OVERVIEW OF GROWTH AND VALUE OPPORTUNITIES IN AUTOMOTIVE INTERIORS

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PLASTICS IN AUTO INTERIORS 2005
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B/mydocs/papers/ftvalue05
HIGHLIGHTS

• AUTOMOTIVE DRIVING FORCES FOR MATERIALS AND PROCESS SUBSTITUTION
• EUROPE/N. AMERICA DIFFERENCES
• NEW INTERIOR MATERIALS COMPETITORS
• NEW FABRICATION TECHNOLOGIES
• AUTO INTERIORS SUPPLY CHAIN SHIFTS
• FOAM, FIBER GROWTH OPPORTUNITIES
• THE COMPOSITES INTERFACE
• VALUE ADDED OPPORTUNITIES
Automotive Interior Soft Trim: Skins, Foams, Coated Fabrics, Textiles, and Acoustic Barriers

Prospectus for a Global Multiclient Industry Analysis
Robert Eller Associates, Inc.
Specialty Thermoplastic Elastomers ... Markets, Economics, Technology, Intermaterials Competition

Prospectus for a Europe/U.S./Japan Multiclient Industry Analysis
September 2004
OPERATING HYPOTHESES

- PROFITABILITY EROSION CONTINUES
- AUTO SECTOR NOT RETURNING COST OF CAPITAL
- STILL TOO MANY COMPONENT SUPPLIERS
- INTERIOR MODULE FABRICATION TECHNOLOGIES SUB-OPTIMIZED
- INTERMEDIATE SUPPLY CHAIN STEPS WILL BE ELIMINATED
- GLOBAL TECHNOLOGY CONVERGENCE
- RISE OF COMPOSITES
- INTEGRATION OF COMPONENTS
OPERATING HYPOTHESES (CONT’D)

- THERMOPLASTIC MATRIX USAGE
- WEIGHT SAVINGS VALUE INCREASED
- SPACE SAVINGS PREMIUM – HEADLINER AND DOOR TRIM
- NATURAL FIBERS ENTER COMPETITION
- GLASS FIBER REINFORCEMENT WILL DECLINE
- GROWTH OF TALL CARS
- LARGER FLOOR MODULES
- INCREASE IN PO FOAM USAGE
ECONOMICS/MATERIALS TECHNOLOGY INTERFACE

• RAPID MATERIALS COST PRICE RISE INTENSIFIES PRESSURE
• PROFITABILITY SQUEEZE ON TIER 1s LESS THAN TIER 2s
• HIGH LEGACY COSTS (US)/LABOR UNREST (EUR)
• GLOBAL PARTS SOURCING THREAT STARTING
• DOLLAR DECLINE CONTINUES
• TIER 1 CONSOLIDATION TO GAIN PRICING POWER
• DOMESTIC CAR MAKER SHARE LOSS
• HIGH VOLUME, GLOBAL MULTI-VEHICLE PLATFORMS GROWING
CURRENT AUTO/SUPPLIER DYNAMICS . . . THE EFFECT OF PRICE PRESSURES

SOURCE: ROBERT ELLER ASSOCIATES, INC., 2005

re/mydox/papers/intauto-suppl dyn price 04.vsd
lg/myfiles/visio/intauto-suppl dyn price 04.vsd
SUPPLY CHAIN SHIFTS

• COMPONENT INTEGRATION (MODULARIZATION)

• LIGHTWEIGHT COMPOSITES ENTERING:
  – SEMI-STRUCTURAL HEADLINERS
  – FLOOR MODULE ELEMENTS
  – INSTRUMENT PANELS

• NEW MATERIALS ENTERING SUPPLY CHAIN
  - NATURAL FIBERS,
  - PO FOAMS IN SEVERAL FORMS
  - NANOCOMPOSITES/HAR FILLERS
  - MICRODENIER NONWOVENS (ACOUSTICS)
  - GENERATION II BICOMPONENT NONWOVENS

• FIBER/NANO COMPOSITE CONCENTRATES

• LGF-TPs VIA DIRECT COMPOUNDING

• POLYOLEFIN FOAMS DRIVING CHANGES
## EUROPE/US DIFFERENCES/SIMILARITIES IN INTERIOR SOFT TRIM

<table>
<thead>
<tr>
<th>MODULE</th>
<th>TECHNOLOGY</th>
<th>N. AMERICA</th>
<th>EUROPE</th>
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<tbody>
<tr>
<td>DOOR TRIM</td>
<td>EA FOAM</td>
<td>MORE EXTENSIVE</td>
<td>STARTING</td>
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<tr>
<td></td>
<td>INTEGRAL EA</td>
<td>STARTING</td>
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<td></td>
<td>HARDWARE MODULE</td>
<td>LD-GMTs STARTING</td>
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<tr>
<td></td>
<td>SKINS</td>
<td>2-SHOT TPE STARTING</td>
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<td>MEDALLION</td>
<td>PO FOAM/TEXTILE</td>
<td>LAMINATES START</td>
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<td>HEADLINER</td>
<td>CORE</td>
<td>LF-RTP GROWTH</td>
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<td></td>
<td>TEXTILE/FOAM</td>
<td>GENERATION 2 PET NONWOVENS</td>
<td>PO FOAM START ?</td>
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<tr>
<td></td>
<td>NONWOVEN FACING</td>
<td>STARTING</td>
<td>EXTENSIVELY USED</td>
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<tr>
<td></td>
<td>PERIMETER SYSTEMS (JCI)</td>
<td>STARTING</td>
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<tr>
<td>INST.PANEL, DOOR TRIM</td>
<td>NEGATIVE THERMOFORM SKINS</td>
<td>RE ACCELERATE&gt;2006</td>
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<tr>
<td>INST. PANEL</td>
<td>SKINS</td>
<td>PVC SLUSH, PU SPRAY GROWTH, PU-RIM START</td>
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<tr>
<td></td>
<td>PP SUBSTRATE</td>
<td>ACCELERATE</td>
<td>WELL ESTABLISHED</td>
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<td></td>
<td>SIMULT. SHOT</td>
<td>START – ’05</td>
<td>ESTABLISHED</td>
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<tr>
<td></td>
<td>2 SHOT</td>
<td>START SOON? (SKIN/SUBSTRATE)</td>
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<tr>
<td>HEADLINER/DOOR TRIM</td>
<td>LT. WEIGHT SHEET EAs</td>
<td>MORE ADVANCED</td>
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## EUROPE/US DIFFERENCES/SIMILARITIES IN INTERIOR SOFT TRIM (CONT’D)

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<th>N. AMERICA</th>
<th>EUROPE</th>
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<tr>
<td>FLOOR</td>
<td>CARPET FACING</td>
<td>TUFTED</td>
<td>NONWOVENS (SOME TUFTING)</td>
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<tr>
<td></td>
<td>FLAT WOVENS STARTING</td>
<td>START</td>
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<tr>
<td></td>
<td>INK JET PRINTING OF CARPET</td>
<td>START</td>
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<td></td>
<td>PLASTIC WHEEL WELL</td>
<td>START</td>
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<td></td>
<td>TRUNK MODULE</td>
<td>STARTING</td>
<td>MORE ADVANCED</td>
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<tr>
<td></td>
<td>INJ MOLD/FILLED TPE</td>
<td>ESTABLISHED</td>
<td>START</td>
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<tr>
<td></td>
<td>ACOUSTIC</td>
<td>LT WT CONSTRUCTIONS</td>
<td>STARTING</td>
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<tr>
<td>SEATING</td>
<td>MICROFIBER SUEDE</td>
<td>SLOW CATCH UP</td>
<td>EARLIER START</td>
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<tr>
<td></td>
<td>EPP INSERTS</td>
<td>START</td>
<td></td>
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<tr>
<td></td>
<td>REAR SEAT BACK</td>
<td>EA INTEGRATION</td>
<td></td>
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<tr>
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<td>INK JET PRINTING</td>
<td>START</td>
<td></td>
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<tr>
<td>HEADRESTS, SUN VISORS</td>
<td>EPP FOAM</td>
<td></td>
<td>MAJOR SHARE</td>
</tr>
<tr>
<td>ELV LEGISLATION</td>
<td></td>
<td>NOT A FACTOR</td>
<td>IN PLACE</td>
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</table>
AUTO COMPOSITE FAMILIES

- NEW COMPOSITE CLASSES EMERGING:
  - NAT FIBERS (MAT AND REINFORCEMENT)
  - LGF-PPs
  - LT. WT. GLASS/PP
  - NEW TECHNOLOGY NONWOVENS

- INTENSIFIED COMPETITION (BETWEEN COMPOSITE CLASSES)

- COMPOSITES CHALLENGING CONVENTIONAL FABRICATION PROCESSES

- INTEGRATION OF EA & ACOUSTIC FUNCTIONS INTO MODULES (HEADLINER, FLOOR, DOOR)

- SELF REINFORCED (PP) STARTING ?
MINERAL REINFORCED THERMOPLASTICS/ROLE FOR NANOCOMPOSITES?

• AVOID DAMAGE TO COMPOSITE MORPHOLOGY
• LOWER DENSITY/CONCENTRATION BENEFITS
  – LOWER VOLUMETRIC COSTS
  – EASIER PROCESSABILITY
  – WIDER PROCESSING WINDOW
  – THIN-WALL MOLDING CAPABILITY
  – WEIGHT SAVINGS
• UNEXPECTED BENEFITS
  – SCRATCH/MAR RESISTANCE
  – LOWER CLTE
  – BETTER DIMENSIONAL CAPABILITY
• H.A.R. TALCs VS NANO MINERALS COMPETITION
NANO-CLAY/TPO PARTS (GM)

- BODY SIDE MOLDING
- STEP ASSIST
- EXTERIOR COMPONENTS
AUTOMOTIVE FOAM FAMILIES AND EXAMPLE APPLICATIONS

SOURCE: ROBERT ELLER ASSOCIATES, INC. SOFT TRIM MULTICLIENT STUDY, 2004
## TECHNOLOGY DRIVERS/ENABLERS FOR POLYOLEFIN AUTOMOTIVE FOAM SUBSTITUTION

<table>
<thead>
<tr>
<th>NEW FOAM TECHNOLOGY</th>
<th>PO FOAM CHALLENGER</th>
<th>INCUMBENT</th>
<th>SHAPE TYPE</th>
<th>EXAMPLE APPLICATION</th>
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<tbody>
<tr>
<td>WATER BLOWN TPE</td>
<td>TPV</td>
<td>EPDM SPONGE</td>
<td>PROFILE</td>
<td>BODY SEALS</td>
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<tr>
<td>RAD XLPO</td>
<td>XLPO</td>
<td>SKIVED PU</td>
<td>THIN SHEET</td>
<td>SKIN/FOAM LAMINATES</td>
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<tr>
<td>HMS PP</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>MICROCELL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXTRUDED THICK SHEET</td>
<td>STRANDFOAM® (DOW)</td>
<td>PU FOAMS</td>
<td>THICK SHEET</td>
<td>HEADLINER EAs</td>
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<tr>
<td>EXTRUDED SHEET</td>
<td>TROCELLEN</td>
<td>CORRUG. PE</td>
<td>TUBE</td>
<td>HVAC DUCTS</td>
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<tr>
<td>ACOUSTIC BEAD FOAM</td>
<td>JSPI</td>
<td>PU FOAMS</td>
<td>MOLDED (STEAM)</td>
<td>FLOOR SYSTEMS</td>
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<tr>
<td>IN-MOLD SKIN/FOAM LAMINATION</td>
<td>EPP</td>
<td>PU SKIVED, PAPER</td>
<td>MOLDED (STEAM)</td>
<td>SUN VISORS</td>
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<tr>
<td>MULTI DENSITY PART INTEGRATION</td>
<td>EPP BEAD FOAMS</td>
<td>PU FOAM, NFCs, LD-GMTs</td>
<td>MOLDED (STEAM)</td>
<td>DT PANELS, HEADLINER EAs</td>
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<tr>
<td>METALLO PO</td>
<td>SHEET FOAM</td>
<td>SKIVED PU</td>
<td>SHEET</td>
<td>GASKETS, SKIN/FOAM LAM.</td>
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<tr>
<td>TEXTILE/PO FOAM LAMINATES</td>
<td>XLPO</td>
<td>SKIVED PU</td>
<td>SHEET</td>
<td>DOOR TRIM MEDALLIIONS</td>
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AUTOMOTIVE INTERIOR FOAM APPLICATIONS

SOURCE: ROBERT ELLER ASSOCIATES, INC. SOFT TRIM MULTICLIENT STUDY, 2004
# EUROPE/NAFTA DIFFERENCES IN NONWOVEN USAGE

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>NONWOVEN STATUS</th>
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<tbody>
<tr>
<td>• HL FACE FABRIC</td>
<td>• HIGHLY PENETRATED-EUR</td>
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<tr>
<td>• FLOOR/SURFACE</td>
<td>• HIGHLY PENETRATED-EUR</td>
</tr>
<tr>
<td>• ACOU. PERF. PRESSURES</td>
<td>• SAME</td>
</tr>
<tr>
<td>• COST SAVE PRESSURES</td>
<td>• SAME?</td>
</tr>
<tr>
<td>• POLYOLEFIN PRESSURES</td>
<td>• HIGHER IN EUR;</td>
</tr>
<tr>
<td>• WEIGHT SAVE VALUE (EURO/KG SAVED)</td>
<td>FAVORS MONOMATLS</td>
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<tr>
<td></td>
<td>• HIGHER IN EUR</td>
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</tbody>
</table>

**SOURCE:** ROBERT ELLER ASSOCIATES, INC., 2005
NONWOVEN HEADLINER SHARES

SOURCE: FREUDENBERG VITECH
HEALDLINER BATTLES

• CORE CURRENTLY DOMINATED BY PU (WET/DRY)

• CORE ALTERNATIVES ENTERING:
  - PET BI-COMPONENT FIBER NONWOVENS
  - POLYOLEFIN FOAMS
  - LOW DENSITY GMTs
  - THERMOFORMED SHEET (IN N. AMERICA)

• REQUIREMENTS INCREASING
  - SIDE CURTAIN AIRBAGS, ACOUSTICS
  - ENERGY ABSORPTION COUNTERMEASURES

• PERIMETER SYSTEMS: GAME CHANGER

• NONWOVEN SURFACE TEXTILE GROWTH?

• NATURAL FIBERS ENTERING CORES

• ALL PET (SURFACE/FOAM/CORE) ENTERING
JCI CROSS SECTIONS FOR HEADLINER MATERIALS (CONT’D)

THERMOBOND
JCI CROSS SECTIONS FOR HEADLINER MATERIALS

ACOUSTICOR
EXAMPLE OF DASH MAT LAYER CONSTR.

HEAVY LAYER

ACOUSTIC BATTING

CARPET

SOURCE: COLLINS & AIKMAN
FLOOR/ACOUSTICS MODULE BATTLES

- STOWAGE, ACOUSTICS, WT SAVE AS DRIVERS
- LT WT NONWOVENS HAVE STARTED
- CHALLENGE TO HEAVY LAYER
- ROLE FOR MICRODENIER NWs (PRICE DROP?)
- ROLE FOR COMPOSITES IN SEMI STRUCTURAL APPLICATIONS
- FOAM VS FIBER COMPETITION
- EUROPE VS U.S. CARPET DIFFERENCES
- PLASTIC SPARE TIRE WELL
- GOING THROUGH THE FLOOR?
- FLAT WOVEN CARPETS STARTING?
- INK JET PATTERNS STARTING
- SEAT STOWAGE SYSTEMS → IMPROVED LOAD FLOOR DESIGN
PU FOAM TRUNK LINER

VEHICLE: MINI

SUPPLIER: RIETER

PHOTO: REA
2004 BMW X3 2.5i-NON HINGED SPARE TIRE COVER
2005 FORD FREESTYLE LTD SPARE TIRE COVER
Single Polymer Design

The 2005 Jeep Grand Cherokee Load Floor has been designed using a single polymer, polypropylene:

- Decorative Carpet
  - 100% PP

- Top Reinforcing Layer (GMT)
  - 60% PP, 40% Fiberglass

- Honeycomb Core
  - 100% PP

- Bottom Reinforcing Layer (GMT)
  - 60% PP, 40% Fiberglass

- Injection Molded Bin Structure
  - 100% PP (not shown)
JCI CRAFTTEC MULTI COLOR INJECTION
JCI CRAFTEC MULTICOLOR INJECTION
PAPER HONEYCOMB SPARE TIRE COVER

VEHICLE: AUDI A3                SUPPLIER: IDEAL
PHOTO: ROBERT ELLER ASSOCIATES, INC., 2005
GM SEQUEL CONCEPT CAR

NOTE: FLOATING INSTRUMENT PANEL, DRIVE/BRAKE BY WIRE, SKATEBOARD PLATFORM, FUEL CELL POWER
GM SEQUEL SKATEBOARD PLATFORM CONCEPT

PHOTO: ROBERT ELLER ASSOCIATES, INC., 2005
MAZDA CROSS SPORT

NOTE: FLAT WOVEN CARPET
PHOTO: ROBERT ELLER ASSOCIATES, INC., 2005
MAZDA CROSS SPORT

NOTE: FLAT WOVEN CARPET
PHOTO: ROBERT ELLER ASSOCIATES, INC., 2005
TYPICAL N. AMERICAN BLOW MOLDED LOAD FLOOR

VEHICLE: CHEVROLET EQUINOX
PHOTO: ROBERT ELLER ASSOCIATES, INC., 2005
GM SILVERADO NONCARPET FLOOR

PHOTO: ROBERT ELLER ASSOCIATES, INC., 2005
SUMMARY

• ECONOMIC PRESSURES:
  – CONSOLIDATING SUPPLY CHAIN
  – FORCING TECHNOLOGY CHANGE

• COMPOSITES:
  – BROADENED PROPERTY ENVELOPE
  – NEW PROCESSES
  – RAPID GROWTH SECTOR
  – NATURAL FIBERS ENTERING

• LD-GMTs:
  – ENTERING MORE COMPLEX, LARGER PARTS
  – ONBOARD ENERGY ABSORPTION AND ACOUSTICS
  – VALUE ADD OPTION
SUMMARY (CONT’D)

• POLYOLEFIN FOAMS:
  - DRIVING POLYOLEFIN USE
  - VALUE ADD OPPORTUNITY
  - ENTERING NEW MODULES (E.G. HEADLINER)
  - FOAM/FIBER COMPETITION

• VALUE ADD APPROACHES
  - LAYER CONSOLIDATION
  - SUPPLY CHAIN CONSOLIDATION
  - REDUCE OFF LINE OPERATIONS
  - MONO-MATERIALS CONSTRUCTIONS
  - ON BOARD FUNCTIONS
  - ACOUSTICS/ENERGY ABSORPTION AT MODULE CONCEPTION
SUMMARY(CONT’D)

• NEW NONWOVENS TECHNOLOGIES ENTERING:
  - MICRODENIER
  - NEW GENERATION BICO FIBERS
  - BETTER ESTHETICS
  - ACOUSTICS TO CHALLENGE FOAM AND HEAVY LAYER
    - WEIGHT SAVE POTENTIAL
• SHIFT TO POLYOLEFIN NONWOVENS?
• NEW NW SUPPLIERS ENTERING
• SUPPLY CHAIN SHIFTING
• INK JET PRINTING OFFERS NEW SURFACE EFFECTS