The current pace and scale of structural change in society and industry are unprecedented. Values and lifestyles are diversifying, while environmental problems and a wide range of social issues, such as urbanization, are growing more pronounced. At the same time, innovation is driving rapid technological development in such areas as information, intelligence, the Internet of Things (IoT), and robotics.

In this time of immense change, Toyota is taking a brand new approach, imagining the world in 2030 in order to create value propositions from a long-term perspective.

Today, Toyota provides customers with the value of mobility through cars. Going forward, in addition to evolving this value as provided through cars, we plan to expand it in the directions of social infrastructure and personal living.

Toyota aims to provide value related to social infrastructure by achieving zero life cycle CO₂ emissions from its vehicles to help create a sustainable world, eliminating causalities from traffic accidents, and improving transportation efficiency through the combined transport of people and things.

We seek to expand the value we provide into the area of personal living by working to help all people move about freely and enjoyably and by providing services optimized to individual lifestyles.

Going forward, Toyota will create a sustainable future mobility society by working hand-in-hand with partners across industry lines to provide broad-ranging value that exceeds customer expectations.
Long-term Strategy

At a Glance
Non-Automotive Business/Corporate

Message from the President

Global Vision

Toyota's Goals

Sustainable growth

Customers' smiles

Reinforcing new value creation capabilities

Steadily strengthening our foundation

Strengthening true competitiveness to lay a foundation for steady growth

Developing Toyota by taking on the future

Toyota Global Vision

Making Ever-better Cars

Strategic Shift toward Electrification, Information, and Intelligence to Build New Business Models

Development Aimed at both Axes of Making Ever-better Cars and Shifting to New Business Models

Focused on the Mobility of the Future

Making Ever-better Cars and Our Strategic Shift toward Electrification, Information, and Intelligence Technologies

Based on the Toyota Global Vision, announced in March 2011, Toyota strives to implement a positive cycle of making ever-better cars that exceed customer expectations, enriching lives of communities, being rewarded with the smiles of customers and communities, and thus reinforcing its stable base of business in order to grow sustainably in concert with society. As it faces the greatest changes to the automobile in a century, Toyota’s long-term strategy is to advance management based on its vision of the future mobility society of 2030.

Since the birth of the automobile in the 18th century, the mobility of people and things has increased dramatically. Today, it is possible to provide convenient transportation to virtually anywhere at any time. The development of mobility has underpinned economic growth and the development of society and culture. The heart of this evolution has been the steady improvement of vehicle performance, safety, and convenience.

Now, changes driven by innovation in automated driving technologies that employ artificial intelligence (AI), connected car technologies, robotics, and other areas are on the verge of linking cars, people, and social infrastructure in new ways, transforming industries, society, and the very ways we live.

We believe that our customers today greatly enjoy car ownership—they feel attached to their cars and appreciate car design and the fun of driving. However, with environmental and resource-related problems growing more severe, cars are increasingly being seen as emblematic of pollution and the waste of energy and resources.

The technologies driving the rapid changes in the business environment surrounding cars, such as electrification, connected systems, and AI, have the potential to provide never-before-seen value. They are also driving the provision of social value by, for example, helping to eliminate traffic accidents and environmental burden. Going forward, the costs associated with these technologies, such as those of enhancing functionality to meet related environmental regulations, automated driving technology, and connected technologies, may significantly impact our businesses. However, mobility services and connected services that utilize such technologies also present opportunities to create new revenue models. Based on this understanding, we believe that Toyota must now endeavor to both make ever-better cars in order to sustain and enhance the automobile manufacturing business, its current mainstay, and shift to new business models for the future.

To make ever-better cars, we are striving to enhance the specific appeal of each type of car, whether it be a Lexus, part of our GR sports car series, or a Land Cruiser, clearly defining the role and key characteristics of each. By doing so, we provide value in the form of uniquely Toyota cars that will be cherished and appreciated by customers for years and years. At the same time, by making a strategic shift toward electrification, information, and intelligence to build new business models, we are expanding our range of business.

In these ways, we will not only continue to evolve our existing car manufacturing business, but expand the scope of innovation to encompass social platforms that meet society’s needs and technological platforms, such as AI, that extend beyond cars. By doing so, we aim to provide broad-ranging value that exceeds customer expectations as we work to create the mobility society of the future.

There is a limit to what Toyota can do to provide such future value. To blaze the trail toward a new mobility society, we must find partners who share our aspirations and will inspire us to continue pushing forward while cooperating and competing with players in other industries.
Focused on the Mobility of the Future

**Eco-car Strategy: Electrification**

Toyota is exploring all available options in powertrain development. We believe that we can build a highly energy efficient mobility society by allowing governments and markets to select the cars best suited to regional energy and infrastructure conditions and allowing customers to choose the cars with the specific characteristics best suited to their needs.

For the time being, the further development of technologies for conventional engines, which are still the mainstream, is a practical, highly realistic way to help reduce CO2 emissions. At the same time, we are working to develop and increase the use of fuel cell vehicles (FCVs), the ultimate eco-cars, and advancing other initiatives in coordination with diverse stakeholders to realize our goal of establishing a low-carbon society that uses hydrogen. We are also accelerating the development of electric vehicles (EVs), another zero-emission vehicle option. To this end, we have established the EV Business Planning Department and a business and capital alliance with Mazda Motor Corporation, launching a new company to implement joint technological development.

Toyota boasts a wealth of accumulated know-how regarding vehicle electrification technology and complementary know-how developed in the automobile manufacturing business and contact with customers through sales of more than 10 million vehicles annually—and the strengths of companies in other industries, including IT. By doing so, even as car usage shifts from ownership toward service-based models, we are working to create a safe, convenient, and exciting future mobility society by providing customers with appealing services.

**Automated Driving and Utilizing AI: Intelligence**

Toyota’s overall development philosophy for automated driving technology is the Mobility Teammate Concept, an approach built on the belief that people and vehicles can work together in the service of a safe, convenient, and efficient mobility.

We believe that it is essential that we develop automated driving technology to be human-centric and, above all, safe. In addition to sophisticated safety assistance, we are developing automated systems that can perform full-time dynamic driving. At the same time, by utilizing our advanced safety technology know-how, we are working to promote the rapid uptake of new safety technologies in the market.

Toyota has established Toyota Research Institute, Inc., with Dr. Gill Pratt, one of the world’s foremost AI researchers, as its CEO, and set up a related venture capital fund. Through these efforts, we are accelerating initiatives in such areas as automated driving, AI, and robotics.

Toyota believes that safe, fun automated driving technologies will expand freedom of movement for all, bringing cars and people even closer together, such that cars will continue to be loved by people.

**Advancing Our Business Structure**

Toyota is working to enhance its true competitiveness, particularly in the automobile manufacturing business, and shifting to new business models. In line with these strategies, we are advancing initiatives focused on ensuring ongoing growth 10 years from now, 20 years from now, and beyond. Seeking to break free of the restraints of Toyota’s existing conventions and rules, we have started from scratch, focusing on the future as we set about to advance business innovation. Ongoing growth will be impossible unless we overcome the major issues created by Toyota’s expansion. Today, Toyota makes and sells more than 10 million automobiles annually. To survive at this scale, we are establishing new ways of operating to achieve the following two targets.

- Develop a sufficient number of people who can lead with quick judgment, quick decisions and quick action based on Gerachi Genbutsu (on-site, hands-on experience), because the changes the company faces require new ways of thinking and acting
- Reduce the time and effort consumed by cross-functional coordination and establish work processes that allow us to focus on making ever-better cars

One of Toyota’s traditional strengths has been the process by which its experts on each function and process engage in thorough discussion to find optimal solutions. However, before we began our current efforts to advance business innovation, overemphasis on function-based logic and reasoning had become a weakness, leaving Toyota unable to make quick decisions in response to a rapidly changing environment. Toyota regards the changes it has been making as opportunities. We seek to take on new challenges, unrestrained by existing approaches and remembering always that there are better methods waiting to be discovered.

**Making Ever-better Cars and Developing People**

Toyota has revised its internal organization a number of times to enhance true competitiveness and promote sustainable growth.

In 2011, we adopted a system of autonomous region-based management, stationing the chief officers responsible for each region in their respective regions to ensure operations are more closely linked with local communities. In 2013, we adopted the Business Unit System, under which we organized workflows by business model. Through these efforts, we made progress toward achieving management closely rooted in local areas and speeding product development.

At the same time, however, it became clear that even with these changes, Toyota’s ways of operating were still basically extensions of the old forms, and...
focused on the mobility of the future

thus carried with them the same problems—
coordination across functions and decision making were taking too long.

In April 2016, we adopted a new system with smaller business units organized around products, aiming to dissolve the barriers between functions, reduce the need for cross-unit coordination, speed up decision making, and better link all the work we do to making ever-better cars while developing human resources to support that goal.

Specifically, we concentrated our forward-looking R&D and production engineering teams within the Advanced R&D and Engineering Company and established four vehicle-based companies specializing in compact cars, mid-size cars, commercial vehicles (CVs), and the Lexus brand. We furthermore concentrated powertrain component-related operations in the Powertrain Company and connected technology-related operations in the Connected Company.

The new product-based companies serve to remove all barriers between functions, consolidating the entire process from planning to production under the authority and responsibility of a single leader and providing all necessary business functions within a compact structure for streamlined, integrated operations.

Toyota also reorganized its head office, which is responsible for corporate functions. We established the Corporate Strategy Division, charged with formulating long-term strategy for ongoing growth, and the Frontier Research Center, responsible for actively incorporating insight from outside the Company to create the technologies and businesses of the future from a long-term, society-oriented perspective.

Continuing our business innovation efforts, we established the EV Business Planning Department in December 2016. Then, in January 2017, we created the Emerging-market Compact Car Company, aiming to bring highly competitive ever-better cars to market based on Daihatsu Motor Co., Ltd.’s approach to manufacturing affordable, high-quality products.

In this way, we set up the EV business as an internal start-up under the direct control of the president. This move was in order to make a clean break from old habits and establish fast ways of operating to help drive Toyota’s overall efforts to advance business innovation.

In April 2017, a year after transitioning to the new system, in line with our ongoing Company-wide business innovation efforts, we established the GAZOO Racing Company, aiming to leverage our accumulated motor sports know-how to develop and release cars that offer customers true Waku-doki! (excitement and exhilaration that wows you). We also consolidated our regional business units into the Business Planning & Operation Unit, unifying region-based operations to facilitate cooperation with the product-based companies.

The new framework has enabled the consolidation of responsibility and authority in the company presidents, helping to speed decision making.

Furthermore, the new framework has helped us operate with a greater awareness of the entire car manufacturing process. This has brought to light previously unnoticed issues, and better positioned us to flexibly change organizational frameworks going forward.

Toyota is stepping up its competitiveness by making ever-better cars while making a strategic shift toward electrification, information, and intelligence to advance initiatives aimed at expanding future mobility value. To achieve the goals of our long-term strategies, we are developing human resources and revamping internal structures and advancing business innovation while reinforcing alliances with a wide range of partners, including those in other industries. Looking at the enormous changes surrounding cars as opportunities, Toyota is steadily advancing toward the creation of a better mobility society.
Eco-car Strategy: Electrification

Toyota considers responding to environmental issues a top management priority and has long endeavored to contribute to the realization of a sustainable mobility society. To this end, we have taken on tremendous challenges, resulting in, for example, the release of the world’s first mass-produced hybrid vehicle, the Prius, in 1997, and a fuel cell vehicle, the Mirai, in 2014.

Nevertheless, severe heat, heavy rainfall, drought, and other extreme weather phenomena attributable to climate change caused by rising levels of greenhouse gases continue to threaten livelihoods around the world. Furthermore, the world’s reserves of oil, the main energy source that powers cars, are not infinite. In response to these circumstances, in 2015, Toyota unveiled the Toyota Environmental Challenge 2050, starting work on six challenges aimed at not only eliminating CO2 emissions, but making a net positive impact on the planet and society.

The first of the six challenges is the New Vehicle Zero CO2 Emissions Challenge, under which we aim to reduce global average new vehicle CO2 emissions by 90% from Toyota’s 2010 global level. Toyota is developing and promoting the use of a variety of eco-cars to help achieve the Paris Agreement* goal of keeping global warming below 2°C.

* The Paris Agreement, reached in December 2015, was negotiated at the 21st yearly session of the Conference of the Parties (COP 21) to the United Nations Framework Convention on Climate Change, held in Paris. The agreement set the long-term goal of limiting global warming to well below 2°C compared with pre-industrial levels and calls for net zero anthropogenic greenhouse gas emissions to be reached during the second half of the 21st century.

Toyota’s Environmental Technology Strategy

Toyota believes that it is vital to pass down to the next generation the gains in the mobility of people and things achieved thus far by global mobility society while also addressing climate change and the uncertain future of petroleum resources. We are therefore focusing efforts on developing eco-cars that save energy and use diverse fuels while also promoting their widespread use. Automotive fuels can be produced by processing a variety of primary energy resources. By developing different powertrains optimized for a range of such fuels, Toyota is working to save energy and respond to fuel diversification.

As illustrated in the chart entitled “Alternative Fuel Comparison” on the next page, there are multiple alternatives to petroleum, each with its own pros and cons. Similarly, energy policy varies by country and region. Toyota is advancing development on all fronts, including hybrid vehicles (HVs), plug-in hybrid vehicles (PHVs), fuel cell vehicles (FCVs), and electric vehicles (EVs). Each type of eco-car has a unique set of characteristics. By enabling customers to pick eco-car that is right for them, we believe that we are helping to build a highly energy-efficient mobility society.
Eco-car Strategy: Electrification

Accelerating Electrification Initiatives

Toyota is advancing development on all fronts, with a particular focus on electric and hydrogen power, which it views as especially promising approaches to fuel diversification. FCVs offer convenience on par with conventional gasoline vehicles in terms of cruising range and refueling time. Moreover, hydrogen can be produced from a wide variety of materials and used for a wide range of applications. And, while EVs currently face hurdles due to battery limitations, namely cruising range and charging time, they offer the advantages of being chargeable at home and requiring only relatively simple infrastructure development. Policies and regulations aimed at promoting the use of zero-emission vehicles are developing rapidly around the world. Toyota believes that it is therefore necessary to advance the development of eco-cars in a way that is responsive to the energy challenges and infrastructure of each country and region as well as the ways customers use vehicles.

We take such an approach with EVs, one zero-emission vehicle option; at the end of 2016, we set up the EV Business Planning Department as an internal start-up aimed at creating and releasing products based on the market characteristics of individual countries and regions. Aiming to quickly bring EVs to market, the new department is running in parallel with Toyota’s core technologies. One aim of this alliance is joint development of technologies for electric cars. Demand and expectations for EVs are growing worldwide. Details are yet to be determined, but Toyota and Mazda are considering the joint development of technologies for the basic structure of competitive electric vehicles. These technologies will enable rapid, flexible response to changing regulations and market conditions. To the extent necessary for the joint development of EVs, we aim to combine the strengths of both companies and freely share know-how related to EVs in order to nimble and efficiently respond to difficult-to-predict changes in the EV market during the development period. In addition, in late September 2017, Mazda, Denso, and Toyota signed a joint technology development agreement related to basic structural technologies and established EV C.A. Spirit Corporation to facilitate said development.

Toyota’s Corolla Hybrid and Levin Hybrid, equipped with hybrid units produced in China, have been well received in the Chinese market. We intend to release plug-in hybrid variants of the Corolla and Levin in this market in 2018 and are considering plans to introduce EVs within a few years.

The development of both EVs and FCVs presents opportunities to leverage Toyota’s electrification technologies, which have been honed by its extensive know-how and experience regarding hybrid technology, one of Toyota’s core technologies.

As our competitors also accelerate their electrification initiatives, we expect that competition to procure onboard batteries will intensify. Among secondary batteries, which can be repeatedly charged and used, lithium ion batteries offer the best performance in terms of power and energy per unit mass and volume. Toyota developed the world’s first method for observing the behavior of lithium ions contained in lithium ion batteries’ electrolyte solution during charging and discharging. This is expected to lead to new insights in research and development aimed at improving battery performance and durability, helping to enhance the cruising distance and battery life of PHVs and EVs.

Lithium ion batteries employ flammable organic solvents, so they must be built to prevent leaks. Given this, Toyota is advancing R&D aimed at creating a solid-state battery that will serve as a high-performance, next-generation battery. In addition to R&D conducted by our own dedicated internal R&D divisions, we are working with universities and other research organizations in this area.

Building a Low-carbon Society

Spurred by the 2020 Tokyo Olympics and Paralympics, further development toward the creation of a hydrogen society is expected in the coming years. Toyota seeks to contribute to this development. Since the 2014 release of the Mirai, Toyota has continued to focus on technological
Eco-car Strategy: Electrification

development related to FCVs, working with numerous important stakeholders, including policy makers, infrastructure- and energy-related industry bodies, international organizations, and citizen groups, as it steadily implements a wide range of initiatives aimed at the overarching goal of building a low-carbon society.

Infrastructure is essential to the widespread adoption of FCVs. In Japan, the government’s Council for a Strategy for Hydrogen and Fuel Cells has compiled a Strategic Road Map for Hydrogen and Fuel Cells, laying out goals for public-private initiatives, aiming, for example, to establish 160 hydrogen stations and have 40,000 FCVs on the road by 2020. Based on this roadmap, an all-Japan consortium led by 11 companies, including Toyota and other automotive and energy companies, has begun work aimed at accelerating the full-scale strategic construction of hydrogen stations. A memorandum of understanding to this effect was signed in May 2017.

Furthermore, Toyota participates in the Hydrogen Council, a global initiative promoting a united vision and long-term goals for the transition to hydrogen-based energy. The Hydrogen Council was created by 13 leading global companies involved in energy, transportation, and other sectors, and has begun work aimed at accelerating the full-scale strategic construction of hydrogen stations. A memorandum of understanding to this effect was signed in May 2017.

In Japan, we have begun studies with Seven-Eleven Japan Co., Ltd., a leading convenience store chain, to improve their store operations. We are considering such measures as using fuel cell power generators that utilize automotive fuel cell units as a base power source at stores with hydrogen stations.

In the United States, we have begun a pilot test using commercial heavy-duty trucks equipped with fuel cell systems at the Port of Los Angeles in California. These trucks are equipped with two of the fuel cell stacks (power generators) used in the Mirai and boast a gross combined weight rating (including cargo) of 36 tons. In addition, to promote infrastructure development and facilitate the adoption of FCVs in the United States, Toyota and Honda Motor Co., Ltd. are providing financial support for a plan being implemented by U.S.-based Shell Oil Company to install hydrogen refueling equipment at seven existing retail stations in northern California.

Furthermore, Toyota is participating in a project called Accelerating the Development and Commercialization of Fuel Cell Vehicles in China being implemented by the Chinese government, which is aggressively promoting the spread of FCVs and establishment of related industry. Under this project, Toyota will begin pilot tests using the Mirai in regions around the country. We are currently testing the Mirai in Canada, working to foster understanding of FCVs.

In-house Development and the Promotion of R&D

The rapid expansion of the zero-emission vehicle business requires not just product development, but changes in production structure. Just in the area of the powertrain—the section of the vehicle most impacted by electrification—in addition to conventional gasoline and diesel engines, we now need motors, inverters, batteries, high-pressure hydrogen tanks, fuel cell stacks, and more. In terms of production technologies, besides conventional machining, polishing, assembly, and iron and aluminum casting, we need technologies that enable increased precision, thinner components, and an expansion in the use of plastics as well as those related to coatings, new materials, nano-scale production, and chemistry. Toyota has internally developed the fuel cell stacks and high-pressure hydrogen tanks that form the heart of the FCV, and has achieved world-class performance in both. We are thus acquiring technologies through in-house development while advancing business innovation to prepare for the anticipated pressures on production site management resources arising from electrification.

20 years ago, Toyota launched the Prius, the world’s first mass-produced HV. Since then, we have continued to hone our core electrification technology, releasing PHVs and FCVs. The technological prowess, know-how, and experience built up in bringing these products to market are strengths of Toyota. We will provide a wide range of options in its powertrain development. We believe it is up to markets to decide between the options, based on national and regional conditions, customer tastes, and other factors. Aiming to achieve zero CO2 emissions from new vehicles, Toyota will diversify its powertrains and strive to make those of each type best-in-class.
Connected Strategy: Information

Building a Connected Platform for the Connected Cars of Tomorrow

As the Internet of Things (IoT) develops, cars are increasingly connected to information networks, enabling consumers to enjoy a variety of new services. Connected technologies have the potential to create new value and new services by creating new modes of use and new roles for cars. In particular, big data collected from connected cars will be put to use in a wide range of services and businesses. As such, connected platforms that encompass information infrastructure will become extremely important business platforms for automakers.

Toyota’s Information Technology Initiatives to Date

Toyota has rolled out information technology in the form of telematics services, in which communication devices installed in cars are used to interactively provide drivers with information via wireless networks and data centers.

In 2002, Toyota launched its G-BOOK comprehensive telematics service. Since then, we have improved navigation functions and added the HELPNET emergency dispatch service and G-Security theft-prevention/stolen car tracking service, enhancing functionality centered on safety and peace of mind.

In 2014, we released T-Connect, a new service based on G-BOOK. T-Connect offers more advanced functions, such as search functions controlled through an interactive voice-controlled interface called Agent as well as Apps, which allows customers to select and install a variety of applications on the onboard navigation system.

Furthermore, Toyota uses probe data from cars (tracking data generated using GPS) to generate its proprietary T-probe traffic information, which it offers as a predictive information service. This service predicts the destination of each car and provides information to help drivers avoid potential issues, such as accidents and congestion, along their anticipated route.

In preparation for the full-scale arrival of connected cars, in April 2016 Toyota established the Connected Company, and in November of the same year announced its Connected Strategy, consisting of three major points (its “three arrows”).

1. Connect all Toyota and Lexus cars and build a connected platform that will serve as information infrastructure
2. Use this platform to utilize big data collected from cars and contribute to the good of customers and society while revolutionizing Toyota’s own businesses
3. Building on this platform, coordinate with various different industries and IT companies to create new mobility services and establish a value chain

Toyota’s Information Technology Initiatives

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>2000</td>
<td>Established GAZOO Media Service Corporation (now TOYOTA Connected Corporation)</td>
</tr>
<tr>
<td>2002</td>
<td>Commercialized DCMs for cars, launched G-BOOK services</td>
</tr>
<tr>
<td>2005</td>
<td>Made DCMs standard on Lexus models in Japan</td>
</tr>
<tr>
<td>2008</td>
<td>Expanded standard installation of DCMs on Lexus models to North America and China</td>
</tr>
<tr>
<td>2011</td>
<td>Built the Toyota Smart Center</td>
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<tr>
<td>2016</td>
<td>Established the in-house company Connected Company</td>
</tr>
<tr>
<td>2016</td>
<td>Established Toyota Connected Inc (now Toyota Connected North America, Inc.)</td>
</tr>
</tbody>
</table>

* DCM: Data communication module. An on-board integrated transmission module developed especially for telematics services.
Communications between DCMs and the Toyota Smart Center pass through a global communications platform built in cooperation with KDDI Corporation. The platform comprehensively manages communications by automatically connecting with selected telecommunications carriers in each country or region based on car location data. At the same time, in North America, Toyota Connected North America, Inc., established in collaboration with Microsoft Corporation, operates the Toyota Big Data Center (TBDC), which consolidates big data collected from cars, and engages in research and development leveraging big data. Toyota Connected North America also works in close coordination with Toyota Research Institute, Inc., a research organization focused on artificial intelligence.

Going forward, as the number of connected cars and connected services increase, we expect the volume of data handled by the TBDC to increase dramatically. We are also at work on the development of next-generation smart center technologies to process the increasingly vast amounts of data expected to be generated as more cars are equipped with DCMs. As part of these efforts, in March 2017, we announced an agreement with Nippon Telegraph and Telephone Corporation to collaborate on ICT platform research and development for connected cars.

In addition, as part of its collaboration with U.S.-based Ford Motor Company, Toyota has announced that it will use the open-source SmartDeviceLink (SDL), which enables users to control apps on their smartphones via the vehicle control interface. On January 4, 2017, Toyota and Ford established the SmartDeviceLink Consortium to promote SDL as a global standard.

Revolutionizing Toyota's Own Businesses with Connected Cars

Becoming connected will change the very ways that cars interact with customers and society. Toyota will be creating millions of new contact points with customers and society around the world every year, enabling the roll out of a variety of new services and businesses.

Connecting cars and establishing a connected platform that will serve as information infrastructure is the first arrow of our Connected Strategy. The second and third arrows are aimed at expanding our businesses that utilize the platform. We are implementing the Connected Strategy not by firing the arrows in sequence, but by releasing them all virtually simultaneously.

In line with the second arrow, aimed at contributing to the good of customers and society while revolutionizing Toyota’s own businesses, we are already using big data collected from connected cars equipped with DCMs to provide a real-time traffic information service covering all of Japan. Using this data, Toyota provides information on which roads are passable by tracking where cars are actually going. This information was used during emergency response and recovery operations following the Great East Japan Earthquake and Kumamoto Earthquake.

Currently, such big data is being fed back to design and quality control divisions to help quickly identify and respond to problems with cars on the market and as a tool to enable them to make ever-better cars. Furthermore, we have launched the e-Care service, which uses data from individual cars to anticipate breakdowns or the need for servicing, encouraging customers to bring their cars to a dealership before problems occur.
Connected Strategy: Information

To provide even greater value through cars, we are accelerating research aimed at generating dynamic maps* that contain information on lane-specific congestion and obstacles based on images collected by onboard cameras to provide more advanced driving assistance services.

* Map data based on a high resolution (25 cm relative precision, 1:500 scale) map linked to constantly updated information about traffic restrictions, congestion, vehicle location, and other factors.

Creating New Services through Our Mobility Service Platform

At the center of the connected platform powered by the Toyota Smart Center will be the Mobility Service Platform (MSPF). The third arrow, creating new mobility services, entails connecting big data collected by Toyota through the MSPF with a variety of companies and services to globally develop new services and markets, and thus enhance the diversity and sophistication of the value provided by cars in the mobility society of the future. Toyota will continue developing new growth strategies based on the MSPF.

Our first major initiative in this area is the development of telematics car insurance services in North America. We are providing multiple insurers with solutions that enable them to offer insurance based on scores generated from big data collected on policyholders’ driving distance and other driving patterns.

Furthermore, we are accelerating the creation and commercialization of new mobility services by implementing pilot testing around the world in collaboration with car sharing and ridesharing services and taxi operators.

Investment in a Mobility as a Service (MaaS) Company

Toyota is working to build a platform utilizing data collected from cars. Connecting all the new cars that Toyota sells will enable data collection from more than 10 million additional cars every year. In the future, all kinds of information, including that from cars, will be integrated in the cloud. We believe this kind of big data technology is the key to building a rich mobility society. As it seeks to provide services that exceed customer expectations, Toyota is working with a wide range of partners, taking on the future with a start-up mindset.

Toyota Financial Services Corporation, together with Aioi Nissay Dowa Insurance Co., Ltd., has invested in MaaS Global, a Finnish company developing multi-modal services. MaaS Global is providing new services that enable efficient transportation combining wide-ranging means of transit, including taxis, rental cars, and other automobiles as well as trains, buses, and other forms of public transportation, alongside reservation and payment services through smartphone apps.

Toyota has made an additional investment in Preferred Networks, Inc., to accelerate the joint research and development of automated driving technologies and other AI technologies in the mobility business field.

Toyota, Intel Corporation, Ericsson, DENSERO Corporation, Toyota InfoTechnology Center, Co., Ltd., Nippon Telegraph and Telephone Corporation, and NTT DOCOMO, Inc. formed the Automotive Edge Computing Consortium, aimed at building a platform to support a variety of businesses necessary for the development of connected cars.

Toyota and Nippon Telegraph and Telephone Corporation are collaborating on R&D related to 5G platforms for connected cars.

Toyota is working with KDDI Corporation to build a global communications platform not dependent on conventional roaming services to secure high-quality, stable data transmission globally for communications between DCMs and the cloud, which is vital to connecting cars.

Toyota jointly established Toyota Connected, Inc. with Microsoft Corporation with the aim of collecting and analyzing data from cars and using the results to inform product development.

Toyota, KDDI Corporation, and Tokyo Hire-Taxi Association are implementing demonstration testing related to the transmission and use of high-volume driving data from connected taxis.

Toyota and Uber Technologies, Inc., are collaborating in the area of ridesharing.

Toyota is collaborating with Grab, Inc., a major ride-hailing service company in Southeast Asia, in the area of ride-hailing.

Toyota is developing a car share application for dealers and distributors and implementing pilot testing in Hawaii.

Toyota established a company to support the development of telematics car insurance services in the United States in collaboration with Aioi Nissay Dowa Insurance Co., Ltd., and Toyota Financial Services Corporation.

Under the open innovation program TOYOTA NEXT, Toyota selected five partners for the joint development of people-centered services that will provide customers the experience of an exciting future to look forward to.

Toyota is collaborating with Line Corporation with the aim of creating new car-related services, such as voice-operated agent services, by linking the cloud-based AI platform Clova being developed by LINE with DCMs and smartphone apps using SDL.

Toyota and Ford Motor Corporation established the SmartDeviceLink (SDL) Consortium to promote industry standardization related to connecting cars with smartphones.
Automated Driving and Utilizing AI: Intelligence

Toyota's Unique Approach to Automated Driving

Since the 1990s, Toyota has engaged in automated driving technology research and development aimed at contributing to the complete elimination of traffic casualties. Today, Toyota is advancing development in this area based on its Mobility Teammate Concept. This concept is an expression of Toyota's unique approach to automated driving and is built on the belief people and vehicles can work together in the service of safe, convenient, and efficient mobility.

As implied by the word “partner,” the inclusion of people is central to this approach, based on our belief that people should have choices. The true value of automated driving technologies, we believe, lies not in the technology itself, but in the social value it creates—helping to create a rich mobility society in which everyone can enjoy safe, convenient, and enjoyable transportation.

Moreover, we believe that the most important factor in the development of automated driving is safety. This conviction is in line with our long-held stance of prioritizing the improvement of safety with the ultimate goal of eliminating casualties from traffic accidents. To create a safe mobility society, Toyota implements three-pronged initiatives aimed at developing safe cars, raising awareness among people, and improving the traffic environment while also pursuing real-world safety by utilizing information from actual accidents in product development.

To eliminate casualties from traffic accidents, we must develop safe driving systems that are highly effective in real-life situations as quickly as possible and promote their uptake as widely as possible. To do this, Toyota is promoting, in parallel, the development of advanced safety technologies and utilizing insights gained through such development to develop popularized technologies. We have already begun to put our active safety technologies on the market in such packages as Toyota Safety Sense and Lexus Safety System+. We plan to offer such packages as standard or optional features on almost all new Toyota and Lexus models sold in Japan, Europe, and the United States by the end of 2017.

The mobility as a service (MaaS) market, including car sharing and rideshare services, is expanding. As a mobility service platform provider, Toyota is actively exploring this market’s possibilities. We believe that mobility service platforms will accelerate the development of automated driving technologies and help bring the freedom and joy of movement to all people, including those who cannot drive. Going forward, the spread of automated driving technology through MaaS will enable the collection of enormous volumes of data, which is extremely valuable to the further development of automated driving systems, giving rise to a virtuous cycle that will provide customers with safer, more convenient, more affordable transportation services.

Our Guiding Development Philosophy

Developing and Promoting the Use of Advanced Technologies

Advanced technologies

- Lexus LS
- New Lexus LS
- Next generation

Popularized technologies

- Toyota Safety Sense
- Next generation
- Following generation

Integrates
- Reduce size
- Reduce cost

Society with zero traffic accident casualties

WEB

Initiatives for Improving Traffic Safety (Sustainability Data Book 2017, p. 11)
Automated Driving and Utilizing AI: Intelligence

Specific Approaches to Automated Driving

Under the Mobility Teammate Concept, Toyota is developing automated driving systems based on two approaches: Guardian and Chauffeur.

Guardian is a unique Toyota approach that assumes that a human will drive the car, while automated driving systems operating alongside the driver provide support when needed, such as when the car is in danger of collision, to protect the car’s passengers. This kind of system might detect, for example, that the driver is distracted and, after giving a warning, brake and steer to allow the car to safely negotiate a curve.

Chauffeur refers to automated driving at level four or five autonomy as defined by the U.S. non-profit SAE International, and does not assume a human driver. Systems designed under this approach would allow, for example, the vehicle to drive autonomously while avoiding obstacles and to safely change lanes without human input to avoid obstacles in the road ahead even if there are other cars traveling at the same speed in adjacent lanes.

The Mobility Teammate Concept aims to give people the freedom of choice by allowing them to enjoy the benefits of automated driving technologies while still allowing them to drive safely, enjoyably and freely when they wish. Drivers will be able to choose Chauffeur mode for some situations, such as expressway and long-distance travel, and Guardian mode for others, such as for low-speed and short-distance trips.

Moreover, the Mobility Teammate Concept’s approach to safety and communication goes beyond the relationship between driver and car to encompass interaction with fully autonomous vehicles and others sharing the road, including pedestrians, bicyclists, and other drivers.

In the near term, Toyota is working to bring the two vehicle systems below, which offer automated driving capabilities, to market.

Vehicle Systems with Automated Driving Functions

<table>
<thead>
<tr>
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<th>Launch target</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highway Teammate</td>
<td>2020</td>
<td>The Highway Teammate will enable driver-supervised automated driving on expressways that includes merging onto and exiting expressways, maintaining and changing lanes, and maintaining appropriate distance from other vehicles</td>
</tr>
<tr>
<td>Urban Teammate</td>
<td>Early 2020s</td>
<td>The Urban Teammate will enable the use of the Highway Teammate's functions on regular roads. In addition to detecting people and bicycles around the vehicle, it will use map data and visual data from intersections and traffic lights to obey local traffic rules</td>
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Toyota’s Approaches to Automated Driving

<table>
<thead>
<tr>
<th>Guardian</th>
<th>Chauffeur</th>
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</thead>
<tbody>
<tr>
<td>Provides driving support when needed, such as when the car is in danger of collision, to protect the car’s passengers; assumes a human driver</td>
<td>Achieves automated driving at level four or five autonomy as defined by the U.S. non-profit SAE International; does not assume a human driver</td>
</tr>
<tr>
<td>The same sensors and cameras will be used for both approaches</td>
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R&D Framework and Collaboration with Stakeholders

Toyota believes that the development of automated driving technologies and the use of big data with artificial intelligence (AI) technologies can solve a range of issues faced by society as well as promote the realization of a sustainable future mobility society. To this end, we are seeking out partners who share these aspirations around the globe and accelerating a wide range of initiatives.

Toyota established Toyota Research Institute, Inc. (TRI) in the United States to reinforce its AI research. Under the direction of Dr. Gill Pratt, previously program manager at the Defense Advanced Research Projects Agency (DARPA), TRI is advancing AI research toward the following four targets.

1. Enhance the safety of automobiles with the ultimate goal of creating a car that is incapable of causing a crash.
2. Increase access to cars for those who otherwise cannot drive, including older persons and those with special needs.
3. Translate Toyota’s expertise in creating products for outdoor mobility into products for indoor mobility.
4. Accelerate scientific discovery by applying techniques from artificial intelligence and machine learning.

Also in the United States, Toyota Connected North America, Inc. (formerly Toyota Connected, Inc.), established in collaboration with Microsoft Corporation, operates the Toyota Big Data Center, which consolidates collected data, and engages in research and development aimed at using big data for a variety of services.

Furthermore, to reduce traffic accident causalities, Toyota’s Collaborative Safety Research Center (CSRC), which engages in joint research with North American universities, hospitals, and research institutions, launched CSRC Next, a new five-year program, in January 2017. Under this program, CSRC has partnered with eight leading research institutions in North America to set up 11 research projects focused on safely transitioning to emerging modes of mobility by addressing the opportunities and challenges presented by evolving vehicle technologies.
Automated Driving and Utilizing AI: Intelligence

With these organizations, Toyota is advancing cutting-edge research, working to quickly bring the goal of zero casualties from traffic accidents closer to reality.

Furthermore, in July 2017, TRI invested $100 million to establish a venture capital fund to provide funding to start-ups in the fields of artificial intelligence, robotics, autonomous mobility, and data and cloud technology. The fund, operated through Toyota AI Ventures, newly established by TRI, will feature decision-making by a dedicated management team with abundant investment knowledge and experience, operating separately from TRI’s R&D operation. In addition to considering unsolicited pitches made by investment candidates, the fund aims to establish an investment model in which it identifies key research challenges and then supports the creation of new companies to solve them.

Legal and regulatory updates, social system reform, and public acceptance—there are numerous hurdles, varying by country and region, on the road to realizing and popularizing automated driving. Given this, Toyota believes that coordination across national and regional boundaries involving a wide range of stakeholders, including those not directly connected to the traditional auto industry, is crucial. In non-competitive areas, such as basic infrastructure and systems, cooperation with a wide range of actors to create solutions is an effective way forward. Building on that shared foundation, companies can then advance development individually, competing to better allow customers to move about safely, freely, and conveniently; we believe that this approach will be efficient and benefit customers and society.

Toyota’s ultimate goal in developing automated driving technologies is not simply to create autonomy for cars, but to expand autonomy for people—to create a world in which mobility is safe, convenient, enjoyable, and available to everyone. Safety is our top priority as we pursue this goal. We believe that we can enhance safety by building partnerships between drivers and their cars.

Even in a future where driving is automated, we believe that cars will continue to be loved. Toyota believes that safe and fun automated driving technologies have the potential to expand freedom of movement for all and bring cars and people even closer together.

Automated Driving Technology R&D Framework

Collaborative Automated Driving Development

| Massachusetts Institute of Technology | Research aimed at furthering the development of automated driving technologies through projects ranging from autonomy to self-awareness |
| Stanford University | Research projects investigating human-computer and human-robot interactions, particularly focusing on the development of innovative and impactful approaches, algorithms and data |
| University of Michigan | Research focused on enhanced driving safety, partner robotics, indoor mobility, automated driving, and student learning and diversity |

Toyota’s Concept of the Cars of the Future

In January 2017, Toyota unveiled the Concept-i, a concept car developed with the aim of building a new driver-vehicle relationship in which artificial intelligence (AI) enables cars to understand the driver, allowing people and cars to grow together as partners. The Concept-i aims to be a beloved car of a new era based on the idea that cars are among the most beloved of manufactured goods. Combining technology that understands people with automated driving and agent technologies, the Concept-i provides drivers with safety and peace of mind as well as new “Fun to Drive” experiences that enrich the enjoyment of transportation. For example, to provide safety and peace of mind, in addition to monitoring the car’s external conditions, the Concept-i assesses the driver’s condition using technology that understands people and monitors the reliability of the driver and the car. If the car’s reliability is high and the driver is overcome by a dangerous or high-stress situation, for example, the Concept-i will decide that support from the car is deemed necessary and switch to automated driving. With such functions, the Concept-i embodies Toyota’s Mobility Teammate Concept, which envisions a future in which people and vehicles monitor and help one another.

Toyota plans to conduct road tests of vehicles equipped with some of the functions presented at Tokyo Motor Show 2017 by around 2020.