A part of BMT in Defence

BMT Defence Services

"Where will our knowledge take you?"

Electric Armour for Armoured Vehicles (ELAV) - Executive Summary

EDA Reference: 09-R&T-005

BMT Reference: 36745/R4563

Date: 4th May 2010

UNCLASSIFIED

1 STUDY OVERVIEW

1.1.1 Under contract number 09-R&T-005, BMT Defence Services Limited (BMT) conducted a pan-European study into previous, current and planned research in Electric Armour (EA). The aim of this study was to coordinate and focus Research & Technology (R&T) effort at the European level and achieve a commensurate increase in efficiency, cross-pollination, innovation and exploitation of Key Technologies throughout the participating Member States (pMS). This study was carried out in the framework of EDA CapTech GEM3 "Ground Systems and their Environment". It was conducted from November 2009 until June 2010.

1.1.2 The potential benefits stemming from the introduction of EA into Armoured Vehicles include:

a. Increased protection to personnel and equipment;

b. Increased strategic air-transportability;

c. Increased tactical mobility.

1.1.3 However, the integration of these systems in a safe, practical and cost effective manner is not without difficulty. Several areas are critical, including:

a. The requirement for high density and very rapid response power generation, storage, control and distribution systems;

b. The safe integration of Mega-Ampere Pulsed Power systems into confined spaces alongside sensitive equipment and crew;

c. Electromagnetic Compatibility and protection of equipment in a high power electrical discharge environment;

d. The robustness and reliability of high energy power system components in hostile environments and the risk to platform survivability in the event of failures.

1.1.4 The report seeks to address many of the above issues.

1.1.5 BMT's approach to this study is illustrated in Figure 1.1 and consists of a number of interconnected work packages across the following four topic areas:

a. Topic 1: addressing the fundamental principles of EA and the state of the art in the field, as well as exploring the historical and contemporary research context;

b. Topic 2: analysing the capability benefits (particularly from a performance vs. weight perspective) of EA in comparison to alternate protection systems, in the context of a Medium Weight Vehicle (MWV, <30 tons);

c. Topic 3: developing a test case specification for EA systems in the light of the analysis undertaken and the resulting performance and power requirements;

d. Topic 4: documenting the Technology Readiness Level (TRL) of critical technologies and outlining a Road-Map for their development.

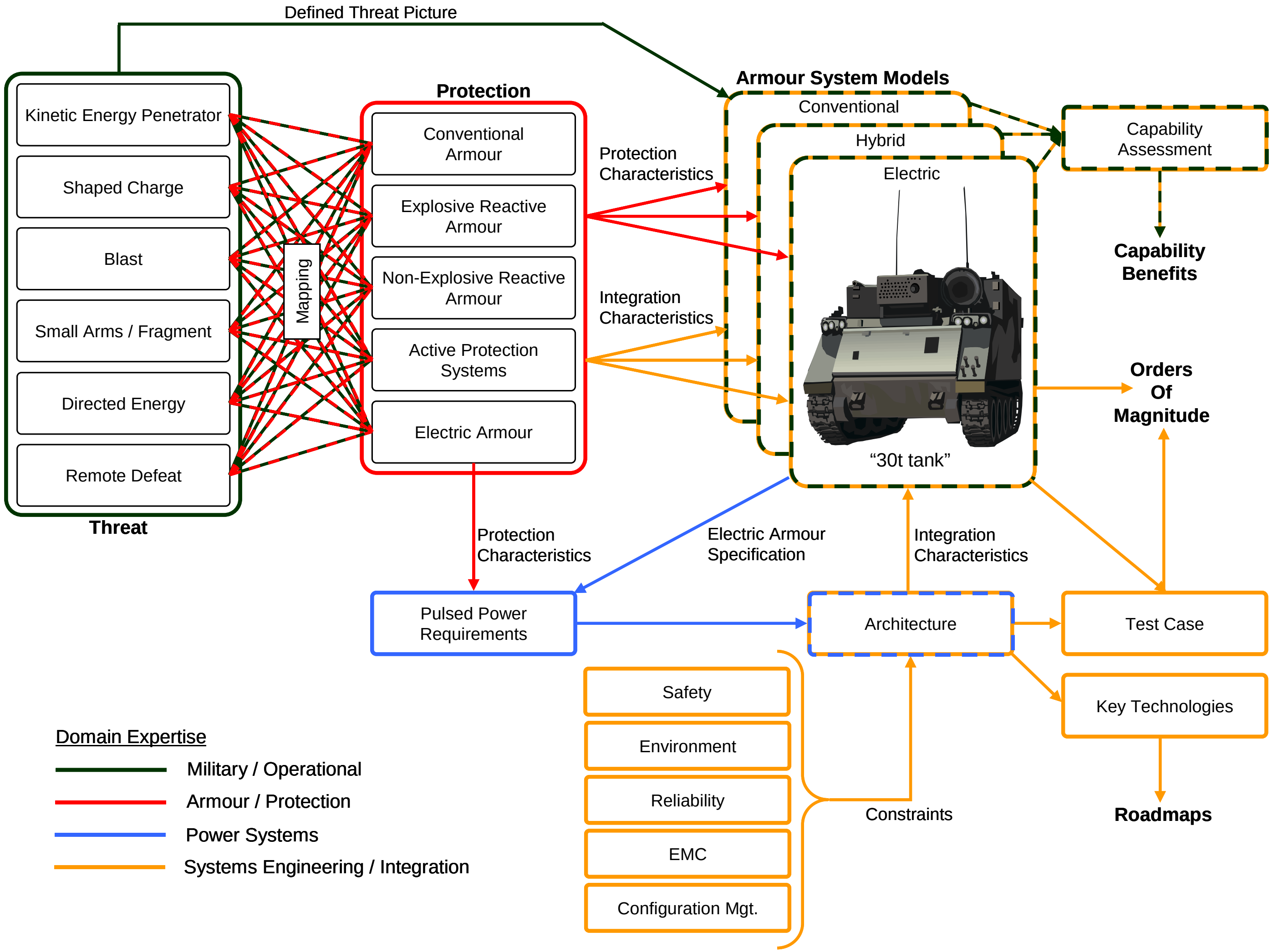

Figure 1.1 - BMT Electric Armour Study Process

2 CONCLUSIONS & RECOMMENDATIONS

2.1 Conclusions

2.1.1 The fundamental principles of EA are reasonably well understood and have been examined in the laboratory environment in quite some detail. A number of mechanisms are thought to be at work in defeating the shaped charge jet, including heating, pinching, deforming and dispersing through magneto-hydrodynamic forces and, to a lesser extent deflecting the jet particles through Lorentz forces.

2.1.2 The performance of EA in reducing the penetration of shaped charge jets into base vehicle armour has also been thoroughly investigated in the laboratory environment. EA is seen as at least as effective (on a Mass Effectiveness (ME) basis) as ERA, both having an ME (relative to Rolled Homogenous Armour) of 8+, although the effectiveness of EA against other threats, particularly Armour-Piercing Fin-Stabilised Discarding-Sabot and similar, has been less thoroughly investigated in the open literature.

2.1.3 Practical EA systems have the potential to offer a number of advantages over other protection options, including:

a. Reduced total system weight;

b. Wider applicability (increased coverage area);

c. Enhanced performance against Shaped Charge;

d. Robustness to ballistic and Kinetic Energy threats;

e. Multiple hit capability.

2.1.4 However, a number of potential disadvantages are also associated with EA systems:

a. Minimum coverage area threshold for implementation;

b. Intermittent protection (recharge cycle dependent);

c. Significant vehicle power requirements.

2.1.5 The weight profile (per unit area coverage) for EA is significantly different from that of other armour types; there is a large fixed component which is determined by the energy required to defeat the threat (and hence by the shaped charge diameter), and a secondary weight component which is area dependent. Other armour types are typically coverage area dependent only.

2.1.6 The analysis presented within this document was able to determine that, within the scope of the Medium Weight Vehicle context, a practical EA system would be likely to outperform conventional and Explosive Reactive Armour based armour solutions of a similar weight and would offer greater scope for weight reduction and system optimisation. It must be noted however, that EA systems, as with all protection types, will form only part of a complete armour solution.

2.1.7 It appears from the open literature, and through direct contact with several European Research Centres, that there is currently little appetite to procure even a partially-integrated All Electric Combat Vehicle and this is likely to remain so for the next five to ten years. Technology will be incorporated incrementally, probably starting with High Voltage distribution and then moving onto Hybrid Electric Drive.

2.1.8 In addition, there is a danger that if the drive for commonality between Electro-Magnetic Gun and other pulse-power systems continues, EA will never be fielded. EA is capable of operating as a stand-alone system within a typical Armoured Fighting Vehicle architecture; albeit with the recharge issues identified in the study.

2.2 Recommendations

2.2.1 It is recommended that research be targeted in the following areas:

a. High Power Switching at 300kA/20kV levels with improved duty cycles;

b. High Current discharging battery packs (1000's of Amps);

c. Testing of the latest 3J/cc capacitors proposed by General Atomics;

d. Experimentation with dual capacitor banks to protect against Tandem Warheads.

2.2.2 It is evident that no single participating Member State has the funding to mature EA on their own. We suggest that funding be sought for an integrated EA Technology Demonstrator Programme. The architecture for which should be based on a more realistic prediction of what Armoured Fighting Vehicles ordered in 2015 (and on) will look like, and what power the associated future mission systems are likely to consume.