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<th>2. REPORT TYPE</th>
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<td>27 JUL 2010</td>
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<td>Armor Considerations for Ground Platforms</td>
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<th>6. AUTHOR(S)</th>
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<td>Dr. Douglas Templeton</td>
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<th>7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)</th>
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<tr>
<td>US Army RDECOM-TARDEC 6501 E 11 Mile Rd Warren, MI 48397-5000, USA</td>
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12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES
The original document contains color images.

16. SECURITY CLASSIFICATION OF:

<table>
<thead>
<tr>
<th>a. REPORT</th>
<th>b. ABSTRACT</th>
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17. LIMITATION OF ABSTRACT
SAR

18. NUMBER OF PAGES
11

19a. NAME OF RESPONSIBLE PERSON
unclassified
Goal:
To develop advanced armor technologies that provide ground combat and tactical wheeled vehicles capability to provide enhanced protection (multiple threats), weight reduction, and adaptability to threat evolution.
Motivation

DRIVERS

- Lightweight/Mobile
- Threat
- Designable/Repairability
- Armor: Multifunctional Ballistic/Structural

NEED TO BALANCE
The 3 Ps!

UNCLASSIFIED
• Optimal use of mechanics and materials
  – Understand/use mechanics to obtain desired effect
  – Use materials that will amplify the performance of the mechanics
  – Demand “ultimate” performance from materials

Numerical simulations are an integral portion, providing understanding and direction
Vehicle Armor Damage Concerns

• Fabrication issues (‘‘Was that supposed to go in there?’’)

• Logistical issues (‘‘Did you drop that?’’)

• Non-combat impact (‘‘Where did that [tree, ditch, wall, (fill in your own) ] come from?’’)

• Combat impacts (penetrating AND non-penetrating ballistic events, blast)
Materials for Ground Platforms

–Ideal situation: materials readily available and fully developed.
  • RHA
  • High hard steel
  • Aluminum

–Reality: Research projects are ongoing to further develop advanced lightweight armors.
  • Composites
  • Ceramics
  • Titanium
  • Magnesium
  • Composite and metal matrix
  • ?????????
- Silicon Carbide Armor Tile Comparison at Equivalent Ballistic Protection

- (production cost)
- Titanium & Aluminum/Lithium Alloy Raw Material Cost

\[ \text{~$12/lb vs. } \text{~$4/lb for Conventional Aluminum} \]
The graphic displays RA outline minus the 2.5” B1 armor.
Note: the ICV has storage on the outside of the side armor.
Combat Vehicles

Current

- Thick, heavy armor
- Structure as by-product of armor
- Inherently damage tolerant
- Arrive on ships
- Well understood materials and manufacturing practices
- Designed for force-on-force engagement
- Cumbersome logistics tail
- Basic situational awareness

Future

- Lightweight armor
- Structure plus armor (A + B)
- Relatively damage intolerant
- Air transportable (C-130)
- Advanced ceramic armors, use of polymer composites and associated mfg. practices
- Designed for noncontiguous, non-linear, reorganizing battlefield
- Common components, reduction of logistics footprint
- Network centric, highly interdependent
Tactical Vehicles

Current

- Tired and aging fleet
- Corrosion prone
- Cabs typically unarmored. Armoring via add-on-armor kits
- Reduced vehicle payload, maneuverability, reliability, safety, maintainability, and life expectancy
  - Increased wear and tear on vehicle components, fuel consumption, and life cycle costs
- Multiple original equipment manufacturers, little commonality
  - Designed for traditional role of logistics support

Future

- Recapitalization with appliqué armor (A-kit/B-kit)
- Be more survivable in mine blast events
- Component commonality (hardware, transparent armor, B-kit panels)
- Gun turret and advanced countermeasures
- Crew installable B-kit, with minimal tools
- Enhanced crew survivability to meet threat
- Increased system reliability
- Taking on more of an assault role

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SUMMARY

- Significant challenges remain in areas of material development and mechanisms
- Modeling and simulation is a critical enabler