

TRUCKS

Overall Trends

1 Introduction

Despite keywords such as “negative interest rate”, “slowdown in consumption” and “volatile yen exchange rate”, the Japanese economy in 2016 exhibited modest signs of recovery as the real growth rate of the gross domestic product (GDP) for the 2016 calendar year (January to December) rose by 1.0%, marking two consecutive years of positive growth (Fig. 1).

For the automotive and related industries, the postponement of the consumption tax increase in June, and the highlights of the 2017 tax reform in which revisions encompassed the fuel-efficient car tax reduction scheduled to expire at the end of March 2017 as well as the tax incentives for green investments, resulted in the good news that the increased tax burden for vehicle buyers would be delayed for two years. In addition, the Diet approved the TPP at the end of the year, leading to conditions expected to stimulate economic recovery for the globally expanding automotive industry.

Outside Japan, in contrast, the year was marked by the stagnant growth rate of China’s GDP that drives the economy of Asia, the uncertainty surrounding the feasibility of the fiscal policies advocated by President Trump, the referendum on the U.K. leaving the EU, and other circumstances with an impact on the Japanese economy. The nature of that impact will draw significant attention.

2 Recent Truck Market Trends

2.1. Freight Shipments in Japan

Freight shipments in Japan in 2015 amounted to 407.3 billion ton kilometers, a 1.9% reduction from 2014, and comparable to the 2012 volume. These shipments break down into 204.3 billion ton kilometers shipped by trucks, 21.5 billion ton kilometers shipped by trains, 180.4 billion ton kilometers shipped by sea, and 1.1 billion ton kilometers shipped by air. In terms of share, trucks accounted

for 50.2%, trains for 5.3%, maritime shipping for 44.3%, and air shipping for 0.3% (Fig. 2).

If the amount of freight shipped by motor vehicles is further broken down by the types of truck used, ordinary trucks account for 78.4%, light-duty trucks account for 2.0%, special-purpose trucks account for 19.5%, and mini-vehicle trucks for 0.2%, representing a ratio almost identical to the one in 2013 (Fig. 3).

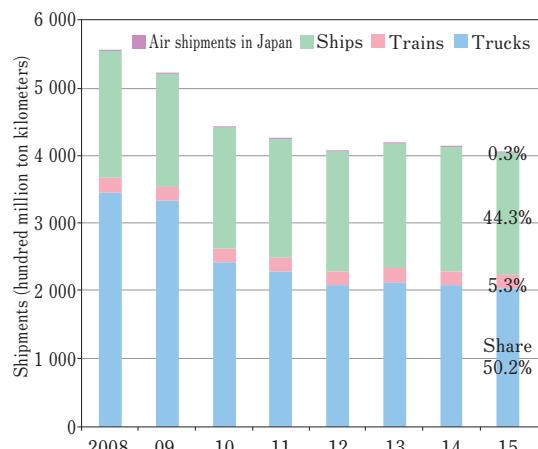
2.2. Number of Trucks in Japan

The number of trucks owned in Japan has continued

Quarterly GDP growth rate	Real	0.3%
Compared to October to December 2016 term	Nominal	0.4%
Annual GDP growth rate	Real	1.0%
2016 calendar year (compared to previous year)	Nominal	1.3%
Quarterly GDP amount	Reall*	524.6 trillion yen
October to December 2016 term	Nominal	539.7 trillion yen
Annual GDP amount	Reall*	521.8 trillion yen
2016 calendar year	Nominal	537.3 trillion yen

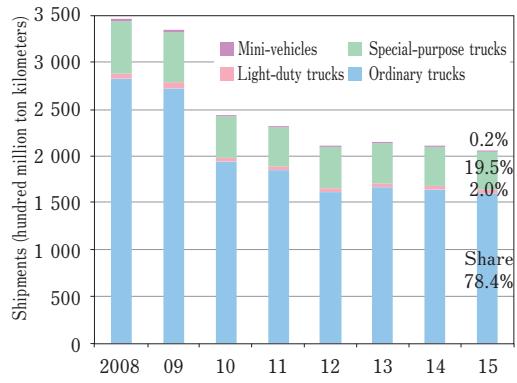
*Real amounts represent the chained 2011 yen.

Fig. 1 Japan 2016 GDP (from Cabinet Office statistical data).



*Private mini-vehicle trucks have been excluded from the survey since 2010.

Fig. 2 Freight shipments in Japan (fiscal year).



*Private mini-vehicle trucks have been excluded from the survey since 2010.

Fig. 3 Freight shipments in Japan by vehicle type (fiscal year).

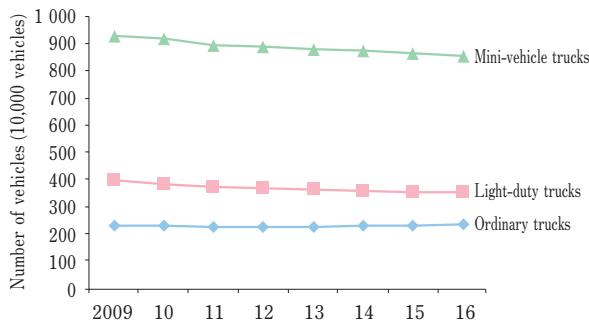


Fig. 4 Number of trucks in Japan according to vehicle type (as of the end of December).

to decline, reaching 14.41 million at the end of 2016, a decrease of approximately 91,000 vehicles, or 0.6%, relative to the previous year. Broken down by type of truck, the number of ordinary trucks grew slightly, by 0.9% while light-duty and mini-vehicle trucks dropped slightly, by 0.5% and 1.1% respectively (Fig. 4).

2.3. Number of Truck Registrations in Japan

The number of truck registrations in Japan in 2016 was approximately 810,000, an increase of 1.1%, or 9,000 vehicles, compared to the previous year. By truck type, there was a tiny 0.4% increase for ordinary trucks, while light-duty and mini-vehicle trucks declined by 2.1% and 1.1%, respectively (Fig. 5).

2.4. Truck Exports

Approximately 380,000 trucks were exported in 2016, a decrease of 82,000 units, or 18%, compared to the previous year. Sales of ordinary and light-duty trucks declined by 13% and 41%, respectively (Fig. 6). By destination, the number of exported trucks remained essentially the same in Southeast Asia, North America, and Oceania, but declined by 35% in the Middle-East, where it had risen for four consecutive years, and by 34% in Africa (Fig. 7).

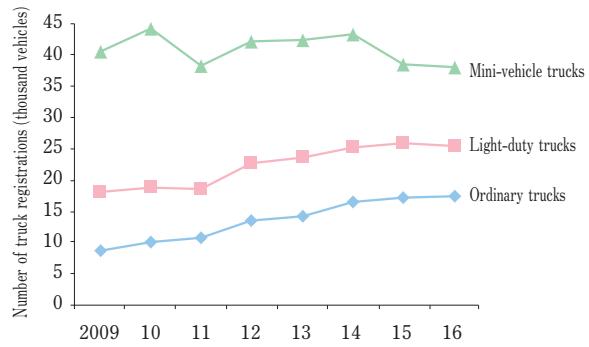


Fig. 5 Number of truck registrations in Japan according to truck type.

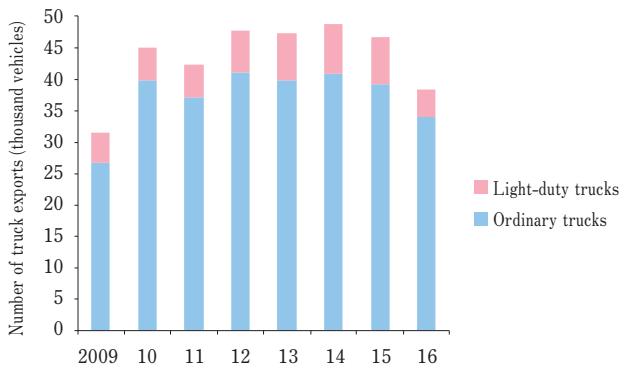


Fig. 6 Number of truck exports according to truck type.

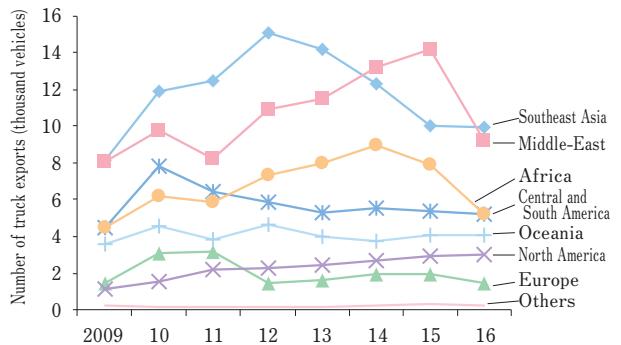


Fig. 7 Number of truck exports according to destination

3 2016 Model Year Trucks and Special Characteristics

3.1. Trucks Manufactured in Japan

The issue of driver shortage in the logistics industry is becoming even more pressing as economic recovery increases the logistics volume. The number of effective job openings for drivers has continued to rise since 2009, and the ratio of effective job openings-to-applicants stood at a very high 2.61⁽¹⁾ in December 2016. Given that the driver workforce has a higher age distribution and lower ratio of young people than other industries, the aging of the population is expected to aggravate the shortage of workers in the long term. This has been leading modified



Fig. 8 Isuzu Giga Tractor⁽²⁾.



Fig. 9 Isuzu Giga CNG⁽³⁾.

specifications thought to appeal to drivers and to the commercialization of trucks that anyone can drive safely and comfortably.

3.1.1. Heavy-Duty Trucks

Isuzu Motors Limited completely redesigned its heavy-duty Giga Tractor truck in April, and added a model equipped with a new lighter engine and a dedicated transmission to its line of Giga heavy-duty trucks. In essence, this represents a continuation of the whole-vehicle modifications unveiled in October 2015.

With the adoption of a larger radiator and the Eco-stop function enabling automatic stops and restarts for the engine mounted on the tractor, some models now exceed the 2015 fuel efficiency standard by +5%. At the same time, the more advanced Smoother-Gx automated manual transmission provides smoother starts and gear changes (Fig. 8).

The additional Giga model is equipped with a newly-developed 7.8 liter 6NX1 engine. Its small displacement and use of a 2-stage turbocharger provide stable torque characteristics through a broad range of low to high engine speeds while ensuring excellent carrying capacity. The new 9-Speed transmission paired with this engine has high-capacity carbon synchronizers for all stages, provides faster gear shifting with less operation effort, exhibits excellent drive performance via a wide gear range, and enables smooth acceleration.

In November, Isuzu also added a cargo short cab model and a 4-axle model that ensures greater loading capacity to its Giga CNG heavy-duty truck line (Fig. 9).



Fig. 10 Nissan NT450 Atlas⁽⁴⁾.

3.1.2. Medium-Duty Trucks

In July, Nissan Motor Co., Ltd. modified some of the specifications of the NT450 Atlas light- and medium-duty truck. The start-stop system that was only standard equipment on some models was made standard on all models, and the diesel model with a maximum carrying capacity of two tons achieved a fuel efficiency of 11.60 km/L (heavy-duty vehicle mode), the highest in its class. At the same time, the Hill-Start Assist function was added to trucks equipped with the Duonic 2.0 dual clutch transmission.

The interior was changed to a basic black and silver theme that offers a sober cabin space. Furthermore, the addition of a driver's seat side support and a larger cushion provide a comfortable driving environment. Convenience was also enhanced by standardizing storage areas such as the driver seat overhead tray, the middle seat center tray, and the magazine rack (Fig. 10).

In November, Isuzu Motors Limited refined some models in its Forward medium-duty truck lineup. The F-Cargo Wing medium-duty truck completed vehicle (GVW of less than 8 t) became the first vehicle in its class to offer the previously optional Advanced View Assist Technology (VAT) and Isuzu Electronic Stability Control (IESC) as standard equipment.

VAT is a driving safety support system consisting of Pre-Crash Braking system (collision avoidance support/collision damage mitigation functions), millimeter wave inter-vehicle distance warning system, and a lane departure warning system (LDWS). A high precision millimeter wave radar and various sensors are leveraged to support the driver's vision. In the IESC system, sensors detect driver operation and vehicle behavior, and provide a warning sound and an alert on the instrument panel while simultaneously automatically controlling the engine and the brakes when an unstable vehicle posture



Fig. 11 Isuzu Forward F-Cargo Wing⁽⁵⁾.



Fig. 12 Mazda Bongo Truck⁽⁶⁾.

that could lead to skids or rollovers, thereby contributing to mitigating accidents (Fig. 11).

3.1.3. Light-Duty Trucks

In February, Mazda Motor Corporation refined the Bongo Van and Bongo Truck. Fuel efficiency was improved, and all vehicles now meet the 2015 fuel efficiency standard threshold. Maximum carrying capacity was also increased. In addition, adopting a 5-speed transmission (5EC-AT) enabled smooth driving offering easy handling when climbing hills or driving at low speeds in conjunction with the improvement in fuel efficiency. Moreover, 4-wheel ABS was made standard equipment on all models (Fig. 12).

In May, Hino Motors, Ltd. refined the Hino Dutro light-duty truck. The refinements focused on offering fully-featured safety systems with the establishment of a new model featuring Pre-Crush Safety (PSC) and a lane departure warning system as standard equipment to complement the already standard vehicle stability control (VSC) and electric parking brake systems. The PCS system includes a monocular camera in the top part of the front windshield in addition to the millimeter wave radar set in the center of the front bumper, and is able to detect pedestrians. The camera provides support for avoiding or mitigating collisions with non-moving objects, slow-moving preceding vehicle, or pedestrians, and also functions as a lane recognition sensor for the lane departure warning system (Fig. 13).

Also in May, Toyota Motor Corporation partially re-



Fig. 13 Hino Dutro⁽⁷⁾.



Fig. 14 Toyota Dyna Cargo⁽⁸⁾.



Fig. 15 Toyota Toyoace Cargo⁽⁸⁾.

fined the Dyna and Toyoace 2-ton series. These are the first 2-ton series models to be equipped with Pre-Crush Safety (with a pedestrian detection function) supporting collision avoidance and damage mitigation in the event of a collision. A lane departure warning system to help avoid collisions due to lane departure was also made standard equipment. This system combines a millimeter wave radar and a monocular camera to achieve highly reliable recognition via two different sensors, providing versatile driving safety support. Improved convenience is also offered via an (optional) smart entry system (with driver- and passenger-side answer back) & start system (Figs. 14 and 15).

In April, Mitsubishi Fuso Truck and Bus Corporation completely redesigned its Canter light-duty truck. The overhaul went beyond just the engine to the vehicle as a whole, improving fuel efficiency, and vehicles with a maximum carrying capacity of 3 tons equipped with a start-stop system now exceed the 2015 fuel efficiency standard by +10%. All other vehicles exceed the same standard by +5%. The interior was renovated to a luxurious black and silver theme. A driver's seat side support



Fig. 16 Mitsubishi Fuso Canter⁽⁹⁾.

provides improved holding and combines with a larger seat cushion to offer a comfortable driving environment that reduces fatigue. Storage areas such as an overhead shelf, floor console, center tray and a magazine rack have also become standard equipment, and expanded, and the vehicle offers a user-friendly working space.

At the same time, the Hill-Start Assist function, which helps reduce rolling down when starting on a slope, was made standard on trucks equipped with the Duonic 2.0 dual clutch AMT. This function temporarily maintains brake force between the time the brake pedal is released and the accelerator is pressed (Fig. 16).

In June, UD Trucks corporation released the Kazet SK/SF/RK light-duty trucks. All 2016 models were equipped with urea selective catalyst reduction environmental technology to enable clean and efficient use of the diesel engine, thereby enhancing environmentally friendliness and fuel efficiency. This ensured all models exceed the 2015 fuel efficiency standard by 5%, and pushed models equipped with the start-stop system into the group of models exceeding it by +10%.

The interior offers a restrained coloring with the change to a black theme, which was also used in the leather fabric for the seat tone, giving the entire interior a unified feel. Changes to the driver's seat, including a modified shape for the back, a side support, and a larger seat cushion offer a comfortable driving environment that further reduces fatigue. Cabin storage capacity has also been enhanced with the inclusion of overhead and floor consoles, a magazine rack and a sun visor pocket as standard equipment.

In terms of functionality, the Hill-Start Assist system that maintains brake force between the time the brake pedal is released and the accelerator is pressed when a stopped vehicle starts on a hill was made standard equipment on models equipped with a dual-clutch AMT.

Customizability was also enhanced with a new dedicated package option for models with a crane mounted



Fig. 17 UD Trucks Kazet SK⁽¹⁰⁾.



Fig. 18 Toyota Dyna Cargo⁽¹¹⁾.



Fig. 19 Toyota Toyoace Cargo⁽¹¹⁾.

behind the cab and a 24 V battery option, creating a line-up that responds to diverse needs better than ever (Fig. 17).

In September, Toyota Motor Corporation partially refined the Dyna and Toyoace 1-ton series. These partial refinements focused on safety and made ABS standard equipment on all models. As with the 2-ton series, the cab design was revamped to a front view that emphasizes strength. In addition, the adoption of multi-reflector headlights contributes to ensuring nighttime visibility. At the same time, expansive legroom enhances cabin roominess, while a large open tray with hooks extending from the passenger to the center seat offers improved convenience (Figs. 18 and 19).

3.1.4. Mini-Vehicle Trucks

In May, Daihatsu Motor Co., Ltd. added a new colored aluminum medium-temperature refrigerator truck to the special purpose vehicle series of the Hijet Truck mini commercial vehicle, and partially refined the Panel Van and Panel Van High Roof, as well as the Atrai Sloper and Hijet Sloper adapted mini-vehicles. The newly released special purpose colored aluminum medium-temperature refrigerator Hijet Truck provides refrigerator capacity



Fig. 20 Daihatsu Hijet Truck⁽¹²⁾.



Fig. 21 Toyota Pixis Truck⁽¹³⁾.

as well as sliding and rear door, opening width and height at the top of its class, making it a refrigerator truck with excellent capacity that expands the lineup of cooling and refrigerator vehicles. The Panel Van and Panel Van High Roof were made more user-friendly with the adoption of a latch-based rear door lock mechanism and other changes made in response to market demand (Fig. 20).

In October, Toyota Motor Corporation partially refined its Pixis Truck mini commercial vehicle. In addition to changing the design of the instrument panel switch display, the upgrade offers a new selectable color pack (option) with eight outer panel colors including the new urban night blue crystal metallic and muscat green metallic, and makes the door handles the same color as the body. With the standard white in addition to those eight colors, customers can choose between a total of nine outer panel colors (Fig. 21).

3.2. Trucks Manufactured outside Japan

In August, the Swedish major commercial vehicle maker Scania announced a next-generation heavy-duty truck in Paris (Fig. 22). This is the first full redesign the 21 years since the introduction of the 4-series in 1995. Scania completely redesigned its new S-series as well as its R-series of premium models that can be customized to match customer needs.

Refinements to the engine and reduced aerodynamic drag provide a 5% improvement in fuel efficiency, and the new position of the driver's seat gives an enhanced



Fig. 22 New Scania Models⁽¹⁴⁾⁽¹⁵⁾.

field of view. The new models also offer safety-related improvements and increased engine horsepower. In addition, connectivity (vehicle data transmission) technology collects driving data in real time, with analysis results provided to customers. One example is notifying customers when the analysis determines that the maintenance period is near.

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Design Trends

1 Trends in Japanese Truck Design

Many recent changes in truck design aim to realize functional improvements such as better fuel efficiency, or are timed with redesigns triggered by the need to comply with regulations, and are often accompanied by design modifications intended to strengthen product appeal. With the coming into effect of the post-new long-term regulations in October 2016, the year 2016 can be described as a period of “calm before the storm” during which manufacturers prepared for the coming changes.

1.1. Exterior Design

The Toyota Dyna and Toyoace, as well as the Hino Dutro, became the first 2-ton trucks equipped with a collision mitigation braking system, and the mounting of a millimeter wave radar led to changes in the shape of the front bumper (Fig. 1). The Dyna and Toyoace 2-ton series were also upgraded to halogen headlamps. As a result, the face design of the 1-ton series, which had remained unchanged in the 2011 full redesign, and the design of the bumper and halogen headlamps on standard width cabs was changed, completing the update of the face design for all models.

For its series of Fuso brand medium- and heavy-duty trucks aimed at emerging countries manufactured by Daimler India Commercial Vehicles Pvt. Ltd., Mitsubishi Fuso Truck and Bus Corporation announced the addition of the new TV heavy-duty truck with a gross tractor-trailer weight of 65 t intended for the Kenyan market (Fig 2). The new model has the same cab as the FJ and FZ models in the same series, but distinguishes itself in a manner appropriate to the flagship model of the series with new headlamps, a changed front grille shape, and the addition of a corner vane.

1.2. Interior Design

The design of the seats and the interior color have been changed in the Mitsubishi Fuso Canter and the OEM supplied Nissan NT450 Atlas and UD Trucks Kasset (Fig. 3). The addition of a driver's seat side support and the use of a larger seat cushion provide better holding while simultaneously expanding the available storage

near the driver's seat. The interior color was changed from the previous gray theme to a beige theme similar to that seen in European heavy-duty trucks, providing a high contrast color arrangement and improving the sense of quality given by the interior as a whole.

2 Trends in Truck Design outside Japan

In Europe, following in the footsteps of the Mercedes-Benz redesign of the Actros in 2011, Volvo and Renault Trucks also completed full redesigns of their heavy-duty trucks to achieve compliance with the Euro VI emissions regulations for heavy-duty diesel vehicles. AT the same time, medium-duty trucks are receiving facelifts that follow the design of each manufacturer's heavy-duty models. In conjunction with these redesigns, manufacturers are setting a course for a shared new brand expression for their medium- and heavy-duty trucks and finalizing the deployment of the face design of the Euro VI generation.

For light-duty (category N1) commercial vans, manufacturers completed their redesigns between 2013 and 2014 in response to the coming into effect of various safety regulations. Consequently, there were very few changes in 2016. However, the Volkswagen Crafter (Fig. 4) and its OEM model, the MAN TGE (Fig. 5), were unveiled at the IAA Commercial Vehicle Show in Hanover. The Crafter was originally an OEM model of the Mercedes-Benz Sprinter, but with its own independent complete redesign, the company has shifted to a design that emphasizes its membership in its family of commercial vans. Similarly, the MAN brand broadens its lineup by complementing its medium- and heavy-duty truck offerings with a commercial van.

As stated earlier, the redesigning of medium- and heavy-duty trucks has been slowing down since 2014. Nevertheless, Scania announced complete redesigns within its lineup for the R-series (Fig. 6) as well as two models in its new S-series.

2.1. Exterior Design

The Scania brand identity is characterized by the bold U-shaped graphic extending from the side windows



Fig. 1 Toyota Dyna.



Fig. 5 MAN TGE.



Fig. 2 Fuso TV.



Fig. 6 Scania R-series.



Fig. 3 Interior of Mitsubishi Fuso Canter.



Fig. 4 Volkswagen Crafter.

down to the bumper and the multilevel front grille therein. The redesigned models inherit that distinctive face design, retaining a sense of family identity with the previous designs seen in the G-series and P-series while making a legitimate evolution to an overall more linear and sharper figure than previous generation cabs. The



Fig. 7 Interior of Scania R-series.

revamped cab frame simultaneously features an upright windshield and a smoothing of the level difference with the front surface of the roof, along with a reworking of the extension of the bottom edges of the bumper and side steps, achieving a 2% improvement in fuel efficiency through the enhanced aerodynamic performance of the cab as a whole. They are also the first trucks to use full LED headlights, and other manufacturers are expected to follow suit.

2.2. Interior Design

The interior of the Scania R-series and S-series (Fig. 7) features safety, comfort, and operability improvements. Compared to previous models, cabin height has been expanded by 100 mm in standard cabs and 160 mm in high roof ones, and the seat has been moved forward by 65 mm which, combined with the flat floor of the S-series,



Fig. 8 Mitsubishi Fuso eCanter.

offers greater convenience when resting. In terms of safety, these models offer an expanded direct field of view and are the first trucks to be equipped with roll-over side curtain airbags. The variations found in previous models due to the differences in the length of the instrument panel have been standardized, bringing the hazard lamp switch within easy reach while driving. The installation of an 8-inch monitor absent in previous models also makes these trucks forerunners in adapting to the larger monitors made essential by advances in HMI functionality. As with the exterior, the overall interior design retains the basic layout while showcasing novelty by incorporating a sharper, more dynamic shape. The beige interior color is unobtrusive and creates a luxurious cabin space.

3 Design of Concept Vehicles

3.1. Concept Vehicles in Japan

Mitsubishi Fuso Truck and Bus Corporation was the only Japanese manufacturer to unveil an EV concept vehicle, the eCanter, at the IAA Commercial Vehicle Show in Hannover (Fig. 8). Building on the technology of the Canter E-Cell, the second generation EV truck field tested in Japan, Portugal and Germany since 2013, the eCanter is a third generation optimized for transportation in urban areas. It has a cruising range of 100 km on a single charge, and is scheduled to start mass production in the latter half of 2017.

Its exterior design exhibits front face differences from the current Canter models. Since it is an EV, the opening of the front grille has become a space providing brand expression through lighting, and the headlamps consist of a series of three LED headlights on each side inserted in black bezels.

The interior of the eCanter (Fig. 9) uses the same basic frame as current Canter models, but features a 12-inch tablet in the center of the instrument panel and a fully



Fig. 9 Interior of Mitsubishi Fuso eCanter.



Fig. 10 Mercedes-Benz Vision Van.

liquid crystal display reflecting a next-generation HMI. The gray theme with blue highlights is in line with the image of an EV, and the bright straight grain pattern decorative pattern on the upper surface of the instrument panel adds a warm accent to the interior color scheme.

3.2. Concept Vehicles outside Japan

Like the Mitsubishi Fuso eCanter, every concept vehicle exhibited at the IAA Commercial Vehicle Show in Hannover was an electric or alternative fuel vehicle. The Mercedes-Benz Vision Van (Fig. 10) is an EV van for last-mile delivery and merges with state-of-the-art network technology to embody a new and efficient delivery system. With features such as automated cargo loading via an unmanned lifting platform, load carrier control by a dispenser in the cargo area, and drone delivery within a 10 km radius, delivery operations are almost entirely automated via cloud-based control, enabling an anticipated improvement of up to 50% in delivery efficiency. The Urban eTruck EV truck concept, also from Mercedes-Benz (Fig. 11) is a heavy-duty truck for transportation in urban areas with a cruising range of 200 km on a single charge. It is expected to connect with urban distribution telematics services and make use of delivery planning, vehicle status, and other data.

Despite the differences between a van and a heavy-du-



Fig. 13 Iveco Z Truck.

ty truck, the exterior design of both vehicles has a lot in common. Mercedes-Benz has a design philosophy known as “sensual purity”, which can be summarized as “the contrast between soft, emotional lines and surfaces and the expression of advanced functionality”. The front grille turned into a display providing information to pedestrians or other passersby, the sharp and narrow LED headlamps, the rearview camera, the covering panel surfaces that have virtually no joints except around the emblem, as well as the contrast between roughness and elegance strongly exude a unique presence. That same design philosophy also manifests itself strongly in the interior of the Vision Van (Fig. 12). The cabin is enclosed by a blue trim seamlessly joined to the display, and the joystick for drive-by-wire control is the only operating device. The ultimate simplification has been applied to the space freed from the constraints of laying out equipment, boldly and directly reflecting the Mercedes-Benz design philosophy.

For its part, Iveco has unveiled the Z Truck bio-LNG heavy-duty truck concept (Fig. 13). The Z in the name comes from the Zero-impact concept encompassing the elements of zero CO₂ emissions, zero accidents, zero stress and zero waste of time for the driver, which are necessary for a sustainable transportation system. A waste heat recovery system, reduced rolling resistance and other technologies complement the bio-methane fueled next-generation LNG engine to reduce fuel consumption by up to 33%.

Attention to aerodynamics and comfort have led to a long front-to-rear exterior made even more distinctive by the prominently narrow front cab frame. The face design carries over the upward diagonal graphic seen on the Daily and Eurocargo, hinting at the next-generation identity of the Iveco brand. Gentle stairs placed behind the left front wheel with steps featuring alternating mirrored



Fig. 14 Interior of Iveco Z Truck.

broader left and right sides emphasize the ease of getting into the vehicle.

Although enhancing the working and living environment has been an important aspect of interior design in heavy-duty truck concept vehicles for some time, it has been receiving even greater attention of late. The main theme of the Z Truck interior (Fig. 14) is the pursuit of a convenient living space. When parked, the rear wall slides back 500 mm to provide extra cabin space for amenities such as a bed, shower, or kitchen, making it possible to adapt the cabin layout to its respective application during autonomous driving, when performing administrative tasks, or while resting. The interior has a white theme with blue and brown accents, with an inverse brown theme with white accents in the kitchen at the rear that clearly sets the functions of each space apart. Finally, the Z Truck symbol sent on the back of the cab follows the lines of every recurring pattern found in the grille, steps, and even the cushions on the sofa, imparting a sense of attention to quality even in the finest details.

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Body Structures

1 Cab and Chassis

1.1. Product Trends

1. 1. 1. Heavy-Duty Trucks

Table 1 shows the heavy-duty trucks announced in Japan in 2016, and the main product technology trends.

This class features a greater range of vehicles from all manufacturers that exceed the 2015 fuel economy standards by 5%, with extensive efforts applied to functions that improve fuel efficiency or safety performance.

The Giga lineup was extended with the addition of a tractor equipped with the newly developed 6NX1 engine and 9-speed transmission, while keeping the pre-collision braking system (which complements the collision mitigation braking function with a collision avoidance support function) that had been made standard equipment to enhance safety.

In the CNG vehicle category, a 3-axle cargo short cab model and a 4-axle model that ensures greater loading capacity have been added to the lineup.

In the over 12 t vehicle weight class, the Profia now exceeds the 2015 fuel efficiency standard by 5% thanks to an engine series and transmission featuring the latest fuel-efficient technology supplemented with a diverse array of fuel-efficient driving support systems.

The collision mitigation braking system was upgraded with a collision avoidance support function. At the same time, the accuracy of the driver monitoring and lane departure warning systems has been enhanced, and those systems were made standard equipment. Furthermore, the safety functions were strengthened by coordinating driver monitoring and vehicle drift warning with the PCS system to apply cautionary braking and induce drivers to keep their focus on the road ahead.

Turning to markets outside Japan, UD Trucks has made its first foray in the Middle East region, selling the

Quester, launched in August 2013 as part of the strategy for Asia, in Qatar, Saudi Arabia, and Oman. It also plans to gradually enter other Middle East markets.

Mitsubishi Fuso Truck and Bus Corporation has announced it would introduce the FJ and TV models to the Middle East and African markets.

1.1.2. Medium-Duty Trucks

Table 2 shows the medium-duty trucks announced in Japan in 2016, and the product technology trends.

As with heavy-duty vehicles, this class also features, in Japan as well, a greater range of vehicles from all manufacturers that exceed the 2015 fuel economy standards by 5%, with extensive efforts applied to functions that improve fuel efficiency or safety performance.

In the Forward line, the F-Cargo Wing completed vehicle (GVW of less than 8 t) now offers the previously optional Advanced View Assist Technology (VAT) and Isuzu Electronic Stability Control (IESC) as standard equipment.

At the same time, some models (GVW of 11 t, 14.5 t, and 16 t) have exceeded the 2015 fuel efficiency standard by 5%.

UD Trucks has reached a basic agreement to receive OEM supplied medium-duty trucks manufactured by Isuzu, and is schedule to start receiving new vehicles for the Japanese market in 2017.

A vehicle stability control (VSC) system and discharge headlamps have been made standard equipment on the Ranger.

The Hino Eco Run system, which suppresses wasteful fuel consumption and supports exemplary fuel-efficient driving, has been made standard equipment on all vehicles without a 5-speed automatic transmission.

In this class, Mitsubishi Fuso Truck and Bus Corporation has also announced the introduction of the FA and FT models to the Middle East and South American markets.

Table 1 Main product technology trends for heavy-duty trucks in 2016.

Month of launch	Truck model name	Main characteristics
February	Quon	Dedicated snow plow vehicle exhibited at Yuki Mirai 2016 in Morioka.
April	Giga	Additional model (tractor) established.
June	FJ	Quester introduced in Middle East.
July	Quester	Launched in Qatar, Saudi Arabia, and Oman.
September	TV	Launched in Kenya.
November	FJ	Reintroduced in the Uruguay market.
	Giga	Additional model established in CNG vehicle lineup.
December	FJ	Sales started in Algeria.

Table 2 Main product technology trends for medium-duty trucks in 2016.

Month of launch	Truck model name	Main characteristics
February	Isuzu medium-duty truck	Announced OEM supply to UD Trucks.
June	FA/FI	Quester introduced in Middle East.
July	FA/FI	Introduced in Paraguay.
November	Forward	Partially refined. • Safety systems installed
	FA	Reintroduced in the Uruguay market.

kets, manifesting its intention to expand outside Japan.

1.1.3. Light-Duty Trucks

Table 3 shows the light-duty trucks announced in Japan in 2016, and the product technology trends.

Vehicles with an expanded array of safety systems and fuel efficiency improvements have been introduced in the Japanese market for this class.

The hybrid versions of the Elf and Dutro, in particular, stood out as vehicles that exceeded the 2015 fuel efficiency standard by 15%.

These latest refinements to the Dutro focused on offering fully-featured safety systems with the establishment of a new model featuring a PCS collision mitigation braking system and a lane departure warning system as standard equipment to complement the already standard vehicle stability control (VSC) and electric parking brake systems.

The newly added PCS system includes a monocular camera in the top part of the front windshield in addition to the millimeter wave radar set in the center of the front bumper, allowing it to detect pedestrians. The camera also provides support for avoiding or mitigating collisions with non-moving objects, slow-moving preceding vehicles, or pedestrians, and functions as a lane recognition sensor for the lane departure warning system. The

Table 3 Main product technology trends for light-duty trucks in 2016.

Month of launch	Truck model name	Main characteristics
January	Canter	Introduced in Iran.
		Exceeded heavy-duty vehicle fuel economy standards by 10 %.
April	Canter E-Cell	Start of 1-year fleet test in Stuttgart.
June	Kazet	Launch of SK/SF/RK.
July	Atlas	Partially refined. • Start-stop system made standard equipment.
November	Canter	Reintroduced in the Uruguay market.

Table 4 Main product technology trends for mini-vehicle trucks in 2016.

Month of launch	Truck model name	Main characteristics
February	Clipper	Partially refined. • Safety systems made standard equipment.
May	Hijet	Colored aluminum medium-temperature refrigerator truck added to the special purpose vehicle series.
November	Hi-Max	Sales started in Indonesia.
	Every	Established a 4 AT model.

design of the front bumper on vehicles with a standard width cab was changed in conjunction with the installation of the PCS system.

The 4P10 engine, already reputed for its fuel-efficient performance, was further improved in that respect in the 2016 Canter models, and vehicles with a maximum carrying capacity of 3 tons equipped with a start-stop system now exceed the 2015 fuel efficiency standard by +10%. All other vehicles exceed the same standard by +5%.

The interior design of the cockpit adopts a restrained black and silver color theme, providing a premium feel and reducing fatigue.

On the EV front, five Canter E-Cell light-duty electric trucks were provided to the city of Stuttgart and logistics company Hermes, to demonstrate electric truck technology in a one year fleet test.

In addition, the introduction of the Canter to the Middle East and South American markets has also been announced for the light-duty truck class.

1.1.4. Mini-Vehicle Trucks

Table 4 shows the mini-vehicle trucks announced in Japan in 2016, and the product technology trends.

Although this class has benefited from improvements in fuel efficiency and practicality, there has been no significant activity since the complete redesign of the Hijet Truck and Carry.

To ensure as large a loading as possible within the limits allowed for mini-vehicles, manufacturers are striv-

ing to raise carrying capacity through approaches such as setting a scoop in an area that does not intrude on the cabin (the bottom of the back panel) or securing space in the longitudinal direction.

Outside Japan, the Daihatsu subsidiary in Indonesia (Astra Daihatsu Motor) has launched the Hi-Max, a new light-duty commercial truck model exclusive to the Indonesian market. Capitalizing on the mini-vehicle technology and know-how cultivated in Japan by Daihatsu, the Hi-Max incorporates local needs (e.g., carrying capacity, rough road performance, and fuel efficiency), making it a mini-vehicle truck that opens up new markets.

The Minicab Truck is an OEM procurement from Suzuki, and the Pixis Truck is an OEM procurement from Daihatsu.

1.1.5. Trucks Manufactured outside Japan

Since the Euro 6 and safety systems major regulations have come into effect, no significant new models other than the complete redesign by Scania have been introduced.

At the International Motor Show Germany in Hanover, all manufacturers prioritized fuel economy and focused on enhancing elements such as the power train system or aerodynamics.

With respect to concept vehicles, there was an increase in heavy-duty EV exhibits by Daimler/MAN, and in light-duty EV exhibits aimed at eventual mass production by Fuso, evoking the continued high level of interest in the environment.

The second priority put forth by all manufacturers was connectivity. Efforts are focused on offering constant online vehicle monitoring and operational support such as offering information on optimal maintenance timing.

1.2. Interior Comfort

Cabins in Japanese trucks must be packed within the regulatory limit, leading to the prioritizing space at the trailer end. However, since truck drivers who spend the majority of the day in the truck cabin are seeking improvements in comfort and functionality, using the limited available space as effectively as possible is critical.

In terms of style, making the form as square as possible, along with providing a wide door opening and a tall roof make it possible to get in or out of the truck with a minimum of crouching, and efforts to improve mobility are being pursued in conjunction with those to reduce fatigue.

For heavy-duty vehicles that involved getting changed

in the cabin or moving a lot, such actions are facilitated by offering high-roof models, and measures such as setting round curtains for prolonged rest periods and adopting fully flat seat layouts also make effective use of cabin space.

As shown by the introduction of vehicles that offer improved cabin mobility through the adoption of retractable parking brake and instrument panel shift levers, manufacturers are finding various ways of improving comfort.

1.3. Operability

With the rapid aging of Japanese society, 26% of the population is now 65 or older. The number of women and older drivers has been rising, as have long driving hours, making it crucial to further simplify driving operations and consider ways to reduce driver fatigue.

Driving is being made easier by systems such as automatic transmissions, two-pedal manual transmissions and the expanded adoption of hill-start assist. Similarly, instrument panel designs that group switches by frequency of use or importance and turn the operated face toward the driver, and the adoption of steering wheel switches aim to improve ease-of-use and reduce driver fatigue.

In addition, vehicles used in service operations involving frequent ingress and egress are improving operability through the use of smart keys that make it possible lock and unlock the doors simply by touching them.

1.4. Noise and Vibration

Measures actively pursued to improve product transport quality enhancing frame rigidity and engine mounts, as well as installing chassis air suspensions. Ride comfort is also being enhanced through cab air suspension and suspension seat improvements designed to reduce fatigue and enhance comfort during prolonged driving.

Reducing noise in the cabin involves the installation of, soundproof covers over the noise sources represented by the engine and transmission in the engine compartment, as well as the optimal placement of sound-absorbing material inside the cabin.

For exterior, which determines the style of the cab, the shape of parts is being optimized (made flush, for example) to prevent wind noise. At the same time, improvements to make cabins even quieter through various methods, including reducing cabin booming or other noises by leveraging cavity resonance analysis at low frequencies.

1.5. Safety

Safety systems can be broadly categorized into systems that minimize damage in the event of an accident (passive safety), and those designed to prevent accidents (active safety).

The earliest passive safety measures initiatives involved strengthening the vehicle body structure through means such as door waist reinforcements or reinforcing the underframe to secure a safe space in the event of a collision through high rigidity cabs exhibiting minimal deformation.

Restraint systems such as seat belts with load limiters, SRS airbags and energy-absorbing steering wheels are used to mitigate impacts on occupants.

In addition, a feature unique to trucks is the adoption of front and rear underrun protection system designed to prevent passenger cars from sliding under the cab in the event of a collision.

Manufacturers are also stepping up the adoption of active safety systems aimed at preventing accidents from occurring.

With improvements in vision assist technology (double detection using a millimeter wave radar and camera) leading to more accurate recognition of the state of the preceding vehicle, the performance of collision avoidance and collision mitigation braking systems that warn the driver and apply the brakes has also improved.

Lane departure warning systems that prevent deviation from the lane, and electronic stability control systems that control skids and rollovers, are also becoming more widespread.

1.6. Aerodynamic Characteristics

Better aerodynamic characteristics not only contribute significantly to reducing fuel consumption, they also decrease wind noise and mitigate the accumulation of dirt on the vehicle body, and manufacturers are proactively pursuing various initiatives in this area.

The cabs, as the first part to be hit by the wind, are

designed with narrower front faces that rectify the flow of air on the vehicle corners. Innovations applied to the shape of the side body reduce air flow resistance along the sides of the rear body, raising aerodynamic performance.

In terms of styles, innovative approaches enable larger front grille openings to offer higher cooling performance without sacrificing aerodynamic performance.

1.7. Corrosion Prevention

Each upgrade to a model involves adopting anti-rust steel sheets at effective locations, as well as the use of plastics.

Specifically, anti-rust steel sheets are applied to 100% of the surface area of the upper body of mini-vehicle trucks, and the switch to plastic for frontal parts prevents rust resulting from flying rocks. Anti-rust steel sheets are also used in the frame, and are complemented by the optimal application of undercoating or paint sealant on the underbody, improving durability for vehicles used in environments such as snowy or muddy roads.

2 Rear Body

As logistics become more and more diversified, constant efforts are being made to reduce weight and increase carrying capacity amidst calls to further improve freight handling and transport efficiency.

The use of new materials such as low density urethane foam is providing further weight reduction, and antibacterial materials are also being adopted in vehicles designed to transport foods.

Disassembly manuals provide explanations on disassembling the vehicles to make them easier to recycle.

Beyond transportation tasks, a vehicle with a rear body designed exclusively for the task of changing airplane tires has also been developed.

References

- (1) Publicity materials, catalogues from each company