Toyota and Safety

TOYOTA

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Kaizen

“Continuous improvement.
As no process can ever be declared perfect,
there is always room for improvement.”

Contents

1 Safety: a shared responsibility

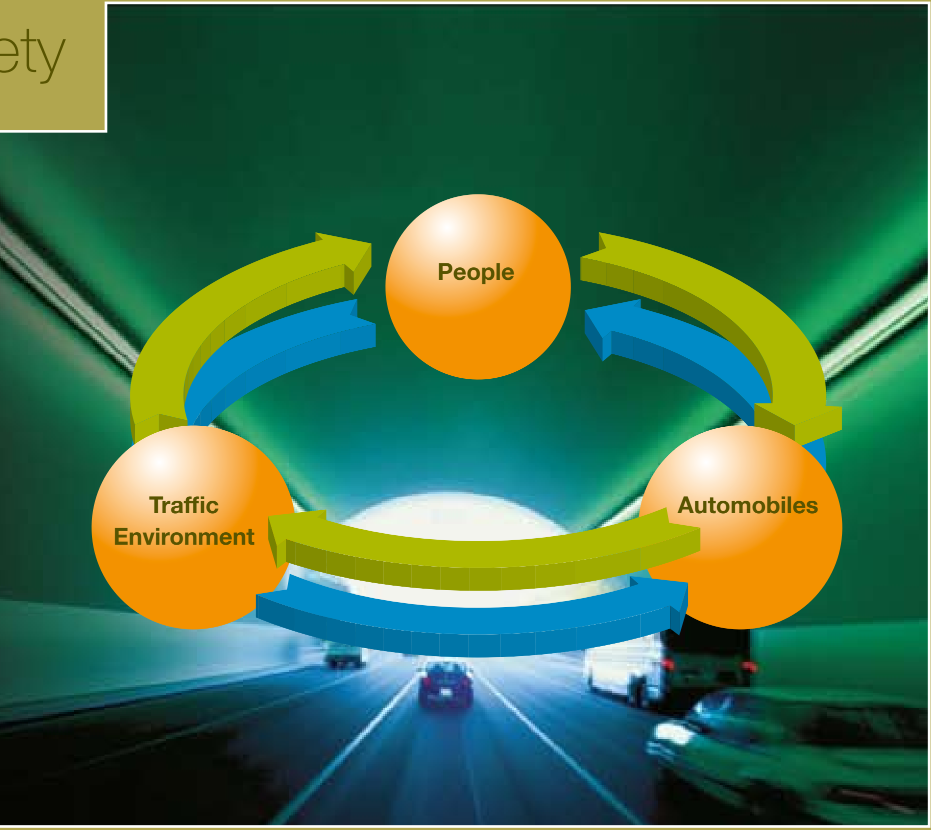
Mobility is key to our quality of life and is one of the strongest engines of economic growth around the globe. Yet, if automobiles are to continue to be accepted by society, we will have to come to terms with the environmental and safety consequences of their use.

Traffic accidents throughout Europe claim tens of thousands of lives every year. The number of accidents that result in injuries reaches into the millions. From drivers to passengers to pedestrians and cyclists, from the very young to the very old, traffic accidents take a heavy toll on Europe's citizens. And the economic impact of accidents is also significant. Lost productivity, medical bills and compensation for victims, physical losses of vehicles and structures, and institutional costs, such as those for insurance, policing, legal actions, all add to the burden.

As a major vehicle manufacturer, Toyota has a clear responsibility in the area of road safety. In working to reduce traffic accidents, injuries and fatalities, Toyota cannot limit itself to the development of new technologies which make vehicles safer to drive. Genuine sustainable mobility also requires the company's active participation in a wide variety of road safety initiatives conducted in collaboration with other stakeholders.

Toyota's Approach to Safety

Toyota believes that all stakeholders in the road safety equation have a shared responsibility for reducing the frequency of road accidents. There are three main factors in that equation: automobiles, the people who drive them, and the traffic environment. Each affects safety in different ways under different circumstances. While Toyota has devoted tremendous resources to improving its safety technologies, the company recognises that **complete safety cannot be achieved solely by improving vehicles**; it also requires **safer roads** and **more effective instruction in safe driving techniques.**



TODAY for TOMORROW

Toyota believes that a responsible company must be proactive – predicting problems and taking corrective measures *before* they happen. Toyota's "TODAY for TOMORROW" vision means that its expectations for the future must shape the company's actions right here and now.

EU OBJECTIVE:
REDUCE THE NUMBER OF TRAFFIC FATALITIES
BY 50% BY 2010.

The good news: positive change

Governments and NGOs around the world play a central role in regulating traffic, educating and licensing drivers, registering vehicles, building and maintaining roadways, setting stringent safety standards for automobile manufacturers, and assessing vehicle safety performance. As a result, in many parts of the world, traffic fatalities have been declining.

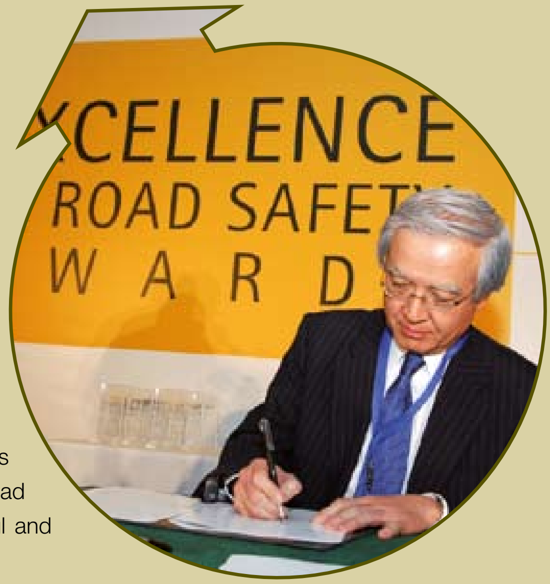
Recent statistics confirm a consistent downward trend in the number of annual traffic accidents, injuries and fatalities in Europe, moving the EU substantially closer to its goal of halving the number of traffic fatalities by 2010. Such results can only be achieved when governments, non-profit organisations, educational institutions and private companies like Toyota work together to create positive change.

Toyota and Road Safety

In line with its comprehensive approach to road safety, Toyota has been supporting initiatives designed to improve the traffic safety environment, enhance safe driving and increase safety-conscious behaviour by all road users. As these initiatives take effect, the company's strategy in this area should have a significant impact, both internally as well as on society at large.

One way Toyota promotes safety awareness is through its commitment to the **European Road Safety Charter**, an initiative sponsored by the European Commission to encourage concrete improvement actions, the analysis of results and increased awareness about the need to reduce road accident fatalities. The Charter also promotes the free exchange of best practice and ideas to improve the road situation in Europe.

By signing the Charter, Toyota Motor Europe (TME) has made a commitment to take steps within the company and in civil society to help improve road safety. Internally, TME's Customer Service Training department provides trainers for the National Marketing and Sales Companies with the knowledge and skills necessary to highlight the importance of safety and to explain the proper functioning of safety technologies to our customers. Such training courses are mandatory for affiliated marketing company instructors before training retailer staff.



In addition, TME has made safety one of the core principles of its Code of Conduct. The Code requires a formal commitment from all employees to produce safe vehicle products and services and to set an example in road safety overall, by being careful and courteous drivers.

Among the actions in civil society that TME is conducting as part of its Charter commitment are:

- Sponsoring TOP-25, a pan-European awareness campaign about the dangers of driving under the influence of alcohol and drugs.
- Supporting a model communication campaign being developed by the U.K.'s Royal College of Art to define and communicate road safety issues for older drivers and pedestrians.
- Delivering a road safety education programme for children and drivers in Turkey by distributing education kits, building a traffic park and establishing driving lessons with the participation of Toyota retailers. TME will use the programme results to improve other safety projects in the European Union.
- Supporting the European Transport Safety Council's research and communication Performance Indicators Programme (PIN) to assess EU Member States' road safety performance and promote high-level debates on key road safety themes in relevant Member States.

Toyota believes that road safety can be improved through collaboration and open dialogue with all stakeholders. To put this commitment into practice, road safety has been selected as one of the focus areas of the social contribution activities of Toyota in Europe. In 2007, over 1.7M EUR was invested in a number of road safety projects across Europe.

ETSC (www.etsc.be)

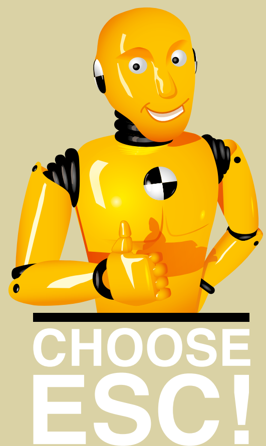
Since 2004, Toyota Motor Europe has supported programmes run by the European Transport Safety Council, an independent NGO that seeks to identify and promote effective measures on the basis of international scientific research and best practice in areas which offer the greatest potential for reducing transport accidents and casualties.

TOP–25 (www.top-25.eu)

Since 2006, Toyota Fund for Europe has been supporting TOP-25, a project that aims to show young people around Europe how important it is to practise responsible driving and thus reduce the number of road accidents. The project uses two specially designed tools. One is AlcoKart, which is equipped with an in-board computer that can simulate the characteristics of driving under the influence of alcohol: slower reactions, overreacting gestures, and late braking. Thus, participants who have not drunk any alcohol can nonetheless experience how difficult it is to control a car when inebriated. The other is Driving Simulator, which is installed in a real Toyota Corolla Verso. It allows the driver, while stationary, to experience dangers that can arise on the road in 15 different scenarios such as driving in rainy and snowy weather. In cooperation with local Toyota companies and local NGOs, TOP-25 tours around Europe using those tools at schools, fairs, and other events to raise awareness of young people about safe driving behaviour.

eSafety Aware initiative (www.esafetyaware.eu) and "Choose ESC" campaign

Toyota Motor Europe has joined this new communication initiative dedicated to accelerating the market introduction of life-saving technologies. Through a variety of information campaigns, the initiative hopes to promote awareness of the benefits of eSafety (or intelligent vehicle safety systems) among policy-makers and end-users. The first campaign in 2007 focused on promoting greater awareness of Electronic Stability Control (ESC). TME will continue to promote this technology over the next few years.



European New Car Assessment Programme (Euro NCAP)

Toyota is committed to offering the highest possible level of protection to its customers. The best evidence of this is the fact that six Toyota and two Lexus models have achieved the top rating of five stars for occupant protection from Euro NCAP, the most important consumer-testing programme in Europe[1]. Across the full range of Euro NCAP tests, Toyota and Lexus offer eight models with five stars for occupant safety, eight models with four stars for child occupant protection and three models with three stars for pedestrian protection. This places Toyota among the best car manufacturers in safety ratings across all three Euro NCAP tests.

MODEL	Year	Occupant protection	Child protection	Pedestrian protection
Toyota Avensis	2003	★★★★★	* not applicable	★
Toyota Prius	2004	★★★★★	★★★★	★★
Toyota Corolla Verso	2004	★★★★★	★★★★	★★
Toyota Auris	2006	★★★★★	★★★★	★★★
Toyota Yaris	2005	★★★★★	★★★	★★
Toyota Aygo	2005	★★★★	★★★★	★★
Lexus GS300	2005	★★★★★	★★★★	★★
Toyota RAV4	2006	★★★★	★★★★	★★★
Lexus IS220d	2006	★★★★★	★★★★	★★
Toyota Corolla	2007	★★★★★	★★★★	★★★

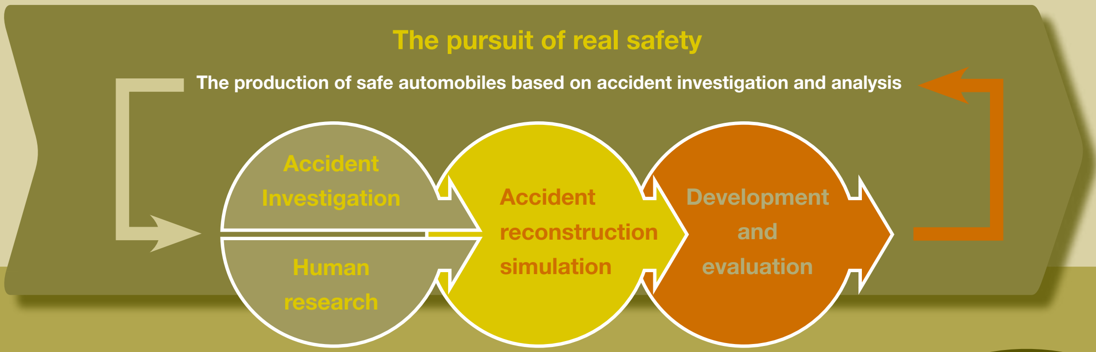
(1) Established in 1997, the European New Car Assessment Programme has rapidly become a catalyst for encouraging significant passive safety improvements to new car design. It is now backed by five European governments, the European Commission and motoring and consumer organisations in every EU Member State.

From Real World Practice to Theory and Back

To build safer cars, Toyota must collect information from actual vehicle accidents to analyse their cause as well as the extent and nature of the injuries sustained. Toyota calls this process the "pursuit of real safety".

By analysing accident data from real accidents occurring all over the world and then recreating such accidents in the laboratory, Toyota has been able to develop new technologies, testing them on actual vehicles and crash-test dummies before offering them to the public in the company's product line-up. This is an ongoing process through which Toyota continually seeks to **improve safety technologies** and **reduce accidents**.

Extensive crash-test research conducted at its three full-scale testing facilities helps Toyota to design cars that can withstand a variety of collision situations with car bodies that help **lessen injury to pedestrians as well**.



A New Approach to Safety Technology

In the area of safety, the TODAY for TOMORROW principle has yielded a new direction known as the **Integrated Safety Management Concept (ISMC)**. The idea is to provide optimal driving support at every possible level of danger, from parking to an unavoidable collision, and even in post-crash emergency response situations. In theory, ISMC will not only integrate individual safety technologies and systems within the vehicle, but will also include an infra-structure-respondent system (processing road-to-vehicle information) and should be capable of integrating information obtained from vehicles other than the driver's (vehicle-to-vehicle information).

Five types of situations defined by the degree of accident risk are the focus of Toyota's safety improvement efforts: driving support, active safety, pre-crash safety, passive safety and emergency response.

DRIVING SUPPORT is designed to help the driver in basic driving tasks. By reducing the driver's mental and physical load, the technology makes it possible for the driver to react in the best way possible whenever the risk of an accident is present. The supporting technologies used in this phase are Intelligent Parking Assist, Lane Keeping Assist and Adaptive Cruise Control.

ACTIVE SAFETY is aimed at the broader goal of preventing accidents from occurring. Technologies such as the Anti-lock Brake System (ABS), Traction Control, Brake Assist and Vehicle Stability Control (known as VSC) use electronic systems to assist drivers in manoeuvring through many kinds of road conditions and situations to avoid accidents.

PRE-CRASH SAFETY technology implements a variety of measures to help the driver recognise vehicles and obstacles on the road, and to help reduce damage and injury from unavoidable collisions. Pre-Crash Brake Assist, Pre-Crash Variable Gear Ratio Steering, Pre-Crash Brake and the world's first Rear-end Pre-Crash Safety System, which uses millimetre-wave radar to detect vehicles approaching from behind, are the technologies employed in this phase.

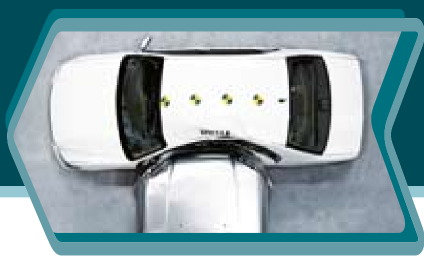
PASSIVE SAFETY, meanwhile, is aimed at reducing injury to occupants and pedestrians in the event that a collision cannot be avoided. Well-designed body structure and restraint systems have been developed. Front, side, head and knee protection airbags have been introduced across the car range, along with seat-belt pre-tensioners and force limiters. Toyota is working to reduce not only life-threatening injuries but also less severe injuries that can impair the quality of life, such as whiplash. More advanced airbag systems, such as knee and chest/abdomen/waist airbags, are also being introduced.

2 Safety technology: an integrated approach

From Active and Passive Safety to Integrated Safety Management

Toyota has a long history of safety innovations and achievements in the areas of both Active and Passive Safety.

From the world's first Active Suspension System in 1991 to the first commercialising of Vehicle Stability Control in 1995, as well as the first Curtain Shield Airbag launched in 1998, Toyota has sought to enhance safety technology and offer its benefits to consumers. (1)



Toyota's Safety Firsts(2)

- Toyota Electronic Modulated Suspension (1983)
- Active Suspension System (1991)
- Vehicle Stability Control – VSC (1995)
- Curtain Shield Airbag (1998)
- Navigated Cooperation Shift Control (1998)
- Electronically Controlled Brake (2001)
- VSC + Variable Gear Ratio Steering (2002)
- Hill-start Assist Control (2002)
- Front & Side View Monitor System (2003)
- Intelligent Parking Assist – IPA (2003)
- Kinetic Dynamic Suspension System – KDSS (2003)
- VSC + (incl. Electronic Power Steering) (2003)
- Pre-Crash Safety – PCS (2003)
- Vehicle Dynamics Integrated Management – VDIM (2004)
- Adaptive Cruise Control with Low Speed Following Mode (2004)
- Advanced Pre-Crash Safety – enhanced pedestrian detection (2006)
- Rear Pre-Crash Safety – Intelligent Active Headrest (2006)
- Radar Cruise Control with All-speed Tracking Function (2006)
- Navi-linked Brake Assist (2008)
- Driver Eye Monitoring (2008)
- Night View System with Pedestrian Detection (2008)

(1) Some of the technologies described are available only in specific markets
(2) Date of market introduction

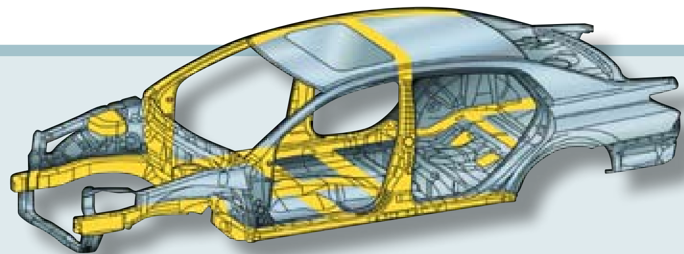
ACTIVE SAFETY

Toyota has developed a wide range of technologies designed to ensure the highest possible level of vehicle control and stability.

In 1995, Toyota launched the world's first Vehicle Stability Control (VSC) system, which automatically controls brake force and engine output to help prevent skidding. Toyota offers VSC on all passenger vehicles, regardless of engine or grade. VSC was the precursor to the company's groundbreaking active safety technology, Vehicle Dynamics Integrated Management (VDIM), introduced in 2004.

- **Vehicle stability**
- **Accident mitigation**
- **Anti-lock Brake System (1971)**
- **Traction Control (1987)**
- **Vehicle Stability Control (1995)**
- **Pre-Crash Safety (2003)**

PASSIVE SAFETY



The focus of passive safety has been to design a car body that will absorb the potentially enormous energy a collision generates and provide restraints – such as seat-belts and airbags – to help protect occupants once an accident has occurred.

As an outcome of Toyota's development of the Global Outstanding Assessment (GOA) standard, in 1995 Toyota introduced an optimised body structure, which includes rigid, well-isolated passenger compartments to offset frontal impact. Various kinds of safety equipment have also been developed. Seat-belt pre-tensioners lock a seat-belt into place during a crash while force limiters maintain a certain pulling-force level. Curtain, Knee and Twin-Chamber Airbags have all been developed and introduced in a variety of Toyota and Lexus vehicles.

Further enhancements in the field of passive safety will concentrate on:

- Vehicle size compatibility (and protection of pedestrians)
- Passenger size compatibility (enhanced protection of small females and elderly people)
- Enhanced protection against less severe injuries (whiplash)

- **Energy absorbing body structure**
- **Occupant restraint system**
- **Optimized Body Structure (1995)**
- **Seat-Belt P/T & F/L (1996)**
- **Curtain Shield Air Bag (1998)**
- **Knee Air Bag (2002)**
- **Twin Chamber Airbag (2005)**

INTEGRATED SAFETY MANAGEMENT CONCEPT

Toyota's new Integrated Safety Management Concept (ISMC) was developed to integrate all of the independent electronic safety systems[(1)] through a single Electronic Control Unit (ECU).

With ISMC, Toyota introduces a complete Driver Support System (DSS) computer, which integrates not only these powerful safety technologies, but also information gathered from multiple sensors inside the vehicle that indicate the driver's condition as well as the vehicle's behaviour. The computer is then able to determine the optimal support to give the driver in order to prevent an accident from occurring, while it also controls the various systems and technologies concerned.

In the **Pre-Crash Safety** area, Toyota's most recent technological advances include the Advanced Pre-Crash Safety System, which uses the world's first fusion of millimetre-wave radar and a newly developed stereo camera to detect other vehicles, obstacles and pedestrians in the vehicle's path. The system automatically retracts seat-belts and warns the driver of a possible collision, and will also apply Pre-Crash Brakes to reduce impact speed.

The groundbreaking Rear Pre-Crash Safety System also uses a millimetre-wave radar device installed in the rear bumper to detect a vehicle approaching from behind. Automated system responses include hazard light flashing to warn the driver of the rear vehicle, as well as automatic adjustment of the driver's and front passenger's headrests to reduce the risk of whiplash injury sustained upon collision.

In the **Driving Facility** and **Active Safety** areas, Toyota has introduced Radar Cruise Control with an All-Speed Tracking Function that monitors the vehicle ahead and automatically maintains a fixed distance from it. This technology makes it possible to maintain continuous control, even in situations such as congested highways, where vehicles are repeatedly starting and stopping. The systemic technology greatly reduces the driver's burden of accident avoidance under such circumstances.

Using various sensors, the **Intelligent Parking System** can estimate the physical dimensions of a vacant parking space and set the target parking position. In combination with other functions, this greatly simplifies the driver's role in safely parking a vehicle without damage to their own or neighbouring vehicles.

Toyota Driving Simulator

- **Intelligent Parking Assist (2003)[(2)]**
- **Advanced Pre-Crash Safety System with enhanced Pedestrian Detection and Collision Avoidance Support Functions (2006)**
- **Rear Pre-Crash Safety System (2006)**

(1) Anti-lock Brake System, Traction Control, Vehicle Stability Control, Variable Geer Ratio Steering and Electric Power Steering
(2) In 2006 for European models

3 Understanding Active and Pre-Crash Safety

ACTIVE SAFETY

Active Safety focuses on preventing accidents from occurring. It covers parking and driving support technologies (such as Intelligent Parking Assist, Adaptative Cruise Control, Blind-Corner Monitor and Lane-Keeping Assist), all of which are designed to make it easier for the driver to evaluate and avoid potential risks in the driving environment. By helping the driver to be fully aware of their driving environment, the technology decreases the risk of accidents, even in low-risk traffic situations. Vehicle Stability Control technology and the more technologically advanced Vehicle Dynamics Integrated Management (VDIM) system takes active safety even further by detecting the driver's intentions and electronically activating the various safety systems to make the car more responsive and enhance overall dynamic performance.

Intelligent Parking Assist

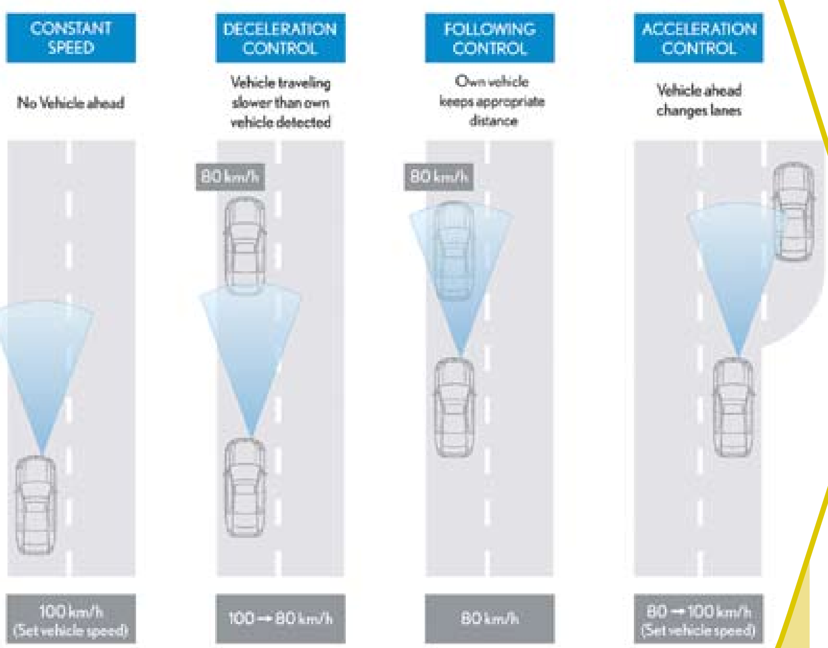
In September 2003, Toyota introduced the world's first **Intelligent Parking Assist** system in the Prius, a technology that supports steering operations when parallel parking or backing into a parking space. In November 2005, the system was complemented with a rear video camera to help the driver detect vehicles and obstacles behind the car on a colour monitor. The system also incorporates a special mode for tight parking places.

The new Intelligent Parking Assist system adds ultrasonic sensors to detect other parked vehicles nearby. With the new information gained, the system can estimate the actual size of the parking place and set the target parking position for the driver.

Blind-Corner Monitor

Toyota's **Blind-Corner Monitor** uses a camera and a colour display screen to minimise the danger of collisions when approaching crossings, or 'T' junctions. A camera with a built-in prism is installed in the middle of the front grille of the vehicle, and it sends a picture to the display screen positioned inside the car. When the car approaches a crossing in the road where visibility is reduced to the left and right, the image on the display shows a view of approximately 20 metres in both directions, at an angle of 25°. This helps the driver see approaching vehicles, bicycles and pedestrians that would not otherwise be visible. When reversing, a compact rear camera helps the driver see vehicles and obstacles behind the car on a colour monitor.

Adaptive Cruise Control



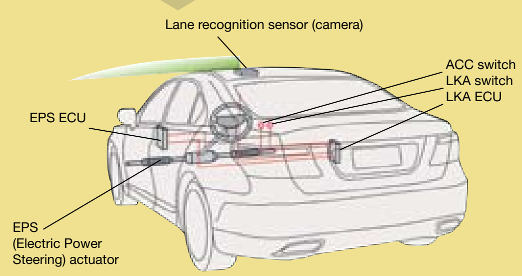
Adaptive Cruise Control (ACC) is a system that controls the accelerator and brakes to maintain a safe distance from the vehicle ahead.

The key to ACC lies in a broader-range radar sensor for detecting vehicles ahead combined with enhanced recognition capabilities, as well as the use of a high-performance braking system. When the vehicle in front slows or accelerates, the system will apply smooth braking or acceleration to maintain safe distance up to the pre-set speed. If the preeceding vehicle brakes suddenly, the system issues a warning sound and a display prompting the driver to apply the brakes.

In 2006, Toyota developed Radar Cruise Control with All-Speed Tracking Function. This latest version of the system maintains continuous control, from 0 km/h to high speed, and can handle repeated starts and stops common when driving on congested highways.

As with the Intelligent Parking Assist and Blind Corner Monitor technologies, the Radar Cruise Control reduces the burden on the driver's attention, making it easier for them to detect and avoid obstacles, pedestrians or vehicles presenting a safety risk.

Lane-Keeping Assist



As the name suggests, Toyota's **Lane-Keeping Assist** technology, or LKA, helps drivers to keep their vehicle within their lane. LKA uses a camera and **Electric Power Steering** to assist the driver in two ways: first, a warning alerts the driver when the vehicle is about to deviate from its lane, and briefly applies a small counter-steering force to help the driver stop the vehicle from leaving its lane; secondly, a lane-keeping assist function constantly applies a small counter-steering force to keep the vehicle on course when the Adaptive Cruise Control is enabled.

Lane Departure Warning Function

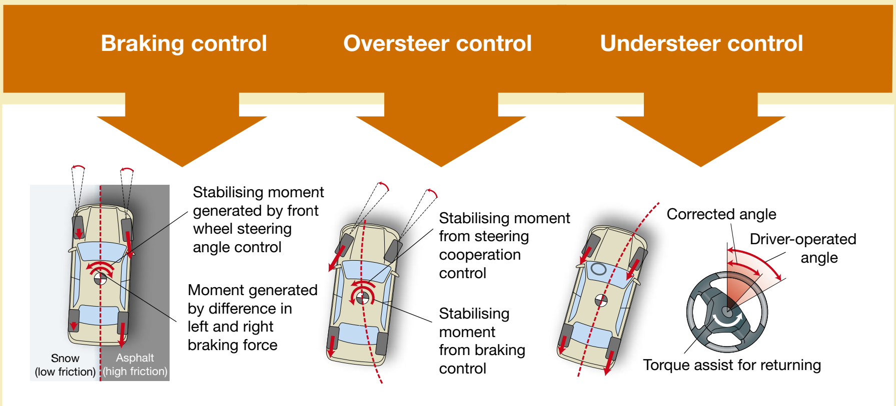
Lane-Keeping Assist Function

Stability Control: Vehicle Stability Control (VSC) & Vehicle Dynamics Integrated Management (VDIM)

Vehicle Stability Control (VSC) is an active safety system that automatically helps to control a vehicle when it starts to slide – due to a sharp turn at too high speed, for example. According to accident analyses in Japan, VSC can reduce single-vehicle accidents by up to 30%.

A variety of electronic sensors tell the car's computer (Electronic Control Unit, or ECU) what the car's condition is, and what the driver is trying to do. Using this information, the VSC system activates the individual brakes as needed and controls the throttle to help maintain stability and keep the vehicle on course.

Preventing Understeer
When the front wheels of a vehicle slip laterally toward the outside when taking a curve, **VSC** operates the brakes as needed and reduces engine output. The reduction in speed enables the tyres to grip the road and put the vehicle back on course.

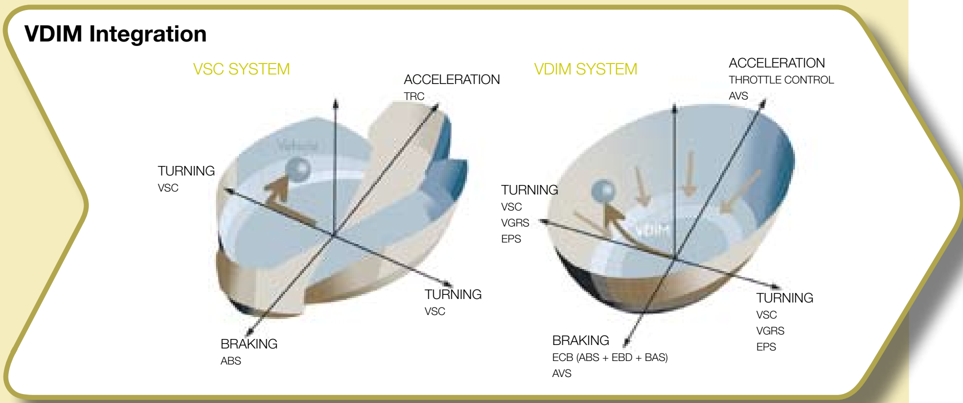


Toyota's **Vehicle Dynamics Integrated Management (VDIM)** resulted from the integration of VSC with Variable Gear Ratio Steering (VGRS) – an advanced technology that uses an actuator to make the steering gear ratio subject to vehicle speed. When the VSC system's rotational speed sensor (also known as a yaw-rate sensor) determines that a car is «tilting» too far off axis in a turn, it feeds this information into a micro-computer. The micro-computer then correlates this data with other information, such as acceleration in forward, reverse and sideways directions, wheel speed, braking pressure on each of the four wheels, steering angle and accelerator position. If the system senses too much yaw (rotation around the car's centre of gravity), it independently applies the appropriate braking force.

VDIM is unique in two ways: first, control is activated before the vehicle exceeds its limits, thereby achieving higher preventive (active) safety performance; second, all of the individual safety technologies (Anti-lock Brake System, Traction Control, Vehicle Stability Control, Variable Gear Ratio Steering and Electric Power Steering) are integrated into a single system and are seamlessly managed.

VDIM is thus a dynamic system that can recognise a driver's intention in an accident situation and electronically activate various safety technologies to make the car more responsive to the driver and enhance overall performance.

While Active Safety technologies that prevent accidents from occurring are Toyota's 'front line' of defence in the safety field, the company's Integrated Safety Management Concept requires that it place equal emphasis on Pre-Crash Safety technology, designed to minimise damage and injury whenever a collision is unavoidable.



Preventing Oversteer

When taking a curve, the rear wheels of the vehicle may begin slipping laterally outward. If this occurs, **VSC** applies the outward front wheel brake for an instant, imparting outward moment to the vehicle's body and controlling the outward lateral slip.

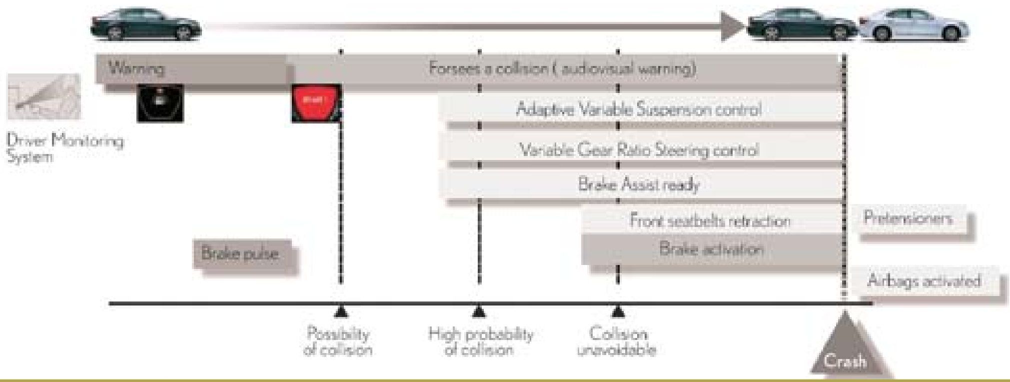
PRE-CRASH SAFETY

According to Toyota's extensive traffic accident analysis, a majority of all accidents resulting in death or serious injury are caused by recognition error - a failure by the driver to adequately monitor the vehicle's surroundings. Toyota has therefore recognised that peripheral on-board monitoring technologies can help predict accidents, making it possible to reduce collision damage, or take preventive action to avoid a collision.

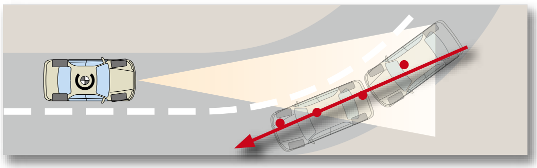
Toyota's **Pre-Crash Safety** system (PCS) consists of a camera[2], millimetre-wave radar, pre-crash brake, pre-crash brake assist, suspension control[2] and pre-crash seat-belt.

The camera and the millimetre-wave radar detect the position, distance and speed of any obstacle in front of the car (even in bad weather with poor visibility), working in combination with the Pre-Crash Safety computer, which monitors vehicle speed, steering angle, and yaw-rate inputs to determine if a crash is imminent. If it is, the system gives an audible and visible warning to the driver, retracts the front seat-belts and activates the pre-crash brake assist for maximum braking force and then applies the brakes to reduce vehicle speed.

Advanced PCS actions before impact

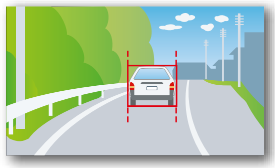


Predicted vehicle path and predicted path of oncoming vehicle



A fusion of image sensor and millimetre wave sensor

Current radar technology



Camera checks size of obstacle

Toyota's Advanced Pre-Crash Safety system is able to provide early warning of an impending collision by detecting when a driver is not looking straight ahead. This new feature – a response to data that suggests that most vehicle accidents are caused by lack of driver awareness[1] – uses a camera mounted on the steering column and an image-processing computer, **to detect the orientation of the driver's face**. If the system reads that the driver is not facing forward when it determines that a collision is likely to occur, it will issue a warning to help the driver avoid the accident or lessen collision injuries. This system also offers enhanced **Pedestrian Detection** capabilities to protect vulnerable road users.

The latest Pre-Crash Safety technologies to emerge from Toyota are the **Advanced Pre-Crash Safety System** with new Pedestrian Detection and Collision Avoidance Support Functions and **the world's first Rear Pre-Crash Safety System**.

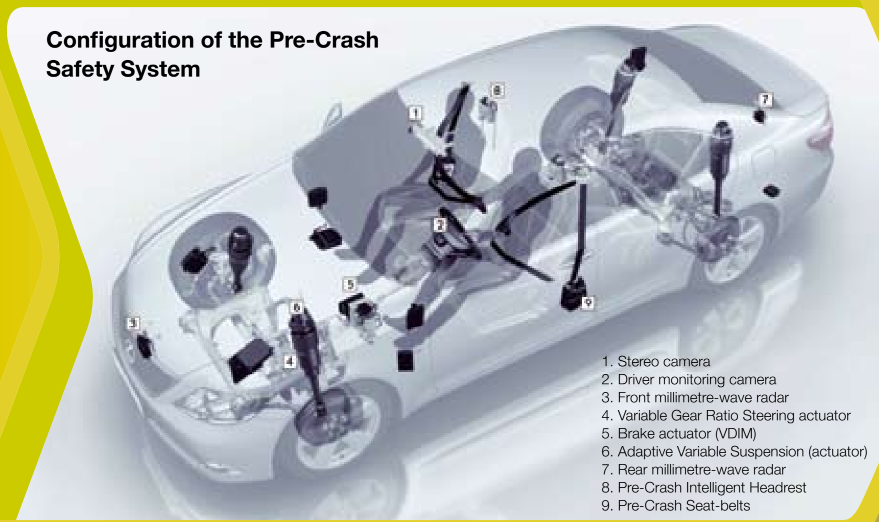
The new Pre-Crash Safety System features a fusion of millimetre-wave radar with enhanced detection functions and a newly developed stereo camera. Information obtained by the millimetre-wave radar is combined with information about three-dimensional objects provided by the stereo camera to make it easier to detect not only vehicles and obstacles, but also pedestrians in the vehicle's path.

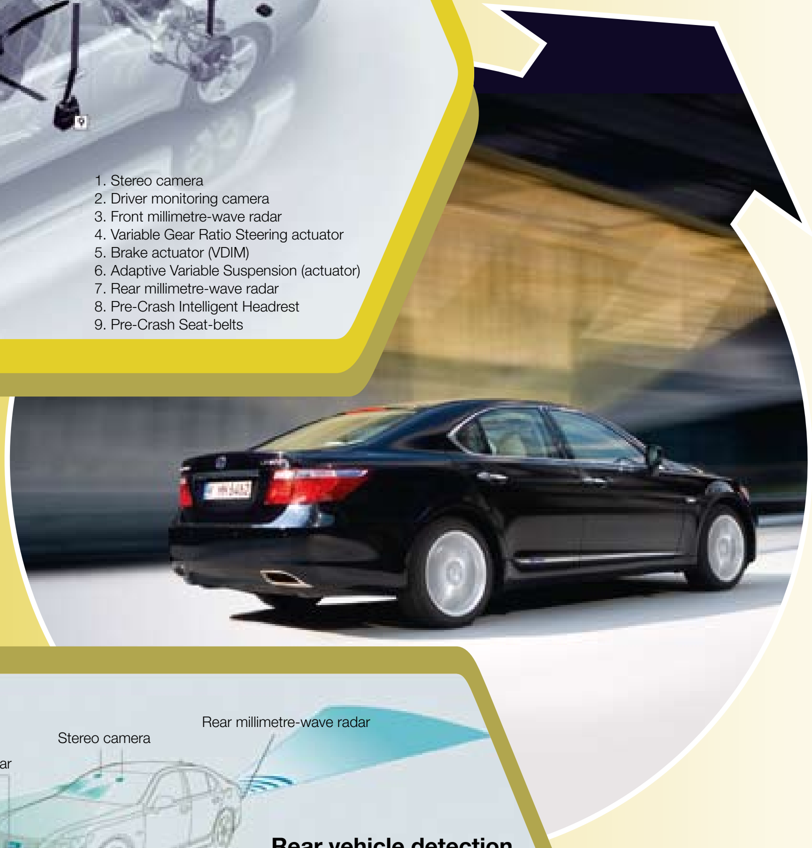
A near-infrared projector located in the headlights makes this possible even at night, when visibility is poor.

When the driver takes emergency action, VGRS (Variable Gear Ratio Steering) and AVS (Adaptive Variable Suspension) optimally control the steering gear ratio and suspension to support the driver's measures. In addition, the system cooperates with the VDIM (Vehicle Dynamics Integrated Management) to keep the vehicle stable.

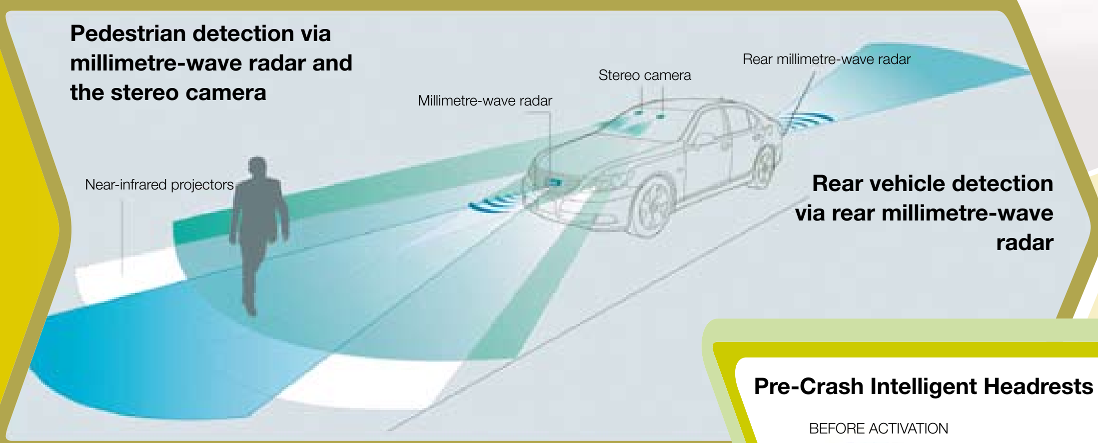
(1) 2004 data from the Institute for Traffic Accident Research and Data Analysis (ITARDA)
(2) Most advanced models

Configuration of the Pre-Crash Safety System





Pedestrian detection via millimetre-wave radar and the stereo camera



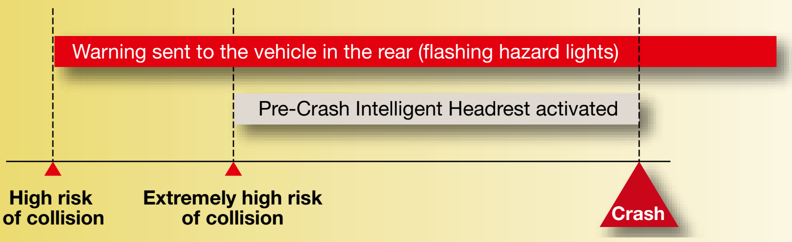
Rear vehicle detection via rear millimetre-wave radar

Pre-Crash Intelligent Headrests

World's First* Rear Pre-Crash Safety System

A millimetre-wave radar device installed in the rear bumper detects a vehicle approaching from behind. If the system determines that there is a risk of collision, the hazard lights flash to warn the driver of the rear vehicle. If the vehicle continues to approach, sensors implanted inside the front headrests of the forward vehicle detect the position of both the driver's and front passenger's heads. Prior to impact, the Pre-Crash Intelligent Headrests shift to appropriate positions to reduce the risk of whiplash injury sustained upon collision.

Diagram of control via Rear Pre-Crash Safety System



* As of the end of July 2006, according to TMC survey

4 Implementing Passive Safety

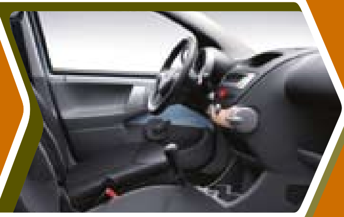
While active and pre-crash safety technologies can go a long way to reduce injuries and fatalities through accident avoidance, the development of cutting-edge passive safety technology is still necessary to protect occupants in the event of an accident.

Vehicles must be designed to absorb the energy of the impact from a collision using a framework with crumple zones to provide additional resistance to deformation and greater protection for occupants. Passenger cabins and door structures must be reinforced, to facilitate escape and rescue after an accident.

Toyota recognises that injuries are often caused by what happens when vehicle occupants strike parts of the interior of the vehicle cabin during a collision. The company therefore strives to design car interiors that absorb secondary impact energy and minimise the possibility of injury to vehicle occupants.

- Seat-belts are the primary restraint system and airbags are a supplemental system.
- Steering columns and wheels are also designed to help absorb impact energy.
- Protrusions are eliminated from the interior wherever possible.
- Padding is placed in strategic positions.
- Toyota is constantly striving to enhance these features and standardise the improvements.

TOYOTA CONTINUES TO RESEARCH AND ENHANCE ITS PASSIVE SAFETY TECHNOLOGIES TO PROTECT VEHICLE OCCUPANTS IN THE EVENT OF A CRASH.

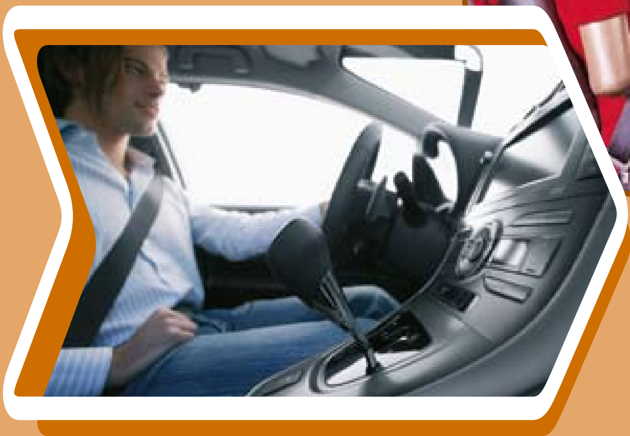


Seat-belts

Passenger safety begins with buckling up. Toyota is working hard to make seat-belts more comfortable and easier to wear. In a collision, the seat-belt is the most important occupant-protection safety device.

During the development of a new automobile, Toyota uses dummies of several different sizes to make sure the seat-belts, anchors, and buckles are positioned for a safe and comfortable fit. While road-testing prototypes, real people use the seat-belts and report on their fit and comfort. Adjustable shoulder anchors are provided for wearers to change the height of the belt for additional comfort and safety.

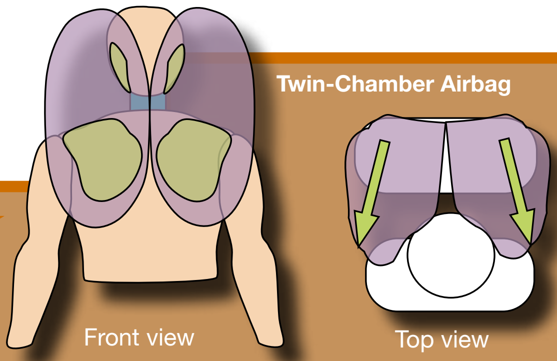
Depending upon the seating configuration, most Toyota vehicles have 3-point belts for the passenger seated in the middle of the back seat.



The **tension-reducing Emergency Locking Retractor (ELR)** automatically locks when vehicle occupants pull on the belt, to ensure it's secure enough to work, yet loose enough to feel comfortable. And most of Toyota's vehicles have **pre-tensioners and belt force limiters** for the front occupants that quickly pull the seat-belt back and restrain occupants with suitable belt force in the event of a head-on collision.

Since 2003, virtually all Toyota passenger models feature a warning lamp and buzzer seat-belt reminder system for the driver and passenger seats.

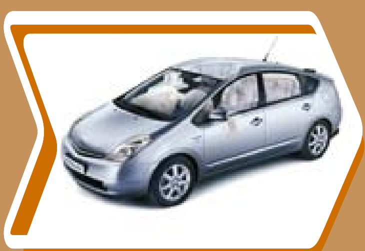
Airbags



Airbags play a vital role in preventing injury to car occupants in the event of a collision. Toyota has played a pioneering role in this area, having developed the world's first curtain shield airbag system in 1998. The Toyota Avensis was the first vehicle in Europe to be launched with an **SRS driver's knee airbag** in 2003.

In June 2005, Toyota became the world's first automaker to develop a twin-chamber airbag to increase front-seat passenger safety.

The **SRS Twin-Chamber Airbag** features an advanced shape: its two chambers create a depression in the centre of the airbag upon deployment, thereby dispersing the physical impact of the airbag over a wider number of areas on the passenger and helping to reduce the potential for injury.



Reduce Whiplash Injury: WIL

Toyota front driver and passenger seats incorporate a **Whiplash Injury Lessening (WIL)** design to help reduce the risk of neck whiplash injuries to upper vertebrae in low-speed rear-end collisions.

WIL seatback frames are carefully designed to yield in a controlled fashion to absorb the energy of occupants' torsos during rear-end crashes.

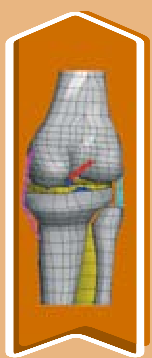
In 2006, Toyota introduced the Rear Pre-Crash Safety-activated WIL headrests, which use radar-supplied information about an approaching car to shift position and reduce the distance between the head and headrest just before an impact to the rear. WIL helps lessen the differential motion of head and torso, which is the cause of whiplash.

The WIL concept seat was introduced in 1997 and its performance has been enhanced by using virtual human body models, known as **THUMS** (the Total Human Model for Safety).

Virtual Human Body: THUMS

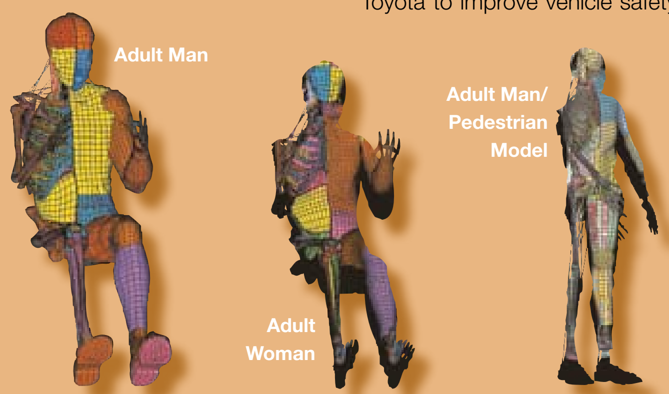
To develop better passive safety technologies and also enhance pedestrian safety, designers must understand how injuries are sustained in a variety of accident types and to a variety of vehicle occupants and other road users.

Traditional crash-test dummies cannot provide such precise information, so Toyota has developed an innovative computer-generated virtual model of the entire human body: **Total HUman Model for Safety**, or **THUMS**.



THUMS reproduces not only the skeletal structure of a person, but also a body's internal organs and muscles, making it possible to understand the effects of accidents on bone structures, skin, joints and ligaments.

The THUMS 'family' currently includes a typical male occupant, a smaller female occupant, a six year-old child occupant and a typical male pedestrian model. Toyota is using THUMS to further its research into automobile body development to enhance passive safety. It is also making THUMS available for use by organisations outside of Toyota to improve vehicle safety in general.



Child Safety

Making vehicles safe for child passengers is a particular challenge that Toyota has embraced. The Toyota Prius Hybrid, for instance, achieved **the highest-ever** Child Safety score from the European New Car Assessment Programme (Euro NCAP) (43 points and four stars). A total of eight Toyota and Lexus models have now achieved four stars, the highest rating awarded thus far for child protection.

Among the standards for safety installations and restraint systems, one of the most widely known is the ISOFIX system for the connection of child restraint systems to vehicles. **The aim of the ISOFIX standard is to avoid the incorrect fitting of universal child seats when installed in cars, in order to reduce the risk of injury to children in the event of a collision.** Toyota first adopted the ISOFIX standard in 1999 and has made it available in all Toyota passenger vehicles since 2006.

Further research into child restraint systems has led to the marketing of a Toyota-designed child seat through Toyota's European retailer network, backed by a Toyota guarantee. In Germany, Toyota Motor Europe has been the sole sponsor of a special education programme conducted by the German Automobile Association (ADAC), entitled "Sicher im Auto" (Safe in the Car). This programme teaches parents how to install child seats properly in their vehicles, with some 80,000 people participating annually.

TOYOTA ACHIEVED THE HIGHEST-EVER CHILD SAFETY SCORE IN EURO NCAP AND OFFERS EIGHT TOYOTA AND LEXUS MODELS WITH THE HIGHEST 4-STAR RATING.

Pedestrian Safety

Toyota's comprehensive approach to safety – focusing on automobiles, the traffic environment, and people – requires that its vehicles afford high levels of **safety for pedestrians** as well as vehicle occupants.

Using THUMS and other test devices, Toyota also simulates pedestrian accidents and analyses the various results obtained depending on the size of the pedestrian. The information gathered from this research is used to create special safety features in Toyota's car bodies, like the underbonnet supporting structure and impact absorbing fender brackets that help minimise collision impact, thereby providing a higher level of safety for pedestrians.

5 What next ?

While many new and advanced technologies have emerged in recent years to make our daily lives more convenient, pleasant and productive, transport infrastructure has lagged behind. Its primary controlling technology is still the traffic light - a technology that has barely changed since it was invented in 1923.

Traffic accidents and congestion are costly to society in terms of lost lives, productivity, and energy. For transport to become more efficient, safe, and environmentally sound, new ways of looking at overall transport objectives are needed.

Toyota's **Intelligent Transport Systems (ITS)** will be the hallmark of the future, helping people and goods to move more safely and efficiently. Critical ITS technologies include microelectronics, satellite navigation, mobile communication and sensors. When integrated into vehicles and the transportation system infrastructure, these technologies will be able to help monitor and manage traffic flows, reduce congestion, provide alternate routes to travellers and save lives.

The implementation of new information and communication technologies in the sector will certainly soon permit **direct road-to-car communication, car-to-car communication and even person-to-car communication**. Businesses, governments and individuals will all need to cooperate in the development of this kind of next generation traffic information system. Toyota is already working with government agencies and local authorities in Aichi Prefecture, Japan, on field operational tests for road-to-car communications. These cooperative systems will help to reduce the risk of accident by providing information to the driver about nearby pedestrians, vehicles and objects that cannot be easily seen.

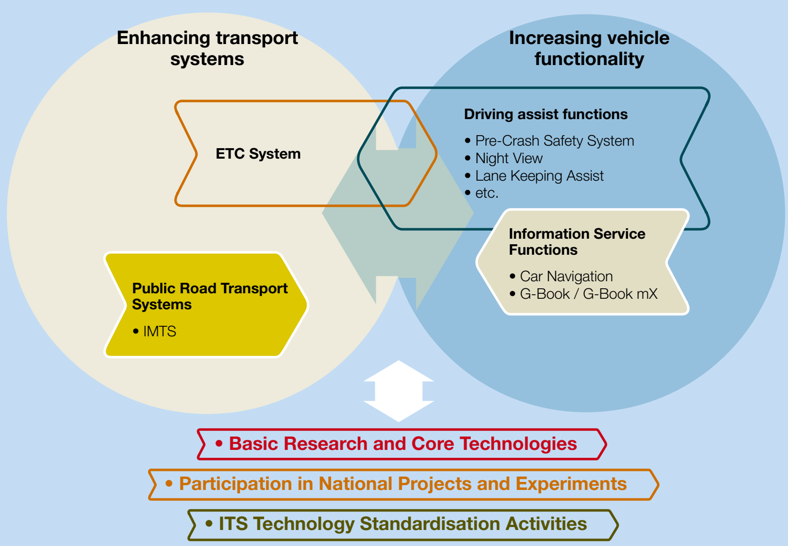
Within the next decade, Europe should see the emergence of new technologies that support eCall, a European Commission initiative to get rapid assistance to motorists involved in a collision anywhere in the European Union. The plan calls for "black box" technology to be installed in vehicles to transmit impact sensor and airbag deployment information as well as GPS coordinates to local emergency agencies. It is hoped that this will help shorten response times and thereby save lives. Toyota is a member of the eCall Driving Group, established to speed up research, development and deployment of intelligent integrated safety systems and their supporting technology. The development of such technology already figures in Toyota's Integrated Management Safety Concept.

Toyota will of course continue its industry-leading development of more effective active and passive safety technologies. These will include radar and camera detection systems, smart restraint systems to enhance the protection of the elderly, disabled and other more vulnerable road users, as well as active safety systems on vehicles for better pedestrian protection. Toyota is also striving to improve the flow of critical information to the driver, making the vehicle itself a medium of information, able to assist both the driver's judgement and operation.

TOYOTA WILL CONTINUE
TO ACT TODAY
FOR TOMORROW !

Continuing to act **TODAY for TOMORROW**, Toyota will also strive to reduce the time needed for the widespread implementation of all new safety technologies developed.

Scope of Toyota's ITS Approach



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Genchi Genbutsu

“Going to the source to find the
facts to make correct decisions, build
consensus and achieve goals.”

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Toyota Motor Europe
Corporate Affairs
Avenue du Bourget 60 - 1140 Brussels, Belgium
Tel. +32 2 745 21 11 / Fax +32 2 745 20 68
e-mail: pr@toyota-europe.com
www.toyota.eu