The partitions of naval functions:

SAFEGUARD	DELIVER
ATTACK	DEFEND

What? Goods and Services in/from the sea
- (10) In the decade of the 1980s, the USN shut down its analytical campaign machine and conducted war games only.
- (—) ...difference between a CA of current capabilities vs future requirements...

#### Questions to Ask:

1. Why do senior officers need two views for forces they command?
2. Why is a timeline important to an analysis scenario?
3. What is the advantage of doing a capabilities analysis before doing a requirements analysis?
4. What is the purpose served in describing a generic littoral warfare scenario? Why should we not use the generic scenario for conducting campaign analysis?

#### 1. Capabilities and Requirements

There is a long-recognized distinction of study aim that has been shoved aside in the rush to make procurement decisions and spend money during the 1980s defense buildup. It is especially relevant now because we shut down our campaign analysis machinery during the 1980s and it needs to be oiled and gotten running again. The distinction is between analysis of current warfare capabilities and analysis to determine requirements that can only be filled in the future. It is well to start with a straightforward capabilities analysis of

present posture to carry out existing strategies, and use the results as a base from which to move back into the much more difficult art of requirements analysis.

a. Capabilities analysis' aim is to construct a mosaic of understanding of WHAT IS: agreement on present posture to deal with present contingencies. Capabilities analysis serves three purposes:

(1) Agreement on What Is — current capabilities — permits a look at the future from a common base. Senior officers all carry a picture of What Is in their heads. Campaign analysis with senior officer influence (and in the best of worlds, their participation) has as one purpose to communicate that picture. The analysis also helps reconcile disagreements that senior officers do not know they have with their peers because their differences will of necessity be surfaced.

(2) Agreement on current capabilities permits intelligent decisions about WHAT TO CUT. When the budget shrinks, you cut back current capability with the aim of a balance based on the world of What Is. Your immediate interest is not in meeting present (much less future) requirements. You want to describe what the new, smaller, forces can't do next year that the current forces are able to do this year. Properly conceived, current military strategy — the ends — derives not from what the national command authority would like to do, but what it has the military means to do. The most useful thing capabilities analysis achieves in this climate is to help determine a new, more modest military strategy that matches capability, and achieves a suitable force mix that matches ends with means.

(3) Also, capabilities analysis applies in — is the tool of — the operating forces. As Admiral Ike Kidd used to hammer home, you can't solve operational problems if war starts today with requirements for new ships, aircraft or gadgets that can only be filled tomorrow. You have to solve your problems with the fleet as it is.

b. Requirements analysis' aim is to construct a mosaic of WHAT WILL BE, as we dimly perceive it. Requirements analysis serves these three purposes:

(1) Agreement insofar as possible on What Will Be, using our knowledge of What Is as a bridge. Agreement comes a lot harder now, because at best we can only prognosticate what could be. In a defense climate of plenty, one hedges bets against several futures. In theory the NCA is now free to establish any ambitious military strategy that supports the nation's future aims; and then build up forces required by the strategy. In practice one expects to take some risks because of budget limitations even in times of plenty. One establishes requirements against the more pessimistic futures. But he expects to see shortfalls from prudent analytically derived requirements.

(2) We estimate What Will Be at the micro level, for example a theater ballistic missile threat, in order to decide WHAT TO DEVELOP: research, design and procure new individual capabilities against these new individual threats (and sometimes

existing threats to which we have feeble responses). Doing this takes relatively straightforward systems analysis of the kind done by Conner and Marshall (Lesson 2a).

(3) We estimate What Will Be at the macro level to make judgments about the FORCE LEVEL AND MIX. Strictly speaking, this is impossible to do. But it is a good thing to try. The macro and micro decisions interact, of course, and working them simultaneously, as in the 1967 MFE and 1994 SCFL Studies, is the highest form of the analytical art.

c. In summary, it is highly desirable to start from a “known,” that is, agreed base of existing military potential to carry out and sustain combat operations in a variety of locations against various enemy strategies (e.g., blitzkrieg, attrition or guerrilla war) and force allocations against U.S. target sets.

– We can use the agreed assessment as the basis of cutbacks.

– It is the basis for correcting glaring deficiencies in the immediate future, e.g., close-in defense against sudden attack; SEW that will transition gracefully from sea to land operating environments, and sea-based missile attacks with an arsenal ship.

## **2. A Generic MTW Campaign**

To examine campaign issues described above it is desirable to start by developing a generic MTW scenario. By this I mean an abstract location and set of military tasks which are common to so many MTWs that the scenario and tasks could be called, if not universal, then at least representative.

a. In Lesson 4c we saw such a generic MTW Scenario not because it is the only one, but to illustrate its components and the degree of generality v. specificity. It serves as a reference against which all specific capability or requirements analyses can be compared. It may be used to seminar-game the broad structural issues: missions, command relationships, SEW placement, enemy choices, etc.

b. There are, however, three provisos:

– The generic scenario cannot itself be played, gamed or analyzed in quantitative detail. A specific opponent, friendly state, a campaign objective and real OOBs are necessary. Both Korea and Southwest Asia are seen to contain the desired properties of a MTW, when compared with the generic scenario. A specific, familiar scenario breathes life in the play, but the operations analyzed and tactical situations need not reproduce only “reality” seen by intelligence estimates. An example is to give North Korea a TBM capability even if this is not currently predicted and thus artificial.

– The scenario play should not be straightlined. An example of straightlining is to regard a certain sequence of events as sufficient for play, such as:

- Precursor events of crisis development
- Strategic sealift and buildup
- Combat along the sea-land interface
- Strike overland
- Amphibious operations
- Assessment of operations.

I recommend branching. There will be turning points, that can be chosen by either side, and milestones. I have participated in a successful SAIC analysis for USCINCPAC of a Far East campaign war plan against the Soviet Union. I also observed the power of the branching in analyzing the Falklands War before the shooting started, so as to convince myself that if the Argentines had conducted a similar rough campaign analysis they would not have lost the war.

– Along with branching is the need to look for campaign indicators of future activities and progress. Where do these indicators come from? From surveillance. I will take this up next, under paragraph 3.c.

### 3. Timelines and TACSITS

a. A common and often satisfactory way to structure a campaign analysis is to build a timeline of events critical to operational success and then examine the imbedded events in tactical detail. This has been all right in the past if the campaign is indeed governed by a sequence of events, each turning on prior successes. This in fact is how a wartime operations plan was written for campaigns in the Pacific theater of World War II. One should explore branches, especially of what the enemy can do differently. If he cannot get Air Superiority unless he takes out most USAF planes on the ground on Day-One, then that defines the enemy's only successful air campaign plan. If our ISR cannot assuredly prevent such a surprise attack, then mobile seapower on scene (e.g., three CVs plus 1000 TLAMs) becomes our best campaign response.

b. On the other hand, if the campaign is governed by the cumulative\* effect of day-to-day increments, then the TACSIT approach must be viewed quite differently. A cumulative campaign is like a continuing bombing campaign or a timely stream of reinforcements and resupplies. A TACSIT becomes a phase in which a stream of sorties, or series of Scud-like land based missile attacks, etc., occur with both sides executing clearly described campaign plans day after day until the advantage (momentum) becomes certain, at which time the "TACSIT" ends, an appraisal is made, and (simply put) the losing side alters its campaign plan.

c. To my knowledge a campaign analysis has never been done in quantitative detail with modern ISR systems played explicitly. Yet ISR and Counter-ISR conducted to

---

\* Sequential and cumulative strategies and their operational distinctions are described by RADM J.C. Wylie in his modern classic, Military Strategy.

gain an “information war” advantage seems to be the cornerstone of success in a modern campaign. This is because firepower effectiveness depends so much on detection, tracking and targeting faster and more completely than the enemy. Information assessment before, during and after the TACSIT apparently dominates combat outcomes. I think it is possible to introduce ISR, but I haven’t seen it done it successfully. The implicit approach to ISR — in which we assume judgmentally that we or they gain the advantage of surprise, successful concentration of fire, an “Inchon Landing,” or whatever — seems not to be sufficient anymore.

#### **4. Illustrating a Set Scenarios and Variations with the Korea MTW**

Scenario # 1. Based on a Naval War College wargame, work out the intra-campaign time lines and geographic locations in detail for each of the following operations:

- a. Preliminary to hot war, the Information Warfare operations to dominate the Surveillance/Information War, which accumulates intelligence and denies same to the enemy. ISR continues into hot war, with addition of destruction of enemy ISR and C2 systems.
- b. Transit and positioning of CVBG and SAGs.
- c. Domination of the littoral air space by Joint Air Offense and Defense operations. Specify how the ATO will be made up, transmitted and executed.
- d. Clearance of land, surface and undersea threats to inshore operations, with emphasis on a timely, successful amphibious landing.
- e. Amphibious landing and post landing build up and support. Specify arrangements for CAS and NSFS.

In addition, to reflect the Joint nature of the campaign scenario, incorporate time-lines and locations of the following operations:

- a-1. Preliminary to hot war, introduce plans to reinforce Army and Air Forces in Korea, with emphasis on shipping scale of effort in time/space. Sources and Terminus? Measure adequacy of undersea, surface and air protection against threats before hot war.
- b-1. Safe transit in hot war of shipping to resupply U.S. and allied forces fighting. Different terminus than in a-1?
- c-1. Conduct naval air attacks coordinated with Army/Air Force in direct support of fighting forces; or reposition CVBG and SAG to interdict enemy resupply by land.
- d-1. By means of inspection, interdiction and destruction, sweep the littoral seas of enemy and neutral shipping and commerce.

e-1. Clear and protect a forward port or harbor in support of the amphibious buildup, and/or to shorten the land LOC from ground forces advancing into North Korea.

In parallel, work out time lines and allocations of enemy initiatives and responses to each of the above. Check for other possible enemy initiatives that are outside the span of a. to e. and a-1 to e-1.

Scenario # 2. Treat as a major variation the close attention to a secure SLOC. The variation's hypothesis is that both the enemy and we believe the SLOC plays a more important role than all other maritime operations. The terminal would be as far forward as we could protect, for example, Inchon. The advantage of Inchon for the Joint defense of Seoul could be compared with, for example, Pusan.

a. Inchon would be an option only if strongly covered against air, surface and undersea attack, including mines. It would be a severe test, but a very desirable test case. U.S. naval forces would have to be substantial and at the scene before the hot war.

b. Pusan or Pohang would require defense primarily against subs and mines but for a limited time only. Enemy subs and mines are highly leveraged threats requiring considerable CFC forces in response, even though the attacks would be concentrated near the terminus.

Scenario # 3. A NEO operation during a high state of tension with North Korea. No CVBG present (the CV might be elsewhere, or out from self-inflicted damage). USAF provides air cover, in the attempt! (Variation: USMC or Navy air supports from airfields ashore.) North Korea uses the NEO operation as a trigger — a *casus belli* — out of an already high state of readiness. A surprise attack with aircraft, surface missile ships and diesel subs must be repelled.

## LESSON 5a

### The Gulf War – Lessons Learned Issues for Campaign Analysis

**Ref:** Reading E; CSIS, “Gulf War: Military Lessons Learned,” July 1991.

**Background:** The Center for Strategic & International Studies (CSIS) provided a report on the Gulf War in July 1991. This “white paper” focused on seven issues. These seven issues are highlighted in this lesson with salient points.

#### Points to Remember:

- (14) Soviet (major power) = a “threat” environment  
MTW/SSC environment = a “risks & opportunities” environment
- (15) The Gulf War is best studied in terms of Combat Potential and Combat Power with results that include Suppression, Demoralization, and Domination as well as Attrition.

#### Questions to Ask

1. What are the Desert Storms of tomorrow?
2. Is uniqueness of a war something to maintain?

**Issue:** How should the analyst use historical battles in the analysis of future Campaigns. Is this war a prototypical conflict in the Post-cold war era? The answer is unknown. Perhaps it is the beginning of a new trend.

**I. THE GULF WAR WAS A UNIQUE WAR.** However, in campaign analysis, goals and objectives of both sides must be analyzed. In the case of the Gulf War,

- a. Goals and Objectives of the enemy (Iraq)
  - Motivated by economic problems
  - Wanted control of 40% of world’s oil reserves
  - Desired leadership of Arab world
- b. Goals and Objectives of U.S.
  - Response to unprovoked aggression
  - Security of world oil supply
- c. Goals and Objectives of
  - Israel
  - Coalition Arab Nations
  - Palestinians
  - Jordan
  - Europe
  - Japan

- \* Ability to create international consensus against the enemy. The U.S. formed world opinion against Iraq.
- \* The role of the U.N. in the conflict – Degree of unilateral U.S. participation.
- \* Host nation logistical basing and support vs CONUS basing. The U.S. had negotiated critical treaties that allowed forward basing.
- \* Enemy response to build-up of friendly forces. Iraq let a 4-month buildup of coalition forces go unchallenged.

## II. U.S MILITARY DEPENDENCE

**Issue:** To what extent can the U.S. “go it alone” in a Campaign? What components of the force require significant assistance from other nations? How much “Host nation” support do we assume for future MRC’s?

- \* Political and economic implications of unilateral action. This is the biggest “animal” to overcome for the coalition.
- \* Gulf war created impression of single world Superpower.
- \* Robustness of U.S. leadership role in this unipolar era.
- \* The real key is: All Campaign Analyses must consider dependencies of each group or the other. These instruments of U.S. power must have coordination and synergy.
  - Political
  - Logistical
  - Economics
  - Industrial
  - Military
- \* Must consider dependencies in three phases:
  - Pre-war (especially logistical transport)
  - Wartime
  - Post-conflict period
- \* Interoperable military equipment and C3I asset requirements. This is a “forever” problem that is difficult to solve.

## III. REVOLUTION IN WARFARE

**Issue:** To what extent has new technology revolutionized warfare? To what extent does this make the use of pre-Gulf War battles invalid for Campaign analyses?

- \* Non-linear warfare – Is there still the notion of a FEBA (Forward Edge of the Battlefield)? The trend is toward localized FEBAs instead of only one large FEBA.
- \* Absolute necessity for service integration and Joint Doctrine.

- \* Lessons from previous Soviet planners.
- \* How much reliance to place on the Air campaign and PGM's?
- \* Joint battle management systems requirements.
- \* Role of space systems and antisatellite weapons in CA.
- \* Bomb damage assessment performed poorly in Gulf war. (This is also a "forever" problem in any war.)
- \* Use of UAV's, Helicopters, TBM's, and Stealth technologies.
- \* Use of Special Operating Forces in nonlinear warfare (a big question to resolve in transition from Operations Other Than War (OOTW) to regional war to full scale war).
- \* Use of Naval Forces and Carrier aviation.

#### **IV. TECHNOLOGY ALONE NOT SUFFICIENT**

ISSUE: How do the effects of personnel, coalition policy, and military strategy interface with weapons technology in a campaign analysis?

- \* Personnel
  - Training: Individual and Collective; Service vs. Joint
  - Morale
  - joint and combined exercises
  - Trade-Off between \$ for training vs. hardware
- \* Coalition Policy
  - Worldwide consensus – How to represent in CA?
  - Security assistance as part of US foreign policy
  - Previous strong bilateral relationships
  - Foreign military sales vs. arms control
- \* Military Strategy
  - Role of Air campaign
  - Operational shock (inducing the enemy to surprise effect of your synergistic forces delivering the big "left hook")
  - Naval blockade
  - Role of deception - feint from the sea

## V. BEYOND THE COLD WAR

**Issue:** How do we assure that our doctrinal and attitudinal reforms are not focused on Moscow in our CA's?

- \* Defense reorganization
  - Goldwater-Nichols Act of 1986
  - Implications in CA for future campaigns
- \* Intelligence. This field has undergone a major
  - Structure focus on Soviet Union
  - Counting equipment vs judging intentions
  - Communications between service intel communities
- \* Total Force Policy
  - Readiness of Reserve units for "round-out"
    - Training time required
    - How to represent effectiveness in CA over time.
    - Combat vs support units
  - What kind of Reserve units to include in contingency force?
  - What should the size of the Guard/Reserve force be?
- \* Strategic Mobility
  - The U.S. does NOT have enough.
  - Did not play large in Desert Storm because of enemy "lack of action".
  - How to represent SM in CA, especially a two MRC scenario.
  - Key Challenge: Strategic lift requirements combined with increased prepositioning and allied capabilities.
  - Force redesign needs to increase transportability.
  - The key question: how much of a logistical chain is needed for the operation?
- \* Modernization Rates
  - No longer based on leading edge of Soviet technology.
  - Current dominant MOE: Minimize friendly casualties, NOT Max (Enemy casualties/Friendly casualties).
  - Emphasis on stealth and precision weapons.
  - Fragility of Defense Industrial Base.

## VI. DETERRENCE, COMPELLENCE, AND WARNING TIME

**Issue:** Because deterrence efforts affect warning time, to what extent must we represent that factor in CA?

- \* Deterrence signal failure
  - lack of awareness of need: Intelligence failure.
  - "Bluffing" vs "The Real Thing".
  - How to interpret build-ups.

- \* Barriers to the Signals
  - domestic political barriers.
  - lack of military capability.
  - created by other nations.
  - Deterrent Policy: deterrent threat vs. reassuring promise.
- \* Failure of Signals
  - attitude and thought process of the challenger.
  - predictability of aggressor's interests.
  - can be missed or misinterpreted.
- \* Deterrence Requirement and Compellence Failure
  - Compellence: use of threats to compel rather than deter actions.
  - Will fail if not supported by people and allies.
  - E.g. Signal to Saddam by failure of Congress to support President Bush until the "last minute".
  - Saddam had constraints: international political suicide to surrender Kuwait (note political suicide is more

## **VII. KNOWLEDGE INCREASES NEED FOR LEARNING**

**Issue:** How do we apply "lessons learned" to future CA?

- \* Shift of strategies from containment to regional contingencies.
- \* War Termination.
  - Military and political objectives usually do not coincide.
  - Unilateral vs. multinational termination conditions.
  - In Desert Storm, the endgame was not carefully considered by political leaders.
  - Must go beyond "bring the troops home quickly".
  - Total vs Limited war.
- \* Fragility of Target States.
  - Physical infrastructure of modern economics.
  - Precision munitions to reduce collateral damage vs. fragility of developing world economics.
- \* Regional Arms Control.
  - Security assistance: useful to prevent war vs. destabilizing effect.
  - Mass destruction weapons.
- \* Ten Principles for Defense Investment concludes paper.

## LESSON 5b

### History vs Wargames & Simulations (Benchmarks)

**Ref:** Reading F; USACAA: “Historical Characteristics of Combat for Wargames [BENCHMARKS],” 1988.

**Background:** This lesson highlights how the analyst must consider wargaming and modern simulations. An analyst must always weigh simulations with caution and avoid blanket statements of “history validates this result.” Stochastic models can be replicated; actual battles cannot. Again, the notion that an actual battle is merely one observation from a highly stochastic process.

**Points to Remember:**

(4) In every model there are two “IF’s”: [MODEL] + [INPUTS] = [RESULTS].

(11) War gaming is a blunt instrument for analysis.

**Questions to Ask**

1. For unexpected results, was a new discovery made OR were there errors in the inputs OR is the model flawed?
2. When the forces in an historical battle are simulated, should the model produce results similar to the actual battle?
3. What is the credibility of wargame/simulation results?

**I. THE NATURE OF THE HISTORICAL DATA**

A. Some models are based on a generic model database. An example is:

\* 260 battles comprise the database

\* One battle described as follows:

- A division attacking a division
- in a frontal attack against a fortified defense
- with 17,000 men attacking 8,500
- on an 8K front
- in mild, dry weather
- on rolling terrain
- with mixed cover
- without surprise
- with the attack producing a penetration
- and the defense resulting in a withdrawal.

As you can see, the wargame model has many “if’s” and conditions to spell out a specific result.

## B. Criteria of Wargame Credibility

- \* Statistical features used are variability, skewedness, & homogeneity (See Figures 1 & 2, and Table 7).
- \* Conclusion from variability chart - Almost anything can happen, and it has.
- \* Thus, almost any result of a wargame or simulation can be considered as credible.
- \* Even if a wargame cannot match a particular battle, it MAY still be quite representative of battles in general.

## C. Benchmarks

These are the gauge of each stochastic characteristic of a model.

- \* Measured by Plausibility – range between 5 & 95 percentiles of the characteristic.
- \* Measured by Centrality – range between 25 & 75 percentiles of the characteristic.
- \* For these measures and the characteristics, see Tables 8 & 9, pages 16 and 17 of report.
- \* Comparison of COSAGE results with Benchmarks – See Tables 10, 11, & 12 in report.
- \* Note the type of conclusions drawn from such an analysis on page 24 of reading material.

## **II. HISTORY AS BENCHMARK**

What lessons should we learn from history? Which is an approximate benchmark? Focus on those decisions that are made early. Historical decisions often made early have affected the campaign.

## LESSON 6a

### Air Ops in Desert Shield/Desert Storm

**Ref:** Reading G; Case, Hines & Satchwell, “Analysis of Air Ops During Desert Shield/Desert Storm,” 1992.

**Background:** The paper was written by USAF officers involved in the U.S. Central Command Air Force during the Gulf War. In it the officers described the efforts needed to bring an analysis concept for the air campaign. The model used was C3ISM.

#### Points to Remember:

- (7) In CA, the concept of Artful Simplicity, due to the endlessness of the variables. The question is, is it Naive Simplicity or Sophisticated Simplicity? Choose the right factors vis-a-vis the decision to be made.
- (15) The Gulf War is best studied in terms of Combat Potential and Combat Power with results that include Suppression, Demoralization, and Domination as well as Attrition.

#### Questions to Ask

1. How did the analysts who employed C3ISIM expect it to contribute to DS/DS? Include such things as the intended purpose, category of analytical application, how it was implemented, and how the military operation it supported was supposed to be done better, easier, or faster.
2. Why do you think C3ISIM fulfilled their expectations or failed to do so? Base your judgment on such attributes as the level of detail, kind of detail, suitability, timeliness, relationships with the people the analysts served, and choice of MOFE or MOE.
3. Were there strengths in C3ISIM as a model and the way it was employed that should be preserved and enhanced? Weaknesses in it and the way it was used to discard or overcome? In making your critique, do not be idealistic or visionary, but stay within the realm of the attainable: a model and scope of analytical assistance for the conduct of an air campaign that is achievable now.

Take as your reader a senior officer who might be charged with the conduct of a future operation similar in scale to DS/DS. He has already read the paper by Case, *et al.*, is intrigued by it, and wants your opinion. The officer has not personally conducted analysis with a Campaign Decision Aid, but is conversant with terms such as MOE, validation, and transparency. Your paper will be graded on not only the quality of the evaluation but the extent that it hangs together as a unified whole, such that the officer who reads it knows what and how much to expect from model-based analysis, and what to ask his analysts to do to prepare for better command and control of a future operation similar to DS/DS.

## LESSON 6b

### The Combat Simulation of Desert Storm

**Ref:** Reading H; Appleget, Jeff: "The Combat Simulation of Desert Storm," 1995.

**Background:** LTC Appleget was at the Concepts Analysis Agency for the U.S. Army when he wrote the evaluation of the Concepts Evaluation Model (CEM). He was the OIC of the CEM simulations runs to complete an overnight analysis of Desert Storm. This started on 12 August 1990, ten days after Iraqi forces invaded Kuwait. The first simulation run completed in two weeks. These simulation runs helped the high level decision makers make key decision.

#### Points to Remember:

- (8) The difference in CA styles between Army and Navy.
- (11) War gaming is a blunt instrument for analysis.
- (15) The Gulf War is best studied in terms of Combat Potential and Combat Power with results that include Suppression, Demoralization, and Domination as well as Attrition.
- (16) All-purpose models always fail.

#### Questions to Ask

1. What were the limitations to model Marine forces?
2. How do you solve model equipment parameters, when the equipment on both sides is the same?
3. When can certain model assumptions be revised?
4. What is a piston-driven model?

#### I. Key Points Brought Out by the Simulation

The air land doctrine had been refined for 40 years. Adaptation to a specific scenario was necessary. The model originally only did NATO/Warsaw Pact forces.

The timing of the model simulations was critical in its acceptance. TACWAR was unusable since it took too long to complete runs.

#### II. Modeling the Air War

CEM modeled the air war crudely. Chiefly close-air support by the Air Force was done by TAC Thunder. The TAC Thunder (Air Force model) was used as an input to CEM.

Based on this, reasonable estimates from air power were obtained. These were input into the CEM model to continue a day-to-day scenario.

### **III. The Ground War**

Decisive operations for CEM modeling the weapon on weapon interactions were critical. Non-western systems were part of the coalition (e.g. Syrian) with Soviet-built weapons.

- Non-linear warfare. This is a result of offensive operations in the rear of an enemy.  
FEBA continuity - this enabled modeling of broken flanks.  
An array of the threat is in constant need of update to produce predictive results.
- Modeling amphibious operations. There was no amphibious capability so a red dummy division was inserted with a no-go line to simulate a beach area.

### **IV. The MOEs (Measures Of Effectiveness)**

The loss exchange ratios and force exchange ratios were the major measures of effectiveness. Determining the percentage loss is key to realizing enemy power.

### **V. Logistics**

What are the different classes of material allowed in the model? These classes of material are commonly used by the Army logisticians.

### **VI. Summary**

All models must be jury-rigged at some point to support current modeling needs. Understanding the model, how it works, what input data is needed, is the key to successful adaptation. If the adaptation is successful and gives the decision maker a *good range* of options supported by data, the analyst can consider the effort complete and supporting.



- b. The costs are reasonable given the platforms the author chooses. After one works through the numbers, this part of the analysis is sound. The question one must ask is, “Are reasonable cost inflators accurate enough for projections?”. The answer here is no. Since an LSS prototype has never been attempted, a similar event to the 1967 MFE study will probably happen. The cost actually doubled in the 1967 MFE. The \$2.0 billion LSS figure is probably going to reach at least \$3.0 billion. To quote RADM Wayne E. Meyer (father of Aegis), “only historians can tell you what a ship actually costs”.

### **III. Crisis Response and LSS Alternatives**

- a. The numbers proposed for crisis response indicate significant amphibious lift capacity versus conventional ARG. But with lesser numbers of LSS’s surge capacity and long term deployment sustainability is eventually sacrificed. The concept of multi-crew (similar to SSBN Blue/Gold) can ease this problem.
- b. The LSS alternatives present the interesting aspects of this analysis. It is quite possible that one combination of the options may indeed bear resemblance to a future amphibious ship. The fingerprint tables 8 – 10 are reasonable estimates of these alternatives.

**IV. Conclusion:** Prof.Calvano’s letter is a good critique. The analysis concept is sound in unconstrained budgets and bigger hull considerations. However, this ship represents too many eggs in one basket even if 21<sup>st</sup> century ISR is able to keep up. It would become the “capital ship” and center of gravity in power projection capabilities.



## I. Campaign Planning and Execution with Blocks of Combat Potential

### A. The Napoleonic Wars

1. In the Napoleonic Wars, the British maritime component of its grand strategy was to forestall an invasion of the continent while securing safe transport of goods at sea and denying transport at sea to Napoleon through naval blockade. The British Admiralty used two rules of thumb for determining blockade force size:

a. Number of blockade ships = number of ships under blockade. It was assumed that ships would fight duels, and that British ships were tougher than French ships.

b. Count a British or French 3-decker as the equivalent of two 2-deckers. In a duel between a 3-decker and a 2-decker, the Admiralty believed that the 3-decker would win the duel, surviving to duel a second 2-decker to a standstill.

### B. British Campaign Analysis

1. The Admiralty did not attempt a refined calculation that incorporated total guns, quality of ship captains, probable wind and weather conditions, or many of the other practical details that would determine whether the tactical commander could actually defeat the enemy fleet if sortied.

2. The art of campaign analysis, like the art of conducting a campaign, is to get the important elements about right. No matter how sophisticated or detailed the analytical tools may be, there is no hope of knowing enough of the inputs (the exact circumstances at the time of battle) to program into such a sophisticated model to predict the outcome.

C. While perhaps a little too macro and coarse-grained for actual application, the Pebbles paper of Arquilla and Fredricksen illustrates how the armed forces of a *maritime power* with far reaching interests over vast distances might determine its forces for presence and deterrence, and deal with one or more conflicts responsively should they occur. As the reader will discern, much of the art is in constructing the composition of the pebbles. They are not merely naval forces, but are an aggregate of several military capabilities.

## II. Utility of the Methodology in the 21st Century

The pebbles methodology may not incorporate all of the important issues that could bear on a deployment scheme. One new feature is the use of long-range bombers based in CONUS with a nearly global reach to apply combat power from a distance. Another that is similar but slightly different is the use of airlift to reach from afar to the scene of action quickly. A third is the extent to which ISR will play to aid in speedy response in a way that was unthinkable in the days of the Roman Empire and the Pax Britannica. How might these elements of modern operational capabilities alter the pebbles methodology? Can you think of other aspects of modern conflict that have major effects?

## LESSON 7b

### A Comparison of Land, Sea, and Littoral Campaigns

**Ref:** Reading K; Otto Bubke, “Clausewitz and Naval Warfare,” German Federal Armed Forces Office of Studies and Exercises, Berlin  
Reading L; Wayne Hughes, “Naval Maneuver Warfare,” Technical Report to the Naval Doctrine Command

**Background.** In these two readings we illustrate efforts using qualitative analysis to examine the larger context of contemporary warfare in a rigorous way. As a rule senior Army officers have been better grand strategists than Navy or Air Force officers. Two of the finest papers describing United States maritime strategy have been written by Army officers, one by General Maxwell Taylor when he was Army Chief of Staff, the other by General xxxx Goodpaster when he was NATO SACEUR.

#### Points to Remember:

- (7) The difference in analysis and doctrinal styles between Army and naval forces.
- (8) The difference between a **sequential** campaign and a **cumulative** one.
- (14) That the MTW/SSC environment is a risks and opportunities environment.

#### Questions to Ask

1. What is the connection between maneuver warfare and the fundamental doctrinal pub of naval forces, NDP1?
2. If maneuver warfare is the preferred style of naval warfare, what is it preferred to?
3. Is maneuver warfare applicable at the theater/campaign level or the tactical/battlefield level? Does it make a difference whether we are talking about ground forces or sea forces?
4. Why is Power Warfare a better term than Attrition Warfare? What are some other warfare dichotomies? What is “Stationary Warfare” and why do we care?
5. What do we learn by contrasting MacArthur’s campaign on the New Guinea coast with Nimitz’ campaign across the central Pacific? By contrasting the Pacific and Atlantic theaters of operations?
6. How does the study of past operations help understand the plans underway for fighting joint littoral warfare? Clarify and compare Operational Maneuver From the Sea (OMFTS), Ship-to-Objective Maneuver, and Sea Dragon.

7. What is the most important effect on navy forces of the successful development of the new Marine doctrine?

A recent book of remarkable insight is Professor John Arquilla's *Dubious Battles: Aggression, Defeat, and the International System* (1992). One of Arquilla's salient conclusions is that when land and sea powers face off, in most instances the land power initiates the war and the sea power wins it. He derives this conclusion from an analysis of interstate wars between 1815 and 1980. It is a paradox. Since the relative sea power of two potential adversaries is generally well known, why would a land state engage a maritime state with great sea power if naval mastery is the crucial factor leading to victory in war? Since the evidence is plentiful that land powers have boldly taken on sea powers, the explanation of the paradox as seen by Arquilla is a subtle one. He embodies his explanation in two testable hypotheses:

1. Leaders of continental powers have substantial but imperfect understanding of maritime affairs, which significantly lessens their inhibitions about starting land-sea wars.

2. The *naval* doctrine of continental powers will be offensive in peacetime, encouraging aggression by the state, but will switch precipitately to the defensive with the onset of war.

Thus, says Arquilla, "Land powers start 'losing' land-sea wars because their political leaders do not fully appreciate the importance of sea power. Also, their naval leaders have convinced them that whatever threat they face from the sea can be dealt with successfully," only to find the swagger gone from their navy when the shooting starts. At great length and in considerable detail Arquilla uses historical evidence to undergird his hypotheses.

What is left to discuss is not the reason why land powers initiate wars with sea powers but what, exactly, the campaign-level attributes are that give sea powers their underappreciated advantage. The next two readings offer some fairly rigorous and broad gauge explanations.

### **I. Bubke: Clausewitz and Naval Warfare**

Bubke says that when a land power is contiguous to a "sea power" (meaning a continental power with a substantial maritime interest) the land power will dominate and probably win a war. But when the sea power is separated by a body of water the advantage rests with the sea power.

What is the advantage? Operational maneuver from the sea (OMFTS) in the jargon of the day. Bubke, a German Army officer, makes his case with some persuasive qualitative analysis. Since he is speaking in abstractions and generalities, the details and specifics of the contending powers' geography and strengths will bear fundamentally on the actual outcome, but the principles he covers are as simple, strong and clear an explanation of sea power's inherent advantage as one is likely to find.

## II. Hughes: Naval Maneuver Warfare

Hughes wrote this paper at the request of the Naval Doctrine Command, who wished to pursue two issues. First was this: while the advantages of maneuver warfare on the ground is fairly well understood (though still contentious in many ways), there is no literature that gets beneath the superficial regarding “Navy” maneuver warfare in blue water operations. In rather short order, Hughes concludes that there is no literature because there is no such thing as *navy* maneuver warfare. Nevertheless, *naval* maneuver warfare at the campaign level has a long and vital history of success. Naval maneuver warfare is in effect, OMFTS, and a firm grasp of its efficacy is central to an understanding of modern American military policy. It is of central importance on the same basis that Bubke describes: a sea power has great freedom of efficient maneuver.

Second, the proposition had been advanced before the Naval Doctrine Command that a concept of strategic *manoeuvre* first propounded by Admiral Raoul Castex (France’s foremost naval theorist in the period 1920-1950) might serve as a unifying theme at the tactical, operational, and strategic levels of naval warfare, and be especially applicable to joint littoral warfare. In today’s strategic environment, should *manoeuvre*, perhaps, be incorporated into naval current doctrine (i.e., NDP-1)? Hughes’ conclusion is no, but since the notion of *manoeuvre* is rich and subtle and leads down many paths, it will be best to let the students read the paper and then discuss its full meaning in class.

## LESSON 7c

### Game Theory and Military Decision

**Ref:** Reading M; Itzhak Ravid, "Military Decision, Game Theory and Intelligence: An Anecdote."

#### I. Background

After the Allies' Normandy landings on 6 June 1944, on 7 August, the German Seventh Army opened an attack on the narrow gap of Avranches, on the French coast of the English Channel, threatening to cut the U.S. Third Army off from its support and logistics base. As a result of uneven intelligence, the attack failed disastrously, and the German Army was almost completely surrounded, resulting in retreat, and the loss of a quarter of a million troops.

In 1954, O.G. Haywood, Jr. published a pioneering paper relating game theory considerations to historical cases of World War II, including the battle at Avranches. In the ensuing years, after the declassification of military secret accounts from World War II, new accounts emerged. These new accounts, published after the disclosure of the Ultra secret in 1974, paint an entirely different picture of the game theory involved at Avranches. Using these new revelations, Ravid makes an intriguing comparison between pre- and post-1974 accounts.

**Table 1**  
Alternative Strategies of Bradley and Von Kluge

		Von Kluge's Strategies		Minimum of row (Bradley's worst result)
		#1 Attack Gap	#2 Withdraw	
Bradley's Strategies	#1 Reinforce gap	Gap holds	Weak pressure on German withdrawal	Gap holds
	#2 Move reserve eastward	Gap cut	Strong pressure on German withdrawal	Gap cut
	#3 Hold reserve in place one day	Gap holds, Germans possibly encircled	Moderate pressure on German withdrawal	Moderate pressure on German withdrawal (maximin)
	Maximum of column (Von Kluge's worst result)	Gap holds, Germans possibly encircled	Strong pressure on German withdrawal (minimax)	

## II. Advantages of Game Theory

A. Opposing options are a useful tool for use in decision-making. By examining the options available, each player may make intelligent decisions based on assumed or known opposition.

## III. Limitations of Game Theory

A. Game theory assumes a logical decision-making process. Based on the decision matrix shown in Table 1, Von Kluge should have opted to retreat. Pressure from above forced Von Kluge into an unfavorable situation from which he could not win.

## LESSON 8

### Methodology for Analysis and Presentation

The outline below provides a methodology for preparing an analytic presentation. Due to time restraints all of the issues cannot be developed, but issues preceded by an asterisk must be addressed. You should choose and/or identify issues you believe will be most instructive to your “decision maker”.

#### I. Historical setting

- A. When did a similar campaign occur in past conflicts?
- B. Where was the theater of war/operations?
- C. Who were the adversaries?
- D. What political, economic, religious, social, and technological factors associated with the war? Were those factors treated in the campaign analysis?
- E. For both sides, what was the purpose of the campaign?

#### II. Campaign setting

- A. What is the geopolitical situation?
- B. What constitutes the theater of operations?
- \*C. What are the political goals? What are the military goals of each side? Do the goals support the national purpose and campaign objectives?
- \*D. What is the correlation between political, economic, and military instruments of power?
- E. Do cultural or ideological factors play a part in the struggle?
- F. What are the strategic strengths and weaknesses of the opposing sides?
- G. Assess the strengths and weaknesses of alliances or coalitions, if applicable.

#### III. Operational analysis method

- A. What will constitute the elements of quantitative analysis?
- B. What is the measure of effectiveness? Is it a robust indicator of the true, more comprehensive, but harder to represent aim of the campaign?

\*C. Are there strategic objectives for the rival theater commanders? What was the center of gravity for each rival? Do objectives focus on opposing centers of gravity?

\*D. How does the analytical methodology reflect the opposing objectives?

\*E. What analytical tools will be most effective? Does time permit them to be brought to bear, or is something simpler necessary?

F. What alternative options that are available to theater commanders will be tested by analysis? How does it keep with the commanders' decisions?

\*G. How are the lines of operation reflected in the analysis?

#### **IV. Results**

\*A. What are the strengths and weaknesses of rival campaign plans? Why are the campaign plans chosen? Does one side have an apparent advantage over the other (strength of numbers, position, combat effectiveness, technology, and the like)?

\*B. Is there a culminating point during the campaign? How did a culminating point arise (accidentally or deliberately)?

\*C. Did you phase the campaign or just "turn the crank"? How are resources applied during each phase? Did the use or the misuse of resources affect the outcome of the campaign? What were the limitations of logistics?

\*D. How did actual outcome compare to campaign goals?

E. Were branches or sequels explored in analyzing the campaign?

\*F. Was either side presumed to achieve synchronization of joint and combined elements? Is it realistic to assume the level of efficiency, cooperation, or coordination "achieved"?

G. Are the effects of geography or terrain reflected in the campaign analysis?

H. Was the command structure represented? How would the command structure affect the campaign?

\*I. Is the analytical outcome of the campaign clear and decisive? Is the outcome in consonance with what either side expects to achieve? Were our operational and strategic objectives met? Why or why not?

\*J. Did any post-campaign issues have strategic or operational importance?

## **V. Future implications and general conclusions**

A. Did the campaign analysis provide significant general lessons to be learned? If so, what were they?

B. Did the campaign analysis provide implications that may be applicable to current U.S. planning or to the conduct of a future campaign?

\*C. How does the campaign analysis relate to current tactical and operational doctrine?