Technical Textiles:
Automotive Applications

North Carolina State University

Nancy B. Powell
Associate Professor

Powell, 2005
Transportation Growth

- 1900: 1 in 9,500 Americans owned a car.
  - Only 22% - internal combustion
  - Others: Steam & electricity.

1996: there would be almost 300 million registered.

2002: 1.7 vehicles per household in the U.S.

2006: 16.9 million units forecast in North America

2020: at least 1.1 billion vehicles on the global roads

Powell, 2005
WARD’S AUTO REPORT

- Average 17 million units annually for ‘99-’02
- N. A. Sales: 22 million unit mark by 2010
- **Competition Toughens with 46 New Vehicles**
  - 46 entirely new or redesigned vehicles coming to the U.S. in 2005, and the total number on sale will rise to 292.

β www.wardsauto.com/
North American Market

- Global Production: 60 million in 2008
- 885 million vehicles in use worldwide by 2008

Ward’s Automotive, 2002

Tramontana

Powell, 2005

www.cardesignnews.com
1. Sunroof
2. Headliner
3. Convertible Tops
4. & 5. Sun Visor
6. Carburator Filter
7. Column Padding
8. Transmission Tunnel
9. Battery Separator
10. Belts & Hoses
11. Composite Panel
12. Air Bags
13. Seat Belt Anchorage Cover
14. Seat Belt
15. Trunk Liners
16. Trunk Floor Covering
17. Muffler Wraps
18. Tire
19. Inside Roof Lining
20. Bodywork Parts
21. Seat Cover Lining
22. Upholstery
23. Insulation
24. Window Frames
25. Fuelcell Component
26. Filters
27. Molded Fuel Tanks
28. Carpet
29. Carpet Backing
30. Rear Shelf Panel

Powell, 2005
Business Opportunities

- Competition global
- Lead times
- Costs
- Differentiation of Products
- Technology Integration

Subaru Cutaway, 2005

Powell, 2005
Who Are the Decision Makers?

- O.E.M. Designers
- Tier One Designers
- Purchasing
- Engineering
- Laminators
- Cut & Sew Operations
Supply Chain

- Fiber
- Yarn
- Fabric

- Foam
- Laminate
- Cut & Sew
- Assemble/Mold

- Component
- Interior
- Vehicle
- Dealer
Automotive Textile Suppliers to the North American Market

- MILLIKEN & COMPANY
- COLLINS & AIKMAN (JOAN)
- GUILFORD MILLS
- GLEN RAVEN
- ACHTER & EBYL (AundE)
- Chatham Borgestena
- EBYL CARTEX
- MICHELE THIERRY
- SEIREN
- KAWASHIMA
- SUMINOE

Powell, 2005
Performance Fibers

- **Polyester**
  - Seats
  - Door Panels
  - Headliners
  - Seatbelt
  - Sunvisors

- **Nylon**
  - Airbags
  - Carpet

- **Polypropylene** (Nonwovens)

NEW FIBERS?
- Carbon
- Kenaf
- Hemp
- INGEKO
- Cotton
- Bamboo

Package Tray
Trunk Liner
Hoodliner

Powell, 2005
Performance Standards - Trim

- Abrasion resistance
- Tear and tensile strength
- Stretch
- Seam strength
- Stretch and set
- Stretch and recovery
- Dimensional stability
- Drape
- Comfort – breathability
- Snagging
- Flammability
- Tensile strength/breaking and elongation
- Color fastness and crocking
- Lightfastness and UV degradation
- Antistatic
- Soiling and cleanability
- Environmental and ageing

Powell, 2005
O.E.M. Standards

Performance standards are set by individual O.E.M’s but are based on some 30 individual tests certified by British (BS), American (ASTM) and the Society of Automotive Engineers (SAE) and German (DIN) methods.

Fung & Hardcastle, 2001
North American Automotive Product Development

NEW PRODUCTS

US Suppliers

Euro Suppliers

CA Advanced Studios

Asian Suppliers

Tier One Suppliers

O.E.M. Int’l

O.E.M. Detroit

Powell, 2005
## Supply Chain Automotive

<table>
<thead>
<tr>
<th>Tier Level</th>
<th>Four</th>
<th>Three</th>
<th>Two</th>
<th>One</th>
<th>O.E.M.</th>
<th>Brand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automotive Supply Chain</td>
<td>DUPONT</td>
<td>UNIFI</td>
<td>MILLKEN</td>
<td>EAGLE OTTAWA</td>
<td>FOAMEX</td>
<td>SHAWMUT</td>
</tr>
</tbody>
</table>

- Fiber
- Yarn
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- Leather
- Foam
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- Dealer

Powell, 2005

North American Tiers

**Tier 1 suppliers**: Complete interior compartment

**Tier 2 suppliers**: Produce the subassemblies that make up those compartments

**Tier 3 suppliers**: Form the individual parts of those subassemblies

- Johnson Controls (JCI)
- Lear Siegler
- Intier – Magna

Powell, 2005
OEM Concerns

- COSTS
- Performance
- Versatility
- Durability
- Brand Image
- Mass Customization
- Sustainability

www.milliken.com

Powell, 2005
Business Issues

- Costs
- Time to Market
- Differentiation of Products – Brand Identity
Key Engineering Challenges

- Performance
  - Fuel Economy
- Safety
- Energy Efficiency
- Convenience
- Cost
- On Board Electronics
  - Entertainment
  - Information


(Design News Panel, Sept. 2003)
Key Design Issues

- COST
- Hand
- Stretch
- Pattern
- Color
- Luster
- Performance
- Innovation

Volvo, 2004

Powell, 2005
“We believe that active lifestyle buyers make up 15 to 20 percent of the SUV market. These people told us they want seats that are tough, comfortable and easy to clean. Their needs are the key part of the FXC story.”

— Barbara Haaksma, Director of Design and Marketing, Milliken Automotive, 2003

Powell, 2005
Performance: Customer Expectations

- What happens inside the vehicle?  
  [https://xweb4.milliken.com/YEW/]

Chrysler Offers Milliken's YES Essentials®

"No Stains, No Odors, No Worries“™
Stow and Go Seats

Powell, 2005
Mitsubishi Design Concept EZ

VERSATILITY – Reconfiguration of the interior space


Powell, 2005
INFOTAINMENT

- Experience of purchasing
- Experience of owning
- Experience over time
- Smart Textiles
  - Safety
  - Communication
  - Entertainment
  - Comfort

Powell, 2005
Challenges

- Fiber to Finished Product
- Performance Issues
- Delivery cycles – response time
- Color management
- QS 9000 Automotive Quality
- Environmental Issues – QS 14000
Leather, Vinyl & Suede

Leather interior may have small % of actual hide depending on the model. These products are less than 25% TRIM market.

- Scrims and foam backings for composites and vinyl (PVC).

- Synthetic suedes such as Kuraray’s Clarino®, and Toray’s Alcantara® and Ecsaine® use polyester microfiber technology impregnated with polyurethane resins.

Powell, 2005

(Smith, 1999)
Acoustical Tunable from C & A

- 2003 Toyota Sienna
- AcTmat
- Floormats part of AcT family of products
- Reduces weight and improves **sound absorption**
- Reduces road, engine and tire noise up to 2 decibels
- Potential to be used in dashboard, headliner and seats

Powell, 2005
After Market: End Consumer Pays.

- Customization
- Brand Identity – Harley Davidson
- Extend the product line
- 5.3 billion US$ trim segment in 2001
- Mass Market Retailers
- Digital technology savvy generations

β www.aftermarket.org

Powell, 2005
Motivating Tier Suppliers

- Reduce Tier One’s cost of doing business.
- Increase Tier One’s unit margin.
- Increase Tier One’s unit volume.
- Change Tier One’s attitude toward the products.
Product Development Cycle

- Flexibility
- Speed
- Responsiveness
- Cost Reductions
- Communication & Collaboration between supplier, manufacturer, dealer and end consumer.
Areas of Future Interest:

- Interior upgrade can improve the perception of total quality
- Noise reduction
- Electro-textiles
- End user comfort
- Reduce weight/Increase space
- Ageing driver: ease of use
- Environmental issues: Green Cars
- Transportation Infrastructure

Powell, 2005
NCSU Integrated Transportation Research

o www.INTRsection.com
Research Focus

- Groups on campus pursuing Transportation Research:
  - College of Textiles
  - N. C. SOLAR Center
  - College of Engineering
  - College of Management
  - CALS
  - College of Design
RESEARCH THRUST AREAS

- Intelligent Vehicle and Infrastructure Design
- Advanced Automotive Materials and Manufacturing
- Advanced Powertrain and Vehicle Performance
- Vehicle Design and Integration
CHALLENGE

- Alignment of industry needs with university objectives:
  - Research
  - Education
  - Service
  - Extension, Engagement, & Economic Development
Transportation Components

- Vehicles
- Infrastructure
- Materials
- Environmental
INTRsection Workshop

- 87 attendees
- 41 Research Posters
- Abstracts
- 4 focus groups
- Media Coverage

www.INTRsection.com

Powell, 2005
Partnership Opportunity

- Advanced Vehicle Research Center of North Carolina (AVRNC)
- Non Profit Public/private Partnership 501 (c )(3)
- General Assembly feasibility study
- Richard Dell – Director (www.avrnc.com)
AVRNC

Integrated resource for transportation research, development, and testing.

- 2.5 mile test and development track
- Dynamomenter and emissions testing
- Hydrogen and bio fuel refueling stations
- Garages, offices, and classrooms
- Materials lab and fuel testing labs
- ITS and infrastructure testing systems
- Other equipment as needed
Advanced Vehicle Research Center

- Management Advisory Board
- Significant industry partnerships formed
- Federal and state support secured
- $15,100,000 in funding committed
- Groundbreaking April 28, 2006

www.avrnc.com
Status of AVRC/NCSU activities, 2006

- NCSU will assist in design and development of the AVRC
  - Architectural and Master Plan
  - Power management
  - Educational adaptability of the AVRC
  - Business development
- (Economic impact, fly-over, supply chain)
- Hydrogen refueling station project
- Demonstration project – flex fuel vehicle

Powell, 2005
Potential Benefits to NCSU

- Access to a world class automotive testing facility
- Enabling ground breaking research in the transportation and energy fields at NCSU
- Focal point for the divergent campus programs related to auto, transport, and energy
- Position NCSU to compete for large scale multidisciplinary research grants
- Enrich students’ experience beyond traditional classroom instruction
- Student support through intern and co-op programs

Powell, 2005