
Motor Sports

1 Introduction

In 2014, the results of the automotive industry improved in line with the depreciation of the yen. The situation of the world of motorsports reflected these trends.

In Japanese car racing, the same newly developed downsized 2.0-liter inline 4-cylinder turbocharged engines as found in mass-market cars were also introduced to the Super GT and Super Formula race series. It is hoped that technical feedback can be obtained from racing and then applied to the mass-market. In 2014, the regulations for Super GT and the Deutsche Tourenwagen Masters (DTM: German Touring Car Masters) series were finally merged, leading to more entries in the series and a more exciting spectacle.

Outside Japan, some teams in Formula 1 (F1) struggled to make the most of the new regulations, and clear differences in competitiveness emerged. The new electric Formula E series also started, reflecting the changing realities of the automotive industry. In the FIA World Endurance Championship (WEC), Toyota won both the manufacturers' and drivers' title with its hybrid vehicle (HV) entrants. Furthermore, 2014 was a year in which the results of female drivers stood out. Keiko Ihara became the first female driver to stand on the WEC podium. She became also the first Asian woman to complete Le Mans and was the top Japanese driver at the same event in 2014.

In motorcycle racing, MotoGP stands at the pinnacle of the sport. Marc Marquez (Honda) won his second successive championship in overwhelming fashion. Suzuki also continued testing with an eye on joining the series in 2015. It is hoped that the larger number of entries will make the sport even more exciting.

In 2015, key events include the return of Toyota to the FIA World Rally Championship (WRC), the participation of Nissan in Le Mans in the LMP1 class. Although it is hoped that the vitalization of motorsports will continue

as the business results of automakers improves, decreases in the number of fans as young people drift away from cars is a cause of deep concern.

2 Car Racing Trends

Table 1 lists the main categories of car races held inside and outside Japan, and the results of each competition.

2.1. Trends in Japan

In 2014, the two leading categories of Japanese car racing, the Super GT and Super Formula series saw major changes in vehicle regulations. These included the adoption of the next-generation Nippon Race Engine (NRE) that is designed to be more environmentally friendly than the outgoing engine.

2.1.1. Super GT (Fig. 1)

With the aim of achieving further international recognition, it was agreed to merge the regulations for the GT500 class with those for the DTM series. These regulations include adopting common parts such as the monocoque and gearbox, and using carbon brakes. A common air conditioning unit has also been adopted as standard equipment. Another change is the introduction of the NRE, 2.0-liter 4-cylinder turbocharged direct injection engines provided with a new fuel flow restrictor that are developed independently by each manufacturer. In combination with certain freely designable aerodynamic



Fig. 1 2014 Super GT: car number 23 (MOTUL AUTECH GT-R)⁽¹⁾

Table 1 Details and results of major car racing categories in 2014

Category	Outline of races	Outline of vehicles	Participating Japanese manufacturers	2014 champions		Remarks		
				Drivers	Manufacturers			
World championships	F1	19 rounds (circuits: Shanghai, Monaco, Austria, Suzuka, Russia, Abu Dhabi, etc.)	Dedicated race cars (formula) 2 WD 1.6-liter V6 turbocharged DI engines + energy regeneration	—	Lewis Hamilton	Mercedes (constructor)	Introduction of penalty point system for driving infractions	
	WEC	LMP1	8 rounds (circuits: Silverstone, Circuit de la Sarthe in Le Mans, Fuji, Shanghai, Bahrain, etc.)	Dedicated race cars (prototypes) 2 WD (HV may be 4 WD) HV: free engine design + energy regeneration Non HV: max. 5.5-liter engine	Toyota	Anthony Davidson, Sebastian Buemi	Toyota (manufacturer)	3 major works teams, participation of Porsche in LMP1-H Toyota wins world championship
		LMP2	Dedicated race cars (prototypes) 2 WD NA engines: max. 5.0-liter 8 cylinders Turbocharged engines: max. 3.2-liter 6 cylinders	Nissan, HPD (Honda) (engine supplier)	Sergey Zlobin			
		LM-GTE	Based on commercially available vehicles 2 WD NA engines: max. 5.5-liter Turbocharged engines: max. 4.0-liter	—	Gianmaria Bruni, Toni Vilander	Ferrari (manufacturer)		
	WRC	WRC	13 rounds on general roads (Sweden, Poland, Australia, etc.)	Based on commercially available vehicles 4 WD 1.6-liter direct-injection turbocharged engines	—	Sebastien Ogier, Julien Ingrassia	Volkswagen (manufacturer)	JWRC: junior category (max. age: 26) below WRC
		WRC2	Based on commercially available vehicles 4 WD Super 2000, R4, R5, N4	Subaru, Mitsubishi	Nasser Al-Attiyah, Giovanni Bernacchini			
		WRC3	Based on commercially available vehicles 2WD R1, R2, R3	—	Stephane Lefebvre, Thibault de la Haye			
	WTCC	24 rounds at 12 venues (Morocco, France, Argentina, Japan, Macao, etc.)	Based on commercially available vehicles 2 WD 1.6-liter direct-injection turbocharged engines	Honda	Jose Maria Lopez	Citroen (manufacturer)		
	International series	Super GT	GT500	8 rounds (circuits: Suzuka, Motegi, Fuji, Thailand, etc.)	Based on commercially available vehicles 2 WD 2.0-liter inline 4-cylinder turbocharged DI engine Common parts (monocoque, gearbox, etc.)	Toyota, Nissan, Honda	Tsugio Matsuda, Ronnie Quintarelli.	New cars (GT500), regulations merged with DTM
			GT300	Based on commercially available vehicles Drive wheels not regulated Engine conversions acceptable Cars must be authorized FIA GT3 vehicles	Toyota, Nissan, Honda, Subaru	Nobuteru Taniguchi, Tatsuya Kataoka		
DTM		10 rounds (circuits: Hockenheim, Hungaroring, Moscow, etc.)	Based on commercially available vehicles 2 WD 4.0-liter V8 NA engine Common parts (monocoque, gearbox, etc.)	—	Marco Wittmann	Audi (manufacturer)		
IRL		18 rounds (circuits: Long Beach, Indianapolis, Toronto, etc.)	Dedicated race cars (formula) 2 WD 2.2-liter V6 turbocharged DI engine Blended fuel consisting of 85 % ethanol and 15 % gasoline	Honda	Will Power	Chevrolet (manufacturer)		
Japanese championships	Super Formula	7 rounds (circuits: Suzuka, Motegi, Fuji, etc.)	Dedicated race cars (formula) 2 WD 2.0-liter inline 4-cylinder turbocharged DI engine	Toyota, Honda	Kazuki Nakajima		New SF14 model cars adopted	
	F3	15 rounds at 7 venues (circuits: Suzuka, Motegi, Fuji, etc.)	Dedicated race cars (formula) 2 WD Max. 2.0-liter inline 4-cylinder turbocharged NA engine	Toyota, Honda	Shinji Matsushita			

Table 1 Details and results of major car racing categories in 2014 (continued).

Category		Outline of races	Outline of vehicles	Participating Japanese manufacturers	2014 champions		Remarks
					Drivers	Manufacturers	
Japanese championships	Rally	9 rounds on general roads (Hokkaido, Tohoku, Chubu, Kyushu, etc.)	Based on commercially available vehicles 4 WD or 2 WD Min. 3.0-liter engine (turbo coefficient: 1.7)	Subaru, Mitsubishi	Fumio Nutahara, Tadayoshi Sato	/	RPN vehicle regulations started in 2014, applicable to JAF-registered vehicles as of Jan. 1, 2006
			Based on commercially available vehicles 4 WD or 2 WD 1.5 to 3.0-liter engine (turbo coefficient: 1.7)	Toyota, Subaru, Mitsubishi, Honda, Daihatsu	Takuma Kamada, Hakaru Ichino		
			Based on commercially available vehicles (JAF-registered) 2 WD 1.6 to 2.0-liter engine (turbo coefficient: 1.7)	Toyota, Subaru	Genki Takeuchi, Naoki Kase		
			Based on commercially available vehicles 2 WD 1.4 to 1.5-liter engine (turbo coefficient: 1.7)	Toyota, Mazda, Honda	Tomoyuki Amano, Yukiko Inoue		
			Based on commercially available vehicles (JAF-registered) 2 WD Min. 1.6 liter engine (turbo coefficient: 1.7)	Suzuki, Toyota, Mazda	Nobuyuki Tanaka, Megumi Fujita		
			Based on commercially available vehicles 4 WD or 2 WD Max. 1.4-liter engine (turbo coefficient: 1.7)	Daihatsu, Suzuki, Mazda, Honda	Masato Nakanishi, Yuki Mino		
Other	Dakar Rally	1 round, held in wild and desert areas through Argentina, Bolivia, and Chile	Dedicated rally vehicles (prototypes) Commercially based vehicles 2 WD or 4 WD	Toyota, Mitsubishi, Nissan, Suzuki, Hino	Nani Roma, Michel Perin	/	
	Pikes Peak International Hill Climb	1 round on paved roads (U.S.)	Dedicated racing vehicles (prototypes) EVs accepted Commercially based vehicles 2 WD or 4 WD	Mitsubishi, Nissan, Honda, Subaru	Romain Dumas		Mitsubishi took 2nd place overall with an entry in the EV class



Fig. 2 2014 Super Formula: car number 37 (Petronas TOM's SF14)⁽²⁾

parts, the result is a competitive race series based on engineering skill. The cars are also performance-balanced depending on race results using ballast, with ballast weights above 50 kg replaced by fuel flow restrictions. The effects of the new vehicle specifications resulted in faster lap times compared to 2013. In the GT300 class, most cars competed under the FIA GT3 category, but some entrants also registered as JAF-GT cars under the new “mother chassis” rule book. This is a concept to encourage the participation of independent private teams

and a number of new entrants are expected for 2015. Eight races will be held in 2015, the same number as the previous year, with the race in Malaysia replaced by a race in Thailand.

2.1.2. Super Formula (Fig. 2)

In 2014, newly developed cars were adopted that factor in the aerodynamic effects when overtaking during a race. These cars also use carbon brakes, the same NRE powerplants as adopted in GT500, and fuel flow restrictions to create competition based on engineering skills and combustion efficiency. A power button was also added to the steering wheel, enabling the driver to boost the fuel flow to 105% of the normal level, thereby creating a unique overtaking system that can be used five times for 20 seconds each time during a race. Unlike Super GT, Super Formula has a single chassis and tire supplier. Super Formula is positioned as a driver's race series at the pinnacle of Japanese motorsports that attracts a large number of top-level drivers from outside Japan. Including the final JAF GP event, the 2014 Super

Formula series consisted of 7 rounds, and the lap times were faster than those in 2013.

2.1.3. Formula 3 (F3)

In 2014, around 10 “C” class cars installed with the direct injection engines introduced in 2013 participated, creating an overall grid of around 20 cars including the older “N” class entries. In 2015, Japan will also host an FIA Formula 4 series, which is an entry category for junior drivers, at local JAF-sanctioned events. It is hoped that vitalizing the lower formulas will also have a knock-on effect on the more senior race series.

2.1.4. Japanese Rally Championship (JRC)

In 2014, in an attempt to revitalize the series, the JRC introduced the RPN category of regulations, which resemble normal cars, creating a total of six classes. The JN2 and JN4 classes of RPN cars have strict regulations restricting permitted modifications, reducing the cost of participation. In addition, to provide regional stimulus by enlisting the support of local authorities, a total of nine rounds were held, including one that served as the Japanese leg of the FIA Asia-Pacific Rally Championship.

2.2. Trends outside Japan

2014 was a turning point that saw finishing touches applied to the innovations being introduced to the international race series hosted by the International Automobile Federation (FIA).

Major changes included the introduction of 1.6-liter turbocharged engines with energy regeneration to F1 and the start of the Formula E series that looks to the future of the automotive industry. The world of motorsports is looking for sustainability by shifting to more environmentally friendly technologies with potential applications for the future, while also reducing costs. 2014 also saw the introduction of a common format for the Japanese Super GT 500 and DTM series. Furthermore, the two existing North American sports car racing series were merged and re-launched as the Tudor United SportsCar Championship (TUSCC). Global motorsport unification trends have now reached the U.S. and 2014 may be seen as the inaugural year of truly international competition.

2.2.1. FIA Formula One World Championship (F1)

The new regulations for 2014 included the introduction of a totally new powerplant, a 1.6-liter V6 direct-injection engine with a single turbocharger. This powerplant also features the regeneration of kinetic and heat energy, creating a further emphasis on energy efficiency. The



Fig. 3 2014 FIA WEC: car number 8 (Toyota TS040) ⁽²⁾

technical regulations for bodywork, aerodynamics, and weight were also revised. Cost cutting measures included new regulations restricting development, testing, and the number of available powerplants over the course of a season.

2.2.2. FIA World Rally Championship (WRC)

The 2014 season was dominated by the Volkswagen Polo. Many changes occurred in 2014, including the Rally of Poland replacing the Acropolis Rally, as well as the return of Hyundai to the competition and Pirelli as the tire supplier.

2.2.3. FIA World Endurance Championship (WEC) (Fig. 3)

The top category of LMP1 consists of hybrid cars from works teams. Interesting new per-lap fuel flow and electrical energy usage restrictions were introduced to boost energy efficiency. Porsche was a new entry, joining Audi and Toyota in a three-way battle that was won by Toyota, which took both drivers' and manufacturers' titles.

2.2.4. FIA World Touring Car Championship (WTCC)

In 2014, substantial performance improvements were introduced to create more exciting races over a fixed 60 km sprint format. The minimum weight requirement was lowered, engine horsepower was increased to 380 hp, and the tire size was also expanded. At the same time, body widths and splitter dimensions were increased, resulting in better more aggressive looking cars. Jose Maria Lopez won ten races for Citroen and took the drivers' title.

2.2.5. FIA Formula E Championship

This series held its first race in September 2014. The first year of the championship adopted a single car, the Spark-Renault SRT 01E. Each driver has two cars to compensate for the short continuous range achievable by the battery and must switch to the second car in a

pitstop during the race. For enhanced environmental appeal, all ten races are held on city circuits. To make the races more interesting, the innovative FanBoost voting system was introduced that allows fans to vote for their favorite drivers during the race. The top three vote getters are allowed to increase the output of the cars from 150 kW to 180 kW twice for 2.5 seconds, thereby creating bursts of extra acceleration.

2.2.6. Tudor United SportsCar Championship (TUSCC)

2014 saw the start of an accelerating trend toward globalization in North America. The Grand-Am Rolex Sports Car Series and American Le Mans Series (ALMS) were merged to form the new TUSCC format. The top category features LMP2 and Daytona Prototype cars, and it was also decided to combine the GT class with the Le Mans Series in 2017.

3 Motorcycle Racing Trends

Table 2 lists the main categories of motorcycle races held inside and outside Japan, and the results of each competition.

2014 was a year of transition for the world of motorcycle sport as technical regulations were revised with an eye on the future.

This section covers the top categories of motorcycle sports, with the main trends being described based on MotoGP, the Road Racing World Championship Grand Prix (Fig. 4).

In MotoGP, in addition to steps to reduce environmental pollution and restrict the performance of bikes that have been becoming faster and faster in recent years, a continuing theme has been the vitalization of the sport by striking a balance between lower costs and competitiveness. As part of these trends, the MotoGP class plans to make a common ECU (including hardware and software) compulsory for all bikes in 2016. All manufacturers have been given fair opportunity to participate in the design and development of this ECU. In preparation, the differentiation between prototype bikes and bikes using engines based on commercially available units (i.e., Claiming Rule Teams (CRT)) was scrapped and common ECU hardware was introduced, regardless of the type of bike. In addition, teams entering under the basic “open” class regulations also used common ECU software. Open-class bikes had the same 24-liter fuel tanks as used by CRT-class bikes up to the previous year. Al-

though the engine allocation was set to twelve, engine development was permitted freely over the season.

In an unusual move, factory options were defined and each manufacturer was permitted to use only four specified riders over the course of the year. Under the factory options, although independent ECU software development was permitted, the fuel tank was limited to 20 liters, and the maximum engine allocation was reduced to five. An authorization system was also adopted under which engine design was frozen from the opening event (regulations were relaxed for manufacturers in their first year of participation and manufacturers with poor results).

As negotiation conditions for changes to these regulations, the manufacturers agreed to sign contracts to provide bikes, engines, parts, and technical support to privateer teams, helping to even the playing field with the works machines.

In the same way, the Superbike World Championship (WSB), which features bike categories based on mass-market models, also plans to unify its regulations to the EVO class, which strictly regulates modifications from mass-market engines, in 2015. In preparation, the EVO class sub-category was introduced in 2014 alongside the existing Superbike (SBK) class. The EVO class ECU must be the same as that used in road bikes or a manufacturer-approved kit ECU with a price cap up to 1.5 times the stock ECU price.

The engine allocation is set to eight for the SBK class and six for the ECO class. Other regulations include upper limits on gear ratio combinations and maximum prices for brakes and suspension components. Furthermore, leading manufacturers are required to provide the same bike package to privateer teams on request and guarantee updates and maintenance throughout the season.

The FIM Motocross World Championship changed the name of the MX1 class to MXGP in 2014. The mixed format of MX1 and MX2 entrants, which was adopted for four Super Final events in 2013, was dropped in 2014.

In addition, although the 2-stroke 290 to 500 cc and 4-stroke 475 to 650 cc engine MX3 class was dropped from the world championship, a 2-stroke 300 cc class was added to the European Motocross Championships due to its low cost and appeal to young riders.

4 Motorsport Tire Trends

In various categories of motorsports, a common trend



Fig. 4 2014 MotoGP Road Racing World Championship Grand Prix: bike number 93 (RC213V) (supplied by Honda Motor Co., Ltd.)



Fig. 5 Pattern name: ADVAN NEOVA AD08R (supplied by The Yokohama Rubber Co., Ltd.)

Table 2 Details and results of major motorcycle racing categories in 2014

Category		Outline of races	Outline of vehicles	Participating Japanese motorcycle manufacturers	2014 champions					
					Riders	Manufacturers				
International series	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, Suzuki	Marc Marquez	Honda				
	Moto2						Dedicated bikes combining a 4-stroke 600 cc commercially available engine and bodies developed by each constructor	Honda (engine supplier)	Esteve Rabat	Kalex
	Moto3									
	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	Sylvain Guintoli	Aprilia				
	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	David Checa, Kenny Foray, Mathieu Gines	Yamaha				
	Motocross	MXGP	Competition for position on a motocross (unpaved dirt or sand) track that lasts for 30 minutes + 2 laps (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						Jordi Tixier	KTM	
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.	Bikes based on mass-production bikes with a maximum displacement of 450 cc	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	Marc Coma	KTM				

is to switch to sole tire suppliers with the aims of reducing costs and creating equally competitive conditions. For example, after ALMS merged with the Grand-Am Rolex Sports Car Series and TUSCC started up in in

2014, all classes except GTLM are using a sole tire supplier.

Swimming against the tide, Super GT in Japan is an example of a high-level series that is technically competi-

tive on a global scale and that allows multiple tire suppliers. However, the Super GT regulations underwent a complete revision in 2014 to merge with the DTM series. Tire regulations also changed. In 2013, the maximum width of the front and rear tires was 14 and 28 inches, respectively. From 2014, this was changed to a maximum width of 13 inches at the front and a maximum outside circumference of 27 inches at the rear. In addition, changes to the regulations will greatly increase downforce and vehicle speed, requiring higher tire grip performance. Therefore, major improvements in performance will be required to compensate for the smaller front tires, while also ensuring durability.

Other major competitions such as the WEC, WRC, and the Nürburgring Endurance Cup (VLN) also have open tire suppliers, but the classes in these series are essentially dominated by single suppliers and are not forums for open competition in the same way as Super GT, even when the races are used for technical development or to boost market share and sales through enhancing the performance of commercially available tires. In contrast, tire development competition is continuing in the All Japan Gymkhana (JGC) and JRC series, which are popular participant-based motor races in Japan.

The PN and AE classes of the JGC competition have already mandated the use of general radial tires and the JRC followed suit for its RPN (tarmac) class in 2014. Adoption of these tires to all classes is due to be extended from 2016. General radial tires are recommended because these tires have lower grip than the “S” class tires designed for competition. These tires impose lower loads on the vehicle and are longer lasting, leading to

significantly lower costs. Within the restrictions imposed on the definition of general radial tires, new competition in this category is already beginning.

Although the GR86/BRZ races that started in 2013 prohibited the use of “S” class tires, participants may use any tire supplier. This is heating up competition to develop better general radial tires, in the same way as the JGC series. In 2014, some suppliers began earnest efforts to develop winning tires. In 2015, two classes will be introduced, with last season’s tires (which have a dedicated design for racing) used in the Professional Series and commercially available general radial tires from any manufacturer used in the Clubman Series (Fig. 5).

As described above, the development of tires for motorsports is diverging greatly between open competition and single suppliers. In the case of open competition, the imposition of restrictions on the tires to be supplied generates new competition to develop those tires, which may eventually result in divergence from the original purpose of the restrictions (i.e., cost reduction or the like). Since even competition tires must satisfy cost and environmental requirements (i.e., compliance with legal regulations), tire manufacturers will have to consider how best to develop tires in the future from the standpoints of both technological development and social contribution.

References

- (1) Publicity materials of Nissan Motor Company Ltd.
- (2) Publicity materials of Toyota Motor Corporation