Plastics in Automotive
The ‘Material’ Impact

Authored by:
Manish Panchal
Charu Kapoor
Hemant Vinod
Naina Malani
Plastics in Automotive: The ‘Material’ Impact

- By TATA Strategic Management Group

This whitepaper, by Tata Strategic, looks at the usage of plastics in the automotive industry. It covers the application areas of plastics and key drivers influencing its adoption. It also highlights the challenges, disruptions which could impact plastic and polymers manufacturers in future and suggests a way forward to create a sustainable competitive advantage.

Disclaimer:

All rights reserved Includes copyrighted material.

The same may not be reproduced, distributed, modified or in any manner communicated to any third party except with the written approval of Tata Strategic Management Group.

This white paper is for information purpose only. While due care has been taken during the compilation of this report to ensure that the information is accurate to the best of Tata Strategic Management Group’s knowledge and belief, the content is not to be construed in any manner whatsoever as a substitute for professional advice. Tata Strategic Management Group accepts no responsibility for any loss arising from any action taken or not taken by anyone basis this white paper.
Introduction
Polymers/Plastics, being versatile raw materials, find applications across host of end use industries including Automotive, Electronics, Consumer Durables, and Packaging to name a few. India is the 3rd largest consumer of polymers globally. The current per capita consumption of plastic products in India is low at approximately 10 to 11 kgs as compared to the developed countries' per capita consumption of 50+ kgs and China's per capital consumption of 45 kgs. Thus, there exists significant headroom for strong growth of polymers/plastics in India in coming decades.

Automotive segment is one of the leading end use segments for plastics. As in case of overall plastic consumption, the consumption of plastics per vehicle in India lags developed countries, considerably. In India, an average car uses 75 kgs of polymers as against a global average of 150 kgs in 2015.

![Figure 1: Usage of polymers in automotive segment](source)

Usage of polymers in a vehicle globally has grown from 120 kg in 2013 to 150 kg in 2015. In India, there is an overall market demand of ~250 KT per annum for plastics in passenger vehicle segment alone. This has been primarily led by replacement of metals by polymers.
Key drivers for Auto OEMs adopting plastics have been its lower weight, cost economies and versatility offered in the design.

**Plastic Applications in Automotive**

Plastic products find applications across the vehicle structure from interior to exterior, from under-the-hood products, powertrain to electrical applications. Plastics have high share of penetration in the interior and exterior parts and are slowly penetrating into other applications.

Polypropylene (32%), polyurethane (17%) and polyvinyl chloride (16%) are the top 3 polymers being used in the automotive sector. ABS and Polycarbonates are the other major plastics being used in automobiles.

**Interiors**

Plastics are currently extensively used in the interior of the vehicles from dashboard, instrumentation panel, seating among others. Its flexibility allows manufacturers to create innovative single piece design which are light weight. It also helps in noise reduction and covering vibration. These advantages not only drive costs down but also help saves time during assembly. As a result more than 50% of car interiors are now made of plastics.
Figure 3: Plastics Application in Automotive

Source: Various Industry Reports

Note: PP- Polypropylene; PUR- Polyurethane; PVC- Poly-Vinyl-Chloride; ABS- Acrylonitrile Butadiene Styrene; PA-Polyamide Nylon 6/6, Nylon 6; PE- Polyethylene; POM- Polyoxymethylene; PC-Polycarbonate; PMMA- Acrylic; PET- polybutylene terephthalate; PET- Polyethylene Terephthalate
The real challenge however is to ensure premium-ness of the vehicle’s interior décor through innovative polymer usage. There have been significant advancements on this front. Today through blended polymers and design & processing techniques, the plastic interiors look and feels (touch) like premium materials. Today, Polypropylene, Polyurethane and ABS are the major polymers used in automotive interiors. Manufacturers need to evolve from being just a plastic materials supplier to a partner that provide a package including product and associated services such as design.

Exteriors
Auto exteriors historically have been dominated by metals. However, penetration of plastics is increasing gradually. Plastic made exterior, unlike metals, are less susceptible to physical damages like dents, stone chips and corrosion. For large exterior parts such as bumper and fascia’s, the recyclability is easier leading to lower environmental impact. As a result, usage of plastics in exterior is increasing.

Auto exterior is witnessing innovation in terms of hybrid material (metal + plastics) being used. With evolution of in-mold techniques (Paint and Mold the part in a single step) the assembly and production costs are reduced further. Polyamides and ABS are the major polymers used in automotive exteriors.

Under the hood
Use of plastic was limited in under-the-hood applications earlier, considering the extreme environment there. With advancement in technology, plastics are also increasingly finding their usage in under-the-hood parts as well. Automakers and suppliers are increasingly using plastics, such as nylon, poly-phenylene sulfide and poly-propylene, to reduce vehicle weight and improve fuel efficiency for under the hood parts.

Powertrain
Powertrain contributes significant weight to an automotive. As a result, automakers are exploring plastic usage in power train as well. Plastic helps automakers to reduce weight of transmission and integrate parts. Nylon, elastomers and polyamides are increasing used for manufacturing seal rings, transmission oil pans, air intake manifolds, air ducts, suction pipes, engine front covers, exhaust gas recirculation cooler units among several others.

Electrical Systems
Plastics have excellent electrical properties and find application across various electric parts in automotive parts such as Battery, safety (fuse) and control systems and Multimedia and infotainment. Typically, polyamides are used in automotive electric systems. Nylon, polyester and acetyl resins find application in switches. Polybutylene terephthalate (PBT) and PET are used for electrical fuel injector connectors’ applications.
Key Drivers

**Light-weighting**
Indian government has put in place stringent norms for improving fuel efficiency in April 2014. The new standards are called Corporate Average Fuel Consumption (CAFC) standard. The Indian government has set a target of 14-percent increase in fuel mileage by 2016/17. Regulation gets even more stringent with a 38% increase in fuel efficiency by 2021/22. Indian OEMs are considering light weighting as one of levers to improve fuel efficiency. Also, the fuel emission norms will get more stringent as India will jump directly from BS IV to BS VI (equivalent of Euro VI) which will come in place in April 2020.

Plastic play a key role in improving fuel efficiency and lower emission by reducing the weight of vehicle. 1 Kg of plastic can typically replace 2-3 Kg of traditional materials in a vehicle. And typically, 100Kg reduction in weight can save 0.3-0.4 Litre of fuel on a distance of 100 Km, as per the Europe commission report on light-weighting.

Even globally, 65% of automakers, as per the Wards Auto 2016 Survey, are considering light-weighting as an option to meet the CAFE (global equivalent of CAFC) 2025 targets. Automakers are however only moderately confident about existing materials to meet the requirements. Engineered plastics are among the top choices along with Aluminium and mixed materials.

**Increased Safety**
Indian government has mandated automakers to undergo frontal and side crash test for their new vehicles from 2017. Plastics, because of their impact absorption capability are being increasing used in parts as shock absorbers for bumpers, air bags and side impact protection. Several automakers are using impact resistant plastics in side doors to provide safety in side-on crashes. Plastics are also used for fuel tanks as they are seamless and less prone to failures during accidents.

**Innovative Design**
Overall automotive design (interior & exterior) is one of key determinant of vehicle purchase among other consideration such as price, brand, and fuel economy. It is also one of the ways to differentiate in the market. As a result, automakers continue to innovate on design. Plastics’ versatility allow innovative shapes, design, styling and forms vis-à-vis metals. For example, design of single unit front fascia, at low cost, is difficult using metal as input. While lending versatility, plastics don’t compromise on safety, comfort or stability of a car. It offers better protection against corrosion than metals and improves lifespan of vehicle. It also allows engineers to combine several parts into one (creating modules) which are cost effective and easy to assemble.

**Lower Assembly Costs**
Plastics help in modularization of automotive parts. For, example, Dashboard, Bumper, Fender among others can be moulded as one part instead of several parts, as for metals. This helps in reducing the assembly time and costs as compared to multi metal parts production and their assembly.
Key Challenges

Managing environmental impact
More than 75% of the automotive parts are recyclable. Most of the large plastics parts such as bumper, fenders can be easily recycled. However, there are large numbers of small plastic parts with encased electronics which are difficult to recycle. End-of-life vehicle (ELV) regulations are being proposed in India where each plastic part will be codified. With stringent tracking and regulation, automotive industry needs to find innovative/alternative way (setting up reverse logistic) of recycling these parts to ensure lower impact on environment. For example, Renault (in Europe) tied up with a plastics compounding to recycle plastics parts like car bumpers.

Other light-weighting options
Aluminium, multi materials, carbon fibres are other materials considered for light weighting of vehicles. Aluminium is one of the key light-weighting options with applications in car body and Chassis & powertrain. As of 2015, 8-10% of vehicle weight is contributed by Aluminium for an average car. Advances in Steel may also stem the rate of substitution. There are developments in steel product in terms of grades (High strength steel, dual grades) and processes (Laser welding, press hardening) which can drive down the weight at lower costs.

Carbon fibre, even though costly (5x times steel), can change the market completely with its significant light weighting potential and high strength-to-weight ratio. Carbon fibre has already made headway into aviation sector and racing cars. Some of the premium passenger vehicles are also incorporating carbon fibre in the vehicle architecture.

Price volatility
With increasing complexity of applications, plastics need to ensure price advantages of plastic products over other light-weighting materials. Since the plastic prices are linked to oil prices, there are concerns over its volatility. Commodity polymers used in automotive industry are derived from crude oil and thus are more prone to price volatility. However, the advanced engineering plastics prices are more driven by end use demand and less susceptible to price volatility of crude.
Possible Mega Shifts

3D Printing

India is still an emerging market for 3D printing but manufacturers across verticals are seeing the benefits of 3D printing and are exploring the disruptive technology. Currently the technology is being majorly used for prototyping. It can help in conceptualizing the design quickly and shorten the time to market which is crucial for the automotive industry. Commercial application on a large scale currently is not economical since large format 3D printers are expensive. 3D printing market in India is estimated at ~USD 1Bn in 2015 with automotive sector contributing approximately 20% of same. With improvement/innovation in 3D printing technology, commercial applications may become a reality sooner than we think and completely alter the automotive manufacturing value chain.

![Intensity of disruption](image1)

Electric/Hybrid Vehicles

Electric/Hybrid vehicles are expected to grow rapidly in the next 25 years and their sales are expected to hit ~40 million by 2040 globally, representing 35% of new light duty vehicle sales. Batteries of these vehicles are heavy and affect the vehicle performance. As a result, there is light-weighting requirement in EVs. EV manufactures are increasingly using plastics to replace metals. Reva e20, Mahindra Reva’s electric vehicle, uses 80 kg of plastics for instrument panel, fenders, front & rear bumper and the plastic body. Rapid growth in EV along with light-weighting is expected to drive demand for plastics in the next 20 years.

Autonomous/Driverless vehicles

Automotive market is also witnessing the emergence of Autonomous/self-driving cars. Google, Ford, Tesla among many others are investing in this concept and are running prototypes. Most of these autonomous cars are electric/hybrid vehicle with significant share of plastics usage. For example, Google’s driverless car body was entirely plastic. Commercial launch of autonomous vehicles, with plastic at heart, can disrupt the automotive industry in the next 2-3 decades. It can potentially transform the auto sector from being a product driven industry to a service driven industry.

Figure 5: Possible mega shifts in Automotive

Source: Various Industry Reports, TSMG Analysis
Uberization

‘Uberization’, providing cheap and convenient transport service along with pooling of customers, can drive people to forgo personal vehicle ownership. This trend along with self-driving vehicles can drastically drive down the sales of new automobiles by 80-90%, as per an OECD study. With people no longer viewing the vehicle as an asset, but as a transport service, the demand for aesthetics and performance of vehicle will no longer be as stringent as for an owned vehicle. For example, people may accept less premium looking vehicle interior for a cab than for their owned vehicle. This will dramatically change the demand dynamics for automotive and role of plastics.

Way Forward

Substitution of metal components in cars by plastics will continue to drive demand for plastics in the coming years. In the short term, this will be primarily driven by requirement of reducing vehicle weight to meet CAFC norms. In the long term, to keep costs in check, OEMs will further move towards composites which provide right price, performance and safety mix. To serve their customers, the plastics manufacturers will need to understand the direction in which the OEMs are moving and will need innovate and adapt for Indian requirements.

Plastic, as a material, has traditionally faced competition from aluminium, steel, magnesium alloys among others. In future, the competition is likely to be increased further from new-age materials comprising of composites, carbon fibre reinforced materials and nano-materials. To add to it, 3D printing could bring in new entrants into the industry which otherwise would not have been easily possible. All of the above could completely alter the value chain of plastics in automotive industry in the future. Automotive plastic manufacturers need to adapt rapidly and build required capabilities to overcome such threats. Existing business models need to be re-assessed and changes need to be implemented timely to ensure that the business continues to remain relevant and successful.

Automotive industry is about to witness a major shift/disruption in the way it operates. ‘Uberization’ is becoming mainstream with each passing day. While there may be certain speed-bumps along the way and it could come under the ambit of regulations but sooner than later, the business model will mature. The impact of this could be tremendous on type of plastics being used. It may completely wipe out or multiply demand several folds for select plastics / composite combinations. Therefore, plastic manufacturers need to ensure that there is adequate diversification in their business and their overall business strategy reflects the initiatives which leverage the possible disruptions to create a sustainable competitive advantage.

Understanding the consumer, their preferences and the factors which influence their preferences could be the key differentiator for plastics manufacturers going forward. This could imply plastics manufacturers moving from product only to a platform based model where they work jointly with automakers and consumers right from the conceptualization/design phase of the product itself. The plastics manufacturers will need to critically assess the consumers’ preferences and future relevance of polymers by application and market. By working closely with customers, market for select polymers / plastics could be created in future.
About Tata Strategic

Founded in 1991 as a division of Tata Industries Ltd, Tata Strategic Management Group is the largest Indian own management consulting firm. It has a 50 member strong consulting team supported by a panel of domain experts. Tata Strategic has undertaken 1000+ engagements, with over 300 clients, across countries and sectors.

It has a growing client base outside India with increasing presence outside the Tata Group. A majority of revenues now come from outside the group and more than 20% revenues from clients outside India.

Tata Strategic offers a comprehensive range of solutions covering Direction Setting, Driving Strategic Initiatives and Implementation Support.

Our Offerings

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Revenue Enhancement</th>
<th>Operational Efficiency</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Competitive Strategy:</td>
<td>• Adjacent Products</td>
<td>• Supply Chain Optimization</td>
<td>• Strategy – Culture Alignment</td>
</tr>
<tr>
<td>Entry /Growth</td>
<td>• Underserved Segments</td>
<td>• Workforce Productivity</td>
<td>• Change Management</td>
</tr>
<tr>
<td>• M &amp; A Support</td>
<td>• Sales Effectiveness</td>
<td>• Throughput</td>
<td>• Family Governance</td>
</tr>
<tr>
<td>• New Biz Models</td>
<td>• Customer Journey</td>
<td>• Service levels</td>
<td>• Talent Management</td>
</tr>
<tr>
<td>• Profit Enhancement</td>
<td>• Route to Market</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Drive Implementation & Change to derive Benefits

• Revenue
• Term sheet
• Market Share

• Profit
• Volume
• Key Milestones

• Cycle Time
• Service level
• Costs
Tata Strategic Contacts

Manish Panchal

Sr. Practice Head – Chemicals, Energy & Logistics
E-mail: manish.panchal@tsmg.com
Phone: +91 22 6637 6713

Charu Kapoor

Principal – Chemicals
E-mail: charu.kapoor@tsmg.com
Phone: +91 22 6637 6756

Co-Authors of the white paper

Hemant Vinod - Project Leader
Naina Malani - Analyst

WWM Contacts

Phone: +91 22 2273 3535
E-mail: themachinist@wwm.co.in