

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.

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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		

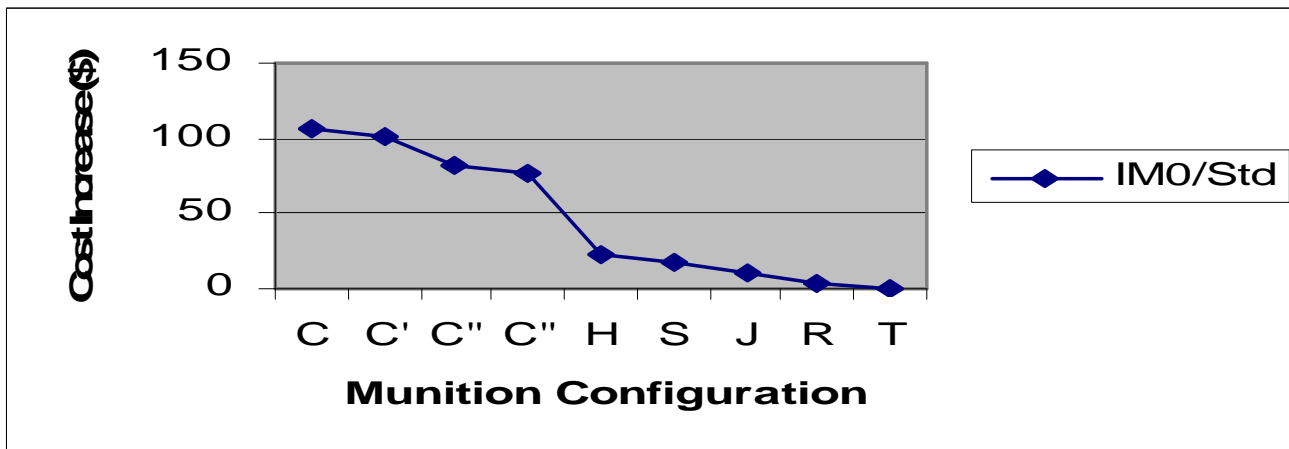
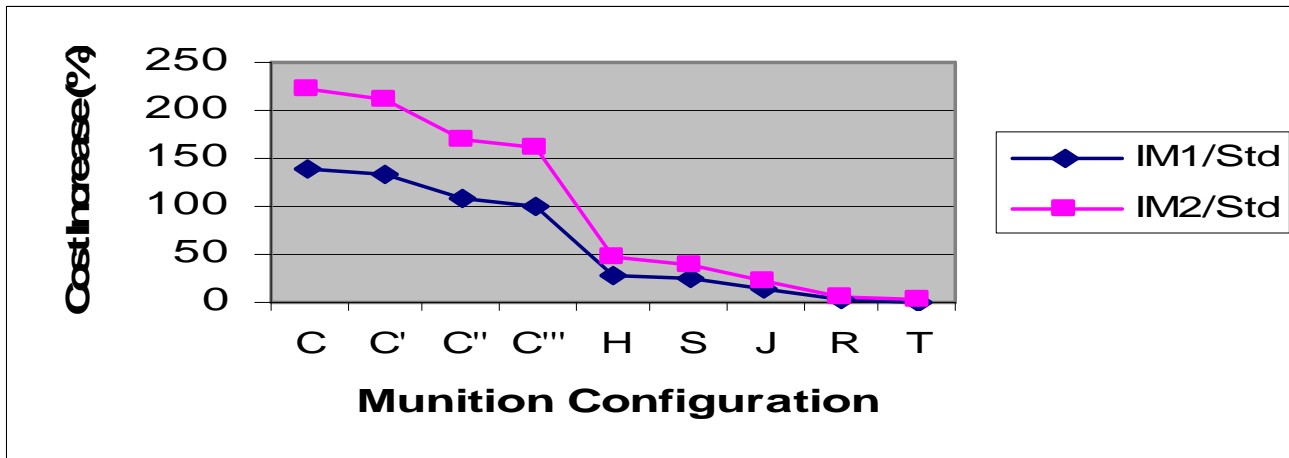
IM Fill vs Standard Fill Costs

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		

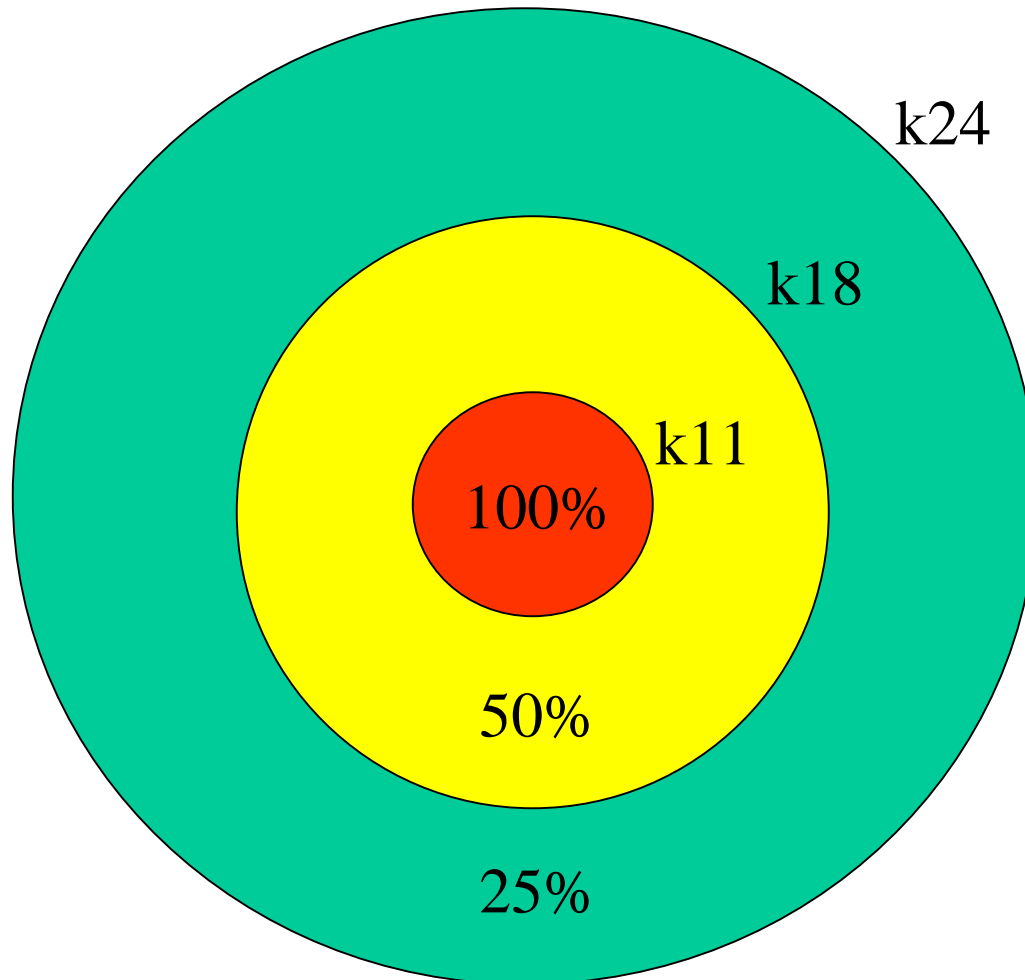
IM Fill vs Standard Fill Costs

Standard Bomb vs Complex Munitions



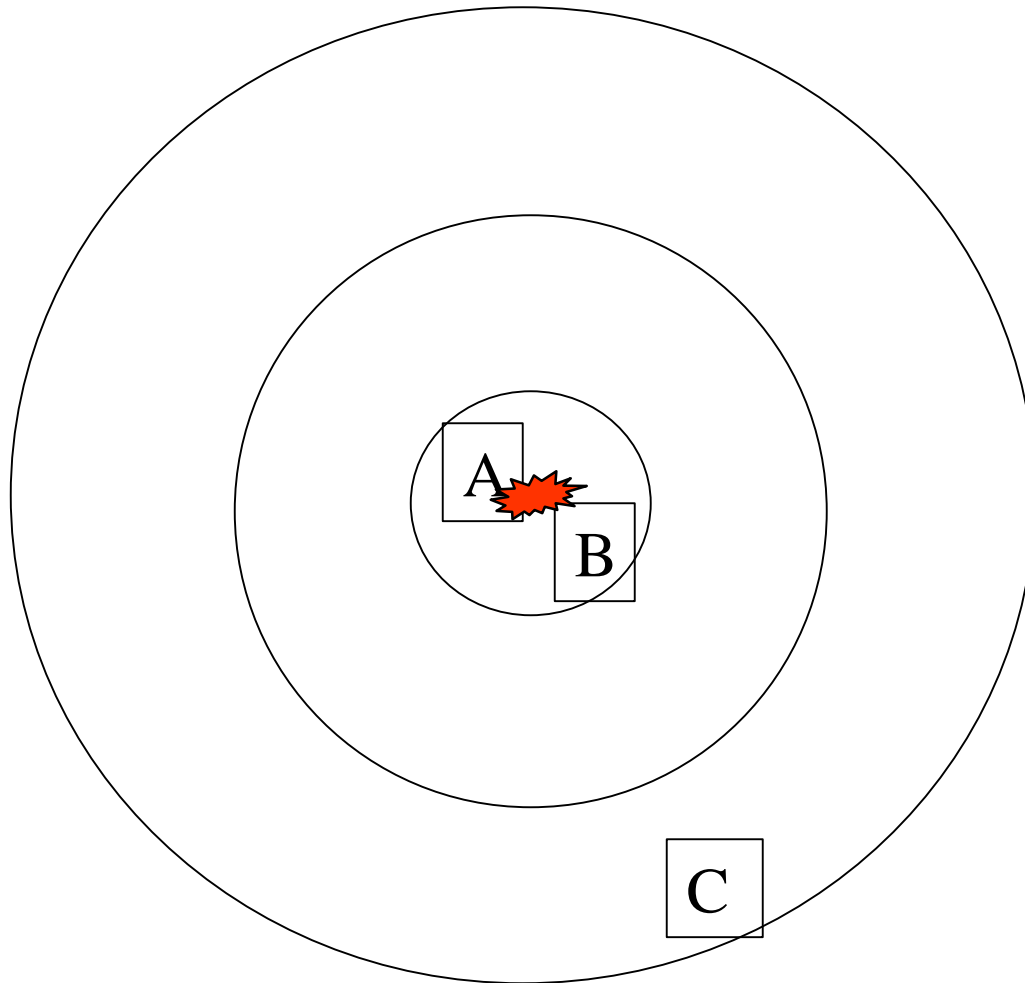
ACE

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

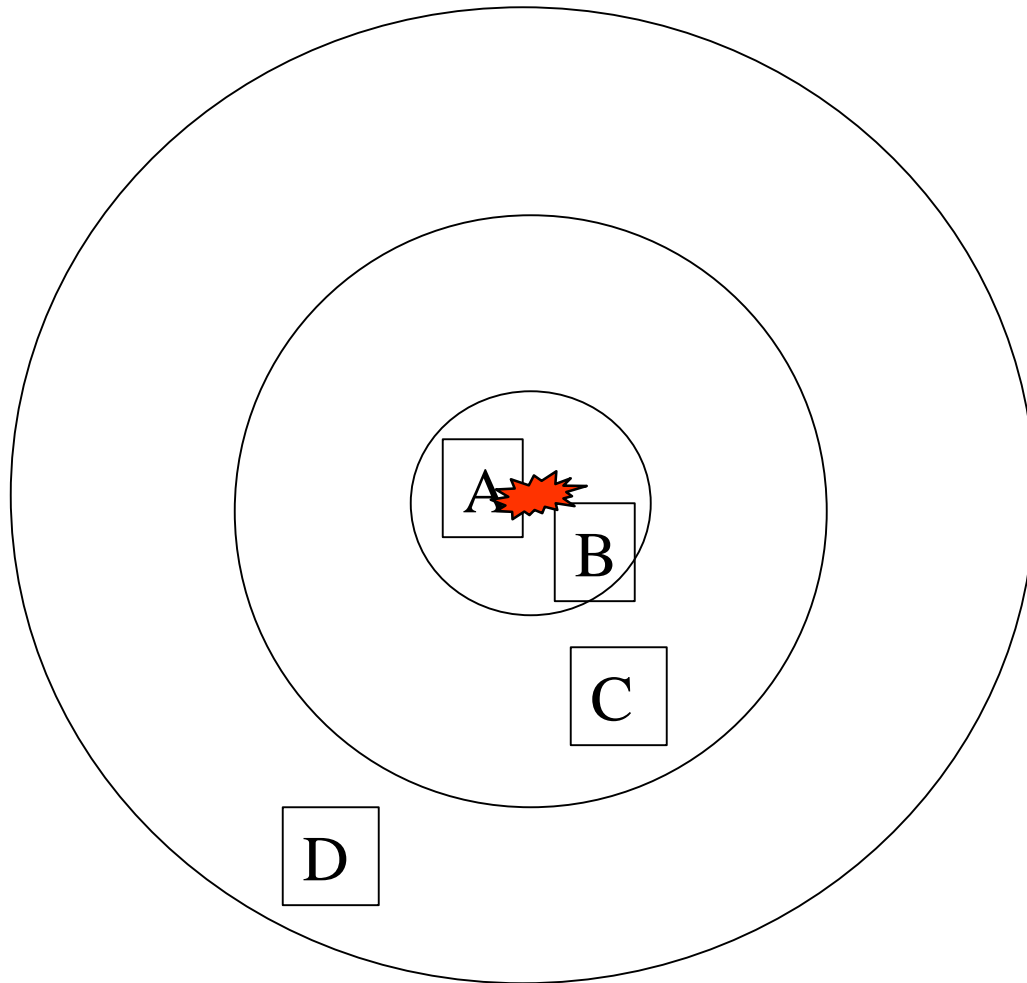
HC/D 1.6/1.1 Cost Ratio: IM0/Standard = 0.59%

IM1/Standard = 0.68%

IM2/Standard = 0.98%

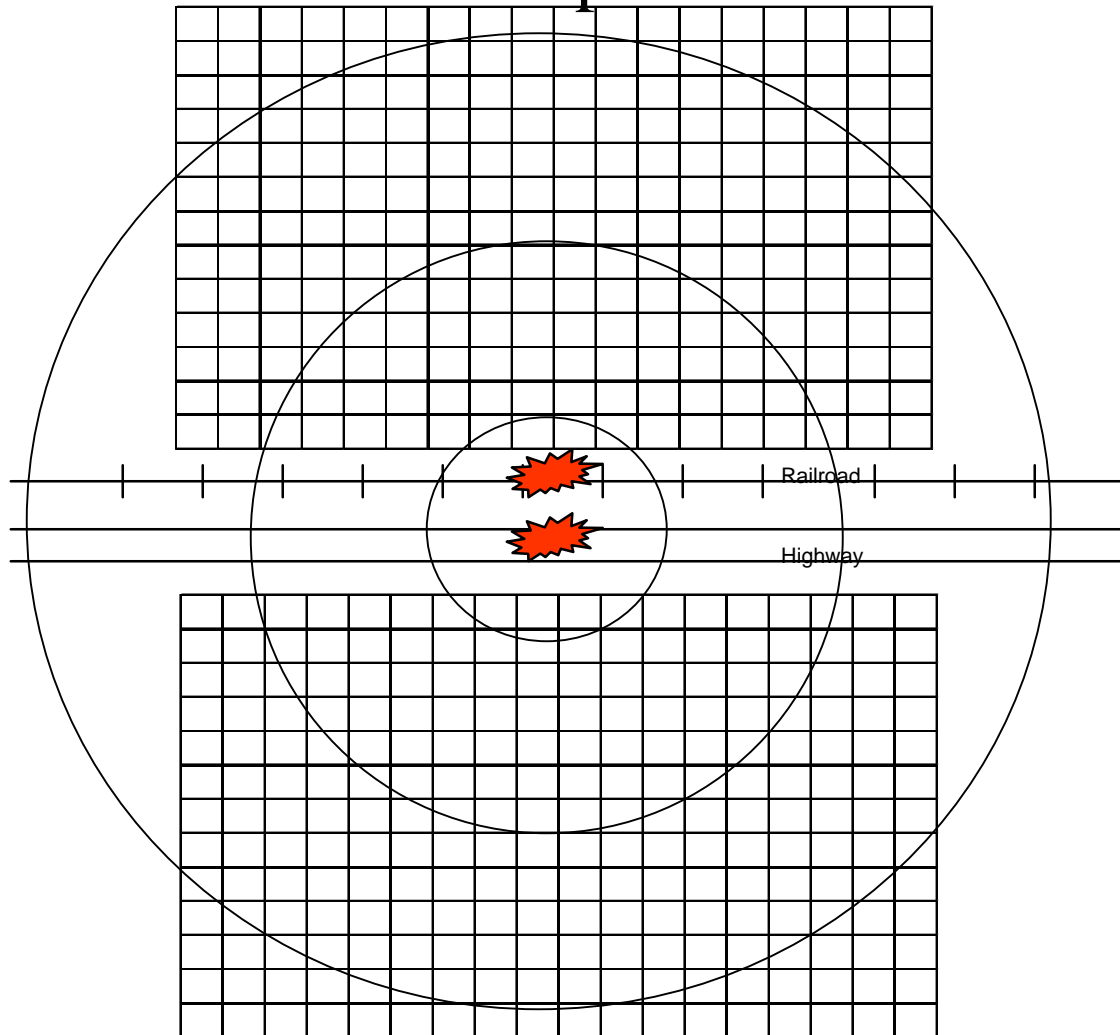
ACE

Ship at Pier



ACE

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

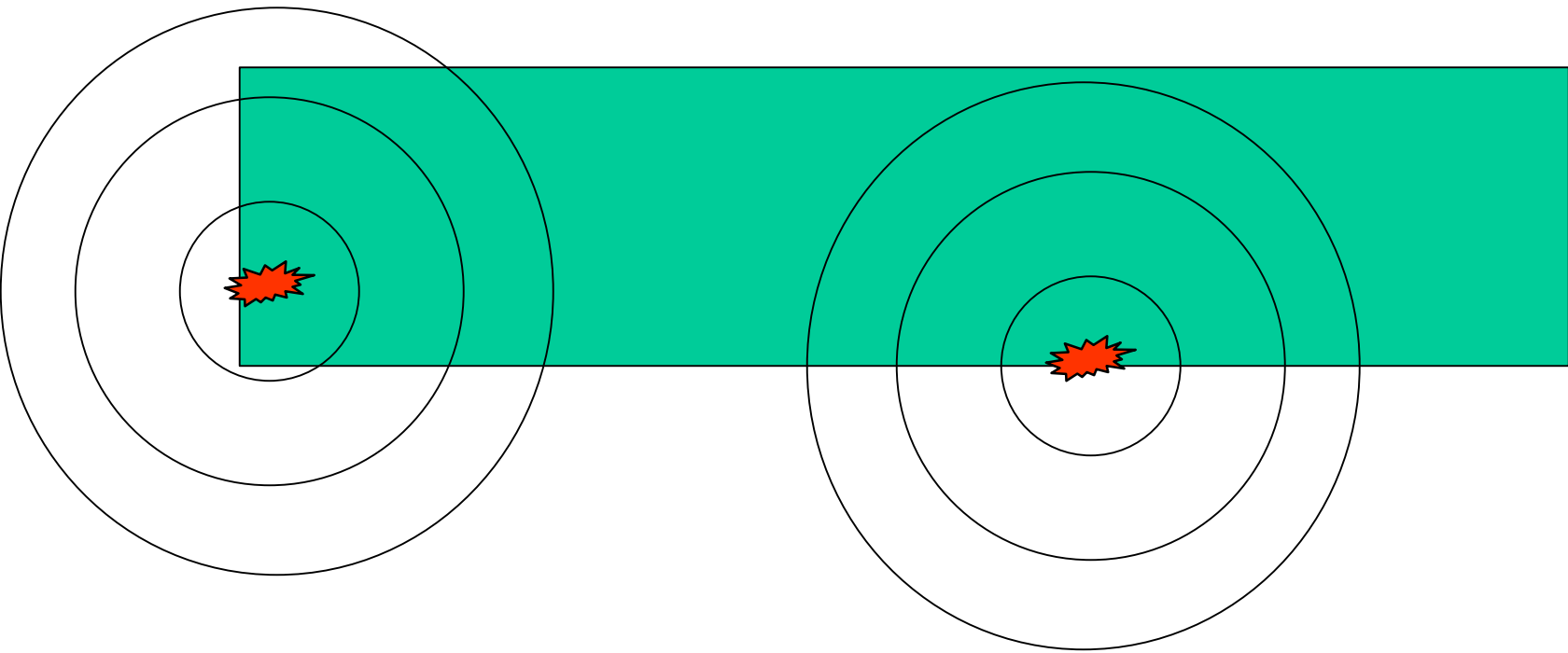
Train: 2 Locomotives, 20 Railcars, 26 Munitions Complements I

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)