AUTO INTERIOR TPOs:
PROFITABLE POSITIONING IN A SHIFTING SUPPLY CHAIN

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PRESENTATION OUTLINE

- N. American auto marketplace/TPE effects
- Globalizing TPE marketplace
- Key TPE marketplace trends
- TPE industry structure shifts
- Expanding properties envelope
- New materials fabrication technologies
- Automotive supply chain implosion effects
- Talc effects
- Body/glazing seals
- The rubber attack
- Paths to profitability
N. AMERICAN AUTO MARKET SHIFTS

• Market shifts will affect TPE industry
• GM agreement:
  - Frees up capital for new model investment
  - Increases incentive for new technology invest.
• Dollar value decline (40% against euro)
• Increased investment in N. America by non-domestic supply chain
• Gain in foreign-produced vehicles
• Fleet composition shift (smaller B-Class & CUVs)
• The CAFE battle
• Vehicle sales stagnation/decline
• Low priced vehicles ($2,500-9,000) from Tata, others entering global fleet
% OF CARS SOLD IN THE U.S.,
MANUFACTURED OUTSIDE OF N. AMERICA

THROUGH AUG. 2007

SOURCE: MOODY'S ECONOMY.COM

b/mydox/papers/SPETPO07-foreignrebound.xls
GROWTH OF LOW COST VEHICLES IN THE GLOBAL FLEET

SALES, MM UNITS

2006  2010  2014

SOURCE: ROBERT BOSCH GmbH

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GLOBALIZING TPE MARKETPLACE

• China: fastest vehicle production growth region.

• The TPE marketplace is rapidly globalizing.

• Most major TPE compounders have established Asia (China) operations.

• Investment and technology flows are following the globalization pattern of the TPE compounding industry.

• A new class of Asian TPE compounders is emerging (eventually global competitors?).
GLOBAL INVESTMENT follows the TPE MKTS.

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2007

r/mydox/papers/SPETPO07-InvTechTPEppt07.vsd
lg/myfiles/visio/SPETPO07-InvTechTPEppt07.vsd
TPE FAMILIES . . .
CHANGING STRUCTURE, INCREASED INTRA-TPE COMPETITION

NOTE: (a) RECYCLATE-BASED TPV

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2007
A CHANGING TPE MARKETPLACE

- Auto stagnation in Europe and N. America
- SEBS compounds challenging o-TPVs
- Entry of new polyolefin candidates
- New transparent grades (SEBS and TPO)
- Renewed o-TPV and some SEBS attack on rubber
- Price erosion continues (commodity vs. specialty pricing)
- An imploding auto supply chain
- Use of single TPEs for multiple applications
- Resin capacity shift to monomer-rich regions
AUTOPLASTIC SUPPLY CHAIN IMPLOSION (N. AMERICA)

- PETROCHEM PRICE INCREASES
- GLOBAL COMPETITION
- OFFSHORE COMPETITION
- IMPORTED COMPETITORS
- RAW MATERIAL PRICE INCREASES
- VEHICLE PRICE DECREASES
- FUEL COSTS (PROD. LINE FIT)
- LEGACY COSTS, LABOR PRESSURES

RAW MATERIALS → COMPOUNDER → TIER 1 FABRICATOR → ASSEMBLY

- PRICE COMMODITIZATION
- MATERIALS TECHNOLOGY LAG
- TIER 2, 3 SUPPLIERS
- PROCESS TECHNOLOGY LAG
- LEGACY COSTS
- MARKET SHARE LOSS
- OVER CAPACITY
- STOCKHOLDER PRESSURES

ELIMINATE/REDUCE:
- MULTIPLE STEPS (2-SHOT MOLD, NEG.-FORM)
- EXCESSIVE LOGISTICS
- SCRAP GENERATION
- INEFFICIENT PROCESS TECHNOLOGIES
- SALES/MARKETING COSTS
- EXCESS LABOR COSTS
- OVER-GLOBALIZATION?

PRESSURES PASSED DOWN THE SUPPLY CHAIN:
- PRICING PRESSURES
- SUPPLY CHAIN "MANAGEMENT"
- DEMAND SLOWDOWN
- REVISED SPECIFICATIONS
- GLOBALIZATION PRESSURES

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2007
Strengthening of Japanese resin companies in N. America

Korean TPE suppliers challenging the incumbents? (Hyundai EP)

Renewed growth of European compounders in N. America

Resin suppliers riding a wave of new reactor technology (direct access to TPE markets)

Tier 1s shifting to o-TPE compounding in-house?

Enhanced role for masterbatch
EXPANDING/SHIFTING PROPERTIES ENVELOPE

• Inroads into SEBS markets by advanced olefin technologies
• Market share shift between TPEs
  - Reactor TPO
  - Improved metallo-plastomers
  - Dow's Infuse™ OBC
• POEs with high melt strength, broadened service temperature, low gloss
• POE/branched PPs
  - Compete with o-TPVs
  - Profiles/thermoforming
  - Enhanced foam properties
INTRA-TPE COMPETITION:
ROLE OF IMPROVED POLYOLEFIN TECHNOLOGY

• Broad range of new PO technologies becoming avail.
• SEBS and TPO compound ingredients
• POE displacement of EPDM in TPOs almost complete
• Will stimulate transparent TPO, elastic fibers, elastic films
• Versatile molecular architecture control
• Still young technologies with broad growth pot’l., e.g.,:
  - Nano morphology control (clear TPOs, e.g., from Mitsui)
  - Long-chain branching control
• Direct sale to fabricators or compounders?:
  - Dow
  - Mitsui Chemical
  - ExxonMobil
  - Sumitomo
  - Borealis
  - JPP
NEW MATERIALS/FABRICATION COMBINATIONS

- Small part, 2-shot molding started
- Shift to large part, 2-shot molding
  - Competition with thermoformed skins
  - Evolving to 3-layer (skin/foam/substrate)
  - Shifts the supply chain
- Co-fabrication (blow, inject, profile extrude)
- Increased role for polyolefin foams
  - 2-shot injection
  - Acoustics
  - Semi-structural applications
  - Role in all-PO constructions
NEW TPE FABRICATION TECHNOLOGY:
LARGE-PART, 2-SHOT MOLDING CHALLENGES SKINS

CURRENT PROCESS

COMPoudING
MAKE SKIN
TRIM SKIN
TRIMMED SKIN
SCRAP

DOOR TRIM OR INSTRUMENT PANEL
ASSEMBLY

- LABOR INTENSIVE
- HIGH SCRAP
- MULTI STEP
- MULTI MATERIAL
- NON-RECYCLABLE
- DIFFICULT CRAFTSMANSHIP

2-SHOT

TPE COMPOUND
(CAN BE FOAMABLE)

SUBSTRATE RESIN
SHOT 1
SHOT 2
3-LAYER DOOR TRIM OR INSTRUMENT PANEL
ASSEMBLY

- LOW LABOR
- LOW SCRAP
- SINGLE STEP
- 1-2 CLOSELY RELATED MATERIAL FAMILIES
- EASILY RECYCLED
- HIGH CRAFTSMANSHIP

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2007
Product: Fan shroud
Manufacturer: Sur-Flo
Material Type: TPV (Nexprene)
TPE Supplier: Solvay Engineering Polymers
Note: Used in Dodge Ram HD pickup
2-Shot Molded Door Medallion

Vehicle: Dodge Caliber (‘07)
Molder: Lear
Material: Thermoplastic Elastomer On PP
LARGE-PART, 2-SHOT, SOFT TOUCH DEVELOPMENT

Part: Instrument Panel Upper
Skin Compound: COPE (Foamed Pibiflex from P Group)
Substrate: PBT/ASA (Ultradur™ S4090IGX from BASF)
Injection Machine: Engel
Foam Technology: Trexel
SOURCE: ROBERT ELLER ASSOCIATES LLC
LARGE-PART, 2-SHOT, SOFT TOUCH: TRUCK IP UPPER

Part: Truck IP Upper
Status: Prototype
Skin Compound: COPE (foamed Pibiflex from P Group)
Substrate: PBT/ASA (Ultradur\textsuperscript{R} S4090IGX from BASF)
Molding machine: Engel Duo Series (for Dolphin process)
Tier 1: IAC
SOURCES: POLYMOTIVE; ROBERT ELLER ASSOCIATES LLC
Door Panel Filler: improved acoustics & water barrier
Photo: Alveo
2-color door trim skin on single natural fiber panel substrate
Vehicle: BMW 5 Series
Tier 1: Johnson Controls
Photo: BMW
TALC EFFECTS

• New micro-talcs broaden the properties envelope

• Exterior and interior applications

• For exterior applications:
  - Europe ahead (front-end modules, hatchback)
  - Could accelerate exterior panel penetration

• Role for masterbatch?
BMW X5 Front-end Module

**Compound:** 30% talc-filled TPO  
**Molder:** Plastic Omnium  
**Filler Type:** Jetfine® 3CA (Rio Tinto Minerals)  
**Key Features:** Class A finish, zero gap, low temp. (-40°C) impact, weight save, high scratch resistance, meets European pedestrian safety requirements  
**SOURCES:** PLASTIC OMNIUM; ROBERT ELLER ASSOCIATES LLC, 2007
BODY/GLAZING SEALS

- Rapid growth
- High volume potential
- In-house compounding vs. merchant supply
- Evolution to in-line compounding?
- Systems will be key to TPE penetration
- Will be o-TPV vs. SEBS battleground
- 2-shot molding opportunity
Vehicle: 2007 DCX Dodge Ram
Supplier: JYCO (compound, profile, design)
Material: o-TPV
  - Little guy scoops the big guys
  - First o-TPV dynamic body seal

SOURCE: JYCO
<table>
<thead>
<tr>
<th>APPLICATION</th>
<th>STATUS</th>
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<tr>
<td>BODY/GLAZING SEALS</td>
<td>- STARTED</td>
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<td>- WILL ACCELERATE</td>
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<td>- FOAMING REQUIRED?</td>
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<td>HOSE</td>
<td>- NO SIGNIFICANT PENET. YET</td>
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<td>- REQUIRES PARADIGM SHIFT</td>
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<td>TUBING</td>
<td>- o-TPV STARTING</td>
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<td>- TPU, SSBS WELL ADVANCED</td>
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<td>BELTS</td>
<td>- UNLIKELY PENET. IN AUTO</td>
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<td>- MAJOR o-TPV, TPU TARGET</td>
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<td>BOOTS/ BELLOWS/ DUCTING</td>
<td>- SUBSTANTIAL PENETRATION.</td>
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<td>- SHIFT TO HIGHER PERF. TPEs?</td>
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<tr>
<td>GROMMETS, BUMPERS, GASKETS</td>
<td>- MODERATE PENETRATION</td>
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SOURCE: ROBERT ELLER ASSOCIATES LLC, 2007
Crank Case Ventilation Hose

**TPE Grade Name:** DuPont™ E-TPV

**Material Type:** s-TPV

**Process:** Co-extrusion

**Status:** Concept

**Key Features:** Blow-by gas resist.
AUTO DEMAND/ OPPORTUNITIES

- 65MM UNITS/ 3%/YR. GROWTH
- 40-50% OF TPE DEMAND
- OEM RESTRUCTURING*
- CAFE LEGISLATION
- AGGRESSIVE COST SAVE SEARCH*
- FLEET COMPOSITION SHIFT*
- SUPPLY CHAIN IMPLOSION*
- CHINA/ASIA VEHICLE SHARE GAIN
- SUPPLIER REDUCTION*

NOTE: * = STRONGEST IMPACT IN N. AMERICA

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2007
SUMMARY

• Fleet changes will impact N. American auto TPE industry structure

• 2-shot molding:
  - Shift from small to large parts
  - Will become major TPE process
  - Shifts supply chain positions
  - SEBS, o-TPV, and TPO will compete

• The auto TPE supply chain is reconfigured

• Technology convergence (Europe/U.S./Asia?)

• TPEs positioned for renewed attack on rubber
SUMMARY (Cont'd.)

- Intensified intra-TPE competition
- Enhanced PO technology is shifting TPE competitive positions
- Enhanced role for talc
- Paths to profits:
  - Systems cost savings
  - Eliminating supply chain steps
  - Scrap reduction
  - Labor saving technology
  - Combine functions
  - Combine processes
  - Win **global** platform business