The PACE Awards and the Pace of Innovation

Michael Smitka
Professor of Economics
Washington and Lee University
msmitka@wlu.edu

ISA Conference
Kansas City, MO
May 30, 2013
Key Points

• From: *ad hoc* and intermittent
• To: systematic and continual
• Driven by: “roadmaps” of the future industry
• Amidst: collaborative R&D with OEMs
• On a: global basis

∑ innovation is central to supplier strategy.
20 years ago it was not.
PACE Competition

• Begun in 1994
  – sponsored by Automotive News with eye of expanding coverage of suppliers
    • funded by Ernst & Young, TRC and others

• Currently ≈100 applicants, ≈33-35 finalists
  – site visit by 2 judges to each finalist for detailed engineering & marketing presentations
  – customer references used to independently verify performance claims
Sample Characteristics

• Self-selected so **not** a random sample
  – especially problematic in early years

• However no apparent size bias
  – Finalists range from very small to Bosch & Denso

• Wide geographic coverage
  – US, Europe
  – Brazil, Poland, Australia, Korea and (indirectly) China
  – disproportionately few from Japan

• Applicant pool expanding over time
PACE Awards

• Award winners must clear 3 hurdles:
  – Have we seen it before?
    • novelty, at least within automotive realm
  – Has it been accepted in the marketplace?
    • for OEM parts, current and future programs
  – Does it change the rules of the game?
    • will others be forced to adopt or innovate around it?
    • is it a big deal in terms of lower cost / lower weight / improved performance / environmental gains?

• About half of finalists are awardees
What do we learn of innovation?

• In the early years, *ad hoc* — [three patterns]
  – invention-driven innovation
    • a neat idea that makes it into a vehicle
    • ex: Gentex auto-dimming rearview mirrors
  – save the business: cost-reduction innovation
    • do-or-die effort by a supplier division
    • *best not name names / non-disclosure agreements*
  – save the customer: “fix it” innovation
    • to overcome a customer issue: packaging, weight, or safety
    • ex: new steering column improving front collision “stars”
Today two patterns

- **Systematic innovation**
  - aimed at concrete goals [6-10 years ahead]
    - technology roadmaps
  - evidenced by repeat winners
    - at least two companies use as culmination of an internal technology competition
Two patterns...#2 (and #3)

• **Collaborative innovation**
  – joint supplier-assembler projects
    • PACE created “collaboration” award to recognize
    • customers increasingly present during site visits
      – even doing some of the engineering presentations!!

• **Invention persists**
  – but typically not for “central” technologies
    • not in drivetrain, not in safety
    • yes for convenience features
Sources of Ongoing Innovation

• Enablers
  – materials science revolution
    • steels, adhesives, plastics, paints, surface treatments
  – engineering tools

• Drivers
  – CAFE and other fuel efficiency standards (CO₂)
  – Emissions standards: NOₓ, CO, PM (particulates)
  – Safety standards: collision ratings, mandated equipment
Data

• Nineteen years (42 site visits) as a judge
• Due to confidentiality can only summarize
  – Non-disclosure agreements for site visits / judging
• Can break down by type
  – Based on this researcher’s personal recollections
  – Do not have files to permit detailed analysis
    • citations from award ceremony and generic
      Automotive News coverage survive
Background knowledge

• Written and oral reports of other judges
  – written reports
    • 2-5 single-spaced pages of prose plus diagrams
  – one (now two) day meeting to select finalists
    • oral presentation on *all* finalists by site visit judges
      – it’s a long, intense meeting!
    • includes finalists rated non-winners by site visit judges
    • includes winners by acclamation

• Neither *Automotive News* nor sponsors privy
  – to conform to non-disclosure materials not retained
Qualitative Examples

• Brose (2013): kick-to-open hands-free liftgate
  – Ford Escape, C-Max & BMW 5-series
  – *simultaneously launched on both luxury and on entry-level vehicles*

• Delphi (2013): zero leak HVAC fitting
  – Ford global rollout
  – *supplier needed to support launch simultaneously in multiple assembly plants across 4 continents*

• Continental telematic solution (2012)
  – first adopter GM in China
  – *German firm from Chicago facility with engineers from China for product launched in China*
• Delphi (2012) wire harness simulation software
  – first adopter Toyota in Japan
  – engineers from former captive GM supplier using engineering teams in China and Ohio for a product developed and launched by Toyota in Japan

• Continental (2013) tire pressure sensor
  – first adopters Dodge and Hyundai
  – Chrysler did part of engineering presentation

• Takata (2013) front center airbag
  – first adopter GM
  – required close coordination as required adjusting design of interior
Qualitative examples illustrate...

- global
  - development process can cross oceans
  - customers varied and global
    - *not “tied” (keiretsu) and local*

- no longer luxury-down
  - innovations launched first on volume brands
  - innovations launched first in developing markets

- no longer top-down
  - customers partner with suppliers to implement
  - paint shops an example since 1910s but now across all facets of industry
Sample 2013 Winners

Federal Mogul

Visteon (now Halla Visteon)

Continental

WINNER: New molding tool produces piston for high-pressure

WINNER: 2 seals prevent leaks of greenhouse gases

WINNER: Low-cost radar for blind spots is suitable for car
Dana: Aluminum driveshaft sheds weight and paint

Valeo: Compact module water-cools diesel exhaust before combustion

Hughes Telematics: Use telematics to update vehicle software
Brose

WINNER: Rear liftgate opens without a touch

Continental

WINNER: System keeps tabs on tire pressure

BorgWarner

WINNER: 3 turbos eliminate lag, boost power and efficiency
Quantitative Analysis

• Sort finalists into:
  – *ad hoc*: invention, other
  – *systematic*
    • “road map”
      – emissions, fuel efficiency, safety
    • systematic
      – materials science, other R&D (chemistry for paints)

• Analysis subjective and constrained by non-disclosure mandate
Three Sample Tallies

• 1996 round: 14 finalists
  • Systematic: 5 firms 1 “roadmap”
  • Fuel efficiency: 1 Emissions: 3 Safety: 0
  • Invention: 4

• 2005 round: 13 finalists
  • Systematic: 8 firms 2 “roadmap”
  • Fuel efficiency: 0 Emissions: 1 Safety: 4
  • Invention: 5

• 2013 round: 33 finalists
  • Systematic: 20 firms 15 “roadmap”
  • Fuel efficiency: 8 Emissions: 9 Safety: 5
  • Invention: 7
Case Study: Roadmaps

- detailed roadmaps are typically highly proprietary
  - Federal-Mogul example is generic, without timeline vs specific target metrics or requirements
  - does provide an example of inputs a firm might use and the areas to which it would be applied
  - companies often combine with a timeline of what technologies they think might be available and generate a set of technologies that would need to be developed (or transferred from other industries)
Global emissions regulations are resulting in increasing temperatures and pressures within engines.

The challenge is to support with both enabling and direct friction reduction component technologies.
The Automotive World: FM Drivetrain

- **CO₂**: EU 2012 130g/Km
- **CO₂**: USA Increased Focus
- **MPG**: USA 2016 35.5mpg
- **MPG**: EPA 2018 On-Highway
- **Emissions**: LEV, ZEV, Tier 2 Bin 5, Euro 6, 2014, Tier 4
- **Emissions**: EU, USA, Japan Similar and Tightening
- **Emissions**: China, India Rapidly Moving to Euro 4 & 5

- **Engines**: Displacement Downsizing, Cylinder Right Sizing
- **Combustion**: GDI, GDIT, HCCI, EBS
- **Energy**: E85, Bio-diesel, Hydrogen, Etc.
- **Efficiency**: Transmissions 6+ speeds, Aerodynamics
- **Weight**: Driving Vehicle Material Changes, Advancements
- **Braking**: Green Formulations
- **Tailpipe**: Catalytic, Particulate Filters
# The Engine World – More Specific

<table>
<thead>
<tr>
<th>Engine Technologies</th>
<th>Gasoline</th>
<th>Diesel</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Friction reduction</td>
<td>Friction reduction</td>
</tr>
<tr>
<td></td>
<td>Weight reduction</td>
<td>Weight reduction</td>
</tr>
<tr>
<td></td>
<td>Direct injection</td>
<td>Futher Downsizing</td>
</tr>
<tr>
<td></td>
<td>Partially stratified charge</td>
<td>Advanced Turbocharging</td>
</tr>
<tr>
<td></td>
<td>Turbocharging</td>
<td>(Dual Stage, Supercharging)</td>
</tr>
<tr>
<td></td>
<td>Lean</td>
<td>High pressure injection (2000+ bar)</td>
</tr>
<tr>
<td></td>
<td>EGR</td>
<td>Multiple injections (precise control)</td>
</tr>
<tr>
<td></td>
<td>Consequent downsizing</td>
<td>High EGR rate</td>
</tr>
<tr>
<td></td>
<td>VVA</td>
<td>Temperature management (air charge)</td>
</tr>
<tr>
<td></td>
<td>Variable flow oil pump</td>
<td>NOx aftertreatment</td>
</tr>
<tr>
<td></td>
<td>Variable flow water pump</td>
<td>DPF particulate filter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SCR Selective Catalytic Reduction</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Variable flow oil pump</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Variable flow water pump</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Alternative Fuels</th>
<th>Bio fuels 1 gen</th>
<th>Bio fuels 1 gen</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Ethanol (E85 – E70)</td>
<td>- Biodiesel (B10-B30-B100)</td>
</tr>
<tr>
<td></td>
<td>Bio fuels 2 gen - BTL</td>
<td>Bio fuels 2 gen - BTL</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Related Technologies</th>
<th>Hybrid</th>
<th>Hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stop/start</td>
<td>Stop/start</td>
</tr>
</tbody>
</table>
Major OE Customers Supported by one Technical Center
Miscellaneous observations

• globalization
  – not significant in 1990s

• balanced portfolio of customers
  – not in 1990s; many suppliers still active primarily in one region serving one dominant customer

• failure of supplier attempts to brand
  – lighting sector trying but clear (to me!) will fail, as did attempt to develop interior “cockpit” branding
    • 1920s-1930s counterexample of “Body by Fisher”
    • GM however ultimately acquired the Fisher Bros.
More observations

• market power: 2-3 dominate many segments esp diesel
  – good margins [but PACE only sees successful bids!]

• was first launch at luxury marques
  – now first launch often volume products
  – eclipse of “content” distinction by luxury marques?
...and more observations

• waves of innovation
  – common rail and injectors; now turbos and electric motors
  – paints driven initially by emissions, now nanotechnology

• most finalists highlight innovation process and their gateways
  – in 1990s, neither term understood!!

• puzzle: where are J suppliers?
  – less innovative? customers discourage participation?
  – Denso is a counterexample that proves the rule?
PACE Competition

- http://www.autonews.com/section/PACE
References

• Theory is not the focus herein, but see:
  – claims on the centrality of (loose) goals to innovation, “directed innovation”
  – innovation responding to factor prices:

• PACE competition pages:
Thanks!

msmitka@wlu.edu

auto blog:
http://autosandeconomics.blogspot.com

auto industry course blog:
http://econ244.academic.wlu.edu