

MOTORCYCLES

Overall Trends

1 Introduction

Although motorcycle production in Japan in 2018 continued the upward trend that started in 2016, total production only increased by 0.8% to 652,000 units, virtually unchanged from 2017. Exports fell by 1.4% to 457,000 units. In addition, the number of motorcycles shipped inside Japan increased by 1.5% to 363,000 units, maintaining around the same level as the previous year. This figure remains at a low level below 400,000 units.

2 Production and Demand Trends

2.1. Production

As shown in Figure 1, the number of motorcycles produced in Japan in 2018 increased by 0.8% from 2017 to a total of 652,000 units. Exports fell by 1.4% to 457,000 units. At the same time the number of motorcycles shipped inside Japan increased by 1.5% to 363,000 units.

2.2. Demand in Japan

Figure 2 shows motorcycle demand in Japan based on engine displacement. Overall demand rose by 1.5% to 363,000 units due to a substantial increase in demand for class 2 motor-driven cycles, which offset lower demand for class 1 motor-driven cycles and mini-sized motorcycles.

2.2.1. 50 cm³ Displacement Motorcycles (Class 1 Motor-Driven Cycles)

In 2018, the demand for this class decreased by 2.9% from the previous year to 169,000 units.

2.2.2. 51 to 125 cm³ Displacement Motorcycles (Class 2 Motor-Driven Cycles)

In 2018, the demand for this class increased substantially by 11.9% from the previous year to 106,000 units.

2.2.3. 126 to 250 cm³ Displacement Motorcycles (Mini-Sized Motorcycles)

In 2018, the demand for this class decreased substantially by 12.9% from the previous year to 50,000 units.

2.2.4. 251 cm³ or Higher Displacement Motorcycles (Small-Sized Motorcycles)

In 2018, the demand for this class increased by 1.3% to 37,000 units, virtually the same figure as the previous year.

2.3. Exports

As shown in Figure 3, motorcycle exports in 2018 were virtually unchanged from the previous year, falling only 1% to 457,000 units. This drop was caused by lower exports to all regions other than North America.

2.3.1. North America

In 2018, exports to North America rose by 6% from

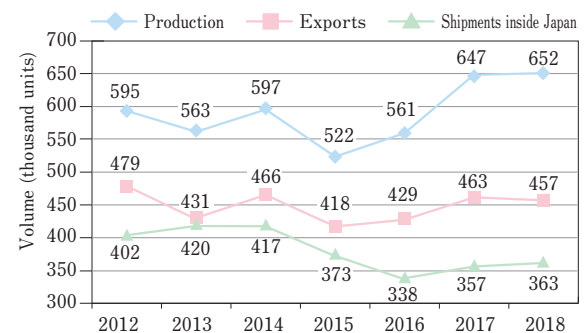


Fig. 1 Trends for Production, Exports, and Shipments inside Japan

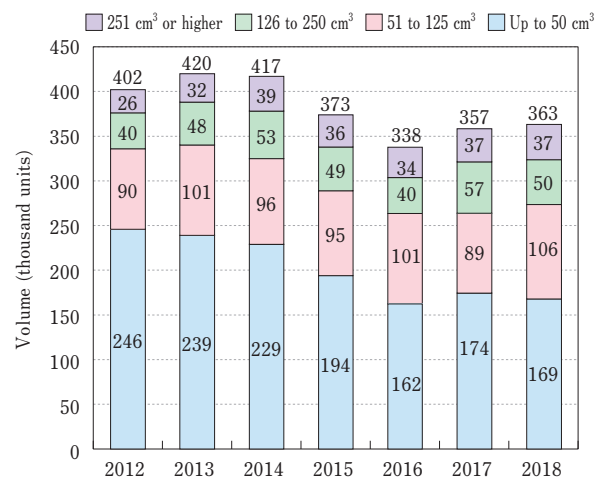


Fig. 2 Shipments inside Japan based on Displacement

the previous year to 139,000 units, the second successive year-on-year increase.

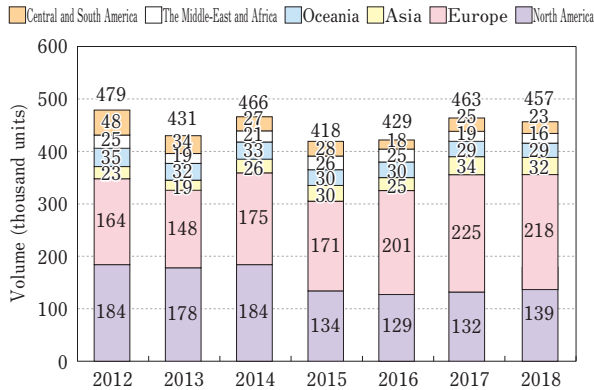


Fig. 3 Shipments per Market

2.3.2. Europe

In 2018, exports to Europe fell by 3% from the previous year to 218,000 units.

2.3.3. Asia

In 2018, exports to Asia fell by 3% from the previous year to 32,000 units.

2.3.4. Oceania

In 2018, exports to Oceania fell by 3% from the previous year to 29,000 units, the fourth successive year-on-year decrease.

2.3.5. The Middle-East and Africa

In 2018, exports to the Middle East and Africa fell by 15% from the previous year to 16,000 units.

Table 1 Details of Main New Motorcycles Launched in 2018

Month of launch	New	Modified	Manufacturer	Name of model	Characteristics
January	○	○	Yamaha	Tricity 125 ABS/Tricity 125	Water-cooled/4 -stroke/single-cylinder/SOHC/4 -valve/FI
			Yamaha	YZF-R3 ABS	Water-cooled/4 -stroke/inline 2 -cylinder/DOHC/4 -valve/FI
			Yamaha	YZF-R25 /YZF-R25 ABS	Water-cooled/4 -stroke/inline 2 -cylinder/DOHC/4 -valve/FI
			Yamaha	XMAX ABS	Water-cooled/4 -stroke/single-cylinder/SOHC/4 -valve/FI
			Yamaha	Majesty S XC155	Water-cooled/4 -stroke/single-cylinder/SOHC/4 -valve/FI
			Suzuki	GSX-R125 ABS	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
			Suzuki	SV650 X ABS	Water-cooled/4 -stroke/90° V-twin/DOHC/4 -valve/FI
			Suzuki	SV650 ABS	Water-cooled/4 -stroke/90° V-twin/DOHC/4 -valve/FI
February	○	○	Honda	Cross Cub 110	Air-cooled/4 -stroke/single-cylinder/OHC/2 -valve/FI
			Honda	Cross Cub 50	Air-cooled/4 -stroke/single-cylinder/OHC/2 -valve/FI
			Yamaha	Vino Deluxe	Water-cooled/4 -stroke/single-cylinder/SOHC/3 -valve/FI
			Yamaha	Jog CE50 ZR	Water-cooled/4 -stroke/single-cylinder/SOHC/3 -valve/FI
			Yamaha	NMAX ABS	Water-cooled/4 -stroke/single-cylinder/SOHC/4 -valve/FI
			Yamaha	Cygnus-X SR	Air-cooled/4 -stroke/single-cylinder/SOHC/4 -valve/FI
			Yamaha	BW's 125	Air-cooled/4 -stroke/single-cylinder/SOHC/4 -valve/FI
			Yamaha	FJR1300 AS	Water-cooled/4 -stroke/inline 4 -cylinder/DOHC/4 -valve/FI
			Yamaha	FJR1300 A	Water-cooled/4 -stroke/inline 4 -cylinder/DOHC/4 -valve/FI
			Suzuki	GSX-S1000 ABS	Water-cooled/4 -stroke/inline 4 -cylinder/DOHC/4 -valve/FI
			Suzuki	GSX-S1000 F ABS	Water-cooled/4 -stroke/inline 4 -cylinder/DOHC/4 -valve/FI
			Suzuki	GSX-S750 ABS	Water-cooled/4 -stroke/inline 4 -cylinder/DOHC/4 -valve/FI
			March	○	○
Kawasaki	Ninja 400 KRT Edition	Water-cooled/4 -stroke/parallel 2 -cylinder/DOHC/4 -valve/FI			
Kawasaki	Ninja 250	Water-cooled/4 -stroke/parallel 2 -cylinder/DOHC/4 -valve/FI			
Kawasaki	Ninja 250 KRT Edition	Water-cooled/4 -stroke/parallel 2 -cylinder/DOHC/4 -valve/FI			
Honda	CRF250 Rally ABS	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI			
Honda	CB125 R	Water-cooled/4 -stroke/single-cylinder/OHC/2 -valve/FI			
Honda	CBR1000 RR SP2	Water-cooled/4 -stroke/inline 4 -cylinder/DOHC/4 -valve/FI			
March	○	○	Yamaha	MT-03	Water-cooled/4 -stroke/inline 2 -cylinder/DOHC/4 -valve/FI
			Yamaha	MT-25	Water-cooled/4 -stroke/inline 2 -cylinder/DOHC/4 -valve/FI
			Yamaha	NMAX 155 ABS	Water-cooled/4 -stroke/single-cylinder/SOHC/4 -valve/FI
			Yamaha	MT-09 ABS	Water-cooled/4 -stroke/inline 3 -cylinder/DOHC/4 -valve/FI
			Yamaha	MT-09 SP ABS	Water-cooled/4 -stroke/inline 3 -cylinder/DOHC/4 -valve/FI
			Suzuki	Address 125 (flat seat specifications)	Air-cooled/4 -stroke/single-cylinder/SOHC/2 -valve/FI
			Suzuki	Address 110	Air-cooled/4 -stroke/single-cylinder/SOHC/2 -valve/FI
			Suzuki	V-Strom 650 XT ABS	Water-cooled/4 -stroke/90° V-twin/DOHC/4 -valve/FI
			Suzuki	V-Strom 650 ABS	Water-cooled/4 -stroke/90° V-twin/DOHC/4 -valve/FI
			Suzuki	V-Strom 1000 XT ABS	Water-cooled/4 -stroke/90° V-twin/DOHC/4 -valve/FI
			Suzuki	V-Strom 1000	Water-cooled/4 -stroke/90° V-twin/DOHC/4 -valve/FI
			Kawasaki	ABS Ninja H2 SX	Water-cooled/4 -stroke/parallel 4 -cylinder/DOHC/4 -valve/FI/supercharged
			Kawasaki	Ninja H2 SX SE	Water-cooled/4 -stroke/parallel 4 -cylinder/DOHC/4 -valve/FI/supercharged
Kawasaki	Z900 RS Cafe	Water-cooled/4 -stroke/parallel 4 -cylinder/DOHC/4 -valve/FI			

Table 1 Details of Main New Motorcycles Launched in 2018 (Cont.)

Month of launch	New	Modified	Manufacturer	Name of model	Characteristics	
April	○		Honda	Gold Wing Tour/Gold Wing	Water-cooled/4-stroke/horizontally opposed 6-cylinder/OHC/4-valve/FI	
		○	Honda	CRF1000 L Africa Twin Adventure Sports	Water-cooled/4-stroke/inline 2-cylinder/OHC/4-valve/FI	
	○		Honda	CB1000 R	Water-cooled/4-stroke/inline 4-cylinder/DOHC/4-valve/FI	
	○		Honda	PCX	Water-cooled/4-stroke/single-cylinder/OHC/2-valve/FI	
		○	Honda	CBR250 RR ABS	Water-cooled/4-stroke/inline 2-cylinder/DOHC/4-valve/FI	
	○		Honda	PCX150	Water-cooled/4-stroke/single-cylinder/OHC/2-valve/FI	
		○	Honda	NC750 X	Water-cooled/4-stroke/inline 2-cylinder/OHC/4-valve/FI	
		○	Honda	CB1100	Water-cooled/4-stroke/inline 4-cylinder/DOHC/4-valve/FI	
		○	Honda	CB1100 EX	Water-cooled/4-stroke/inline 4-cylinder/DOHC/4-valve/FI	
		○	Honda	CB1100 RS	Water-cooled/4-stroke/inline 4-cylinder/DOHC/4-valve/FI	
		○	Honda	X-ADV	Water-cooled/4-stroke/inline 2-cylinder/OHC/4-valve/FI	
		○	Honda	400 X	Water-cooled/4-stroke/inline 2-cylinder/DOHC/4-valve/FI	
		○	Honda	CBR400 R	Water-cooled/4-stroke/inline 2-cylinder/DOHC/4-valve/FI	
		○	Honda	NC750 S	Water-cooled/4-stroke/inline 2-cylinder/OHC/4-valve/FI	
		○	Honda	CBR1000 RR	Water-cooled/4-stroke/inline 4-cylinder/DOHC/4-valve/FI	
		○	Honda	CBR1000 RR SP	Water-cooled/4-stroke/inline 4-cylinder/DOHC/4-valve/FI	
		○	Yamaha	MT-07 ABS	Water-cooled/4-stroke/inline 2-cylinder/DOHC/4-valve/FI	
		○	Yamaha	Tracer 900 ABS	Water-cooled/4-stroke/inline 3-cylinder/DOHC/4-valve/FI	
	May	○		Yamaha	Jog/Jog Deluxe	Water-cooled/4-stroke/single-cylinder/SOHC/2-valve/FI
			○	Yamaha	Bolt ABS/Bolt R-Spec ABS	Air-cooled/4-stroke/V2/SOHC/4-valve/FI
		○	Suzuki	GSX-R1000 R ABS	Water-cooled/4-stroke/inline 4-cylinder/DOHC/4-valve/FI	
		○	Suzuki	Burgman 200	Water-cooled/4-stroke/single-cylinder/SOHC/4-valve/FI	
		○	Kawasaki	Z125 Pro	Air-cooled/4-stroke/single-cylinder/SOHC/2-valve/FI	
○			Kawasaki	Z900	Water-cooled/4-stroke/parallel 4-cylinder/DOHC/4-valve/FI	
○			Honda	CB250 R	Water-cooled/4-stroke/single-cylinder/DOHC/4-valve/FI	
○			Yamaha	Vino	Water-cooled/4-stroke/single-cylinder/SOHC/2-valve/FI	
		○	Yamaha	TMAX530 DX ABS	Water-cooled/4-stroke/inline 2-cylinder/DOHC/4-valve/FI	
		○	Yamaha	TMAX530 SX ABS	Water-cooled/4-stroke/inline 2-cylinder/DOHC/4-valve/FI	
June		○	Honda	CB400 Super Four	Water-cooled/4-stroke/inline 4-cylinder/DOHC/4-valve/FI	
		○	Honda	CB400 Super Bol D'Or	Water-cooled/4-stroke/inline 4-cylinder/DOHC/4-valve/FI	
		○	Yamaha	Tracer 900 GT ABS	Water-cooled/4-stroke/inline 3-cylinder/DOHC/4-valve/FI	
	○		Suzuki	Swish	Air-cooled/4-stroke/single-cylinder/SOHC/2-valve/FI	
		○	Suzuki	Gixxer	Air-cooled/4-stroke/single-cylinder/SOHC/2-valve/FI	
July		○	Honda	Lead 125 Special	Water-cooled/4-stroke/single-cylinder/OHC/2-valve/FI	
	○		Honda	Monkey 125	Air-cooled/4-stroke/single-cylinder/OHC/2-valve/FI	
	○		Honda	Forza	Water-cooled/4-stroke/single-cylinder/OHC/4-valve/FI	
		○	Kawasaki	Z900 RS	Water-cooled/4-stroke/parallel 4-cylinder/DOHC/4-valve/FI	
August		○	Honda	CRF450 R	Water-cooled/4-stroke/single-cylinder/OHC/4-valve/FI	
		○	Honda	CRF450 RX	Water-cooled/4-stroke/single-cylinder/OHC/4-valve/FI	
		○	Yamaha	YZ450 F	Water-cooled/4-stroke/single-cylinder/DOHC/4-valve/FI	
	○		Yamaha	YZ250 F	Water-cooled/4-stroke/single-cylinder/DOHC/4-valve/FI	
		○	Yamaha	YZ250	Water-cooled/2-stroke/single-cylinder	
		○	Yamaha	YZ125	Water-cooled/2-stroke/single-cylinder	
	○		Yamaha	YZ85 LW	Water-cooled/2-stroke/single-cylinder	
	○		Yamaha	YZ85	Water-cooled/2-stroke/single-cylinder	
	○		Yamaha	YZ450 FX	Water-cooled/4-stroke/single-cylinder/DOHC/4-valve/FI	
		○	Yamaha	YZ250 FX	Water-cooled/4-stroke/single-cylinder/DOHC/4-valve/FI	
		○	Yamaha	YZ250 X	Water-cooled/2-stroke/single-cylinder	
		○	Yamaha	YZ125 X	Water-cooled/2-stroke/single-cylinder	
		○	Yamaha	Serow 250	Air-cooled/4-stroke/single-cylinder/SOHC/2-valve/FI	
		○	Kawasaki	KX250	Water-cooled/4-stroke/single-cylinder/DOHC/4-valve/FI	
		○	Kawasaki	KLX110 L	Air-cooled/4-stroke/single-cylinder/SOHC/2-valve/FI	
		○	Kawasaki	KX100	Water-cooled/2-stroke/single-cylinder/piston reed valve	
		○	Kawasaki	KX85	Water-cooled/2-stroke/single-cylinder/piston reed valve	
	○	Kawasaki	KX85 -II	Water-cooled/2-stroke/single-cylinder/piston reed valve		
	○	Kawasaki	KX65	Water-cooled/2-stroke/single-cylinder/piston reed valve		
	○	Kawasaki	Ninja 1000	Water-cooled/4-stroke/parallel 4-cylinder/DOHC/4-valve/FI		
	○	Kawasaki	Z900 RS Cafe	Water-cooled/4-stroke/parallel 4-cylinder/DOHC/4-valve/FI		

Table 1 Details of Main New Motorcycles Launched in 2018 (Cont.)

Month of launch	New	Modified	Manufacturer	Name of model	Characteristics
September		○	Honda	CRF250 R	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
	○		Honda	Super Cub C125	Air-cooled/4 -stroke/single-cylinder/OHC/2 -valve/FI
	○		Honda	PCX Hybrid	Water-cooled/4 -stroke/single-cylinder/OHC/2 -valve/FI + AC synchronous motor
	○		Honda	CRF450 L	Water-cooled/4 -stroke/single-cylinder/OHC/4 -valve/FI
	○		Yamaha	Niken	Water-cooled/4 -stroke/inline 3 -cylinder/DOHC/4 -valve/FI
		○	Yamaha	Tricker XG250	Air-cooled/4 -stroke/single-cylinder/SOHC/2 -valve/FI
	○		Suzuki	Swish Limited	Air-cooled/4 -stroke/single-cylinder/SOHC/2 -valve/FI
		○	Suzuki	Burgman 400 ABS	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
		○	Suzuki	GSX-R125 ABS	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
		○	Suzuki	RM85 L	Water-cooled/2 -stroke/single-cylinder/reed valve
		○	Suzuki	RM-Z450	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
		○	Kawasaki	KX450	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
	October	○		Honda	CRF250 RX
		○	Honda	CB1300 Super Four	Water-cooled/4 -stroke/inline 4 -cylinder/DOHC/4 -valve/FI
		○	Honda	CB1300 Super Bol D'Or	Water-cooled/4 -stroke/inline 4 -cylinder/DOHC/4 -valve/FI
		○	Honda	CB1300 Super Four SP	Water-cooled/4 -stroke/inline 4 -cylinder/DOHC/4 -valve/FI
		○	Honda	CB1300 Super Bol D'Or SP	Water-cooled/4 -stroke/inline 4 -cylinder/DOHC/4 -valve/FI
		○	Yamaha	PW50	Air-cooled/2 -stroke/single-cylinder
		○	Yamaha	YZF-R6 Race Base model	Water-cooled/4 -stroke/inline 4 -cylinder/DOHC/4 -valve/FI
		○	Yamaha	YZF-R1 Race Base model	Water-cooled/4 -stroke/inline 4 -cylinder/DOHC/4 -valve/FI
		○	Suzuki	Address 125	Air-cooled/4 -stroke/single-cylinder/SOHC/2 -valve/FI
		○	Suzuki	Address 125 (flat seat specifications)	Air-cooled/4 -stroke/single-cylinder/SOHC/2 -valve/FI
		○	Suzuki	GSX250 R	Water-cooled/4 -stroke/2 -cylinder/SOHC/2 -valve/FI
		○	Suzuki	V-Strom 250 ABS	Water-cooled/4 -stroke/2 -cylinder/SOHC/2 -valve/FI
		○	Suzuki	V-Strom 250	Water-cooled/4 -stroke/2 -cylinder/SOHC/2 -valve/FI
		○	Suzuki	GSX-S750 ABS	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
		○	Kawasaki	Z900	Water-cooled/4 -stroke/parallel 4 -cylinder/DOHC/4 -valve/FI
		○	Kawasaki	Ninja 400	Water-cooled/4 -stroke/parallel 2 -cylinder/DOHC/4 -valve/FI
		○	Kawasaki	Ninja 400 KRT Edition	Water-cooled/4 -stroke/parallel 2 -cylinder/DOHC/4 -valve/FI
	○	Kawasaki	Vulcan S	Water-cooled/4 -stroke/parallel 2 -cylinder/DOHC/4 -valve/FI	
	○	Kawasaki	Z900 RS Cafe	Water-cooled/4 -stroke/parallel 4 -cylinder/DOHC/4 -valve/FI	
November		○	Honda	Gold Wing	Water-cooled/4 -stroke/horizontally opposed 6 -cylinder/OHC/4 -valve/FI
		○	Honda	Super Cub 50 60 th Anniversary model	Air-cooled/4 -stroke/single-cylinder/OHC/2 -valve/FI
		○	Honda	Super Cub 110 60 th Anniversary model	Air-cooled/4 -stroke/single-cylinder/OHC/2 -valve/FI
		○	Honda	CBR250 RR	Water-cooled/4 -stroke/inline 2 -cylinder/DOHC/4 -valve/FI
		○	Honda	NC750 X	Water-cooled/4 -stroke/inline 2 -cylinder/OHC/4 -valve/FI
		○	Honda	CB400 Super Four	Water-cooled/4 -stroke/inline 4 -cylinder/DOHC/4 -valve/FI
		○	Honda	CB400 Super Bol D'Or	Water-cooled/4 -stroke/inline 4 -cylinder/DOHC/4 -valve/FI
		○	Honda	PCX Electric	AC synchronous motor
		○	Yamaha	SR400	Air-cooled/4 -stroke/single-cylinder/SOHC/2 -valve/FI
		○	Yamaha	SR400 40 th Anniversary Edition	Air-cooled/4 -stroke/single-cylinder/SOHC/2 -valve/FI
	○	Yamaha	Cygnus-X	Air-cooled/4 -stroke/single-cylinder/SOHC/4 -valve/FI	
	○	Kawasaki	Ninja ZX-6 R (track-only model)	Water-cooled/4 -stroke/parallel 4 -cylinder/DOHC/4 -valve/FI	
December		○	Honda	CRF1000 L Africa Twin	Water-cooled/4 -stroke/inline 2 -cylinder/OHC/4 -valve/FI
		○	Honda	CB1000 R	Water-cooled/4 -stroke/inline 4 -cylinder/DOHC/4 -valve/FI
		○	Honda	VFR800 F	Water-cooled/4 -stroke/V4 /DOHC/4 -valve/FI
		○	Honda	VFR800 X	Water-cooled/4 -stroke/V4 /DOHC/4 -valve/FI
		○	Kawasaki	Ninja ZX-6 R	Water-cooled/4 -stroke/parallel 4 -cylinder/DOHC/4 -valve/FI
		○	Kawasaki	Ninja ZX-6 R KRT Edition	Water-cooled/4 -stroke/parallel 4 -cylinder/DOHC/4 -valve/FI
		○	Kawasaki	Z1000	Water-cooled/4 -stroke/parallel 4 -cylinder/DOHC/4 -valve/FI
		○	Kawasaki	Ninja H2 Carbon	Water-cooled/4 -stroke/parallel 4 -cylinder/DOHC/4 -valve/FI
		○	Kawasaki	Ninja H2 R (closed-course-only model)	Water-cooled/4 -stroke/parallel 4 -cylinder/DOHC/4 -valve/FI

2. 3. 6. Central and South America

In 2018, exports to Central and South America fell by 8% from the previous year to 23,000 units.

3 Product and Technological Trends

3. 1. Product Trends

Table 1 lists some of the representative motorcycle models launched in Japan in 2018. New models on the

market included the Honda Cross Cub 50, and the Yamaha Vino and Jog class 1 motor-driven cycles, the Honda PCX, PCX150, PCX Hybrid, PCX Electric, and Monkey 125, the Yamaha Tricity 125, NMAX 155 ABS, and XMAX ABS, the Suzuki GSX-R125 ABS and Swish, and the Kawasaki Ninja 250 class 2 motor-driven or mini-sized motorcycles, as well as the Honda Gold Wing Tour, the Yamaha Niken, the Suzuki SV650X ABS, and the Ka-

wasaki Ninja 400, Ninja H2 SX, and Z900RS Cafe /Z900 small-sized motorcycles.

3.2. Technological Trends

Manufacturers are focusing on making all classes of motorcycles more environmentally friendly, and launched several new models incorporating technologies to improve fuel efficiency and reduce weight. Models also featured electronic control technologies emphasizing a more enjoyable ride and greater comfort, in addition to higher power and performance. At the same time, 2018 saw the unveiling of the motorcycle world's first hybrid scooter and Japan's first electric mini-sized motorcycle, as well as systems that interact with smart phones. These trends demonstrate the increasing spread of electrification and IoT technologies across the motorcycle world.

References

- (1) Japan Automobile Manufacturers Association, Inc., Monthly statistics, <http://www.jama-english.jp/>
- (2) Japan Automobile Manufacturers Association, Inc., Website database, <http://jamaserv.jama.or.jp/newdb/eng/index.html>
- (3) Honda Motor Co., Ltd., https://global.honda/?from=navi_header
- (4) Yamaha Motor Co., Ltd., <http://www.yamahamotor.co.jp/mc/> (in Japanese)
- (5) Suzuki Motor Corporation, <http://www.globalsuzuki.com/>
- (6) Kawasaki Motors Corporation Japan, <http://www.kawasaki-motors.com> (in Japanese)

Engines

1 Technological Trends in Japan

1.1. Overview

Table 1 shows the specifications of the main new engines launched by each manufacturer in Japan in 2018. In the small-sized motorcycle category, the continued emphasis on fuel efficiency and environmental performance prompted Honda and Yamaha to launch hybrid models that attracted a great deal of comment. In the off-road category, manufacturers are actively developing high-performance lightweight engines with an eye on creating a more enjoyable ride. Additionally, in the large touring model category, manufacturers are developing engines that focus on ride comfort and weight reduction, in addition to environmental performance.

1.2. Trends of Each Manufacturer

1.2.1. Honda Motor Co., Ltd.

(1) Gold Wing

This motorcycle is equipped with a 1,833 cm³, water-cooled, 4-stroke, OHC, 4-valve, horizontally opposed 6-cylinder engine. The bore × stroke dimensions are 73.0 × 73.0 mm and its compression ratio is 10.5. This remains the only water-cooled 4-stroke horizontally opposed 6-cylinder engine used by a motorcycle. Weight- and size-reduction measures, such as the adoption of a next-generation uni-cam valve train and other refinements, also help to improve dynamic performance. The drivetrain has been updated with Honda's third-generation dual clutch transmission (DCT) with seven forward speeds and one

reverse speed. This transmission includes a Walking Mode with a reverse mechanism that allows the rider to move forward and back up at very low speeds. An integrated starter generator (ISG), which combines the functions of an AC generator (ACG) and starter motor, ensures quiet engine starts. Together with the DCT and throttle-by-wire system control, this creates a highly refined feeling from a standing start appropriate to a motorcycle like the Gold Wing. Figure 1 shows the external appearance of this motorcycle.

(2) PCX Hybrid

This motorcycle is equipped with a 124 cm³, water-cooled, 4-stroke, OHC, 2-valve, single-cylinder engine. The bore × stroke dimensions are 52.4 × 57.9 mm and its compression ratio is 11.0. The PCX Hybrid uses Enhanced Smart Power (eSP) engine technology to enable ample dynamic performance, simple operation for daily use, as well as excellent fuel efficiency and environmental performance. Environmental performance is further enhanced by Honda's Programmed Fuel Injection (PGM-FI) system that ensures the appropriate fuel supply for the road conditions, as well as power-saving LED headlamps, tail lamps, and indicators. By adopting a lithium-ion battery as an energy source for the engine and an ACG starter to assist engine starts, engine torque is increased by approximately 33% while maintaining a compact system package. The hybrid system provides approximately 4 seconds of motor assist, which helps to ensure excellent dynamic performance, including rapid

Table 1 Specifications of New Engines in 2018

Manufacturer	Name of model	Engine type	Displacement (cm ³)	Bore (mm)	Stroke (mm)	Max. output (kW/rpm)	Maximum torque (Nm/rpm)
Honda	Gold Wing	Water-cooled/4-stroke/horizontally opposed 6-cylinder/OHC/4-valve/FI	1,833	73.0	73.0	93/5,500	170/4,500
	PCX Hybrid	Water-cooled/4-stroke/single-cylinder/OHC/2-valve/FI + AC synchronous motor	124	52.4	57.9	9/8,500	12/5,000
Yamaha	Grand Filano Hybrid (model for outside Japan)	Air-cooled/4-stroke/single-cylinder/OHC/2-valve/FI + AC synchronous motor	124	52.4	57.9	N.A.	N.A.
	YZ250 F (racing model)	Water-cooled/4-stroke/single-cylinder/DOHC/4-valve/FI	249	77	53.6	N.A.	N.A.
	YZ85 (racing model)	Water-cooled/2-stroke/single-cylinder	84	47.5	47.8	N.A.	N.A.
Suzuki	GSX-R125 ABS	Water-cooled/4-stroke/single-cylinder/DOHC/4-valve/FI	124	62.0	41.2	11/10,000	11/8,000
Kawasaki	Ninja 250	Water-cooled/4-stroke/parallel 2-cylinder/DOHC/4-valve/FI	248	62.0	41.2	27/12,500	23/10,000
	KX450 (racing model)	Water-cooled/4-stroke/single-cylinder/DOHC/4-valve/FI	449	96.0	62.1	N.A.	N.A.



Fig. 1 External Appearance of the Gold Wing Fig. 2 External Appearance of the PCX Hybrid. Fig. 3 External Appearance of the Grand Filano Hybrid.

throttle response when required and improved acceleration on hills and under normal riding conditions. Figure 2 shows the external appearance of this motorcycle.

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

(1) Grand Filano Hybrid (model for outside Japan)

This motorcycle is equipped with a 124 cm³, air-cooled, 4-stroke, OHC, 2-valve, single-cylinder engine. The bore × stroke dimensions are 52.4 × 57.9 mm and its compression ratio is 11.0. This is a fully redesigned version of the Blue Core engine that emphasizes both environmental performance and riding enjoyment. The separate starter motor and gear have been replaced with the newly developed integrated Smart Motor Generator (SMG). In addition to a new stop-start system (a mechanism to prevent unnecessary idling), the SMG enables smoother starts and a substantial reduction in noise since it rotates the crankshaft without passing through any gears. Eliminating the separate starter motor and gear enabled the belt line to be brought in by 15 mm, thereby reducing the engine width. Combined with the new plastic cylinder head cover and other measures, the weight of the new engine was reduced by 840 g. With heavy loads and two people riding on a single motorcycle common practice in ASEAN countries, motor assist is provided only from a standing start for a maximum of 3 seconds up to 5,500 rpm to help reduce instability immediately after starting off. Compared to the PCX Hybrid, which provides assist from an additional 48 V lithium-ion battery installed under the seat, the Grand Filano Hybrid uses a single conventional lead-acid battery for all functions, which helps to reduce the overall weight of the motorcycle. Figure 3 shows the external appearance of this motorcycle.

um-ion battery installed under the seat, the Grand Filano Hybrid uses a single conventional lead-acid battery for all functions, which helps to reduce the overall weight of the motorcycle. Figure 3 shows the external appearance of this motorcycle.

(2) YZ250F (racing model)

This motorcycle is equipped with a 249 cm³, water-cooled, 4-stroke, DOHC, 4-valve, single-cylinder engine. The bore × stroke dimensions are 77.0 × 53.6 mm and its compression ratio is 13.8. This engine features a unique combination of a frontal straight-intake, fuel injection (FI), and a rearward-slanting cylinder. The competitiveness of the model is boosted by the adoption of a self-starter and lightweight lithium-ion battery. Newly developed forged pistons have been adopted to improve performance at high engine speeds, and to reduce weight and loss. The intake and exhaust ports are also newly designed. Two special processes are applied to the intake ports after casting to ensure smooth port geometry. In addition, the cam profile and working angle were optimized to realize synergistic effects from greater valve lift and the like. The resulting enhanced combustion helps to create a powerful sensation of traction. A new throttle body (diameter: 44 mm) has been equipped with twelve-hole injectors that inject fuel up to the port surface over a wide range. Figure 4 shows the external appearance of this motorcycle.



Fig. 4 External Appearance of the YZ250F



Fig. 5 External Appearance of the YZ85

(3) YZ85 (racing model)

This motorcycle is equipped with an 84 cm³, water-cooled, 2-stroke, single-cylinder engine. The bore × stroke dimensions are 47.5 × 47.8 mm. Synergistic effects generated by the newly developed cylinder, plastic reed valve, Yamaha Power Valve System (YPVS), crankshaft with additional plastic weights, crankcase, and combustion chamber produce excellent power characteristics. Among these refinements, the newly installed YPVS achieves seamless power transition from high to low and medium speeds through a valve provided at the exhaust port, which opens and closes in accordance with the engine speed. Superior flow control and excellent response were achieved by revising the plastic fiber direction of the reed valve and adding a new spacer. The mixture supply rate of the carburetor was optimized by changing the bypass port configuration, thereby improving response at low speeds. Figure 5 shows the external appearance of this motorcycle.

1. 2. 3. Suzuki Motor Corporation

(1) GSX-R125 ABS

This motorcycle is equipped with a 124 cm³, water-cooled, 4-stroke, DOHC, 4-valve, single-cylinder engine. The bore × stroke dimensions are 62.0 × 41.2 mm and its compression ratio is 11.0. The engine uses a cylinder plated with the Suzuki Composite Electrochemical Material (SCEM), an original technology of Suzuki that reduces friction, and achieves high heat dissipation, wear resis-



Fig. 6 External Appearance of the GSX-R125 ABS



Fig. 7 External Appearance of Ninja 250

tance, and air-tightness. The dual-spray four-hole fuel injection system is equipped with six sensors, which allow optimum control under various riding conditions, while ensuring powerful and fuel efficient performance. These refinements enable sporty engine characteristics with excellent fuel efficiency. Figure 6 shows the external appearance of this motorcycle.

1. 2. 4. Kawasaki Motors Corporation

(1) Ninja 250

This motorcycle is equipped with a 248 cm³, water-cooled, 4-stroke, DOHC, 4-valve, parallel 2-cylinder engine. The bore × stroke dimensions are 62.0 × 41.2 mm and its compression ratio is 11.3. The air cleaner box was moved from its previous position under the seat to inside the fuel tank. This engine also features a downdraft structure with straight intake flows and a short intake manifold. Optimizing the stiffness of the top of the air cleaner box also helps to achieve a clear intake sound that creates an uplifting sensation of acceleration. This model features many of the same components as higher displacement sporty motorcycles, such as a high-strength lightweight forged camshaft, iridium spark plugs that help to improve the feeling of power at extremely low speeds, and a sleeveless plated cylinder. The result is greater power over all engine speed ranges, not just at high speeds. These refinements help to create a strong and improved power sensation at all engine speeds. Figure 7 shows the external appearance of this motorcycle.

(2) KX450 (racing model)

This motorcycle is equipped with a 449 cm³, water-cooled, 4-stroke, DOHC, 4-valve, single-cylinder engine. The bore × stroke dimensions are 96.0 × 62.1 mm and its compression ratio is 12.5. Despite larger valves, adopting a finger follower rocker arm reduced the weight of the valve mechanism by 4.2% on the intake side and 7.9% on the exhaust side compared to tappet valves. The larger intake and exhaust valves and greater valve lift ensure higher air flow, which helps to increase power. Friction was reduced by adopting a lighter piston (reduced from 259.8 to 243 g) and replacing the needle bearing at the big end of the connecting rod with a plane bearing. The downdraft intake line enabled an even more linear intake approach. The intake angle into the cylinder was increased from 10 to 20 degrees, boosting the cylinder charging efficiency and increasing engine power. Figure 8 shows the external appearance of this motorcycle.



Fig. 8 External Appearance of the KX450



Fig. 9 External Appearance of the R1250GS

2 Technological Trends outside Japan

2.1. Trends of Each Manufacturer

2.1.1. BMW

(1) R1250GS

This motorcycle is equipped with a 1,254 cm³, water-cooled, 4-stroke, DOHC, 4-valve, horizontally opposed 2-cylinder engine. The bore × stroke dimensions are 102.5 × 76.0 mm and its compression ratio is 12.5. This new boxer engine features a newly developed BMW Shift Cam variable valve timing system, a mechanism that varies the valve timing and valve lift on the intake side. The core element of this technology is an integrated camshaft that features a pair of cam lobes per valve, one for partial load and one for full load operation. Motor-driven actuators shift (move) the camshaft in accordance with engine speed and load, switching between the partial load cam lobe and full load cam lobe. The full load cam lobe provides the maximum amount of valve lift and is optimized for performance. The partial load cam lobe has different phases that vary the lift and angle of the left and right inlet valves. Consequently, these two inlet valves can be opened and closed with a time difference. This intensifies the swirl of the mixture entering the combustion chamber and helps to generate more effective combustion, resulting in greater combustion efficiency and smoother dynamic performance. Figure 9 shows the external appearance of this motorcycle and Figure 10 shows the variable valve timing mechanism.

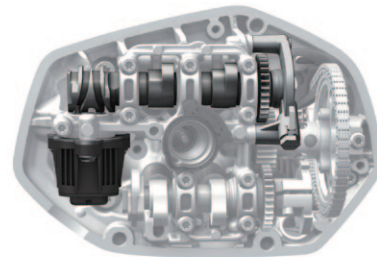


Fig. 10 Variable Valve Timing Mechanism

2.1.2. Ducati

(1) Panigale V4

This motorcycle is equipped with a 1,103 cm³, water-cooled, 4-stroke, desmodromic, 4-valve, V4 engine. The bore × stroke dimensions are 81.0 × 53.5 mm and its compression ratio is 14. The V4 layout is designed to achieve a natural balance against primary vibration, which is an important characteristic for an engine that exceeds 14,000 rpm. The newly developed desmodromic system closes the valves mechanically with the same precision as when the valves are opened. This allows the adoption of a more aggressive cam profile and extreme valve timings, improving gaseous flows on both the intake and exhaust sides and further enhancing engine performance. The crankshaft rotates in the opposite direction to the wheels, unlike conventional street motorcycles and the same set up used by most MotoGP bikes. This arrangement counteracts some of the gyroscopic effects generated by the wheels when the bike's inclination



Fig. 11 External Appearance of Panigale V4

changes, creating more agile handling. The Panigale V4 features Ducati’s first variable length intake funnel. This optimizes the intake at all engine speeds, creating major advantages in terms of power delivery and handling. Each throttle body contains two injectors that operate in accordance with the load range. The result is a compact and lightweight engine with a maximum power of 157.5 kW and a maximum torque of 124.0 Nm. Figure 11 shows the external appearance of this motorcycle.

3 Research and Development Trends —

With the Euro 5 emissions regulations due to start phasing in from new models in 2020, small engine development is focusing on improving combustion characteristics and engine efficiency while keeping an eye on emissions compliance. For large engines, manufacturers are developing variable valve mechanisms to comply with the emissions regulations, improve combustion, and boost dynamic performance. Here, a great deal of research and development is looking to achieve excellent environmental performance while ensuring a fun-to-ride experience for motorcycle users. For example, research is examining the effects of the crankshaft rotation direction on the behavior of the motorcycle body and the effects of the com-

bustion interval in multi-cylinder engines on traction. Manufacturers will be looking to emphasize the advantages of gasoline-powered engines that cannot be reproduced by electric motorcycles. Some of the main topics this year include the appearance of hybrid motorcycles and integrated starter motor and ACG systems in large touring bikes. These trends of reducing weight and size by combining two different functional parts and integrating mechanical and electrical components are likely to accelerate in the future.

Recent social trends have seen growing digitalization and disillusion with physical products. However, running counter to these trends, sales of off-road racing bikes from entry-level to professional models have been robust and manufacturers are in the process of developing a wide range of new models. With these bikes eagerly anticipated by users around the world, research and development is likely to continue focusing steadily on lightweight, compact, and powerful engines that realize exciting and fun-to-ride performance.

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◆◆◆◆◆◆◆◆◆◆ Design Trends ◆◆◆◆◆◆◆◆◆◆

1 Firm Establishment of the Shift from Possessions to Experiences —

Over the last few years, stringent speed regulations in developed countries, the desire to lower accident risks, and higher insurance costs have caused a cooling off of demand for excess performance in sporty models. Excluding some top-end users, many people are beginning

to lose their interest in extreme speed.

With the concept of using ultra-high performance specifications to drive product sales long abandoned, users are becoming more attached to the brand value provided by manufacturers and individual bikes, and companies have shifted their approach to a greater expression of self-identity. It is frequently stated that the modern era is seeing a shift in consumption from possessions to

experiences. Manufacturers are working to link the creation of connections with the surrounding world through events or the Internet with the joy of owning a motorcycle via narratives involving product ownership or sympathy with the worldview of a company.

In particular, some European and American manufacturers with long histories are making strong appeals to potential customers via psychology to compete against Japanese manufacturers that have prospered from a performance-first approach. These European and American manufacturers are investing strongly to enhance the tangible and intangible value of their products.

Through this approach, storied companies such as Harley-Davidson and BMW with their own unique engines have attracted many high-end users despite the high price of their models. This has drawn in a large number of followers, who are driving demand for premium motorcycles and have made large waves in developed markets in recent years.

2 Growing Awareness of the True Meaning of “Experience”

Although historic manufacturers in Europe and the US are proclaiming the start of an “era of experiences,” it can be argued that the value of these “experiences” is currently expressed by the value inherent in the products they create.

Even though the obsession with technical specifications has been lost, users still like to show off alongside these products, which manufacturers have worked to imbue with new value created from new standpoints. Ultimately, the value of an experience can be described in terms of the product, which is essentially no different from the so-called “era of possessions.” In different terms, investment has simply shifted from products valued in terms of high performance to products valued in terms of history and brand value. In both cases, users equate higher prices with higher value.

However, users that enjoy a motorcycle-based lifestyle have started to move away such from product-driven experiences and are now searching for what these experiences truly mean.

These users dislike the motorcycles that form a part of their lifestyle to have an overpowering brand image or extreme performance, and desire a clear subordinate-superior relationship with their possessions. It is possible to see a gradual return to the treatment of motorcycles



Fig. 1 Ducati Scrambler⁽¹⁾



Fig. 2 Honda Rebel

as user-friendly tools imbued with inherent freedoms, such as a natural integration with user tastes and lifestyles, discreet non-extreme specifications and brand value, and the space for free self-expression without worrying about the categories or hierarchy imposed by the industry. Glimpses of this trend are being to become visible in developed markets as the antithesis of the high performance, high price and standardized brand value demanded by some high-end users. The French market in particular is enjoying a conspicuous movement back toward lifestyles focused on smaller motorcycles.

Successful examples in recent years include the Ducati Scrambler (2015) and Honda Rebel (2017) (Figures 1 and 2).

Mass-production manufacturers have also demonstrated new concept models, with noticeable characteristics including wholly manageable sizes and performance, relatively reasonable pricing, and most importantly, informal and relaxed styling. These models generate impressions of freedom not totally constrained by history or branding.

These concepts are likely to retain support, primarily from younger users wanting to go beyond the unwritten rules of enthusiasts and enjoy a free, casual, and unrestrained motorcycle-based lifestyle.

This resembles the success enjoyed by bikes such as the Kawasaki Zephyr and Honda Ape that emerged in Japan after the replica racer boom in the 1980s, which did not depend on high-performance specifications for

their popularity. This trend was driven by the rich imagination and push back between designers and customers. However, the waves created by such trends in recent times are not large enough to be called a boom. With multiple sets of preferences vying for attention, it is particularly important to note the blurring of boundaries between these preferences and the timings at which they occur. This is not manufacturer-driven, and is spreading as a naturally occurring movement from the market.

3 Expansion of the Definition of “Café”

A recent trend is the attribution of varied and vague meanings to the word “café.”

Originally, “café racer” was the name given to young riders that gathered in cafés in Europe in the 1960s. Café has now turned into an iconic word used to express freedom from conformity and set definitions. The freedom to enjoy motorcycle riding and individual appetites to express personal creativity have expanded the meaning of this word beyond its conventional restraints. Café is now seen as an expression of an individual approach to achieving a global style.

The means to accomplish this is completely free and without borders, unbound by existing concepts of manufacturers, categories, or hierarchies. It extends across all types of motorcycles, including on-road and off-road, as well as single and multi-cylinder engines.

With new ideas being quickly trialed by individual users and shops, and information shared repeatedly via social networks and the like, new café racer trends spread at a speed that cannot be emulated by mass-production stock bikes.

However, despite this diversity, there are common design elements across these so-called café bikes. This might be defined as a rejection of aggressiveness and a lack of interest in cutting-edge and precision design elements. Although the main components of these bikes project styling anchored in traditional methods, the retro-feeling is supplemented by an aura of safety and comfort that looks at home on the street. As a result, a dominant common theme of modern café bikes is an overall casual impression. Most have been designed with great care to include modern elements to prevent the styling becoming too retro, which is something that the designers have obviously lavished a great deal of attention. Instead of leaning too far toward a retro feel, designers have taken hints from products and trends of the 1960s



Fig. 3 Yamaha XSR900⁽³⁾



Fig. 4 Kawasaki Z900RS Cafe⁽⁴⁾



Fig. 5 Suzuki SV650X⁽⁵⁾



Fig. 6 Honda CB1000R

and 1970s to create traditional bike styling cues, and are attempting to turn street fashions into popular motorcycles.

Beginning with the Yamaha XSR900 that was launched in 2016, Japanese manufacturers have also begun to incorporate this trend in accordance with their own interpretations. As a result, 2018 saw the launch of several café-themed models, including the Kawasaki Z900RS Cafe, Suzuki SV650X, and Honda CB1000R (Figures 3 to 6).



Fig. 7 Husqvarna Vitpilen 701⁽⁶⁾



Fig. 9 Harley-Davidson LiveWire⁽⁸⁾



Fig. 8 Husqvarna Svartpilen 401⁽⁷⁾



Fig. 10 Fantic E-Caballero

However, two models launched in 2018 that gained particular attention as flag-bearers for next-generation trends were the Husqvarna Vitpilen 701 and Svartpilen 401. These models have stand-out styling while still retaining a café racer theme (Figures 7 and 8).

These models feature cutting-edge chassis components and lights fitted to a relatively traditional engine frame. These bikes have extremely fresh designs that combine traditional proportions incorporating a basically horizontal long fuel tank with a modern and iconic solid look.

The Svartpilen has a highly novel crossover design created by the incorporation of off-road elements.

The borderless style of modern café racers has also started to influence the styling of cutting edge electrified bikes, as evidenced by the 2018 Milan Motorcycle Show (officially called the Esposizione Internazionale Ciclo Motociclo e Accessori (EICMA).

Motorcycles unveiled at this event included the Harley-Davidson LiveWireTM, which combines a traditional exterior design (Figure 9) with cutting-edge hardware, and was first shown as a prototype in 2014. The same approach has been applied by European and Chinese manufacturers to the new Fantic and Super Soco models exhibited in the show booths (Figures 10 and 11).

In these cases, the design has been achieved from the opposite direction to Husqvarna. To offset the high-tech battery and styling cues around the motor, these models feature extremely traditional exterior designs. Although



Fig. 11 Super Soco TC⁽¹⁰⁾

these are electric motorcycles, their design is in line with the current trend for a café racer-style image of freedom and user-friendliness.

Even new concepts that look ahead to the next generation are not being given futuristic styling that draws attention to their new technology. The manufacturers have incorporated the café image to stress that these products will fit in with customers' lifestyles.

This discussion has already suggested that some customers are shying away from overly strong brand imaging. For these people, extreme product-oriented proposals from manufacturers are not likely to fit comfortably with their needs.

Unpretentious motorcycle styling is like a suit of clothes that projects an image of the rider's lifestyle or a tool that communicates individuality. The psychology of customers that dislike wearing an image created by a manufacturer and having a standardized look may well

be connected to this trend that combines cutting edge technology with café racer style.

4 Concerns about Homogenized Styling through the Influence of the Internet

The 2018 EICMA featured a large number of proposed models incorporating café racer design cues from major manufacturers and those in emerging markets, extending from small to electric motorcycles. The momentum of manufacturers from emerging markets, who are primarily focusing on small motorcycles, was particularly evident. This café racer trend, which is not strongly reliant on branding or technical capabilities, is a business opportunity for these manufacturers. Products with a certain degree of competitiveness are entirely within reach if sufficient performance and quality can be combined with a reasonable price and café racer styling cues, which do not require particular risks on behalf of the designer. As customer preferences can be identified by intelligently linking the large volumes of data available on the Internet, any manufacturer can strike a chord with the market with relatively little effort.

Possibly due to the effects of the strong commitment of these manufacturers to enter today's distinctive market, the booths of major and emerging market manufacturers at EICMA did not show the large differences in mood that are usually evident.

Since each manufacturer seems to be treating the current café-style trend as a textbook for its new products, clear differences between manufacturers have begun to disappear. Many of the motorcycles on display looked much the same and would be indistinguishable without the manufacturer's badge.

In today's age where large volumes of data are easily obtainable over the Internet, this homogenization of styling of models that fall inside the definition of a café racer is also causing changes to the working styles of today's in-house designers.

Before the Internet age, motorcycle styling was created in an environment of limited information availability. Styling was expressed as imaginative value generated from knowledge and ideas built onto a designer's experience. It was a creator-driven process in which customers returned a fellow-feeling with a company by purchasing that company's motorcycles. This was an age of strong designer individuality in which these exchanges of value were relatively obvious and expressed through the prod-

uct.

Now, free ideas and proposals from the market have a large impact on development via the Internet, and this phenomenon is having a direct influence on the creative process of in-house designers.

Underlying the current café trend is the fact that it is easy to create an average sort of styling that can elicit fellow-feeling from customers, even without individual experiences or ideas, just by coordinating the overflowing resources of the Internet. It seems as if today's in-house designers are being increasingly required to act as producers that simply speedily collect and re-arrange information.

Over-dependence on information sourced from the Internet and the avoidance of risky activities such as the creation of new value may result in manufacturers prioritizing uniformity over individuality. Then, without realizing it, motorcycle styling may gradually become homogenized.

Due to the importance of volume to ensure profits, it is normal for in-house designers to be familiar with market trends. However, superficial communication with customers over the Internet and the withering of capabilities to make fresh proposals is lowering the idiosyncrasy of styling of individual manufacturers, which may cast a shadow over the revitalization of the market in the future.

In the years to come, if manufacturers can equate styling with corporate value, there is hope that in-house designers can create new and individual value by maintaining a dedication and passion to read the market and trends while carefully tracing the psyche of customers.

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