Trucks

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Overall Trends

1 Introduction

The Japanese economy in 2012 showed signs of recovering from the contraction in demand caused by the global recession. The real growth rate of GDP suffered a significant downturn due to the Great East Japan Earthquake in March 2011 and continues to be affected by other factors, such as the end of Japan's preferential tax scheme for environmentally friendly vehicles. However, it has maintained positive growth since 2009 and is up 1.2% compared to the previous year (Fig. 1). The effects of the economic policies undertaken by the second Cabinet of Prime Minister Abe, who returned to power in December 2012, have resulted in a significant depreciation of the yen, which has aided the economy, particularly in the case of Japan's exports. The real growth rate of GDP between January and March 2013 increased by 0.9% compared to the previous quarter (October to December 2012) (Fig. 1) and the annualized rate of growth increased by 3.5%.

Despite this brightening outlook however, careful consideration of the effects that trucks have on the environment and the economy is still required through measures to fight global warming and reduce shipping costs. In addition to this, there are an increasing number of other demands for improvements in safety and other aspects of performance.

In Japan the post-new long-term (2009) emissions regulations are now in force and these are the strictest such emissions regulations in the world. Furthermore, starting in October 2013 the off-cycle emissions must also be reported.

In conjunction with the preferential tax scheme for environmentally friendly vehicles in 2012, consumers can also qualify for tax reductions of 50 to 100% on the vehicle purchase and weight taxes by purchasing a vehicle that complies with the post-new long-term emissions regulations. In addition, these tax reductions also apply to vehicles with nitrogen oxide (NOx) or particulate matter (PM) emissions at least 10% below the standard and fuel efficiency at or above the 2015 fuel economy standards.

In the export truck market, the Euro 5b+ and Euro VI emissions regulations are now in effect in Europe and the even stricter Euro 6 emissions regulations are scheduled to go into effect starting in October 2015. The current CO_2 regulations in Europe are also drawing near to the final year of phased-in application (2017) and it will be necessary to meet even stricter regulation values starting in 2020.

Stricter regulations concerning emissions and vehicle safety are also continuing to be introduced in many other countries around the world and vehicle manufacturers must meet these regulations as well.

2 Recent Truck Market Trends

2. 1. Freight shipments in Japan

The total amount of freight shipments in Japan in 2011 was approximately 427 billion ton kilometers. This amount has been decreasing since 2007 (Fig. 2). The

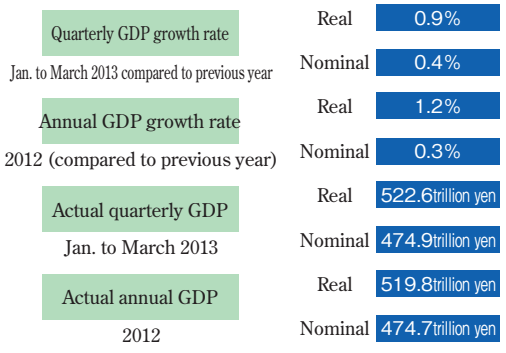
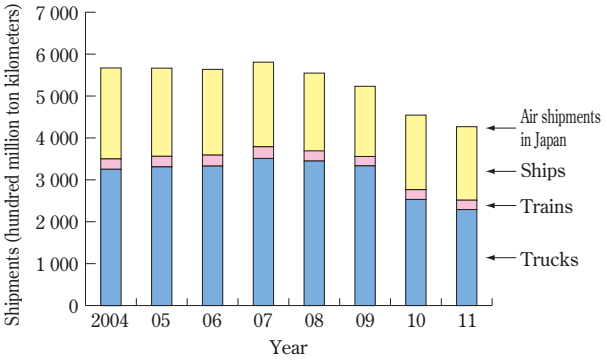
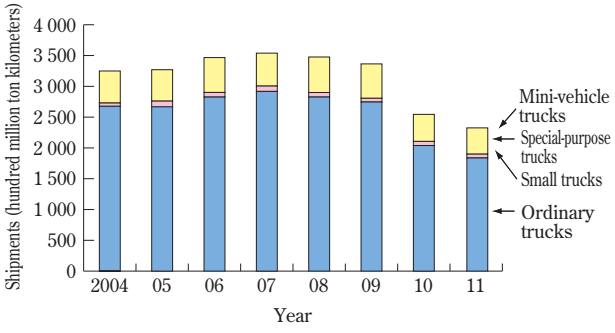


Fig. 1 Preliminary figures for latest quarterly GDP[(1)].



※Since 2010, private mini-vehicle trucks were excluded from the survey.

Fig. 2 Freight shipments in Japan[1].



※Since 2010, private mini-vehicle trucks were excluded from the survey.
2010 revised

Fig. 3 Freight shipments by vehicle type[1].

2011 total breaks down into approximately 231.1 billion ton kilometers shipped by motor vehicles, 20 billion ton kilometers shipped by trains, 174.9 billion ton kilometers shipped by ships, and 1 billion ton kilometers shipped by air. In terms of share, motor vehicles accounted for 54.1%, ships for 41.0%, trains for 4.7%, and air shipping for 0.2% (Fig. 3).

If the amount of freight shipped by motor vehicles is further broken down by the types of truck used, light-duty trucks (ordinary trucks) account for approximately 80.2%, small trucks account for approximately 1.7%, special-purpose trucks account for approximately 17.9%, and mini-vehicle trucks account for approximately 0.2%. Compared to the previous year, the number of ordinary trucks in Japan decreased by 0.4%, while the number of special purpose trucks increased by 1.0% (Fig. 4).

2. 2. Number of trucks in Japan

Although the number of cars owned in Japan is currently around 80 million vehicles, the number of trucks continues to decrease. At the end of 2012 the number of trucks was approximately 14.84 million vehicles, a decrease of approximately 140,000 vehicles or 1.0% com-

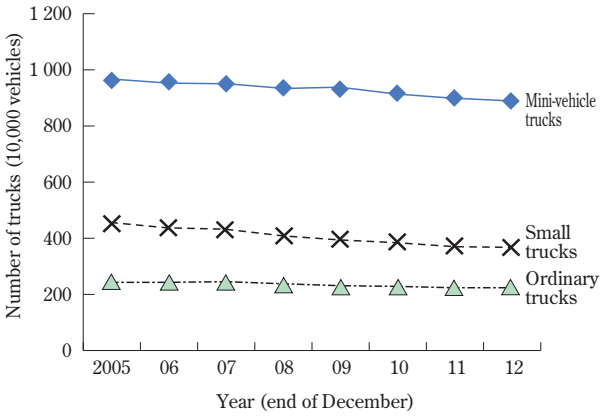
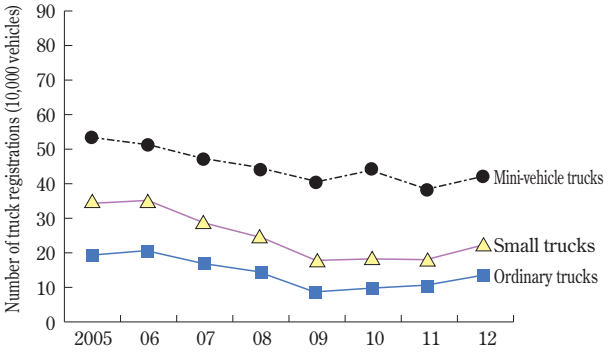


Fig. 4 Number of trucks in Japan according to vehicle type[2].



Note: Starting in 2003 the classification criteria were changed from the vehicle chassis to license plate number (mini-vehicle trucks are excluded).

Fig. 5 Number of truck registrations in Japan according to truck type[2].

pared to the previous year. The number of ordinary trucks stayed at almost the same level as the previous year, but the rate of decrease for small trucks was fairly large. In this case, the decrease was approximately 1.9% compared to the previous year (Fig. 5).

2. 3. Number of truck registrations in Japan

The number of new truck registrations in Japan in 2012 was approximately 760,000, an increase of approximately 3.8% compared to the previous year. When this is broken down according to the different types of trucks, the number of ordinary trucks increased by approximately 13.6%, the number of small trucks increased by approximately 10.8%, and the number of mini-vehicle trucks decreased by 2.5% compared to the previous year. Consequently, all types of trucks, except for mini-vehicle trucks, increased in 2012 (Fig. 6). This trend is probably caused by the synergistic effects of customers switching to vehicles that comply with the post-new long-term emissions regulations, the limit of the replacement cycle for vehicles in use since the economic boom in the 1990s,

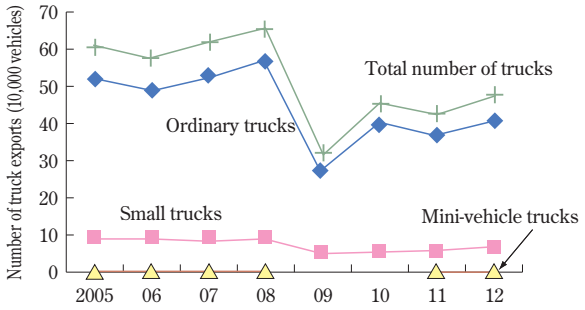


Fig. 6 Number of truck exports according to truck type.[2]

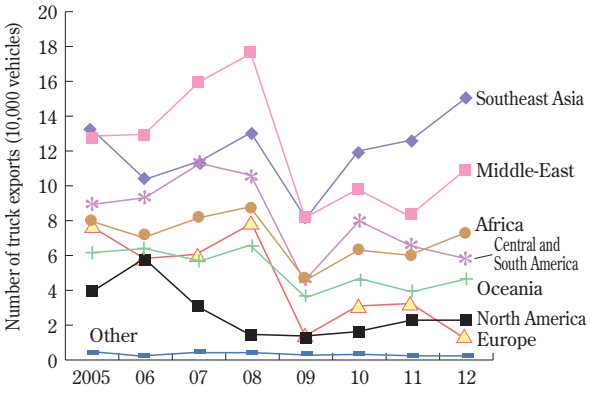


Fig. 7 Number of truck exports according to destination[2].

and the policies to stimulate demand, such as the preferential tax scheme for environmentally friendly vehicles.

2. 4. Truck exports

Approximately 4.66 million vehicles were exported from Japan in 2012, an increase of approximately 40,000 or 1% compared to the previous year. Approximately 480,000 trucks were exported, an increase of approximately 30,000 or 6% compared to the previous year. When this is broken down according to the different types of trucks, the number of ordinary trucks increased by approximately 4.4% and the number of small trucks increased by approximately 16.6% compared to the previous year. This shows a significant increase in small truck exports (Fig. 7).

When the number of truck exports is analyzed according to destination, there was an increase in exports to Asia, the Middle-East, Africa, and Oceania. This shows the continuing strength of economic development in emerging markets. However, truck exports to Europe, North America, and Central and South America decreased, particularly in Europe where there was a significant decrease in both the exports of ordinary trucks by approximately 42.8% and exports of small trucks by approximately 58.2%. This probably reflects the downturn

Fig. 8 Mitsubishi Fuso Super Great[2].

in consumer spending caused by the effects of the credit crunch that spread throughout Europe as a result of the financial crisis in Greece.

3 2012 Model Year Trucks and Special Characteristics

3. 1. Trucks manufactured in Japan

Since each truck manufacturer has already finalized vehicles for compliance with the post-new long-term emissions regulations, there were few major changes to truck specifications and equipment in 2012. Instead, efforts were made to improve reported fuel economy values and to expand the range of trucks that can qualify for the preferential tax scheme for environmentally friendly vehicles.

New diesel hybrid system buses were introduced for use as fixed route buses in addition to conventional sightseeing bus applications. This is because these buses are compliant with the post-new long-term emissions regulations, exceed the 2015 heavy vehicle fuel economy standards by over 10%, and are rated as “excellent” according to the 2009 standards in the nine-prefecture low-emissions vehicle designation system.

3. 1. 1. Large trucks

There were no major model changes from any manufacturer and the available vehicles are roughly equal in terms of qualification for the preferential tax scheme for environmentally friendly vehicles and safety equipment. In April 2012, Mitsubishi Fuso Truck and Bus Corporation made some changes to the large Super Great model. All are now equipped with a brake override system, which gives the brakes priority if the accelerator and brake pedal are operated at the same time, and emergency braking indicator lights, which automatically flash the hazard lights on and off rapidly to warn following vehicles if the truck decelerates strongly due to emergency braking, as standard equipment to improve safety (Fig. 8).

3. 1. 2. Mid-size trucks

There also were no major model changes from any manufacturer for mid-size trucks.

In April 2012, Mitsubishi Fuso Truck and Bus Corporation modified the mid-size Fighter model. Similar to large trucks, all are now provided with the brake override system as standard equipment.

Isuzu Motors Limited also modified the mid-size Forward model in October and December 2012. Fuel economy was improved and Isuzu also expanded the range of vehicles that qualify for the preferential tax scheme for environmentally friendly vehicles (Fig. 9).

3. 1. 3. Small trucks

In May 2012, Mitsubishi Fuso Truck and Bus Corporation began selling a HEV version of the small Canter model that is compliant with the post-new long-term emissions regulations. This HEV truck exceeds the 2015 heavy vehicle fuel economy standards by over 20%, reduces both NOx and PM emissions by 10%, and received a "super" rating according to the 2009 standards in the nine-prefecture low-emissions vehicle designation system (Fig. 10). Consequently, this truck not only qualifies for a vehicle tax reduction as a fuel-efficient vehicle, it is also exempt from some vehicle taxes.

Fig. 9 Isuzu Forward[3].

Fig. 10 Mitsubishi Fuso Canter Hybrid[4].

In February 2013, Hino Motors, Ltd. announced that it was developing an ultra-low-floor EV truck (Fig. 11). This truck is envisioned to be used for short-range driving in urban areas consisting mostly of densely packed commercial facilities. Trial operations of this EV truck to verify its viability have begun in cooperation with major delivery companies.

In March 2013, Isuzu Motors Limited changed the au-

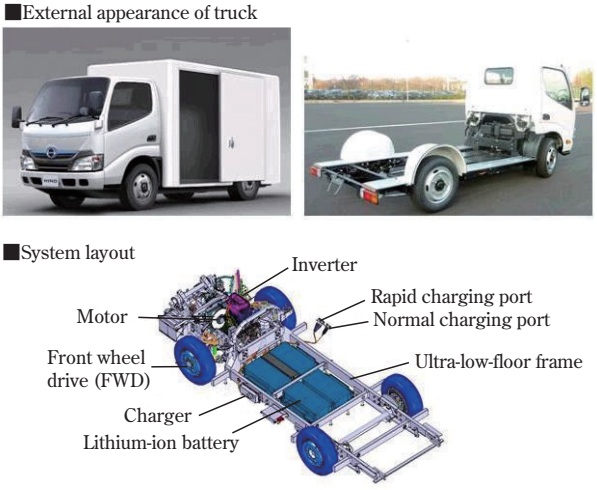


Fig. 11 Hino ultra-low-floor FWD electric truck[5].

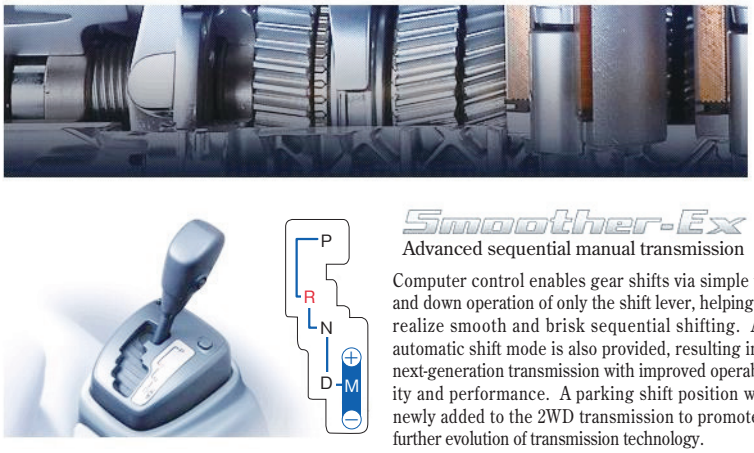


Fig. 12 Isuzu Elf[6].

tomated manual transmission (AMT) on its two-wheel-drive small Elf model to also include a parking shift position (Fig. 12).

Starting in January 2013, Nissan Motor Co., Ltd. and Mitsubishi Fuso Truck and Bus Corporation began mutual OEM supply of the Fuso Canter, a 2 to 4 ton-class commercial vehicle, and the Nissan Atlas F24, a 1.15 to 1.5 ton-class commercial vehicle (Fig. 13).

3. 1. 4. Mini-vehicle trucks

Mitsubishi Motors Corporation made driver's side air-bags and seat belt pre-tensioners standard equipment on all grades of its Minicab Truck during the model change in July 2012. This improved the safety of these trucks and also brought all grades of the Minicab Van into line with strengthened door latch and hinge regulations. A rear reflective plate was also added to some vehicle models during the model change in December 2012 for compliance with regulations (Fig. 14).

Daihatsu Motor Co., Ltd. began OEM supply of its mini-vehicle Hijet truck to Fuji Heavy Industries, Ltd. and Fuji Heavy Industries is now selling this vehicle under the Sambar name (Fig. 15).

3. 1. 5. Safety and other equipment

Active safety technologies were first introduced on large trucks in the form of cruise control using millimeter-wave radar, vehicle-to-vehicle distance warnings, pre-collision braking systems, stability control systems, and the like. These kinds of safety equipment are now becoming common on many trucks and adoption is also spreading to mid-size and small trucks to help enhance vehicle safety. Hino Motors, Ltd. has equipped its mid-

- Nissan supplies the small Atlas F24 truck (load capacity of 1.15 to 1.5 tons) to Mitsubishi Fuso as the Canter Guts.
- Mitsubishi Fuso supplies the small Canter truck (load capacity of 2.0 to 4.0 tons) to Nissan as the NT450 Atlas.

Canter Guts　　NT450 Atlas

Fig. 13 Nissan and Mitsubishi Fuso begin mutual OEM supply[7].

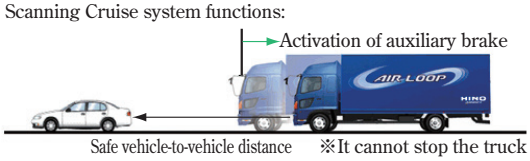
Fig. 14 Mitsubishi Minicab Truck[8].

Fig. 15 Fuji Heavy Industries Sambar Truck[9].

Scanning Cruise (optional equipment) contributes to both safety and economic efficiency.

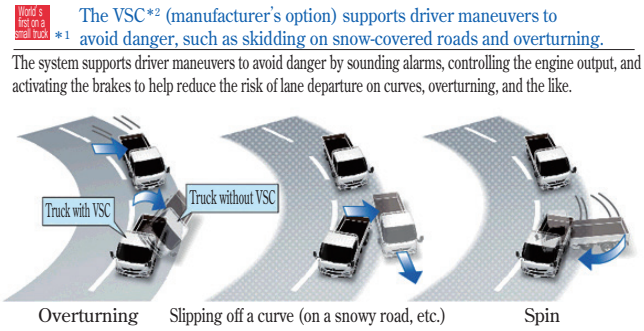
It detects the vehicle-to-vehicle distance and relative speed of the vehicle in front and automatically controls the speed of the truck. This helps to enhance driving safety and also improves economic efficiency by eliminating wasteful and unnecessary acceleration.

Scanning Cruise system functions:



Safe vehicle-to-vehicle distance　※It cannot stop the truck automatically.

Fig. 16 Scanning Cruise system on the Hino Ranger[10].



*1 Small truck in the 2.0-ton class
*2 VSC: Vehicle Stability Control system. VSC is a registered trademark of Toyota Motor Corporation.

Fig. 17 VSC on the Hino Dutro[11].

Fig. 18 Mercedes-Benz Actros[12].

Fig. 19 Volvo Trucks FH.

Fig. 20 Iveco Stralis Hi-Way.

size Ranger truck with the Scanning Cruise system that uses an infrared laser to measure the vehicle-to-vehicle distance and relative speed, and then activates an auxiliary brake if necessary (Fig. 16). Hino Motors also offers the optional Vehicle Stability Control (VSC) system on the small Dutro truck. This system adjusts the engine output and activates the brakes to help the driver avoid danger (Fig. 17).

3. 2. Trucks manufactured outside Japan

In 2012, Mercedes-Benz expanded the engine line-up for its large Actros truck, which complies with the Euro VI regulations. It added the 10.8-liter OM470 and 7.7-liter OM936 engines to the existing 12.8-liter OM471 engine. It also added two new models, the large Antos truck for short distance shipping, and the large Arocs truck for construction work (Fig. 18).

Volvo Trucks made a full model change to its large FH and FH16 trucks and adopted a new independent front suspension, a 12.8-liter D13 engine that is compliant with the Euro VI regulations, a dual clutch transmission (DCT), and an electronically controlled automatic transmission. This was done to help reduce noise and improve the fuel economy of these trucks (Fig. 19).

Iveco Magirus AG made major improvements to its large Stralis truck and announced the addition of the Stralis Hi-Way model that is equipped with an engine compliant with the Euro VI regulations (Fig. 20).

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Design Trends

1 Trends in Japanese Truck Design

There is often a long span of time between model changes for the cabs of trucks. These changes often occur at the same time that other large changes are made to the truck's specifications following revisions to relevant regulations and standards. Recently the post-new long-term emissions regulations for diesel engine emissions were carried out between 2009 and 2010 and the next period when new regulations will go into effect is in 2016. In addition, the equipping of large trucks with advanced emergency braking systems (AEBS) is scheduled to become mandatory in 2014. Consequently, the year 2012 fell into a lull period between these regulations. As a result, there were no new truck launches or re-designs featuring modified styling. However, there was the start of a new mutual OEM supply agreement between Nissan Motor Co., Ltd. and Mitsubishi Fuso, as these two companies furnished each other with vehicles.

The Nissan Atlas is now based on the Mitsubishi Canter, instead of the truck supplied by Isuzu Motors Limited. The name of this model was changed to the NT450 Atlas (Fig. 1). In addition, the Mitsubishi Fuso Canter Guts is now supplied by Nissan Motor Co., Ltd. (Fig. 2). In the case of both these truck models, the decision was made to change the design as little as possible. The only changes are minor modifications to the front radiator grille to accompany the new brand badge and changes to the color of the bumpers.

Isuzu Motors Limited did carry out a full model change on its 1-ton class D-MAX pickup truck (Fig. 3) that it manufactures at a plant in Thailand (winner of the Good Design Award 2012). However, it does not sell this vehicle in Japan. The vehicle was developed under a design concept that emphasized both the toughness of a truck and the comfort of a passenger vehicle. This vehicle is being shipped to and sold in approximately 100 different countries as a worldwide pickup truck. Currently in Thailand, a large number of vehicle manufacturers are attempting to break into the market with a full line up of pickup trucks. Since this is causing intense competition, automakers are constantly developing fresh new vehicle styles. As a result, new technological trends that are more often seen in passenger vehicles, such as dashboard meter clusters with LCD monitors and rear lights that use LEDs, are now being reflected in the design of pickups as well.

2 Trends in Truck Design outside Japan

The IAA International Motor Show in Hannover, Germany was held in 2012. One of the purposes of this show was to emphasize the latest European emissions

Fig. 1 Nissan NT450 Atlas.

Fig. 2 Mitsubishi Fuso Canter Guts.

Fig. 3 Isuzu D-MAX.

regulations (Euro VI). As a result, every European manufacturer announced new models at this show.

Major changes to truck cab shapes are not permitted due to the framework of the cab, but the front faces of the cabs did undergo some significant changes. These were probably caused by the new high-efficiency engine performance requirements in the Euro VI specifications, which require further improvements in engine cooling performance. Consequently, the new grille designs factor in the degree of ventilation and featured enlarged ventilation openings.

Cab interiors reflect the increasing amount of information that is displayed digitally and feature multiple large displays and monitors within the meters on the dashboard. The forms and molding of the instrument panels have also been changed to a more basic straight-line shape to facilitate efficient and simple layout for the increasing amount of equipment.

Many dark color tones are used around the driver's seat to reduce the amount of visual noise. However, the area around the front passenger's seat and the trim colors tend to be brighter beige and gray colors to provide a feeling of more space and higher contrast.

2. 1. Exterior design

Mercedes-Benz announced the large Antos truck (Fig. 4) in addition to the Actros. The cab variations emphasize short-distance shipping and specialized uses, and the width of each cab is 2.3 m. The conventional cab dimensions that included room for a bed (cab length of 2,300 mm) were abandoned and a new medium cab (the cab length of 2,000 mm is similar in size to Japanese truck cabs with a bed) has been adopted instead.

The cab style of the previous Axor model used the cab module from the mid-size Atego truck. This was switched to the Actros cab module to make it equal to the top class cabs. The grille portion of the front face was given the same style, but holes were placed in the grille surface to improve cooling performance and achieve both better ventilation and styling.

The Volvo FH has been given a full model change (Fig. 5). The cab and grille shape of the bumper on the front face have been given a single continuous style and the VOLVO brand mark has been moved from the center of the grille to a position on the panel below the front windshield. This reduced the surface area of the body color portion of the front panel. The grille panel portions around the front of the truck were enlarged significantly and are composed of a mesh pattern that increases the amount of air that passes through to improve both cooling performance and styling. The headlights are accentuated by LEDs for the position and daytime running lights. The composition of the outside mirrors is also new, and a cover that integrates the shape of the mirror body and the stay helps to save space. This improves the aerodynamic effect compared to the previous mirror and the new mirror body also reduces the size of the blind spot.

Fig. 4 Mercedes-Benz Antos.

Fig. 5 Volvo Trucks FH.

Fig. 6 Iveco Stralis Hi-Way.

The Iveco Magirus Stralis Hi-Way (Fig. 6) received a face-lifted design and was selected as the 2013 Truck of the Year. The front grille graphics before the model change were composed of simple horizontal lines characteristic of Iveco trucks. This was changed so that the IVECO logo space is now incorporated into the radiator grille area to more clearly express the distinction between Iveco trucks and trucks from other companies with updated grilles.

Fig. 7 DAF XF.

Fig. 8 MAN truck line-up.

The large DAF XF truck was also given a face lift to significantly revamp its image. DAF continues to use straight horizontal stripe graphics on the front grille, which are characteristic of all previous models. However, the graphics were slightly changed to connect the front panel and bumpers with curves. The brand badge was made much larger and the space was arranged in the center. It is likely that this same face design will be reflected on other truck models in the future as well (Fig. 7).

MAN gave a face lift to every truck in its line up. The styling gives the impression of following the image of previous models, but the logo mark was redesigned and the color of the bumper grille was changed to a more simple black graphic (Fig. 8).

2. 2. Interior design

The basic interior framework of the Mercedes-Benz Antos (Fig. 9) is the same as the Actros. The colors used in the interior of the Actros are a combination of black and beige to give the impression of a luxurious space, but the colors in the interior of the Antos are a combination of black and a bright grey to give it more of a practical image.

The switches, equipment, and LCD monitors are all lined up within a rounded cluster panel that is centered on the driver for easy operation. This concentrates these devices in a range that is easier for the driver to reach than on the previous models, and this layout clearly places a priority on the ease of driving operations.

Fig. 9 Interior of Mercedes-Benz Antos.

Fig. 10 Interior of Volvo Trucks FH.

The interior colors in the Volvo Trucks FH (Fig. 10) are a base black with bright gray on the upper portions to express a feeling of space and openness. In the interior of the FH16, a vivid yellow is used as an accent and the contrast with the black gives a new high-class feeling. The shape of the instrument panel is different from the rounded shapes that surround the instruments often used by other companies. Instead, it stretches out in a horizontal direction that faces the driver, and it is on a different level than the center cluster that contains all the switches and other equipment. This style helps to eliminate the claustrophobic feeling of being surrounded by instruments. Two LCD monitors are provided within the instrument panel and another large LCD monitor is located next to the instrument panel. This layout prioritizes good visibility through clearly identifying the area containing the switches and other devices in the operation system by special coloring, and ensuring that the driver's eyes do not have to move very much between the different dashboard meters.

3 Design of Concept Vehicles

3. 1. Japanese concept vehicles

The FUSO-Concept II (Fig. 11) is a design study model of a truck to be driven on the Asian Highway that will connect Tokyo and Istanbul in 2032, which also is the year that the FUSO brand would celebrate the 100th anniversary of its founding. A special characteristic of

Fig. 11 FUSO-Concept II.

Fig. 12 MAN Concept S.

its style is the integration of the cab and cargo box into a unified flowing shape that improves aerodynamic performance. The truck's cabin is a cockpit with no A pillars that should improve visibility and provide a greater sense of openness. The promotional video for this concept truck promoted the innovativeness of the design by simulating how the truck would use the latest technology to drive in a platoon.

3. 2. Concept vehicles outside Japan

In the future it is possible that efforts to reduce the fuel consumption of trucks through power train improvements will reach a limit. Consequently, study models are being proposed that feature better aerodynamics for the entire vehicle body to meet demands for further improvements in fuel economy.

The MAN Concept S was developed as an aerodynamic design study for a semi tractor (Fig. 12). This design study was first submitted at the IAA International Motor Show in 2010, but is now appearing again in its completed form after being combined with the Aero Liner semi trailer concept that was jointly developed with the German trailer manufacturer, Krone. The shape of the upper part of the roof is formed so that it swells smoothly from the cab to the cargo box to help reduce drag along the entire vehicle body and that air flows smoothly all the way to the rear end of the vehicle.

The Mercedes-Benz Aerodynamics Trailer (Fig. 13) is connected to a semi tractor that appears to be almost the same as the commercially-available Actros truck with aerodynamic items that can be attached to the cab

Fig. 13 Mercedes-Benz Aerodynamics Trailer.

as manufacturers options. The towed semi trailer was jointly developed with Schmitz Cargobull AG, one of the largest trailer manufacturers in Europe. The trailer was subjected to wind tunnel testing for 2,600 hours. The truck box does not simply use a cover to prevent wind from getting underneath. Instead, the rear side of the trailer has a boat tail shape that controls the flow of the wind and 400-mm long flaps extend out from the back of the trailer (which can be folded down).

Ultimately, when it comes to trying to improve the fuel efficiency of trucks, the current method of addressing the truck's aerodynamics by focusing only on the cab will prove to be insufficient. Therefore, it is thought that, in the future, a major trend in truck design will be to improve the aerodynamics of the entire vehicle, including the rear body. In fact, Europe has already started examining revisions to the regulations that concern the total length of trucks in consideration of the attachment of various aerodynamic items to the truck body. Furthermore, the introduction of next-generation technologies, such as ideas on how to control the flow of air between trucks being driven in a platoon, will likely have a significant impact on truck styling in the future.

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(6) MAN TRUCKS&BUS Website, http://www.tg.mantruckandbus.com/distribution-transport/
(7) Mercedes-Benz Catalogue
(8) Volvo Trucks Website, http://www.volvotrucks.com/trucks/uk-market/en-gb/trucks/volvo-fh-series/Pages/the-new-volvo-fh.aspx#thumbid-5-volvo
(9) Mitsubishi Fuso Truck&Bus Website, http://www.mitsubishi-ifuso.com/jp/news/news_content/120405/120405_c.html

Truck Body Structures

1 Cab and Chassis

1. 1. Product trends

1. 1. 1. Large trucks

Table 1 shows the large trucks announced in Japan in 2012 and the main product technology trends. Also in 2012, vehicles that met the fuel economy standards in the low-emissions vehicle certification system were eligible for Japan's preferential tax scheme for environmentally friendly vehicles, which were special measures in the 2012 tax system reforms to reduce the vehicle weight and purchase taxes. In addition, any vehicles that met the 2015 heavy vehicle fuel economy standards were eligible for a fuel-efficient vehicle subsidy. Consequently, truck manufacturers have been releasing a series of vehicles that meet these standards. In the large truck class, the ECO Series of the Giga line of trucks were released after being certified as low-emissions vehicles under the 2009 standards. In conjunction with this, these trucks were also installed with rear under-run protection devices that comply with the new standards and a pre-collision braking system that uses millimeter wave radar to help mitigate damage in the event of a collision. These changes not only reduce the impact of these trucks on the environment, but also help to enhance safety. The Super Great trucks were made compliant with the safety regulations that went into effect in July 2012 and now have a newly developed brake override system, which gives the brakes priority if the accelerator pedal and brake pedal are operated at the same time, as standard equipment to respond to incorrect driver operation. Furthermore, to further enhance safety performance, all models of these trucks also have emergency stop signals as standard equipment to help alert vehicles behind the truck of sudden braking and to help reduce collisions. To further enhance the safety performance of the Quon trucks, warnings are sounded and displayed if there is a risk of a collision with the vehicle in front, to encourage the driver to avoid the collision. If the system judges that the collision cannot be avoided, it automatically activates the brakes to reduce speed and to help mitigate the damage caused in the collision. This is called the Traffic Eye Brake system and is standard equipment on cargo hauling models and others. The entire lineup of the Profia brand of trucks was also made eligible for the preferential tax scheme for environmentally friendly vehicles.

1. 1. 2. Mid-size trucks

Table 2 shows the mid-sized trucks announced in Japan in 2012 and the main product technology trends. In this class of trucks, the Forward received certification as a low-emissions vehicle under the 2009 standards, thereby expanding the range of GVW 8-ton vehicles that are eligible for the preferential tax scheme for environmentally friendly vehicles. The Fighter also has the brake override system as standard equipment, the same as for large trucks. This truck is now also equipped with a rear under-run protection device that helps prevent passenger cars and other small vehicles from submarining underneath the truck in a rear-end collision. This also brings the truck into compliance with the new safety regulations. In conjunction with these changes, the light sources in the fog lamps were brought into compliance with the ECE regulations to ensure that the light intensity of the fog lamps is within the regulation values ahead of July 2013, when the relevant safety regulations take effect. The entire lineup of the Ranger brand of trucks, including the hybrid models, was made eligible for the preferential tax scheme for environmentally friendly vehicles.

1. 1. 3. Small trucks

Table 3 shows the small trucks announced in Japan in 2012 and the main product technology trends. In this class of trucks, a new Canter model called the Canter Eco Hybrid went on sale. This truck is equipped with a new DCT with a built-in electric motor for hybrid vehicles and it also uses a very efficient, high-performance laminate-type lithium-ion battery. These changes help to improve the efficiency of the hybrid system and also to reduce size and weight. The Atlas F24 is one of the mutual OEM supply trucks that went on sale under the Canter Guts name. This truck helps to realize a wide ranging product lineup that extends from 1.5-ton class trucks to hybrid trucks. The other truck manufacturers also launched new trucks in this class that comply with the post-new long-term emissions regulations (the strictest such emissions regulations in the world), the 2015 heavy vehicle fuel economy standards, and the new

Table 1 Main product trends for large Japanese trucks in 2012.

Month of launch	Truck model name	Main characteristics
March	Quon	Partial improvements - Traffic Eye Brake system to reduce collision damage is standard equipment - Certified as a low-emissions vehicle under 2009 standards
April	Giga	Partial improvements - The Eco Series trucks are certified as low-emissions vehicles under 2009 standards and go on sale - Rear under-run protection devices that comply with new standards
	Super Great	Partial improvements - Emergency stop signals are standard equipment on all vehicles - Newly developed drag foiler and rear spoiler
	Profia	Partial improvements - Full lineup of vehicles that are eligible for Japan's preferential tax scheme for environmentally friendly vehicles

Table 2 Main product trends for mid-size Japanese trucks in 2012.

Month of launch	Truck model name	Main characteristics
April	Ranger	Partial improvements - Full lineup of vehicles that are eligible for Japan's preferential tax scheme for environmentally friendly vehicles
	Forward	Partial improvements - The Eco Series trucks are certified as low-emissions vehicles under the 2009 standards and go on sale
	Fighter	Partial improvements - Emergency stop signals are standard equipment on all vehicles - Rear under-run protection devices that comply with new standards
October	Forward	Partial improvements - Certified as a low-emissions vehicle under 2009 standards GVW 8-ton trucks that run at 177 kW & 154 kW go on sale

safety standards for rear under-run protection devices, and that are equipped with rear reflector plates in accordance with the new lighting equipment safety standards that went into effect in January 2013.

1. 1. 4. Mini-vehicle trucks

Table 4 shows the mini-vehicle trucks announced in Japan in 2012 and the main product technology trends. In this class, every truck manufacturer ensured compliance with the revisions to the safety standards for seats and seat belts that took effect in July 2012. These measures included the adoption of high-back-type seats and

Table 3 Main product trends for small Japanese trucks in 2012.

Month of launch	Truck model name	Main characteristics
April	Elf	Partial improvements - The Eco Series trucks are certified as low-emissions vehicles under 2009 standards and go on sale - Rear under-run protection devices that comply with new standards
	Dyna	Partial improvements - The 2-ton load capacity hybrid truck meets the 2015 fuel economy standards - Equipped with a rear reflector plate in accordance with the new lighting equipment safety standards
	Atlas	Partial improvements - The Atlas H43 is certified as a low-emissions vehicle
	Condor	Partial improvements - Trucks certified as low-emissions vehicles under 2009 standards go on sale - Rear under-run protection devices that comply with new standards
	Toyoace	artial improvements - The 2-ton load capacity hybrid truck meets the 2015 fuel economy standards
May	Titan	Partial improvements - Trucks certified as low-emissions vehicles under 2009 standards go on sale - Rear under-run protection devices that comply with new standards
	Canter	Full model change for the new Canter Eco Hybrid model
August	Dutro	Partial improvements - All models certified as low-emissions vehicles - Equipped with a rear reflector plate in accordance with the new lighting equipment safety standards
November	Canter	Full model change for the new Canter Guts model

larger headrests. Furthermore, trucks in this class are now equipped with rear reflector plates to comply with the regulations concerning lighting equipment and reflectors that went into effect in January 2013. In addition, several manufacturers made efforts to improve interior and exterior quality, and enhanced the available equipment to keep up with recent trends. Truck manufacturers also expanded the usage of rust-resistant steel sheets and the areas of body sealer application on an increasing number of truck models to improve corrosion resistance.

1. 1. 5. European and American trucks

In the midst of the tough economic conditions in 2012, the Euro VI emissions regulations for large trucks went into effect in early 2013 in Europe. Consequently, each truck manufacturer equipped large trucks with the necessary devices to comply with these regulations. Even though there are small differences in how each of these manufacturers approached this task, the Euro VI require-

Table 4 Main product trends for mini-vehicle Japanese trucks in 2012.

Month of launch	Truck model name	Main characteristics
May	Carry	Partial improvements - Seats converted to high-back type due to revision of safety standards - Rear reflector plates added to comply with regulations
June	Acty Truck Acty special-purpose vehicles	Partial improvements - Rear reflector plates added to rear mud guards - Seats converted to high-back type due to revision of safety standards
July	Minicab Truck	Partial improvements - Driver's side airbag made standard equipment - Seat belt pre-tensioner also made standard equipment
December	Minicab Truck	Partial improvements - Rear reflector plates added to comply with regulations - Improved feeling of quality due to change in seat fabric
	Hijet Truck	Partial improvements - Rear reflector plates added to comply with regulations - Expanded use of rust-resistant steel sheets and expanded areas of body sealer application
	Minicab-MiEV Truck	New-generation electric vehicle put on sale - Zero-emissions vehicle equipped with EV components
	Pixis Truck	Partial improvements - Rear reflector plates added to comply with lighting and reflector regulations, etc. - Expanded use of rust-resistant steel sheets and expanded areas of body sealer application

ments were achieved through a combination of common rail direct fuel injection, variable nozzle turbochargers, cooled exhaust gas recirculation (EGR), oxidation catalysts, urea selective catalyst reduction (SCR) systems, and the like Scania and Mercedes-Benz adopted a cruise control device that uses GPS to predict changes in the terrain and then control the truck's speed as part of a new approach to improving fuel economy. The number of truck models that have adopted safety devices, such as AEBS and lane departure warning systems, is also increasing. Mercedes-Benz announced the new Actros in 2011. In 2012, it introduced the large Antos truck as a new model that shares key components with the Actros. However, this model is specialized for short-distance shipping and features a low-roof cab with no bed. Volvo announced the new large FH truck series, which was its first full model change in 20 years. These trucks feature improved fuel economy, a more expansive cabin space, the first independent front suspension on a large truck, and the first LED truck headlights. DAF carried over the sheet metal of the cab, but completely redesigned the chassis. The new power train is compliant with the Euro VI regulations and the large XF trucks were given a full model change with LED headlights, the same trend as Volvo. Iveco Magirus AG released its latest large Stralis truck called the Stralis Hi-Way. This model is a significant improvement over the previous one. The engine and cab were altered and both the fuel economy and interior comfort were greatly improved as well. It was selected as the 2013 Truck of the Year.

1. 2. Interior comfort

Truck drivers spend the majority of the day in the truck cabin. The cabin is both a work and a living space. It must be easy to get into and out of as well as comfortable and safe. Consequently, improving the interior comfort of the cabin has become an important theme for manufacturers. In recent years the cabin has taken on a square-shaped framework with wide door openings and high roofs that make it easy for the driver to get in and out of the vehicle in an almost upright posture. Short cabin models are often given high roofs and a layout that places the bed space in the upper portion of the cabin to provide better interior comfort and to help reduce fatigue on long drives. The ability to move around the interior was improved through the adoption of a folding parking lever that can be installed in a compact space and a shift lever on the instrument panel that can be operated easily like the lever in a passenger vehicle to improve mobility between the driver's and front passenger's seat. The shape of the instrument panel has also been improved in front of the knees and around the lower portion to expand the leg room of the central seat. Seats with superior hold and support for the occupants have also been developed along with greater storage space to enhance the overall comfort of the interior.

1. 3. Operability

The number of driving operations must be reduced as the average age of truck drivers increases, more women become truck drivers, and driver fatigue from long drives becomes a greater factor. More and more trucks are now being equipped with automatic transmissions, manual transmissions with no clutch pedal, devices that aid the driver when starting on a hill, and the like. This trend of making trucks easier to drive has been expanding gradually from small to mid-sized

trucks, and the proportion of trucks using these devices has been increasing. Manufacturers have also started examining how the various interior switches are operated, and round-form cockpits are increasingly being adopted based on the latest ergonomic ideas to provide a functional meter, switch, and lever layout in line with driver motions, especially in large trucks. This is being done to help realize an ideal driving environment for the driver and to reduce driving fatigue. In contrast, the accumulation of many small and barely noticeable factors in driving operations is preventing better fuel economy. Consequently, technologies are being developed to automatically control these factors, and trucks are now being equipped with environmentally friendly cruise control functions for shifting and acceleration. The number of trucks that are equipped with these technologies to minimize driver stress and realize more fuel efficient driving is continuing to increase.

1. 4. Noise and vibration

Drivers that frequently make long drives would benefit from even the smallest reductions in fatigue and improvements in comfort. One way of addressing these issues is to improve noise and vibration in the cabin, which are one source of driver fatigue. Air suspension seats have been adopted that improve ride comfort and absorb many fine vibrations from the road surface that would normally be transmitted up to the driver's seat. These seats hold the driver firmly in place while allowing a relaxed posture. The seats have an automatic weight adjustment mechanism that holds the seat surface at a constant height depending on the driver's weight and a lumbar support mechanism. These abundant adjustable functions have allowed seats to significantly reduce driver fatigue and improve ride comfort. Other measures for the vehicle body include improving the engine mounts, frame stiffness, and cab suspension. Noise issues have been addressed by reducing wind and air intake duct noise, and by optimal placement of sound insulation and sound-absorbing material in cabin floor panels. These changes have led to a significant improvement in the overall quietness of the cabin.

1. 5. Safety

The development of better safety technologies for trucks has been promoted with a focus on minimizing the deformation of the cab in the event of a collision, strengthening the structure of the vehicle body to ensure a safe space for the driver, and enhancing the safety equipment. Stronger vehicle body structures are being promoted through the optimal arrangement of cross members in the cab structure, the adoption of high-tensile steel sheets, the use of tailored blanks, and the like. Every truck manufacturer is incorporating cab structures that optimize the strength balance of the cab to raise the strength of the vehicle body around the occupants, ensure sufficient survival space, and absorb collision energy. The development of cabs that mitigate collision injuries is also being promoted. As a result, the front and rear under-run protection devices that help to prevent passenger vehicles from submarining underneath the truck are being further improved. Impact-absorbing steering wheels and driver's side SRS airbag systems for the driver's seat are also being adopted as new safety equipment for accidents. In recent years the adoption of active safety technologies that help to ensure vehicle safety and support the avoidance of accidents in the first place has also been strongly promoted. Some specific examples of these are pre-collision safety technologies, such as collision mitigating brake systems, lane departure warning systems, millimeter-wave radar and other state of the art devices that help to visualize danger, electronic stability control systems that control skids and rollovers, and so on. Pillar cross sections in cabs are also being made as thin as possible to improve visibility and to ensure that the driver has a wide and unobstructed field of view. Some trucks are now also equipped with dual-surface mirrors that expand the view to the sides and rear of the vehicle to help prevent accidents, as well as discharge headlights that automatically adjust the optical axis of the beam as other examples of active safety equipment.

1. 6. Aerodynamic characteristics

The aerodynamic characteristics of a truck are a performance aspect that can make a large contribution to reduced fuel consumption. Consequently, all manufacturers are putting more effort into improving aerodynamics. The cab of the truck in particular is the first part of the truck that contacts the wind and then funnels it to the left and right, up and down, and toward the rear of the vehicle. Consequently, the cab is being designed with more flush surfaces, such as a narrower front to the cab and innovations to the corners to rectify the flow of air and reduce drag. However, when the design is changed to change the flow of air around the cab, it also can have a negative effect on the wind noise in the

cabin, the aerodynamics around the tires, driving stability in a crosswind, engine cooling performance, interior comfort, and so on. This means that any design changes must also try to minimize these kinds of problems at the same time as improving the aerodynamics. The basic framework of the cab can be reviewed and radical improvements can be promoted at the time of a full model change. In the case of a minor change, alterations are made to the design of the cab's external appearance. At the same time, further improvements can also be made to the parts around the front of the cab, the corner panels and bumper, the change in level between the cab and the cargo trailer, the air deflector and cab shield, the side guards around the trailer and the rear spoiler, and so on. In recent years, the improvement of analytical technologies, such as optimization calculation methods, has led to major improvements in the flow of air under the floor, which has a large impact on the cooling performance, as well as in the flow of air in the engine compartment, and to the negative pressure region behind the rear body. A lot of time and effort is now going into initiatives that make use of computational fluid dynamics (CFD) analysis in addition to conventional wind tunnel testing with scale models to carry out these aerodynamic design activities more efficiently.

1.7. Corrosion prevention

In recent years, improved corrosion prevention has been promoted, even on mini-vehicle trucks. The application of rust-resistant steel sheets and body sealer on the Hijet was expanded to improve corrosion resistance. Model changes have been used as an opportunity to expand the application of rust-resistant steel sheets on trucks and also to actively promote the adoption of more plastic parts. The use of plastic parts is being promoted not only in consideration of recyclability and as an alternative to heavy metal materials to help reduce substances of environmental concern (SOCs), but also to improve the corrosion-resistance performance of the whole vehicle.

2 Rear Body

As logistics become more and more diversified, there are increasing demands to further improve freight handling and transport efficiency. Truck manufacturers are now offering complete wing body trucks where the chassis and body are part of a single package to meet these demands. The number of wing body trucks with refrigerated storage has continued to rise. These are now very common and may be considered to be a fully accepted part of the market. The use of aluminum and plastic materials in these trucks has expanded for some time and improvements to design and structure have helped to reduce weight. There has also been a continuing trend of adopting interior materials with antibacterial and odor eliminating specifications to address hygiene issues and the spread of odors when transporting foods. There has also been a shift from using apitong plywood material, which is often used as the material for truck trailer floors, to using material from planted trees and laminated lumber to better protect the natural environment. Furthermore, trucks with electric-powered cargo areas (including refrigerated trucks) are now starting to be introduced to the market as a more environmentally friendly option.