Electric Vehicles – The Technology and Stamping Industry Impact Ranges from Mild to Full

David Andrea
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Plante Moran Automotive Practice
at a Glance

2,000+
Manufacturing &
distribution clients

500+
Automotive related
clients

23
Offices in USA,
Mexico, China, India,
Japan

90+
Years of Industry
Experience – founded
in 1924

Manufacturing Industry Expertise

• Senior manufacturing professionals
  averaging 20+ years of industry
  experience
• Substantial global and international
  expertise
• Access to specialized knowledge
  through the Plante Moran Supplier
  Intelligence Center™
• Manufacturing industry involvement
  • Original Equipment Suppliers Association (OESA)
  • Society of Automotive Engineers (SAE)
  • Automotive Aftermarket Association
  • Precision Metalforming Association (PMA)
  • Manufacturers Association of Plastics Processors (MAPP)

Comprehensive Services

• Strategy and Operations Consulting
• Information Technology Consulting
• Transaction Advisory Services
• Global Services
• Tax Compliance and Consulting
• Real Estate (Plante Moran CRESA)
• Investment Banking (PM Corporate Finance)
• Audit and Accounting
The Industry Has Always Faced Significant Risk

*It is the magnitude and number of simultaneous risks that is different as technologies, competitor sets, and use sets converge.*

Diagram:
- Technology Enablers
  - Mobility Access
  - Propulsion
  - Vehicle/Environment/Occupant
  - Fusion
- VMT Ownership – The Use Case
  - Autonomous
  - Shared
  - Individual
- Industry Value Stream
  - Industry 4.0
  - Industry 5.0
  - Industry 6.0?
Electrification and Mobility Are the Greatest Drivers of Value Stream Reconfiguration

OEMs and First Tiers will carve out, merge, and/or outsource engineering, **manufacturing and vehicle and sub-system assembly** to meet new cost, time to market, product performance and scale of economy hurdles.

<table>
<thead>
<tr>
<th>Current State</th>
<th>Future State</th>
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<tbody>
<tr>
<td><strong>Research Development &amp; Engineering</strong></td>
<td>In order to gain increased cost competitiveness and reduce duplicative industry development costs, OEMs will increase outsourcing of engineering and development services and vehicle subsystems to trusted parties</td>
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<tr>
<td>The Top 10 OEMs combined spend over $100 B annually on vehicle development and tooling costs. Often, much of the R&amp;D spend is on duplicative engine and transmission technologies and narrow ranges of vehicle architectures, trim levels and options</td>
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<tr>
<td>OEM manufacturing is a core competencies enabling brand differentiation. OEMs control the manufacturing of engines, transmission, class-A stamping/body in white, as well as the assembly and painting processes of the entire vehicle. Due to high costs and OEMs desire for quality control outsourcing of vehicle assembly is used by select OEMs (BMW, Mercedes) for only niche, low volume, luxury vehicles where profit margins are greater</td>
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<tr>
<td><strong>OEM Focus on Manufacturing</strong></td>
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<tr>
<td>As EV/mobility model emerges OEMs/Mobility providers will increase focus on customer experience, manufacturing capability and validation compliance. Mobility cost/time convenience/ utility captures increasing share against personal ownership and exterior style. Mobility as a Service (MaaS) and EV market growth and capital requirements is pushing OEMs and suppliers to focus on product design, purchasing, marketing and sales, leading to the separation, merger, or outsourcing of “traditional” components and processes</td>
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What If Mobility Consumption Was Truly Seamless for Consumers?

In this pursuit, all commercial boundaries are up for grabs

- **Competitive Response** – *Drives Networks of Networks and Technology Adoption*
- **First and Last Mile Interface** – *Drives Partnerships to Make Boundaries Transparent*
- **Technology Capabilities** – *Drives True Optimization of Consumer Interface and Service Delivery*
- **Costs and Break Even Points** – *Drives Ultimate Market Potential*

Source: Center for Automotive Research, The Impact of New Mobility Services on the Auto Industry, August 2016
Traditional Vehicle Segmentation is Losing Relevance
*Car/truck split relevant for regulation, but not for consumer segmentation in a true usage model*

**TODAY’S Transportation**

- **EXPENSIVE**
  - Rental services
  - Taxi
  - Chauffeur Services

- **INEXPENSIVE**
  - Fleet sharing
  - P2P car sharing
  - Private Ownership
  - Ride-hailing (personal)
  - Ride-hailing (pooled)
  - P2P Carpooling
  - Public Transport

**GET DRIVEN**

**TOMORROW’S Transportation**

- **Privately Owned**
  - Private Autonomy

- **Personal/ Pooled Taxi**
  - Autonomous Taxi

- **Public**
  - Public Autonomous Transport

**AUTONOMOUSLY DRIVEN**
Market Segmentation . . .

It’s not just about the vehicle; ownership will be as important
The traditional view of the automotive value chain has focused on designing, engineering, manufacturing, selling, financing and servicing a vehicle with a finite partnership set, in a linear fashion.
Future Mobility Industry Value Chain

Manufacturing, MaaS, Mobility Operations and Energy Management will be required to enable the future mobility industry, as well as to be tightly integrated with the traditional supply base.

**Vehicle Manufacturing (including Engineering)**
- OEM
- Tier Suppliers
- Systems/components
  - Powertrain – ICE and EV
  - Chassis
  - Interiors
  - Exteriors
  - Electronics & Autonomous
  - Other

**Key Vehicle Manufacturing Characteristics**
- Bifurcated market: commodity and emotion
- Common platform architectures
- Modular design for component replacement
- High volume production for cost efficiencies
- Electrified powertrains
- Autonomous capability
- Connected technology

**MaaS and Mobility Operations**

**Ownership & Financing**
- Vehicle Owners
  - Fleets
  - Private
  - Fractional
- Financing
  - Loans
  - Leases
  - Subscription
  - Pay per mile

**Mobile Services Provider**
- Pay per ride/sharing
- Freight/package service
- Specialized mobility services
- Mobility technology broker/interface

**Connectivity**
- V2V communications
- Telecommunications access
- Vehicle data – OTA updates, monitoring
- In-vehicle infotainment services

**Mobility Operations Services**
- Vehicle maintenance and repair
- Vehicle staging – cleaning, charging, storage
- Vehicle roadside assistance
- Passenger biometrics support

**Energy Management**
- Battery pack/ cell production and raw materials
- Battery financing
- Charging infrastructure manufacturing and installation
- Energy storage and discharge:
  - V2G
  - 2nd use batteries
- Battery recycling
Wherever You Are in the Value Stream –  
*Disintermediation is Occurring*

**Disintermediation**, the process of removing intermediaries from a supply chain, a transaction, or, more broadly, any set of social, economic, or political relations.  
Encyclopedia Britannica

- **OEMs** – How far will the OEMs go in removing captive powertrain in an EV world?  
  How customized (or commoditized) will these MaaS fleets become to disrupt assembly and stamping scales of economy?

- **Suppliers** – Will electronics, software and AI IP suppliers subvert commercial leverage away from today’s first tier suppliers?  Where will today’s Newcos and Survivor Corps play in the future?

- **Dealerships** – Are COSTCO, Amazon and TESLA big enough to break dealer franchise agreements?  What is a dealership point in a pay-for-mile world?

- **Fuels** – Will consumers plug into the “refinery?”  And what even is a “power plant” in an inductive charge, vehicle-to-grid, renewable energy future?

- **Services** – How pervasive will pay-for-play take market share away from today’s unit purchase and premium/subscription/payment world?  What will the market spit be between private cash/loan/lease and fleet corporate/personal ownership?
U.S. Electrified Vehicle Projections

A mix of electrified powertrains steadily replace internal combustion engines over the next 20 years until cost, regulations and technology advances drive the rapid adoption of battery electric vehicles.

**U.S. EV Model Sales Projections**

**EV Model Characteristics**

<table>
<thead>
<tr>
<th>Model Inputs</th>
<th>Factors</th>
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<tbody>
<tr>
<td><strong>Market Dynamics</strong></td>
<td>• Lower fuel and electricity cost</td>
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<td></td>
<td>• Improving electric infrastructure</td>
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<td></td>
<td>• EVs available in most vehicle segments</td>
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<tr>
<td><strong>Government Regulations</strong></td>
<td>• CAFE requirements</td>
</tr>
<tr>
<td></td>
<td>• Government incentives for infrastructure and EV purchases</td>
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<td></td>
<td>• 11 States adopting Zero Emissions vehicle standards</td>
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<tr>
<td><strong>Technology Advances</strong></td>
<td>• Electrification cost becomes comparable to ICE over time</td>
</tr>
<tr>
<td></td>
<td>• ICE cost grows due to fuel efficiency requirements</td>
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<tr>
<td><strong>Customer Perception</strong></td>
<td>• Social pressure to reduce emissions</td>
</tr>
<tr>
<td></td>
<td>• Range anxiety declines with increase battery efficiency and reduced costs</td>
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Note: Hydrogen fuel cell propulsion technologies did not have significant volume in projections, due to uncertain infrastructure for fueling and product costs.
One OEM is a Data Point; But 10+ is the Momentum to Overpower the Tension Between Supply and Demand

<table>
<thead>
<tr>
<th>OEM</th>
<th>Electrified Powertrain Objectives</th>
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<tbody>
<tr>
<td>GM</td>
<td>General Motors to introduce 20 new all-electric cars by 2023, Mark Reuss - GM’s head of product has stated “General Motors believes the future is all-electric”</td>
</tr>
<tr>
<td>Ford</td>
<td>70% of nameplates will have electrified powertrain options by 2025</td>
</tr>
<tr>
<td>FCA</td>
<td>Plans to produce two BEV Maserati’s by 2020 focused on European Market -- expected to disclose additional product plans early 2018</td>
</tr>
<tr>
<td>VW</td>
<td>Plans to launch 30 BEVs by 2025</td>
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<tr>
<td>DAIMLER</td>
<td>Goals for 15-25% of all their production being EV by 2025</td>
</tr>
<tr>
<td>BMW</td>
<td>Goals of 15-25% of total sales consisting of PHEVs and BEVs by 2025 (400k-650k units)</td>
</tr>
<tr>
<td>HONDA</td>
<td>Goal of HEV, PHEV, BEV and FCEV to make up 66% of global sales by 2030</td>
</tr>
<tr>
<td>KIA</td>
<td>Plan to launch 26 electrified vehicles by 2020 (at least 12 HEV, 6 PHEV, 2 EVs and 2 FCEV)</td>
</tr>
<tr>
<td>NISSAN</td>
<td>Zero-emission cars will make up to 20% of its sales in Europe by 2020</td>
</tr>
<tr>
<td>TOYOTA</td>
<td>Goal to produce all zero-emissions vehicles by 2050</td>
</tr>
</tbody>
</table>
ICE Remains a Key Component in OEM Electrification Mix
Mild (P0) to Full (P4) – Drive Potential BOM Changes

Source: BorgWarner
Optimizing the Gas/EV Hybrid: Volvo Polestar

Pressures materials, processes, costs – things you know too well

Source: Volvo Cars, Polestar
Electrification Forces a Focus on Weight and Cost Reduction Across all Systems

Source: Ducker Worldwide
Aluminum Share of Material Needs to Grow by 60% to Make Up Half of the Net Weight Increase of EVs

To achieve a reduction of 270 PPV from 2015, significant content increases required in AHSS, Aluminum, Magnesium and CFRP

Source: Ducker Worldwide
Extreme . . . or Maybe Not So Much (in concept at least)
The Williams Advanced Engineering FW-EVX

Source: SAE International, Automotive Engineering, 2017
ICE v EV: Where Does the Content Cost per Vehicle Move?

ICE: $21,934

EV: $35,625

Major Moves
- Traditional Powertrain ($7,483)
- Body/Structural $951
- Other Systems $1,443
- EV System $5,700
- Battery Cells & Pack $13,000

Source: Merrill Lynch, Global Automotive Supplier Review, May 2017
The Inflection Point in Your Future:

• As EV (pure) and autonomous vehicle (levels 4 and 5) demand increases, vehicle architectures and body designs will need to change to optimize cost and functionality.

• Current body on frame and unitized body configurations will continue for work trucks, performance, and other needs and fundamental consumer demands.

• Leading up to 2035 it is all about material and process trajectories, increasing unit cost and CapEx pressures, customer/platform navigation, propulsion system fragmentation, component consolidation/material substitution.
Utilitarian-Driven Design – Form follows function and material selection competition

- EV skateboard propulsion systems could be commoditized (but use-sets: shuttle, personal, family, etc. will drive ultimate number)
- Top hat designs could proliferate (but regulatory compliance and aftermarket SKUs still critical – volumes will still matter)
- Press bed capacity/demand; draw requirements, etc. will be a function of those use sets, material spec, vehicle size, etc. – no different than today
- Battery chemistry/vehicle integration/calibration becomes a key differentiator to monitor to judge OEM (or first-tier) customer success

Source: Chris Bangle Associates
Don’t Forget the Feedback Loops of the Distribution and Service Parts Chain Disintermediation and How This Impacts Your Business

Dealership Purchase and Repair

• Build-to-order becomes more prevalent (but not exclusive) - supplier production schedules may become more volatile (hopefully suppliers won’t get paid for VMT)

• Finished good inventory drops (OEMs don’t want idle assets) but time to deliver may increase as new and used internet locator services grow – true, trend demand may be better determined

• Inspection/ maintenance requirements tighten and VMT/year increase; may move the “sweet spot” for the aftermarket demand up to 3 to 4 years from the 6 to 7 year old vehicle of today
Unit Production is being supplemented (but not replaced) with VMT usage fees and consumer data revenue streams – it has to be to make mobility affordable, accessible, and aspirational in an electrified, MaaS, zero emission/fatality world. Keep asking these questions:

- Individual v. Fleet Ownership
- Vehicle Utilization Cycles
- Absolute VMT Levels
- VMT Usage

- Reliability and Durability Requirements
- Vehicle Replacement Cycles
- Distribution of Value Through the Chain
- Financial Flows
EVs and MaaS Trends Impact the Motor Vehicle EcoSystem

New, used, scraped and VIO all provide important feedback loops related to trade-in support, commodity markets, operating costs . . .

Source: Experian, 3Q 2017

U.S. Vehicles In Operation – a 12 month view

Source: Experian Automotive as of September 30, 2017 (U.S. light duty vehicles only)

*In millions; U.S. totals include Puerto Rico
Take Aways

• The inflection point for radical product change is in the 2035 to 2040 timeframe
• To get there, and beyond, the value stream will be radically altered
• As that occurs don’t count out the incumbents, don’t extrapolate the newcomers, and don’t forget about the feedback loops
• Global momentum towards EVs will move US share towards 50 percent in the timeframe – ICE share declines as BEV gain share post-2035
• Vehicle unit sales will increase with new mobility – but vehicle designs, ownership schemes and usage patterns will radically change the segmentation underneath the top line

• For the metal forming sector, key tripwires include:
  • The transition away from traditional engine, power transfer, and fuel systems to pure BEV
  • The transition toward skateboard architectures
  • The transition toward multi-service personal transportation
• In 2030 we will be talking that the level of industry change – frequency and magnitude – will be the greatest in the next 10 years as previous 50 years
One Certainty: It is Always About One-Upmanship . . . .

Yesterday: Battle of the Fins

This time it’s about software code, not hardsteel tools
Thank You