R&D Selection Methods
for New Materials and Processes

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Automotive R&D in New Materials / Processes

• Why do OEMs and suppliers support R&D?
  • Creating Profit Surplus
  • Medium to long term view

• Methods to Create Profit Surplus through new Materials and Manufacturing Processes
  • Lower cost production through process innovation
  • Raising market demand curve through marketable performance enhancement
R&D Portfolio Planning

Technical Risk: 40%
Market Risk: 60%
Potential Reward: 30%
Competitive Position: 85%

Risk / Reward Balance

Unattractive | Strategic
---|---
Bread and Butter | No Brainer

Increasing Risk → Increasing Reward
Selection of Automotive Materials R&D Projects

Viability

- Grasp opportunity!
- Lower risk
- Communication between Marketing and R&D

Value Analysis

Cost-Performance Balance

Market Assessment

Exchange constants

Cost / Unit

Volume

Cost / Use

Performance

Most suitable markets

Technical Cost Model

Material in Basic Form, Shaped Material

Technical Feasibility

Application Requirement, Material Selection

Establishing Performance Enhancements

Foam selection for head protection (75% of energy absorbed by elastic deflection of A-pillar)

Minimum Thickness (m)

Deceleration (g)

<table>
<thead>
<tr>
<th>Material (Density)</th>
<th>Minimum Thickness (m)</th>
<th>Deceleration (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyethylene (0.04)</td>
<td>0.024</td>
<td>0.08</td>
</tr>
<tr>
<td>Melamine Foam</td>
<td>0.08</td>
<td>0.16</td>
</tr>
<tr>
<td>Polyethylene (LD18)</td>
<td>0.15</td>
<td>0.25</td>
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<tr>
<td>Polyethylene (PE80)</td>
<td>0.15</td>
<td>0.30</td>
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<tr>
<td>Polyethylene (HDE15)</td>
<td>0.15</td>
<td>0.50</td>
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<tr>
<td>Polyurethane (0.35)</td>
<td>0.10</td>
<td>0.70</td>
</tr>
<tr>
<td>Polyurethane (0.50)</td>
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<td>1.05</td>
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<tr>
<td>Polyurethane (0.80)</td>
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<tr>
<td>Melamine (0.05)</td>
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<tr>
<td>Aluminiun (H)</td>
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<td>Aluminiun (SC)</td>
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<td>Aluminiun (0.8)</td>
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<td>Aluminiun (0.5)</td>
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<td>0.25</td>
</tr>
<tr>
<td>Polystene (1.0)</td>
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</tr>
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EMAT and MFA, University of Cambridge, Sept. 99
Establishing Performance Enhancements

Foam selection for head protection (75% of energy absorbed by elastic deflection of A-pillar)

Minimum Thickness (m)

Deceleration (g)

Forecasting Cost / Unit

Production Volume (Thousands of Units / Year)

$ / Unit

Technical Feasibility
Material Selection

Material in Basic Form
Shaped Material

New Material
Incumbent

Technical Cost Model

Material in Basic Form
Shaped Material

Minimum Thickness (m)

4.5 kg head, impact velocity 11.2 m/s (40 km/hr) knock down factor 0.25

Material Selection

- Melamine Foam (0.024)
- Polyurethane (0.08)
- Polyethylene (LD18)
- Polyethylene (PE80)
- Polyethylene (HD115)
- Polyurethane (0.20)
- Polyurethane (0.35)
- Polyurethane (0.70)
- Aluminium-SiC (0.15)
- Aluminium (0.5)
- Polyethylene (0.02)
- Aluminium-SiC (0.41)
- Aluminium (0.8)
- Polyurethane (0.35)
- Polyurethane (0.53)
- Polyurethane (1.05)
- Polyurethane (0.800)
- Polyethylene (0.16)
- Aluminiun (1.0)
- Polyethylene (1.15)

Material in Basic Form
Shaped Material

- Polyethylene (0.800)
- Polyethylene (0.16)
- Aluminiun (1.0)
- Polyethylene (1.15)
- Polyethylene (0.800)
- Polyethylene (0.02)
- Polyurethane (0.35)
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- Aluminium (0.8)

Material in Basic Form
Shaped Material
Performance Cost Trade off

Value
Analysis
Cost Performance
Balance

Performance metrics for
panel of specified stiffness

Density/(Young’s modulus)$^{1/3}$, [Mg/m$^3$]/[GPa$^{1/3}$]

R&D Selection Conclusions

• Better way to Assess New Materials and Processes for Automotive R&D
  • Differentiation
  • Lower Costs

• Material Suppliers and Industry Consortiums are ALL going to tout their material
  • Need for in house assessment and prioritisation
  • OR standardised methods
Performance Cost Trade Off

Index $M_1$
(Based on Cost)

Tradeoff Curve defined by Exchange Constant

Index $M_2$
(Based on Mass)