THE BENEFITS OF
Injection Molded Plastics in an EV/AV World

By PTI Engineered Plastics

Over the years, plastic has developed into one of the most critical materials in modern manufacturing. The advancements in plastic injection molding technology have made the entire design and manufacturing process faster, more predictable and precise, thus enhancing the functionality and application capabilities of the plastic materials. Plastic components are the preferred choice for advanced technological and scientific applications across many industries, as plastics offer functionally diverse, high quality, durable, corrosion-resistant, dimensionally repeatable and affordable products.

Utilizing plastic injection molded components is standard practice in automobile manufacturing. Plastic components cost less to produce, weigh less, and are often more durable. Using plastics in electric and autonomous vehicles goes hand in hand with the market goals of reducing a vehicle's adverse impact on the environment, while still offering attractive and safe vehicles that provide for reliability and cost efficiency. Plastic components can contribute to an enhanced driver and passenger experience by reducing noise and vibration in the vehicle interior. And, by reducing its overall weight, a vehicle's handling and acceleration is improved while achieving a greater range between charges.

On the supply side of the equation, the process to produce plastic components can be more energy efficient and cost effective than producing metal components. Utilizing plastic components can also provide manufacturers with greater flexibility in meeting their EV/AV design requirements.

Advancements in injection mold manufacturing equipment, such as high-speed CNC and EDM processes, have significantly improved project lead times. Additionally, utilizing the plastic injection molding process during the product development and prototype phase can appreciably shorten the overall part development stage, thus reducing time-to-market.

During an event hosted by Plastic News titled "Plastics in Automotive 2020," several industry leaders shared their thoughts and opinions around the future innovations of vehicle design and product development, particularly with the movement towards electric (or alternative energies) and autonomous vehicles. They see substantial, current trends in investments for innovation, research & development, prototyping and much shorter design-to-market timelines. The panel stated that there is a significant need for collaboration between the OEMs, Tier 1s and their sub-suppliers to determine how vehicles will be designed and built in the future. For a quickly evolving marketplace, there are several significant needs/demands:

- ***Achieve shorter design-to-market timelines*** – What processes and technologies can best support the 'go-fast' timing requirements of the automobile industry's intent to achieve a 12 to 16-month total vehicle development cycle timeframe?
- ***Reduce costs*** – Discover cost-effective ways to meet the challenge of a 'low volume' based market segment with a high mix of the ever-changing wants, needs and requirements.
- ***Make use of resources*** – Identify product development resources that can quickly take advantage of opportunities that the exponential growth of technological advancements is presenting.

Functional prototyping may prove to be a significant tool to be used in pursuit of considerably reducing the "design-to-market" timeline in a very affordable manner.

BRINGING A NEW PRODUCT TO THE MARKETPLACE THROUGH PROTOTYPING

"Functional prototyping" for injection molded parts can play a key role in successfully fulfilling the industry's critical needs of achieving quick to market, product development-to-production launch cycles in a very cost-effective way. Computer generated design models and simulations should help provide confidence that an idea is conceivable and manufacturable, however prototyping will generate a working model which is functional. Developers can then be allowed to get their hands on it and try it out and experience the product in its intended function and form. This critical step can be a very low-cost / low-loss investment providing for either a 'go,' 'no-go' decision or feasible refinement opportunities to arrive at the final product. Utilizing lower cost aluminum tooling will allow for a sufficient number of parts to be produced to fulfill these protype goals. Prototyping allows you to streamline the design development process, focusing on important interface elements.

Below are several general benefits of prototyping:

- Advance through the development process quicker and more efficiently;
- Discover potential and probable design errors and/or opportunities;
- Identify hurdles early in the development process rather than later, providing low risk, cost-effective ways to:
  - Examine potential manufacturing difficulties before they even have a chance to develop
  - Gain real-life experiences before product launch
  - Test and verify the design's feasibility and correctness before investing time, money and resources into volume production
  - Identify unnecessary elements that are best abandoned
- Acquire valuable, increased, user involvement and input;
- Visually represent requirements instead of abstractly defining them in a computer-based model.

Industry experts agree that we cannot underestimate the importance of the prototyping process. The main reason for prototyping has always been to validate an idea and is the very critical step in converting an 'idea' into a 'real product.' Prototyping provides a low-cost approach to deliver a detailed working model allowing for the creation of a viable product, thus paving the way for a manufacturable final product and its variations.

Computer generated design models and simulations ideally should provide confidence that an idea is conceivable and manufacturable. There has often been the thought or desire by OEM's to skip the physical prototyping phase of a project and go straight to production tooling from CAD generated information. However, most will argue, primarily based on past experiences, that relying on this theoretical type of information alone to invest in the construction of production tooling comes with great risk.

FUNCTIONAL AND SEMI-FUNCTIONAL PROTOTYPING

The plastics industry offers several prototyping processes, including additive manufacturing and plastic injection molding.

Additive manufacturing processes such as SLS, SLA and 3D printing will provide affordable opportunities to produce physical prototype models. In many cases these models can serve to prove out a design for function and aesthetics, also giving the designer and engineers the opportunity to touch, feel, and perhaps trial the products intended design. However, this method can also provide deceptive results if the intent for production will be that of injection molding. Part feature can be produced using additive manufacturing that cannot be accomplished with injection molding.

The injection molding industry also has a collection of methods available to achieve quick-turnaround functional prototypes. By utilizing a collection of high-speed machining equipment, machine friendly materials – most frequently some grades of aluminum – and modular tool build options, it is not uncommon to see functional prototype parts in a matter of 2 to 4 weeks. Based on the simplicity or complexity of the part design and required thermoplastic material, there are services available where you may receive functional parts in days rather than weeks.

PRODUCTION CAPABLE PROTOTYPING

"Production Capable Prototyping" is an efficient path from concept to production. So, what exactly is production capable prototyping? A production capable protype part is one that can be used for testing and design verification; it can also be used to satisfy the most rigid of validation protocols such as the PPAP process. Tooling for these types of parts can be made from varying strengths of steel depending on the complexity of the part and market entry production volume. Benefits of a "production capable prototype" include:

- Speed of a prototype with the quality of production
- Provides for design verification, prototype requirements, and can be utilized as a bridge tool for production
- Lower overall development costs
- Has the potential to yield tens of thousands of shots
- Has the flexibility to handle design changes quickly
- Can handle complex shapes and tolerances
- No compromise to intended designs
- No resin or color limitations
- Provides an excellent collection of manufacturing information creating a powerful learning curve to leverage
- Can have the ability to satisfy the most rigid of validation protocols
- Reduces the number of manufacturing processes allowing for a streamlined timeline

By achieving this validated level, parts off these tools can then be used as saleable product for testing and filling early market needs. This bridge-type tooling

approach can generate a revenue stream for the customer while their high-volume production tool is being designed and manufactured. In some cases, especially in low production volume scenarios, this solution may have the ability to provide enough parts to satisfy the life cycle of the product.

THE FUTURE OF MOBILITY

In continued pursuit of gaining a deeper, thought provoking, understanding into how industry leaders view the future of mobility, ***John Waraniak, SEMA Vice President Vehicle Technology, 2019 SAE Fellow***, provided the following insight:

Today's automobility trends and technologies are driving future vehicles as well as the future of manufacturing through generative design and deep customization. Future factories will be physical, virtual, additive, injected and digital. Automotive and mobility design, manufacturing, prototyping and

production technologies are rapidly evolving on many fronts. *"Generative design practices and innovative lightweighting techniques combined with plastic injection and additive processes will make impossible designs possible."* Future cities will be dominated by connected, electrified and automated vehicles. Our cars will be faster, smarter and cooler – and so too will our future factories. Automotive customers are demanding greater vehicle personalization and unique ride experiences. *"Welcome to the Golden Age of New Performance, Automobility and Deep Customization."*

The auto industry, racing and performance are experiencing one of the biggest transformations since the beginning over 100 years ago. Autonomous, electrification and advanced safety performance technologies are some of the most disruptive technologies of our lifetime. "Beyond just cool, the automobile has been a cornerstone of man's ingenuity, mythology, mobility and fascination. Cars are works of art, access, power, fashion and fun. They uniquely capture the ideals of freedom, mobility and inventiveness that drove us straight into and through a remarkable Industrial Age years ago – *and will continue to do so after our current COVID-19 challenges*."

Motorsports and racing have always been a driving force for automotive product development. Racing is part of our autonomous future. It's the Gemba and frontline for solving problems and demonstrating technology on the World Stage. If you aren't already paying attention to today's advanced design, manufacturing, prototyping and production technologies and the role that plastics play in our autonomous and electrified future – start now! *The future belongs to the prepared!*

FINAL THOUGHTS

The challenges for the EV and AV markets will be many. The electrification and connectivity of vehicles are driving a dramatic difference in how vehicles are designed and built and affecting almost every element of the vehicle as we know it – especially the platforms on which they are built. In the past, everything was basically built to print. We have now entered an era of innovation trial & error until the design solution is achieved. The strategic and innovative use of plastics along with functional prototyping will be invaluable and integral to the successes of this future direction. These are evolutionary and very exciting times for the vehicle marketspace and the future of mobility. As Kevin Roberts, Global Automotive & Transportation Senior Analyst at Ernst & Young put it, "Future is about striving towards environment-friendly, integrated, automated and personalized travel on demand. Because so many of the futuristic mobility services have yet to transition to reality, many analysts including Roberts seem to agree that it "may be easier to forecast the long-term future than the near-term." (Automotive World, March 2019). In the meantime, we must continue to explore ways in which we can apply the materials we have at hand to keep pace with our active and sometimes outrageous imaginations.

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