



Robert Eller Associates, Inc.

CONSULTANTS TO THE PLASTICS AND RUBBER INDUSTRIES

AUTOMOTIVE ENERGY MANAGEMENT ABOVE THE BELT LINE

PRESENTED BY:

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PREPARED FOR:

**PLASTICS IN AUTOMOTIVE
INTERIORS, III
PRAGUE, CZECH REPUBLIC**

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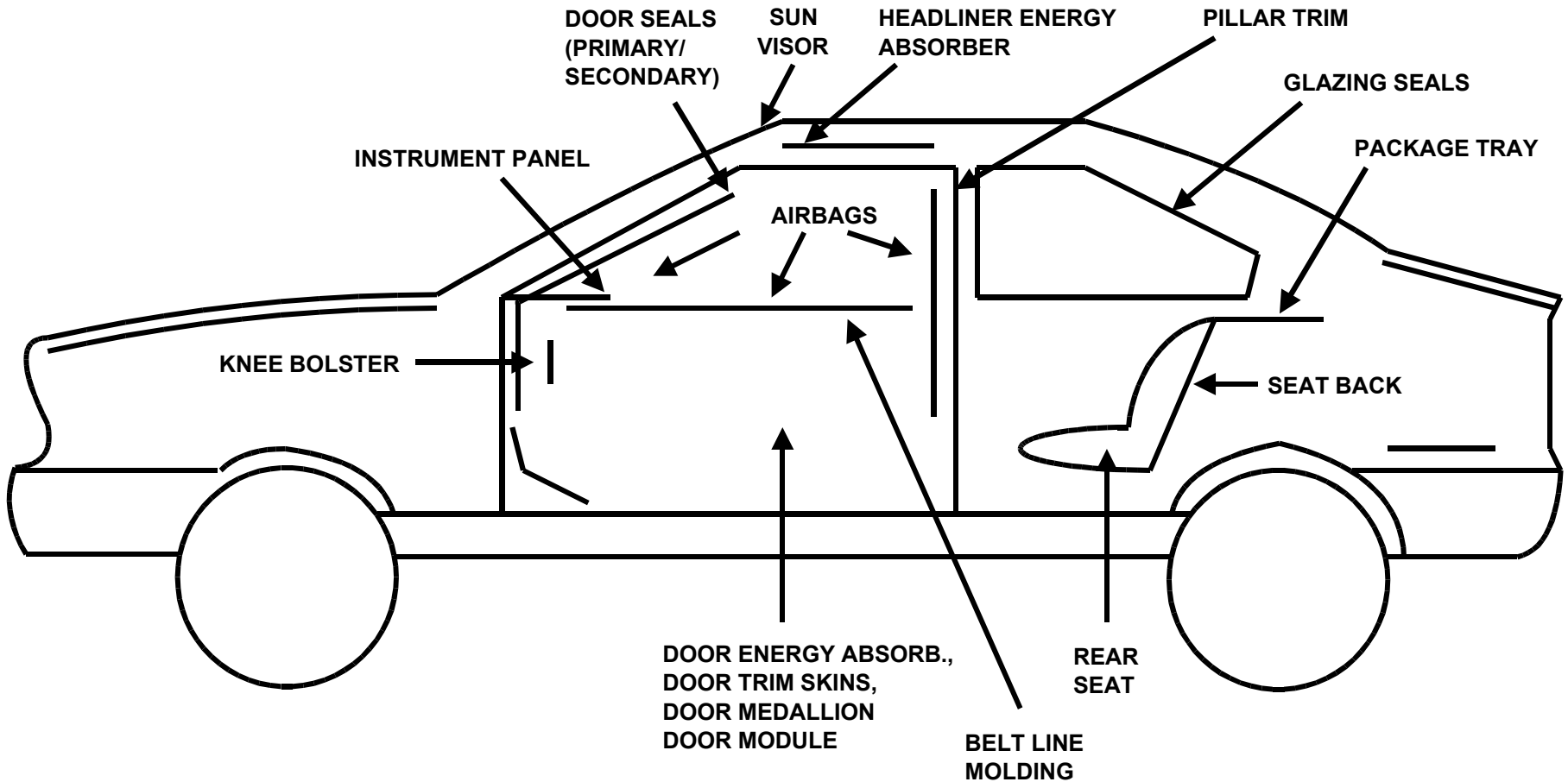
PRESENTATION HIGHLIGHTS

- **OPERATING HYPOTHESES**
- **DRIVING FORCES FOR MATERIAL/PROCESS SUBSTITUTION**
- **DRIVING FORCES FOR FOAM SUBSTITUTION**
- **HEAD IMPACT AND ENERGY MANAGEMENT REQUIREMENTS DRIVE TECHNOLOGY CHANGE AND COMPETITION**
- **AIRBAG DOOR IMPLICATIONS**
- **EUROPE/NAFTA DIFFERENCES**

OPERATING HYPOTHESES

- **ABOVE BELT LINE ENERGY MANAGEMENT REQUIREMENTS INCREASING**
- **ALTERNATIVE APPROACHES COMPLEMENT AND COMPETE**
- **REQUIREMENTS CREATING NEW MARKETS FOR PLASTICS**
- **CUSTOMERS WILLING TO PAY FOR SAFETY**
- **ON-BOARD ENERGY MANAGEMENT CAN SAVE COSTS**

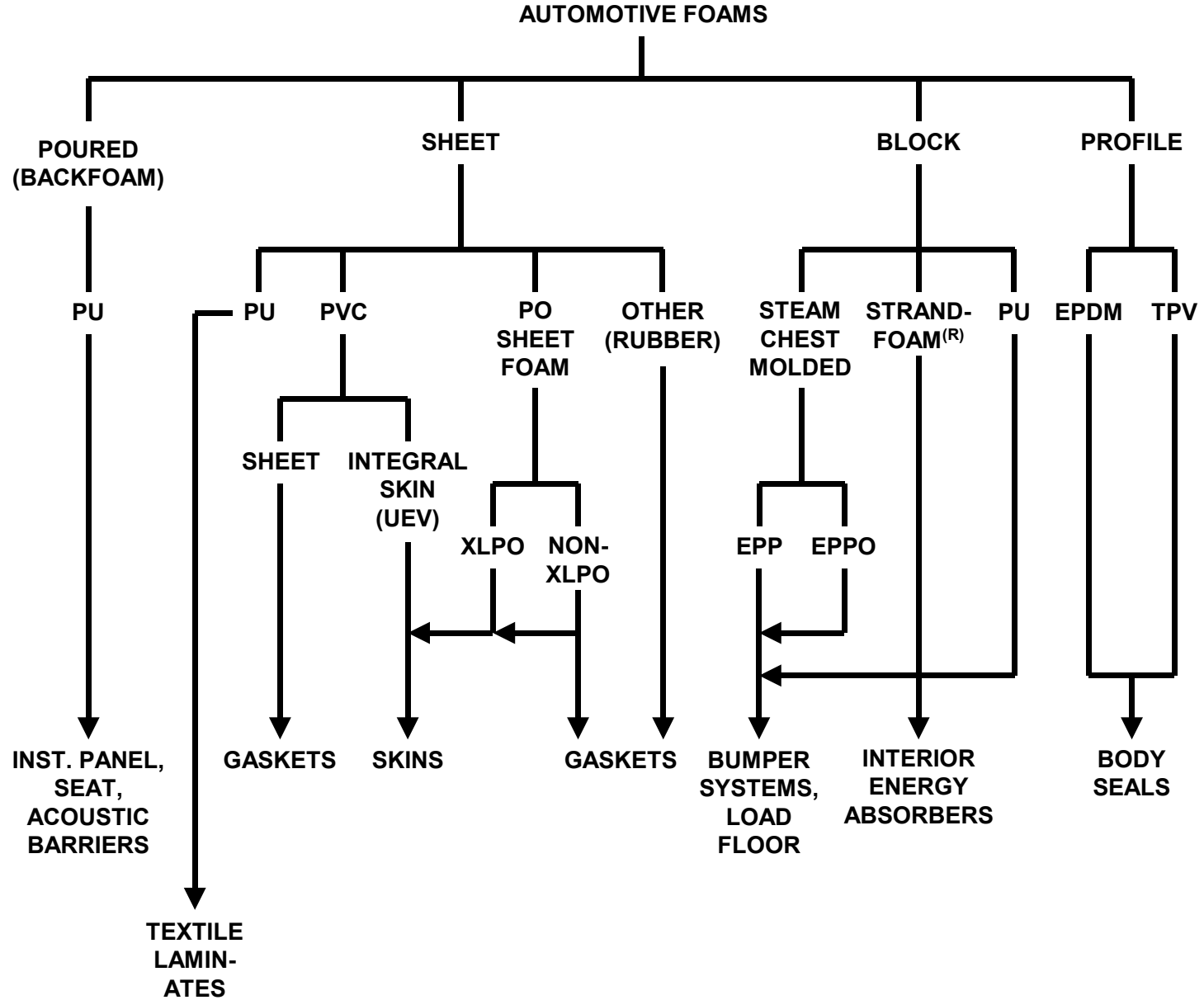
AUTOMOTIVE ABOVE THE BELTLINE ENERGY MANAGEMENT APPLICATIONS



APPROACHES TO ENERGY MANAGEMENT

- **SIDE IMPACT BEAMS**
- **AIRBAGS**
- **ENERGY MANAGEMENT RESINS**
- **SHAPED CONFIGURATIONS**
- **FOAMS (SEVERAL TYPES) MANY POTENTIAL APPLICATIONS**
- **COMPOSITE CONSTRUCTIONS**
- **INCREASED BODY STRUCTURE STIFFNESS**

AUTOMOTIVE FOAM FAMILIES /EXAMPLE APPLICATIONS



SOURCE: ROBERT ELLER ASSOCIATES, INC. SOFT TRIM MULTICLIENT STUDY

CURRENT AUTO FOAM APPLICATIONS

- **PU_s CURRENTLY DOMINATE**
- **PO FOAMS USAGE WILL GROW ALONG WITH INTER-FOAM COMPETITION IN APPLICATIONS SUCH AS:**
 - **ENERGY ABSORPTION**
 - **SOME ACOUSTIC APPLICATIONS**
 - **SEMI-STRUCTURAL APPLICATION**
 - **BODY AND GLAZING SEALS**
 - **TEXTILE LAMINATES**
 - **SEATING**

AUTOMOTIVE FOAMS ABOVE THE BELT LINE

FOAM SHAPE	FOAM CANDIDATES	EXAMPLE APPLICATIONS
MOLDED	<ul style="list-style-type: none"> -BEAD FOAMS (PRIMARILY EPP, SOME EPP/PS) 	<ul style="list-style-type: none"> -SUN VISORS -ENERGY ABSORBERS -SEMI STRUCTURAL APPLICATIONS -SEATING, HEADRESTS (a)
	<ul style="list-style-type: none"> -PU FOAMS 	
SHEET	<ul style="list-style-type: none"> -SKIVED PU (INCUMBENT) -INTEGRAL SKIN/FOAM PVC -EXTRUDED PO (XLINK, NON-XLINK) 	<ul style="list-style-type: none"> -INSTRUMENT PANEL SKINS -DOOR TRIM PANEL SKINS -TEXTILE & SKIN/FOAM LAMINATES
THICK SHEET	<ul style="list-style-type: none"> NO CURRENT CANDIDATE 	<ul style="list-style-type: none"> -ENERGY ABSORBERS (DOOR TRIM, HEADLINER)
PROFILES	<ul style="list-style-type: none"> -TPV, SBC-TPV 	<ul style="list-style-type: none"> -BODY/GLAZING SEALS

NOTE: (a) EPP BEAD FOAMS STARTING

INTERMATERIALS COMPETITION ABOVE THE BELT LINE

PART	INCUMBENTS	GROWTH CANDIDATES	NOTE
SUN VISOR	<ul style="list-style-type: none"> -CARDBOARD -SKIVED PU* -INJ MOLDED* 	EPP GROWTH	<ul style="list-style-type: none"> -EPP ESTABLISHED IN EUROPE AND JAPAN -STARTING IN N. AMERICA
AIR DUCTING	EXTRUSION BLOW	EXTRUDED FOAM	STARTING IN EUROPE
HEADLINER SUBSTRATES	<ul style="list-style-type: none"> -FIBER BASED* -PU FOAMS* 	<ul style="list-style-type: none"> BICOMPONENT NONWOVENS -EXTRUDED PO FOAMS 	RAPID CHANGE MODULE

INTERMATERIALS COMPETITION ABOVE THE BELT LINE (CONT'D.)

PART	INCUMBENTS	GROWTH CANDIDATE	NOTE
HEADLINER ENERGY ABSORBERS	-PU FOAMS -HONEYCOMBS	EPP FOAMS	-FOR ENERGY ABSORBER LATERALS -HEADLINER INTEGRATION?
DOOR TRIM PANELS	-LOW PRESSURE MOLDING* -CELLULOSICS*	-EPP,EPP/PS -PP SHEET FOAMS?	-INTENSE INTERMATL'S. COMPETITION -NATURAL FIBER COMPOSITES GROWING -ENERGY ABSORPTION DRIVER
HEADREST	PU FOAM*	EPP FOAMS	START IN EUROPE

INTERMATERIALS COMPETITION ABOVE THE BELT LINE (CONT'D.)

PART	INCUMBENTS	GROWTH CANDIDATES	NOTE
KNEE BOLSTER	<ul style="list-style-type: none"> -STRUCTURAL IM -BLOW MOLD -LOW DENSITY GMT 	HIGH	<ul style="list-style-type: none"> -INTEGRATION W/ IP -KNEE AIRBAGS STARTING
ABC PILLAR	<ul style="list-style-type: none"> -INJ. MOLD* -EA FOAMS 	-EA RESINS	-INJ. MOLDING IS CHEAPER
INSTRUMENT PANEL	<ul style="list-style-type: none"> --INJ. MOLD* -SOME BLOW MOLD 	-EA RESINS	-INTEGRATION W/STRUCTURAL IP.?
PACKAGE TRAY	<ul style="list-style-type: none"> -CELLULOSICS* -LOW PRESSURE MOLDING* 		-NO FOAM SUCCESS YET/DESPITE EFFORT

NOTE: *= DOMINANT INCUMBENT

SOURCE: ROBERT ELLER ASSOCIATES, INC. SOFT TRIM MULTICLIENT STUDY

SKIN AND TEXTILE/FOAM LAMINATES

- **TEXTILE/PU SHEET FOAM IS MAJOR INCUMBENT**
- **HEADLINER, SUNVISOR, SEATING, DOOR MEDALLIONS**
- **TEXTILE/PO FOAM LAMINATES ENTERING**
- **DOOR MEDALLIONS– INTIAL ENTRY POINT**
- **PO FOAMS ENCOURAGING ENTRY OF PO TEXTILES (NONWOVENS?)**
- **INSERT MOLDING STARTING?**

WHAT DRIVES ENERGY MANAGEMENT SYSTEMS CHOICES

- **HEAD IMPACT REGULATIONS**
- **MONOMATERIALS CONSTRUCTIONS**
- **SYSTEMS COST SAVINGS**
- **PVC SKIN SUBSTITUTION?**
- **LOWER COST CONSTRUCTIONS**
- **RECYCLABILITY**
- **ACOUSTIC PERFORMANCE**
- **NVH**
- **EMISSIONS**
- **LOW TEMP PERFORMANCE**
- **WEIGHT SAVINGS**

NEW FOAM CANDIDATES

- **PE/PS BEAD FOAMS**
- **2-SHOT MOLDED FOAMS?**
- **MICROCELLULAR TECHNOLOGY**
- **NON-XLPO FOAMS(HMS RESINS-BASED)**
- **PO FOAM/TEXTILE LAMINATES**
- **IN-MOLD SKIN (OR TEXTILE)/EPP FOAM LAMINATION PROCESSES**
- **PO SKIN/FOAM COEXTRUSION**
- **EXTRUDED PO FOAM TUBES(AIR DUCTS)**
- **DEVELOPMENT/PROLIFERATION OF IM/EXTRUDED RIGID SHEET FOAMS**
- **TPE FOAMS**

EUROPE/NAFTA AUTOMOTIVE FOAM DIFFERENCES

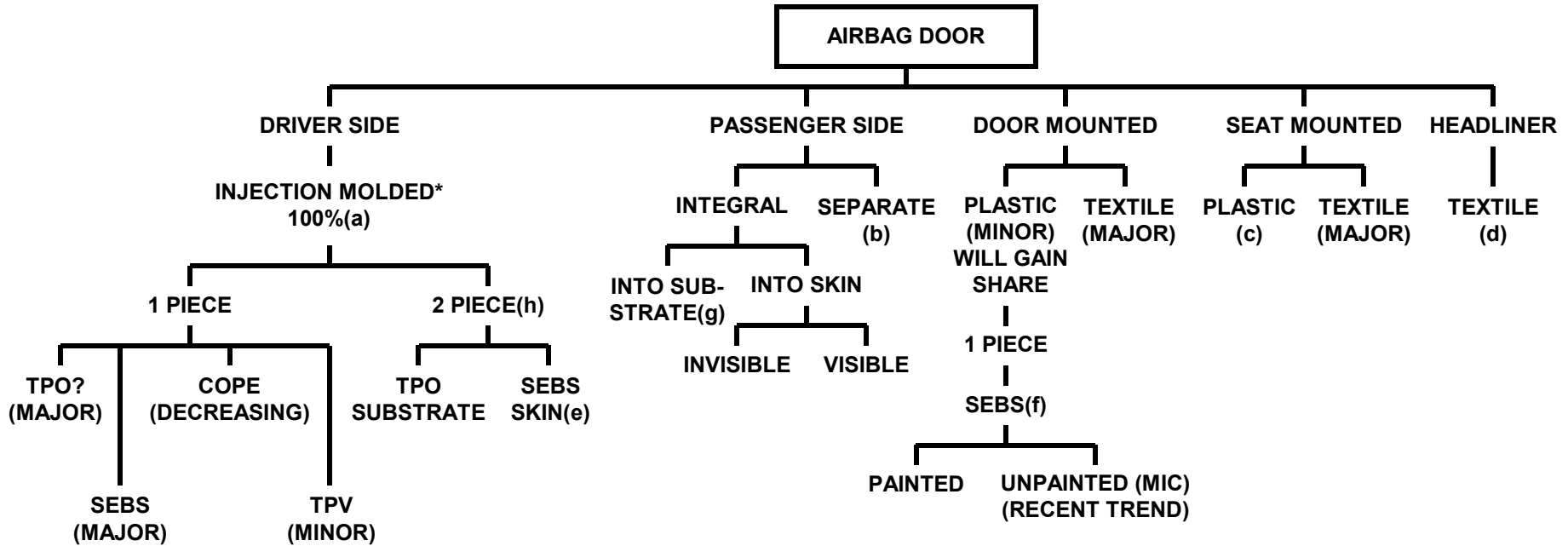
FACTOR/SECTOR	EUROPE	N. AMERICA
TEXTILE/FOAM LAMINATES	HIGHER USE OF XLPO SHEET FOAMS	WILL GROW WITH NEGATIVE THERMOFORMING
SUN VISORS	EPP FOAMS	INJECTION MOLDED
INTERIOR ABOVE THE BELTLINE EA REQUIREMENTS	LOWER (NOT MAJOR DRIVER YET)	MAJOR FOAM DRIVER FOR HEADLINER/DOOR TRIM PANELS
TPE BODY/GLAZING SEALS	-MICROCELLULAR FOAMS ENTERING SBC-TPV STARTING IN EUROPE	
INTEGRAL SKIN/FOAM PVC AND PU	USED FOR IP, DT STEERING WHEEL	CHALLENGED BY TPO/XLPO FOAM LAMINATES

(CONT'D.)

FACTOR/SECTOR	EUROPE	N. AMERICA
INTERIOR VOC STANDARDS	COULD AFFECT PU FOAMS	NOT A FACTOR YET
ZERO SMELL INTERIOR	A MATERIALS SELECTION CRITERION	STARTING
RECYCLING	SIGNIFICANT DRIVER	LESS IMPORTANT
ELV LEGISLATION	IN PLACE	NONE YET
REQUIREMENT FOR PROCESS COST SAVINGS	MAJOR MATERIAL SUBSTITUTION DRIVER	

SOURCE: ROBERT ELLER ASSOCIATES, INC. SOFT TRIM MULTICLIENT STUDY

AIRBAG DOOR MARKET POSITIONS



NOTES:

* PRIMARY MARKET FOR TARGET TPEs

- (a) INTEGRATED STEERING WHEEL/AIRBAG DOOR IN PU HAS NOT BEEN SUCCESSFUL
- (b) USUALLY HINGED, BASED ON MORE RIGID COMPOUNDS, TREND TOWARD INTEGRATION INTO IP SKIN, WILL TEND TOWARD 2-PIECE (SEBS SKIN/TPO SUBSTRATE, COPE, TPO SHARE GAIN)
- (c) SOME COPE AIRBAG DOORS ARE SEAT MOUNTED, USE EXTRUSION GRADE r-TPO CLAMSHELL (E.G., NISSAN, HONDA, GM); ABOUT 200 GRAMS/VEHICLE
- (d) PRIMARILY CURTAIN TYPE SUPPLEMENTED BY ENERGY ABSORBERS
- (e) SEBS SKIN
- (f) SCRATCH RESISTANT SEBS
- (g) HARD IPs (E.G., WITHOUT SKIN) CAN CONTAIN AN INTEGRAL ABD (OFTEN INVISIBLE). EXAMPLES ARE OPEL CORSA AND SEVERAL VW MODELS.
- (h) SHARES VARY U.S./EUROPE; SEE TEXT

AIRBAG DOOR TRENDS

- **INVISIBLE CONTINUES TO GAIN SHARE**
- **SMALL BUTTON TYPE DOORS**
- **SEVERAL ABD POSITIONS WILL GAIN SHARE AND CREATE NEW RESIN MARKETS**
 - **CURTAIN**
 - **SIDE**
 - **KNEE**
 - **SEAT BACK**
 - **NIGHT VISION**
 - **OTHERS**
- **PRESENCE OF AIRBAGS CREATES MARKET FOR ENERGY MANAGEMENT RESINS**
- **TAKATA, AUTOLIV, ARE MAJOR SUPPLIERS**
- **SIDE AIRBAGS INCREASING**
- **SIDE CURTAIN (HEADLINER, A-PILLAR)**

GLOBAL AUTO OCCUPANT RESTRAINT MARKET: \$16 BN. (2004)

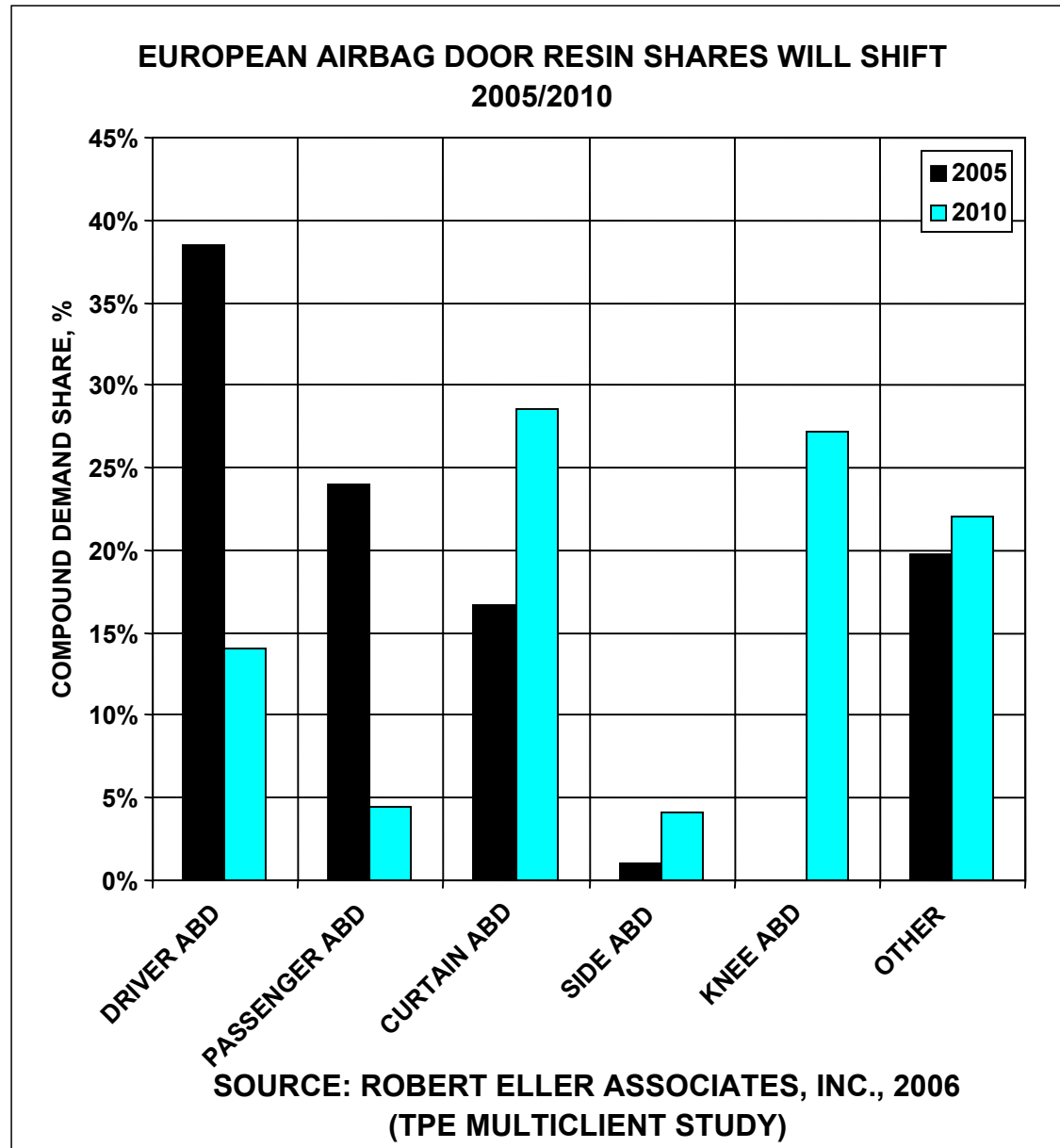
TYPE	VALUE SHARE, %	2004 GLOBAL UNITS, MM	NOTE
FRONT AIRBAGS	35	100	GROWTH SLOWED
SIDE AIRBAGS	15	65	RAPID GROWTH
SEAT BELTS	30		
ELECTRONICS	20		
TOTAL	100		

GLOBAL AIRBAG PENETRATION RATES

REGION	SHARE OF NEW 2004 VEHICLES, %			
	DRIVER	PASS.	SIDE CHEST	SIDE HEAD
N. AMERICA	100(a)	100(a)	23	17
EUROPE	90	80	70	40
JAPAN	90	80	15	15
ROW	50	50	LOW	LOW

NOTE: (a) MANDATED IN THE U.S.

AIRBAG DOORS AND ENERGY MANAGEMENT WILL BE MAJOR GROWTH SECTORS FOR TPEs



AIRBAG DOOR RESIN TRENDS(EUROPE)

COPE	-LOSE SHARE -GAIN VOLUME
SEBS	-SHARE LOSS -ROLE FOR SBC-TPV?
TPO/TPV	-REACTOR-TPO STRONG GAINS -MOLDED IN COLOR -MINOR ROLE FOR TPV

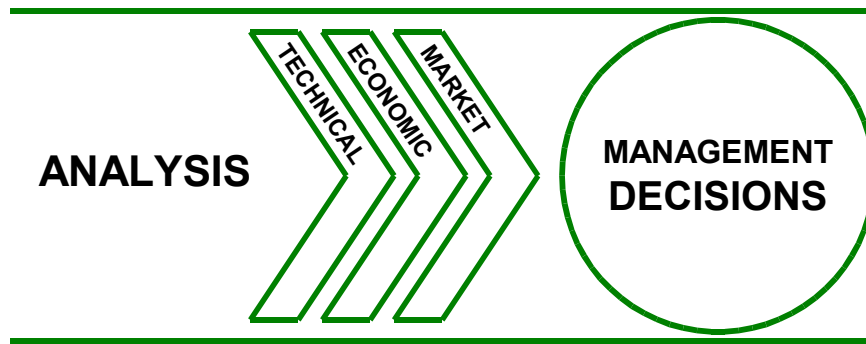
SOURCE: ROBERT ELLER ASSOCIATES,INC TPE MULTICLIENT,2006

SUMMARY

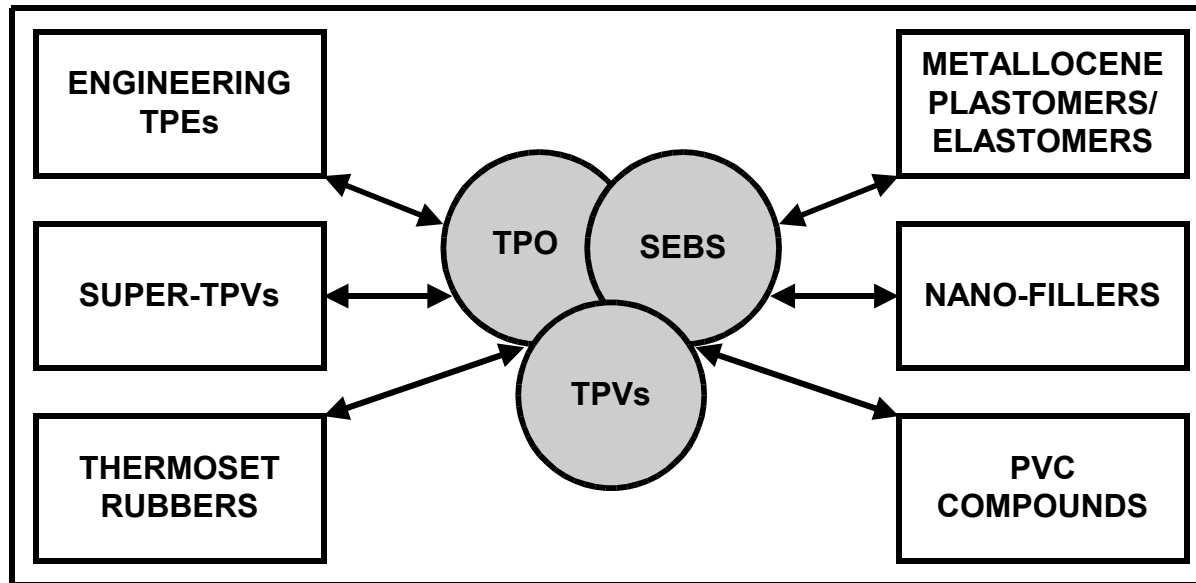
- **FOAMS WILL GAIN IN ABOVE-THE-BELT LINE ENERGY MANAGEMENT BUT THEY MUST COMPETE WITH**
 - LT. WT. GMTs
 - ENERGY MANAGEMENT PO RESINS
 - MISC. EA SOLUTIONS(E.G. HONEYCOMBS)
- **BEAD FOAMS WILL EXHIBIT BIGGEST GAIN**
- **FURTHER BEAD FOAM GROWTH POSSIBLE FOR:**
 - SEMI-STRUCTURAL COMPOSITES
 - ACOUSTIC APPLICATIONS(IF OPEN CELL CAN COMPETE WITH FIBER SOLUTIONS)
- **PE/PS BEAD FOAMS ARE ENTERING THE MARKET AND HAVE STARTED PENETRATING DOOR TRIM(AND FLOORS)**

SUMMARY(CONT'D)

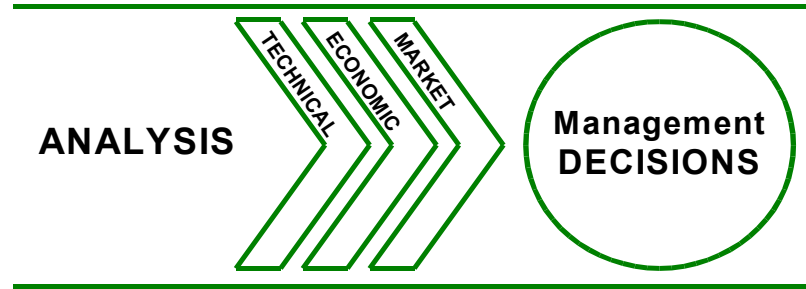
- **ON BOARD FOAMS THAT COMBINE STRUCTURE, EA AND ACOUSTIC PROPERTIES COULD ADD CONSIDERABLE VALUE**
- **PO SHEET FOAM APPLICATIONS WILL:**
 - BROADEN THEIR APPLICATION RANGE**
 - FACE NEW NON-XL COMPETITORS**
 - BRING PO TEXTILES INTO THE MARKET**
- **SIDE AIRBAG GROWTH WILL STIMULATE ENERGY MANAGEMENT RESIN GROWTH(ABC PILLAR)**
- **REACTOR-TPO WILL BE THE BIG WINNER IN AIRBAG DOORS(MOLDED-IN COLOR) AND ENERGY MGT RESINS**
- **THIRD GENERATION NONWOVENS WILL GAIN SHARE IN HEADLINER CORES AND FACE FABRICS**



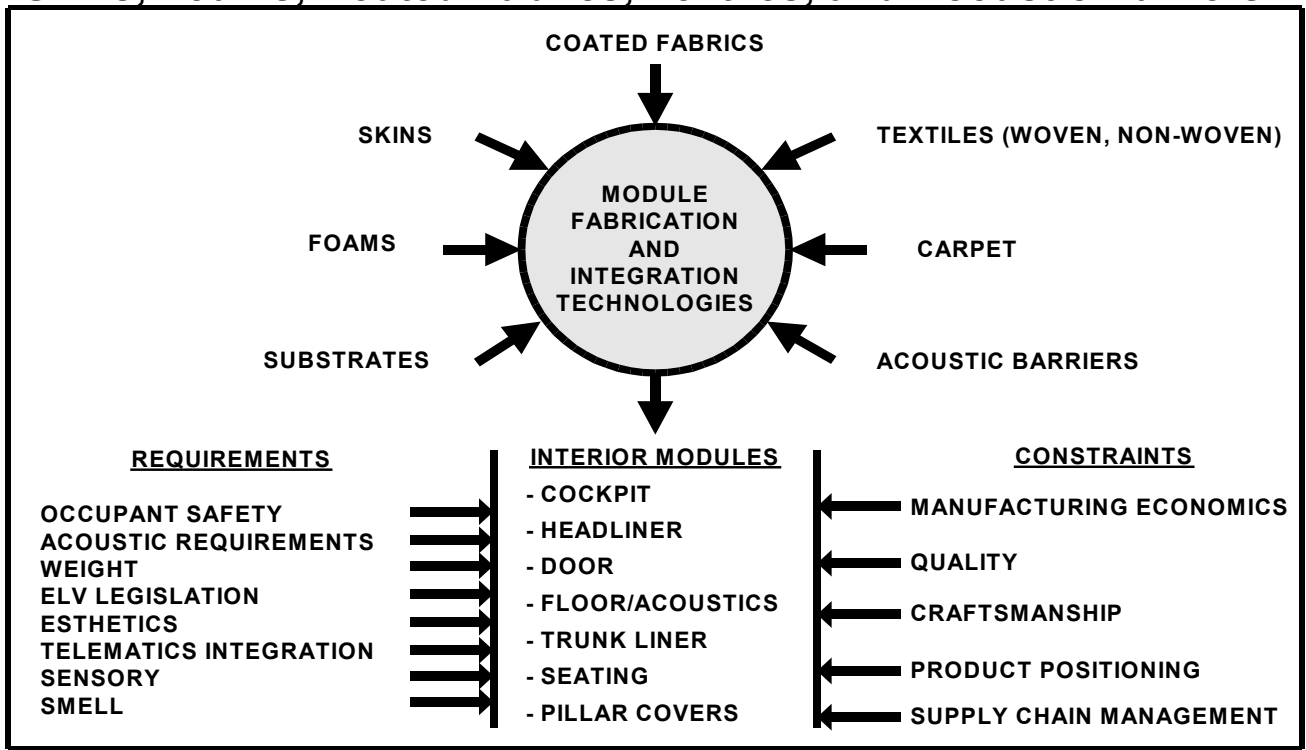
Specialty Thermoplastic Elastomers . . . Markets, Economics, Technology, Intermaterials Competition



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



Automotive Interior Soft Trim: Skins, Foams, Coated Fabrics, Textiles, and Acoustic Barriers



Prospectus for a Global Multiclient Industry Analysis
Robert Eller Associates, Inc.

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