Technology Work Session for the South African Army; Hosted by the CSIR

FIREPOWER

Direct- and In-Direct weapons

Steve Matthews
Denel Land Systems
&
Braam Greeff
CSIR Defence, Peace, Safety and Security

Date: 18th April 2012

CSIR
our future through science

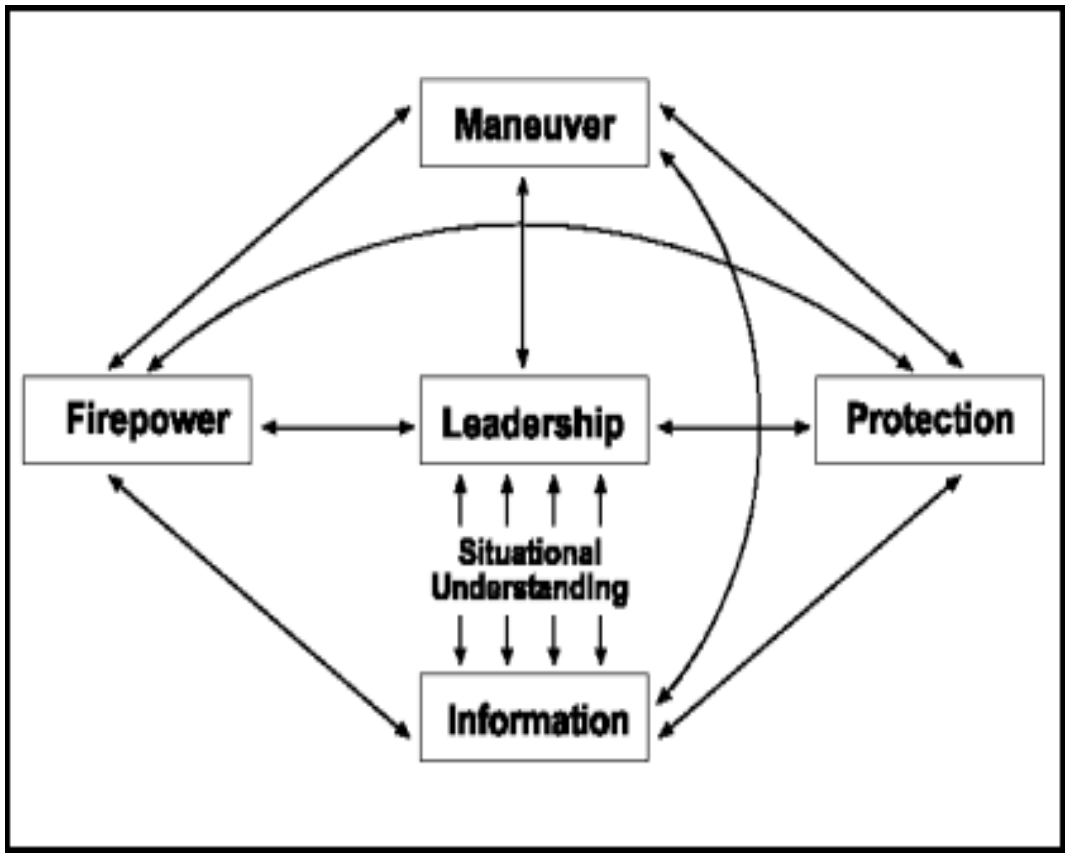
What is Firepower.....?

The capability to direct force at the enemy – “*Soft or Hard.*”

Firepower is one of the key elements to project combat power.

CSIR
our future through science

Elements of combat power

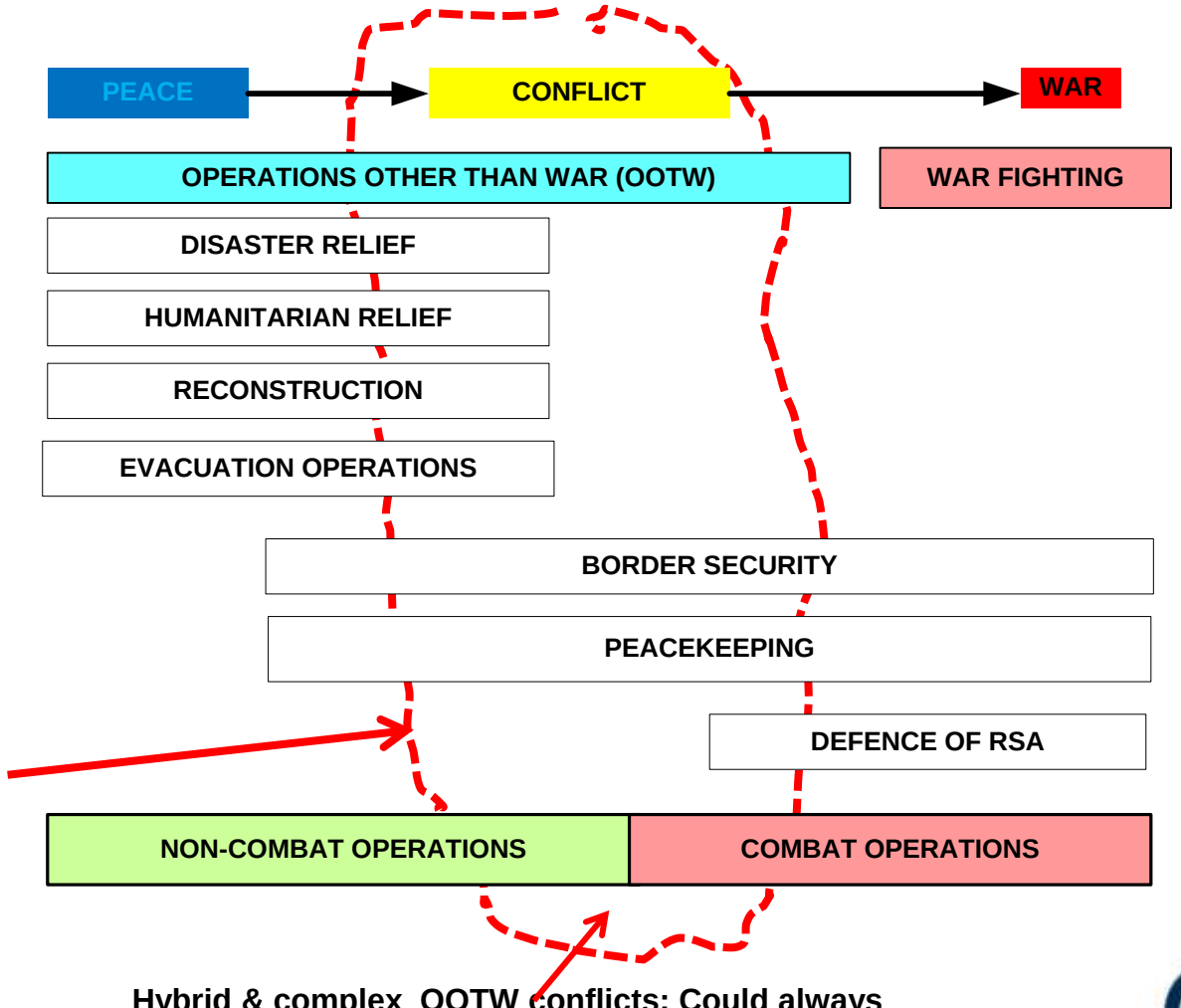


- In any conflict, the ability of armies to project combat power to win, underlies success in all types of operations (lethal- or "soft").

- The ability of a commander to provide leadership to integrate the key elements : Firepower, Mobility, Protection, based on good situational awareness

- Firepower is one of the key elements to enable the projection of combat power.

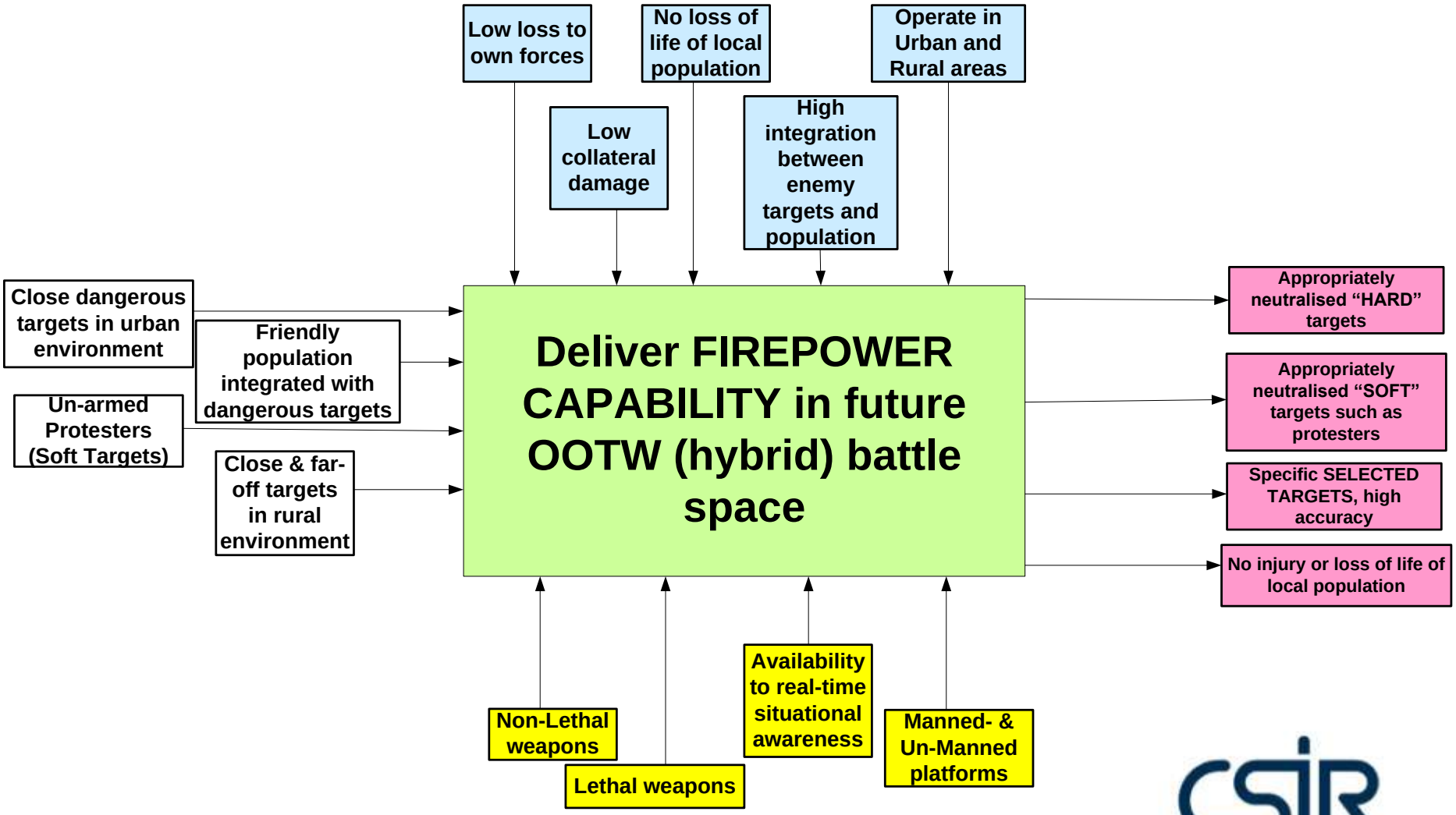
Spectrum of future conflicts and continuum of operations



The complex hybrid nature of future conflicts will require that firepower , as key element of combat power, will have to be delivered to lethal and non-lethal targets on a moments notice.

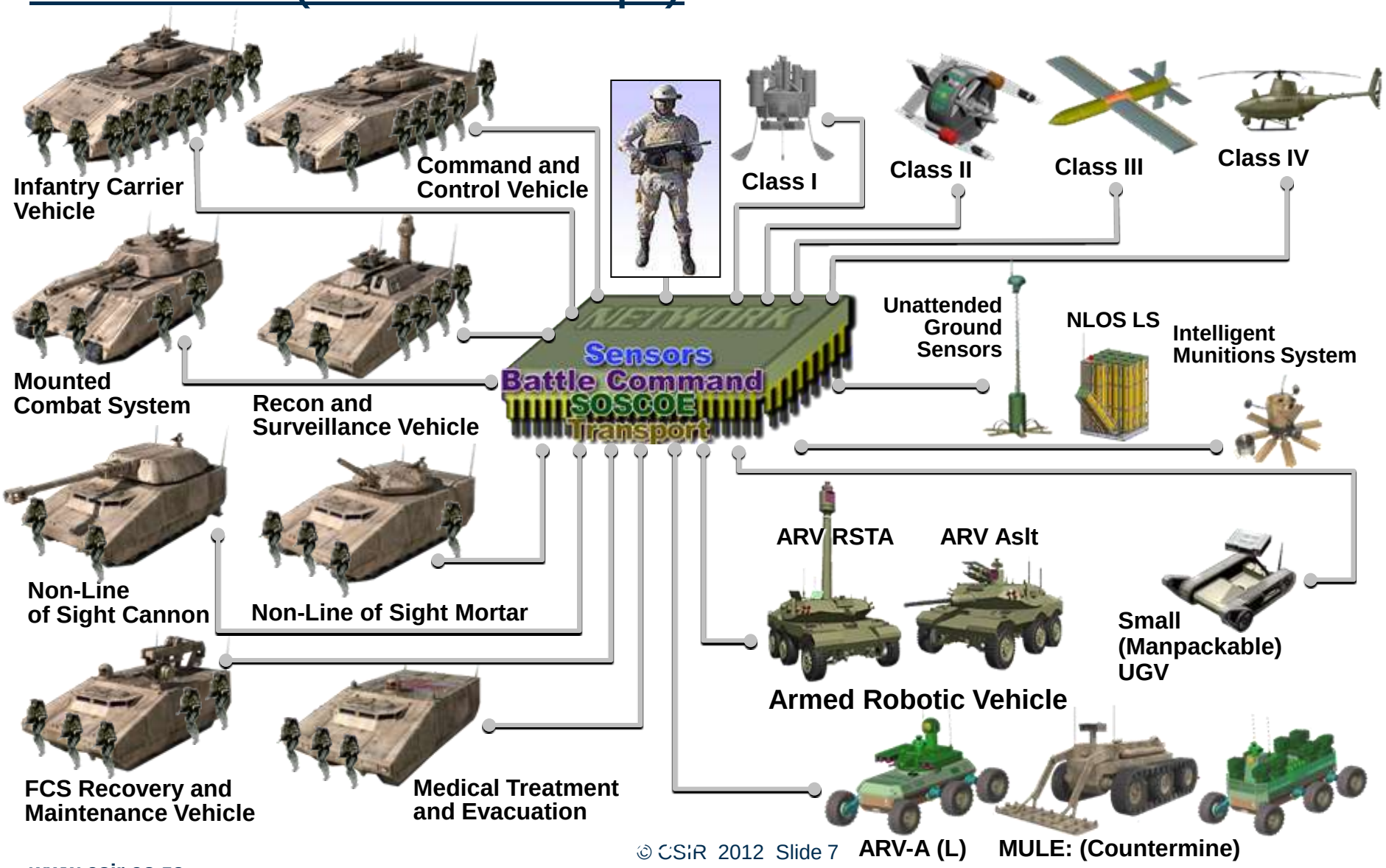
Hybrid & complex OOTW conflicts: Could always expect to execute a mix of combat & non-combat type of operations

Firepower delivery in OOTW scenarios

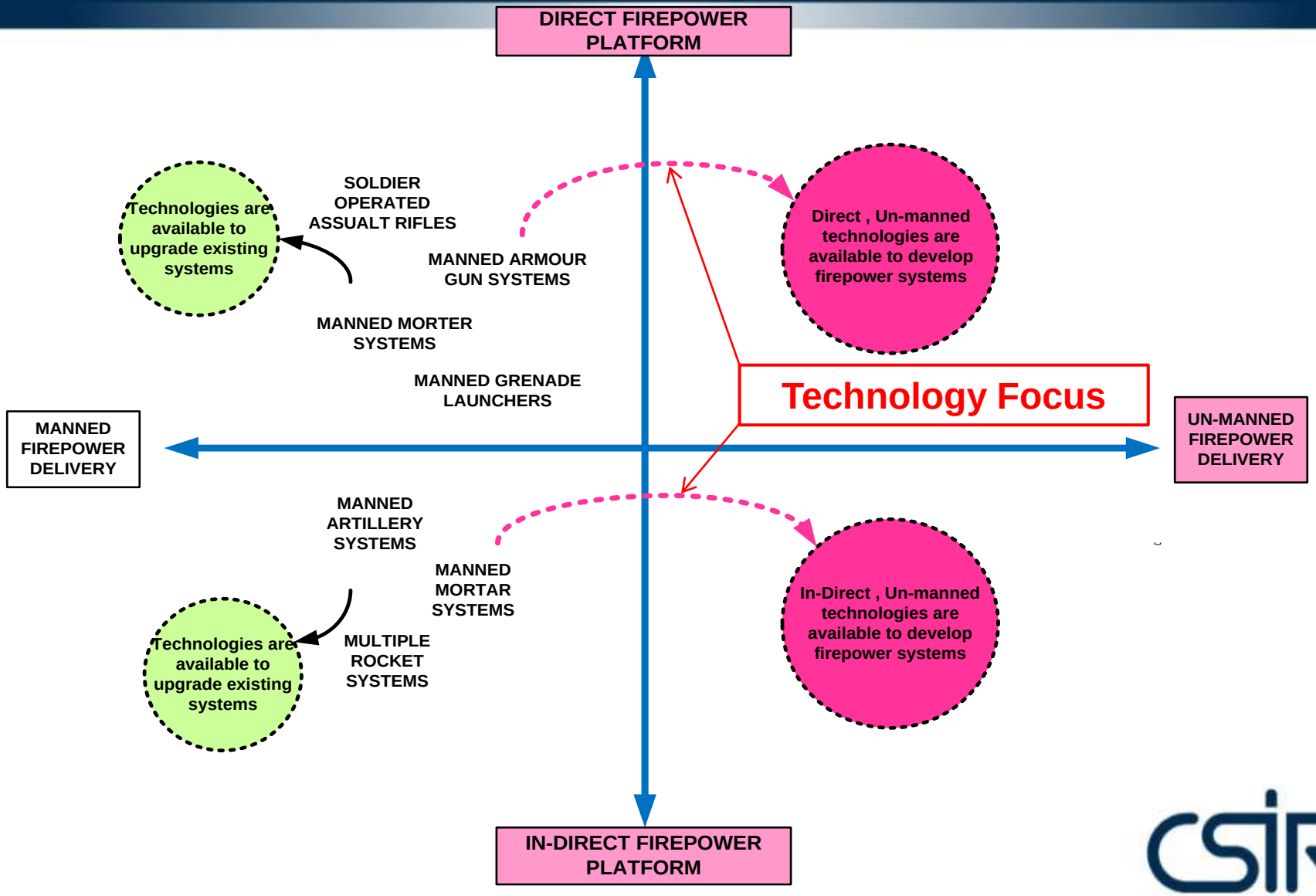


Firepower within a “Balanced Force”

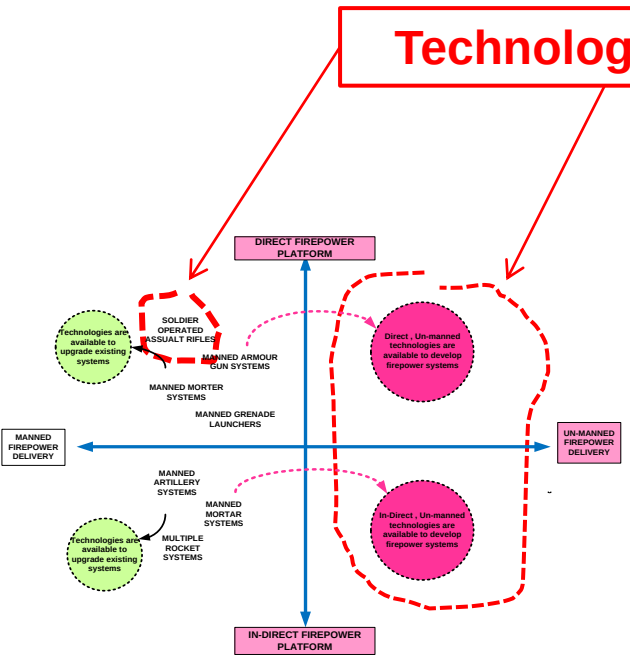
The future firepower: Highly interconnected & co-ordinated (FCS Concept)



Future FIREPOWER Delivery platforms



Explore firepower technologies



Certain key technologies shall consequently be explored that could cause a firepower capability improvement for the future identified operational scenarios.

Manned “Soft-kill” ammunition & multi-ammo weapons

The soldier has the capability to pacify “soft” targets, by means of electronic stun rounds.

The eXtended Range Electronic Projectile (XREP) – operational range is 50m to 100m.

The soldier has the capability to fire a lethal 12-gauge or non-lethal XREP stun projectile.

The XM25 “Smart” multi-target programmable ammunition assault rifle [for USA Army]

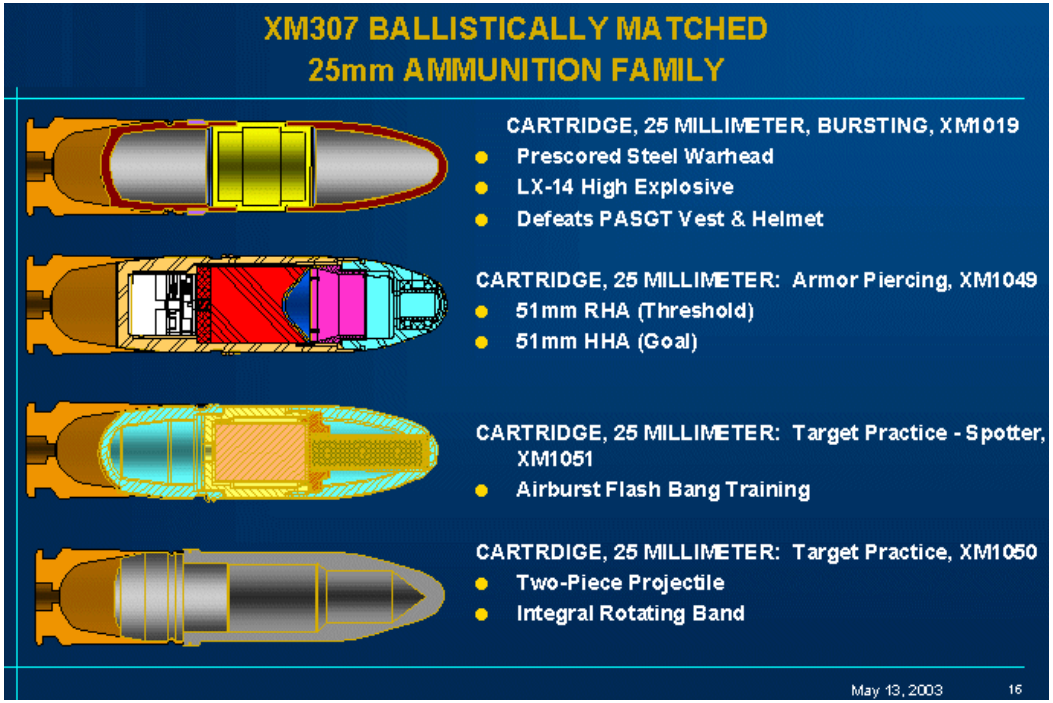
Non-Lethal –Security crowd control applications

•The EEL is specifically developed for security agencies for law enforcement purposes – shoot to stop, not to kill
•Operational range of 50m.
•Its a repeat fire weapon, firing a charged liquid gel stun charge.
•The stun charge instantly converts the blood sugar in the suspect's body to lactic acid, simulating the effects of major physical exertion resulting in severe muscle fatigue and temporary immobility

The EEL Non-Lethal weapon

Ballistically matched ammunition

•The XM307 is a programmable ammo weapon system.
•It has the capability to program the projectile to address the target type – e.g. only explodes the moment it passes through an open window.



XM307, Advanced Crew-Served -25mm

Non Line of Sight (NLOS) Loiter weapons

Fire Support for Infantry Missile (FSIM) – Denel Land Systems

- Loiter weapons provides the capability for the dismounted soldier to engage high-value targets over longer stand-off distances.
- Ideal for urban, jungle, ambush situations
- The small weapon will have a mass lighter than 4kg including a 1kg warhead consistent of a 100mm shaped charge with anti-personnel fragmentation effective to a 5m radius. The weapon would have an average airspeed of 100m/s, a minimum range of 20m and a maximum of 10 000m. Loiter time would be up to 10 minutes.

Extreme high rate of fire technology....1 million rounds per minute – Metal storm development

Metal Storm 5,56 robotic machine gun

Electrically ignited metal storm technology

- Area denial applications
- High reliability
- Non-Complex ammunition handling concepts

•5.56 mm robotic machine gun to guard the Prussian border regions, is shown
•The Intelligent Surveillance and Guard Robot can identify and shoot a target automatically from over two miles away. The robot, which was developed by a Prussian university, uses "twin optical and infrared sensors to identify targets from 2.5 miles in daylight and around half that distance at night. It is also equipped with communication equipment (a microphone and speakers), so that passwords can be exchanged with human troops. If the person gives the wrong password, the robot can sound an alarm or fire at the target using rubber bullets or a swivel-mounted firestorm gun.

Metal Storm - Remote turret mount extreme high levels of fire

•The Metal Storm technology enables designers to fit weapons on remotely operated turrets with simple ammunition handling, without ammo belts and extreme reliability.

Metal Storm weapon on a remote turret – simple ammo handling

The capability to destroy highly armoured vehicles such as MBT's, without the use of another MBT. It shall be required in future to eliminate well protected vehicles

Anti-Armour Hyper-velocity missile, replacing the APFSDS ammunition

H E M i

•The capability to destroy highly armoured vehicles such as MBT's, without the use of another MBT. It shall be required in future to eliminate well protected vehicles, with lighter armoured vehicles (LAV's) such as APC's and IFV's.

•The basic HEMi concept is a 23-kg, 1.2-m hypervelocity missile using a kinetic energy segmented rod penetrator kill mechanism. The HEMi design is based on a two-stage missile (booster and dart) approach for energy conservation purposes. The booster and the dart are both guided. Following ignition, the booster accelerates the missile, reaching top speed (approximately 2 400 m/s) at a range of 400 m. The dart is then ejected from the booster. After separation, the dart coasts to target, maintaining its lethality specification (1000 mm of Rolled Homogeneous Armour (RHA) **up to 5 km).** Typical MBT reach is 2.5 to 3km.

NLOS weapons: Thoughts on future artillery

EXISTING G5 155MM TOWED ARTILLERY

INCREMENTAL TECHNOLOGY INDUSTRY UPGRADE PATH

ADVANTAGES
-Accuracy
- Firing distance(40km)
-Selfpowered on firing point
-High firing rate

DISADVANTAGES
-Large Logistics footprint
-Not lift able by helicopter for tactical mobility

UPGRADED NEW GENERATION FIRECONTROL

INTEGRATION WITH UAV SENSOR SYSTEMS OVER TARGET AREAS

AUTOMATED AMMUNITION BURST-LOADER

USE OF INTELLIGENT AMMUNITIONS

Long:High-rate

Rapid-focussed response

Situational Awareness

Short: Burst_fire

Improved ACCURACY

EXPLORE THE DEVELOPMENT OF 105MM TOWED & SELF-POWERED ARTILLERY

OR Mount 155mm on existing commercial trucks

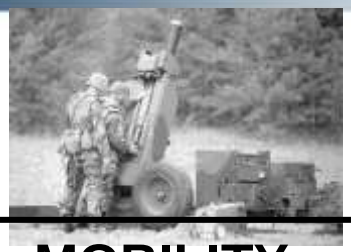
Suggested technology development focus

ADVANTAGES
-Accuracy
-Adequate firing distance (30km)
-Excellent tactical mobility
-High firing rate
-Smaller log footprint
-Liftable by helicopter
-Manned or un-manned operation

DISADVANTAGES
-Less terminal effect

CSIR
our future through science

NLOS weapons: Thoughts on mortars



MOBILITY = Towed + Self-powered

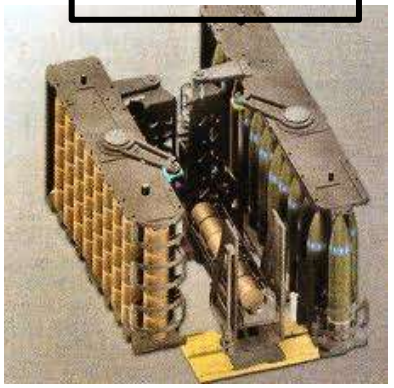
+

+

GUIDED AMMO & FIRE CONTROL

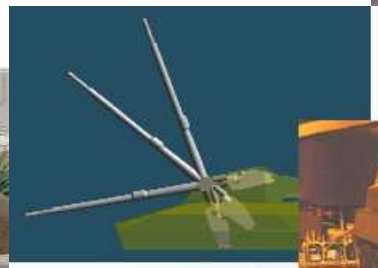
+

AUTO-LOADING



NLOS – High mobility artillery – 105mm

105 mm “towed” and self-propelled air transportability with C130



Self-propelled LAV-Stryker T7 (Co-developed by DENEL)

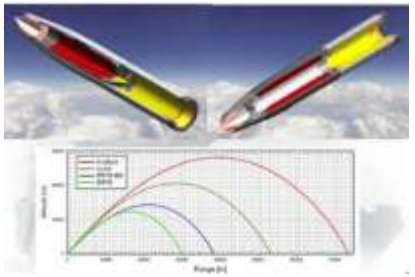
NLOS- Smart Artillery Ammunition

- Taking artillery fire to new levels
- The fuse at the nose, could be replaced by a Precision Guided Kit (PGK), which will transform the dumb shell into a precision guided projectile

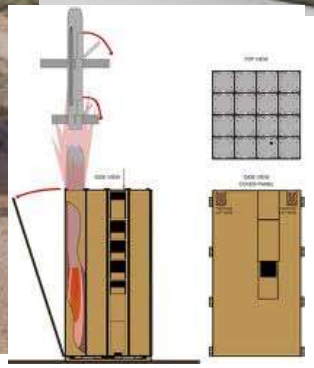
PGK projectile guidance system

Extreme distances with artillery ammunition

- RAM-Jet HE155mm projectile
- Improving the operational distance beyond 70km



Future NLOS, high value targets – Remote “artillery on a truck”



•These weapons systems are used to attack vehicles, armour, bunkers, and other targets of opportunity.
•It uses 3 modes of guidance, namely GPS/INS, semi-active laser homing, and autonomous imaging infrared

The Non-Line of Sight Launch System (NLOS-LS) was a self-contained missile launcher system that was under development by , a partnership between Lockheed Martin and Raytheon

Area denial: Unattended intelligent remote triggered munitions

- **Intelligent Munitions Systems (IMS) is an unattended munitions system providing both offensive battlefield shaping and defensive force protection capabilities.**
- **The IMS is a system of lethal and non-lethal munitions, integrated with robust command & control for detonation.**

IMS provides unmanned dominance, economy of force and risk mitigation for a commander

INFANTRY ASSAULT RIFLES

Overview

- Operating Environment
- The Current Assault Rifle (AR) Generation
- Observations
- The Challenge
- *“Meeting the challenge”* – a South African Perspective.

INFANTRY ASSAULT RIFLES

Operating Environment (1)

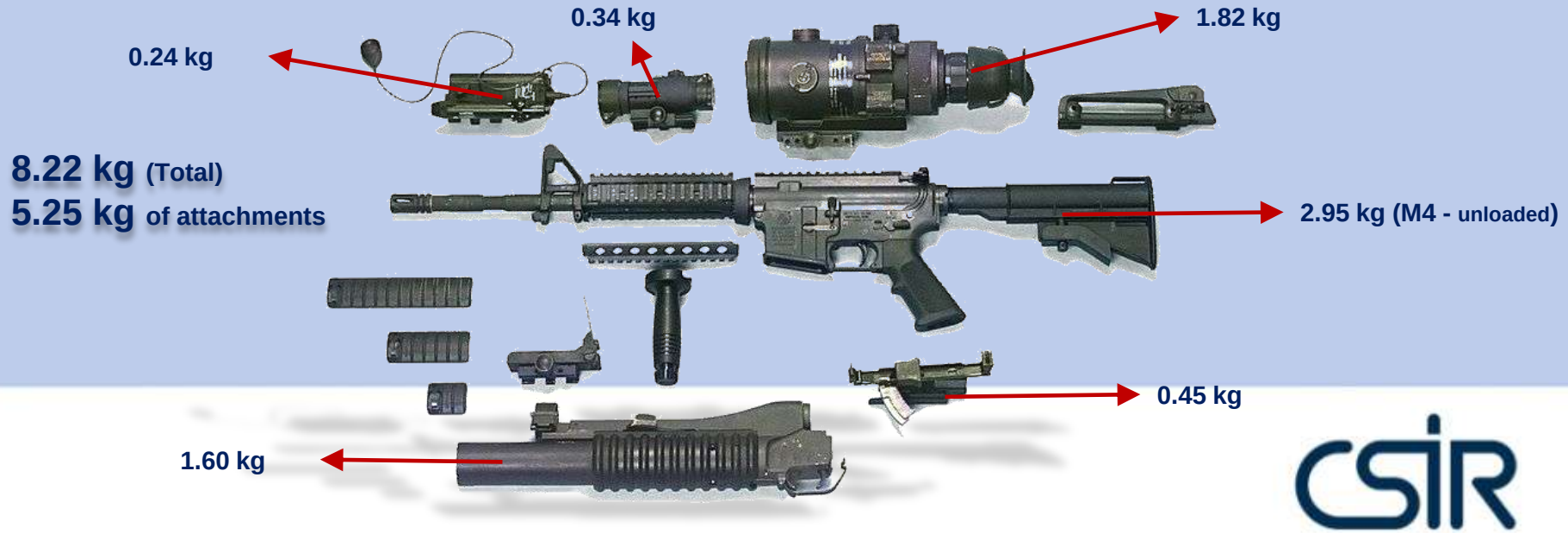
Modern warfare has undergone a massive philosophical shift where the attempt is made to isolate the threat from the general population and damage to the social infrastructure is expected be minimal resulting in a “War amongst the people”

Critical fire control requirements for the modern assault rifle are; the rifleman must have the accuracy, both in clearly identifying and confirming the threat and then engaging the very specific threat with a low probability of collateral damage but with a high kill-probability

INFANTRY ASSAULT RIFLES

Operating Environment (2)

- Conventional assault rifles have achieved their mechanical optimisation limit
- The current limit to the integration of the assault rifle in the modern battlefield is seen as sub-systems that are simply “added-on”
- Very few of the assault rifle attachments are integrated into a unified system
- This currently results in a bulky piecemeal and heavy weapon system
- Losing the potential performance benefits of truly integrating the various fighting sub-systems into a unified fighting system



INFANTRY ASSAULT RIFLES

The Current Generation

M4 / M16

SA80 L85A2

FN2000

H&K 416

BERETTA ARX-160

FN SCAR

REMINGTON ACR

AK-47 (AK-49 Milled Receiver)

STEYR AUG

CSIR
our future through science

INFANTRY ASSAULT RIFLES

Key Observations (1)

- The Bull-Pup type rifles are unique to specific countries and are not really well suited to the addition of attachments
- The majority of manufacturers are putting their effort into designing an improved M16/M4 rifle
- These improvements address the gas-drive problems of the M16 but retain the user existing operator interfaces
- The retained philosophy is simply adding attachments as required and as these items develop – no real integration
- The Australian program Land 125 is one of the few current development programs that is attempting to develop a fully integrated, mechanical/electronic system
- The Beretta ARX-160 is the only current production weapon system that attempts to integrate a Fire Control system with a “Hands-on-Grips” user control interface
- The various attachments all use differing batteries – logistic and operator nightmare

Note size of attachments

INFANTRY ASSAULT RIFLES

Key Observations (2)

- The current generations of sighting systems are optical glass based – leading to a relatively large size
- Infantry Fire Control systems are being developed from crew-served weapons systems and are thus large and heavy.
- Is the sight fitted to the rifle or vice versa??
- We are starting to lose the key function of an assault rifle – a lightweight, accurate, manoeuvrable weapon system packing a reasonable ballistic punch

INFANTRY ASSAULT RIFLES

The Challenge

- To synthesise the current and any future sub-systems into a continually useful infantry weapon system

- To present the soldier with an advanced integrated and continuously upgradeable close-quarter fighting package

8.2 kg
(without sight)

XM29 OICW - What not to do!!!

INFANTRY ASSAULT RIFLES

R4 AR Status

MP43/44 Stg44

Valmet/SAKo Rk62/76/95

AK-47 *(AK-49 Milled Receiver)*

IMI Galil ARM

R4/5 AR

R4 AR Upgrade *(Medium Term)*

FUTURE ASSAULT RIFLE

Long Term

INFANTRY ASSAULT RIFLES

R4 AR Upgrade - Current Goals (1)

- The short-term R4 AR upgrade hardware acquisition is now funded under an SANDF program
- To establish a fundamental knowledge base of the soldier and the upgraded AR systems' interaction
- The capabilities and short comings of the R4 are very well understood thus providing an ideal baseline from which to measurably expand it's tactical capability
- An adaptation of the R4 is an ideal backbone for the development of medium term requirements

R4 AR GRENADIER

INFANTRY ASSAULT RIFLES

R4 AR Upgrade - Current Goals (2)

- The short-term R4AR upgrade integrates COTS/MOTS attachments with a dedicated Picatinny Rail System. *(MIL-STD-1913 / STANAG 4694 METRIC RAIL)*
- To implement a short-term advanced weapon system relative to the current SANDF AoO
- To establish a quantifiable improvement of the tactical capabilities of the R4

BASIC R4 AR UPGRADE

INFANTRY ASSAULT RIFLES

Technologies / Developments

FIGHTING

- 12 gauge Underslung Shotgun – provides the ability to fire the numerous non-lethal and breeching rounds developed worldwide
- Integrated Sound Suppressor - reduces muzzle flash, dust kick-up, protects operators ears and allows for better fire-fight orientation of own *vs* enemy firing positions
- Change in calibre – current NATO & US DOD studies into the future calibre - 5,56 / 7,62 / 6,5 / 6,8 mm
- Improved ballistic system (SS109 & 1:9 barrel) or other
- Programmable multi-function 40x46mm Grenades fired from UBGL
- Sub-system integration forming a unified assault rifle capability

XM-26 LSS

PEACE KEEPING

- 12 gauge Underslung Shotgun
- Underslung paintball gun – marking of potential threats

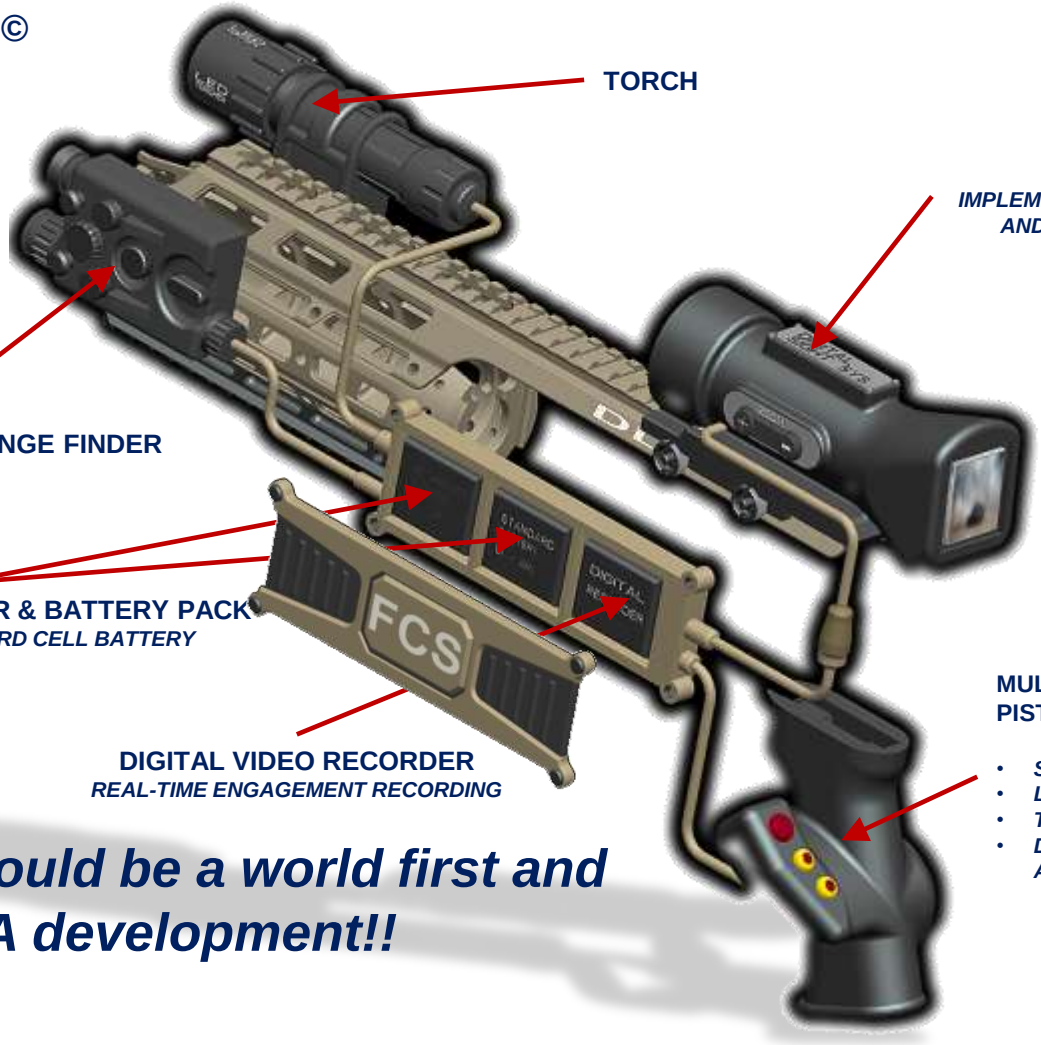
The biggest challenge remains mass and volume!!

INFANTRY ASSAULT RIFLES

Advanced Solution – AR Advanced Integrated Digital System

ARAIDS©

Denel Land Systems



TORCH

DIGITAL SIGHT
IMPLEMENTING BALLISTIC OFFSETS AND DISPLAYING RIFLE TILT

LASER DESIGNATOR & RANGE FINDER

FIRE CONTROL COMPUTER & BATTERY PACK
RAIL MOUNTED & STANDARD CELL BATTERY

DIGITAL VIDEO RECORDER
REAL-TIME ENGAGEMENT RECORDING

MULTI-FUNCTION HAND CONTROLLER / PISTOL GRIP: CONTROLLING

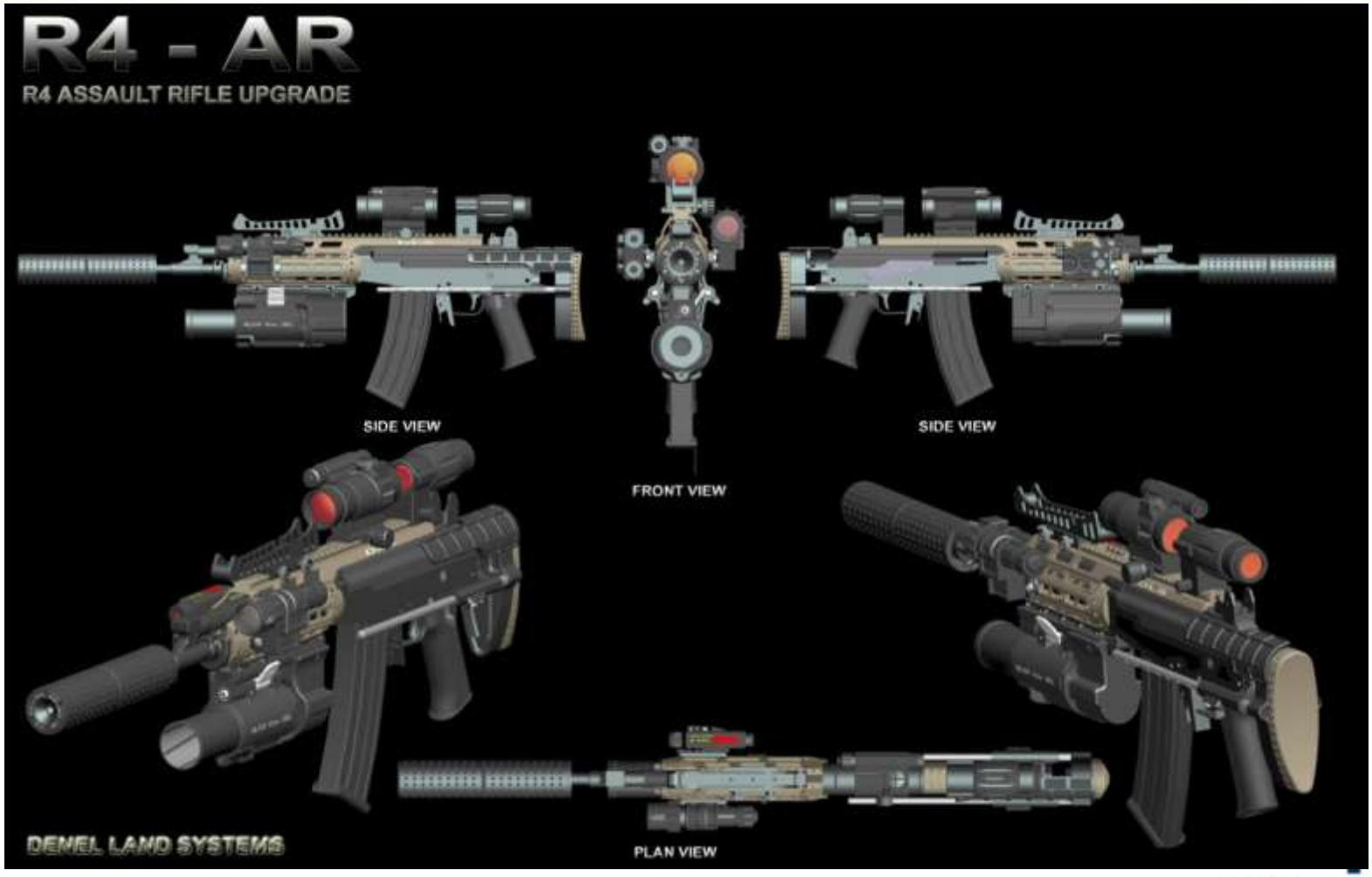
- ***SIGHT SYSTEM***
- ***LASER***
- ***TORCH***
- ***DIGITAL AUTO-RECORD ON SIGHT ACTIVATION***

This system would be a world first and a uniquely RSA development!!

Currently not funded

INFANTRY ASSAULT RIFLES

R4 AR – With everything to go!!



Recommendations and implications

- The personal assault rifle shall always be present on the future operational space. The complexity of operations would require that assault rifles be upgraded/developed with improved day/night fire-control, with a choice of soft & hard target engagement options.
- The soldier as a firepower platform can now apply NLOS firepower over 10km – improving firepower of the dismounted soldier- with Mortars + FSIM
- NLOS weapons, such as artillery systems should improve air-and tactical mobility, & reduce logistics footprint by reducing to 105 mm and or mount weapon on trucks.
- Smart 155mm & 105 mm ammunition could improve the accuracy and operational reach – vital for OOTW.
- Occasional hard targets , such as MBT's could be engaged in future with weapons such as HEMi at extended ranges of 5km.

Thank You

Steve Matthews
Stevem@dlsys.co.za
Braam Greeff
bgreeff@csir.co.za

our future through science