Motor Sports

1 Introduction

Although the Japanese economy showed signs of recovery in 2013, the world of motorsports continued to struggle with difficult economic conditions and cost reduction remained a key focus for each sport.

Despite this situation, bright spots for Japanese motorsports in 2013 included the announcement by Suzuki of a return to the pinnacle of motorcycle road racing in 2015, and Honda's decision to return to F1 as an engine supplier in the same year. Kamui Kobayashi also announced his return as an F1 driver for the 2014 season. Furthermore, the launch and adoption of entry-level sporty models such as the Toyota 86/Subaru BRZ as base models in various race categories promises a boost to motorsports in the future by widening the base of participation.

In 2013, further progress was made in preparations to merge the regulations for Super GT and the Deutsche Tourenwagen Masters (DTM: German Touring Car Masters) series from 2014. It is hoped that moves such as this will help further stimulate motorsports in Japan as the economy recovers.

In the engine field, the Nippon Race Engine (NRE) was announced. This is a concept 2.0-liter inline 4-cylinder turbocharged engine provided with a fuel flow restrictor. Developed in Japan, this engine will be used in the Super GT and Super Formula (formerly known as Formula Nippon) race series.

Outside Japan, it was announced that the FIA Formula E Championship would start in 2014 and that Porsche would return to endurance racing with a hybrid vehicle (HV) entrant in the FIA World Endurance Championship (WEC) in the same year. The engines used in F1 were changed to downsized 1.6-liter V6 direct injection turbocharged engines, with similar specifications to those used on commercially available vehicles. In place of the previous kinetic energy recovery system (KERS), F1 also decided to adopt a new energy recovery system (ERS) that also recovers thermal energy. These trends demonstrate the continuing desire of motorsports to adopt cutting edge environmentally friendly technology in addition to the pursuit of sheer speed.

2 Car Racing Trends (Table 1)

2. 1. Trends in Japan

Although there were no major changes to the regulations of any category in 2013, various organizational modifications and initiatives were carried out.

2. 1. 1. Super GT (Fig. 1)

In 2013, a total of eight rounds of the Super GT series and the Special JAF Grand Prix in November were held. In addition, the 2013 season introduced two knockout qualifying rounds instead of the customary Super Lap qualifying format.

In the GT300 class, the previous six categories have been reduced to three to increase the number of entrants and reduce costs. These categories are made up of FIA GT3 cars and JAF-GT300 cars that are based on authorized or registered vehicles. As a result, FIA-GT2 cars in the FIA GT category, LM-GTE cars, and low-production sports cars in the JAF-GT category, which were permitted to participate up to 2012, were unable to take part in Super GT in 2013. As in 2012, the regulations for performance adjustment of FIA GT3 cars continued to adopt world championship standards. As a result, the number of FIA GT3 cars in Super GT increased.

In the GT500 class, although no changes were made to the regulations used in 2012, 2013 was the last season of the rear-wheel drive (RWD) format using 3.4-liter V8 naturally aspirated (NA) engines. From 2014, races will be run under new chassis and engine regulations.

2. 1. 2. Super Formula (Fig. 2)

In 2013, the Formula Nippon series was re-named Super Formula and a change was made to the race lengths. As in 2012, excluding the dual race format of the final round, all Super Formula races are 250 km. However,

Table 1 Details and results of major car racing categories in 2013.

Category			Outline of races	Outline of vehicles	Participating Japanese manufacturers	2013 champions		Remarks
						Drivers	Manufacturers	
World championships	F1		19 rounds (circuits: Shanghai, Monaco, Brazil, South Korea, Suzuka, Abu Dhabi, etc.)	Dedicated race cars (formula) 2.4 -liter V8 NA engines	—	Sebastian Vettel (fourth consecutive year)	Red Bull Racing (team)	Sweeping changes to regulations planned for 2014
	Rally	WRC class	13 rounds on general roads (Sweden, Mexico, Greece, UK, etc.)	4WD cars based on commercially available vehicles Maximum 1.6 -liter direct-injection turbocharged engines	—	Sebastien Ogier	Volkswagen Motorsport (team)	Group R cars allowed to participate from 2013
		WRC-2 class	13 rounds on general roads (Sweden, Mexico, etc.), with 7 rounds counting toward the championship	Group N4, Super 2000, Group R4, and Group R5 cars based on commercially available vehicles	Subaru, Mitsubishi	Robert Kubica	Citroen World Rally Team (team)	
		SWRC class	13 rounds on general roads (Sweden, Mexico, etc.) , with 6 rounds counting toward the championship	2WD Group R1, Group R2, and Group R3 cars based on commercially available vehicles 1.6 -liter turbocharged engines, etc.	—	Sebastien Chardonnet	Citroen World Rally Team (team)	
	WEC		8 rounds (circuits: Silverstone, Spa, Circuit de la Sarthe in Le Mans, Fuji Speedway, Bahrain, Shanghai, etc.)	Dedicated race cars (open/closed body) LMP1 : Maximum 3.4 -liter NA, maximum 2.0 -liter turbocharged, or maximum 3.7 -liter turbo-diesel engines LMP2 : Cars based on commercially available vehicles, maximum 5.0 -liter NA or maximum 2.3 -liter turbocharged engines	Toyota, Nissan, Honda	Allan McNish Tom Kristensen Loic Duval	Audi Sport Team Joest (team)	
	Touring cars (WTCC)		24 rounds at 12 venues (Italy, Morocco, Germany, Japan (Suzuka), Macao, etc.)	2WD cars based on commercially available vehicles, maximum 1.6 -liter direct-injection turbocharged gasoline engines	Honda	Yvan Muller (Chevrolet)	Honda (manufacturer)	
	Dakar Rally		Held in a single direction through Peru, Chile, and Argentina	A mixture of commercially available and prototype vehicles, including motorcycles, cars, trucks, buggies, and all-terrain vehicles (ATVs).	Toyota, Mitsubishi, Nissan, Suzuki, Hino, Isuzu, Yamaha	Stephane Peterhansel (car), Cyril Despres (motorcycle), Eduard Nikolaev (truck)		
International series	Super GT	GT500 class	8 rounds (circuits: Suzuka, Sepang, Okayama, Fuji, etc.)	FWD cars based on commercially available vehicles, 3.4 -liter V8 NA engines Uniform vehicle ground height, width, wheelbase, and overhangs	Toyota, Nissan, Honda	Yuji Tachikawa Kohei Hirate		Special JAF Grand Prix also held
		GT300 class		Cars based on commercially available vehicles. Engine conversion, displacement, turbocharging, and drive wheels are not regulated but cars must be authorized FIA GT3 vehicles.	Toyota, Nissan, Honda Subaru	Hideki Kondo Yuki Nakayama		
	DTM		11 rounds (circuits: Hockenheim, Nurburgring, Brands Hatch etc.)	FWD cars based on commercially available vehicles, 4.0 -liter V8 NA engines	—	Mike Rockenfeller	Audi Sport Team Phoenix (team) BMW (manufacturer)	
	IRL		19 rounds on oval circuits (Indianapolis, San Paulo, Long Beach, etc.)	Dedicated race cars (formula) 2.2 -liter V6 direct-injection turbocharged engines Blended fuel consisting of 85 % ethanol and 15 % gasoline	Honda	Scott Dixon	Chevrolet (team)	
Japanese championships	Super Formula		6 rounds (originally 7 planned) (circuits: Suzuka, Motegi, Fuji, etc.)	Dedicated race cars (formula) 3.4 -liter V8 NA engines	Toyota, Honda	Naoki Yamamoto		Special JAF Grand Prix also held
	F3		15 rounds at 7 venues (circuits: Fuji, Okayama, etc.)	Dedicated race cars (formula) Maximum 2.0 -liter inline 4 -cylinder NA direct injection engines	Toyota, Honda	Yuichi Nakayama		

Table 1 Details and results of major car racing categories in 2013 (continued).

Category			Outline of races	Outline of vehicles	Participating Japanese manufacturers	2013 champions		Remarks
						Drivers	Manufacturers	
Japanese championships	Rally	Class 4	9 rounds on general roads (Hokkaido, Chubu, Kyushu, etc.)	4WD or 2WD cars based on commercially available vehicles, engine displacement: more than 3.0 -liters (turbo coefficient: 1.7)	Subaru, Mitsubishi	Norihiko Katsuta (fourth consecutive year) Sayaka Adachi		
		Class 3		4WD or 2WD cars based on commercially available vehicles, 1.5 to 3.0 -liter engines (turbo coefficient: 1.7)	Toyota, Honda, Daihatsu, Mitsubishi	Yoshinori Yokoo Soichiro Nagayama		
		Class 2		2WD cars based on commercially available vehicles, 1.4 to 1.5 -liter engines (turbo coefficient: 1.7)	Toyota, Mitsubishi, Honda, Mazda, Suzuki	Ken Kawana Noritaka Kosaka		
		Class 1		4WD or 2WD cars based on commercially available vehicles, maximum 1.4 -liter engines (turbo coefficient: 1.7)	Daihatsu, Honda, Nissan	Tatsuya Matsuoka Yukihiro Nawata		First participation of EVs, Class 4 championship decided in final race
Other	Pikes Peak International Hill Climb		Held once a year in Colorado (U.S.) a hill climb up to an altitude of 4,300 m.	Entries by various vehicles including the unlimited class, EVs, motorcycles, and sidecars	Toyota, Mitsubishi, Honda	Sebastien Loeb (car) Nobuhiro (Monster) Tajima		

Fig. 1 2013 Super GT: Car No. 38 (Zent Cerumo) (Source: PR materials of Toyota Motor Corporation).

Fig. 2 2013 Super Formula: Car No. 2 (Petronas Team TOM' S) (Source: PR materials of Toyota Motor Corporation).

the length of the opening race was set to 300 km.

From 2014, Super Formula will switch to a new chassis and the same engine format as the GT500 class of Super GT. Therefore, 2013 was the final season under the existing regulations.

2. 1. 3. Formula 3 (F3)

In 2013, the FIA F3 regulations were revised, requiring the adoption of direct injection gasoline engines. However, although the main F3 series in Europe decided to delay the switch to direct injection, the All-Japan Formula Three Championship made the change more quickly and the 2013 season was run using the new engines.

2. 1. 4. Japanese Rally Championship

As in 2012, a total of 9 rounds were held from April to October in locations stretching from Kyushu to Hokkaido. Following on from last year, Rally Hokkaido also served as the Japanese leg of the FIA Asia-Pacific Rally Championship.

Victory in Class 4, the highest category in the championship, was not decided until the final race. This race attracted a large number of spectators who watched Norihiko Katsuta become champion for the fourth consecutive year.

The 2014 championship will feature more classes, including one closer to commercially available vehicles, with the aim of attracting more participants and vitalizing the sport as a whole.

2. 2. Trends outside Japan

Although car racing outside Japan is still feeling the effects of the global economic downturn, organizers con-

tinued efforts to adopt more environmentally friendly regulations. At the same time, innovative changes to reduce costs and other measures were implemented to aid the recovery of motorsports and to encourage sustainability.

2. 2. 1. FIA Formula One World Championship (F1)

No major changes were made to the regulations ahead of the sweeping modifications due to be launched in 2014. As a result, 2013 was the final year for the 2.4-liter NA V8 engines introduced in 2006. To compensate for changes to the specifications of the tires provided by the sole tire supplier, the minimum weight of an F1 car was increased from 640 kg to 642 kg. Although each team worked hard to understand the characteristics of the new tires, the frequency of tire failures at the British Grand Prix led to the tires being declared unsafe, and the 2012 specifications were gradually re-introduced from the German Grand Prix.

An important change was also made to the aerodynamic regulations, with the introduction of more stringent front wing deflection tests. The permitted deflection in both the vertical and directions when a 1,000 N load is applied was reduced from 20 mm to 10 mm in an effort to restrict innovations related to aerodynamic performance.

2. 2. 2. FIA World Rally Championship (WRC)

The WRC is mainly held in European countries and no major changes were made to the technical regulations in 2013. However, a reorganization of the different classes resulted in a transitional season full of interesting developments. Despite the lack of changes to the regulations, 2013 was notable for the decision by Sebastien Loeb, who had won the championship nine times in a row up to 2012, to switch to the FIA World Touring Car Championship (WTCC) in 2014. As a result, Loeb only participated in four rounds of the 2013 WRC, before formally retiring at his home event of Rally France.

2. 2. 3. FIA World Endurance Championship (WEC)

The second year of the WEC saw no major changes to the technical regulations. The use of diesel engines was permitted in the LMP2 class. To reduce costs, new sporting regulations were also introduced restricting the number of engines and tires that may be used over the season.

2. 2. 4. FIA GT Series

Participants in the FIA GT Series drive authorized FIA GT3 cars. The key feature of this series is a system called balance of performance (BOP), which adjusts the performance of each car. The sporting regulations also aimed to reduce vehicle costs by adopting result-based weight handicaps called success ballast. However, despite these innovations, the FIA GT Series ended in 2013, the same fate as suffered by the previous FIA GT1 Championship.

2. 2. 5. FIA World Touring Car Championship (WTCC)

No major changes were made to the technical regulations of the WTCC in 2013 ahead of a major revamp planned for 2014. The east configuration of the Suzuka circuit was used for the third year to host the Japanese leg of the championship. However, in 2014, this will be changed to the same full circuit as used in F1. Honda participated in the WTCC from the final three races of 2012 and took the manufacturer's title in 2013.

2. 2. 6. FIA Formula E Championship

The launch of the FIA Formula E Championship was announced for 2014. This series will be a full-scale single-seater championship using electrically powered racing cars equipped with a common chassis, electrical system, powertrain, battery, and tires. Starting in Beijing, events are planned for six countries (all on closed street circuits) in the second half of 2014. This championship should help to stimulate global interest in environmentally friendly zero-emission car racing.

3 Motorcycle Racing Trends (Table 2)

2013 saw a continuance of the 2012 technical regulations in all categories of motorcycle racing. However, a number of organizational initiatives were implemented with the aim of vitalizing the sport.

In MotoGP, the highest class in the Road Racing World Championship Grand Prix, 2013 was the second season after the increase in engine displacement from 800 cc to 1,000 cc in 2012. Furthermore, the number of engines permitted over the season for prototype bikes was cut from 6 in 2012 to 5 in 2013. Teams using engines based on commercially available units (i.e., Claiming Rule Teams (CRT)) were limited to 12 engines, unchanged from 2012. As a result, one of the key points of the season was the battle to boost engine performance while further improving durability.

CRT status was introduced in 2012 as a participation qualification to encourage the participation of privateer teams. It gives eligible teams an advantage in terms

Table 2 Details and results of major motorcycle racing categories in 2013.

Category			Outline of races	Outline of vehicles	Participating Japanese motorcycle manufacturers	2013 champions	
						Riders	Manufacturers
World championships	Road races	MotoGP	Competition for position by racing around a circuit (approximately 110 km). Races are held in different countries and the total of points awarded at each race determines the annual standings. MotoGP is the highest class.	Dedicated bikes for MotoGP with 4-stroke maximum 1,000 cc engines	Honda, Yamaha	Marc Marquez	Honda
		Moto2		Dedicated bikes combining a 4-stroke 600 cc commercially available engine and bodies developed by each constructor	Honda (engine supplier)	Pol Espargaro	Kalex
		Moto3		Commercially available or dedicated racing bikes with a 4-stroke 250 cc engine	Honda	Maverick Vinales	KTM
	Superbikes		Same competition style as road racing, but uses a two-heat system of two races in each round.	Bikes with a commercially available maximum 1,000 cc engine (2-cylinder bikes are permitted a maximum displacement of 1,200 cc.)	Honda, Suzuki, Kawasaki	Tom Sykes	Kawasaki
	Endurance		Road races in which teams compete for position with two or three riders alternating stints on a single bike over an extended period of time (8 or 24 hours).	Bikes with a commercially available maximum 1,000 cc engine (2-cylinder bikes are permitted a maximum displacement of 1,200 cc.)	Honda, Yamaha, Suzuki, Kawasaki	Vincent Philippe Anthony Delhalle Julien Da Costa	Suzuki
	Motocross	MX1	Competition for position on a motocross (unpaved dirt or sand) track that lasts for 35 minutes + 2 laps (or 30 minutes + 2 laps for MX3) (two-heat system). Races are held in different countries and the total of points over a year determines the standings.	Dedicated motocross bikes with a maximum 4-stroke 450 cc or 2-stroke 250 cc engine	Honda, Yamaha, Suzuki, Kawasaki	Antonio Cairoli	KTM
		MX2		Dedicated motocross bikes with a maximum 4-stroke 250 cc or 2-stroke 125 cc engine		Jeffrey Herlings	KTM
		MX3		Dedicated motocross bikes with a maximum 4-stroke 650 cc or 2-stroke 500 cc engine		Klemen Gercar	Honda
	Trials		Competition to complete set courses within a time limit without touching the ground.	Dedicated trials bikes (no displacement restrictions)	Honda	Toni Bou	Montesa Honda
Japanese championships	Road races (JSB1000)		Competition for position by racing around a circuit. Races are held at different circuits and the total of points over a year determines the standings.	Bikes with a generally commercially available maximum 1,000 cc engine (2-cylinder bikes are permitted a maximum displacement of 1,200 cc.)	Honda, Yamaha, Suzuki, Kawasaki	Katsuyuki Nakasuga	Yamaha
	IA1 (motocross)		Highest class of the All Japan Motocross Championship. Competition for position on a motocross track lasting for roughly 30 minutes. Races are held at different tracks and the total of points over a year determines the standings.	Dedicated motocross bikes. The IA1 class features dedicated motocross bikes with a maximum 4-stroke 450 cc or 2-stroke 250 cc engine.	Honda, Yamaha, Suzuki, Kawasaki	Akira Narita	Honda
	IA super (trials)		Competition to complete set courses within a time limit without touching the ground. Highest class of the All Japan Trial Championship.	Dedicated trials bikes (no displacement restrictions)	Honda, Yamaha	Tomoyuki Ogawa	Honda
Other	Dakar Rally		Annual rally raid style (long-distance off-road racing) event, originally held between Paris, France, and Dakar in Senegal and moved to South America in 2009. The race is held under grueling conditions over two weeks and is roughly 10,000 km in length.	Bikes based on mass-production bikes with a maximum displacement of 450 cc	Honda, Yamaha, Suzuki, Kawasaki	Cyril Despres	KTM

of the permitted number of engines for the season, fuel tank volume (24 liters compared to 21 liters), and other regulations. From 2014, a compulsory common ECU will be introduced to simultaneously curb excessive electronic controls on prototype bikes and to narrow the performance gap between prototype and CRT bikes. CRT bikes were also permitted to use this ECU from 2013, which was another notable point of last year's season.

The minimum dry weight of the bikes was increased to 160 kg in 2013 from 157 kg in 2012. The participating teams cleared this hurdle and improved performance enough to shorten the average race time by 7 seconds compared to 2012.

There were various race-related and organizational changes in 2013. To ensure safety and smooth running, qualification for the MotoGP class was divided into two. Other changes included increasing the number of races in the U.S. to three. Continuing on from 2012, both the

Moto2 (which combines a single 600 cc commercially available engine type with a chassis supplied by a contractor, and was held for the fourth year in 2013) and Moto3 (which uses 4-stroke 250 cc engines, and was held for the second year in 2013) classes were equally compelling popular in 2013 with several bikes vying for top position.

Marc Marquez, the 2012 Moto2 champion took part in the MotoGP class for the first time. He re-wrote the record books by becoming the youngest-ever pole-position holder and race winner in 31 years, and the youngest-ever winner of consecutive races for 51 years. The first-ever rookie champion, Marquez won 6 races in 2013 and also became the youngest-ever world champion. Intense competition between riders, teams, and manufacturers ensured that final victory in the MotoGP class was not decided until the last race. The introduction of CRT status and other efforts to reduce costs has encouraged the participation of a large number of teams in the Road Racing World Championship Grand Prix. At the same time, technical and organizational efforts have successfully enhanced the sport as a spectacle.

In 2013, the leading road race series using production bikes was the Superbike World Championship, followed by the Endurance FIM World Championship and superbike championships held in each country around the world. The FIM Motocross World Championship incorporated various measures to expand the fan base and vitalize races in each category, such as holding its first ever night race in Qatar, introducing the so-called Super Final format featuring bikes from both the MX1 and MX2 classes, and organizing a race for the first time in Thailand.

4 Motorsport Tire Trends

Two main trends in motorsports since the global financial crisis in 2008 have been cost reduction and the creation of equally competitive conditions. For these reasons, both car and motorcycle race series have steadily switched to sole tire suppliers. For example, after the American Le Mans Series (ALMS) merges with the Grand-Am Rolex Sports Car Series in 2014, all classes except GTLM will use a sole tire supplier. In the case of motorcycles, the ST600 class will switch to a sole tire supplier in 2015 for the All-Japan Road Race Championship and in 2016 for regional races.

Running against this trend, Super GT in Japan is an example of a high-level series that is technically competitive on a global scale and that allows multiple tire suppliers. However, major changes are planned for Super GT in the future. The Super GT regulations underwent a complete revision with the aim of uniting the regulations with the DTM series from 2014. Tire regulations also changed greatly. The most significant changes are to the minor diameter of the front tire and to reduce the width of the tire (no important changes were made to the rear tires). Specifically, until 2013, a maximum width of 14 inches and a maximum outside circumference of 28 inches was permitted. From 2014, this was changed to a maximum width of 13 inches and a maximum outside circumference of 27 inches. Despite differences due to design methods, this roughly translates to a 7% reduction in width and a 3% reduction in outside circumference. Overall, the load-bearing air volume has been reduced by more than 15%, which presents challenges in terms of wear resistance and durability. Furthermore, changes to the vehicle regulations are likely to result in increased downforce, and tire suppliers will be required to ensure higher grip performance to make the best use of the dynamic potential of the Super GT cars. How teams and suppliers will tune and make full use of these smaller

Fig. 3 2013 MotoGP road race (JSB1000): Katsuyuki Nakasuga (source: PR materials of Yamaha Motor Company, Ltd.).

Fig. 4 2013 Dakar Rally: Helder Rodrigues on Honda CRF450 RALLY (source: PR materials of Honda Motor Company, Ltd.).

front tires will be of great interest.

Efforts to reduce costs are particularly significant in gymkhana competitions, which are a popular form of grass-roots motorsports in Japan. Classes that do not allow much scope for vehicle modifications tend to limit tires to so-called general radial tires. Although general radial tires have a lower grip than S type tires that are designed for competition, these tires apply lower loads to vehicles (which is particularly useful for vehicles that cannot be greatly modified), incur less damage, and are longer lasting. As a result, general radial tires are considered to a good way of helping to reduce racing costs (Fig. 5). After the PN and AE classes of the All Japan Gymkhana competition mandated the use of general radial tires from 2011, the number of vehicles in these classes grew rapidly. Currently, these tires are now used by around 33% of all participants. However, the general radial tire category is difficult to define in technical terms. Current regulations state that tires must have a continuous longitudinal grove running around the whole circumference. However, this also covers more specialist racing tires and may invite the use of tires against the basic purpose of the regulations.

Fig. 5 DIREZZA ZII STAR SPEC tire (source: Sumitomo Rubber Industries, Ltd.).

Therefore, in 2013, reflecting the growing environment consciousness of modern society, an idea was put forward to limit tires to those labelled according to the Japan Automobile Tyre Manufacturers Association (JATMA) system. This is due to be adopted in the PN and AE classes of the All Japan Gymkhana competition in 2015. As a result, 2013 may come to be regarded as the turning point when sporting regulations for tires as well as vehicles began to be determined in accordance with changes in the environment.