

Interoperability and Integration of Dismounted Soldier System Weapon Systems

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SCI-178 RTG-043

9 May 2007

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Quantico, Virginia

Overview

- NATO Research and Technology Organization: formed in 1998; ensures the Alliance has at its disposal the best scientific knowledge and technical capability that member nations are prepared to make commonly available. R&T must be responsive to changing requirements and conditions, long term capability requirements, and new science and technology advancements. See www.rta.nato.int for more info.
- Land Capability Group-1 Weapons and Sensor Sub Group desired to initiate a R&D effort to answer critical weapons subsystem problems for current interoperability issues and long term soldier system interfaces and development issues.
- 11 Countries from LCG-1 teamed together: Canada, Germany, Italy, The Netherlands, Norway, Romania, Slovakia, Spain, Sweden, United Kingdom, and United States (Army and Marine Corps). Submitted a proposal to the NATO RTO Panel which was approved.
- Exploratory Team developed Terms of Reference, Technical Activity Plan, and Plan of Work during 2005. A Task Group was initiated in January 2006 with a completion timeline slated for December 2008.
- Membership in the Task Group requires countries to allocate resources to support the Task Group.
- Task Group meets every 3-4 months.
- Includes live fire events with current and prototype soldier system equipment.

Objectives

- Recommendation for NATO standard Weapons System Interface STANAG.
- Define and Outline Human Systems Integration principles and concepts for future Soldier Weapons Systems.
- Investigate the Power Requirements for future weapon systems and methods of providing or generating power.



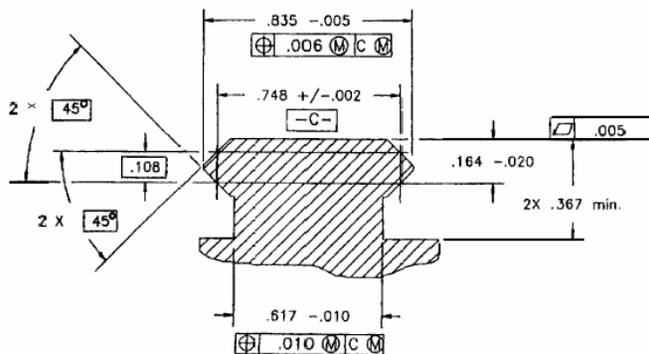
Organization

- The Task Group is led by the Chairman and the Heads of Delegation of the 11 countries.
- Three sub groups
 - Technical Interface Team: Led by Mr. Per Arvidsson from Sweden.
 - Human Factors Team: Led by Major Linda Bossi from Canada.
 - Power Team: Led by Mr. Karl Heinz Rippert from Germany.
- All three Teams have to work together because of overlap in various areas.
- Completion of tasks: NLT December 2008

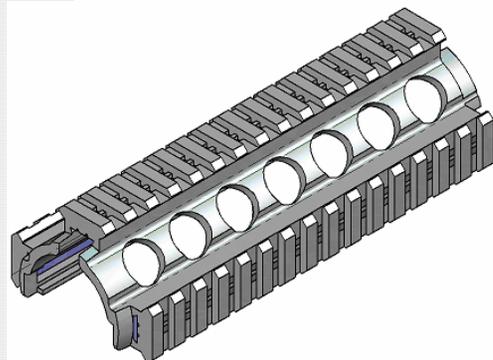
Weapon Rail History



Desert Storm 1991: Clamping and duct tape...



1995 US MIL-STD-1913



2010 Powered STANAG-rail

Current available rails

- CAN C7/C8 "Weaver"
- DEU G36 Dovetail
- 3/8" Match Dovetail
- GBR AI L96/AW Dovetail
- GRB SUSAT Dovetail
- NATO STANAG 2324
- USA MIL-STD 1913 "Picatinny"
- USA XM8 PCAP



Weaver/Picatinny



AI L96/AW
11.43 x 2.64 - 60°



SUSAT
19.10 x 5.0 - 60°

Requirements for future rail

- Straightness
- Repeatability
- Zero retention
- Power supply
- Data transfer
- Physical characteristics
- Environmental resistance

Definitions

- **Straightness:** It shall be possible for the user to move the aiming device from its rearmost position to its foremost position on the rail without losing his zero.
- **Repeatability:** It shall be possible for the user to remove the aiming device and put it back again without losing his zero.
- **Zero retention:** The aiming device on the user's weapon shall maintain its zero even after extensive firing.

TI Team Main Road Map

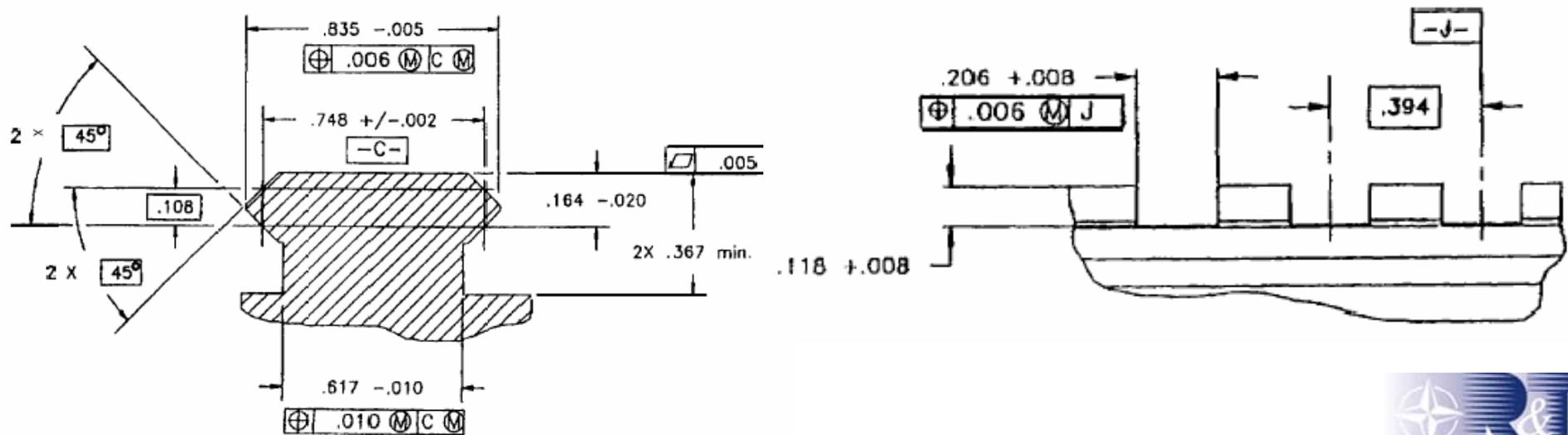
- Even though there are many different rails available today, the team has decided that the MIL-STD-1913 rail is the main alternative.
- It may not be the perfect solution, but being the only rail that has yet been standardized, industry has adopted it as "The Rail".
- Most sensors are today available with this interface.
- The group has decided to investigate on how this rail and grabbers could be optimized.

Zero retention, repeatability and straightness

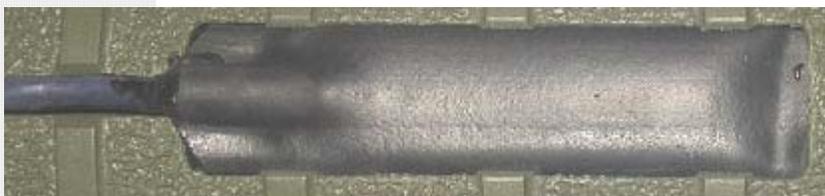
- Draft test protocol. To be finalized at June -07 meeting.
- All to test existing aiming devices, and to report at the June -07 meeting.

Some disadvantages in MIL-STD-1913

- No requirements on repeatability, zero retention or straightness.
- Angles lack measurements and tolerances.
- No tolerances on recoil slots.



Other possible TI's that could be standardized

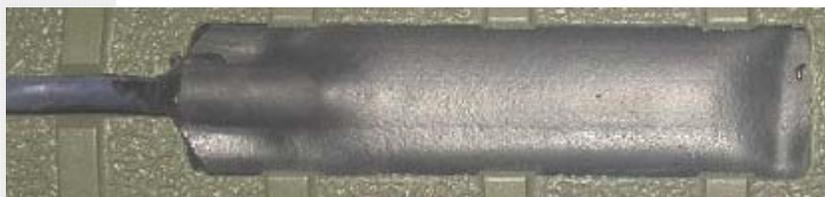


- M16 Magazine
- Pressure Switch
- 22mm Flash hider
- Muzzle Thread
- Bayonet Lug



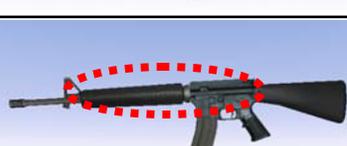
Other TI's to standardize

- The team will monitor other technical interfaces.
- It has linked with the Human Factors team and recommended standardization of a pressure switch.



Digital Models

1	M203 Grenade Launcher	
2	Bayonet	
3	C79 Scope	
4	Tactical Flashlight	
5	Holographic Sight	
6	Laser Sight	
7	Tri Rail Mount	

8	AN/PVS-13 Thermal Weapon Sight	
9	AN/PVS-14 I2 Sight	
10	Off-bore Camera	
11	Controls (e.g. Radio)	
12	FCU-HW Fire control for M203	
13	Battery Stock	
14	Butt-stock Magazine Pouch	

Preliminary Model

- Example digital models of rifle and ancillary equipment.

Equipment

1. M203 Grenade Launcher
2. Bayonet
3. Telescopic Scope (Elcan C79)
4. Tactical Flashlight
5. Holographic Sight
6. Laser Sight (e.g. red dot)
7. Tri Rail Mount
8. Off-bore camera
9. Controls (e.g. radio controls)
10. Battery Stock
11. Butt-stock magazine pouch
12. Thermal weapon sights (AN-PVS-13 Medium, Small)
13. I2 (Image Intensification) sight (AN-PVS-14)
14. Fire control unit for M203

Configuration	Equipment	Total Mass
Light	C7A2 only (loaded)	3.53 kg
Medium	C7A2 plus 1,2,3,4	6.45 kg
Heavy	C7A2 plus 1,2,4,7,8,10,11,12, 14	9.68 kg

Light Weight Rifle

Light (3.78 kg): C7 assault rifle, holographic sight, and 1 loaded (30 round) magazine



Medium Weight Rifle

Medium (6.14 kg): C7 assault rifle, 1 loaded (30 round) magazine, ELCAN C79 Optical Sight, M203 Grenade Launcher, Flashlight, and Laser Aimer



Heavy Weight Rifle

Heavy (8.31 kg): C7 assault rifle, 1 loaded (30 round) magazine, M203 Grenade Launcher, AN/PAS Thermal Weapon Sight, tactical flashlight, and bayonet



Aiming Simulation

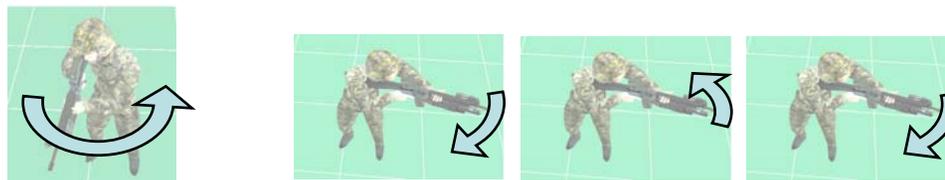
Aiming with / without Equipment on C7A2



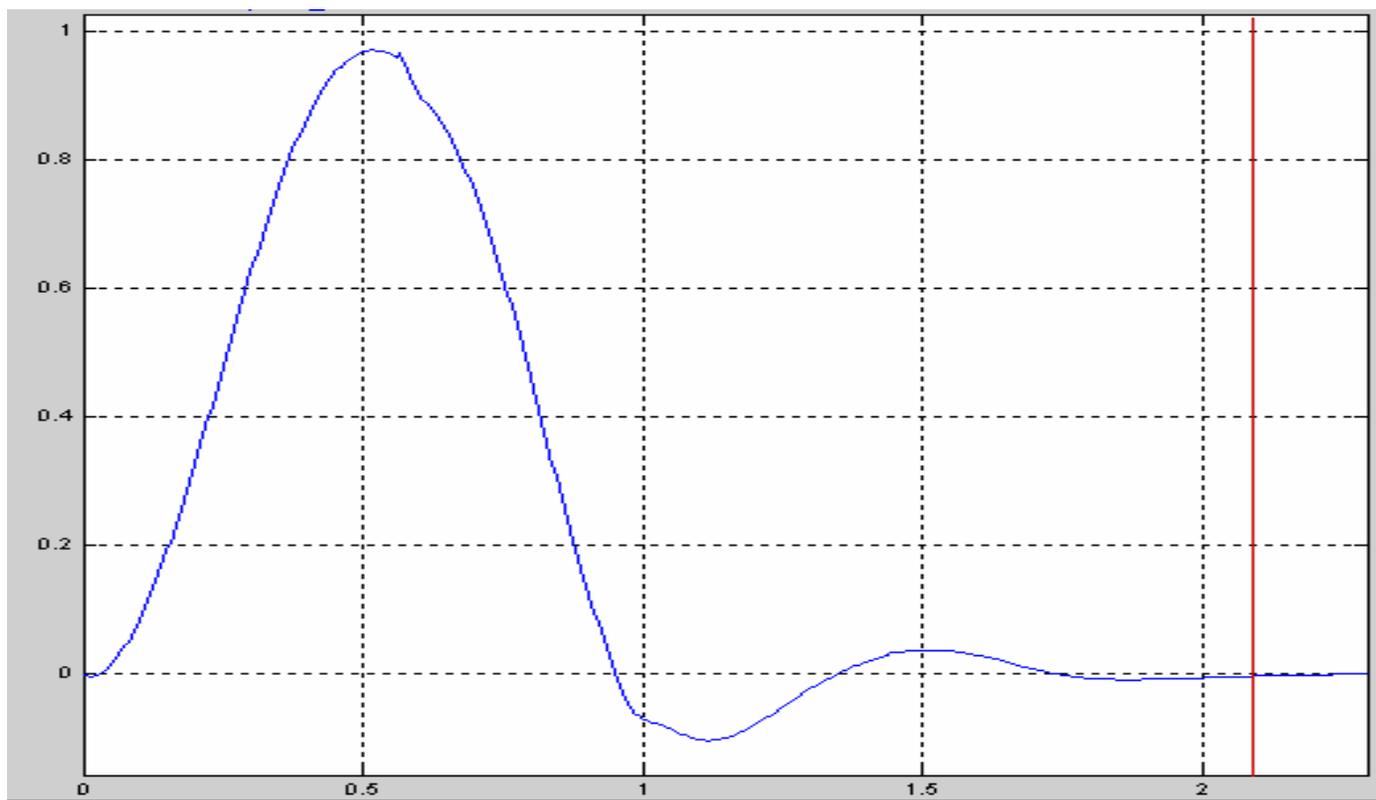
Camo - 3.53kg
Shadow - 6.45kg

Boston Dynamics

Angular Velocity

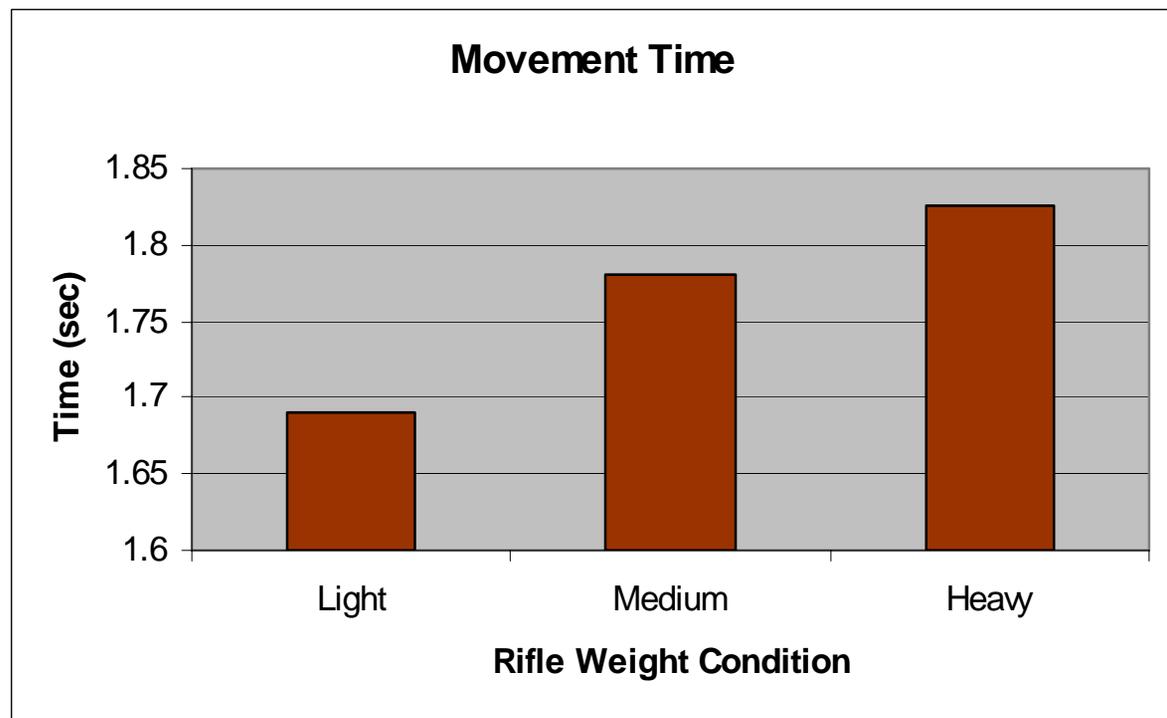


Angular Velocity (radians/sec)

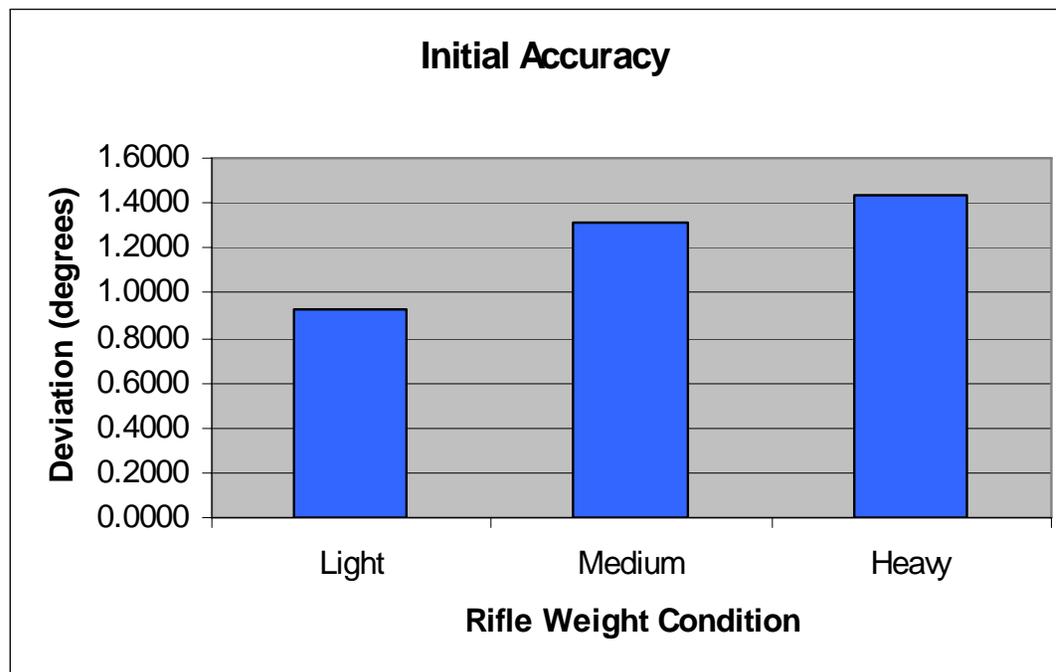
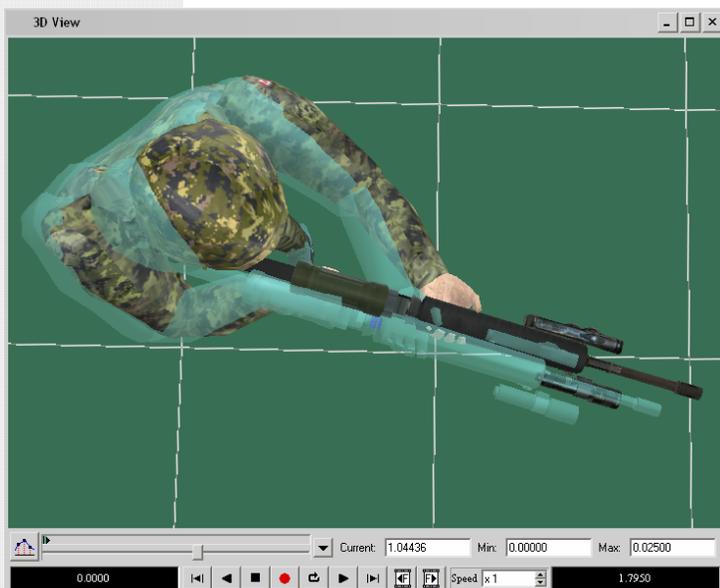


Time (sec)

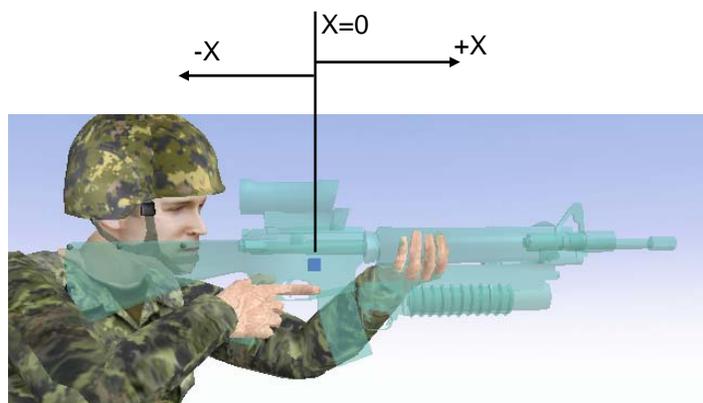
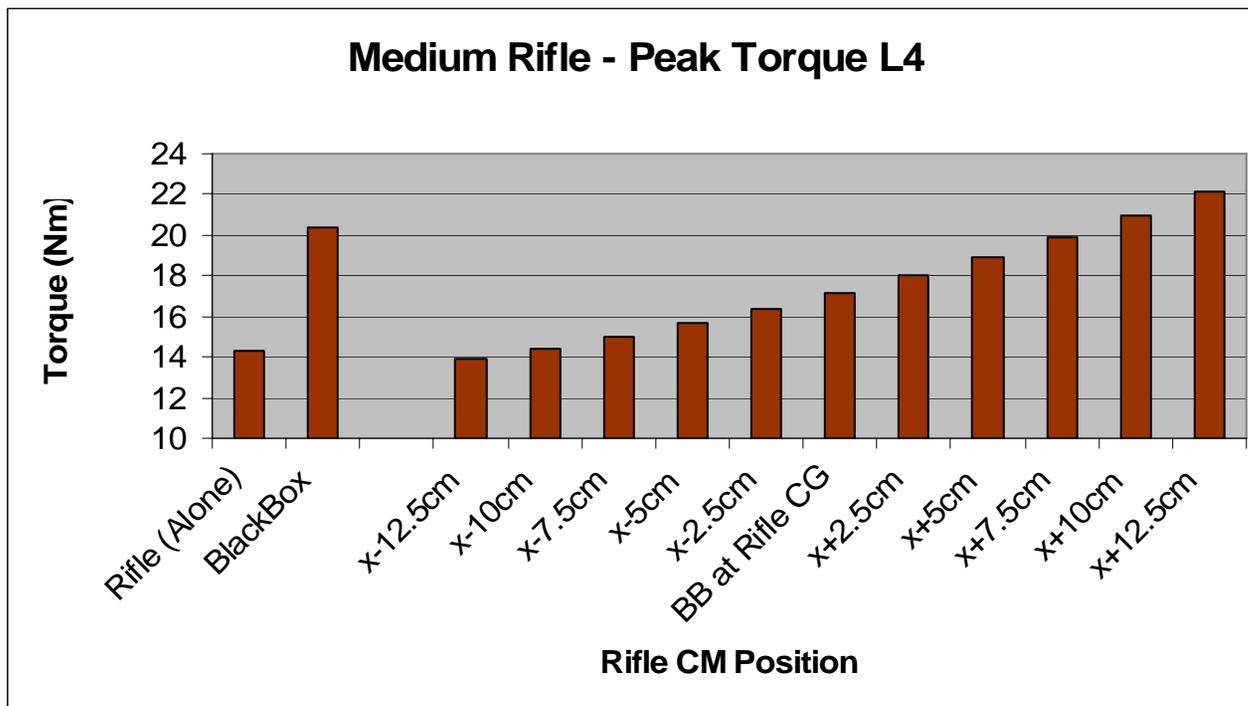
Movement Time



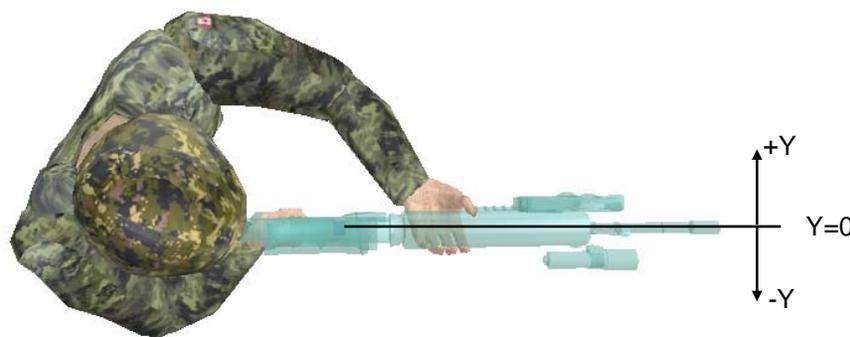
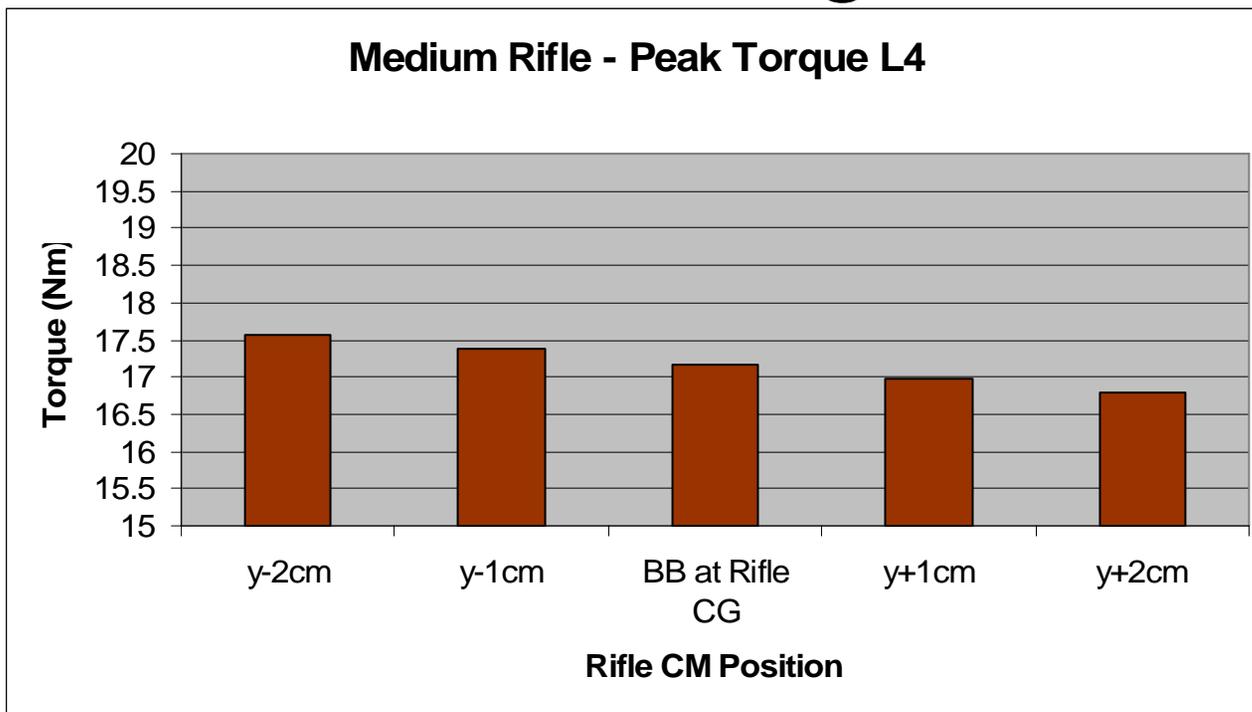
Movement Accuracy



Rifle CoM along X-axis



Rifle CoM along Y-axis



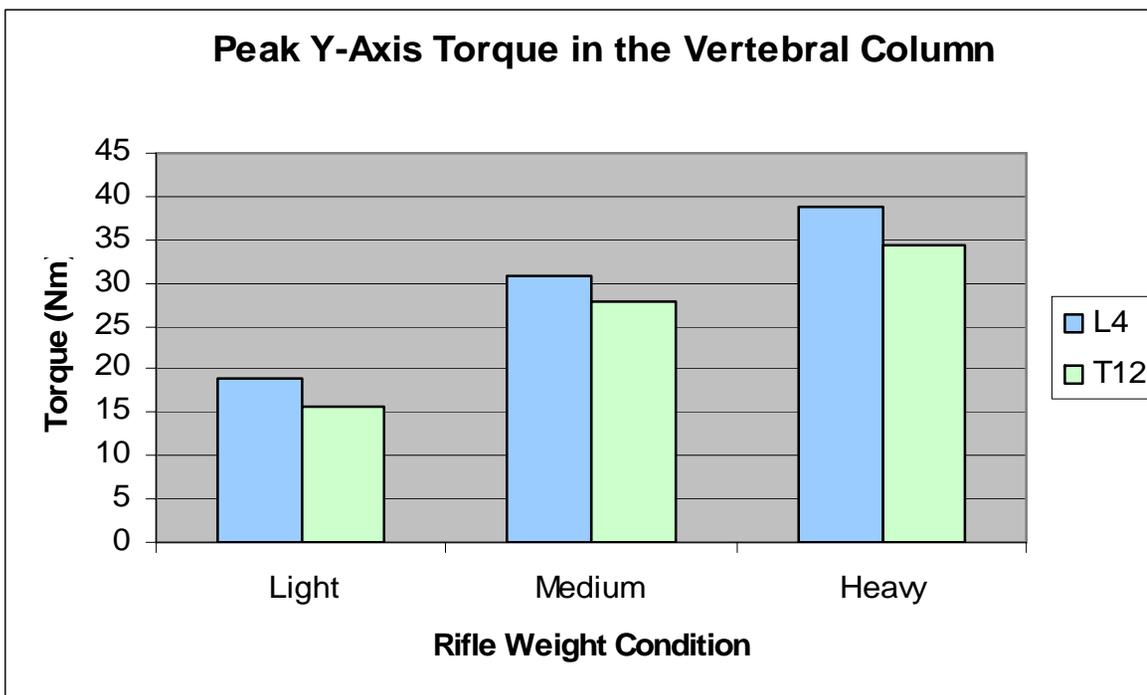
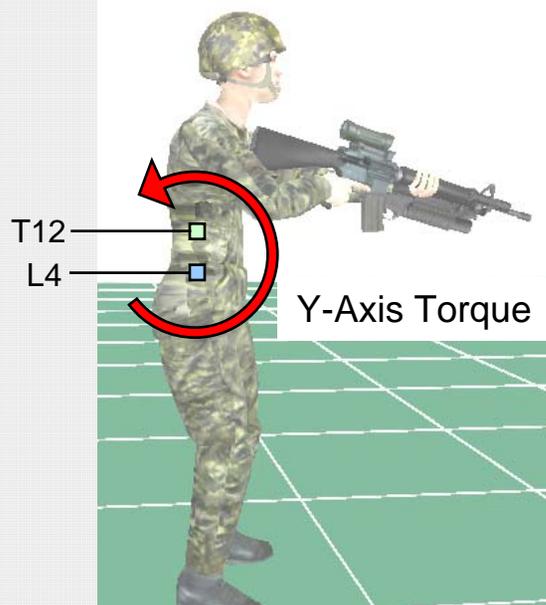
Aiming Simulation

Aiming Test

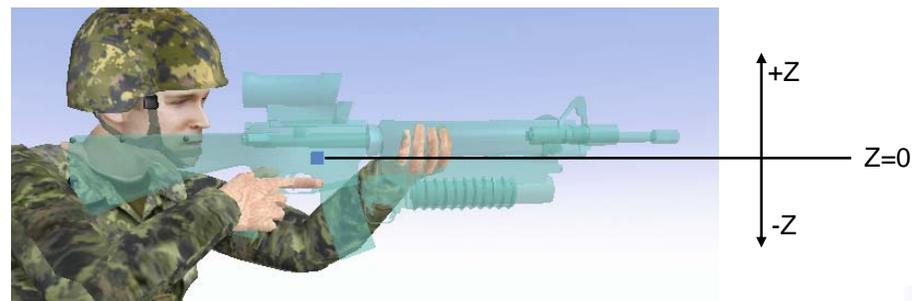
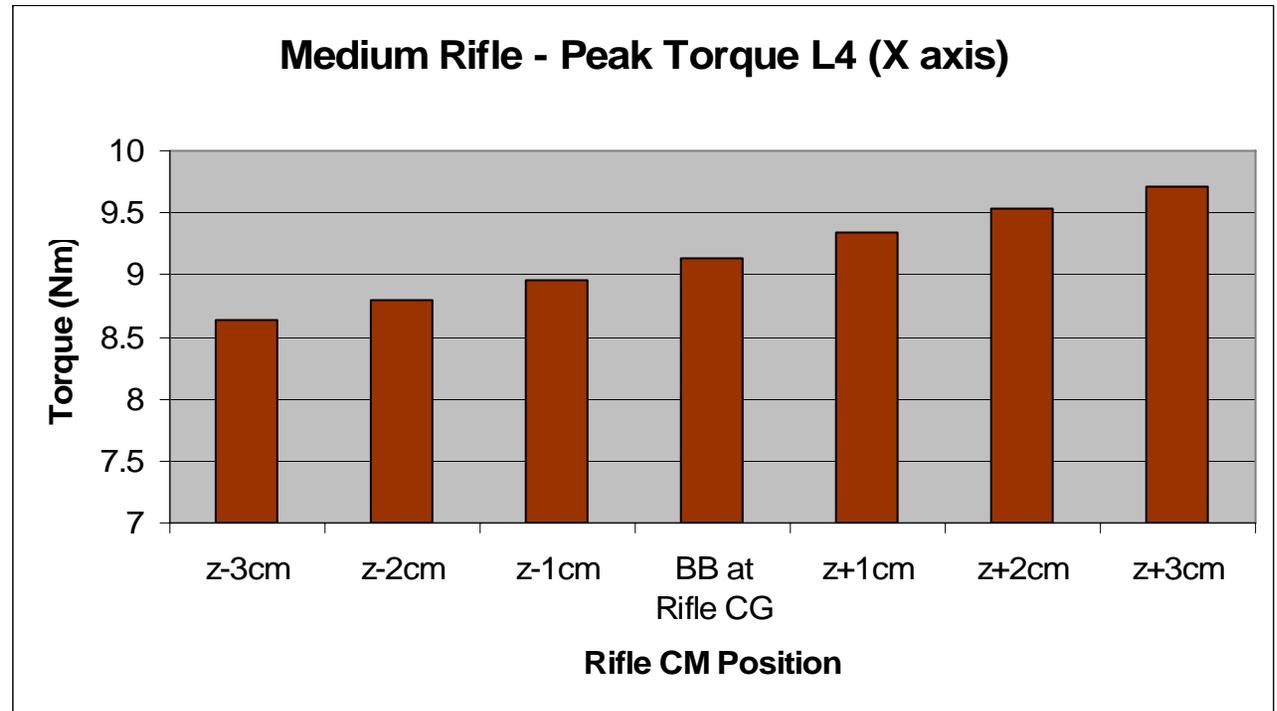
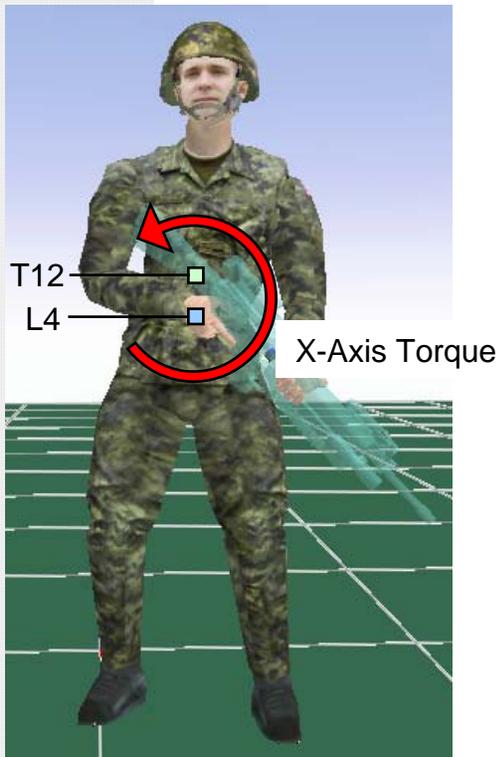


Boston Dynamics

Torque Forces about Y-axis



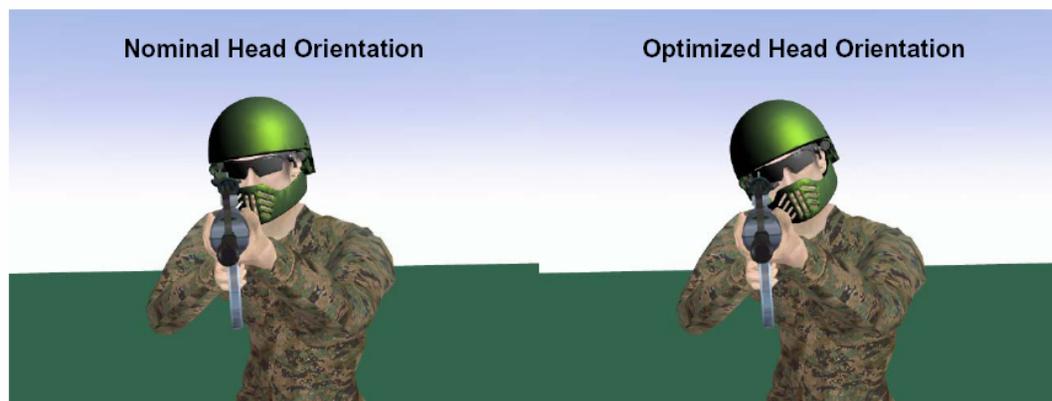
Torque about X-axis



Weapon Sighting

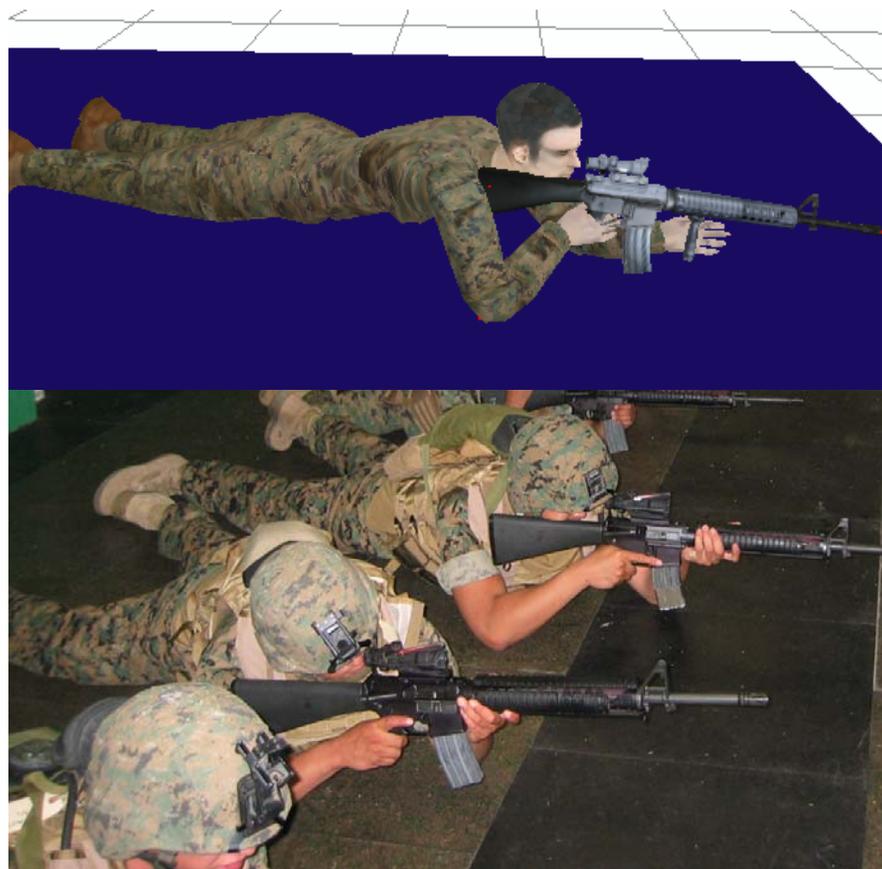


Figure 2-4 Formulating Desired Orientation Euler Angles



Way Ahead

- Conduct more combat weapon simulations.
- Model weapon sighting.
- Develop a live fire weighted weapon test rig.
- Utilize combat experienced NCO's in the test.



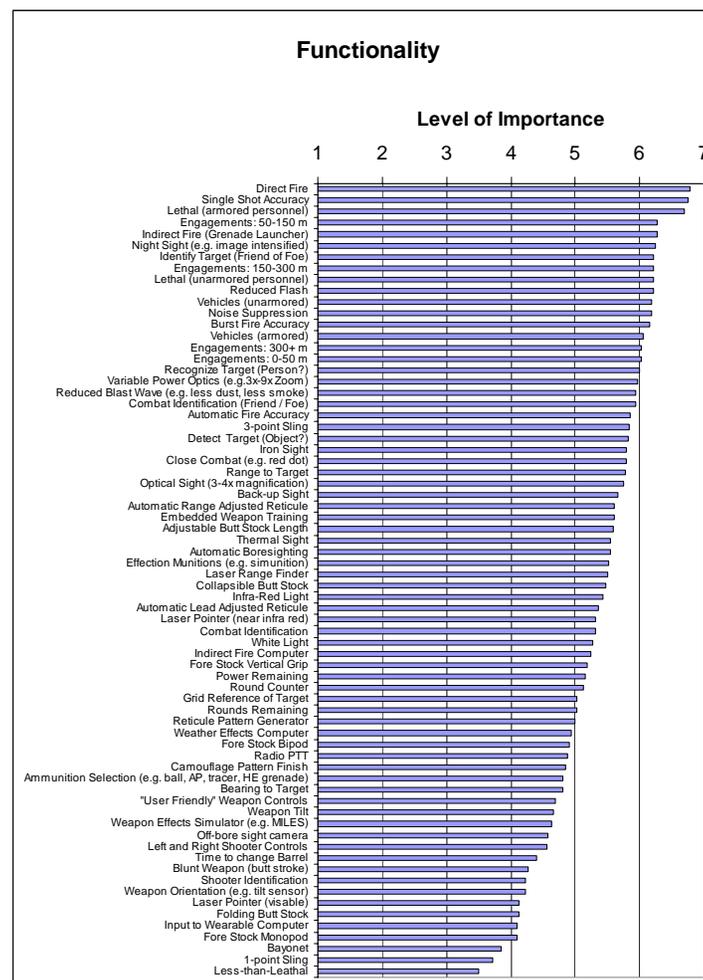
Future Assault Rifle Questionnaire



Priorities for Functionality

Higher Priority Functionality:

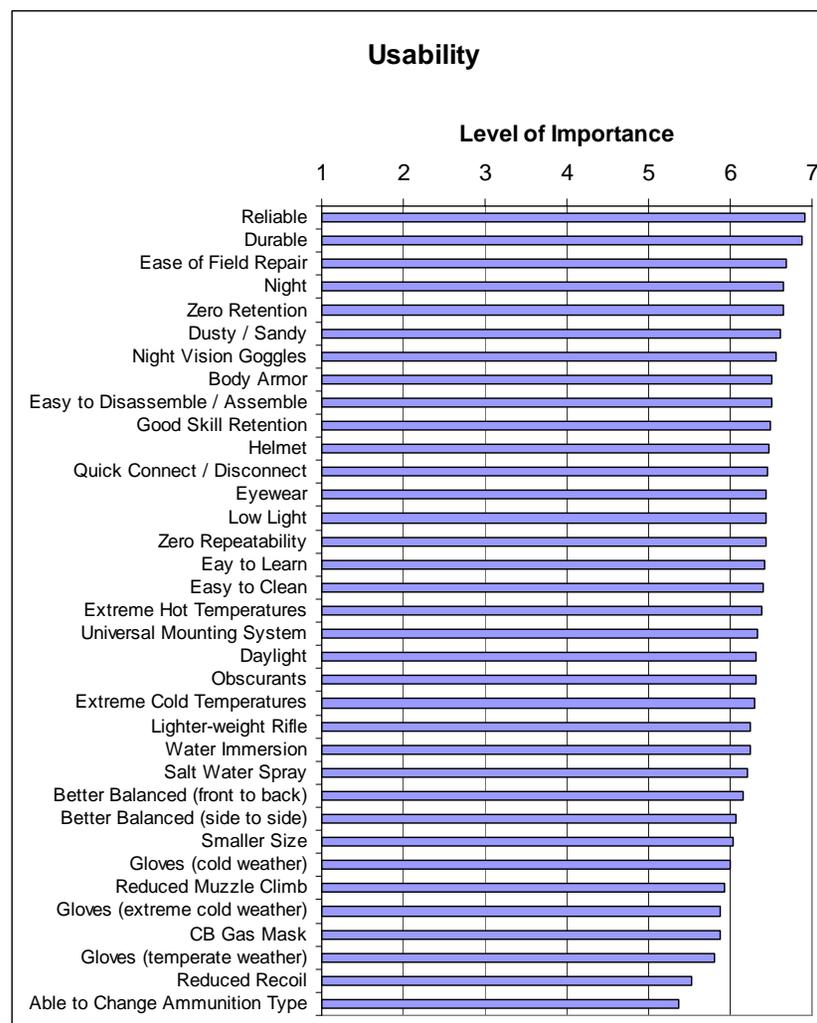
- Single shot accuracy in direct fire.
- Indirect fire capability for lethal engagement of armored and unarmored personnel.
- Night sight with reduced flash and noise suppression.
- Target identification is most important followed by target recognition, and then detection.
- Engage targets between 50-300m primarily.
- Variable power optics, reduced blast wave during firing, and a combat ID capability.
- Accurate automatic fire.
- Three-point sling, close combat, iron, and optical sights, and ranging to target information.
- Back up sight, automatic range adjusted reticule, embedded weapons training, and adjustable butt stock.
- Laser range finder, thermal sight, automatic boresighting, and effects munitions training.



Priorities for Usability

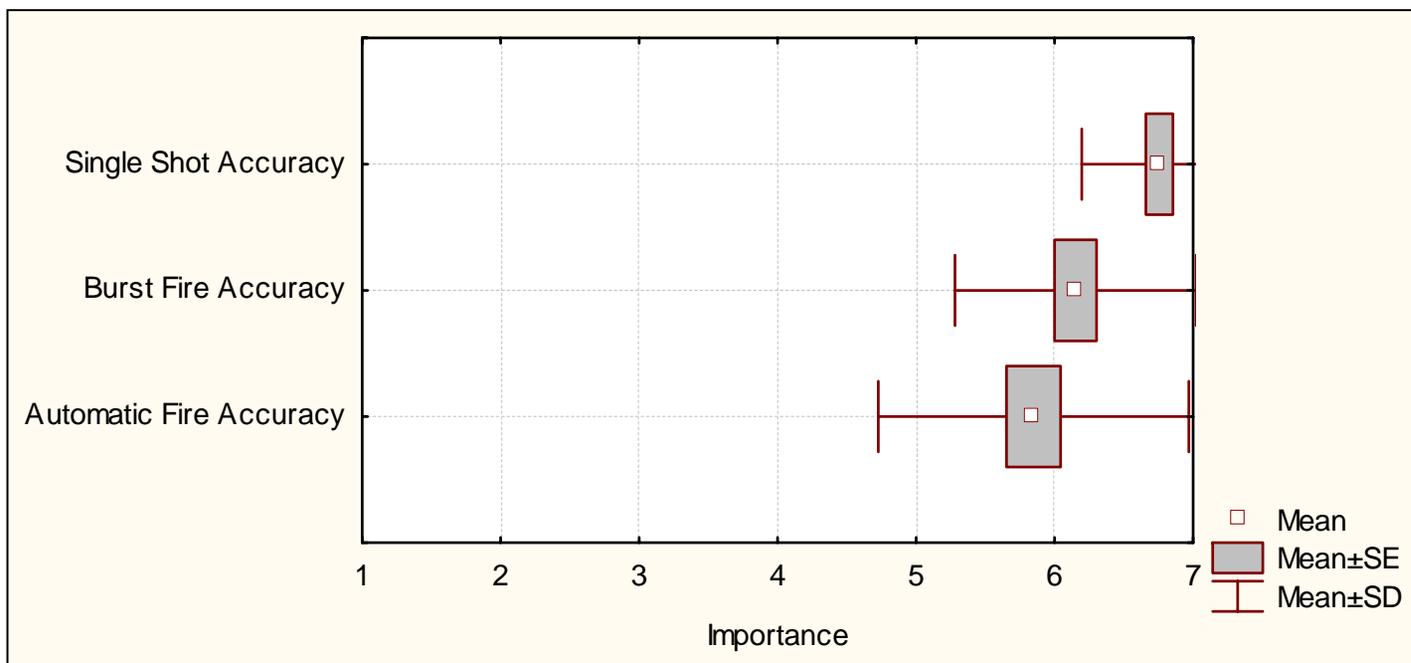
Higher Priority Usability Issues:

- Reliable, durable, and easy to repair.
- Effective at night and compatible with NVGs.
- Good zero retention, easy to disassemble and assemble, with quick connect/disconnects.
- Compatible with body armor and helmet.
- Good skill retention, easy to learn..
- Zero repeatability, low light use, easy to clean.
- Extreme hot and cold temperatures.
- Universal mount, daylight, and obscured vision.
- Lighter weight, better balance, and small size.
- Water immersion and salt spray.
- Glove compatibility.
- Reduced muzzle climb and recoil.
- CB mask compatibility.



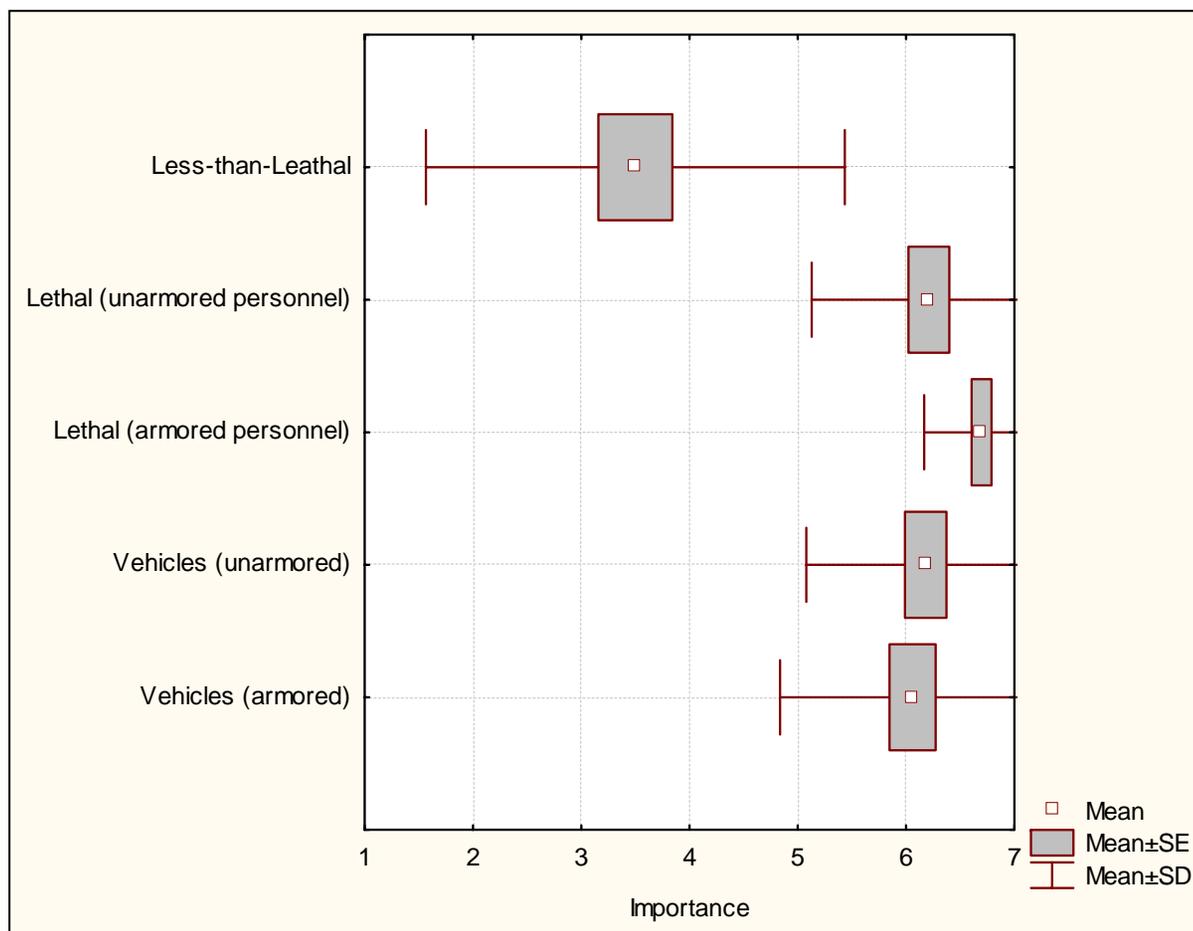
Assault Rifle Capabilities

Shot Accuracy



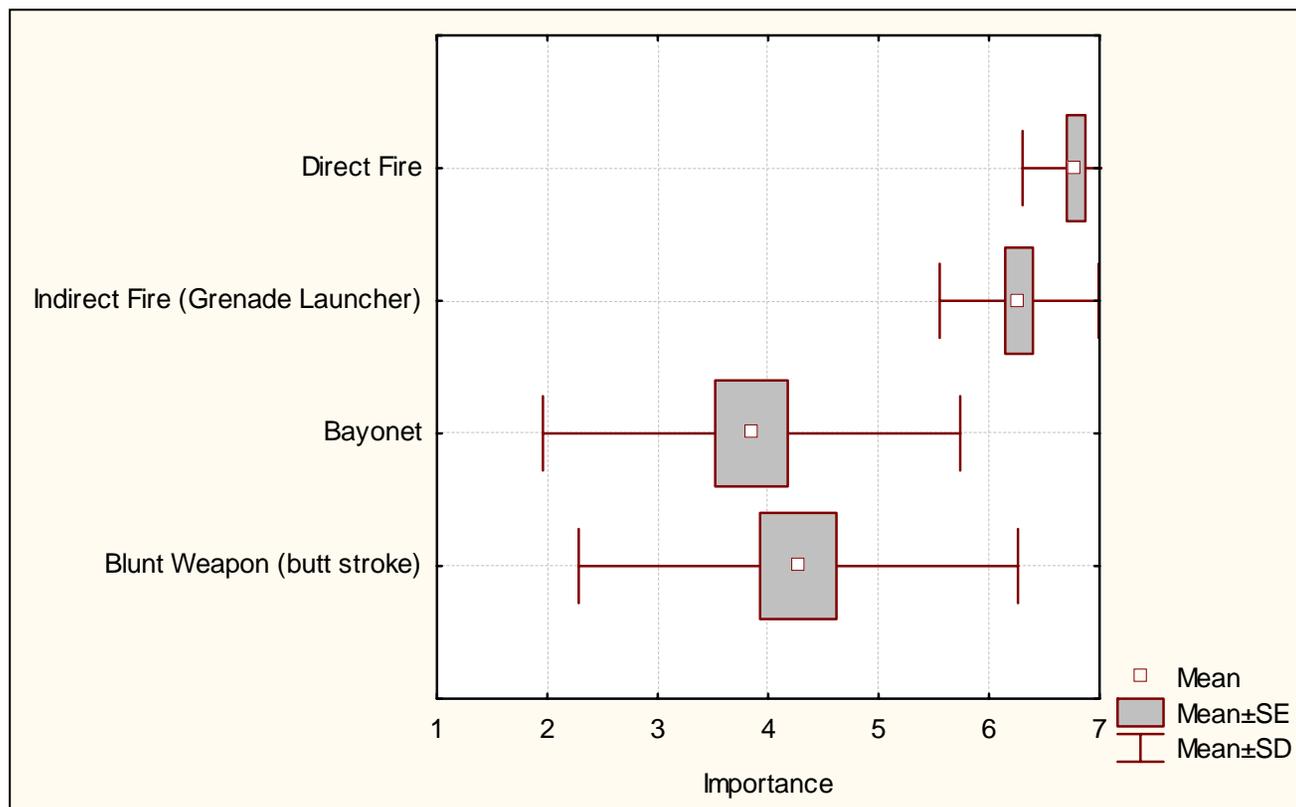
Assault Rifle Capabilities

Weapon Effects



Assault Rifle Capabilities

Weapon Types



Power Assumptions –

- **1.0 Amp should be sufficient current for power rail**
 - **Issue: Depending on how configured may need to comply to STANAG 4619 – 5 Amps current**
 - **Confirm it conforms to Interface Group thoughts**
- Existing systems to be mounted on future weapons for forward and backward compatibility (will still be needed).
- Charging of the weapon system should be possible via both the soldier system and from the vehicle.
Additionally, it is required that the power source may be removed from the system then recharged or replaced.
The operation of the weapon including the ancillary equipment must also be possible during recharging.

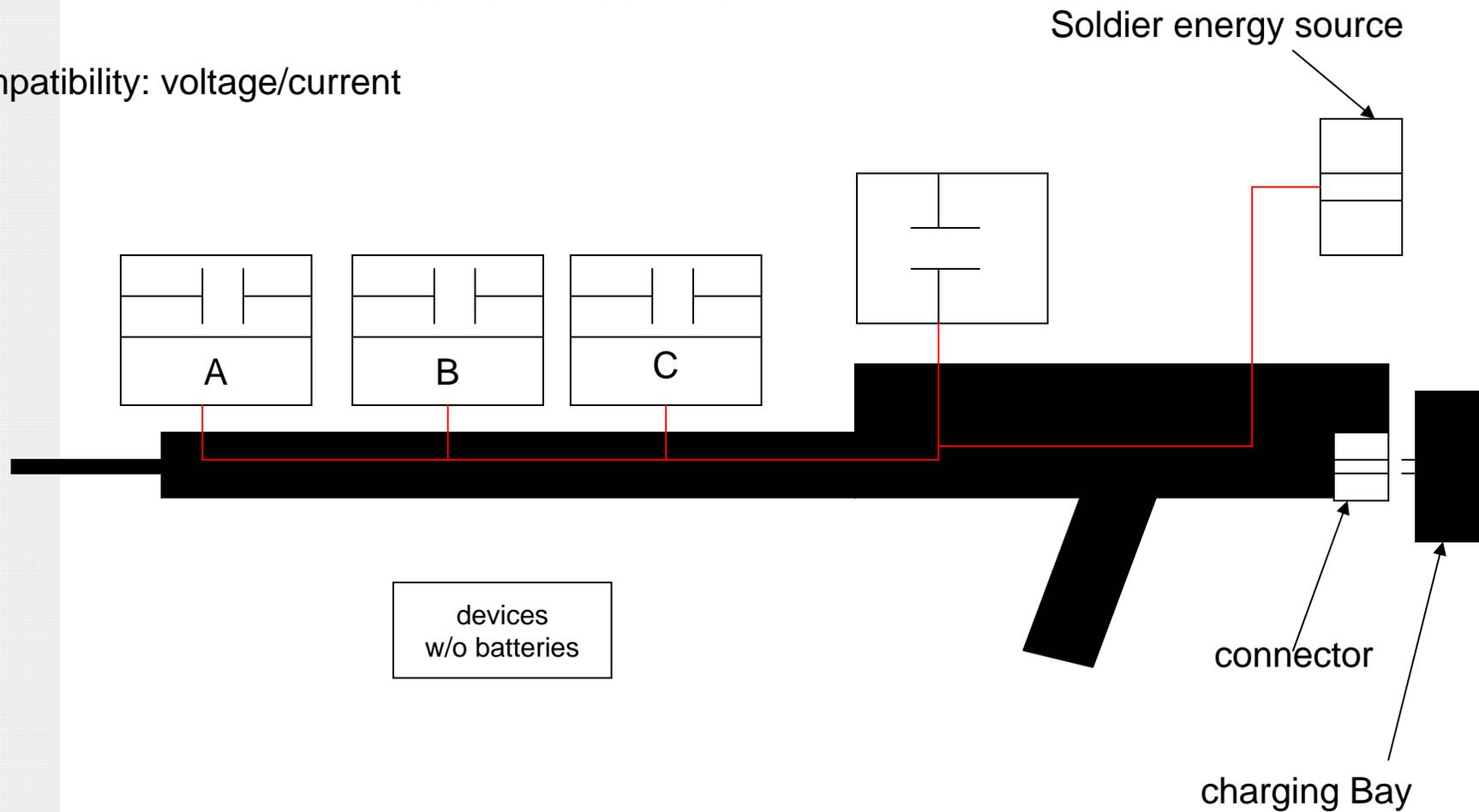
Power Issues

Interoperability and Standardization

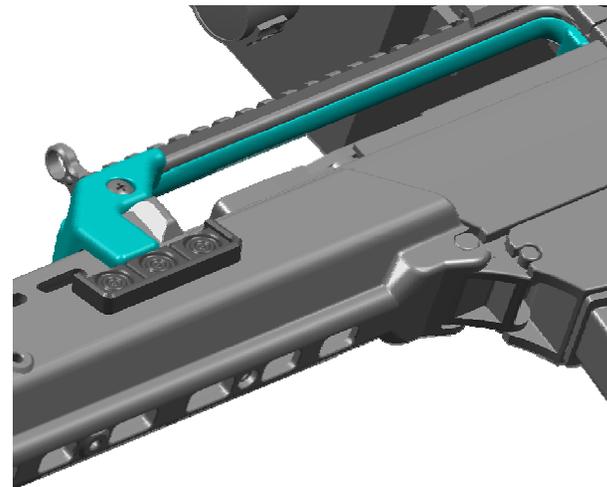
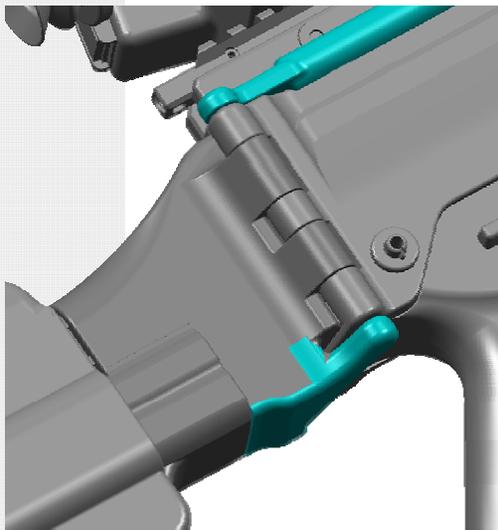
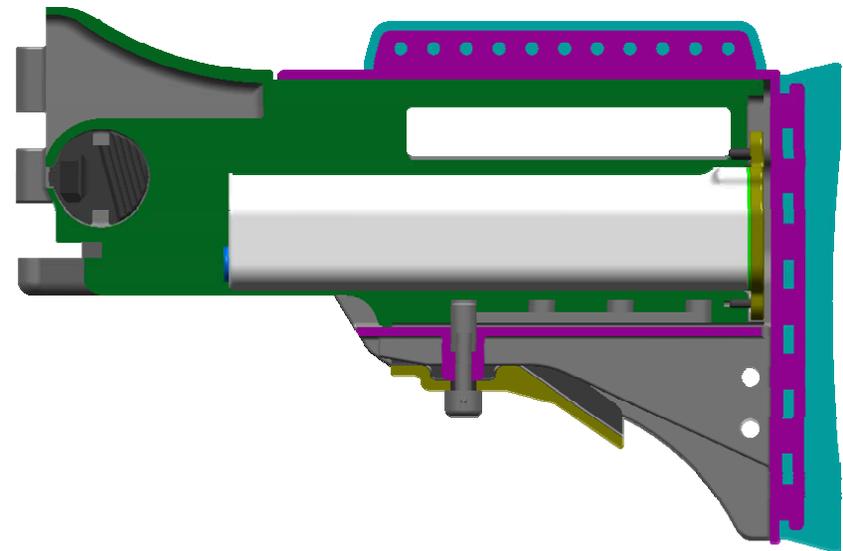
- Difficult to standardize on one battery type - “family” of batteries need to be explored (part of report)
- Consult with HF and Interface
 - “maximum” room on weapon (size, weight and location) could be recommended for future weapons concepts
- Common connection to outside – LCG1 has overarching document on C4I architecture

Power requirement schematic No data connection

Compatibility: voltage/current



Batteries in Butt stock G36



Concepts on Power Wiring/Distribution

- ***Questions to other Sub-groups***

Human Factors what is weight distribution/balance effect if power moved to back of weapon (how much weight in the rear of weapon gives better balance).

Also possible to have weapon for “Power storage” at times? ie. Carry extra battery (walking, non-combat)

Interface group about butt stock option for battery (which feeds to power rail) and form factor of power source (would like commonality - same for all “family” of weapons).

Concepts on Power Wiring/Distribution

Concept 1:

No device shall have a battery, all power comes from “outside” the weapon (typically from soldier system torso etc.)

- Advantage

Takes all weight of power in devices (up front of weapon) and puts them on the soldier

- Disadvantage

Loose connection to soldier then loose power to devices

This is part of report for draft completion this year (To be explored by NLD)

Concepts on Power Wiring/Distribution

Concept 2:

Move power source to back of weapon for high power consumers.

- Some devices (lower power for example) may still contain individual power source
- Best location of power source in this concept.

Butt stock, power rail, grips etc.

This is part of report for draft completion this year (To be explored by DEU)

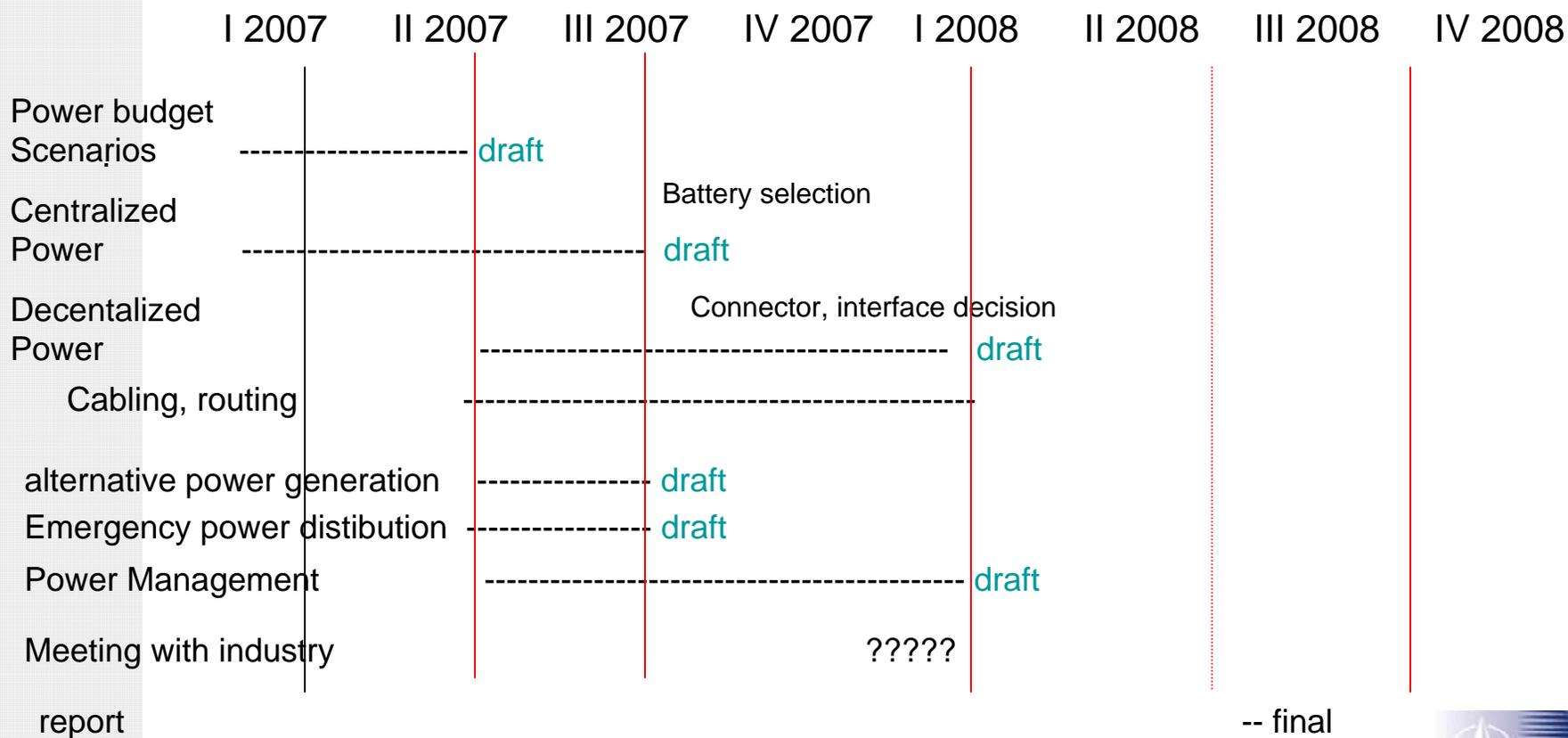
Concepts on Power Wiring/Distribution

Concept 3:

“Christmas tree” approach - Everything has own power source

- Current situation for “most” weapons today
- Try and lower power at device level.

Time Schedule



-- final

Near Term Efforts

- Human Factors simulation study at Army Research Lab, Aberdeen Proving Grounds
- Live Fire Weight Test Rig
- User trials
- National studies in specific areas
- Zero retention verification tests
- Powered rail system testing
- Next meeting: 12-14 June 2007 Quebec City Canada

Industry Participation

- Participation of Industry encouraged to assist in the success of this Task Group.
- Provide support to the sub groups areas of expertise.
- Sponsorship by a participating nation or information presentation or work.
- Intellectual Property; preference for open source
- Solicitations provided by participating countries
- On schedule; 18 Months left.

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Points of Contact

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- Spain – Mr. Angel Perez
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- United Kingdom – Mr. Richard Smith
- United States Army – Mr. Jason Regnier
- United States Marine Corps – Mr. Mark Richter