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Customer Success Is Our Mission

Presentation to 44th Annual Guns & Missiles Conference

Evolving Artillery Operational Concepts from Guided Projectiles

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NOTE – All equations, weapon descriptions, and equipment specific materials are from open sources, usually the internet to avoid ITARS or classification issues

Need for Guided Projectiles-Operational

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- The Air Force and Navy aircraft tend to be more suited to Operational Support vs Close Air Support
  - Operational level targets are more valuable
  - CAS targets age out before response
  - "Broken Arrow" changes everything

- Army must fight 24/7 once engaged - all weather and does not have the luxury of weather "down times"
  - **Battle of the Bulge 1944** - enemy exploitation of loss of air power
  - Time to call in support needs to be "immediate" in many cases
  - Response timeline may not allow bringing to bear the full air might
  - Some places just can't get air support easily

The Army that can deliver overwhelming force in the shorter time will break the enemies will to resist - guided projectiles provides an army on the ground with the stand off precision heretofore only available from air forces

Cost to Delivery "First" Precision Weapon

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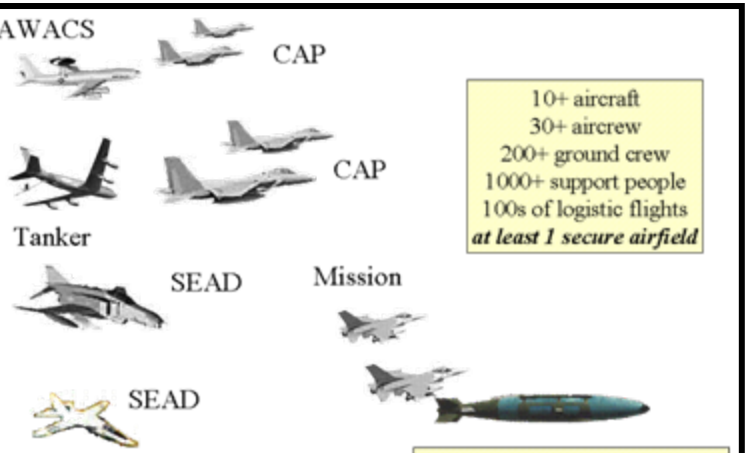
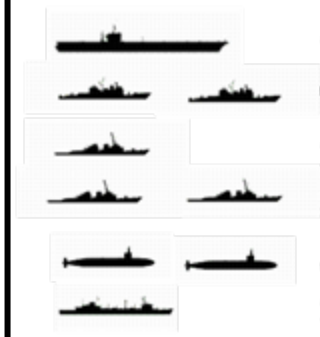
USAF



10+ aircraft
30+ aircrew
200+ ground crew
1000+ support people
100s of logistic flights
at least 1 secure airfield

First Bomb ~ $14B

USN

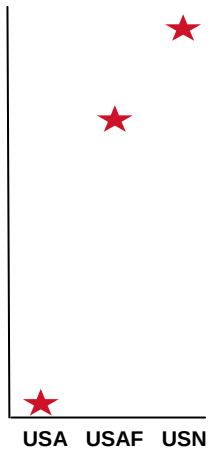


	Cost	Men	Planes	Weapons
a carrier –	$4.5B	5,680	~$4B	~$500M
two guided missile cruisers –	$2B	730	$24M	$100M
a guided missile destroyer – AAW	$.8B	323	$12M	$50M
2 destroyers – ASW	$1.6B	646	$24M	$100M
two attack submarines	$4B	270		$50M
a combined ammunition, oiler, and supply ship	$.5B	667	$15M	$10M
	$13.5B	8316		$800M

First Bomb ~ $20B

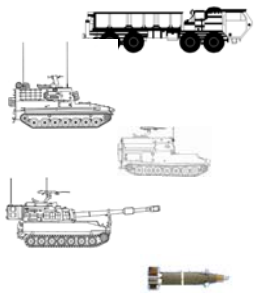
Cost to deliver Precision varies dramatically as cost and required types of platforms to execute mission considered

WOT vs. NPW cost calculus



Cost of first projectile ~ $59M

USA



	Cost	Men	Weapons
5x HEMMT truck	$1.0M	10	
1x M992A2 Fire Direction Center Vehicle (FDCV)	$2.0M	5	
6xM992A2 FAASV Field Artillery Ammunition Supply Vehicle	$6.6M	24	
6x M109A6 Paladin Self Propelled Howitzer	$9.6M	24	
M982 Excalibur Basic Load			$40M
	$19.2M	63	$40M

Cost per Kill

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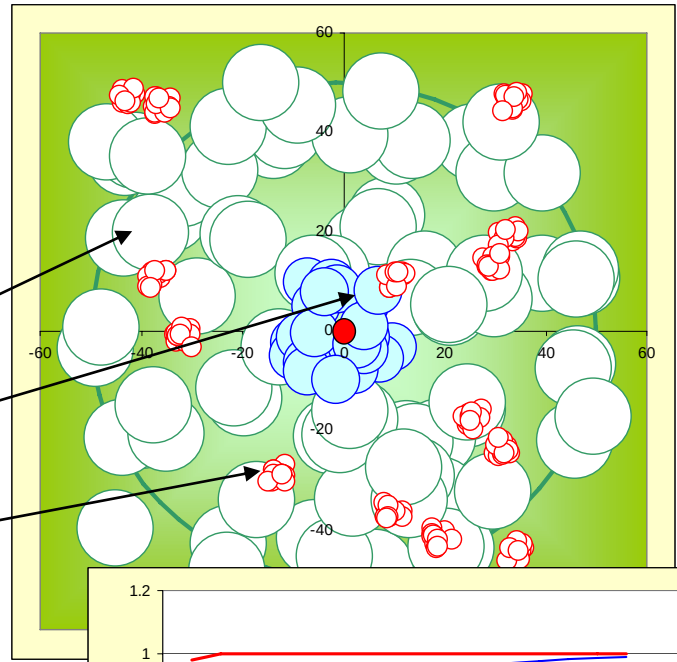
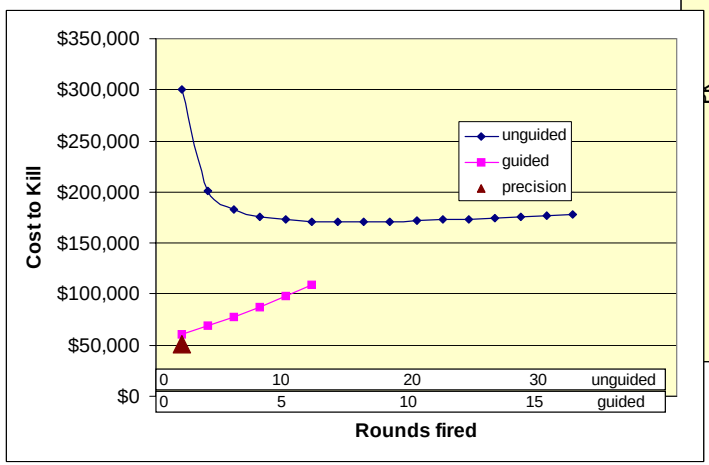
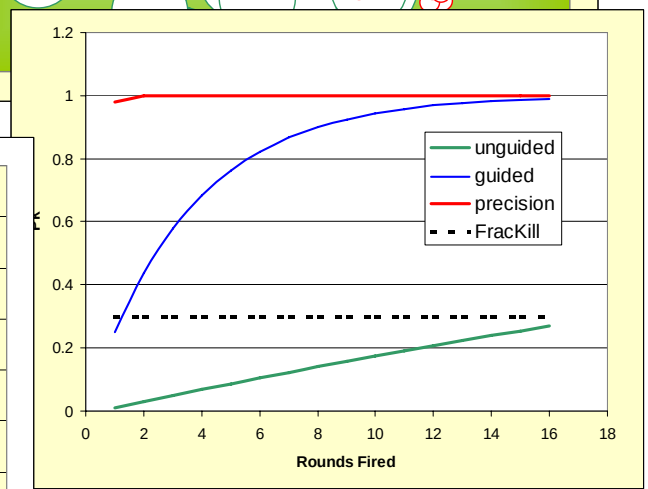
Assume a scenario of an area target and attack the center of the area using either:
unguided projectiles
guided projectile
Terminally guided projectiles



The cheapest projectile does not result in the cheapest kill





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What is Cost? How do you Measure it?

	USA	USAF	USN
■ Weapon Acquisition Cost	1.0	1.0	1.0
■ Life Cycle Cost	2.0	2.5	2.5
■ Cost per kill	8.0	10.0	10.0
■ Attrition Adjusted Cost	8.1	13.0	13.0
■ Campaign Cost	8100	21100	21100
■ "Opportunity" Cost	<5 min	<30 min	<30 min

With the employment of precision weaponry, the homily "when seconds count, the police are minutes away" is appropriate in looking at costs

Fire Support Priorities (Ranked)

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1. Precision *(Accuracy)*
2. Responsiveness *(Tempo)*
3. Mobility *(Logistics)*
4. Range

(See the “State of the Field Artillery 2007” by MG Vangjel in the September-December 2007 *Fires*.)

Major Factors in Change in Employment

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- Accuracy –
  - Specific targets rather than area
  - Reduce the number of rounds fired required to execute the mission
  - Reduce cost to execute the mission
- Tempo –
  - Fewer rounds means more missions executed in any time period
  - Operational tempo means shorter campaign
  - Shorter mission time reduces exposure to the counter fire threat
  - Ability to provide precision supporting fire allows rapid transition from fires to assault
- Logistics –
  - Fewer rounds reduces direct logistics train to support battery
  - Shorter campaigns reduces the indirect logistics train required to provide support personnel

Accuracy – New Missions

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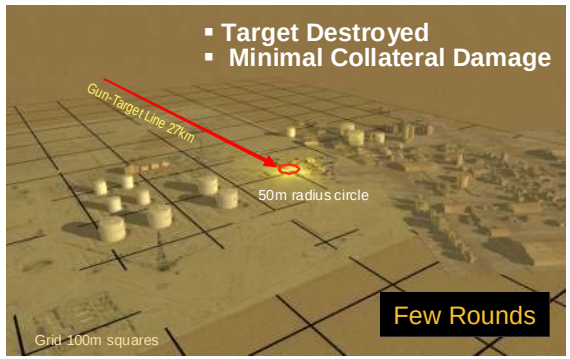
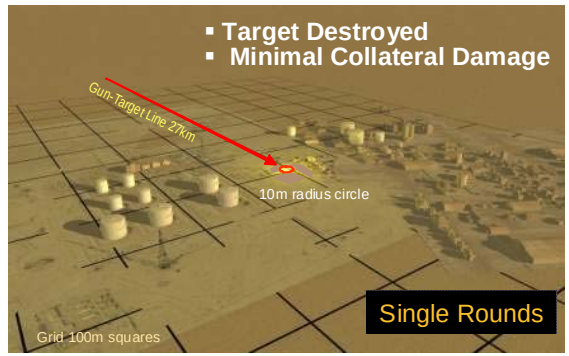
Today's Capability: 183m CEP*

PGK: ≤50m CEP



EXCALIBUR: ≤10m CEP



*** M109A6 (Paladin) at 27km: 155mm (HE) M549A1**

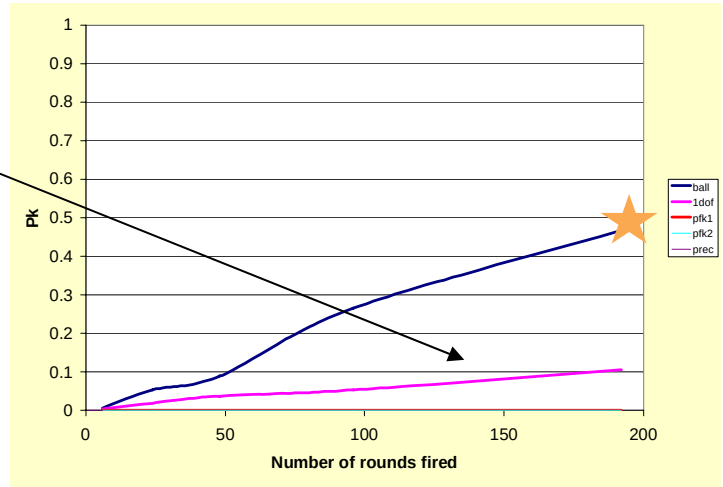
- **Improves Munition Accuracy**
  - **Faster Deployment – Fewer Unit to Ship**
  - **Improved Cost Per Kill**
  - **Faster Mission Response Time**
- **Greatly Reduces Possibility of Collateral Damage**
  - **New Missions for Artillery**
  - **Organic Precision for Engaged Small Units**
- **Increases Number of Kills per Basic Load of Ammunition**
  - **Faster OPTEMP**
  - **Smaller Logistics Tail**

Accuracy - Fewer rounds per mission

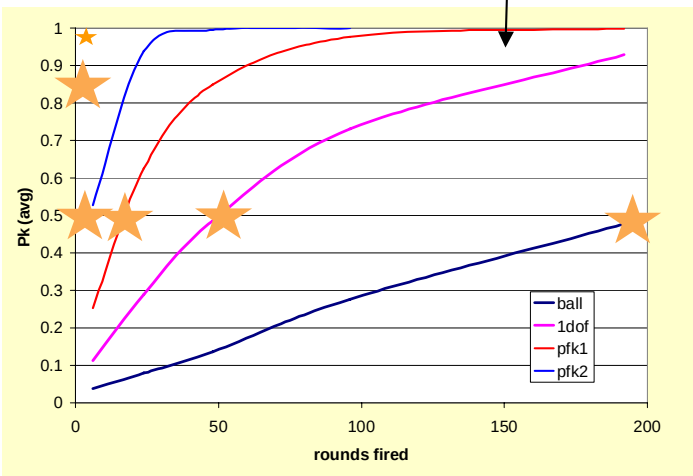
= Number of rounds to execute mission

- Precision does not help against areas targets using a single center aimpoint
- Precision helps against area targets with smart sheafing, but precise accuracy isn't as important
- Precision helps against a single target and improved accuracy does help

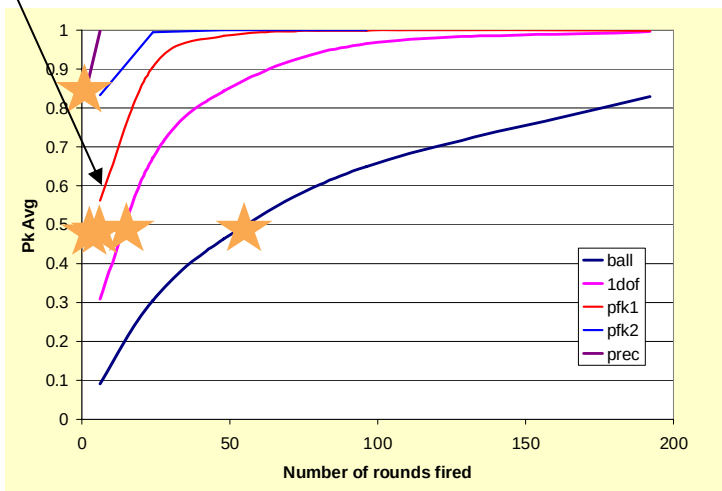
Multiple Targets – Center Aimpoint



Single Target



Multiple Targets - Sheafed



Accuracy – Lower Cost to Execute a Mission

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=cost to execute mission

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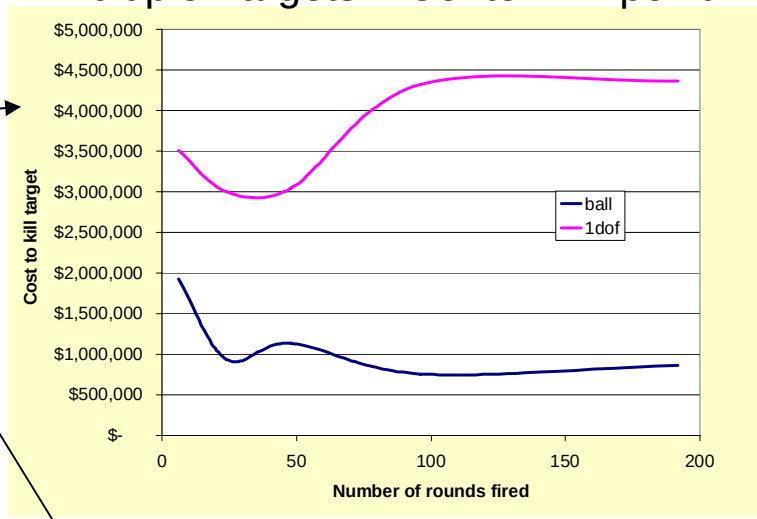
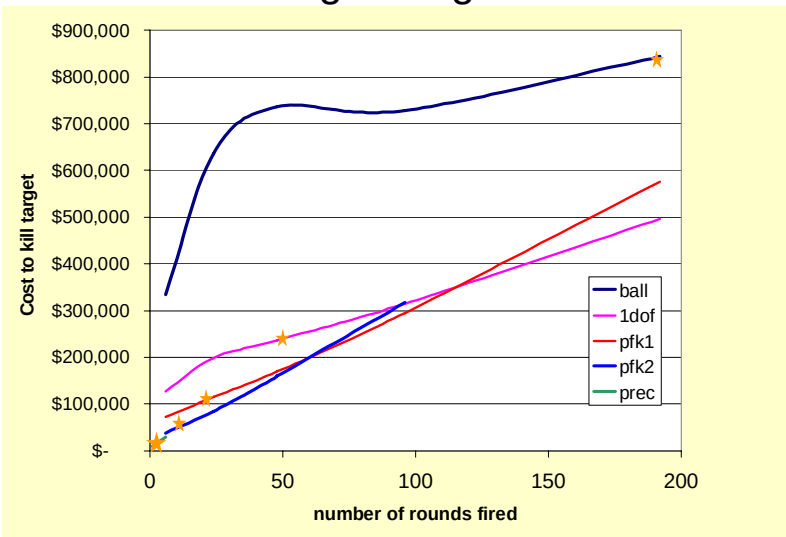
- Precision helps against a single target and improved accuracy does help

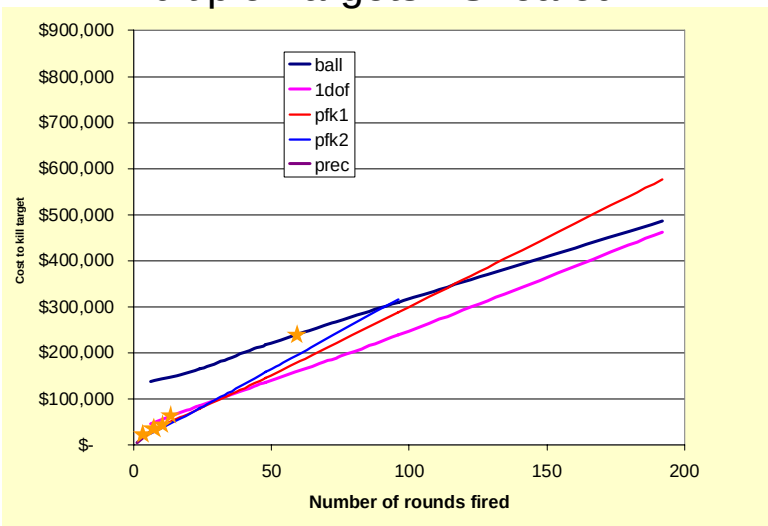
Multiple Targets – Center Aimpoint



Single Target



Multiple Targets - Sheafed



Precision - Also Provides Tempo

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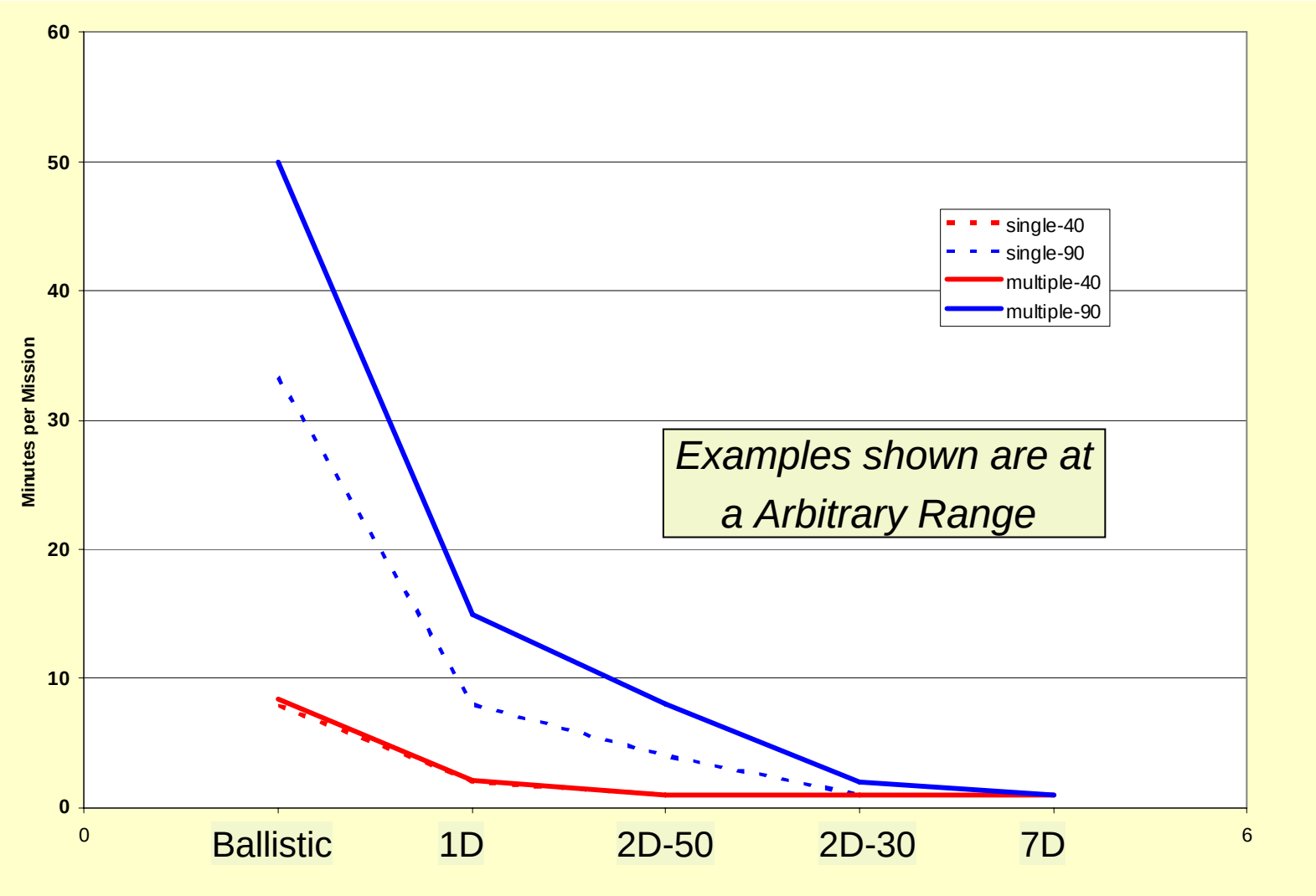
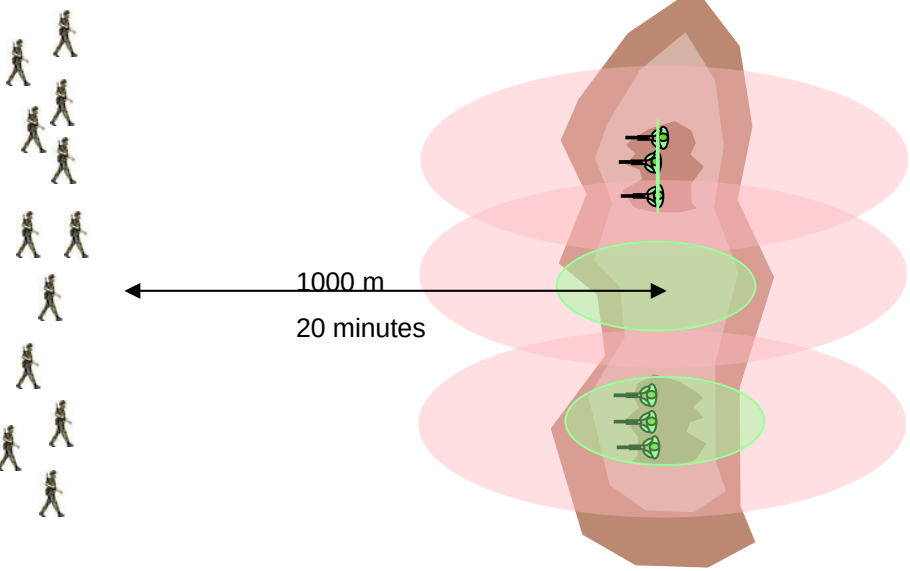
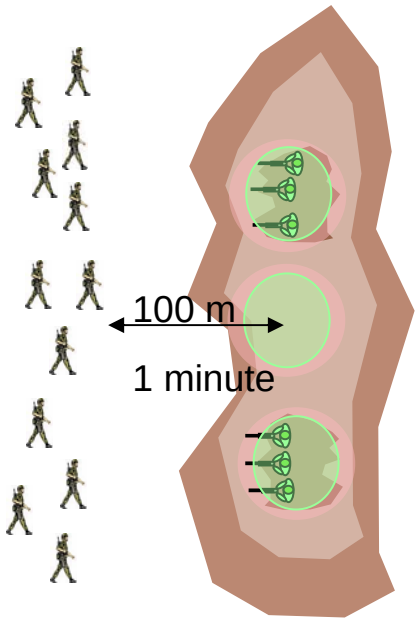


Tempo - Open Area Assault



Artillery prepares for assault by infantry
Mission requires infantry to complete
Artillery must be lifted 20 minutes before assault
Infantry advances against defensive fire



Artillery prepares for assault by infantry
Mission requires infantry to complete
Artillery lifted seconds before assault
Infantry advances before defensive fire reestablished

Artillery is now an integral part of the assault rather than preparation to assault

Tempo - Urban Operations

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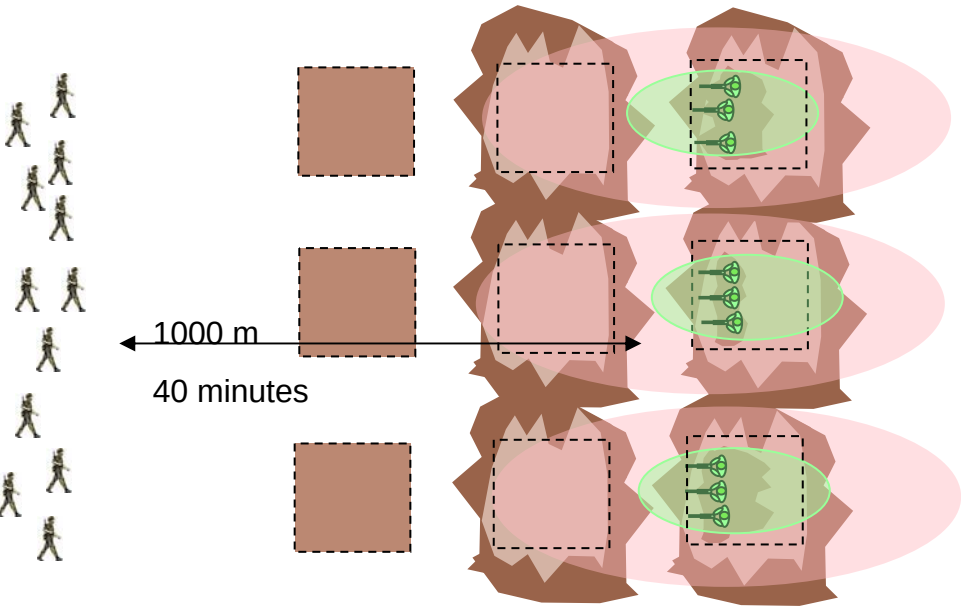
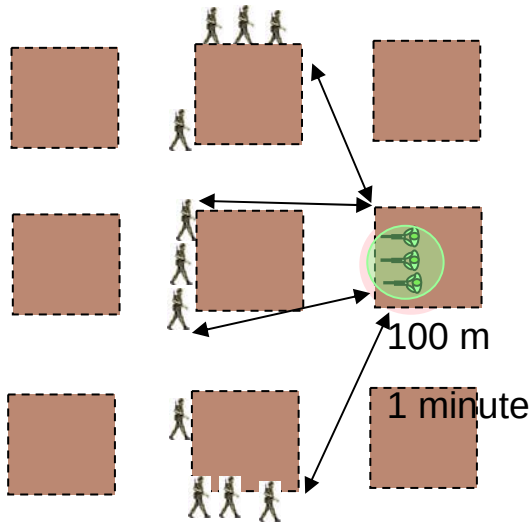


Artillery prepares for assault by infantry
Mission requires infantry to complete
Artillery must be lifted 20 minutes before assault
Infantry advances into rubble against effective defensive fire

"STALINGRAD"



Infantry advances until hostiles engage from building
Artillery fired at building, until fire suppressed
Infantry clears objective, proceeds

"BAGDAD"

Tempo – Improved exchange ratios

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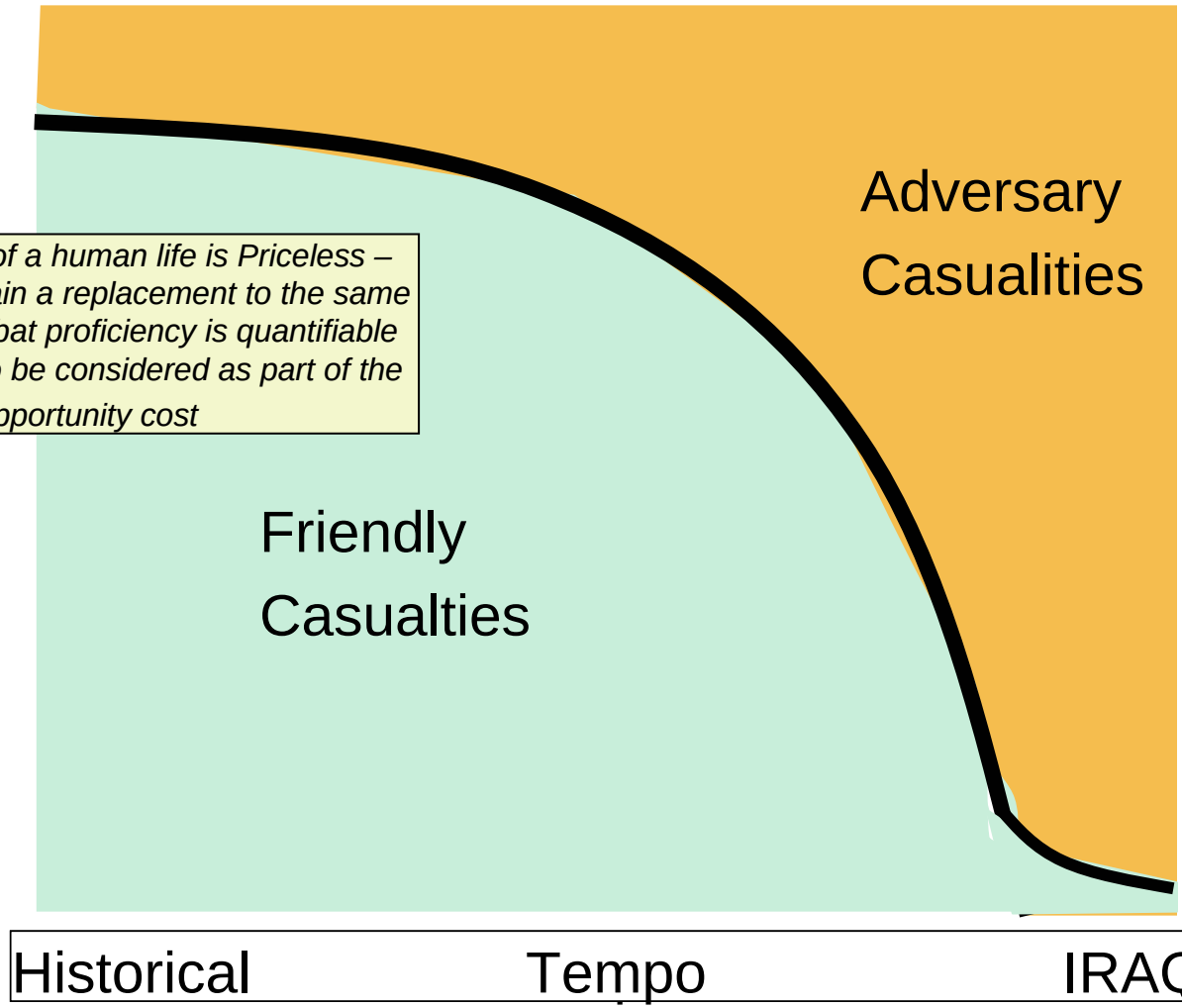
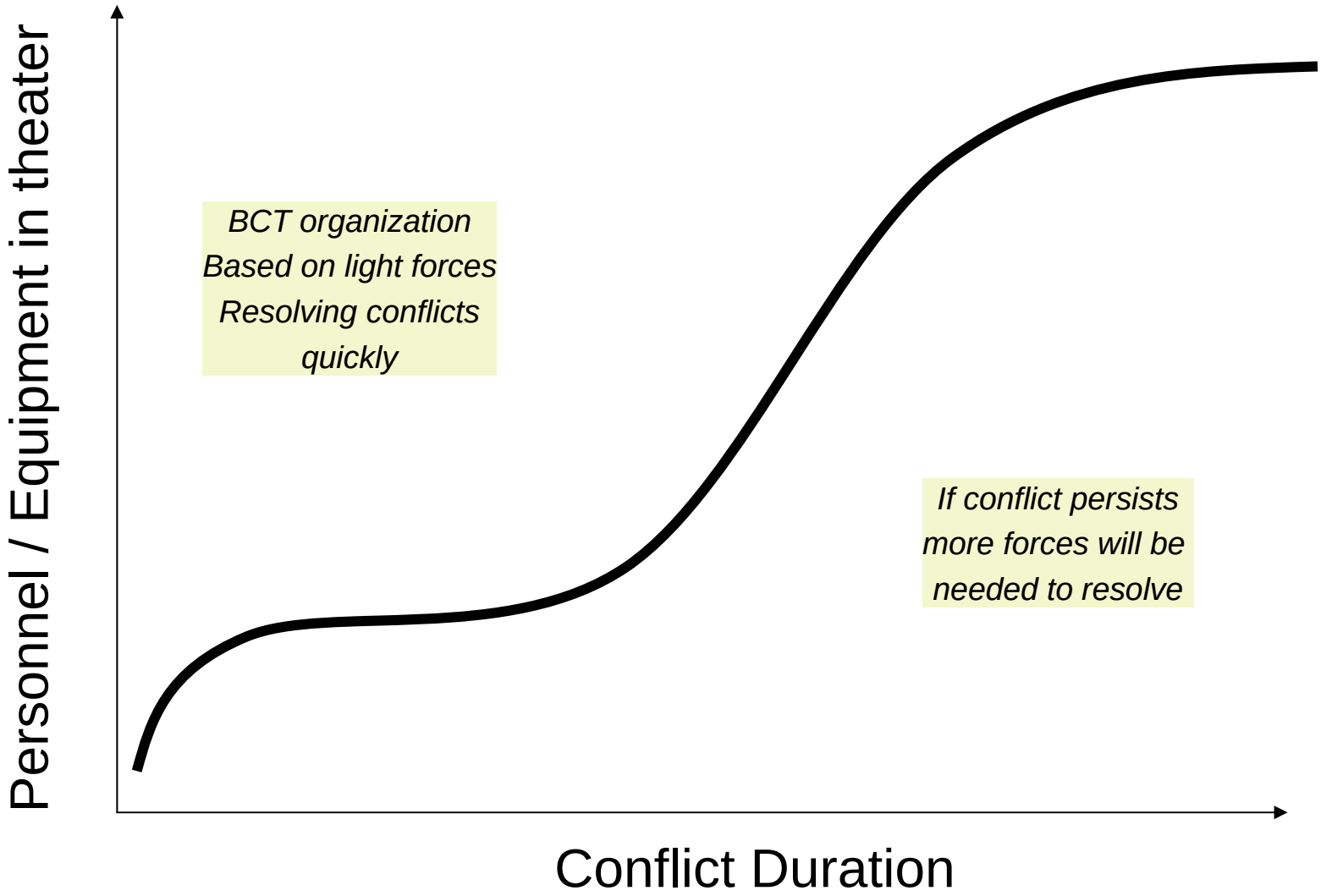
While the cost of a human life is Priceless – the cost to train a replacement to the same level of combat proficiency is quantifiable and needs to be considered as part of the opportunity cost



Tempo – Will effect Logistics need



Logistics - Demands increases rapidly as combat duration grows

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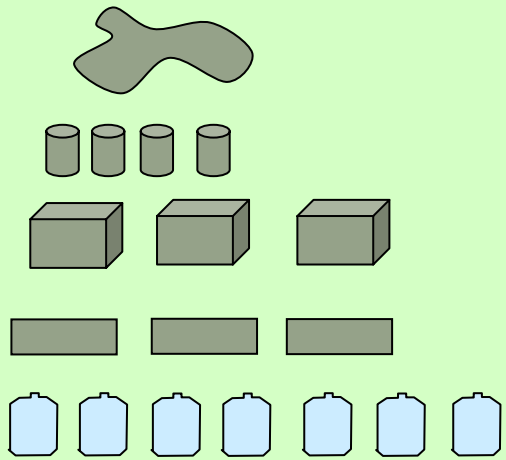


Sunscreen, salt tablets, filters, insect repellent, toilet paper, aspirin, bandages, mail, socks , etc

?? Batteries

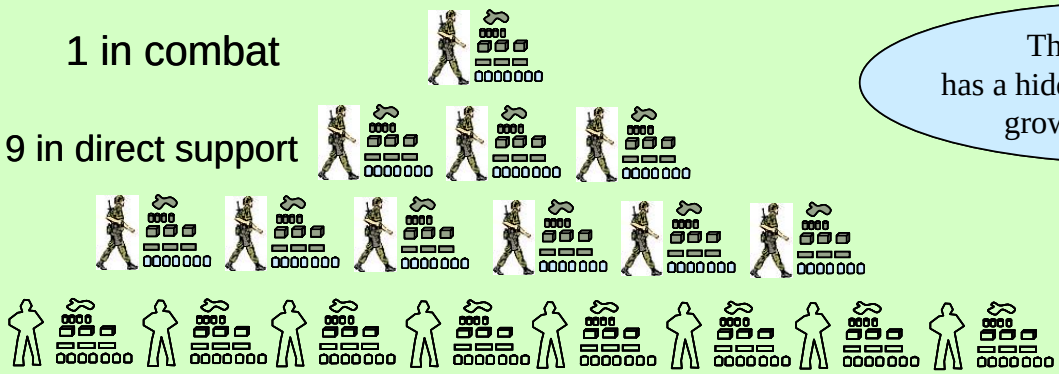
?? Clips Ammunition

3 meals

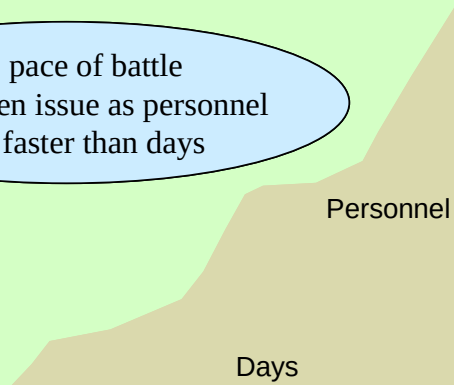
7 gallons of water

1 in combat

9 in direct support



The pace of battle has a hidden issue as personnel grow faster than days



Logistics - The True Cost of a Projectile Mission

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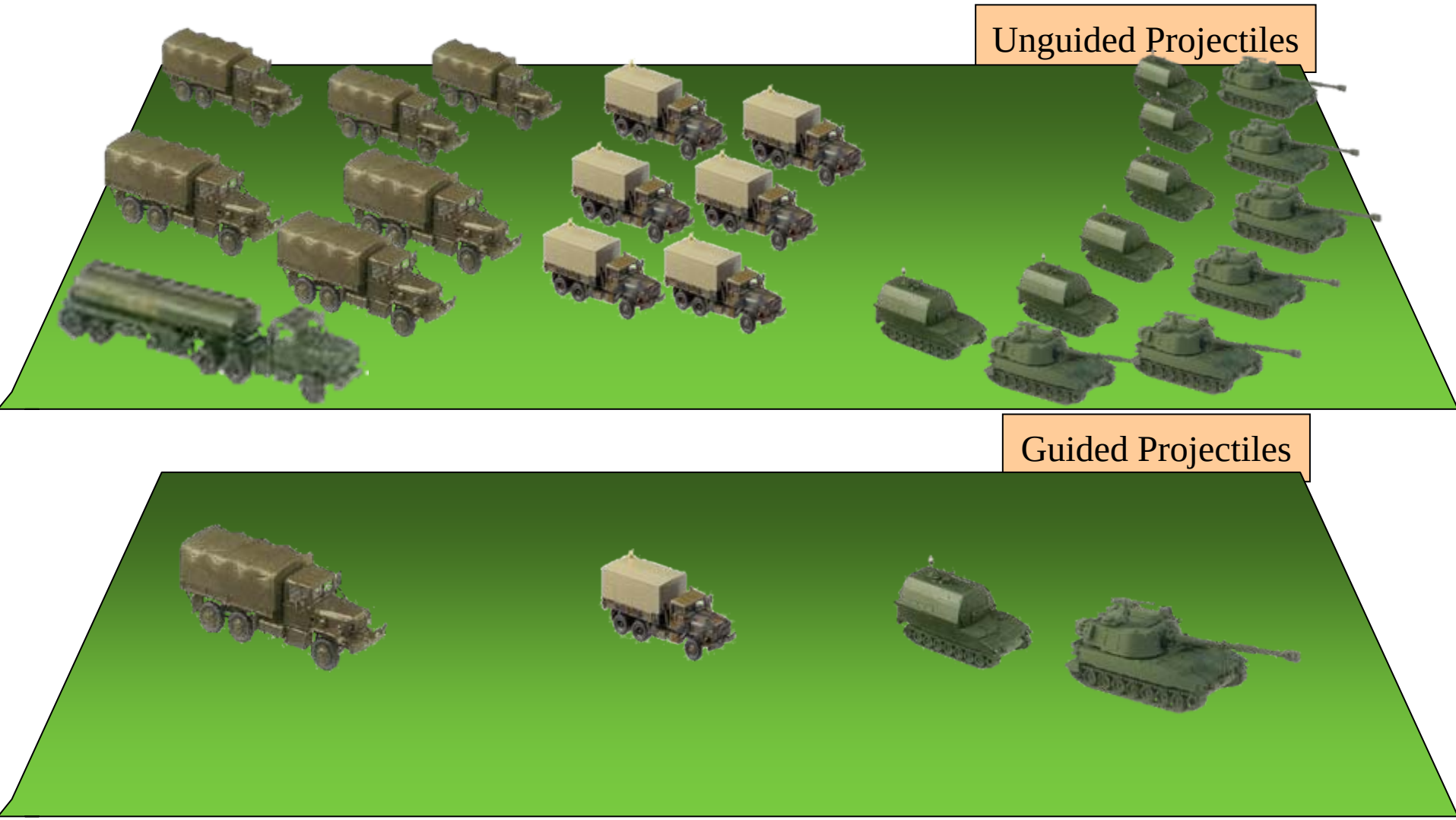

Logistics – Support logistics dominates combat logistics

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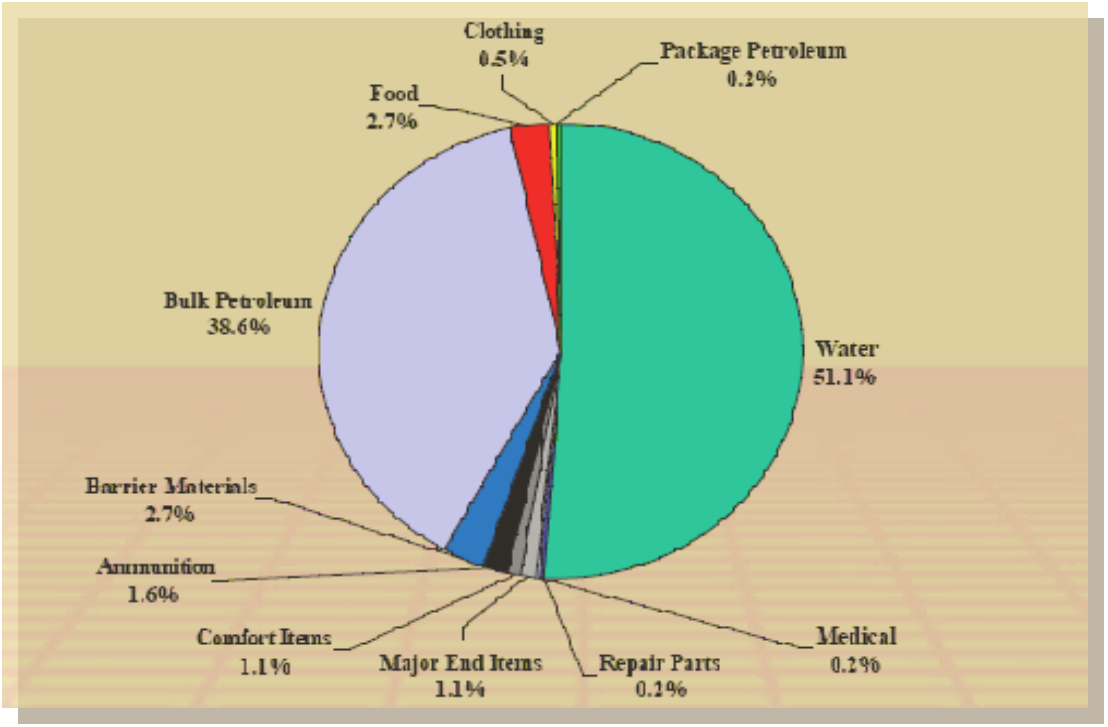

Water/ petroleum	~ 90%	(90% to support)
Combat (ammunition, barrier, medical, repair)	~ 5%	
Other	~ 5%	(90% to support)

Only 15% of Logistics is “direct” support

SUMMARY

Raytheon Missile Systems

- Precision
  - Faster destruction of target
  - Less Collateral Damage
  - Reduction of rubble defensive positions
- Delivery Control
  - Multiple mission capability
  - Less Collateral Damage
  - Mission Responsive Ordnance activities
- Reliability
  - Reduced logistics tail
  - Less Collateral Damage
- Design Flexibility
  - Multiple Gun capability
  - Seeker / Hard Kill Variants
  - Payload evolution (Inherent PIP)

Precision is good in itself, but the major operational benefits are that the logistics reduction and that reduced time to complete mission greatly increases operational tempo and reduces friendly casualties