Vector Strategy Presentation on Ballistic Fiber / Fabric / UD Materia Usage Within the US Military Armor Industry

Presented at NC Military Performance Textiles Conference
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26 Pinecrest Plaza, #
Southern Pines, NC 28
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Brief Outline

- About Vector Strategy
- US Military Ground Vehicle Armor Market
  - Ballistic Fiber (and Fabric and UD Material) Demand
  - Ballistic Fiber Technology Trends in Ground Vehicle Armor
  - US Military Ground Vehicle and Vehicle Armor Procurement Trends
  - Structure of the Industry
- US Military Body Armor Market
  - Ballistic Fiber Demand in US Military Body Armor
  - Ballistic Fiber Technology Trends in Military Body Armor
  - US Military Body Armor Procurement Trends
  - Structure of the Industry

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- Woven and non woven materials
- Fabrics and uni-directional materials

Notes:

- We typically don't use the term "textiles" in the US ballistic fiber market or hard armor industry, we refer to:
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  - Fabrics and uni-directional materials
- This presentation will not be available for distribution to conference attendees as it contains detailed information from Vector Strategy reports.

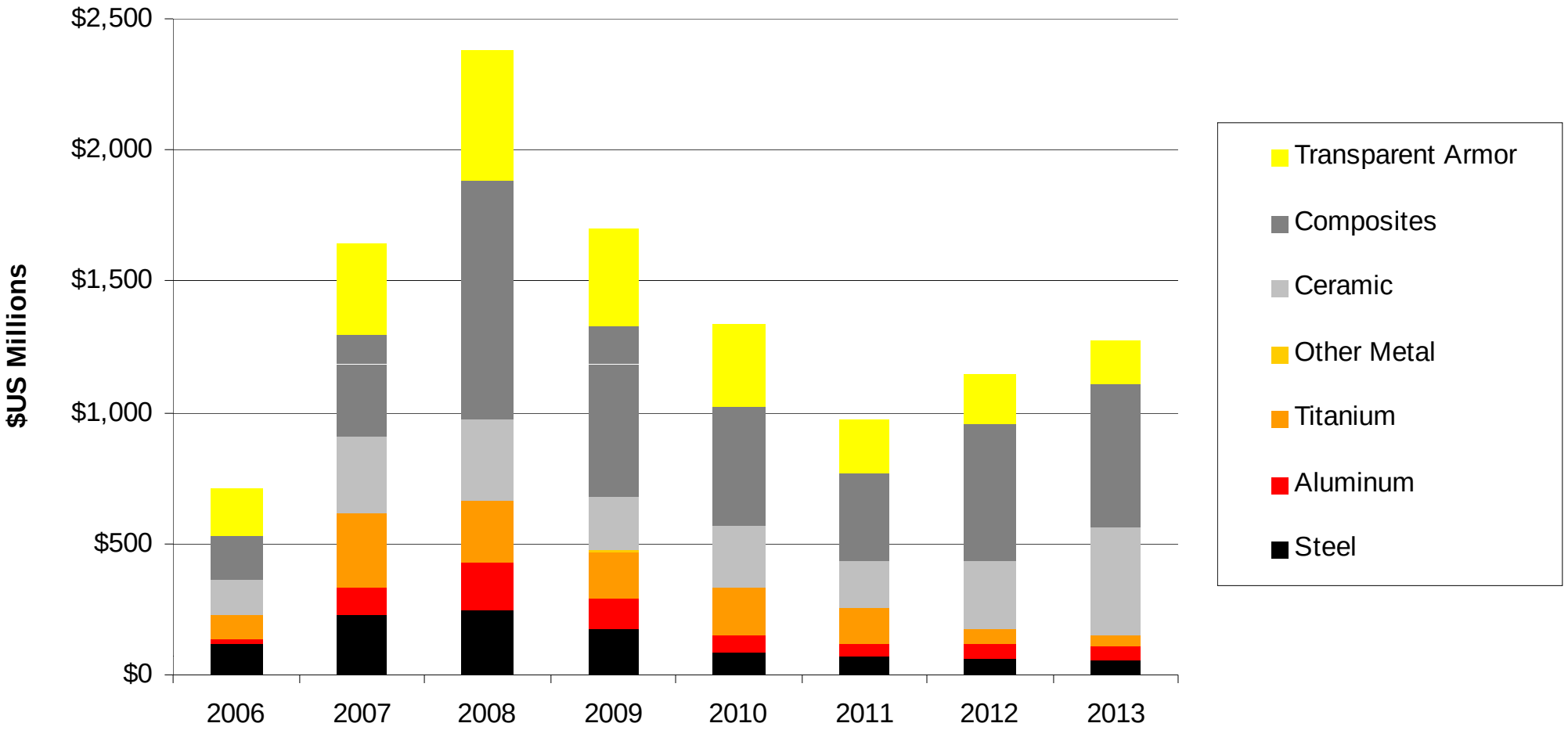
About Vector Strategy

- **Mission: Provide market intelligence for the military armor industry.**
- **Business Model:**
  - **Offer a set of reports and forecasts related to the military armor industry.**
  - **Offer limited custom research and intelligence services such as technology assessments, market size and segmentation analysis, acquisition analysis, product development strategies.**
- **Core Competencies:**
  - **Identifying, tracking, and disseminating strategic, market, and technical trends.**
  - **Developing forecasts and analysis from the bottom up with supporting detail by program and platform.**
  - **Providing intelligence that is valued by companies involved in producing military armor.**

History of Vector Strategy

- Founded Vector Strategy in 2004 to provide industrial and technical market research to Fortune 1000 companies.
- Engaged in an armor related project in May 2006.
- After completing that project in the 4th quarter of 2006, decided to focus Vector Strategy solely on the military armor industry.
- Currently, Vector Strategy services over 50 clients from the armor industry and armor supply chain, military / government agencies, and the financial community.

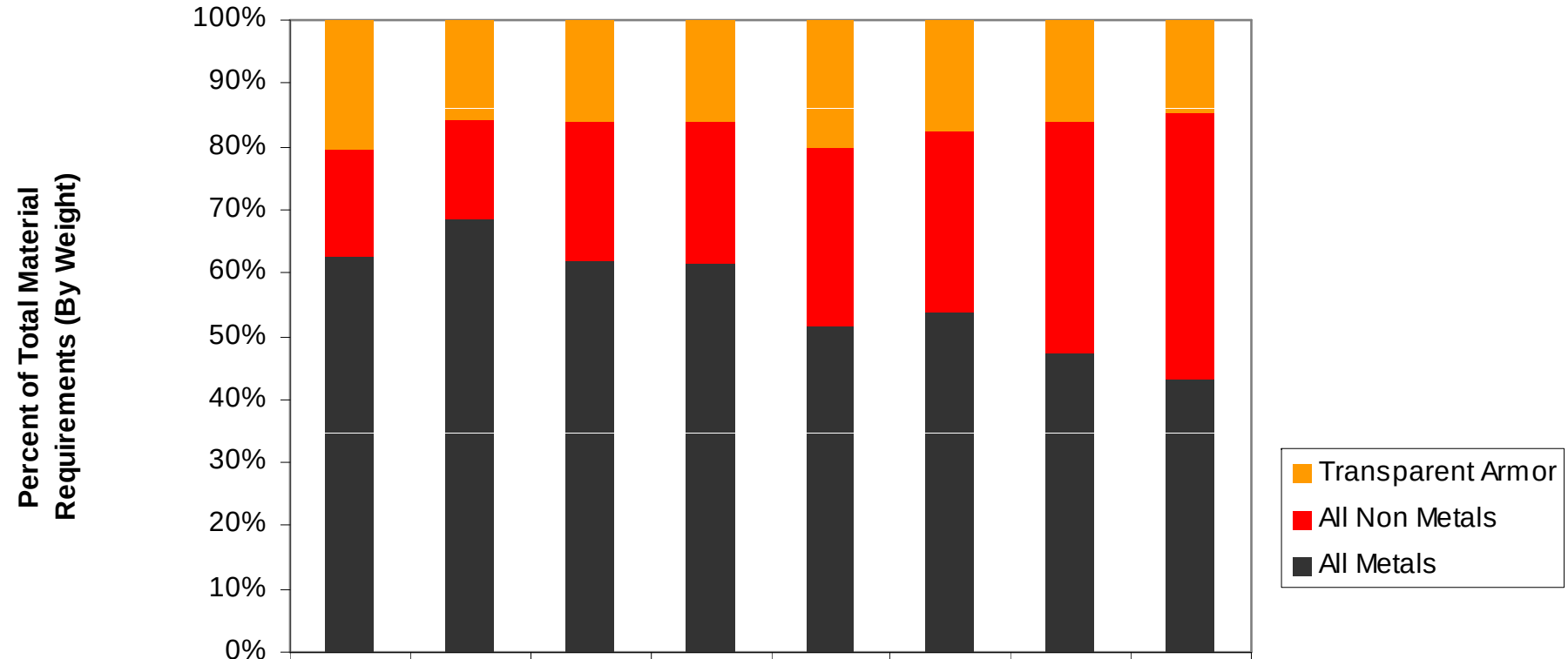
Material Requirements For US Military Ground Vehicle Armor (US$ Graph)



US Military Ground Vehicle Armor Material Requirements (Weight – Pounds)

- 2008 total material requirements to meet procurement rates for MGV armor was 248 million pounds.
- By 2013, only 84 million pounds of material will be required to meet armor procurement for MGVs.
- Surge in 2008 is due to increased procurement of MRAP vehicles and the procurement of EFP protection for MRAP and selected other vehicles.
- The decline through 2013 is due to two factors:
  - A decrease in both armor and vehicle procurement funding.
  - A transition to lighter weight and lower areal density armor solutions (a transition to both non-metallic and lighter metallic solutions).

Metallic Versus Non-Metallic Armor Solutions



	2006	2007	2008	2009	2010	2011	2012	2013
Transparent Armor	20%	16%	16%	16%	20%	17%	16%	15%
All Non Metals	17%	16%	22%	22%	28%	29%	36%	42%
All Metals	63%	68%	62%	61%	52%	54%	47%	43%

Discussion of Metallic Versus Non-Metallic Armor Trends

- **Metal material requirements decline from 68% of total requirement in 2007 to only 43% of total material requirements in 2013. Metals include steel, aluminum, titanium, depleted uranium, and other metals.**
- **Armor design trends that drive this transition:**
  - **Composite use in EFP kits.**
  - **Increased use of composite and ceramic solutions in base vehicle armor (such as the current MATV and Stryker armor solutions).**
  - **JLTV armor (modular and spall liners) starts to drive requirements in 2013 and beyond.**
  - **MPC (Marine Personnel Carrier) and Ground Combat Vehicle will also drive ceramic-composite armor as they come into production.**
- **Armor supply chain participants need to position themselves now to benefit from future uptick in new vehicle production (JLTV, GCV, MPC, M113 replacement) and vehicle block upgrades (MRAP, Stryker, Bradley, Abrams).**

Ballistic Fiber Requirements in US Militar
Ground Vehicle Armor

Ballistic Fiber Requirements

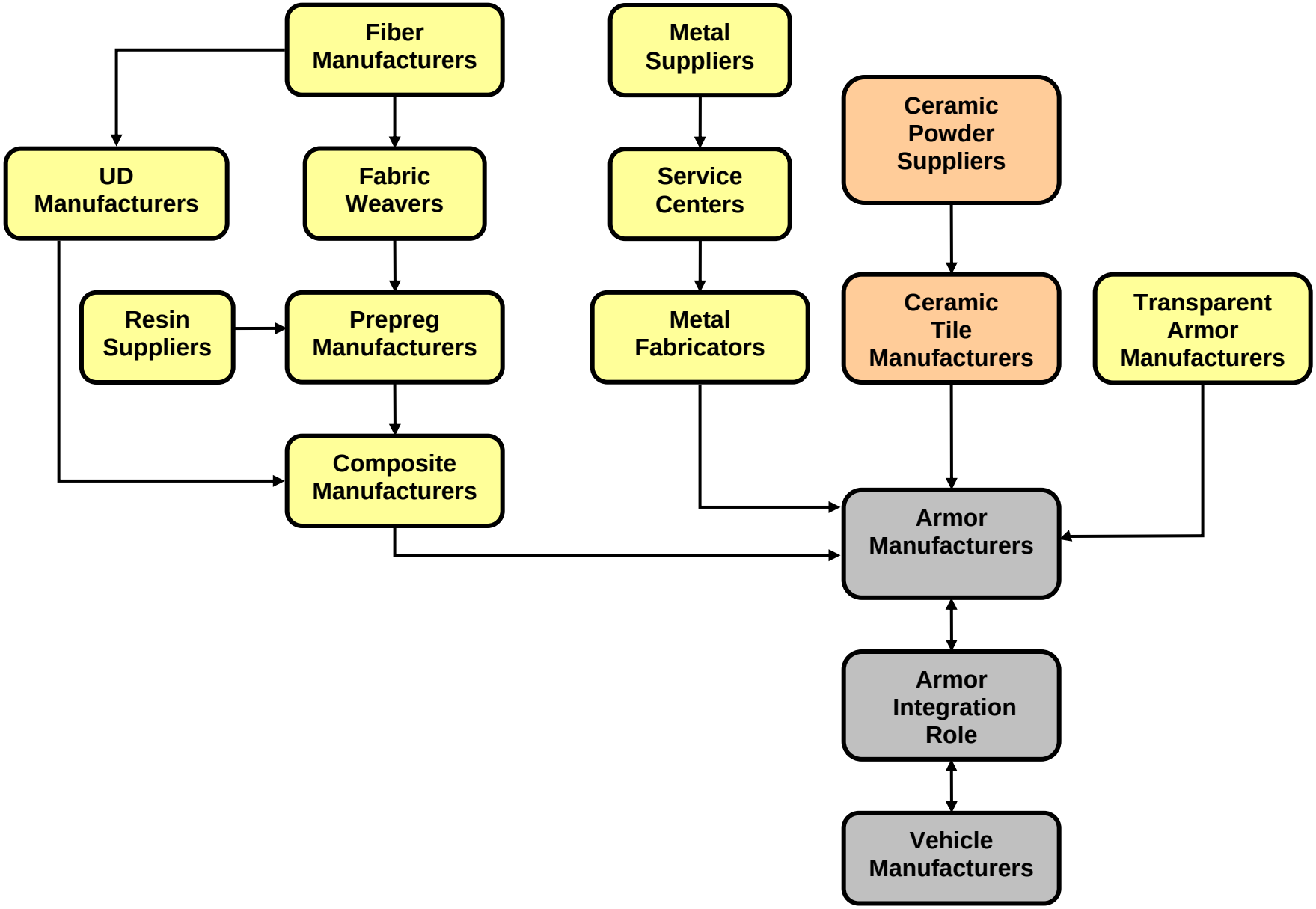
- 2007 requirements for ballistic fiber are 15.1 million pounds based on MGV armor procurement rates.
- 2008 requirements are 31.2 million pounds.
- By 2013, we forecast that the market will require 16.4 million pounds of ballistic fiber, below the peak created in 2008 due to MRAP vehicle spall liners and EFP protection, but a figure driven higher by initial production of JLTV spall liners and ceramic/composite armor.

Ballistic Fiber Technology Trends

- Increased use of uni-directional UHMWPE for EFP protection.
- More lower cost non traditional fibers will be incorporated into armor packages for ground vehicles.
- Offerings of lower cost high performance glass; affect on market unknown.
- Increased use of internal rigid spall liners in both tactical and combat vehicles.
  - Floor upgrades to protect against IED (retrofits and new vehicles).
  - Roof protection and more “all-around” spall protection.
  - Conversion from ballistic blankets to rigid composite panels.
- Increased use of ceramic base vehicle armor that incorporates a composite backface.
- On commercial verge of using some woven materials in transparent armor production.

Structure of the US Military Ground Vehicle Armor Industry

Military Ground Vehicle Armor Supply Chain



Ballistic Fiber Usage Within The US Military Body Armor Industry

Technology Trends In Ballistic Fibers Used For US Military Body Armor

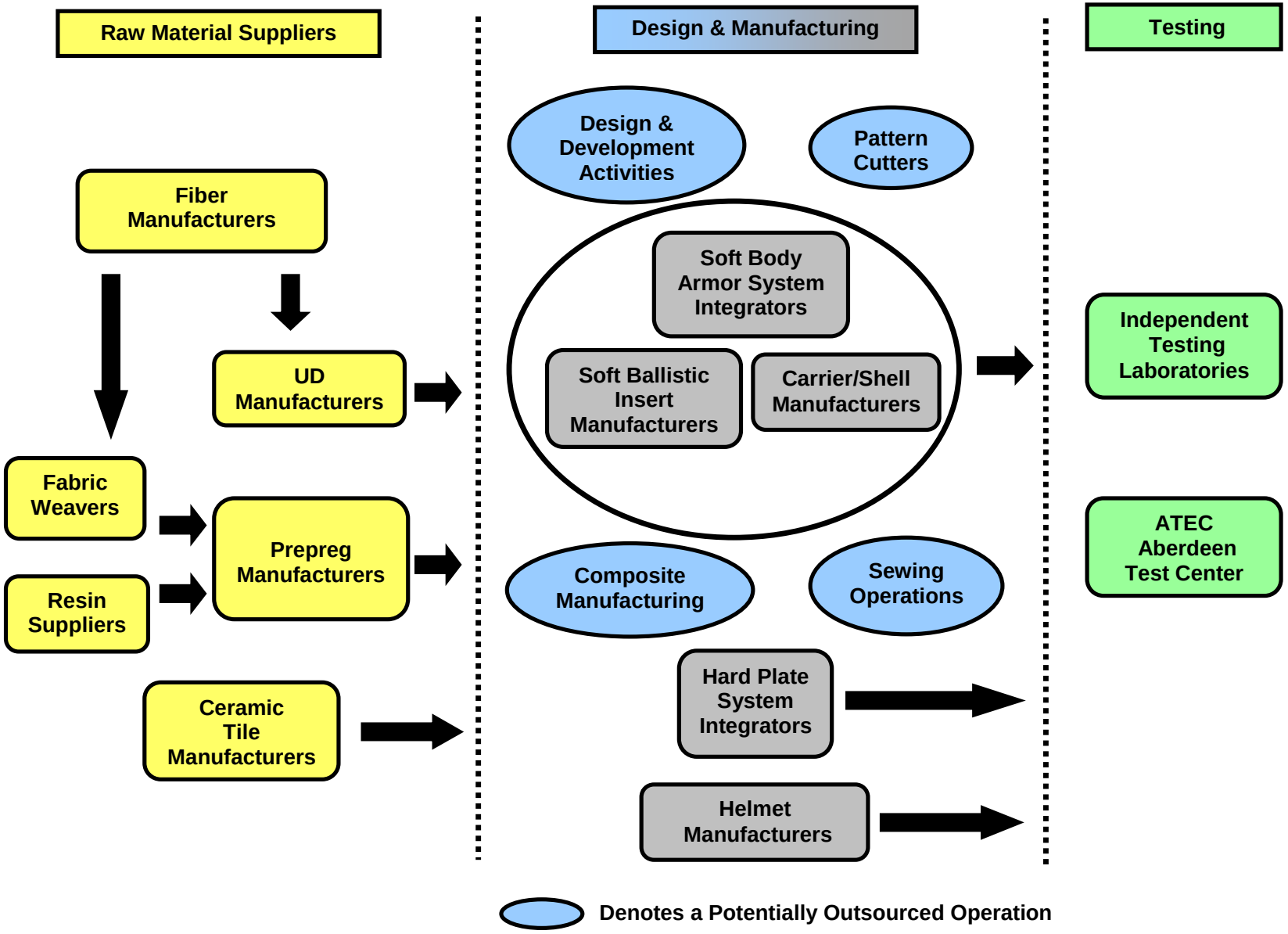
- All the major fiber companies are actively developing new high performance fiber technologies that could provide revolutionary improvements in performance over currently available fibers.
- They are also developing enhancements to current fibers that could yield evolutionary improvements in physical properties and ballistic performance.
- We believe the latter, evolutionary improvements in current fibers, are likely to be incorporated in US military body armor in the next one to five years and more step-change or revolutionary fiber improvements will occur in five to ten years.
- We expect that UD materials and fiber hybrid materials (woven and UD) will become increasingly important in the next one to five years.
- We believe that both DSM and Honeywell are investing in UHMWPE UD, aramid UD, and fiber technology that will lead to advancements in this arena including improvement in abrasion resistance; increased durability; increased resistance to H2O, seawater, and POL (petroleum, oil, and lubricant) degradation; and improved ballistic performance.

Technology Trends Continued

- New resin systems, new coatings and films, non symmetric layups, new stitching patterns and other engineered changes in material construction as well as fiber enhancements will yield UD, hybrid fiber, fabric, and material advancements.
- Resin systems, coatings, and films have traditionally been the responsibility of fabric weavers, prepreggers, and UD manufacturers.
- However, fiber manufacturers will need to increasingly invest in R&D in these areas if they wish to participate in fiber solutions that meet ever increasing threats.

Structure of the US Military Body Armor Industry

Structure of the US Military Body Armor Industry



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