



Special Feature: Toyota's Safety Technology

Safe and Secure Mobility Toyota's Approach to Safety

Our three-pronged integrated approach to technology development combining safe vehicles, traffic safety education activities and the creation of a safe traffic environment is a natural consequence of our guiding principle of always providing safe products.

This approach pleases our customers with safety and quality and contributes to achieving zero casualties from traffic accidents, which is the ultimate goal of the future mobility society.

The real question is how do we relate to people and communities. What are our goals?

The following section provides a comprehensive overview of Toyota's approach to safety, focusing on our safety technologies.

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Our Basic Safe Vehicle Philosophy

Contributing to the ultimate goal of the future mobility society: Zero casualties from traffic accidents

Toyota's Global Vision reveals that safety is Toyota's highest priority and it is important to provide highly reliable quality that will enable people to feel good about driving and riding in its vehicles. Toyota takes a three-pronged approach to safety that integrates people, cars and the traffic environment. By doing so, we seek to contribute to the ultimate goal of the future mobility society, which is zero casualties from traffic accidents. Another of our core philosophies is to pursue real safety by learning from actual accidents and continuing to evolve for substantially enhanced safety.

Safety through our three-pronged integrated approach and the real safety lessons learned by studying accidents

In regions that are rapidly becoming motorized, driver awareness programs, such as traffic safety education, are indispensable, as are improvements to the traffic environment that make accidents less likely. We believe that our three-pronged integrated approach, which combines vehicle safety with traffic safety education activities and traffic environment improvements, is vital to realizing a safe mobility society. At the same time, we pursue real safety through the study of actual accidents. Accident investigations and analysis to reveal the causes of accidents and injuries can help to pursue safety technologies. We continue to investigate and analyze accidents after vehicles we have developed reach the market, so we can confirm their effectiveness.

These two approaches formed the foundation of the Integrated Safety Management Concept we announced in 2006, and we proceeded with the development of "vehicles that support the driver in avoiding dangerous situations" by linking individual safety technologies and systems. In January 2011, we established the Collaborative Safety Research Center in North America as our

new base for accident analysis and problem resolution. Toyota's research goal is to contribute to the realization of a safe mobility society through improved driver and pedestrian safety and security.

Toyota's Approach to Safety



Three-pronged approach integrating people, cars and the traffic environment

The number of traffic fatalities in Japan in 2009 was just under 5,000, which is roughly one-third lower than the historical high. It is likely that this reduction is not only because of vehicle development but also as a result of people-oriented measures, such as improved rates of seat-belt usage and stricter penalties for traffic violations, as well as efforts to create a better traffic safety environment, such as making improvements at intersections where the incidence of accidents is high.

Traffic safety education activities for people

Toyota has conducted traffic safety education activities for drivers since 1960, and in 2005 we established the TOYOTA Safety Education Center "mobilitas" at Fuji Speedway with the goal of increasing traffic safety awareness among everyone involved in the traffic infrastructure. At "mobilitas," we conduct high-quality safe driver training, ranging from classroom lectures to training on specialized courses, for the general public, as well as for companies and other organizations.

Vehicle technology for helping to prevent accidents and crash safety

Toyota's pursuit of vehicle safety led to the development and adoption of technologies such as VSC (Vehicle Stability Control) and GOA (Global Outstanding Assessment) in 1995 and PCS (Pre-Crash Safety System) in 2003, each of which was the first of its kind in the world. Toyota will continue to lead the world in developing active safety technology that supports the driver in

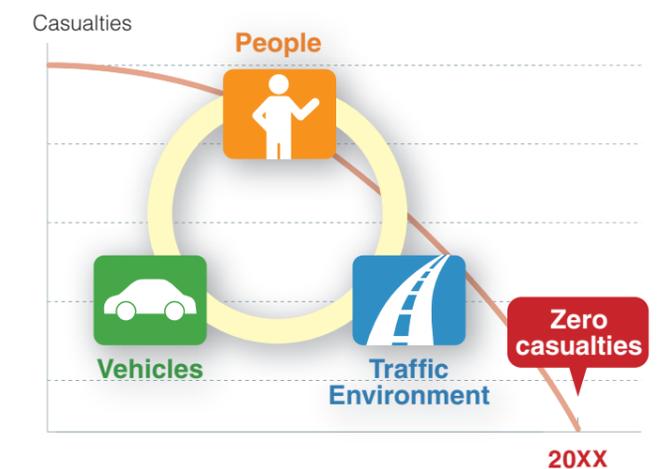
avoiding dangerous situations as well as passive safety technology that contributes to injury reduction of driver and passengers on vehicle collision. We plan to adopt these technologies in most models and encourage their use.

Working with government agencies for enhanced traffic environment safety

Toyota is going further in our efforts to enhance traffic environments by participating in "smartway" projects (next-generation roadways that use IT to link people, cars and roadways) in cooperation with government agencies. We will continue our R&D and testing of the next-generation vehicle infrastructure integration system.

► Additional details available at [Click HERE](#)

Three-Pronged Integrated Approach



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Pursuit of Real Safety: Accident Reconstruction Technology

Developing effective safety technology through accident reconstruction and analysis

Toyota's safety technology development pursues real safety. Our first step is to analyze a broad spectrum of accident investigation data to determine why an accident occurred and what kinds of injuries were incurred. Next, the accident is reconstructed through a simulation and applicable technologies are developed. In the final stage we conduct vehicle tests to confirm that the targeted performance has been achieved.

We continue to investigate and analyze accidents after the vehicle have reached the market. By repeating these steps, we pursue to develop safety technologies. This indicates the substantial importance of fundamental technologies for accident reconstruction in the development of safety technologies.

Pursuit of Real Safety



Accident Reconstruction Technology 1

The world's largest indoor test facilities Driving Simulator

In 2008, Toyota developed one of the world's largest driving simulator, equipped with a high-resolution imaging system and providing a full 360-degree driving perspective. This allows research on the driver behavior that precedes crashes, which is difficult to be conducted in a real environment. By repeating the same conditions multiple times, it is possible to examine the benefits of safety assist equipment.

For example, when measuring the effects of the PCS (Pre-Crash Safety System), it is possible to sample and analyze the behavior of a variety of drivers by assessing different drivers under repeated, identical conditions. Also, the simulator makes it possible to reconstruct driving condition in a state of reduced consciousness and thereby we are developing technologies for a safety guidance system to early detect states of mind unsuitable for driving.

Toyota will continue to utilize our driving simulators for tasks such as the analysis of human behavior and measuring the effectiveness of safety systems.

▶ Additional details available at [Click HERE](#)



Driving simulator



Sense of realism through high-resolution, full-surround CG

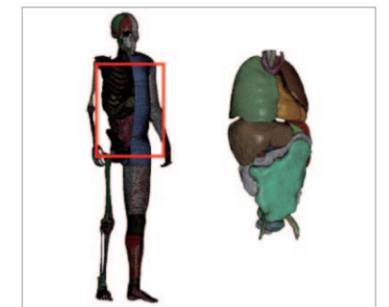
Accident Reconstruction Technology 2

Ascertaining injury mechanisms THUMS—the virtual human model

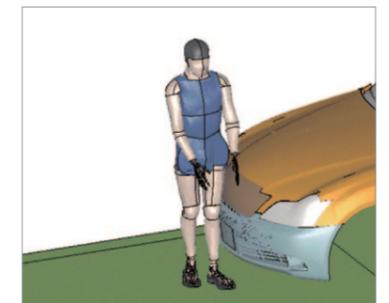
Although crash test dummies used to test the effects of crashes on the human body allow for comparisons of load magnitude on the body, they do not provide the means for analyzing injury mechanisms. This is particularly true in the case of pedestrian accidents, in which body positions change moment by moment, making it difficult to examine what happened where. To meet that challenge, in 2000 Toyota and Toyota Central R&D Labs developed human models known as THUMS (Total Human Model for Safety), starting off with a skeletal model on which the human body is precisely reproduced. The current THUMS Version 4 is made up of 2 million elements. The digital representation of parts of the body such as the brain, internal organs and muscles enables a detailed analysis of the crash impact on organs.

THUMS: THUMS allows highly detailed analysis of bone fractures, severed ligaments, etc., by simulating many characteristics of the human body, ranging from the shape of the body to its skeletal structure and skin. Toyota began developing THUMS in 1997 in cooperation with Toyota Central R&D Labs, Inc. Version 1 was completed and commercially launched in 2000, followed by Version 2 in 2004, which added a face and bones to the model. Version 3 was launched in 2008 through the completion of a model to which a brain was added in 2006. Version 4, with detailed modeling of the shape of internal organs made using high-resolution CT scans, was completed and released in 2010.

▶ Additional details available at [Click HERE](#)



Detailed modeling of internal organs



Ascertaining injury mechanisms on crash

Special Feature: Toyota's Safety Technology

Integrating Leading-Edge Safety Technologies Aiming to Make Vehicles Less Likely to Be Involved in an Accident

Toyota technology aiming to minimize risk at every driving stage

Toyota's Integrated Safety Management Concept, which is rooted in our technological development, should not be thought of as a collection of independent safety systems installed in a vehicle. Rather, the goal is to link each of these systems to enhance overall effectiveness. Not only the conventional safety technology area which is focused on the sequence just before and after the accident, we are focusing to provide optimal support at every driving stage, from being parked through normal driving, pre-crash, post-crash to the arrival of rescue. We are developing active safety, pre-crash safety, passive safety and rescue technologies with the goal of producing vehicles that support the driver in avoiding dangerous situations.

[Active safety technology]

VSC (Vehicle Stability Control)

When this driver support system senses a loss of traction or a slip during cornering or on a slippery road, braking is automatically applied to all four individual wheels and engine power is reduced.

▶ Additional details available at [Click HERE](#)

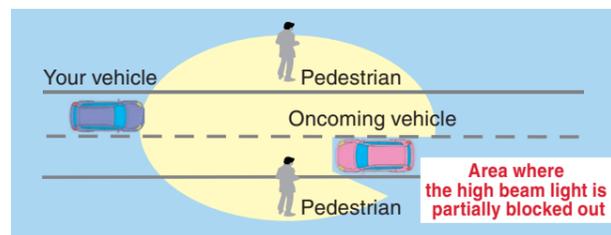
VDIM (Vehicle Dynamics Integrated Management)

The goal of the VDIM is to provide stability of the vehicle based on vehicle performance control technology. Great passive safety and ideal maneuverability plus driving stability are fundamental elements of success. The VDIM effectively aims to reduce the possibility of an accident by integrating ABS, TRC, VSC and power steering together as one.

▶ Additional details available at [Click HERE](#)

Variable light distribution headlamps (ADB)

We are developing an ADB system that aims to retain night time visibility nearly equivalent to high-beam illumination while high-beam light from ADB-fitted vehicle is partially shielded by ECV automatically to prevent glare that can interfere with the visibility of drivers of vehicles ahead.



▶ Additional details available at [Click HERE](#)

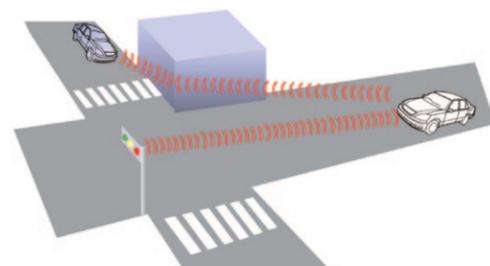
Wrong way driving alert for navigation systems

Drivers unaware that they are on the wrong side of the road can cause serious highway accidents. Our navigation system sense when the car is traveling against traffic and alert the driver.

▶ Additional details available at [Click HERE](#)

Infrastructure-linked driving support safety system

These systems offer transmission between the road and the vehicle, or between vehicles, to help drivers prevent accidents. (ITS Spot Service (DSRC) vehicle infrastructure integration systems, etc.)



▶ Additional details available at [Click HERE](#)

[Pre-crash safety technologies]

Development of the pre-crash safety system

When the pre-crash safety system detects an obstruction and determines the possibility of collision, it notifies the driver with a warning buzzer. Then the pre-crash brake assist is activated and increases the braking force when the driver hits the brake. By accident avoidance maneuverability through extended nighttime sensor range and the integration control of breaking and steering, we are seeking to develop pre-crash safety system which helps to avoid collision as well as reduce collision damage via a "collision avoidance support system."



▶ Additional details available at [Click HERE](#)

[Passive safety technologies]

Vehicle bodies which help to mitigate pedestrian injury

Toyota began manufacturing vehicle bodies that help mitigate pedestrian injury in 2001 and has been expanding their use. Also, we are developing a pop-up hood that even applies to vehicles with low hoods that cannot maintain sufficient space underneath by which bumper sensors will detect a collision with a pedestrian, automatically lifting the back section of the hood to expand the space under the hood. This contributes to a reduction of head injuries to the pedestrians.



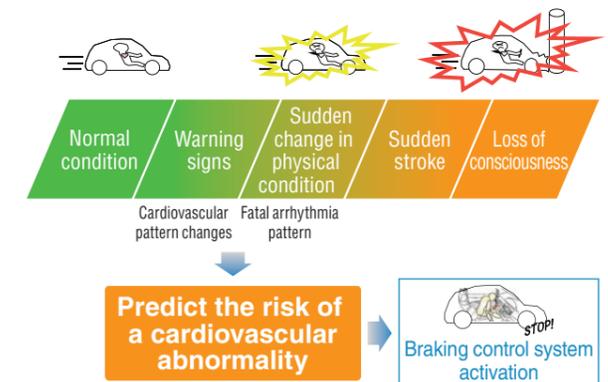
ABS: Antilock Braking System
 ADB: Adaptive Driving Beam
 DSRC: Dedicated Short Range Communications
 ITS: Intelligent Transport Systems
 PCS: Pre-Crash Safety System

THUMS: Total Human Model for Safety
 TRC: Traction Control
 VDIM: Vehicle Dynamics Integrated Management
 VSC: Vehicle Stability Control

[Rescue-related technologies]

Emergency-response technology

We are developing technologies that predict danger prior to emergencies caused by the driver losing consciousness, such as steering wheels equipped with cardiovascular monitors that check for abnormalities while the steering wheel is gripped. In the future, we aim to commercialize systems that can assist daily health maintenance.



Special Feature: Toyota's Safety Technology

Future Direction of Safety Technologies

Customers can feel good about driving and riding in Toyota's vehicles

Toyota is engaged in developing both active and passive safety technologies, based on the Integrated Safety Management Concept, so as to achieve the future mobility society's ultimate goal of zero casualties from traffic accidents. Under the Integrated Safety Management Concept, Toyota is pursuing safety by linking the various safety systems installed in vehicles.

We also intend to secure product safety by thoroughly incorporating data from simulation and accident analyses, as well as feedback from customers, in our technology development.

In addition to the reliability design that Toyota has focused on until now for reliable products that are durable, we are pursuing safety design which aims to avoid occurrence of safety issues when malfunctions occur in the vehicles or when our customers drive the vehicles and such design that takes into consideration customers feelings.

Toyota will continue to develop technologies and work to provide solutions with the goal of offering the world's highest level of safety.

Placement of a CSTO for vehicle development

On April 1, 2011, Toyota created the position of chief safety technology officer (CSTO) to comprehensively coordinate Toyota's safety technologies and appointed Managing Officer Moritaka Yoshida to the post. The aim of this position is to speed up decision making and further strengthen global external communication abilities in the field of vehicle safety technology development.

The CSTO handles the following four main issues: 1) Propose and arrange safety policies; 2) Promote vehicle safety technology development; 3) Coordinate external safety-related explanations and technology information; and 4) Act as a spokesperson about safety technological aspects.

Although the CSTO is Toyota's representative for our technological progress and enhancement at the global safety technology and policy level, the CQOs (Chief Quality Officers), who were newly appointed last year, are responsible for regional quality control.



Managing Officer, CSTO
Moritaka Yoshida

Direction of Future Safety Technologies



Product Safety

Ensure safety and peace of mind by reflecting benchmarking and customer information in development



Integrated Safety Management Concept

