AUTOMOBILES AND SAFETY

1 Introduction

In 2015, the number of fatalities from traffic accidents reached 4,117, the first increase in 15 years, made conditions look grim. However, in 2016, fatalities decreased to 3,904 thanks to ongoing traffic safety initiatives, dropping below 4,000 for the first time since 1949. Nevertheless, tragic accidents involving children, frequent accidents due to mistakes by elderly drivers, and tragic accidents resulting from reckless driving such as still far too common occurrences of drunk driving, among others, continue to present a bleak outlook on achieving the government target of reducing fatalities to 2,500 or less by 2020. Dealing with such accidents will require intensified cooperation between the public and private sectors and to adopt concrete integrated three-part measures that incorporate lndividuals, vehicles and the society.

2 Traffic Accident Trends and Measures

2. 1. Traffic Accident Trends

The number of annual traffic accident fatalities (within 24 hours of the accident) peaked at 16,765 in 1970, before falling to 8,466 in 1979 due to a range of measures to enhance safety. Traffic accident fatalities then began to trend back upward, peaking again at 11,452 in 1992. Since the year 2000, the number of fatalities fell in an increasingly gradual trend, reaching 4,113 in 2014. In 2015, fatalities rose to 4,117, which was the first increase in 15 years. However, in 2016, that number decreased to 3,904, a 5.2% drop over the previous year, falling below 4,000 people for the first time since 1949. The number of traffic accidents and injuries (including fatalities) has fallen since reaching a peak in 2004. In 2016, the number of injuries was 621,835, 7.2% less than in the previous year, and the number of traffic accidents was 499,232, a 7% decrease compared to the previous year. These numbers are at the same level as those of the 1960s (Figure 1)[1].

The following sections outline the salient characteristics of fatal accidents in 2016.

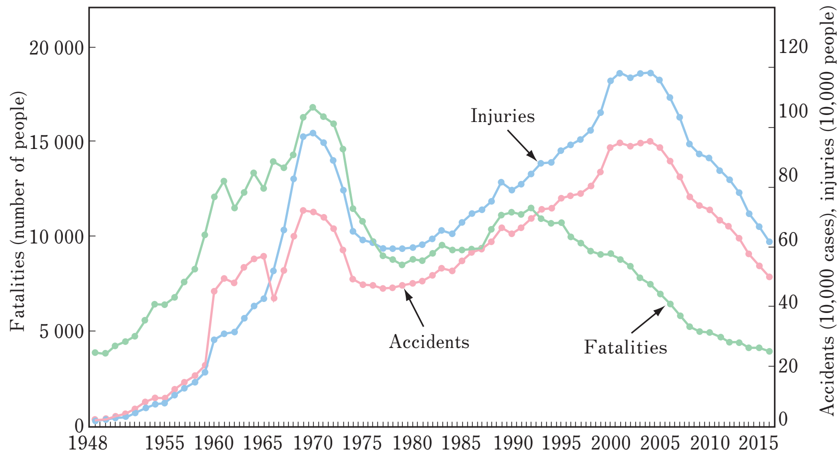
2. 1. 1. Number of Fatalities Per Road User Status

The total number of traffic accident fatalities in 2016 was 3,904. Of these, 1,361 were pedestrians (down 11% from 2015), a proportion of 35%, and the number of vehicle occupant fatalities was 1,338 (up 1.2% from 2015), a proportion of over 34%. Since 2008, the proportion of pedestrian fatalities has continuously exceeded that of vehicle occupants. However, the pedestrian fatalities have started to decrease after the increase seen in the previous year. The number of cyclist fatalities was 509 (down 11% from 2015). 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 the spread of the adoption of AEBS (Autonomous Emergency Braking System) for Pedestrian bicycle-related revisions to the Road Traffic regulation, and the improvement of road infrastructure (Figure 2)[2].

2. 1. 2. Increase in the Number of Elderly Fatalities

Breakdown traffic accident fatalities by age shows that in 2016, there were 2,138 fatalities of people aged 65 or older, which accounted for 54.8% of the total. This number was the highest ever. Pedestrians accounted for around half of these elderly fatalities (47%), far exceeding the overall proportion for all age ranges (35%). In addition, the proportion of elderly people in the cyclist and pedestrian categories of fatalities was extremely high at 63%. This reflects the fact that elderly vulnerable road users account for a high percentage of the total number of victims.

The fatality risk is 0.2% for vehicle passengers younger than 65, but 1.2% for elderly people 65 or older, a very high sixfold difference. This difference is explained by the increase in accidents involving the elderly that follows from the higher number of elderly drivers, as well as by the greater risk of serious injury due to lower impact tolerance, which is a physical characteristic of elder-



Note 1 Until 1959, these statistics did not include minor accidents (injuries lasting less than eight days, material loss of 20,000 yen or less).
2 Until 1965, these statistics also included accidents involving property damage.
3 Until 1971, these statistics did not include Okinawa Prefecture.
4 Accident and injury figures for 2016 are approximate numbers collected by the traffic accident daily report collection system.

Fig. 1 Traffic accident trends (1950 to 2016)

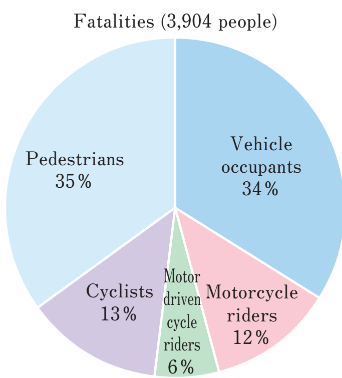


Fig. 2 Fatalities by road user (2016)

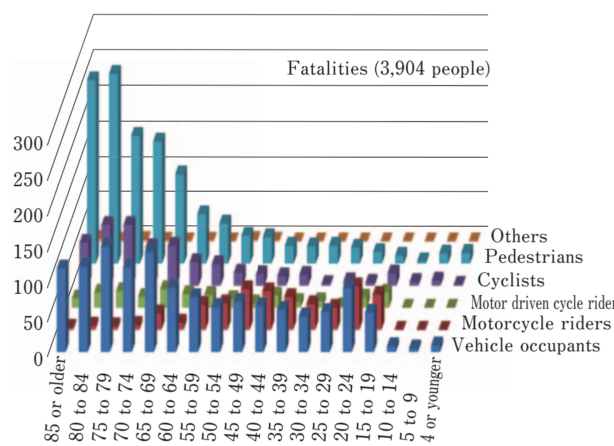


Fig. 3 Fatalities by age and road user (2016)

ly people (Figure 3)[2].

As Japan's society continues to age, these trends are likely to become even more significant. In addition to government-led measures to enhance traffic safety courses for elderly drivers and provide better support those who give up their license, initiatives that apply to vehicles are also becoming more and more important. These include active safety initiatives to compensate for the drop in cognitive, decision-making, and movement abilities that characterize elderly drivers, as well as passive safety initiatives adapted to the lower impact tolerance of elderly people if an accident does occur.

2. 2. Traffic Accident Measures

In March 2016, the Japanese government introduced the Tenth Fundamental Traffic Safety Program[3], which included targets to reduce the number of traffic accident fatalities and injuries to 2,500 and 500,000, respectively by 2020. The main measures to achieve these targets are: (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, (j) improving and promoting victim support, and (h) improving research and development as well as investigative research. MLIT's traffic safety measures are based on a report drawn up in June 2016 called Future traffic safety countermeasures plan for realizing zero fatality society[4]. This report describes the following basic concepts for future traffic safety measures.

Four pillars of traffic safety measures

(a) Measures for accidents involving children and elderly people
(b) Safety measures for pedestrians and cyclists
(c) Safety Measures for serious accidents involving

heavy-duty vehicles

(d) Encouraging new technologies such as automated driving system

These measures are explained below.

2.2.1. Safety Measures for Children and Elderly People

For child occupant safety, promotion and proper use of user-friendly child seats and junior seats compliant with ISOFIX and i-size (UN-R129) could be considered as countermeasure. and user-friendly child seats and junior seats compliant with ISOFIX and i-size (UN-R129), and promoting their proper use.

Measures envisioned to prevent accidents involving pedestrian or cyclist include the use of a camera monitoring system (CMS) or other that helps drivers check the safety of their surroundings.

Traffic accidents involving elderly people, as both victims and offenders, are increasing. Measures to prevent elderly people becoming offenders include active safety technologies incorporated in the vehicle that can prevent accidents or mitigate the damage they cause, even when an elderly driver makes a mistake. Measures to prevent elderly people becoming victims include making automatic lighting mandatory as a means of letting elderly pedestrian or cyclist know of approaching vehicles in semi-darkness so they can act safely. In addition, formulating occupant protection standards that take the physical characteristics of the elderly into account may be an effective measure for vehicle occupant.

2.2.2. Safety Measures for Pedestrians and Vehicle Occupants

It is important to incorporate measures that apply active safety technology to prevent collisions between vehicles and pedestrians, or vehicles and bicycles, to reduce injuries to pedestrians and cyclist.

Effective approaches to preventing collisions between heavy-duty trucks and bicycles include measures such as decreasing blind spots and notifying cyclist detected around the vehicle.

2.2.3. Measures for Serious Accidents Involving Heavy-Duty Vehicles

Accidents involving heavy-duty vehicles such as buses and trucks tend to cause serious damage. Therefore, the installation of active safety technologies such as AEBS electronic stability control, lane departure warning, or CMS is important. In addition, it is also important to popularize technologies that provide safe driving assistance for drivers, such as drive recorders or systems that address abnormal driver states to ensure the safe operation of trucks or buses.

2.2.4. Adaptation to New Technologies such as Automated Driving

In conjunction with conducting effect evaluations of advanced safety technologies studied through the ASV project, vehicle assessments of highly effective technologies (such as AEBS) are evaluated and disclosed to improve their performance and promote their popularization. In the fifth phase (2011 to 2015)[5] of the ASV project, initiatives aimed at promoting greater understanding and popularization of these technologies were taken. For example, the 2013 ITS World Congress in Tokyo was used as to showcase a total of six support systems making use of vehicle-to-vehicle and vehicle-to-pedestrian communication. In the sixth phase[6], the completed ASV technologies, are scheduled to be complemented with initiatives to promote the spread of automated driving technologies. Driver errors account for approximately 90% of traffic accident factors. Automated driving technology could drastically reduce accidents caused by such errors or the traffic law violations such as failing to check for safety.

2.3. Vehicle Safety Assessment Trends

2.3.1. Trends in Japan[7]

In 2016, the collision speed for the pedestrian protection head injury assessment in the collision safety performance test was raised from 35 to 40 km/h, and the dummy chest injury criterion in the full-lap and frontal offset impact tests was changed from deceleration to deflection.

The assessment of AEBS that mitigate pedestrian injuries was also added to the active safety performance test in 2016.

The active safety assessment includes lane departure warning, rear view monitoring system, and AEBS (vehicles, pedestrians). The highest assessment rank has been changed from ASV+, with a maximum 46 points, to ASV++, with a maximum 71 points. All eleven models presented in the assessment results released in December for the JNCAP tests conducted in the first half of 2016 achieved ASV++ (the highest rank).

Assessments to tackle the important issues concerning traffic accidents in Japan will be gradually implemented. In 2017, lane-keeping assistance systems (LKA, LDP) will be added to the active safety performance assessment, and i-size compliant models of the new child seat will be announced. In 2018, assessments of AEBS (pedestrian, nighttime) and head lamp performance are planned.

2. 3. 2. Global Trends

In the U.S., major changes to the US-NCAP were scheduled from the 2019 model year. However, the change of government could alter those plans.

In contrast, Euro NCAP announced a significant update of the frontal collision and side collision performance tests (new offset collision, side collision (far-side collision, collision velocity, barrier weight change)) in 2020. In terms of active safety, the assessment scenario for AEBS will be expanded (pedestrians at nighttime, bicycles, intersections, and more) between 2018 and 2020 in a manner similar to the JNCAP.

The trend toward broadening the scope of active safety performance assessments is spreading worldwide, and there are plans to introduce AEBS (vehicles, pedestrians, and more) in the CNCAP 2018 and the Latin NCAP 2019 assessments. In addition, the head light performance assessment test has already been adopted by the IIHS, and its introduction in the CNCAP 2018 assessment is under consideration.

3 Research and Technology Related to Active Safety[8]

The year 2016 imparted considerable additional momentum to the spread of system. At the Ise-Shima Summit in May, VIP participants rode Toyota[9], Nissan[10], and Honda vehicles (Figure 4) that demonstrated the achievements of the Strategic Innovation Promotion Program (SIP) administered by the Cabinet Office. In May 2016, the Public-Private ITS Initiative/Roadmaps 2016[11] indicated that the aim of building and maintaining the world' s most advanced ITS, as well as contributing to society in Japan and the world would continue to be pursued. The document describes initiative aimed at realizing that aim by around 2020. Specifically, it defines the timeframe for the realization of technologies such as level 3 automated driving and level 4 unmanned automated driving transport services in designated areas in light of recent progress of technical development in the private sector (Figure 5).

At the G7 Transport Ministers' Meeting held in September, participants agreed to promote private investment and strengthen the coordination of interests aimed at safe and globally harmonized future looking regulations.

Toyota (Urban Teammate) Nissan (ProPilot)

Fig. 4 Demonstration at the Ise-Shima Summit

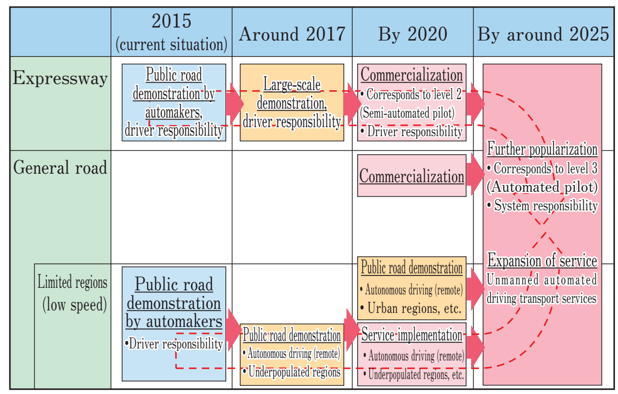


Fig. 5 Overall roadmap consisting of two automated driving systems (conceptual)

That same month, NHTSA announced its policy on Autonomated driving system, which consists of a 15-point guideline for automobile manufacturers planning to sell, or conduct demonstration tests of, such vehicles. Similarly, in the U.S., California and Michigan have clarified the legal procedures concerning the driving of Autonomated driving system on public roads. Demonstration tests for Autonomated driving system are being carried out worldwide. In the U.S., ventures such as Uber are offering vehicle dispatching and distribution services, and in Europe, governments are providing support for bus or truck fleet driving.

Vehicles featuring level 2 Autonomated driving system are already available. In July, Mercedes-Benz launched a new E-Class model equipped with the Drive Pilot system, and in August, Nissan launched a Serena with the ProPilot 1.0 system. In addition, Audi A8 equipped with a level 3 automated driving system planned for launch in FY2017[12]. The pace of Autonomated driving system refinement and its spread in the real world is accelerating. However, the refinement and spread of Autonomated driving system, makes it essential to develop criteria for measures to prevent hacking (e-security) and maintain functionality during vehicle use (e-safety).

4 Research and Technology Related to Post crash Safety

With the spread of active safety technologies, the occurrence of traffic accidents may be reduced drastically. Therefore, studies on regulations and assessments concerning active safety are gaining attention. However, current active safety technologies do not apply to all accidents, and it is difficult to completely eliminate all traffic accidents using these functions. Consequently, passive safety performance remains important. Authorities and research institutions in various countries are continuously analyzing accidents to ascertain their actual conditions, performing root cause analyses on injuries, studying technological countermeasures, and assessing new test methods or measurement devices.

4. 1. New Test Methods and Measurement Devices[13]

The adoption of test methods stricter than those in current tests is being researched and discussed based on actual accident conditions in various countries.

The U.S. and Europe are considering the introduction, around 2020, of a frontal collision moving barrier test designed with more realistic assumptions about accidents between vehicles. The adoption of Advanced frontal impact test dummy THOR is also under evaluation, and Japan and China are considering the introduction of these test methods in the future.

Japan and China are also planning to adopt the AE-MDB barrier and advanced World SID dummy used for side impact tests in Europe. Tests using these new barriers and dummies apply different values for barrier mass, collision point, and collision velocity according to the situation the various countries. The adoption of World SID in North American US-NCAP and IIHS side impact tests is also under consideration. The use of Q10 and Q6 child dummies, as well as World SID small female dummies in assessments of the rear seats is being considered.

In the field of pedestrian protection performance assessment testing, a test method that uses subsystem impactors to simulate specific pedestrian body parts has been widely adopted. The Flex-PLI, established as a global technical regulation (GTR) following the proposal by JAMA/JARI in 2009, reproduces the human leg with high bio fidelity and is used in Japan and Europe. Its use in China and the U.S. is being considered.

As shown above, efforts to set stricter impact conditions than those of current impact performance assessment tests, as well as introduce advanced dummies with superior bio-fidelity, are intensifying. In addition, research on dummies representing elderly people and whole-body pedestrian dummies is being carried out to further reduce the number of victims.

4. 2. Protection Systems

Occupant protection devices such as seat belts and airbags have benefited from numerous improvements, including pretensioners that increase constraint force on the occupant and force limiters that control the constraint load. Reminders encouraging occupants to wear their seat belts are becoming more sophisticated. The seat belt usage rate is expected to rise even more with advances of occupant detection function and the introduction of relevant assessments.

Other effective protection devices in collisions between a vehicle and pedestrian have already been commercialized. These include pop-up hoods, which raise the hood after a collision to create space between the pedestrian and the rigid components in the engine compartment, and pedestrian protection airbags, which mitigate head injuries by inflating an airbag over rigid parts such as the A-pillar[14].

Studies of future systems intended to improve occupant protection performance and reduce secondary collision through coordination with advanced sensor systems and the partial electrification of passive safety devices are currently in progress. Devices that coordinate with active safety systems retract the seat belt and correct the seat position, and technologies that reduce the possibility of secondary injuries by having the airbag sensor activation signal trigger automatic braking have already been commercialized. Technologies that coordinate between ADAS, connected car technologies, and passive safety devices will continue to be studied.

4. 3. Automatic collision Notification

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. Emergency notification systems that communicate the location of an accident and other information automatically immediately after a collision (ACN, e-Call) are gradually coming into operation to shorten that delay. ACN and e-Call are already operating in parts of Japan, the U.S., and Europe, and efforts to regulate them and mandate their installation are moving forward. Russia and EU are planning make their installation mandatory in 2015 and 2018, re-

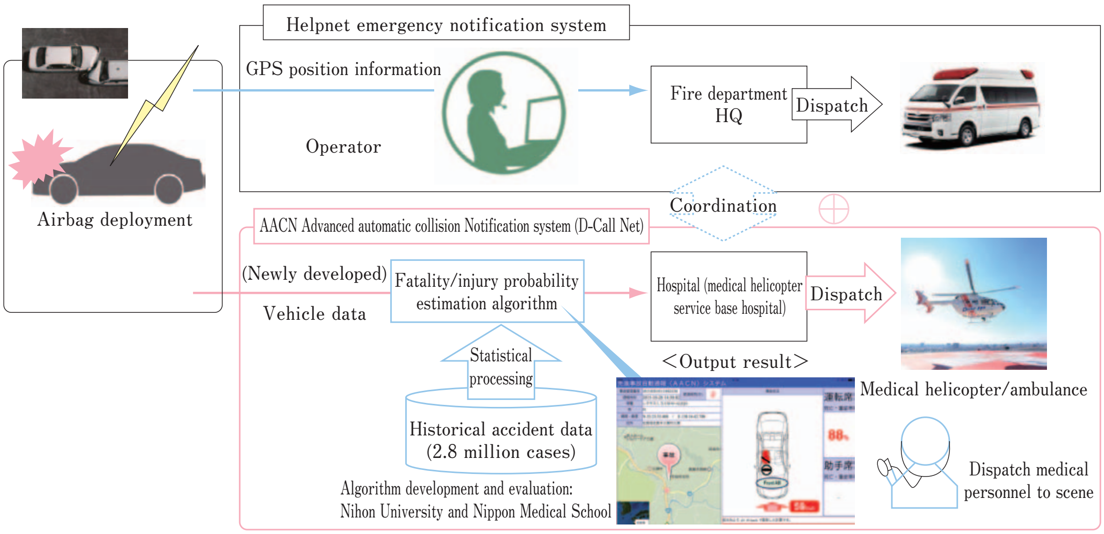


Fig. 6 AACN Advanced automatic collision Notification system (D-Call Net)

spectively. At the same time, UN WP 29 is leading discussions to include these systems in UN regulations.

In addition, North America has started the operation of AACN, a system which determines the degree of injury based on the vehicle information transmitted at the time of the accident (e.g., deceleration rate or seat belt use). Japan has started the trial operation of an AACN Advanced automatic collision Notification (D-Call Net), that determines whether to dispatch a medical helicopter at an early stage (Figure 6)[15]. The announcement of models equipped with ACN/AACN, and the introduction of performance assessment tests by JNCAP starting in 2017, are under consideration.

References

(1) Japan Traffic Safety Association, http://www.jtsa.or.jp/topics/T-274.html
(2) National Police Agency: 2016 traffic accident statistics, http://www.e-stat.go.jp/SG1/estat/List.do?lid=000001168544
(3) Cabinet Office: 10th Fundamental Traffic Safety Program (Japanese only), http://www8.cao.go.jp/koutu/kihon/keikaku10/index.html
(4) MLIT, http://www.mlit.go.jp/common/001137710.pdf
(5) MLIT, 5th Advanced Safety Vehicle (ASV) project (Japanese only), http://www.mlit.go.jp/jido sha/anzen/01asv/japanese/planning5.html
(6) MLIT, 6th Advanced Safety Vehicle (ASV) project (Japanese only), http://www.mlit.go.jp/common/001155042.pdf
(7) MLIT, JNCAP roadmap 2015, http://www.mlit.go.jp/common/001110830.pdf
(8) Cabinet Office, http://www.kantei.go.jp/jp/singi/it2/senmon_bunka/detakatsuyokiban/dorokotsu_dai2/siryou1.pdf
(9) Toyota Motor Corporation, http://newsroom.toyota.co.jp/jp/
(10) Nissan Motor Corporation, https://newsroom.nissan-global.com/
(11) Cabinet Office, ITS roadmap 2016, http://www.kantei.go.jp/jp/singi/it2/kettei/pdf/20160520/2016_roadmap.pdf
(12) Audi, http://www.audi.jp/piloted_driving/
(13) Humanitecs: Crash Test Dummies, http://www.humaneticsatd.com/crash-test-dummies
(14) Tanaka et al., Forum 2016, National Traffic Safety and Environment Laboratory
(15) Toyota Motor Corporation, http://newsroom.toyota.co.jp/jp/download/10415946