INVESTIGATION OF IM BENEFITS FOR NAVY APPLICATIONS

Patrick N. Carlton, Orion International Technology, Inc.
David M. Osborn, Sverdrup Technology, Inc.
Robert E. Hester, Orion International Technology, Inc.

Overview

- Introduction
- Munitions Complements Costs
  - IM Fill Compared to Standard Fill
- Accident Consequence Evaluation (ACE)
  - Production Plant
  - Port Facility
  - Carrier
- Munitions Flow
  - Port Efficiency (Storage)
  - Carrier Efficiency (Flow Model)
- Summary

Introduction

- Major Department of Defense (DoD) Insensitive Munitions (IM) objectives include enhancing safety and reducing life cycle costs.
- This work supports the DoD objective in its examination of safety and cost issues.
- It is part of the Navy IM Technology Transfer Program (IMTTP) to improve ship, personnel, and aircraft survivability and encompasses consideration of activities at the plant, port and carrier.
- It shows that IM provide significantly reduced accident consequences and improved efficiency in storage and handling at a meager increase in munitions cost.

IM Fill vs Standard Fill Costs

Munitions Complement I

Munition	Number	Cost Standard	IM0	IM1	IM2
A	8	22	29	37	38
D	56	1260	1316	1366	1366
E	18	1033	1089	1107	1143
F	2	1750	1752		1753
G	2	400	400		401
Total Cost ($K)		4465	4585		4701

Cost Ratio: IM0/Standard = 1.027:1

IM2/Standard = 1.053:1

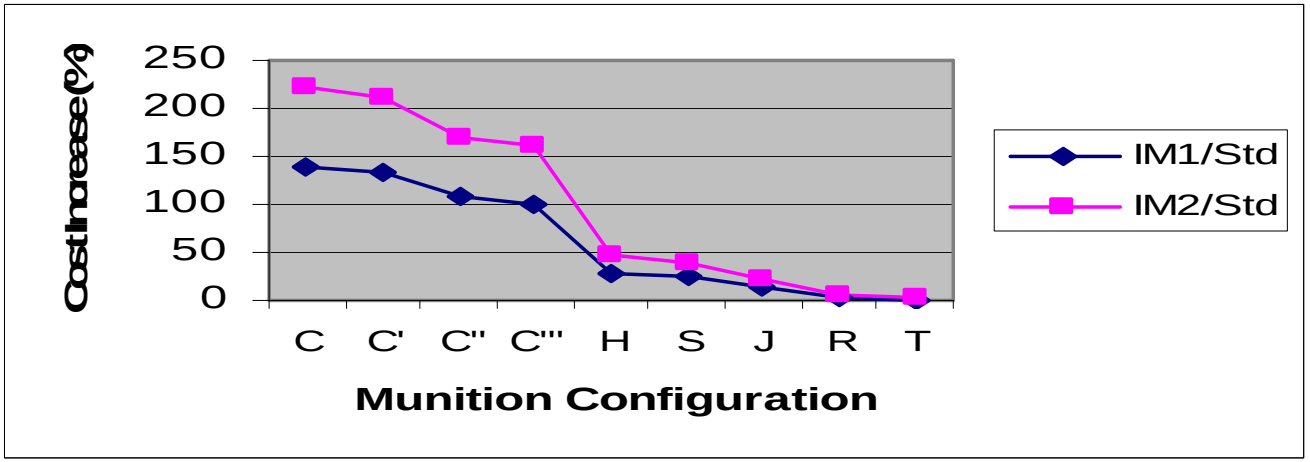
IM Fill vs Standard Fill Costs

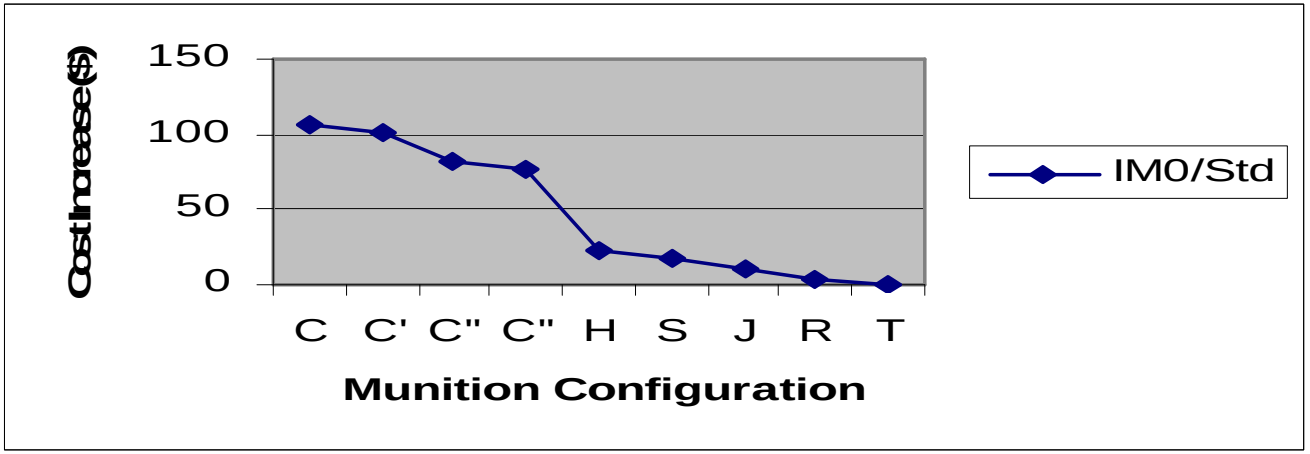
Munitions Complement II

Munition	Number	Cost	Standard	IM0	IM1	IM2
H	10		243	296	313	355
I	6		138	138	160	169
J	6		295	327	337	362
K	6		180	195	202	211
L	22		33	44		55
M	14		2520	2523		2526
N	62		5146	5149		5151
P	48		24672	24682		24696
G	4		800	801		803
Q	6		960	963		965
Total Cost ($K)			35116	35312		35552
Cost Ratio:	IM0/Standard = 1.006:1					
	IM2/Standard = 1.002:1					

IM Fill vs Standard Fill Costs

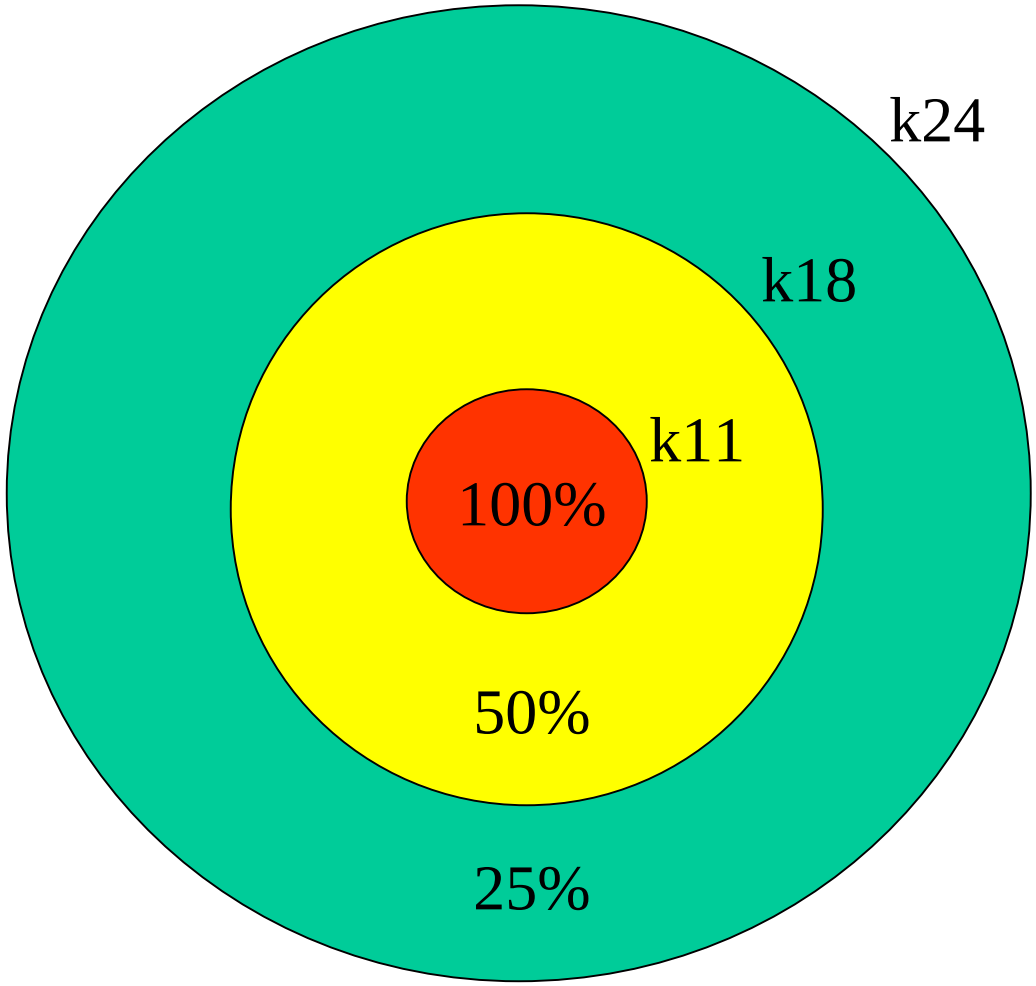
Standard Bomb vs Complex Munitions





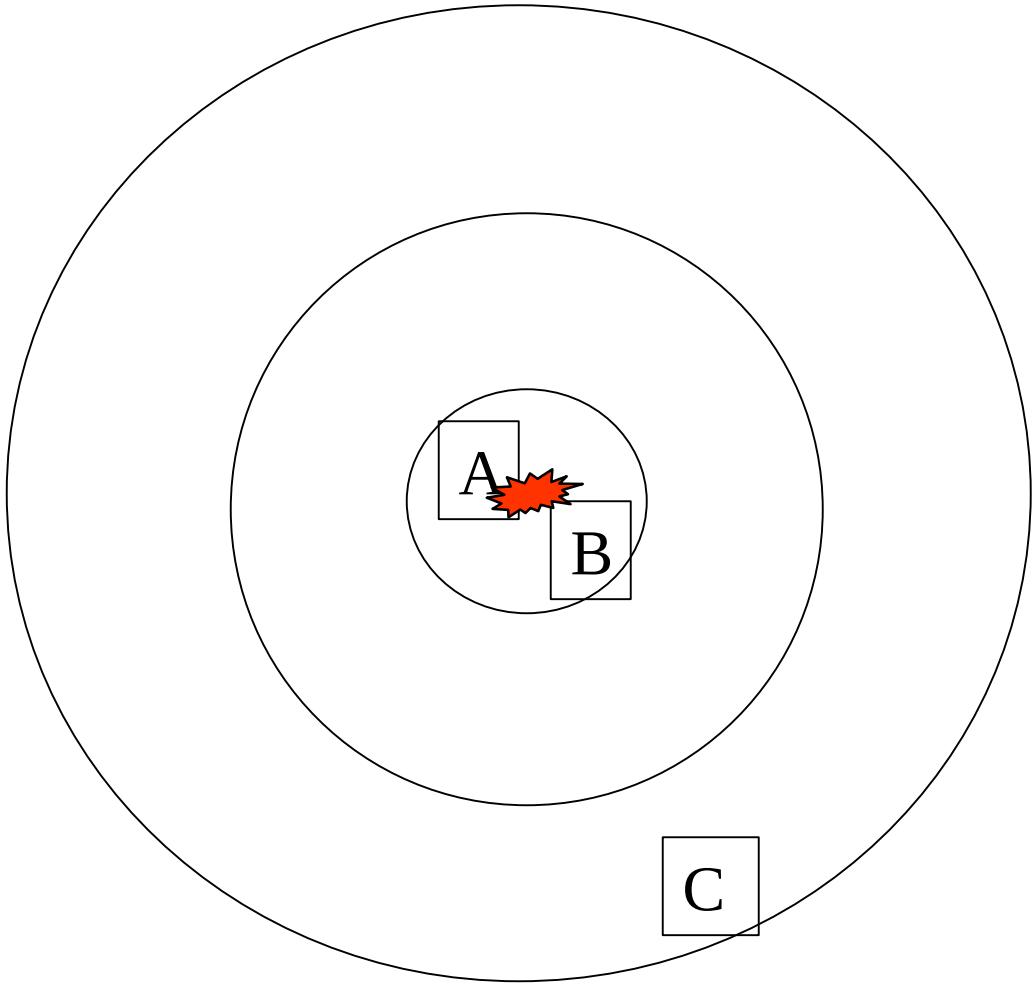
ACE

Graduated Hazard Function



ACE

Production Plant



ACE

Production Plant

Mixing Facility

HC/D 1.6/1.1 Cost Ratio: IM0/Standard = 94%

IM1/Standard = 94%

IM2/Standard = 94%

Melt/Pour Facility

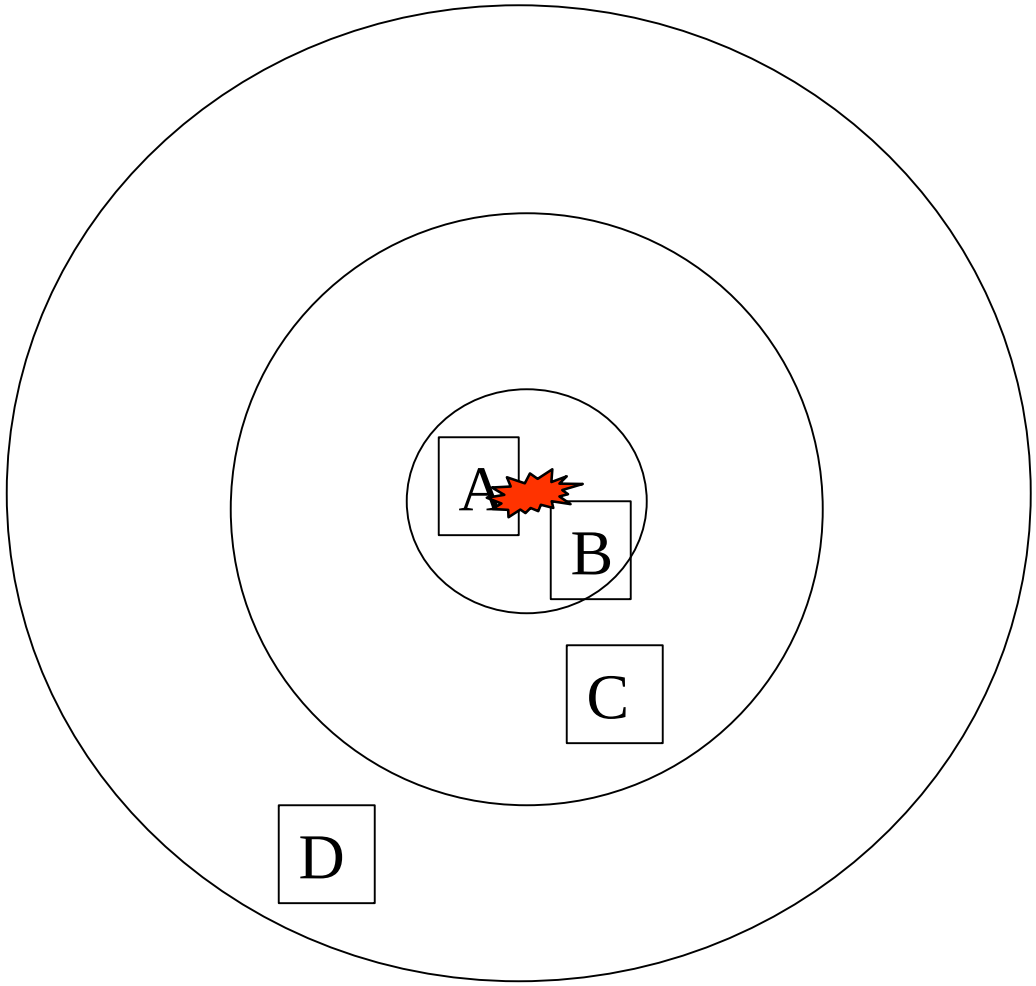
HC/D 1.6/1.1 Cost Ratio: IM0/Standard = 0.59%

IM1/Standard = 0.68%

IM2/Standard = 0.98%

ACE

Ship at Pier



ACE

Ship at Pier

Complement I

HC/D 1.6/1.1 Cost Ratio: IM0/Standard = 0.017:1

IM2/Standard = 0.017:1

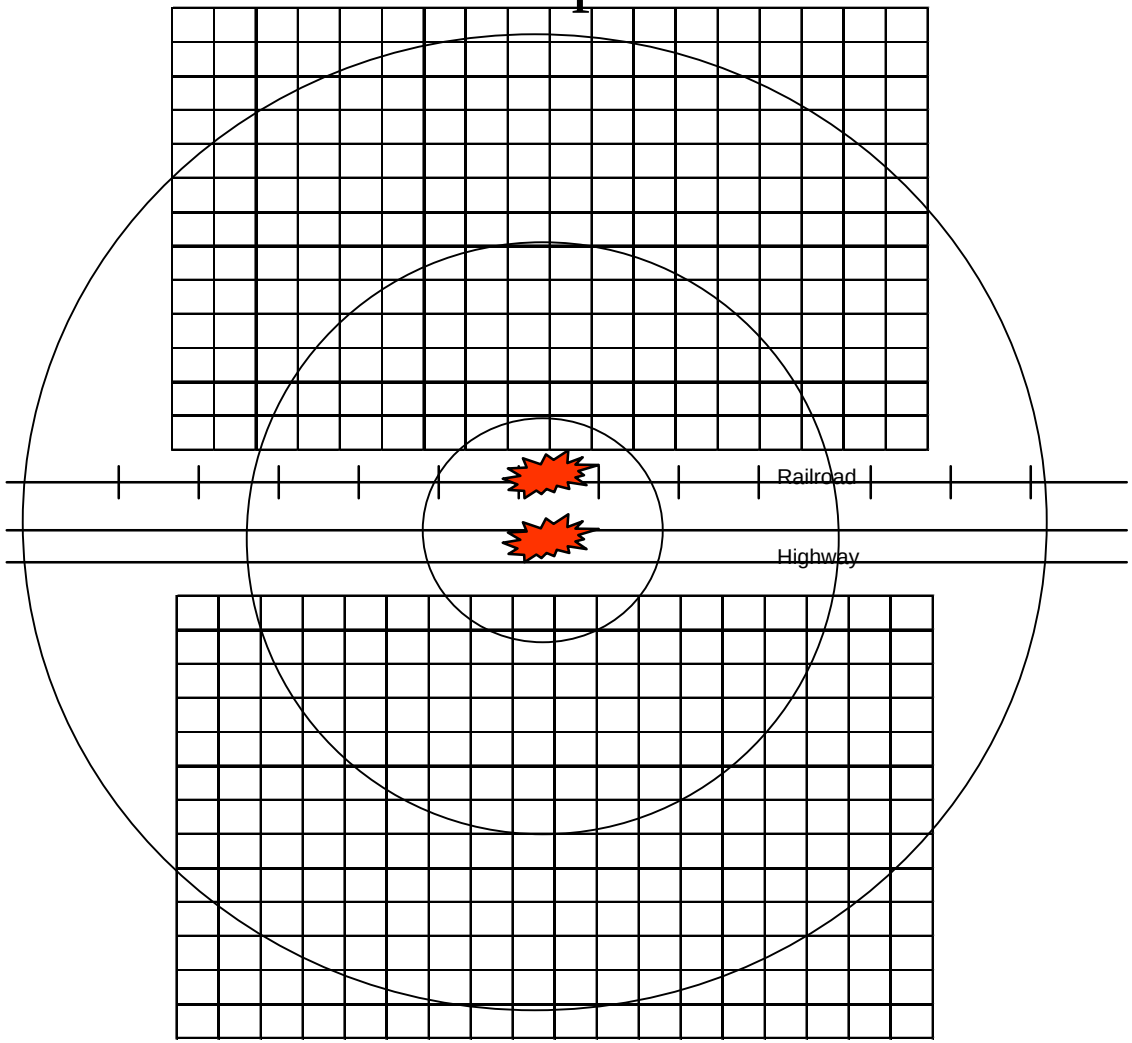
Complement II

HC/D 1.6/1.1 Cost Ratio: IM0/Standard = 0.004:1

IM2/Standard = 0.004:1

ACE

Port Transportation



ACE

Port Transportation

Classification	Asset Value ($M)	Ratio (IM/Standard)
Road		
HC/D 1.1	**43.5**	**1**
HC/D 1.2.3	**1.96**	**0.045**
HC/D 1.6	**0.337**	**0.0077**
Rail		
HC/D 1.1	**251.3**	**1**
HC/D 1.2.3	**6.35**	**0.025**
HC/D 1.6	**2.472**	**0.0098**

Convoy: 5 Semi-Trailers, 3 Munitions Complements I

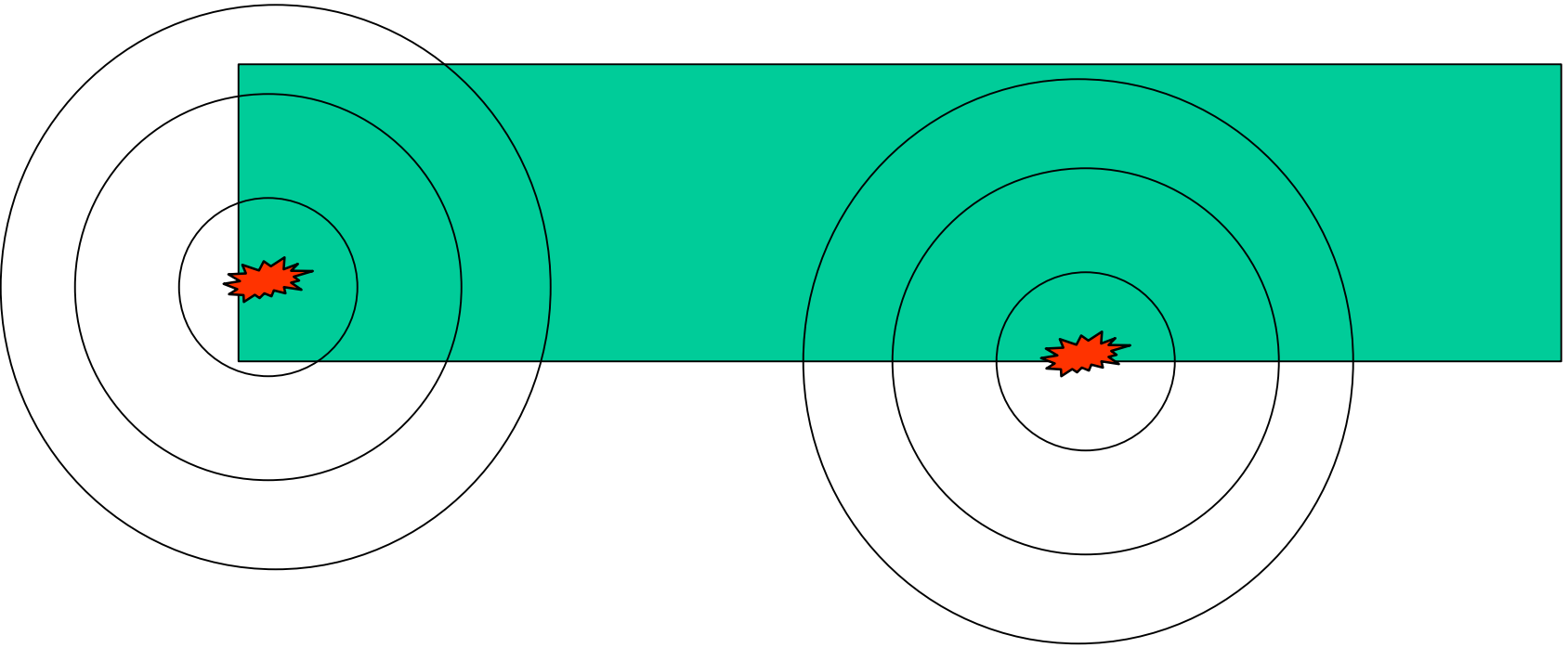
Train: 2 Locomotives, 20 Railcars, 26 Munitions Complements I

ACE

Carrier

Complement I

Complement II



ACE

Carrier

Classification	Asset Value ($M)	Ratio (IM/Standard)
Complement I		
HC/D 1.1	**390.3**	**1**
HC/D 1.2.3	**330.3**	**0.85**
HC/D 1.6	**3.9**	**0.01**
Complement II		
HC/D 1.1	**401.5**	**1**
HC/D 1.2.3	**335.2**	**0.83**
HC/D 1.6	**4.2**	**0.01**

Port Ef

Storage

Number of Groups	Number of Structures	Storage Gain Ratio Mun A	B	C
	Storage Structures			
11	282	2.50:1		2.82:1
	Trailer Parking			
1	30 (slots)		5.0:1	

Carrier Ef

Flow Model

ProModel Process Simulation Tool

Stochastic – Discrete Event

Constraint – Throughput Comparison

2 bomb types, 2 component types assembled into 2 weapon types delivered to 2 A/C types.

2 missile types tested and delivered to 2 A/C types.

Carrier Ef

Flow Model

	Delivery times (min)				AC Departures			
	w1	w1	m1	m2	AC1	AC2	AC3	AC4
Standard Process from Magazine								
min	102	95	22	20	9	28	2	2
max	159	165	156	157				
avg	127	134	89	88				
Ready Weapons on X Deck								
min	12	14	10	10	9	28	2	2
max	173	192	156	151				
avg	76	96	59	57				

Summary

- Munitions Costs
  - IM fill does not significantly increase cost of
    - Typical Flight Deck complements of munitions (0.9% – 4%)
    - Sophisticated complex all-up rounds (0.6% – 8.7%)
- Accident Consequence Evaluation (ACE)
  - IM (HC/D 1.6) provide significant accident cost reduction
    - Plant (96% – 99.4%)
    - Port (96% – 99.9%)
    - Carrier scenarios (98% – 99.6%)
- Munitions Flow
  - IM (HC/D 1.6) significantly improve munitions efficiency
    - Port Facility storage capacity (2.5:1 – 5:1)
    - Carrier dynamic Air Tasking Order response (>50% reduction in delivery time)