Robert Eller Associates LLC

CONSULTANTS TO THE PLASTICS AND RUBBER INDUSTRIES

DEMAND SHIFTS & NEW TECHNOLOGY IMPACTS ON TPE MARKETS & INDUSTRY STRUCTURE IN EUROPE AND N. AMERICA

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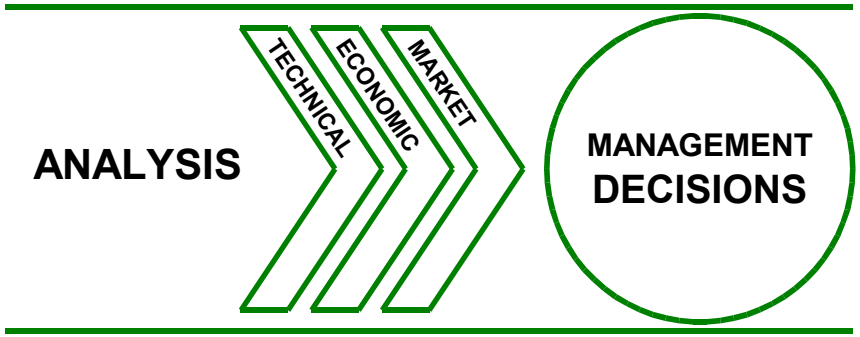
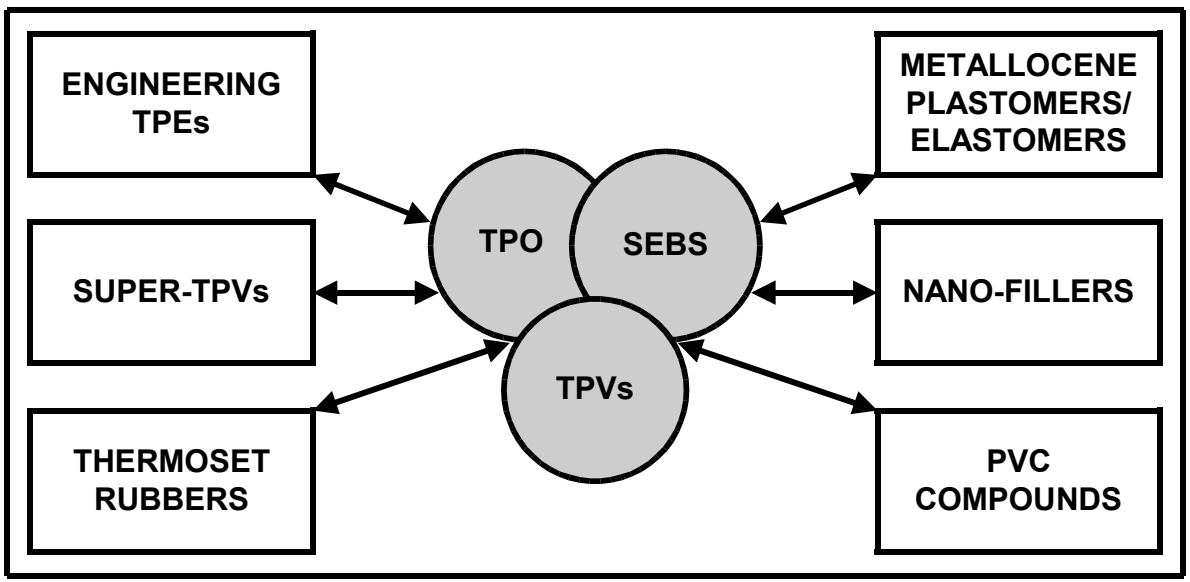
PRESENTATION OUTLINE

- Global market dynamics/growth
- Industry structure shift
- Intra-TPE competition
- Profitability effects
- Development targets
- Materials/fabrication technologies
- Automotive market
- Critical success factors



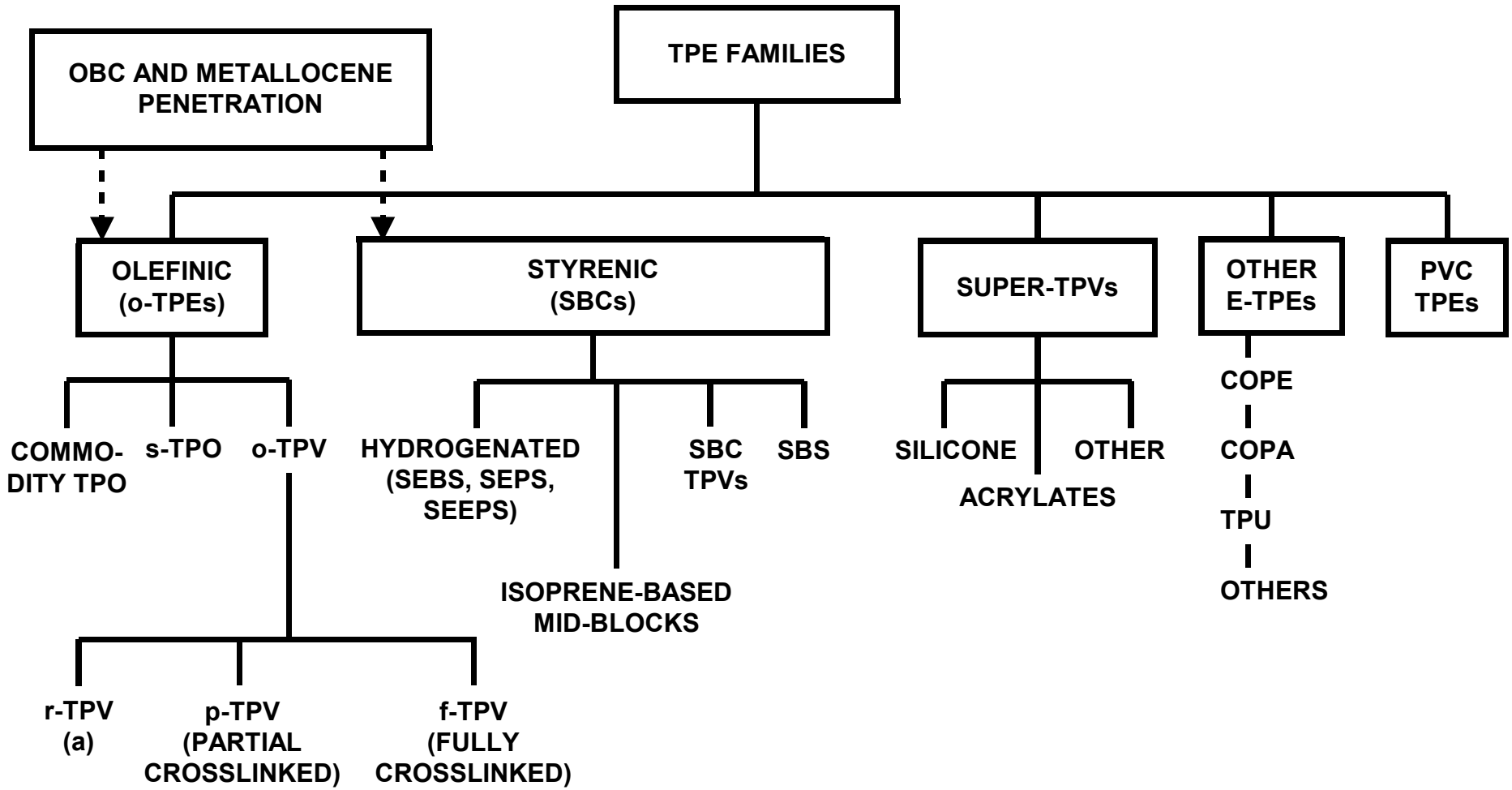
Specialty Thermoplastic Elastomers . . . Markets, Economics, Technology, Intermaterials Competition



A Europe/U.S./Japan Multiclient Industry Analysis

January 2006

TPE FAMILIES . . . CHANGING STRUCTURE, INCREASED INTRA-TPE COMPETITION



NOTE: (a) RECYCLATE-BASED TPV

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2007

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TPE GLOBAL MARKET DYNAMICS

- **Big Picture:**
  - **End product regional shift**
  - **Renewed thermoset rubbers attack (hose, tube, belting - role for SEBS? vs. o-TPV, TPU)**
  - **N. American rubber prices at all-time high**
- **Key Demand Drivers:**
  - **End market shift from N. A./Europe to Asia**
  - **New olefin and SBC resin technologies**
  - **Broadened performance envelope (both o-TPE, SBC)**
  - **Continued US$ weakness/economic slowdown**

TPE GLOBAL MARKET DYNAMICS (Cont'd.)

- **Industry Structure Change:**
  - **Private equity spin-offs? (industry player entry)**
  - **Compounder acquisitions/consolidation/JVs**
  - **TPE product line diversification by compounders**
  - **Offshore compounder (Europe/Japan/Korea) investment in N. America**
  - **Japanese largest investment share (especially olefinics)**

TPE GLOBAL MARKET DYNAMICS (Cont'd.)

- **Path-to-Market Shift?:**
  - **Back integration by fabricators to compounding**
  - **Potential role for masterbatch (start o-TPV, role in SEBS?)**
  - **Forward integration to compounding by SBC resin suppliers (TSRC, Kuraray [recent expansion to 5 kT])**

GLOBAL TPE MARKET GROWTH

- **Compounder future demand estimates usually high -- Europeans generally estimate 8-10% per year for SEBS compound market growth**

- **REA growth rate estimates for SEBS compounds (macro-economic uncertainties):**

  - Europe: 6-7%

  - U.S.: 6-7%

  - Asia: 10-12%

GLOBAL TPE MARKET GROWTH (Cont'd.)

- **Growth rate uncertainties:**

  - Inroads into SEBS markets by advanced olefin technologies

  - Impact of:

    -- New metallocene-catalyzed SEBS technology on cost?
    -- New SBC-TPV technology, cost, and competitive position
    -- SBS/SEBS blends (especially in China)
    -- Maturing soft touch, 2-shot, small-part markets

GLOBAL TPE MARKET GROWTH (Cont'd.)

- **Macro-economic factors:**
  - **Credit crunch impact (housing, auto markets, recreational markets)**
  - **U.S. economic uncertainty (de-industrialization, stagnant middle class income)**
  - **Global growth prospects (3 billion new consumers in Asia)**

TPE INDUSTRY STRUCTURE SHIFTS

- **Technology convergence -- (Europe/U.S./Asia?)**
- **Share shift in U.S. end use markets -- Europeans, Japanese, Koreans entering U.S.**
- **Japanese o-TPE compounders -- major share gain in N. America**
- **Private equity group entrance/exit affected by credit crunch?**
- **Reactor TPO/metallo-plastomers/OBCs -- could cause market share shift between TPEs**

TPE INDUSTRY STRUCTURE SHIFTS (Cont'd.)

- Compounder product lines -- broadening to include several TPEs, increased alloy usage
- SBC-TPV -- could shift competitive positions (styrenic vs. o-TPV)
- In-house compounding by fabricators -- will change industry structure and path to market (starting in o-TPEs)
- PVC/rubber substitution -- accelerating, driven by WEEE and RoHS in Europe

INTRA-TPE COMPETITION: PVC REPLACEMENT

- **Europe Role: WEEE, RoHS requirements will result in market shift to TPEs (SEBS primary beneficiary)**
- **Target Markets: wire/cable*, electrical*, auto, medical (tubing, stoppers, film)**
- **Auto: skins, glazing seals, wire jacketing***
- **Recyclability: All PP compatible structures will continue to be the goal.**

Note:

*** = flexible Noryl (Sabic Innovative Plastics) is a contender**

TPE/RUBBER SUBSTITUTION STATUS

BODY/GLAZING SEALS	- STARTED - WILL ACCELERATE - FOAMING REQUIRED?
HOSE	- NO SIGNIFICANT PENET. YET - REQUIRES PARADIGM SHIFT
TUBING	- o-TPV STARTING - TPU, SEBS WELL ADVANCED
BELTS	- UNLIKELY PENET. IN AUTO - MAJOR o-TPV, TPU TARGET
BOOTS/ BELLOWS/ DUCTING	- SUBSTANTIAL PENETRATION. - SHIFT TO HIGHER PERF. TPEs?
GROMMETS, BUMPERS, GASKETS	- MODERATE PENETRATION

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2007

o-TPV PROFITABILITY DRIVERS

HIGH

PROFITABILITY

LOW

- IMPROVED PROPERTIES: -- FOAMING -- ADHESION -- COLOR CONTROL - PREVIOUS MKTG. MOMENTUM - CHINA MARKET PENETRATION (FOR EARLY ENTRANTS) - BRAND IMAGE - SYSTEMS COST SAVE	RUBBER PENETRATION - HOSE - BELTING - TUBING - SYSTEMS COST SAVE - AUTO PARTS STANDARDIZATION
- AUTOMOTIVE DEPENDENCE - TECHNOLOGY PROLIFERATION - INCREASED COMPETITION - PRICE PRESSURES - CASCADE TO LOWER PRICED TPEs	- CHINA MARKET PENET. - DIRECT COMPOUNDING OF o-TPVs??? - COMPETITION FROM IMPROVED SBCs

SHORT TERM ——— TIMING ———→ LONG TERM

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2007

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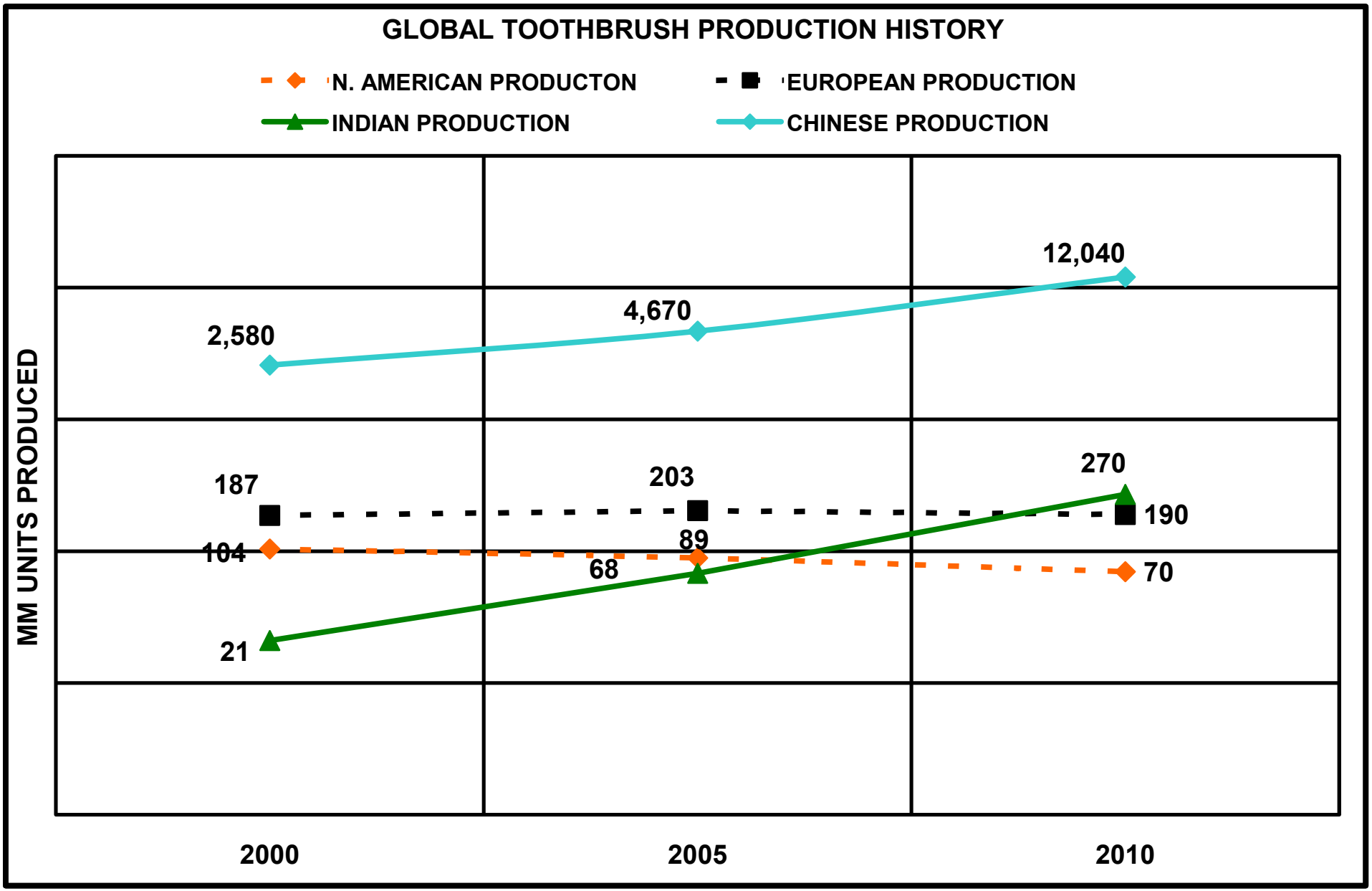
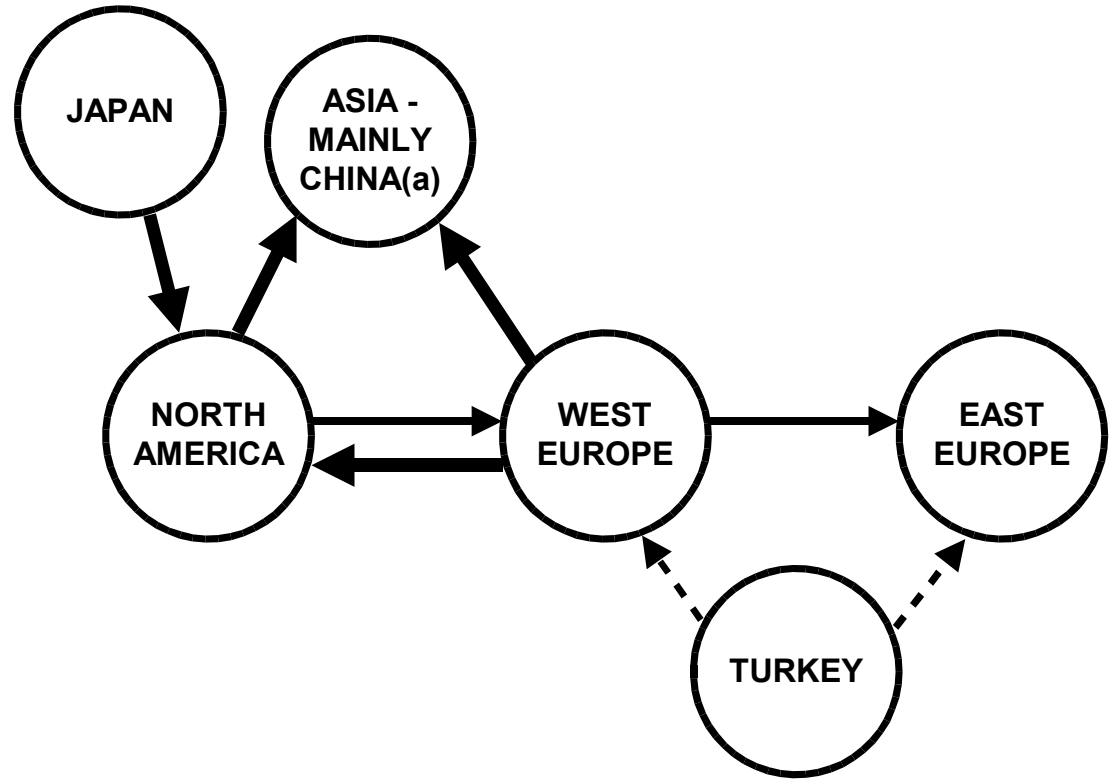
TOOTHBRUSH MANUFACTURING SHIFT



SOURCE: ROBERT ELLER ASSOCIATES LLC, CHINA TPE MULTICLIENT STUDY, 2006

MAJOR FLOWS OF INVESTMENT, TECHNOLOGY, AND TPE COMPOUNDS



STRONG FLOW OF CAPITAL INVESTMENT AND TECHNOLOGY

WEAK FLOW OF CAPITAL INVESTMENT AND TECHNOLOGY

FLOW OF TPE COMPOUNDS

NOTE: (a) INDIA IS STARTING

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2007

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TPE DEVELOPMENT TARGETS

- Hose assembly
- Belting
- Coated fabric (recent penet. gains by TPU)
- Body/glazing seals (auto and bldg./constr.)
- Masterbatches
- TPOs in exterior auto panels (micro-talc is technology enabler)
- Multi-purpose TPOs in auto interiors
- Foaming (still in early development stage)
- Elastic fibers
- Elastic films
- Conductives
- Medical markets

MARKET DYNAMICS AND TRENDS: MATERIALS TECHNOLOGIES

- **s-TPVs (super-TPVs): small current volumes**
  - **Acrylic, nitrile, and silicone based**
  - **Auto under-hood is main target**
  - **High price limits application potential**
- **r-TPOs: broadening property range, new competitors**
- **Blurring the styrenic/olefinic TPE interface**
- **Plastomer/HMS PP: poor man's crosslinking**
- **Broader alloy range**

MARKET DYNAMICS AND TRENDS: MATERIALS TECHNOLOGIES (Cont'd.)

- Olefin block copolymer: recent introduction by Dow shifts competitive interface
- Transparent TPOs: Mitsui Chem (nano-morphology control)
- Enhanced masterbatch role
- Recyclate-based TPEs (mining the waste stream?)

TPE MARKET DYNAMICS AND TRENDS: FABRICATION TECHNOLOGIES

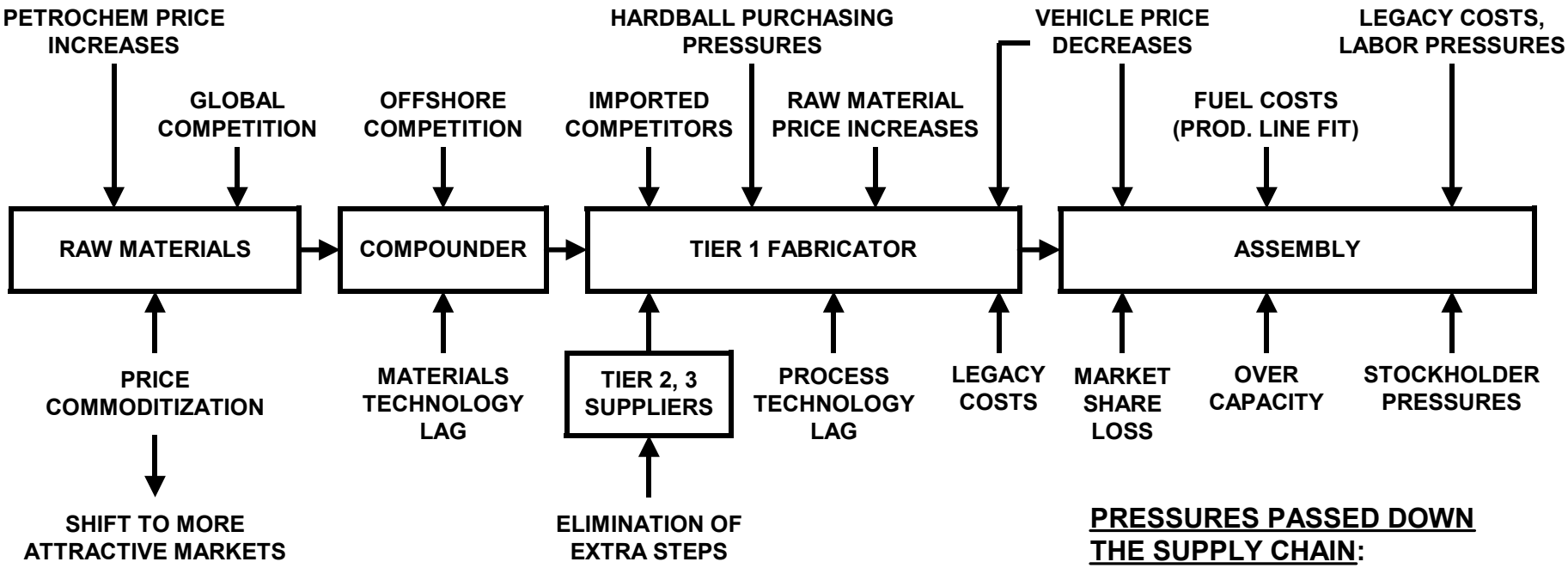
- Large part, 2-shot molding
- Co-ex*; co-blow*; co-inject*
- In-line compounding?
- Enhanced foaming technologies
- Negative forming/in-mold graining
- Profile extrusion*
- Body/glazing seal TPE substitution*
- In-mold decoration
- Injection molding advances (low gloss/fewer flow lines/ fine grain)
- Sheet thermoforming (major TPO growth pot'l.)

* = rubber challenge technologies

MARKETS/APPLICATIONS: AUTOMOTIVE

- **Size: largest TPE market, technology driver**
- **Intra-TPE competition: will intensify**
- **SBC position: lags o-TPV, ability to penetrate large rubber replacement markets?**
- **Automotive TPE growth drivers/dynamics:**
  - **Rubber replacement**
  - **New fabrication technology (large-part, 2-shot molding, systems, co-processing, advanced co-injection)**
  - **Fabricator back integration**
  - **Compounder forward integration?**
  - **European (primarily German?)/Japanese design influence in U.S. fleet**

AUTOPLASTIC SUPPLY CHAIN IMPLOSION (N. AMERICA)



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

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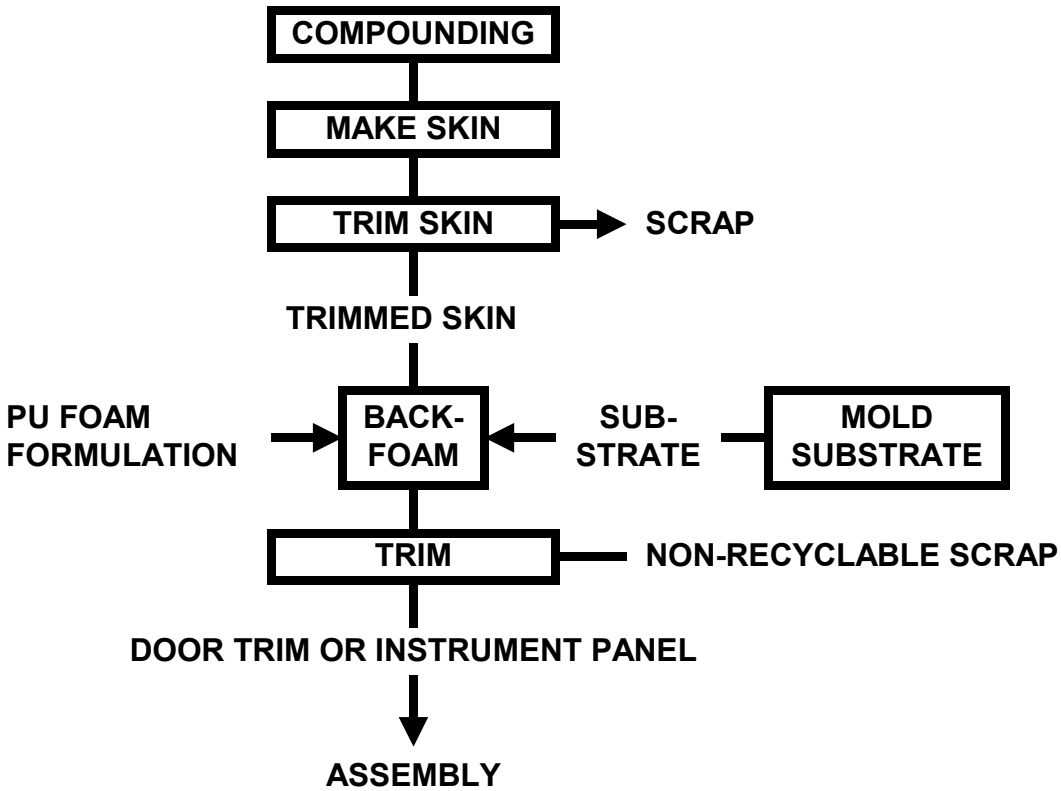
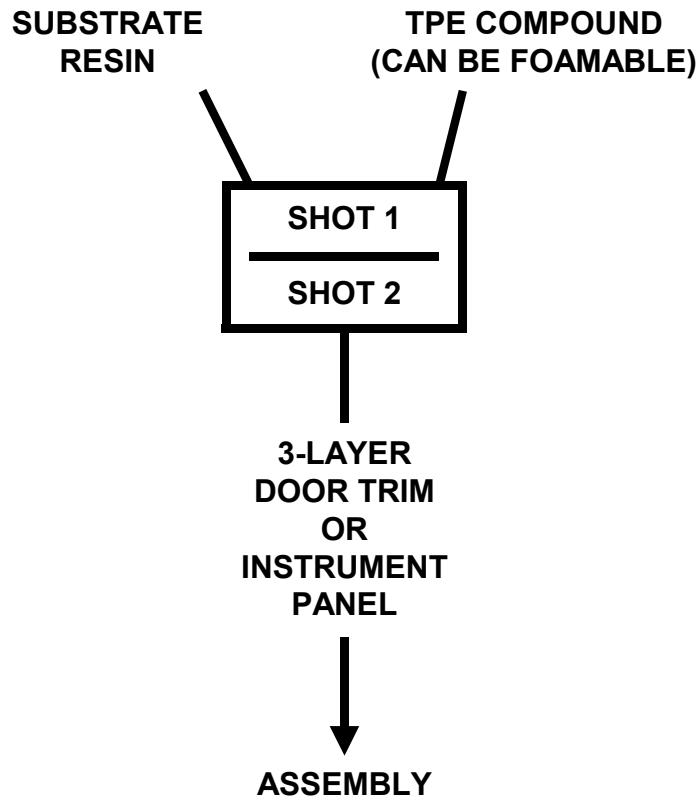
NEW TPE FABRICATION TECHNOLOGY: LARGE-PART, 2-SHOT MOLDING

CURRENT PROCESS



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

2-SHOT



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

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2007

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Product: Seamless passenger airbag lid
Vehicle: Honda Civic 2006
Material Type: Mitsubishi Chemical AP15 TPO
Process: Injection molding directly into soft thermoformed TPO skin, no paint, all plastic
Fabricator: Visteon

2-Shot Molded Door Medallion

Vehicle: Dodge Caliber ('07)
Molder: Lear
Material: Thermoplastic Elastomer On PP

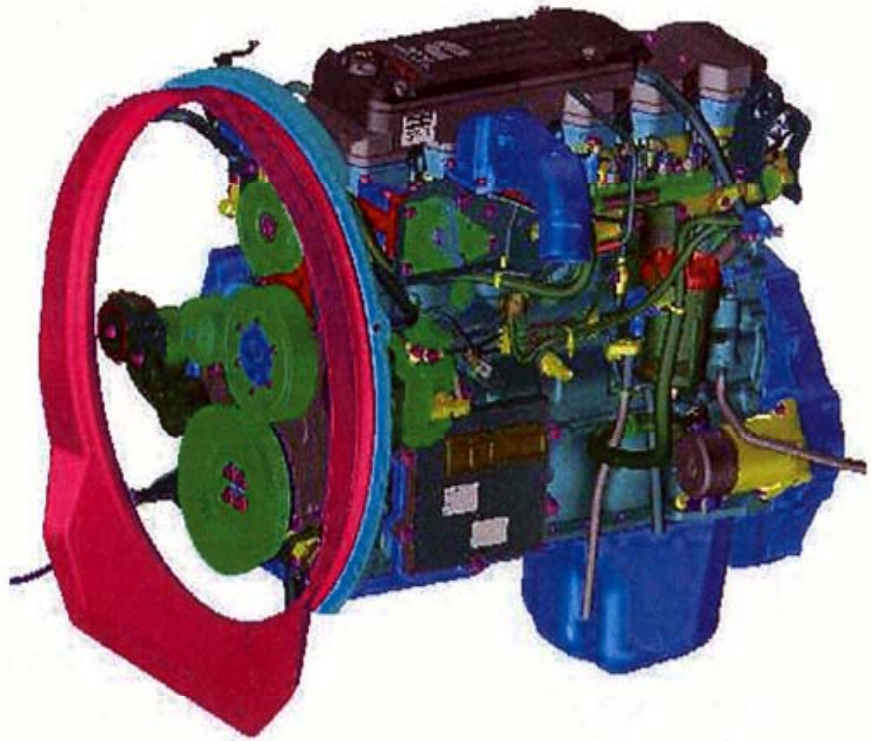
E.G., LARGE-PART, 2-SHOT, SOFT TOUCH DEVELOPMENT

Part: Instrument Panel Upper
Skin Compound: COPE (Foamed Pibiflex from P Group)
Substrate: PBT/ASA (Ultradur^{R} S4090IGX from BASF)
Injection Machine: Engel
Foam Technology: Trexel

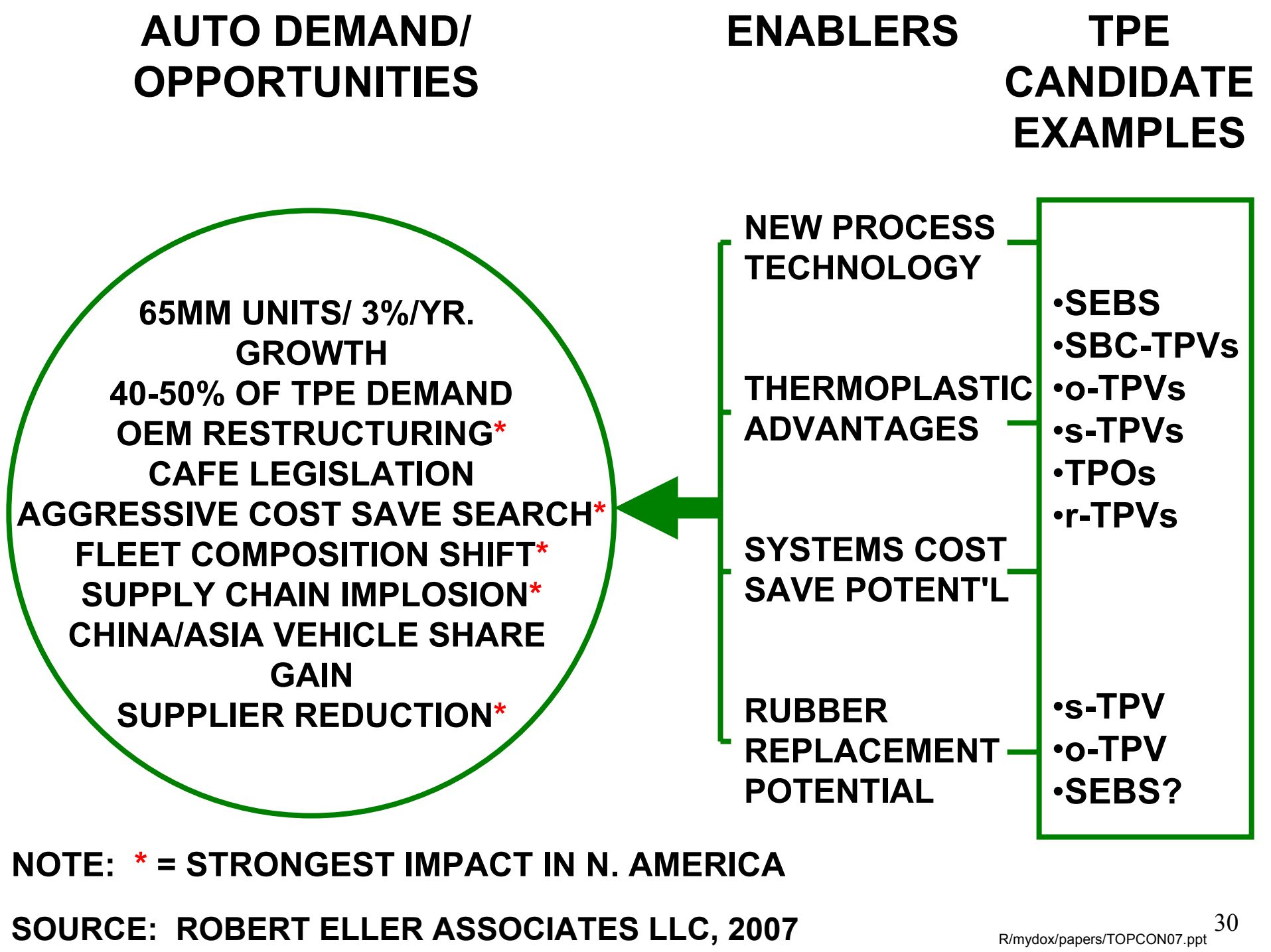
SOURCES: ROBERT ELLER ASSOCIATES LLC

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^{R} S4090IGX from BASF)
Molding machine: Engel Duo Series(for Dolphin process)
Tier 1: IAC
SOURCES: *POLYMOTIVE*; ROBERT ELLER ASSOCIATES



Product: Fan shroud
Manufacturer: Sur-Flo
Material Type: TPV (Nexprene)
TPE Supplier: Solvay Engineering Polymers
Note: Used in Dodge Ram HD pickup



NOTE: * = STRONGEST IMPACT IN N. AMERICA

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2007

Crank Case Ventilation Hose

TPE Grade Name: DuPontTM ETPV

Material Type: s-TPV **Status: Concept**

Process: Co-extrusion **Key Features: Blow-by gas resist.**

BODY/GLAZING SEALS: EPDM SUBSTITUTION ACCELERATES

- 2007 DCX Dodge Ram
- Supplier: JYCO (compound, profile, design)
- Little guy scoops the big guys
- Material: o-TPV
- First o-TPV dynamic body seal

SOURCE: JYCO

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. (-40ºC) impact, Weight save, High scratch resistance, Meets European pedestrian safety requirements

SOURCES: PLASTIC OMNIUM; ROBERT ELLER ASSOCIATES LLC, 2007

SUCCESS FACTORS FOR TPE COMPOUNDERS

- **Global supply capability**
- **China/Asia presence**
- **Product line diversification (multiple TPE types)**
- **Rubber replacement market target (seals, belting?, tube)**
- **Short production run capability**

SUCCESS FACTORS FOR TPE COMPOUNDERS

- **Rapid response time**
- **Anti-price commoditization strategies**
  - **Systems development capabilities**
  - **IP protection**
  - **Branding**
  - **Balance of custom vs. proprietary off-the-shelf compounds**
  - **Shift to higher value markets**
- **Response to in-house compounding by fabricators**

SUMMARY/FUTURE VIEW

- High growth Asian market influences
- N. America and Europe demand slowing (recession effects?)
- Intensified SEBS vs. o-TPV and TPO competition
- Accelerating rubber and PVC replacement
- Continued industry structure and path-to-market shifts
- Independent compounders challenged by resin suppliers

SUMMARY/FUTURE VIEW (Cont'd.)

- Western compounders shift to higher value markets
- Enhanced role for fabrication/materials technologies
- TPE profitability effects:
  - Price commoditization for undifferentiated TPE compounds
  - Customer consolidation/global sourcing
  - Search for system cost savings
  - Raw material price impacts