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Customer Success Is Our Mission

Presentation to 52nd Annual Fuze Conference

Alternative Architectures from PGK Derived Components

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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

Wide Variety of Concepts and Programs

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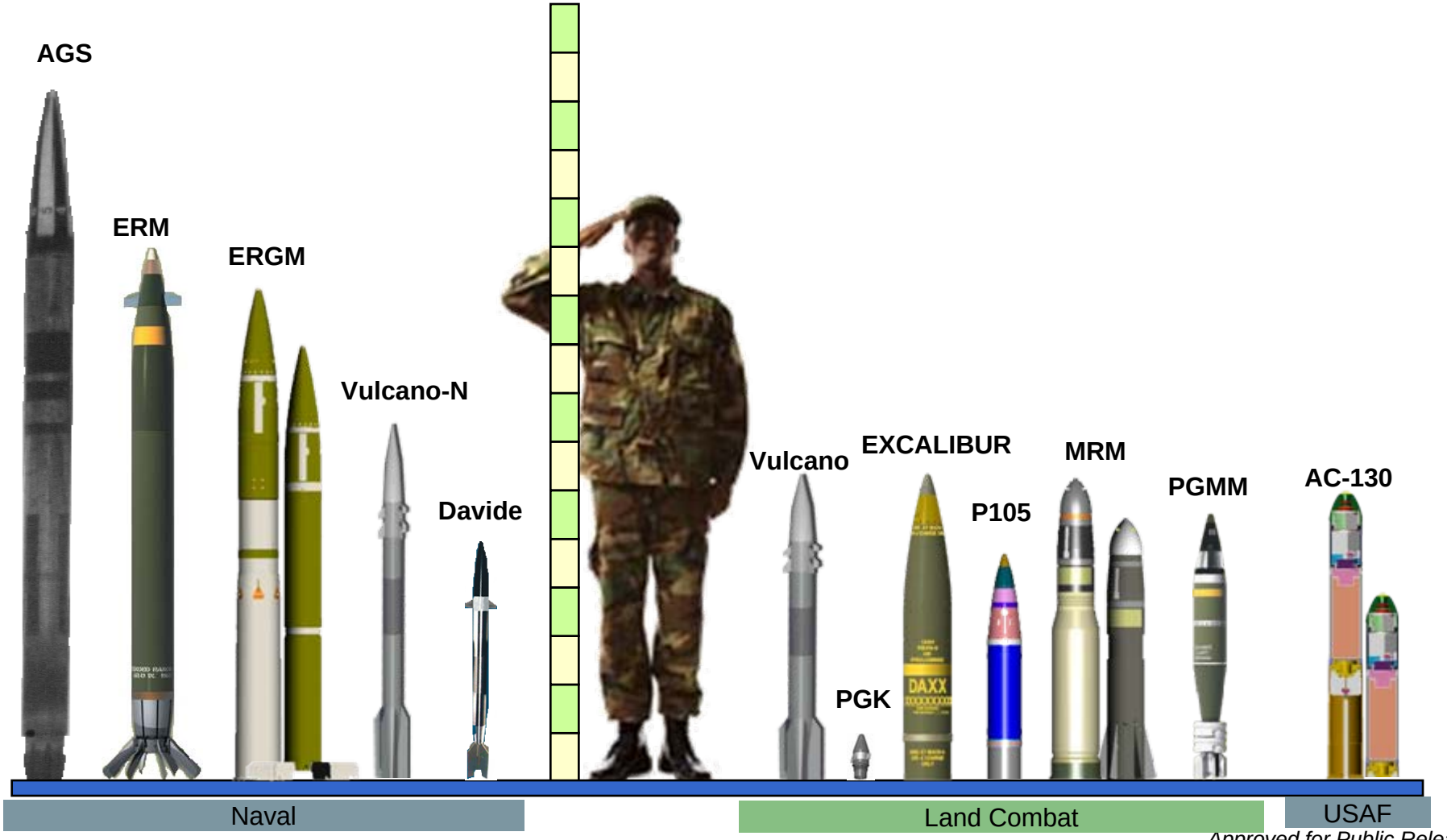
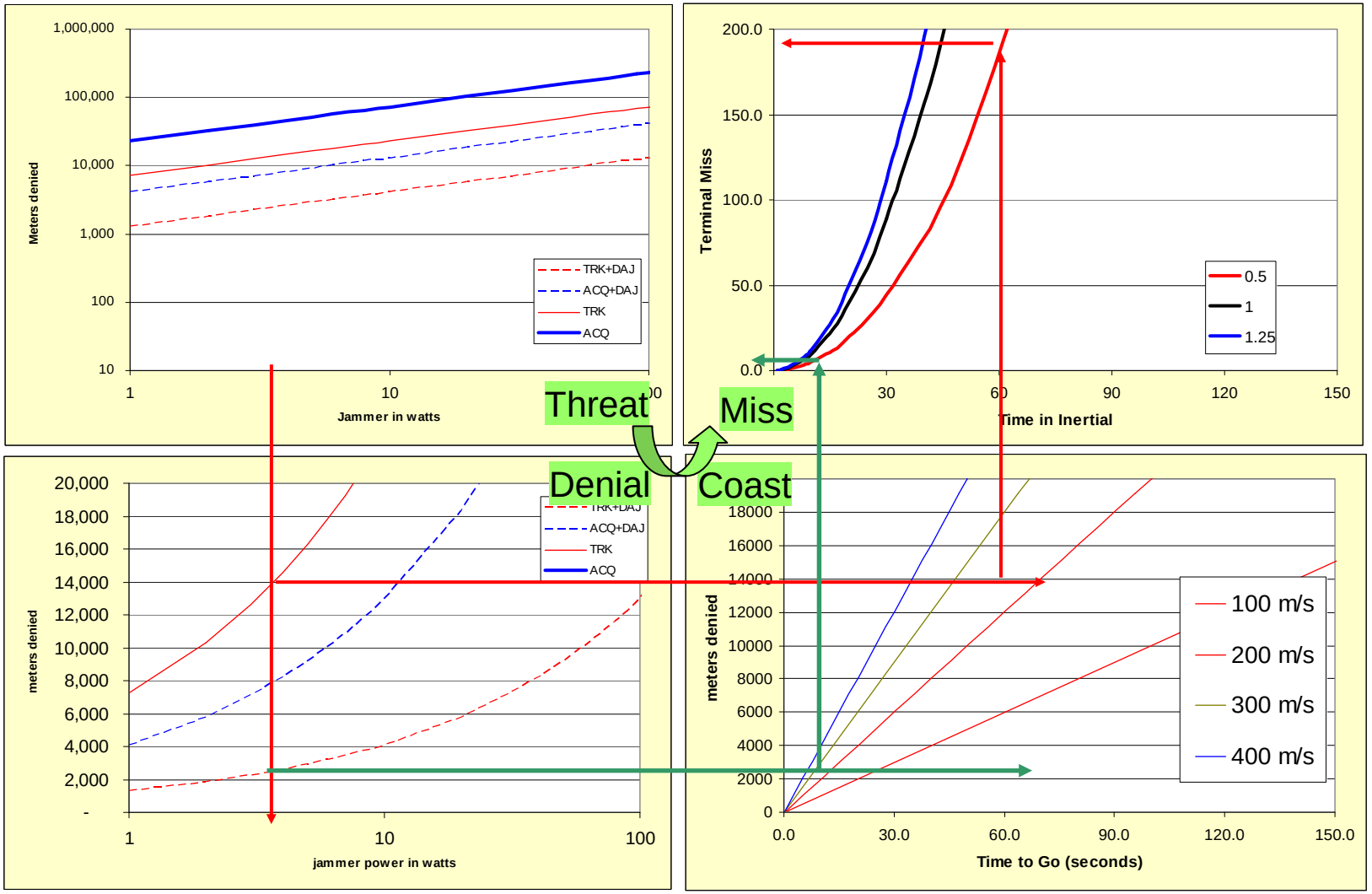


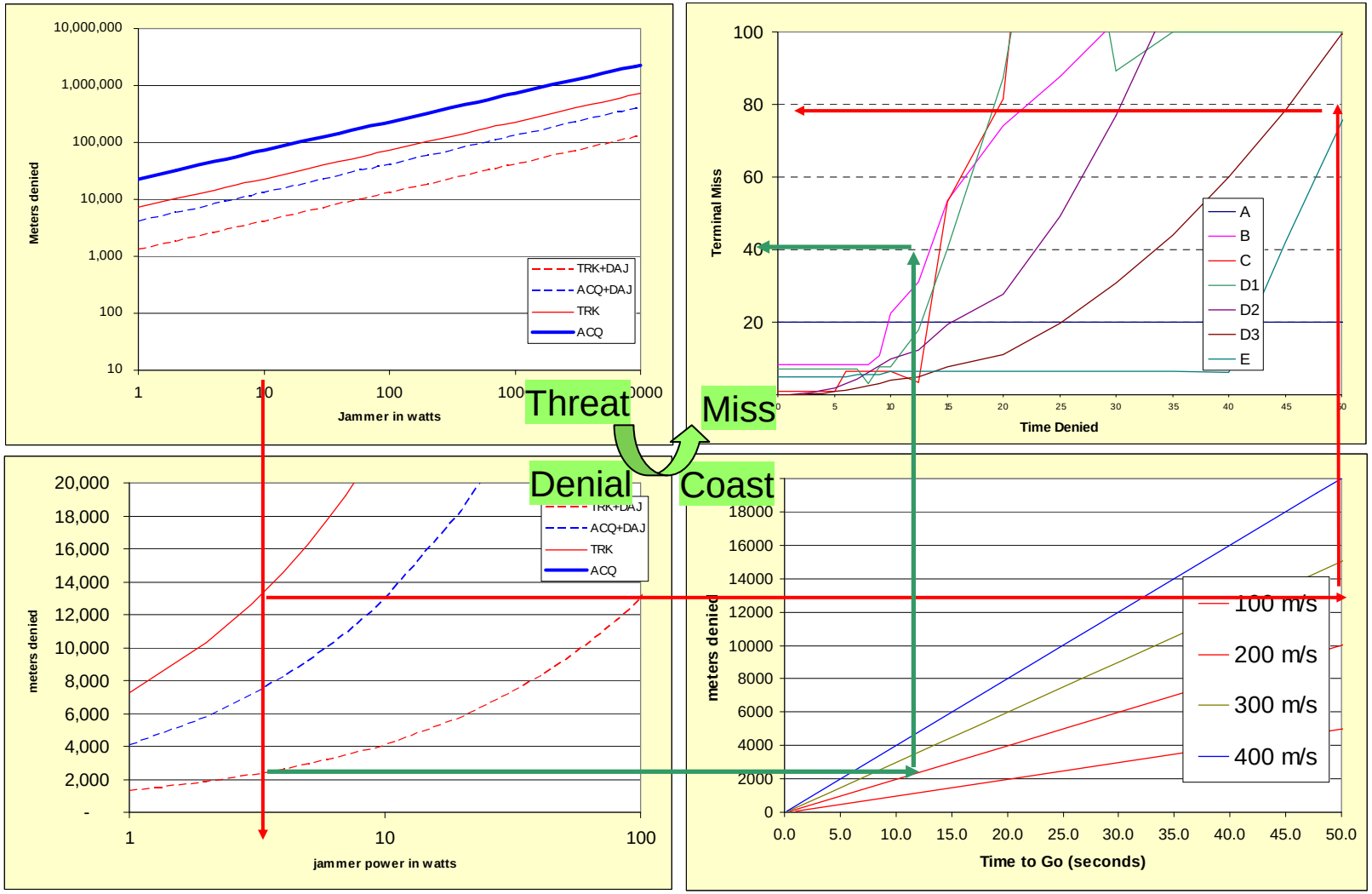
How we tradeoff GPS AJ and CEP performance (gliding weapons w IMU)



Traditional Trade Off between GPS and IMU Specifications

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

How we tradeoff GPS AJ and CEP performance (trajectory correcting weapons)



Trade Off between GPS and Trajectory Correction

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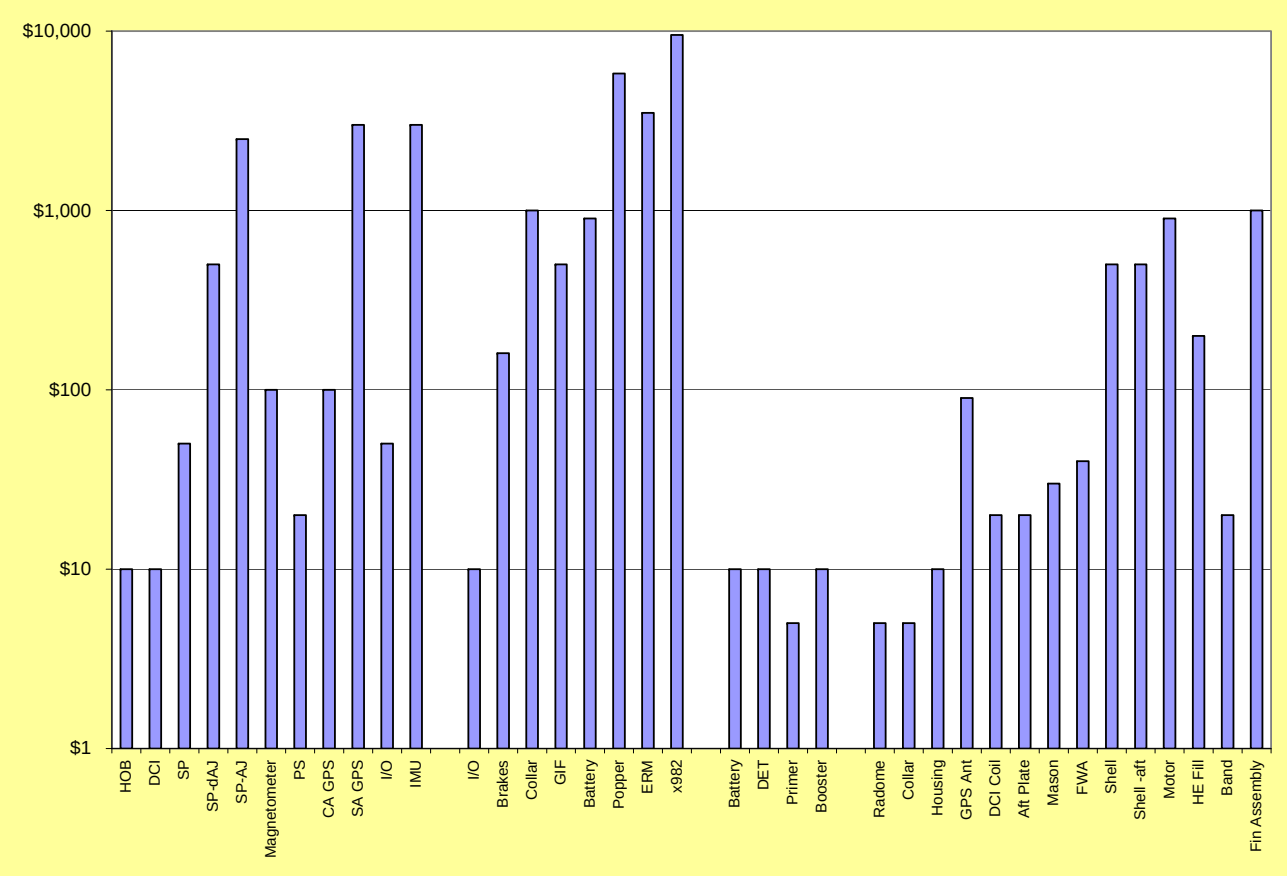
Study used "Functionality Based Costs"

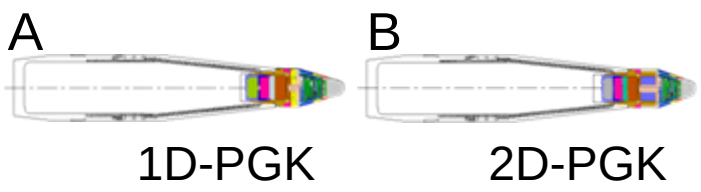
Technique in NATO Study Groups to Compare Concepts



Technology / Cost – Best Architecture Evolves
(use for relative – not absolute costs analysis)

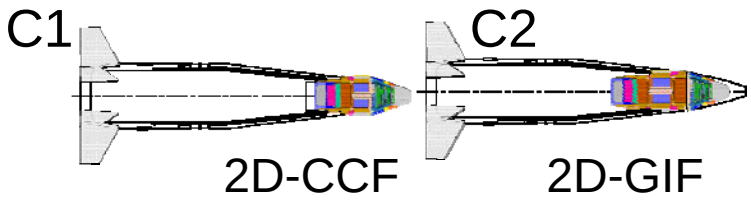
Relative Concept Architectures and Functionality Derived Costs

PGK (<50 m CEP)



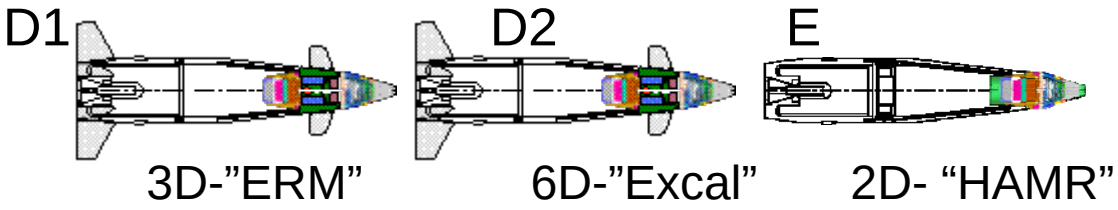
AUPC ($K)	2.2	3.4

Hybrid (<20 m CEP)



AUPC ($K)	4.6	10.3

Precision (<10 m CEP)



AUPC ($K)	14.5	31.0	17.3

HW Functional Differences

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Concept A 1D PGK	Concept B 2D PGK	Concept C1 2D "PGK"	Concept C2 2D "GIF"	Concept D1 2D "ERM"	Concept D2 6D "Excal"	Concept E 2D HAMR
						
DCI HOB CA GPS Power Design MOFA Flight Computer I/O to 1D	Magnetometer I/O CCA to 2D		I/O to Act	I/O to Act	I/O to Act I/O to IMU	(I/O to TC)
			Collar Assembly Extra battery	ERM CAS Extra Battery	CAS IMU Extra Battery	TC Assembly Extra Battery
Brake Assembly	2D CAS					
		Finned base	Finned base	Finned base	Finned base	
PGK-like Weapon Architecture		**Hybrid Weapon Architecture**			**Precision Weapon Architecture**	

SW Functionality is Remarkably Consistent

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Concept	FUNCTION	Aimpoint estimation	Arming function - Brake	Arming function - FS&A	Ballistic aiding of GPS	BIT	DCI	Fail Safe	Fuzing	GPS HOT START	GPS Processing Interface	Jamming Detection	Latitude / Altitude compensation	Launch detection	Mini- TM/HOB interchange	Operating system	Optimum braking timing	Power up processing	Precession Drag count	Provisions - Unique projectile characteristics	Reprogramability	Telemetry Output Subsystem	WGS-84 Earth Model Transformations	Winds Aloft compensation	Factory / Manufacturing / Test Functions	PIL/HIL data entry test ports	Special factory tests	Telemetry	New 2D KIT FUNCTIONS	Collar braking command	Control "UP"	DOD WMM 2005 Integration	Magnetometer "UP"	Magnetometer calibration function	New Projectile variants FUNCTIONS	CAS commands	Control section BIT	GPS- AJ / or Coast Logic	Trajectory shaping	Autopilot	IMU	Popper firing logic
	today	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
PGK																																									
A		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x															
B		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x								
Hybrid																																									
C1		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x								
C2		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x		x						
D1		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x		x	x	x				
D2		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x		x	x	x	x	x	x	
E		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x			x	x				x
Precision																																									

Insertion Of new function into SW

Software Infrastructure Needs Support Many Solutions

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Concepts vs. Precision 105 Requirements (of 8-2007)

Attribute	B PGK	C1 PGK	C2 GIF	D1 ERM	D2 982 jr	E HAMR	Comments
Precision							HAMR depends on achievable popper impulse
Reliability							.90
Net Ready							All support NET
Lethality							New Pre-formed fragment warhead
Range							Min 5km, Max 20 km
Compatibility							All EPIAFS compatible
Initialization							All Support requirements
Fuze Function							All Use MOFA fuze well
SAL Compatible							All would require different packaging to support
Angle of Fall							70 degree angle achievable at 2/3 range (spec)
Projectile Weight							<54 lbs
Projectile Length							<40 inches
Render Safe							Unused Poppers may still initiate
Reset							
Reset after Ram							
Extraction							
Query							Power up charges caps and fuze can answer queries
20 year Shelf							IMU 20 yr uncertain
IM Compliant							Poppers on surface and are “projectiles”
Risk of meeting KPPs							Combined assessment of simultaneously meeting CEP / impact angle / packaging / concept risk

Candidate Space Offers Multiple Potential Solutions

Concept Trade Space
CEP performance vs System Architecture

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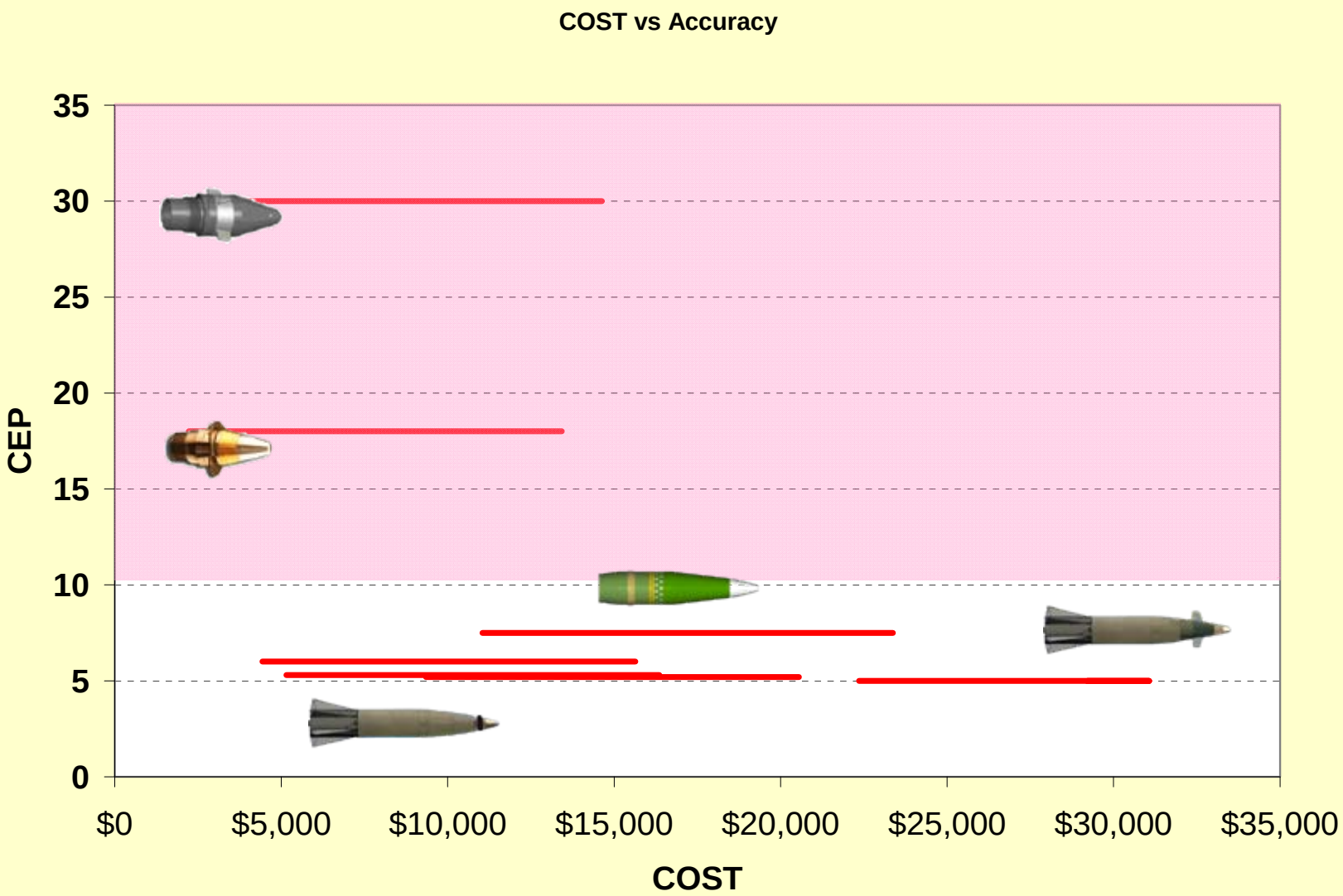

Concept Trade Space
AJ performance vs System Architecture

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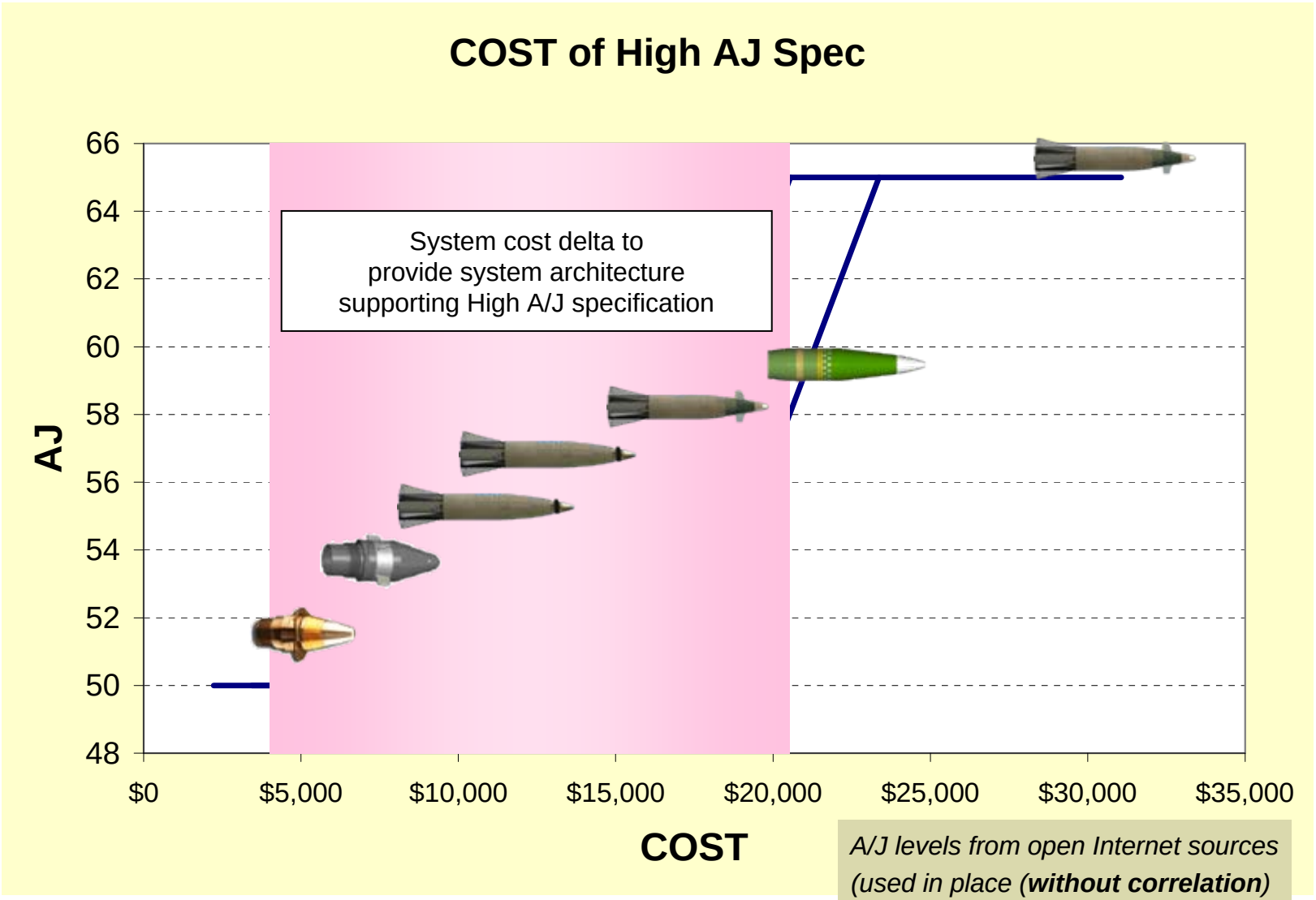

Concept Trade Space - AJ vs Miss growth

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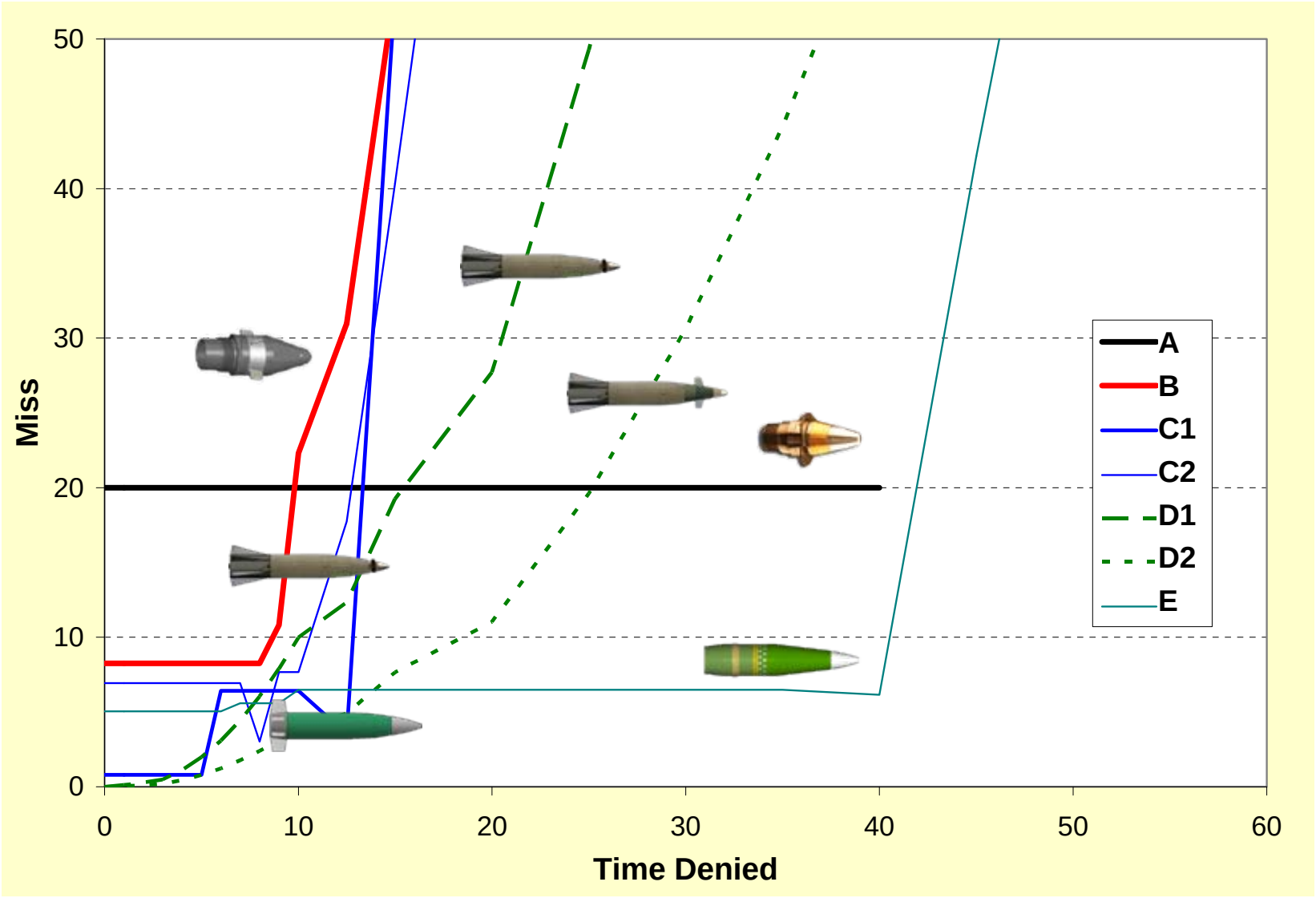

Potential Cost of Specification Compliance

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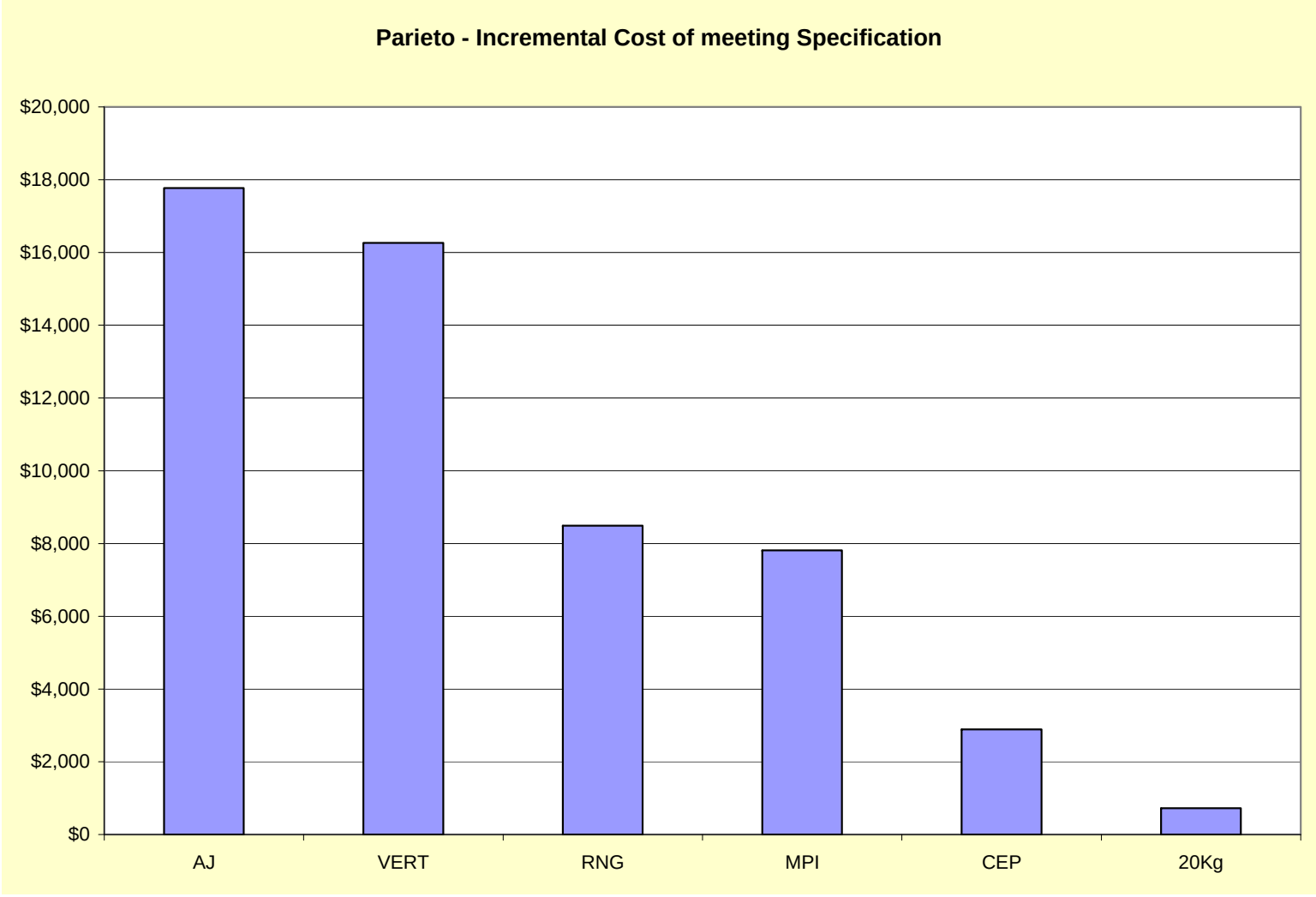

Some Requirements Drive Majority of Architecture Costs

Summary

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- PGK derived components can organically flow into higher performance architectures
- There are a number of viable guided projectile concepts that can meet both 20km and 10 meters CEP
- Specifications will drive viable concept architecture
  - GPS A/J performance
  - Verticality
  - Maximum Range
  - Robustness to MET / MPI variations
- Concept architecture will drive cost
- A/J level specified is largest potential cost driver
  - High A/J eliminates most projectile concept architectures
  - Remaining concepts are EXCALIBUR like in components required
- Interpretation of Vertical requirement next largest cost driver

Customer is in control of the specification growth and therefore
The customer is in control of pacing the potential system growth