AUTOMOBILES AND SAFETY

1 Introduction

The number of fatalities in 2020, the final year of the Tenth Fundamental Traffic Safety Program, dropping below 3,000 for the first time. Although this represents one sixth of the peak figure, it failed to reach the stated goal of reducing traffic accident fatalities within 24 hours to 2,500 or less by 2020.

Starting in 2021, the Eleventh Fundamental Traffic Safety Program will have to form the basis for cooperation between the public and private sectors as well as even faster adoption of integrated three-part measures that incorporate pedestrians, vehicles, and society. The explanations below focus on vehicle-related measures.

2 Traffic Accident Trends and Measures

2. 1. Traffic Accident Trends

The number of traffic accidents and the number of people injured in traffic accidents peaked in 2004. In 2020, and declined to 309,178 cases and 369,476 people, which is 18.9% and 20.0%, respectively from the previous year, and represents a level comparable to the early 1960s. The number of traffic accident fatalities peaked at 16,765 in 1970, before falling to 8,466 in 1979 due to the development of road traffic infrastructure such as traffic lights and guardrails. Higher cruising speeds and the deterioration of driving environments due to the popularization of vehicles caused the number of traffic accident fatalities to rise again and reach 11,452 in 1992. Until 1985, only drivers were required to wear seat belts. Since 1985, traffic rules were reinforced with provisions such making the wearing of seat belts mandatory in passenger seats, prompting a decrease in the number of traffic accident fatalities. As vehicle safety performance improved, drivers started respecting traffic rules more closely, and regulations became stricter, the number of fatalities since 2000 fell gradually year after year, dropping to 4,113 in 2014. In 2015, the number of fatalities rose to 4,117, the first increase in 15 years. However, in 2016, that number decreased to 3,904. In 2020, the number of fatalities dropped to 2,839, falling below the total of the previous year, which had been the lowest total since the National Police Agency started recording statistics in 1948 (Fig. 1).

The characteristics of fatal traffic accidents in 2020 are presented below.

(1) Number of Fatalities per Road User Status

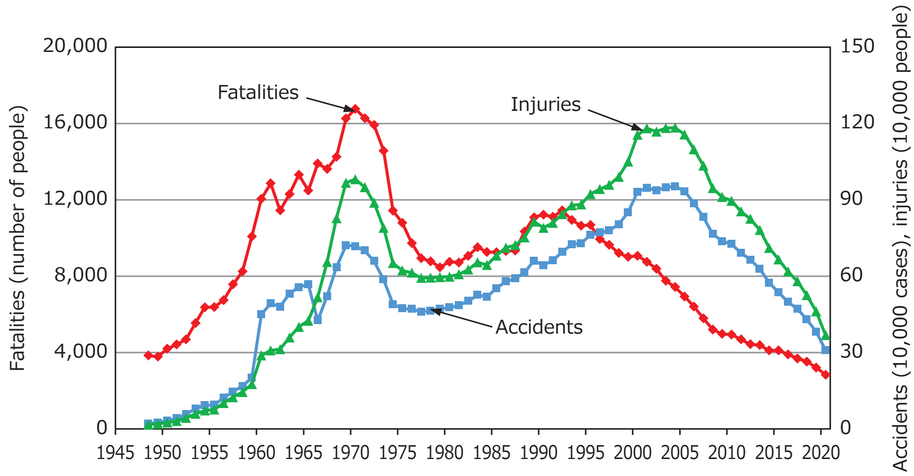
The total number of traffic accident fatalities in 2019 was 2,839. Of these, 1,002 were pedestrians, which was 174 fewer people than in the previous year, continuing the downward trend observed since 2016. The number of cyclist fatalities was 419 (down 3.2% from 2019). Fatalities of pedestrians and cyclists, who are vulnerable road users, both decreased compared to the previous year. This is attributed to the effects of integrated three-part safety measures such as initiatives intended to ensure pedestrians and cyclists follow traffic rules, the spread of the adoption of pedestrian-aware collision mitigation braking systems, and the improvement of the road infrastructure (Fig. 2).

(2) Number of Fatalities per Age Range

Breaking down traffic accident fatalities by age shows that in 2018, there were 1,596 fatalities of people aged 65 or older, which accounted for 56.2% of the total. This exceeds the 2018 figure of 55.7%), and represents an all-time high. Pedestrians accounted for 46.6% of these elderly fatalities, far exceeding the 35.3% overall proportion for all age ranges. In addition, elderly people accounted for 65.0% of pedestrian and cyclist fatalities. This reflects the fact that elderly vulnerable road users account for a high percentage of the total number of victims (Fig. 3).

2. 2. Traffic Accident Measures

In March 2016, the Japanese government introduced the Tenth Fundamental Traffic Safety Program, which included targets to reduce the number of traffic accident fatalities within 24 hours of the accident to 2,500, reduce



Note 1: The population data used to calculate these statistics consists of the statistical data for population estimates compiled by the Ministry of Internal Affairs and Communications for each preceding year (current population as of October 1 of each year (Population Census figures in years when that census is conducted and no intercensal adjustment is made. However, intercensal population estimates are used for 1948 and 1949)).
Note 2: Until 1959, the number of traffic accident and injuries statistics did not include minor accidents (injuries lasting less than eight days, material loss of 20,000 yen or less).
Note 3: Since 1965, the number of traffic accident statistics does not include the number of property damage accidents.
Note 4: Until 1971, the number of traffic accidents, injuries, and fatalities statistics did not include Okinawa Prefecture.

Fig. 1 Traffic accident trends (1948 to 2020).

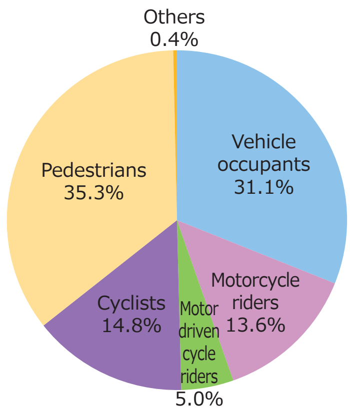


Fig. 2 Fatalities per road user status (2020)

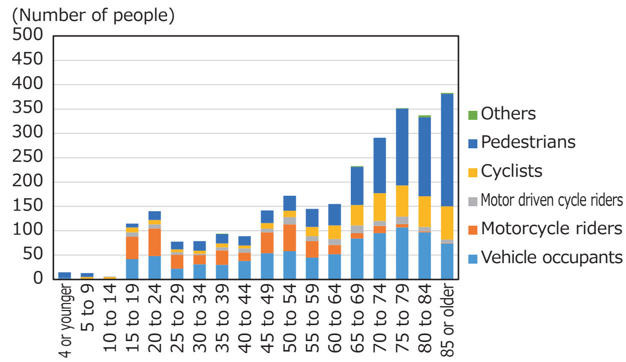


Fig. 3 Fatalities per age range and road user status (2020)

the number of traffic accident fatalities and injuries to 500,000, and achieve the world's safest road traffic environment. The traffic safety initiatives to achieve these targets are based on the following eight perspectives: (a) improving the road traffic environment, (b) ensuring thorough awareness of road safety, (c) ensuring safe driving, (d) enhancing vehicle safety, (e) maintaining an orderly traffic situation, (f) enhancing rescue and emergency services, (g) improving and promoting victim support, and (h) improving research and development as well as investigative research.

The Ministry of Land, Infrastructure Transport and Tourism (MLIT) traffic measures are based on a report drawn up in June 2016 called Vehicle Safety Measures for Building a Society Free from Road Traffic Accidents. This report describes the basic concepts that will form the four pillars of future traffic safety, including (a) addressing accidents involving children or the elderly, (b) measures for the safety of pedestrians and automobile occupants, (c) measures to address grievous accidents involving heavy-duty vehicles, and (d) addressing new technologies such as automated driving. An overview of current initiatives is presented below.

(1) Safety Measures for Children and Elderly People

Measures based on the age range (infants, elementary school students, junior high and high school students) are viewed as critical for the safety of children, and popularizing the safer and user-friendly child seats and junior seats compliant with ISOFIX and i-Size (UN R129) is viewed as a potential solution. Faced with year-on-year increases in accidents caused by elderly people, the government defined vehicles equipped with collision mitigation braking systems, devices that suppress unintended acceleration in accidents involving pedal misapplication, advanced lighting, and similar systems as safe driving support vehicles, nicknamed "Safety Support Car (support car)" in 2017 as part of traffic accident prevention measures for elderly drivers. To encourage the spread of such vehicles, the government also launched a support car subsidy program in 2020 to provide financial assistance to elderly drivers. The subsidies are available to drivers aged 65 or older who purchase a vehicle equipped with pedestrian-aware collision mitigation braking or sudden unintended acceleration suppression systems, or who retrofit an already purchased vehicle with a such as sudden acceleration suppression system.

(2) Safety Measures for Pedestrians and Cyclists

The basic concept of safety measures for pedestrians and vehicle occupants is defined by the importance of incorporating technology that improves recognition of drivers, pedestrians, and cyclists, and capitalizing on active safety technology to prevent collisions. Specific efforts from automakers and automotive parts manufacturers include the development headlamps with advanced functionality and increased adoption of automatic lighting systems, which quickly make drivers of pedestrians or cyclists during twilight or at night, and the expansion of the range of detected objects and scenarios for collision mitigation braking systems.

(3) Measures against Serious Accidents Involving Heavy-Duty Vehicles

Accidents involving heavy-duty vehicles such as buses and trucks tend to cause serious damage and it is critical to actively prevent them. As part of efforts to spread advanced safety technology, the Japanese government made the installation of collision mitigation braking and vehicle stability control systems mandatory for new models of buses and trucks in 2014. In addition, it made lane departure warning systems mandatory for new vehicles starting in 2017 (2019 for existing vehicles).

(4) Adaptation to New Technologies such as Automated Driving

Phase 6 of the Advanced Safety Vehicle (ASV) Promotion Project (2016 to 2020) to promote the development of ASVs, involves examining advanced technologies focused on autonomous driving and studying specific technologies. Guidelines for a driver emergency response system that utilizes autonomous driving technology that makes a vehicle pull over on a road shoulder in case of a sudden condition change of the driver, as well as for a driver emergency autonomous detection system that utilizes cameras and sensors inside the vehicle to autonomously detect driver emergencies, were established (Fig. 4). The spread of such systems is expected to help decrease accidents resulting from a driver emergency, which occur 200 to 300 times a year.

2. 3. Vehicle Safety Assessment Trends

Vehicle safety assessments are seen as a means of accelerating the development and spread of safety technology. Vehicle safety assessments are not only carried out in Japan, the U.S., and Europe, but also in China, the ASEAN nations, and Latin America. Test items are revised and evaluations are expanded on a regular basis. Recent trends include the introduction of active safety performance evaluations in addition to passive safety performance evaluations. Trends in Japan and around the world are presented below.

(1) Trends in Japan

The Japan New Car Assessment Program (J-NCAP) evaluates passive and active safety performance. Recent expansions to active safety performance evaluations include broadening the scope of objects detected in collision mitigation braking system evaluations and adding the evaluation of devices that suppress acceleration when the accelerator is depressed by mistake. Starting in 2021, there are plans to change the system from separate evaluations of passive and active safety performance to a single overall evaluation, and to add the evaluation of automatic accident notification systems.

(2) Global Trends

As of December 2018, vehicles are assessed and updated every year by government organizations and insurance institutes in Europe, the U.S., China, Australia, the ASEAN nations, and South Korea. The majority of systems now make one overall evaluation of passive and active safety performance.

In Europe, the U.S., and other developed countries, there are plans to add collision evaluation methods corresponding to actual accidents and damage conditions (oblique collision test that simulates oblique frontal collision, far side lateral collision test) and add to active safety performance evaluations that account for autonomous driving (driver monitoring evaluation, damage mitigation braking system evaluation that simulates an intersection accident scenario).

Emerging countries such as the ASEAN nations and Latin American countries, are planning to introduce active safety performance evaluations adapted to their own markets in addition to passive safety performance evaluations. These active safety performance evaluations are based on the requirements in the assessments used in Europe or other developed countries.

3 Research and Technology Related to Active Safety and Autonomous Driving

The section on Enhancing Vehicle Safety in the Tenth Fundamental Traffic Safety Program, which stipulates broad measures regarding traffic safety in Japan, states that "in addition to implementing collision mitigation measures, every effort will be made to prevent traffic accidents, including accidents mainly caused by operation errors or other human factors, through measures based on vehicle structure". The evolution of active safety technologies and of the autonomous driving technologies they lead to is crucial to improving vehicle safety. Throughout 2020, many trends were observed in the research and technology conducted in these fields.

3. 1. Active Safety Technology Trends

Automakers have been introducing collision mitigation braking systems and new technologies, as well as reducing their cost, to further popularize active safety technology. To provide further impetus to this trend, the Japanese government established the Advanced Emergency Braking System Performance Evaluation System in 2018 to certify that advanced emergency braking systems have a certain level of performance, in complement to the initiatives to promote greater popularization of the safe driving support vehicles described earlier. Since April 2020, performance certification has been expanded to pedestrian-aware collision mitigation braking and sudden unintended acceleration suppression systems. A program to certify the performance of retrofitted systems to suppress sudden unintended acceleration due to pedal misapplication has also been added.

Information of the certified vehicles are announced on the MLIT website and are expected to serve as a means to effectively convey to users that the vehicles are certified to be safe by the Japanese government. For example, information on the certified vehicles are used in automaker propagation activities.

3. 2. Automated Driving Technology Trends

The Japanese government established the Public-Private ITS Initiatives & Roadmap in 2014 as a strategy for the entire government regarding ITS and autonomous driving. The roadmap promotes the objective of building and maintaining a society with the world's safest and smoothest traffic by 2030, and is revised every year. The 2020 revision lists the realization of Level 3 autonomous driving technology around 2020, and of Level 4 automated driving on expressways by 2025, as well as offering driverless delivery services in limited areas during the 2021 fiscal year, in the targets for introducing private cars into the market. The public and private sectors are unifying their efforts to assess how to achieve these targets from the dual standpoint of developing technology and establishing legislation.

The government, industry, and academia are conducting collaborative technological development in the context of the SIP-Automated Driving for Universal Services project of the Strategic Innovation Promotion Program (SIP) promoted by the Cabinet Office. Specifically, use cases for cooperative driving automation are being assessed, large-scale field operational tests to identify the environmental conditions required for the transmission of signal information and clearly define the issues to solve to foster public acceptance are being carried out, and an environment for the commercialization and deployment of automated driving services is being prepared.

In terms of legal systems, the MLIT established safety technology guidelines that set the operational design domain (ODD) for autonomous vehicles and defined requirements such as the need to install data recording devices. The first international standard on automated driving systems (Level 3) was established in June 2020. The National Police Agency had prepared an amended draft of the Road Traffic Act that allows Level 3 autonomous driving. The revised law came into effect in April 2020 following the 2019 ordinary session of the Diet.

4 Research and Technology Related to Post-Accident Safety

The types of accidents that can be avoided with the advancement of active safety technology are rapidly expanding. However, real world accidents are varied and active safety technology cannot respond to all cases. Consequently, passive safety performance remains important. Authorities, research institutions, and automakers in various countries are analyzing accidents in detail to minimize damage in the event of an accident, assessing more effective technological countermeasures, and continuously studying test and measurement methods.

4. 1. New Test Methods and Measurement Devices

New test methods and measurement devices are continuously being researched in various countries based on surveys of real world accidents to further decrease the number of fatalities and injuries. There are movements to adopt these test methods and measurement devices for the assessment evaluations described above.

The U.S. is evaluating the introduction of an oblique test that simulates oblique frontal collisions and is stricter than conventional offset collision tests. In Europe, an MPDB test method was developed to improve reproducibility of accidents through vehicle-to-vehicle collisions, and introduced in 2020. Testing to evaluate not only the protective performance of a test vehicle but also that of a counterpart vehicle (compatibility) has begun. A far-side impact test to evaluate the safety of an occupant in the seat opposite the impact side was introduced in 2020, and evaluations in actual vehicles have begun.

In the area of measurement devices, next-generation dummies are being developed and adopted. They allow the damage to an occupant in a collision to be measured with greater precision as they mimic human body responses more faithfully and rely on multi-point sensors. For frontal collisions, THOR dummies will be adopted for oblique tests in the U.S. and MPDB tests in Europe. For lateral collisions, WorldSID dummies were adopted for conventional tests and the far side lateral collision test. Both THOR and WorldSID 5th percentile female dummies representing small female occupants are being developed. They will replace currently used dummies in the future. It is anticipated that measuring injury resulting from head rotation and performing multipoint displacement measurements for the chest with the THOR and WorldSID dummies will make more precise injury evaluations possible. For pedestrian protective performance tests, JAMA and JARI are taking the initiative in developing an advanced pedestrian legform impactor (aPLI) with improved reproducibility of lower body behavior to solve problems found in the currently used FLEX-PLI legform impactors. In response to the global standardization of the aPLI by the ISO, Europe and China are giving its use in assessments serious consideration.

4. 2. Protection Systems

Protection systems are also subject to research and development aimed at expanding the scope of protection and improving its performance to cover various accident conditions, boarding positions, and physiques found in the real world.

Research on air bags is focusing on front air bags with an improved shape and larger size to improve restraint performance in the event of an oblique collision, on side air bags adapted to far side collisions to prevent a collision with the occupant in the seat on the other side in the event of such an accident, and on front air bags for rear seats that protect occupants there. A pedestrian airbag that covers rigid parts of the vehicle such as the lower part of the windshield and the pillar to mitigate impact to the head and reduce damage in the event of a pedestrian accident has been commercialized.

Technology that uses active safety technology sensors to optimize the occupant's posture by winding the seat belt and correcting the seat position before a collision, as well as technology that optimizes the timing for the triggering of air bags and seat belt pretensioners to improve occupant protection, have been available for some time. The interlinking of advanced technologies, such as those for active safety and connected cars, is anticipated to proceed at an even faster pace in coming years.

4. 3. Automatic Accident Notification Systems

The survival rate of a person seriously injured in an accident is greatly affected by how long it takes for that person to receive emergency medical care. Automatic accident notification systems (automatic collision notification (ACN)) that communicate the location of an accident and other information in the event of a collision are gradually coming into operation to shorten that delay. The installation of automatic accident notification systems is already mandatory in Europe and there are efforts to do the same in Malaysia and the UAE. Since the international standard related to ACN was established by the United Nations Economic Commission for Europe World Forum for Harmonization of Vehicle Regulations (WP.29), new models installed with ACN in Japan after 2020 will be required to meet the standard.

The U.S. has launched an advanced automatic collision notification (AACN) with more advanced functionality. The AACN determines the degree of injury based on the vehicle information transmitted at the time of the accident (e.g., collision direction, deceleration, seat belt use by occupants, and whether there are multiple impacts). In November 2015, Japan started trial operations with the cooperation of some base hospitals with a medical helicopter, and transitioned to official operation in 2018. As of the end of 2019, a framework involving 60 cooperating hospitals in 43 prefectures and all 728 fire department headquarters in Japan had been established.

The above indicate how initiatives to spread ACN and AACN are becoming increasingly proactive around the world.