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Ingenuity for life

Automotive suppliers must embrace faster innovation to adapt to new realities

The automotive industry is facing many ongoing challenges, including adapting to global growth, adhering to enhanced fuel efficiency and emissions standards and increasing reliance on electronics and embedded software. In addition, automotive suppliers must be prepared for regional expansion and to invest in new technologies in spite of highly competitive conditions. So there is greater pressure than ever to provide innovative solutions while maintaining profitability and meeting delivery expectations.

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Executive summary

Three of the more significant trends in the automotive industry include meeting new fuel economy standards, relying more on electronics and embedded software and keeping up with the growth of the industry. Stricter fuel economy and emissions standards are called for around the world and are expected to be met by 2025. These fuel economy and emissions standards as well as improvements to safety, growth of intelligent mobility and customer desires for integrating their lifestyle into the vehicle means that the original equipment manufacturers (OEMs) have to rely on a combination of design innovation and more electronics and embedded software content to meet the demands of the marketplace. The industry has also recovered nicely from the financial crisis in Asia and the United States, but is still struggling to return to growth in Europe. Growth is expected to continue around the world, especially in Asia.

These trends are causing a fundamental change in vehicle technologies, requiring more innovation from automakers and suppliers in alternative propulsion, vehicle lightweighting and energy optimization. Adopting these new technologies and product innovations is driving more interactions across vehicle systems and components. Integrating mechanical, software and electronic components is critical for meeting performance targets.

Suppliers need to expand their capabilities in electronics and embedded software design and integration with mechanical design to make sure that they manage these interactions and the effect that they have on vehicle attributes and overall program execution and delivery. The global growth of the industry also increases the pressure on suppliers to expand their own engineering, manufacturing and supply chain footprints around the world, which adds program and operational complexity.

For suppliers to realize more profitable innovation, they need to consider opportunities to optimize designs and improve validation earlier in the development process, enable cross-discipline development, quickly adapt to a changing global structure and improve visibility to program execution and risk management.

The ideal solution set to capitalize on the pressure for greater innovation includes model-driven program execution to provide early and comprehensive simulation and validation, fast and efficient design creation, integrated manufacturing validation and predictable program performance and profitability.

Global growth drives innovation

The growing importance of emerging economies – most notably China – will dramatically affect OEM and supplier value creation.

The automotive industry continues to enjoy robust growth. The industry has recovered very well from the financial crisis and growth continues at a high rate in spite of the lowest European sales levels in 20 years.

Asia continues to be the growth engine for the industry. China became the world's number one market in 2009, while the

United States has recovered from selling less than 10 million vehicles in 2008 to 15.6 million vehicles in 2013. This growth is providing industry record-setting profits, with the exception of a few OEMs that have more of a European-centric footprint. The high profitability of the industry in the current cycle is providing the necessary incentives for driving investment and innovation to achieve the forecasted growth.



Fueling an unprecedented rate of change

Mandatory fuel consumption, fuel economy and greenhouse gas (GHG) standards for light-duty vehicles are currently in effect for more than 70 percent of the global new vehicle market.

In fact, according to the analyst firm Aberdeen Group, automotive companies report that fuel efficiency and emissions standards are the top pressure that they face, and that is driving an unprecedented rate of change for OEMs and suppliers in developing more efficient powertrains and vehicles. Companies are pursuing new propulsion technologies, such as electrification and hybridization, improving the internal combustion engine and transmissions as well as making other improvements in driveline components. Vehicle teams collaborate closely with powertrain engineers to lessen the energy demands throughout the vehicle, including lightweighting, improved aerodynamics and other elements.

The industry continues to push for performance not only to be best-in-class, but also to define brand differentiation and

character. This is critical for defining best-in-class products. The brand differentiation for automakers includes passive and active safety, comfort, driving experience, reliability and acoustic sound quality. Many of the innovations introduced for fuel economy also affect the brand performance. The effort to achieve the balance of performance and cost is driving significant investments in systems engineering and optimization. As the complexity of vehicle systems increases with new types of powertrain and chassis actuators and breakthroughs in reducing losses and waste energy recovery technologies, these innovations demand a fundamental increase in the sophistication of the control system. Increasingly, the simulation of mechanical systems with control software is playing a larger role in the design process. Modeling is helping suppliers better address the complexity of vehicle systems and reduce the risks and financial investments as they seek to implement systems integration and verification.

Electronics and software play a key role

Automotive OEMs rely on electronics and software as a key mechanism to manage vehicle and powertrain performance to meet the fuel economy and emissions regulations, improve safety, enable intelligent mobility and incorporate new features and capabilities demanded by consumers to better integrate their individual lifestyle.

The advantage of using software to implement much of this functionality is that automakers can keep pace with the fast changing requirements and desires of the global markets.

According to a January, 2014 report by the Aberdeen Group entitled, "How Prepared Is the Automotive Industry? Solutions

for Meeting Fuel Efficiency and Emissions Standards", in response to the question, "What do you expect to be the most significant change to automobiles and the automotive market within the next decade?", the leading answer with 23 percent was "greater use of embedded software to control vehicles."

When asked what their companies were doing to achieve the fuel efficiency or emission standards in the next six to 12 years, 42 percent said they were relying more on embedded software to control systems.

Taking the necessary steps to meet fuel efficiency standards

Suppliers face increasing pressure to innovate more than ever before while attempting to maintain profitability and meeting delivery expectations. The rate of technology adoption drives increasing cost pressure and risk.

The top external pressure driving this technology adoption and greater innovation is compliance with fuel efficiency standards. In fact, according to that same Aberdeen Group report, 60 percent said that the top external pressure driving the development of new automobiles was the need to comply with fuel efficiency standards.

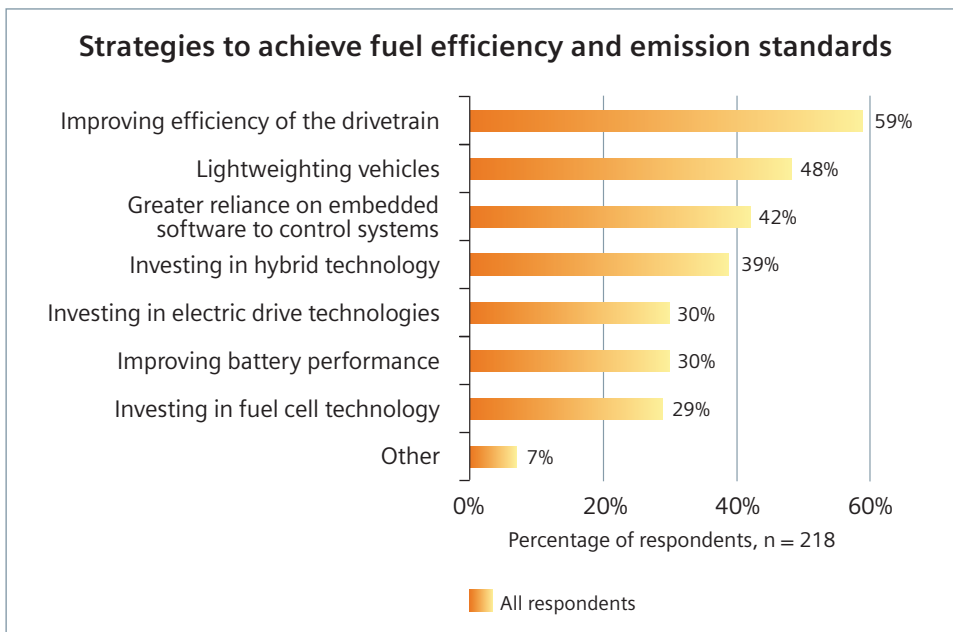
To this end, reducing vehicle weight will be a challenge that affects all parts of the vehicle. Suppliers will be asked to reduce weight of components, even those that have performed well in the past. The challenges of meeting lightweight targets will require that suppliers push to optimize their structural designs through weight reduction by a combination of redesign and introduction of new materials.

Vehicle lightweighting is driving a shift to alternative materials, such as aluminum, new steels and increased utilization of

plastics, including long-fiber reinforced thermoplastics, composites and foamed polymers. Most suppliers don't have extensive experience working with these materials, so improved modeling and simulation can help them shorten the learning curve and quickly ramp up the engineering of these new materials.

Alternative propulsion and energy optimization requires new technologies to be developed and tough engineering problems to be solved, not only by OEMs but by the suppliers as well. System complexity has risen significantly with the level of vehicle system interactions, and that, in turn, has driven further product and process complexity.

Suppliers must still deliver flawless performance for new products and technologies that do not have a performance history. Just by their nature, these clean sheet designs carry more risk in terms of executing to timelines and milestones, cost and quality targets; not only for program execution, but also for the value recovery by the supplier who made the investment.



Source: "How Prepared Is the Automotive Industry? Solutions for Meeting Fuel Efficiency and Emissions Standards." January, 2014. Aberdeen Group, Inc.

Software speeds the adoption of electronics

Suppliers must improve their electronics and software capabilities as well as system development knowledge to deliver more complex systems.

WardsAuto reported that Jacqui Dedo, chief strategy and procurement officer for auto supplier Dana, told attendees at the 2013 CAR Management Briefing Seminars at Traverse City, Michigan: "Every part of the vehicle has been impacted by electronics in the past 30 years, and today it accounts for more than 40 percent of a vehicle's cost, up from 20 percent just 10 years ago. Electronics will continue to become more

pervasive throughout the vehicle, with sensors, controllers and new innovations being used to improve existing systems."

With electronics content currently accounting for 30-40 percent or more of a vehicle's cost, and projections predicting continued growth in this area, the need to manage more complex phenomena and interactions of the systems in vehicles makes systems design and integration across multiple domains critical for success. Incorporating new technologies and innovations demand a fundamental increase in the sophistication of the control systems in the vehicle.

Meeting rising global demand

In order to meet the needs of the market, top automakers have been greatly expanding their model lineup. Since 1998, most automakers have tripled the number of models they have to create to meet the demand for each market and to enhance their brand. This model proliferation is creating huge challenges for supplier engineering and manufacturing organizations to manage the increased number of product variations and configurations to be engineered and manufactured around the world.

As automakers expand their market reach, they expect suppliers to follow suit and engineer and produce parts globally in these same local markets. This adds significant complexity to program execution for suppliers as they must manage a larger base of operations and develop personnel to deliver components that meet the automakers' expectations in each of these markets.

The general graying of the workforce around the world and a lack of experienced, skilled professionals affects the supplier's ability to execute programs globally. The effect of retiring baby boomers is particularly acute in the United States; the first of this generation reached retirement age in 2011 and this will continue well into the next decade.

The expansion of vehicle system design and development to emerging markets also requires development of the required skills and knowledge transfer for core product development processes and methods and appropriate managerial oversight.

The Tier 1 supply base will face larger risks in terms of missing cost, time and quality targets. Having visibility into the execution of the program will be critical.

Executing program innovation to gain a competitive advantage

For suppliers to realize more profitable innovation, they need to consider opportunities to optimize designs and improve validation earlier in the development process, enable cross-discipline development in a unified environment, quickly adapt to a changing global structure and improve visibility to program execution and risk management. We call this new, more efficient approach “executing program innovation” because it enables automotive suppliers to achieve greater success in this dynamically changing industry.

Optimizing designs and improving validation earlier in the process

These trends and new innovation focus areas will shift the industry toward more new clean sheet designs, pushing the need for more advanced computer-aided engineering (CAE) and simulation models that are integrated into the design process to improve validation of both parts and system performance earlier in the development process.

Vehicle lightweighting is increasing demands on the CAE and simulation environment with the introduction of new materials and assembly processes.

There will also be extreme pressure on program execution for suppliers. New programs will require more innovative content and taking higher risks with weight-optimized designs, new materials and more complex alternative propulsion and control systems.

Clean sheet designs carry more risk in terms of executing to timelines and milestones, cost and quality targets. Program visibility will become even more central to suppliers. Visibility and transparency into design status, timing, cost and part/system validation will be critical as designs are pushed to new limits.

Enabling cross-discipline development in a unified environment

To address these trends and new innovation focus areas that require greater system complexity and embedded software controls, it is important to ensure that the extended team can collaborate across the vehicle and system disciplines, and leverage a product development environment that can bring together mechanical, electrical and software systems.

Decisions on system architecture made early in a program cycle have a strong effect on downstream design activities, and provides the ability to meet cross-functional requirements effectively while managing costs. As such, suppliers of these systems need simulation tools that help with these early architectural decisions and drive the correct requirements for subsystem and component design.

Making this full context or complete product definition available to all the members of the distributed team allows them to design their products effectively while ensuring that they do not compromise the overall performance of the final vehicle.

Quickly adapting to a changing operating structure

For suppliers to improve overall program control and risk management in this global environment, they need to quickly adapt to a rapidly changing operating structure with greater transparency and accuracy to optimize costs and investment, lower the risk of quality issues and warranty and minimize launch delays.

Suppliers are required to demonstrate and provide increased responsibility for the design, development, prototyping and final production of parts. The supplier is asked to do more project management with extensive coordination, sourcing, qualifications and all at lower costs. Suppliers need to

demonstrate their ability to perform all these tasks on time, on budget and with high-quality successful launches. With changes to their product portfolio, global distribution of plants and development centers and multiple customers, there is a great need for a standardized, simplified process that will enable suppliers to work across all product lines and ensure that operations are profitable.

Improving transparency and accuracy across the value chain

To address these trends and the increasing rate of change in vehicle programs, program visibility will become even more central to suppliers. Visibility and transparency into design status, timing, cost, weight and other attributes as well as part/system validation will be critical to reduce program risk as designs are pushed to new limits and development personnel around the world grow their overall skill level.

Higher product variability means that quick, detailed and reliable cost and weight information is required even during very early product stages. Also, the share of tool costs in relation to the total costs of a product line is steadily increasing. This implies a greater need to include the cost estimates of tools and timing of investments in product cost management, both in tool and mold making as well as in tool purchasing from suppliers and OEMs.

Program execution is cross-functional, involving many different roles in an organization such as program management, sales, product development, purchasing, cost engineering, finance and production. An integrated, cross-functional approach improves efficiency, speed and accuracy of decisions, delivering greater return on investment (ROI).

Achieving innovation through model-driven program execution

Model-driven program execution can help suppliers capitalize on this greater pressure for innovation while improving overall program control and risk management. To ensure success, the following key focus areas should be considered part of the overall solution:

- **Comprehensive development of systems through model-driven simulation and validation, including integrated controls/physics simulation, 1D and 3D simulation**
With the rate of change of new technologies and designs in vehicle systems, it is critical to have the ability to virtually model and validate the performance and behavior of these systems before physical prototypes are developed. Addressing system validation requires a multilevel systems approach, in which performance validation tools are complemented with control models and integration models to assess the relevant system and vehicle performances. A clever combination of simulation and test-based approaches contribute to the overall performance validation cycle.



- **Fast and efficient design creation**
To reduce development time, look for an integrated solution with an open and flexible modeling and design approach, the capability to capture the organizational knowledge and best practices and the capacity to effectively integrate the product design and validation with the manufacturing engineering of molds, tools and fixtures.
- **Integrated validation of manufacturing to optimize process productivity and efficiency**
Improved cost, quality and flexibility in manufacturing are critical for taking advantage of new innovations and platforms to meet the regulatory demands in each market as well as customers' desires for reliable performance and comfort. Manufacturing must also ensure that the production volumes can be achieved while meeting the quality targets, operator safety is always maintained and the facility meets any regulatory requirements for its geographic location.
- **Integrated program planning and costing for predictable program performance and profitability**
Automotive suppliers must collaborate effectively in all stages of a program to avoid absorbing costs associated with fixing last-minute launch or warranty problems. This becomes especially important when faced with managing an ever-increasing number of programs. Greater visibility and transparency into program execution will be critical as the industry moves forward on its journey to meeting future fuel and emission standards and overall global growth.

Conclusion

Automotive suppliers are required to demonstrate and provide increased responsibility for the design, development, prototyping and final production of parts and systems. They are asked to do more project management with extensive coordination, sourcing and qualifications, all at lower costs.

Suppliers need to demonstrate their ability to perform all these tasks on time, on budget and with high-quality successful launches. However, they are more diversified, have remote plant locations and multiple customers. As a result, there is a great need for a standardized, simplified process that will work across all product lines and ensure that operations are profitable.

Meeting these needs for faster innovation combined with greater program control and risk management requires adoption of a model-driven approach to program execution.

Suppliers who do not adequately adapt to these changes will find themselves struggling for survival, while those that capitalize on the greater innovation pressure to bring to market new technologies and products while improving overall program visibility, control and risk management will carry the day.

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