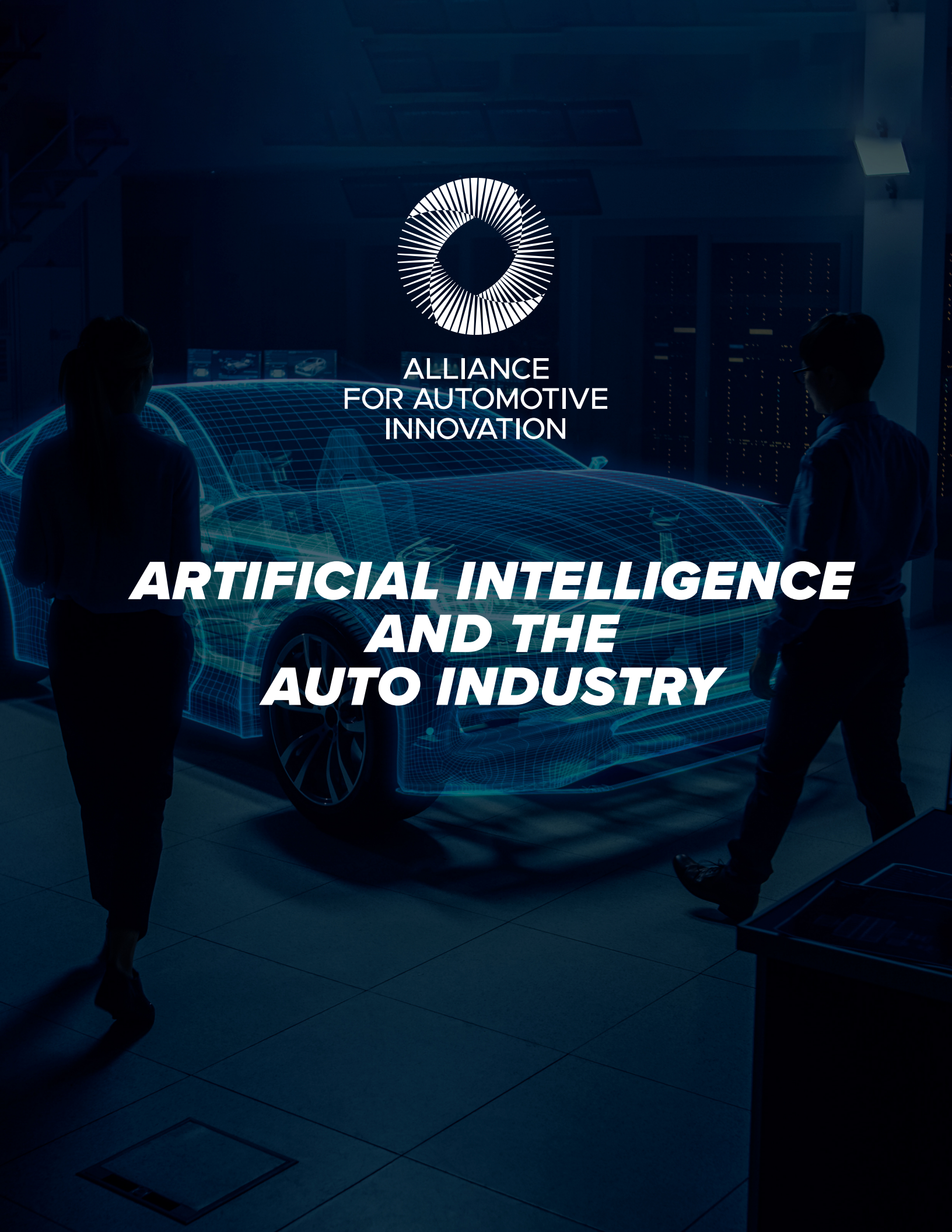

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Executive Summary

The U.S. automotive industry is at the leading edge of an unprecedented, generational transformation. This transformation involves creating a cleaner, safer, and smarter future for personal mobility.

The technologies that are facilitating this global transformation – including automation, electrification, connected services and applications, and new mobility models – are increasingly enabled by advanced technologies, including artificial intelligence.

U.S. law defines "artificial intelligence" as "a machine-based system that can, for a given set of human-defined objectives, make predictions, recommendations or decisions influencing real or virtual environments."[1] Artificial intelligence is a broad term and includes technologies like natural language processing, machine learning, and computer vision.

Artificial intelligence is used widely across the automotive industry, and the potential applications for this technology in the automotive space are extensive. Advances in artificial intelligence have the potential to protect vulnerable road users, reduce serious traffic injuries and deaths, improve roadway safety, and provide environmental benefits.

Examples of automotive use cases involving artificial intelligence include:

- ***Design engineering processes*** that reduce the number of iterations needed to align design ideas and engineering considerations.
- ***Advanced vehicle manufacturing*** that engages in quality control, assists workers, anticipates equipment failures, and manages supply chains and demand forecasting.
- ***Collision avoidance systems*** that monitor a vehicle's surroundings, identify potential hazards, and direct a vehicle to take certain actions to prevent a crash.
- ***Attention assistance systems*** that alert drivers to help mitigate driver error and help reduce risky driving behaviors.
- ***Predictive maintenance systems*** that warn drivers to correct potential vehicle system problems before they occur.

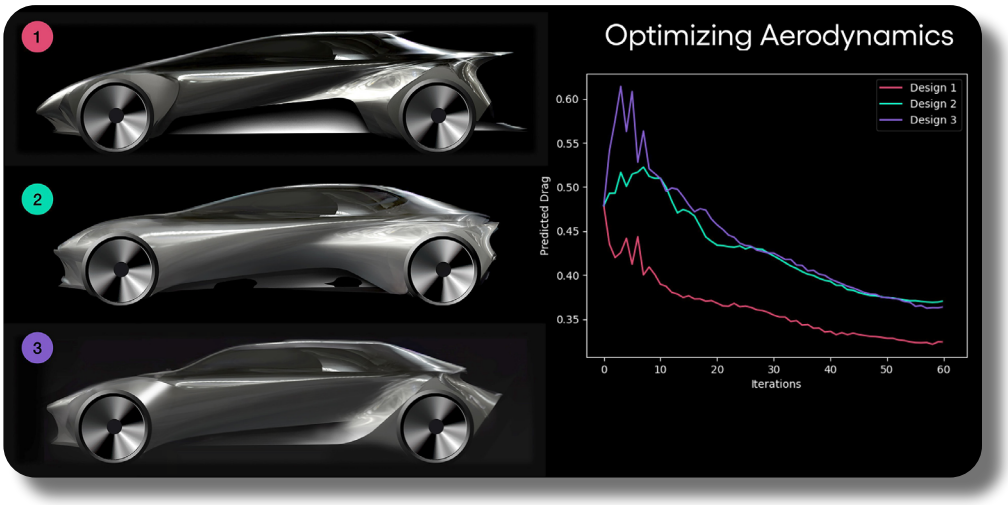
To ensure a healthy and competitive automotive industry that supports U.S. economic and national security, the U.S. government should foster a regulatory environment that promotes innovation and encourages the trustworthy development and deployment of artificial intelligence. Such an approach should aim to address specific risks and use cases; avoid overburdensome regulatory obligations; support further advancements in technology through research, design, and development; and ensure global harmonization of regulatory frameworks.

[1] See 15 U.S. Code §9401 (3).

Artificial Intelligence and Vehicle Design

Generative artificial intelligence is a type of artificial intelligence that can create new content, such as text, images, audio, and video. In the automotive context, generative artificial intelligence can be used to design vehicles, supplementing the traditional product development process to address characteristics like aesthetics and aerodynamics. The use of generative artificial intelligence tools can reduce the number of iterations needed to align design ideas and engineering considerations.

For example, designers can incorporate drag, which impacts aerodynamics and fuel efficiency, into the vehicle design process via generative artificial intelligence. Using generative artificial intelligence in this manner allows the designer to minimize drag while maintaining the intended vehicle style. The addition of engineering constraints to the generative artificial intelligence model sets limitations on subsequent designs, improving efficiency for both design and engineering teams. Use of this technique can speed up electric vehicle design because it allows designers to improve the range of a vehicle without increasing the size of the battery.



Artificial Intelligence and Vehicle Manufacturing

The U.S. automotive industry is the nation's largest manufacturing sector, employing nearly 11 million people and comprising a key component of the country's industrial base. Automotive companies use artificial intelligence in their manufacturing environments to optimize production, improve efficiency, and increase worker safety. For example, artificial intelligence can help companies detect and anticipate equipment failures before they happen.

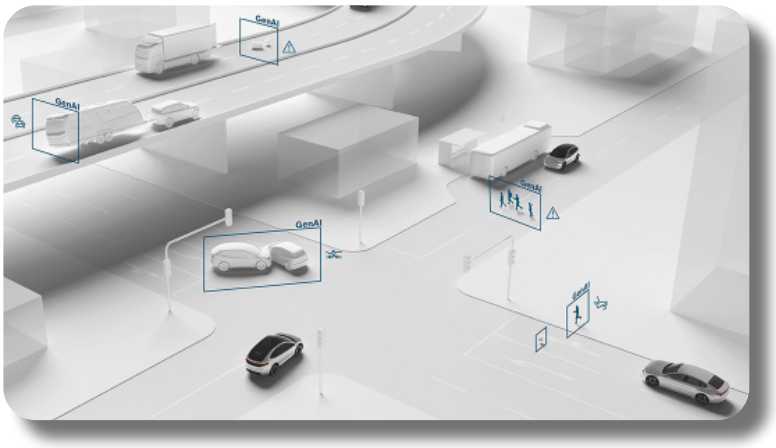
Automotive companies have led in the use of robotics and industrial machinery for more than half a century, supporting workers with tasks such as painting, welding, high-speed fastening, and material handling. The use of robotics and industrial machinery in manufacturing has meaningfully reduced ergonomic injury rates among workers, particularly musculoskeletal disorders, by removing heavy and repetitive tasks. Continued scaling and deployment of robotics and industrial machinery – including collaborative and autonomous mobile robots – will be critical to preserving and expanding America's global competitiveness in the automotive sector.

Another way in which automotive companies can use artificial intelligence in their manufacturing facilities is for quality control purposes. Algorithms can analyze visual data from cameras and sensors deployed along assembly lines to identify any product defects. Artificial intelligence can also automate measuring the physical dimensions and attributes of products to ensure adherence to product specifications and quality standards. The speed and efficiency with which artificial intelligence can assist with these tasks can help automotive companies maintain high levels of productivity while minimizing production errors.

Artificial Intelligence and Vehicle Safety

Automotive companies leverage the power of artificial intelligence to integrate driver support features, advanced safety technologies, and automated driving systems into consumer vehicles. These and other technological advances have the potential to improve roadway safety, protect vulnerable road users, and reduce serious injuries and deaths.

One area where artificial intelligence supports vehicle safety is collision avoidance systems. Collision avoidance systems include forward-collision warning, lane departure warning, traffic-sign recognition, and adaptive cruise control. These systems can use cameras, sensors, radar, LiDAR, and artificial intelligence algorithms to monitor a vehicle's surroundings, process data to identify potential hazards, and direct a vehicle to take certain actions to prevent a crash. Data processed by these systems can include the speed, direction, distance, and trajectory of objects around a vehicle.



Artificial Intelligence and Driver Safety

Driver behavior continues to be a significant factor in roadway safety. Minimizing driver error and reducing risky driving behaviors are key priorities for the automotive industry. Automotive companies continue to pursue ways, including attention assistance systems, to address human factors like distraction, inattention, fatigue, speeding, and impairment.

Attention assistance systems utilize advanced sensors, cameras, and hardware to provide drivers with distraction alerts, fatigue detection, attention warnings, health monitoring, and child presence detection. These systems can also monitor occupants to help optimize safety features like airbag deployment and seatbelt tension based on size and position. Artificial intelligence tools like algorithms and machine learning can leverage data and images from in-cabin sensors, cameras, and hardware to determine a driver's attention, focus, and visual engagement during the driving task. Automotive companies can use algorithms to support collision warning systems and assist with crash reconstruction.

Artificial Intelligence and Vehicle Maintenance

The automotive industry is using artificial intelligence to shift from purely preventive maintenance of vehicles to predictive maintenance. Instead of setting regular intervals for vehicle servicing and parts replacement or waiting for a failure to occur, predictive maintenance utilizes artificial intelligence to monitor vehicle systems and alert drivers to correct potential problems before they occur.

Artificial intelligence can analyze sensor data from monitoring a vehicle's critical components to suggest maintenance may be necessary, as well as forecast potential parts failure and estimate the remaining useful life of vehicle components. Predictive maintenance can help avoid vehicle downtime, reduce repair costs, and prevent unexpected vehicle system failure.

While every failure and system cannot be monitored or predicted, artificial intelligence-based evaluation helps drastically reduce the scope of failure possibilities that impact daily vehicular use, lowering costs, enhancing safety, and increasing convenience for consumers.

How Policymakers Can Support Automotive Industry Use of Artificial Intelligence

As a critical technology central to U.S. economic growth and national security, policymakers should promote policies that support the U.S. automotive industry's continued adoption of, and innovation with, artificial intelligence. The development of such policies should include the engagement of automotive stakeholders, who have significant expertise regarding the opportunities presented by this technology. Some policy recommendations to ensure that the U.S. continues to lead in this space include:

- *Regulatory Coordination*
  The U.S. automotive industry is highly regulated, and therefore, policymakers should consider how other regulatory frameworks and standards activity on related issues, such as cybersecurity and privacy, already account for and include artificial intelligence. In addition, policymakers should consider how artificial intelligence could be useful to improve and modernize other regulatory frameworks and standards activity, such as workplace safety. There should also be interagency coordination to minimize duplication or conflict with respect to existing regulatory requirements.

- *Assessing Risk*
  Policymakers should recognize that risk associated with artificial intelligence depends on the specific context in which the technology is used. Efforts to manage or mitigate such risks should leverage industry standards and best practices whenever possible. An example of a best practice is the National Institute of Standards and Technology ("NIST") Artificial Intelligence Risk Management Framework.

- *Limit Unnecessary Compliance Obligations*
  Policymakers should not impose overly costly and/or burdensome compliance obligations on developers and deployers of artificial intelligence. Such policies will unnecessarily raise costs for automotive companies and stifle innovation. Policymakers should seek to balance the need for artificial intelligence governance with the immense benefits of artificial intelligence-enabled technologies in use today and being developed for the future.

- *Support Data Availability*
  To accelerate the development and deployment of artificial intelligence, policymakers should help ensure the availability of high-quality public sector data. Leveraging platforms that centralize public data from diverse sources and federated learning models can help account for the velocity, volume, and variety of data and to improve accuracy and robustness in the real-time collection, processing, and analysis of such data. Further, encouragement of open-source data sets could be integral for research, benchmarking, and early-stage model development, particularly when it comes to automated vehicle design, development, and deployment.

- *Foster and Develop the Artificial Intelligence Talent Pool*
  The U.S. must invest in developing a robust artificial intelligence talent pool, especially as the automotive sector undergoes a profound transformation driven by electrification, automated driving, connectivity, and software-defined vehicles. These innovations rely on advanced artificial intelligence systems for safety, predictive maintenance, and real-time decision-making, yet there is a significant skills gap in areas like machine learning, data analytics, and simulation. Supportive occupations, like the skilled trades, must also be a priority for workforce development to facilitate the development and implementation of these technologies. Failure to target workforce development in this space risks the loss of U.S. global competitiveness and slowing the progress on critical goals such as roadway safety, sustainability, and economic growth.

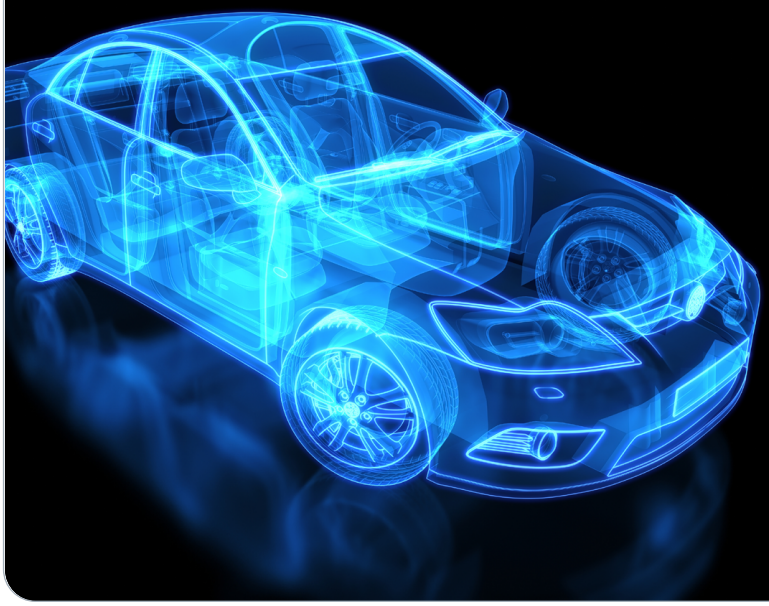
- *Promote Broad Artificial Intelligence Technology Stack Exports*
  The U.S. should take a broad approach to promoting the export of artificial intelligence technology stacks. Edge AI, with its advances in hardware and lightweight models, enables the use of trained models to make predictions or decisions on new data (i.e., inference) with reduced latency, a critical component of vehicle safety when reaction times and real-time decision making are paramount. Embedding edge AI directly in vehicles can cut down on energy and compute costs, enhance data security because sensitive data remains on-device, and optimize performance through customizable models and less bandwidth usage. The promotion of broad AI technology stacks, including edge AI, is crucial to U.S. efforts to innovate faster and more comprehensively than its competitors in the development, deployment, distribution, and adoption of new artificial intelligence technologies across every field including the automotive sector.

- *Protect Against Artificial Intelligence-Enabled National Security Threats*
  Policymakers should consider actions to protect U.S. national security by preventing malicious actors from utilizing artificial intelligence or robots to gain access to sensitive information or to infiltrate the U.S. industrial base. Additionally, policymakers must support the development of U.S.-based technical knowledge and resilient supply chains.

- *International Harmonization*
  Policymakers should seek to internationally harmonize any regulations and standards governing the development and deployment of artificial intelligence. The U.S. automotive industry builds for the global market, and aligned global requirements enable companies to remain competitive. Harmonization reduces regulatory uncertainty, encourages development of new technologies, and ensures the responsible and safe use of artificial intelligence across borders.

ARTIFICIAL INTELLIGENCE:

Fueling Next-Generation Vehicle Technologies



DESIGN ENGINEERING
AI can be used to accelerate and optimize the vehicle design process, reducing the amount of time it takes to finalize and validate a new design.

MANUFACTURING
AI can help detect potential anomalies, conduct root cause analysis, and support production scheduling

VEHICLE SAFETY
Next-generation Advanced Driver Assist Systems (ADAS) are increasingly integrating AI to help avoid crashes.

OCCUPANT SAFETY
In-vehicle features that help detect unattended children or help ensure that drivers remain engaged in the driving task may rely on AI.

PREDICTIVE MAINTENANCE
AI helps monitor vehicle systems and alert drivers to correct potential problems before they occur.