

MOTORCYCLES

Overall Trends

1 Introduction

The number of motorcycles produced in Japan in 2016 increased 7% compared to that in 2015 to a total of 561,000 vehicles. Motorcycle exports from Japan increased by 3% compared to the previous year to reach 429,000 vehicles. Domestic shipments of motorcycles increased temporarily in 2013, but they have continued to decline since 2014, and in 2016 they declined 9% compared to the previous year to 338,000 vehicles.

2 Production and Demand Trends

2.1. Production

Fig. 1 shows that the number of motorcycles produced in Japan in 2016 increased 7% compared to 2015 to a total of 561,000 vehicles despite the temporary decrease in the first half of the year due to the impact of the Kumamoto earthquake in April. This was due to the fact that motorcycle exports increased 3% compared to the previous year up to 429,000 vehicles thanks to an increase in demand in Europe, even though Japanese domestic demand decreased by 9% from the previous year to 338,000 vehicles.

2.2. Demand in Japan

Fig. 2 shows the demand for motorcycles in Japan broken down by engine displacement. Even though demand for class 2 motor-driven cycles increased 7% compared to the previous year to 101,000 vehicles, demand for all other classes decreased. Consequently, overall demand for motorcycles in Japan decreased by 9% from the previous year to 338,000 vehicles.

2.2.1. 50 cm³ displacement motorcycles (class 1 motor-driven cycles)

In 2016, demand for this class decreased by 16% from the previous year to 162,000 vehicles, the largest decrease in the last five years.

2.2.2. 51 to 125 cm³ displacement motorcycles (class 2 motor-driven cycles)

In 2016 the demand for this class increased 7% compared to the previous year to 101,000 vehicles.

2.2.3. 126 to 250 cm³ displacement motorcycles (mini-sized motorcycles)

In 2015 the demand for this class decreased by 9% compared to the previous year to 49,000 vehicles and in 2016 it further decreased by a drastic 17% compared to the previous year, to 40,000 vehicles.

2.2.4. 251 cm³ or higher displacement motorcycles (small-sized motorcycles)

In 2016 the demand for this class decreased by 4%

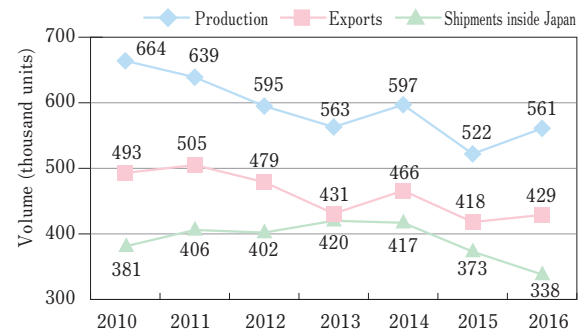


Fig. 1 Trends for production, exports, and shipments inside Japan.

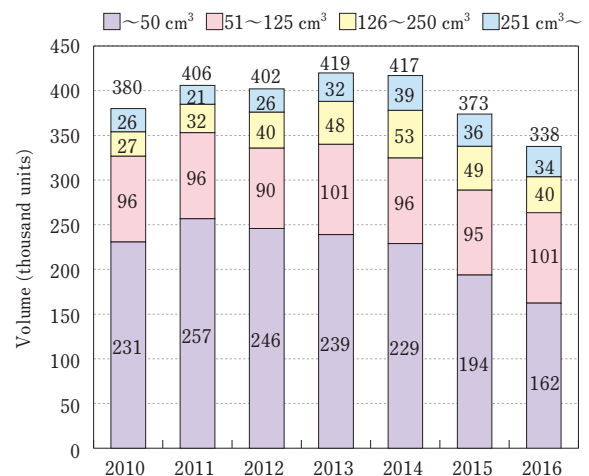


Fig. 2 Shipments inside Japan based on displacement.

compared to the previous year to 34,000 vehicles.

2.3. Exports

Fig. 3 shows that Japanese motorcycle exports in 2016 increased by 3% compared to the previous year to 429,000 vehicles. However, this increase is attributed to a last-minute surge in demand in Europe due to the expansion of exhaust emissions regulations to existing vehicles beginning on January 1, 2017, and therefore is unlikely to represent a recovery in motorcycle exports as a whole.

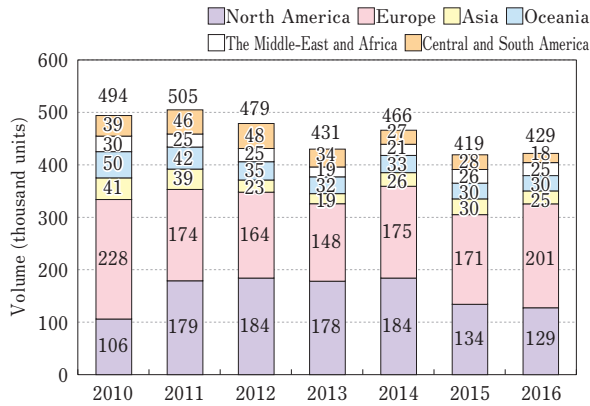


Fig. 3 Shipments per market.

2.3.1. North America

In 2016 motorcycle exports to North America decreased 3% compared to the previous year to 129,000 vehicles.

2.3.2. Europe

In 2016 the demand for Japanese motorcycles in Europe was driven by a last-minute surge due to the expansion of exhaust emissions regulations to existing vehicles beginning on January 1, 2017. Consequently, exports to Europe increased by 18% compared to the previous year to 201,000 vehicles.

2.3.3. Asia

In 2016, exports to Asia decreased by 14% compared to the previous year down to 25,000 vehicles.

2.3.4. Oceania

In 2016, exports to Oceania essentially remained the same as the previous year at 30,000 vehicles for a change of $\pm 0\%$.

2.3.5. The Middle-East and Africa

In 2016, exports to the Middle East and Africa decreased by 3% compared to the previous year down to 25,000 vehicles.

Table 1 Details of main new motorcycles launched in 2016.

Month of launch	New	Modified	Manufacturers	Name of model	Characteristics
January			Yamaha	TMAX530 ABS/IRON MAX	Water-cooled/4 -stroke/V2 /DOHC/4 -valve/FI
			Honda	NC750X /Type LD, NC750X ABS/Type LD	Water-cooled/4 -stroke/V2 /DOHC/4 -valve/FI
			Honda	NC750X DCT/Type LD, NC750X DCT Epackage	Water-cooled/4 -stroke/V2 /DOHC/4 -valve/FI
			Suzuki	DR-Z50	Air-cooled/4 -stroke/single-cylinder/OHC/Cab
			Kawasaki	ESTRELLA/ESTRELLA SPECIAL EDITION	Air-cooled/4 -stroke/single-cylinder/SOHC/2 -valve/FI
February			Yamaha	YZF-R25 /ABS	Water-cooled/4 -stroke/V2 /DOHC/4 -valve/FI
			Yamaha	YZF-R3 ABS	Water-cooled/4 -stroke/V2 /DOHC/4 -valve/FI
			Yamaha	BW'S 125	Air-cooled/4 -stroke/single-cylinder/SOHC/4 -valve/FI
			Yamaha	BOLT/R-SPEC/R-SPEC ABS	Air-cooled/4 -stroke/2 -cylinder/SOHC/4 -valve/FI
			Yamaha	SR400	Air-cooled/4 -stroke/single-cylinder/SOHC/2 -valve/FI
			Yamaha	MT-09	Water-cooled/4 -stroke/3 -cylinder/DOHC/4 -valve/FI
			Yamaha	Vino Boy / Vino Girl	Water-cooled/4 -stroke/single-cylinder/SOHC/3 -valve/FI
			Yamaha	VOX DX	Water-cooled/4 -stroke/single-cylinder/SOHC/3 -valve/FI
			Yamaha	BW'S	Water-cooled/4 -stroke/single-cylinder/SOHC/3 -valve/FI
			Yamaha	MT-07 /ABS	Water-cooled/4 -stroke/V2 /DOHC/4 -valve/FI
			Honda	Monkey	Air-cooled/4 -stroke/single-cylinder/OHC/2 -valve/FI
			Honda	Tact, Tact Basic	Water-cooled/4 -stroke/single-cylinder/OHC/2 -valve/FI
			Honda	NC750 S/ABS	Water-cooled/4 -stroke/2 -cylinder/OHC/4 -valve/FI
			Honda	NC750 S ABS DCT	Air-cooled/4 -stroke/2 -cylinder/OHC/4 -valve/FI
			Honda	400 X/ABS	Water-cooled/4 -stroke/V2 /DOHC/4 -valve/FI
			Honda	Dunk	Water-cooled/4 -stroke/single-cylinder/OHC/2 -valve/FI
			Honda	CRF1000 L Africa Twin	Water-cooled/4 -stroke/2 -cylinder/OHC/4 -valve/FI
			Honda	CRF1000 L Africa Twin DCT	Water-cooled/4 -stroke/2 -cylinder/OHC/4 -valve/FI
			Honda	CBR400 R/ABS	Water-cooled/4 -stroke/V2 /DOHC/4 -valve/FI
			Honda	PCX	Water-cooled/4 -stroke/single-cylinder/OHC/2 -valve/FI
		Suzuki	Hayabusa	Water-cooled/4 -stroke/4 -cylinder/DOHC/4 -valve/FI	
		Suzuki	Bandit 1250 S	Water-cooled/4 -stroke/4 -cylinder/DOHC/4 -valve/FI	
		Suzuki	Bandit 1250 F	Water-cooled/4 -stroke/4 -cylinder/DOHC/4 -valve/FI	
		Kawasaki	Ninja ZX-6 R (track-only model)	Water-cooled/4 -stroke/4 -cylinder/DOHC/4 -valve/FI	
		Kawasaki	ZRX1200 DAEG Kawasaki authorized dealer special spec vehicle	Water-cooled/4 -stroke/4 -cylinder/DOHC/4 -valve/FI	
		Kawasaki	Z250 ABS	Water-cooled/4 -stroke/V2 /DOHC/4 -valve/FI	

Table 1 Details of main new motorcycles launched in 2016 (Cont.)

March	○	○	Yamaha	MT-09 ABS	Water-cooled/4 -stroke/3 -cylinder/DOHC/4 -valve/FI
		○	Yamaha	DragStar 250	Air-cooled/4 -stroke/V2 /SOHC/2 -valve /FI
		○	Yamaha	DragStar 400 , DragStar 400 Classic	Water-cooled/4 -stroke/V2 /SOHC/2 -valve /FI
		○	Yamaha	Jog Special Edition	Water-cooled/4 -stroke/single-cylinder/SOHC/3 -valve/FI
		○	Yamaha	NMAX125	Water-cooled/4 -stroke/single-cylinder/SOHC/4 -valve/FI
		○	Honda	special-order color scheme	Water-cooled/4 -stroke/2 -cylinder/OHC/4 -valve/FI
		○	Honda	special-order color scheme	Water-cooled/4 -stroke/2 -cylinder/OHC/4 -valve/FI
		○	Honda	CB400 SUPER FOUR/ABS, CB400SF ABS Epackage	Water-cooled/4 -stroke/4 -cylinder/DOHC/4 -valve/FI
		○	Honda	CB400 SUPER BOL'DOR/ABS, CB400SB ABS Epackage	Water-cooled/4 -stroke/4 -cylinder/DOHC/4 -valve/FI
		○	Honda	CB1300 SUPER FOUR, CB1300SF Epackage	Water-cooled/4 -stroke/4 -cylinder/DOHC/4 -valve/FI
		○	Honda	CB1300 SUPER BOL'DOR, CB1300SB Epackage	Water-cooled/4 -stroke/4 -cylinder/DOHC/4 -valve/FI
		○	Kawasaki	Z250SL	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
		April	○	○	Yamaha
○	Yamaha			XSR900	Water-cooled/4 -stroke/3 -cylinder/DOHC/4 -valve/FI
○	Honda			Giorno Kumamon Version	Water-cooled/4 -stroke/single-cylinder/OHC/2 -valve/FI
○	Honda			CB400SF ABS SPECIAL EDITION	Water-cooled/4 -stroke/4 -cylinder/DOHC/4 -valve/FI
○	Honda			CB400SB ABS SPECIAL EDITION	Water-cooled/4 -stroke/4 -cylinder/DOHC/4 -valve/FI
○	Honda			CB1300SF Epackage SPECIAL EDITION	Water-cooled/4 -stroke/4 -cylinder/DOHC/4 -valve/FI
○	Honda			CB1300SB Epackage SPECIAL EDITION	Water-cooled/4 -stroke/4 -cylinder/DOHC/4 -valve/FI
○	Honda			LEAD125	Water-cooled/4 -stroke/single-cylinder/OHC/2 -valve/FI
○	Honda			PCX150, PCX150 SPECIAL EDITION	Water-cooled/4 -stroke/single-cylinder/OHC/2 -valve/FI
○	Honda			PCX SPECIAL EDITION	Water-cooled/4 -stroke/single-cylinder/OHC/2 -valve/FI
○	Suzuki			Burgman 200	Water-cooled/4 -stroke/single-cylinder/SOHC/4 -valve/FI
○	Suzuki			Address 110	Air-cooled/4 -stroke/single-cylinder/SOHC/2 -valve/FI
○	Kawasaki			Z125 PRO	Air-cooled/4 -stroke/single-cylinder/SOHC/2 -valve/FI
May	○	○	Kawasaki	NINJA250SL, NINJA250SL KRT EDITION	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
		○	Kawasaki	KLX250 FINAL EDITION	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
		○	Kawasaki	D-TRACKER X FINAL EDITION	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
June	○	Honda	GROM	Air-cooled/4 -stroke/single-cylinder/OHC/2 -valve/FI	
July	○	○	Yamaha	Vino NAVY STYLE	Water-cooled/4 -stroke/single-cylinder/SOHC/3 -valve/FI
		○	Yamaha	YZF-R25 MOVISTAR YAMAHA MotoGP EDITION	Water-cooled/4 -stroke/V2 /DOHC/4 -valve/FI
		○	Yamaha	FJR1300	Water-cooled/4 -stroke/4 -cylinder/DOHC/4 -valve/FI
		○	Kawasaki	KX65	Water-cooled/2 -stroke/single-cylinder/Cab
		○	Kawasaki	KX85 /II	Water-cooled/2 -stroke/single-cylinder/Cab
		○	Kawasaki	KX100	Water-cooled/2 -stroke/single-cylinder/Cab
		○	Kawasaki	KLX110L	Air-cooled/4 -stroke/single-cylinder/SOHC/2 -valve/Cab
		○	Kawasaki	KX250F	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
		○	Kawasaki	KX450F	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
		○	Kawasaki	W800 FINAL EDITION	Air-cooled/4 -stroke/2 -cylinder/SOHC/4 -valve/FI
August	○	○	Yamaha	PW50	Air-cooled/2 -stroke/single-cylinder/crankcase reed valve/Cab
		○	Yamaha	YZ85 /LW	Water-cooled/2 -stroke/single-cylinder/reed valve/Cab
		○	Yamaha	YZ125	Water-cooled/2 -stroke/single-cylinder/reed valve/Cab
		○	Yamaha	YZ250 /X	Water-cooled/2 -stroke/single-cylinder/reed valve/Cab
		○	Yamaha	YZ250F/FX	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
		○	Yamaha	YZ450F/FX	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
		○	Suzuki	SV650 ABS	Water-cooled/4 -stroke/V2 /DOHC/4 -valve/FI
September	○	○	Yamaha	WR250R	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
		○	Yamaha	WR250X	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
		○	Suzuki	RM-Z250	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
		○	Suzuki	RM-Z450	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
		○	Kawasaki	NINJA250 /ABS SE/ABS KRT	Water-cooled/4 -stroke/V2 /DOHC/4 -valve/FI
		○	Kawasaki	ZRX1200DAEG FINAL EDITION	Water-cooled/4 -stroke/4 -cylinder/DOHC/4 -valve/FI
October	○	○	Yamaha	YZ125X	Water-cooled/2 -stroke/single-cylinder/reed valve/Cab
		○	Honda	NC750L(Instructional vehicle spec.)	Water-cooled/4 -stroke/2 -cylinder/OHC/4 -valve/FI
		○	Honda	VTR/Type LD, VTR SPECIAL EDITION	Water-cooled/4 -stroke/V2 /DOHC/4 -valve/FI
		○	Honda	VTR-F	Water-cooled/4 -stroke/V2 /DOHC/4 -valve/FI
		○	Honda	GOLD WING	Water-cooled/4 -stroke/horizontally opposed 6-cylinder/OHC/2 -valve/FI
		○	Kawasaki	NINJA400	Water-cooled/4 -stroke/V2 /DOHC/4 -valve/FI
November	○	○	Honda	CRF450R	Water-cooled/4 -stroke/single-cylinder/OHC/4 -valve/FI
		○	Kawasaki	Z125 PRO KRT EDITION	Air-cooled/4 -stroke/single-cylinder/SOHC/2 -valve/FI
		○	Kawasaki	NINJA250 WINTER TEST EDITION	Water-cooled/4 -stroke/V2 /DOHC/4 -valve/FI
December	○	○	Yamaha	XSR900	Water-cooled/4 -stroke/3 -cylinder/DOHC/4 -valve/FI
		○	Yamaha	MT-25	Water-cooled/4 -stroke/V2 /DOHC/4 -valve/FI
		○	Yamaha	MT-03	Water-cooled/4 -stroke/V2 /DOHC/4 -valve/FI
		○	Honda	CRF450RX	Water-cooled/4 -stroke/single-cylinder/OHC/4 -valve/FI



Fig. 1 External appearance of CBR250RR.



Fig. 2 External appearance of CBR250RR engine



Fig. 3 External appearance of CBR150R.

normal driving conditions, it has been given wide-ranging output characteristics that can also handle more aggressive circuit racing. The bore and stroke are 62.0 mm by 41.3 mm. Weight reduction technology and friction reduction technology were applied to the aluminum cylinder sleeves and pistons. Highly efficient air intake was pursued in addition to a high compression ratio of 11.5, large diameter valves and a large throttle bore, to help provide high power output. The muffler has an innovative design with two pipes attached on the right side of the vehicle. This motorcycle also features the first throttle-by-wire system in a 250 cm³-class engine. It is also equipped with three different riding modes.

(b) CBR150R (overseas model) (Fig. 3):

This model features a newly developed water-cooled, DOHC four-valve engine with a single cylinder and 149



Fig. 4 External appearance of Tricity 155



Fig. 5 External appearance of XSR900

cm³ of displacement. The compression ratio was changed from 11.1 to 11.3, a roller bearing rocker arm has been adopted in place of a direct-striking tappet and it produces 12.6kW at 9,000 rpm and 13.7 Nm at 7,000 rpm.

1. 2. 2. Yamaha Motor Co., Ltd.

(a) Tricity 155 (overseas model) (Fig. 4):

This model is equipped with a new engine designed with a focus on high efficiency combustion, high-level cooling performance, and reduced power loss. It has a water-cooled, four-stroke, SOHC, 155 cm³ single-cylinder, four-valve engine with FI and a CVT.

This engine was developed and tuned according to Yamaha's Blue Core concept that aspires to achieve both a high level of "riding enjoyment" and "fuel efficiency / environmental performance". An aluminum forged piston, an all-aluminum DiASil cylinder, the application of an offset cylinder, as well as variable valve actuation (VVA) technology were used to achieve high efficiency combustion.

(b) XSR900 (Fig. 5):

Based on the 845 cm³, inline three-cylinder lightweight engine equipped on the MT-09, the engine in this model also features a traction control system (TCS) and an assist and slipper (A&S) clutch. In addition to the smooth torque characteristics and a feeling of growth in the high-speed range, the engine draws on an abundant amount of torque and also realizes smooth engine pick-up. When the TCS detects signs of rear wheel spin dur-



Fig. 6 External appearance of SV650



Fig. 8 External appearance of Access 125



Fig. 7 External appearance of Satria 150



Fig. 9 External appearance of Ninja ZX-10R

ing start-off from a stopped state or acceleration the Yamaha Chip-controlled Throttle (YCC-T) and Yamaha electronic-controlled throttle provide integrated control of the (a) ignition timing, (b) amount of fuel injection, and (c) degree of throttle valve opening. This supports smooth acceleration and running. In addition, the A&S clutch contributes to nimble handling in urban areas through gentler vehicle body behavior during deceleration and a lighter operating load on the rider.

1. 2. 3. Suzuki Motor Corporation

(a) SV650 (Fig. 6):

The engine in this model is equipped with dual spark plugs and Suzuki Dual Throttle Valve (SDTV) which, along with the unique beat of the V-twin engine caused by irregular interval combustion and high combustion efficiency, provides this motorcycle with smooth power output characteristics over the entire speed range, while also achieving an excellent fuel consumption of 26.6 km/L under the WMTC test cycle. The engine also has a low-rpm assist function to mitigate the drop in engine speed during starts off as well as realize smoother acceleration.

(b) Satria 150 (overseas model) (Fig. 7):

The engine in this model has inherited the established bore-stroke ratio of 62.0 mm by 48.8 mm from the previous model. However, the compression ratio was increased from 10.2 in the previous model to 11.5 in the new one through water cooling, narrowing the valve pinching an-

gle, increasing the diameter of the valve, and optimizing the combustion chamber, an 11% increase that realizes higher power output. A large-capacity air cleaner box 24% larger than in the previous model has also been installed. A fuel injection system equipped with 6 sensors has been adopted and so it is now possible to perform optimal control under all riding and weather conditions, which has made major contributions to the improvement of power output and fuel efficiency.

(c) Access 125 (overseas model) (Fig. 8):

This model is equipped with an all-new engine that incorporates the Suzuki Eco Performance (SEP) concept. The bore and stroke of 53.5 mm by 55.2 mm in the previous engine, were changed to 52.5 mm by 57.4 mm in the new model. A newly developed shape for the combustion chamber, called M-Squish, has been adopted and the shapes of the air intake ports were also reviewed. The compression ratio has been increased from 9.6 in the conventional model to 10.3 in the new model, which is 7% higher, and as a result an engine that has lower fuel consumption and higher power output in comparison to the previous model was realized. A thorough review of the engine layout enabled a massive reduction in weight from 37.8 kg down to 31.8 kg, allowing an incredible 119% improvement in fuel efficiency compared to the previous model.

1. 2. 4. Kawasaki

Ninja ZX-10R (overseas model) (Fig. 9):

This model is equipped with a 998 cm³, 16-valve,

DOHC inline four-cylinder engine. The bore and stroke are 76 mm by 55 mm and the compression ratio is 13.0. This engine is also equipped with a lightweight crankshaft and a counter balancer. The pistons have also been reduced in weight, and the air intake and exhaust ports have been polished. The shape of the combustion chamber was changed and the diameter of the head of the titanium exhaust valve was enlarged. Changes made to the camshaft profile of the air intake and exhaust improved the power at high engine speeds. The adoption of long-reach spark plugs made it possible to enlarge the coolant passage to the cylinder heads, which in turn contributed to improved cooling performance and realized higher overall engine performance. The adoption of iridium and platinum electrodes contributed to the improvement of ignition performance and durability. The capacity of the air box was increased by 25%, and the engine is equipped with a ride-by-wire-type throttle body. Other features include the S-KTCR traction control system, KLCM launch control, and KEBC engine brake control. The transmission is a close-ratio cassette-type gearbox.



Fig. 10 External appearance of G 310 R

2 Trends Outside Japan

2.1. Trends of Each Manufacturer

BMW Motorrad

G310R (Fig. 10):

This model is equipped with a 313 cm³, four-stroke, water-cooled, single-cylinder engine. The bore and stroke are 80.0 mm by 62.1 mm and the compression ratio 10.6. It has a maximum output of 25 kW at 9,500 rpm and 28 Nm at 7,500 rpm. This is a front intake and rear exhaust engine and the cylinder has been tilted toward the rear in an unusual fashion. The cylinder head has also been rotated by 180 degrees, lowering the center of gravity and shifting it toward the front wheel. These changes make the G310R a more agile and easier to control motorcycle.

3 Research and Development Trends

Europe and Japan have already begun preparations to

bring vehicles into compliance with the Euro 5 exhaust emission regulations that will apply to all new models in 2020. The differences between these regulations and the Euro 4 regulations include more stringent exhaust emissions regulation values, a review of the endurance travel range, more stringent regulation values for fuel evaporative emissions, and enhanced OBD (Stage 2: detection of part and system degradation and detection of decline in torque on the basis of exhaust emissions threshold diagnosis). The application of variable valve mechanisms to large-sized motorcycle models is expected to enable compliance with exhaust emission regulations, improve fuel efficiency, and promote improved driving performance. In smaller models progress in developing less expensive variable valve mechanisms is likely to follow other engine improvements.

Moving forward it is expected that the research and development of motorcycles equipped with superchargers, hybrid motorcycles that are similar to hybrid cars, and also fully electric-powered motorcycles will all continue to advance.

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- (5) BMW Motorrad Japan, <http://www.bmw-motorrad.jp/>

Design Trends

This section looks back on the motorcycle design trends observed in 2016 based on the vehicles exhibited at the INTERMOT 2016 motorcycle fair held in Cologne, Germany and at the EICMA 2016 motorcycle show in

Milan, Italy.

INTERMOT 2016 was held from October 4th to 9th, featured 1,133 exhibitors, and was attended by approximately 220,000 visitors. EICMA 2016 was held from No-

vember 8th to 13th, featured 1,443 exhibitors, and was attended by approximately 680,000 visitors. As these two events are some of the largest international motorcycle shows in Europe, they are also often used by manufacturers to present their next generation of mass-production vehicles, mules, and concept vehicles, and gauge the reaction of the marketplace. Consequently, shows such as these can be described as essential to understanding current trends at motorcycle manufacturers, as well as the future of motorcycle designs.

1 Responding to Diversifying Values —

The products (designs) created until now are considered the result of manufacturers trying to surpass one another in terms of how much personality and originality they can muster within the larger flow of motorcycle design trends. More recently, however, and particularly since 2014, this flow of major design trends has diminished, and manufacturers are now focusing on motorcycle design that expresses as much individuality and distinctiveness as possible. This is likely a response to changes in user preferences and values, as well as the growing diversity of consumers.

In the past, it was thought that the longing for, and appeal of, motorcycles stemmed from the acceleration performance, cornering speed, and maximum speed made possible by the latest technologies, as represented by models in the super sports category. However, the performance level of the modern super sports model far exceeds what an average user can handle, and similar motorcycles can no longer be fully handled without support from various electronic devices. The high prices of these models and the expensive insurance premiums they require are also a factor, but the year on year decline in the number of super sports category models sold suggests that many motorcycle users also feel that such models are not for them. While there is still a certain number of motorcycle users who continue to seek the highest levels of performance, the great majority of other motorcycle users have far more diverse demands and may purchase motorcycles to show off, or just as a means to enjoy their free time.

The realization that larger motorcycles are no longer necessary for everyday life seems particularly prominent in developed countries such as Europe, North America, and Japan. Purely in terms of everyday life convenience, four-wheeled vehicles have overwhelming advantages



Fig. 1 Honda RC213V-S

over motorcycles. Automobiles can carry more luggage. They protect occupants from the rain and wind. Air conditioning keep occupants from getting too sweaty or cold. (Motorcycles do, however, make commuting easier when in bad traffic jams.) Moreover, motorcycles are often more expensive than automobiles.

Given these circumstances, what is the value of a motorcycle? Motorcycles offer a feeling of exhilaration and agility that cannot be matched by automobiles, as well as the feeling of satisfaction that comes from managing the danger of an unsteady vehicle and controlling it on your own. Owning a vehicle different from that of others provides a sense of self-satisfaction. It also serves as a means of self-expression. These may be the requirements motorcycles must satisfy these days as primarily hobby-oriented instruments. The design of motorcycles is changing from one that appeals to general consumers to one that resonates strongly with specific individuals. This appears to be the new age motorcycle design is entering.

The number of super sports models of motorcycles sold is decreasing, but for many manufacturers they nevertheless remain flagship models created to showcase their technical and design prowess. In addition, there are also models that are shifting more toward satisfying the user's sense of ownership through more extreme examples of unique styling and increased vehicle value.

Although not presented at the two motorcycle shows mentioned previously, the Honda RC213V-S (Fig. 1) was announced as a model equipped with the required safety parts for driving on public roads, but otherwise minimizes modifications from the RC213V, a Moto GP racing machine. The price is an astounding 21.9 million yen.

A similar model that was presented at the two European motorcycle shows was the 1299 Superleggera from Ducati (Fig. 2). Leggera means "light" in Italian, as in lightweight. Production is limited to just 500 vehicles.



Fig. 2 Ducati 1299 Superleggera



Fig. 3 Honda X-ADV

The body, frame, swing arms, and wheels are all made of carbon fiber, and these super lightweight specifications allow it to live up to its name with a vehicle weight of 167 kg. This all-carbon vehicle body is paired with a 215-horsepower engine. The price tag is between 65,244 and 73,413 Euros (about 8 million to 9 million yen).

1. 1. New Category and Styling Proposals

Motorcycles have been broadly divided into categories such as super sports with their roots in racing machines, neo-retro designs that are the exact opposite of racers, adventure tourers capable of driving both on and off the road, scooters that have evolved from everyday means of transportation, and cruisers derived from motorcycles used to drive across continents. Lately, however, new models that cross over between these categories and models that tackle the challenge of opening up new genres have emerged.

One example is the Honda X-ADV (Fig. 3) that was developed as a new proposal for an adventure model. In the past, such models that also seemed capable of running off road were regarded as fun bikes and small displacement vehicles. However, the X-ADV has a displacement of 745 cm³ and its specifications and equipment are clearly designed for packed dirt roads, so this is a full-fledged adventure model that can be said to also be a new proposal for a commuter bike.

Next, let's look at an example that provides a proposal for new motorcycle styling.



Fig. 4 MV Augusta F4Z by Zagato



Fig. 5 Husqvarna VITPILEN 401



Fig. 6 KTM 390Duke

Here is the MV Agusta F4Z by Zagato (Fig. 4). As its name implies, this model is based on the MV Agusta F4. It was designed by the famous automobile design company Zagato. The design is characterized by an automobile-like ample surface quality and form, a rarity among motorcycles. This distinctive design will clearly divide opinion on whether it is good or bad and whether people will love it or hate it, and feels like a concept that originated in a place totally removed from the usual motorcycle designs.

The Duke Series that is the core brand of KTM's street model motorcycles features a design with details reminiscent of insects. This futuristic and aggressive design was overseen by an Austrian design company. Here, however, the focus will be the Vitpilen 401 from Husqvarna (Fig. 5), another motorcycle designed by this same company. This motorcycle utilizes the same platform as the KTM 390 Duke (Fig. 6), but the design proposal is one of more sophisticated styling, like that of simple Nordic furniture designs. Extra effort was clearly put into the design of small details, such as the electrical



Fig. 7 Husqvarna VITPILEN 401 AERO



Fig. 8 Ducati XDiavel

equipment and fittings. This wipes away the oily and mechanical image that is peculiar to motorcycles and instead summarizes the overall styling into a more fashionable and clean feeling. Even though this clean design is often associated with electric vehicles, it does not feel incompatible with a motorcycle and the fact that it still feels like a proper motorcycle is a good thing. A simple and iconic design such as this has been rare in motorcycles until now, and applying this design to a conventional gasoline-engine powered vehicle, rather than an electric one, should appeal to people outside the usual target market. The Vitpilen 401 Aero (Fig. 7) announced at the same time is equipped with what was called a rocket cowl in the old days, suggesting there is still room for the development of derivative models.

The above examples hint at how manufacturers will continue to actively propose a varied array of styles in response to the greater diversity of values in the market.

1. 2. Commitment to Incorporating Detail

As the values in the market continue to diversify, it is predicted that consumers will also find value in the degree of finish of the model, the depth of quality it incorporates, and the uncompromising commitment of the designer, rather than just in the genre and level of performance of the vehicle. The soul is said to lie in the details, and each manufacturer tries to emphasize their styling in a way that characterizes the vehicle. They spend resources on that part of the design and incorporate details and quality to efficiently showcase the appeal of their product. In some high-priced motorcycles, every single part is built to uncompromising standards. One example of this is the XDiavel from Ducati (Fig. 8). The design of this motorcycle is said to have been built up element by element to achieve an ultimate level of finish in its proportions, and the incorporation of design is evident in every part. This is an example where the expression of the design in the engine, exhaust muffler, and wheels is easy to understand. While each of these ele-

ments asserts itself aggressively, the overall design harmonizes them all, amplifying the aggressiveness without causing the design to fall apart, and giving a clear sense of the intent (soul) of the designers.

The design of the headlight is just one example of how the overall design is incorporated into the individual components. Manufacturers are now adopting LED technology for the lights on their vehicles due to the novelty, originality, and freedom in shaping that it provides. However, Ducati did not just use an LED, but added a characteristic new element, such as adding a ring light to a round headlight, to clearly showcase the novelty and originality of their styling. It is certain that headlights and other electronic components will continue evolve dramatically as technology improves, and will therefore remain a major factor in vehicle design.

2 Growing Popularity of Neo-retro Models

The first neo-retro models started to be unveiled around 2014, and by 2016 they were cementing themselves as a standard genre rather than a fleeting fad.

Manufacturer efforts to respond to the growing diversity of values in the market led to styling proposals such as the MV Agusta, and other models from KTM and Husqvarna. At the same time, the polar opposite represented by the neo-retro style with its strong nods toward the styling of famous bikes from past eras and their associated heritage, has been establishing itself in Europe as a maturing design trend.

These neo-retro motorcycles are not high-performance bikes that are beyond the ability of their riders to control. Instead, they are more affordable, easier to ride, have parts that can be removed easily, can be customized to the owner's liking, and allows users to experience the original enjoyment of motorcycles. Thanks to their ubiquitous and motorcycle-like form (design), these vehicles are largely unchanged from days past and mesh



Fig. 9 BMW R nineT series

well with the values being demanded by today's motorcycle users.

The cultures of Europe cherish the ubiquity of their historic townscapes, paintings, and sculptures at the same time that they demand advanced technologies. So, in that sense it seems only natural that for motorcycles, which are more of a leisure vehicle than a necessity, the needs of the market would flow toward products that are accessible and affordable. Consequently, as the demand has grown larger, manufacturers have announced numerous models derived from previously released (standard) models.

Offering an even wider world of possibilities

One of the key points of the neo-retro design is that while the exterior styling looks classical, the guts of the motorcycle and its driving performance are all on the cutting edge. It is nothing less than one of the latest, modern vehicles. The frames are no longer made from steel pipes, but rather from cast aluminum. The brakes are the latest radial mount calipers. And while the headlights look like the regular round lights of old, they now use LEDs.

In addition, manufacturers are not just offering finished neo-retro motorcycles for sale, they are designing them so that owners can change parts to their own liking. These are products that can be enjoyed by their individual users long after they have been purchased. If

you go to a manufacturer's booth at a motor show you will see that they have prepared a wide variety of additional products to help customers easily imagine the world of possibilities open to them after purchasing their motorcycle. These include genuine manufacturer's parts, accessories, and even apparel that looks good with your motorcycle. All of these items are for sale and on display along with the latest models so that customers can mix and match them to their own liking. In addition, in recent years many manufacturers have begun actively utilizing their own brand heritage to emphasize their original culture and traditions as a further selling point.

The BMW R nineT series (Fig. 9) are basically on-road models, but they have newly added an on-road/off-road (adventure) model with a common frame and engine to their product lineup. The Ducati Scrambler series (Fig. 10) were originally scrambler models, as their name suggests, with the rider in an upright position, but as a result of various changes, such as the tire size, they have also added a café racer-style model to their product lineup. Both of these vehicles are a part of product series that expand their user's enjoyment by straddling different categories.

In an effort to expand the world of possibilities for their customers, some manufacturers are also pursuing collaborations with other industries. The number of such manufacturers looking to expand these sorts of new pos-



Fig. 10 Ducati Scrambler series (Desert Sled and Café Racer were added)



Fig. 11 Yamaha XSR900 Abarth



Fig. 12 Suzuki DL250



Fig. 13 Kawasaki Versys 300

sibilities will only continue to increase as they try to reach out to previously untapped groups of potential target customers.

Yamaha, in particular, is actively collaborating with different industries and seems intent on freeing itself from the existing concepts associated with motorcycles. Although their collaboration with the Abarth automobile tuning manufacturer (on the XSR900 Abarth, Fig. 11) involves another company in the vehicle industry, they are also pursuing a wide range of different projects including a collaboration with Yamaha musical instruments, collaborations with the apparel industry, and collaborations on urban renewal projects.

3 Easy-to-ride Adventure Models

Until now, the so-called adventure tourer motorcycles have been strongly associated with larger sized models in the mid-class and above. However, manufacturers have responded to the huge popularity of these models by announcing models with an output of 35 kW or less, allowing them to be ridden with a European A2 license. Consequently, the adventurous image associated with these motorcycles has begun to influence the designs of

smaller models that have lower insurance premiums and more affordable price tags, and are easier for beginning riders to handle. Several manufacturers have announced models with a higher level of off-road performance than those of their competitors. These include the DL250 from Suzuki (Fig. 12), the Versys 300 from Kawasaki (250 cm³ in Japan, Fig. 13), the G 310 GS from BMW (Fig. 14), and the CRF250 Rally from Honda (Fig. 15).

The increase in these smaller, easy-to-ride adventure models should lead to an increase in younger motorcycle users, including beginning riders, as well as in returning riders who will choose these smaller, more affordable models.



Fig. 14 BMW G 310 GS



Fig. 16 BMW G 310 R



Fig. 15 Honda CRF250 Rally



Fig. 17 Suzuki GSX250R

One of the more interesting special characteristics of motorcycles in this category is that they are developed as derivatives of another existing model, and may share many parts in common with this other model.

The BMW G 310 GS and Suzuki DL250 are actually derivative models based on on-road models, specifically the G 310 R (Fig. 16) and GSX250R (Fig. 17) respectively. The Honda CRF 250 Rally is derived from the CRF 250 L/M. Even the Kawasaki Versys was not developed as a unique model, but rather was designed to have many parts in common with other models. It is important to make changes to designs that straddle different categories while sharing the frame and engine forming the base of the motorcycle in a way that still fits the image of those categories. This increases the degree of difficulty of the design process. However, each of these models is designed on the assumption that they will be derived from a base model starting from the earliest design stage of that base model. Therefore, the styling and parts that will transmit the image of a high-class adventure tourer model can be incorporated wherever necessary without causing the whole design to fall apart.

Moving forward, it is fully expected that the different values that consumers will demand from motorcycles will continue to change due to various external factors, making it essential for manufacturers to take the lead in proposing new designs suitably adapted to these new values to avoid falling behind the pace of change.

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