
MOTOR SPORTS

1 Introduction

In 2021, the world of motor sports continued to be affected by the COVID-19 pandemic, which caused planned regulations changes to be postponed, some races to be cancelled, and host regions to be changed. However, unlike the previous year, all categories of racing were able to implement measures against spreading infection and virtually the normal number of races were held despite the backdrop of the coronavirus. From an environmental perspective, many race categories announced regulation changes, including the adoption of hybrid engines or synthetic or biofuels, indicating that the search for sustainable forms of motor sports is becoming an even more serious trend.

As usual, each race series saw fierce competition. Outside Japan, Honda's F1 team took the drivers' championship on the last lap of the final race, providing a dramatic finale to their last year as a manufacturer in F1. Continuing on from last year, car racing inside Japan provided thrilling battles including come-from-behind championship-winning drama in the last race of the season.

In the field of motorcycle racing, MotoGP saw no fewer than eight different race winners across an evenly matched season, with Yamaha winning its first riders' championship in six years. Yamaha also took its first riders' title in the Superbike World Championship for twelve years, breaking Kawasaki's streak of six consecutive triumphs.

2 Car Racing Trends

2.1. Trends in Japan (Table 1)

In 2021, motor sports in Japan felt the lingering effects of the COVID-19 pandemic, with entry restrictions to Japan causing several drivers to drop out or miss races. These circumstances gave younger replacement drivers a chance to shine, with some successfully winning seats for next season.

The two top Japanese race series retained their popularity and crowned new champions. However, it cannot be denied that motor sports has been late in joining the fight against environmental issues. It is hoped that the leading organizations and manufacturers will cooperate in bringing together better countermeasures and adopting them across the different race series.

(1) Super GT (Fig. 1)

As was the case in the previous year, the rounds of the 2021 Super GT series that had been scheduled to take place outside Japan were cancelled and the season consisted of eight rounds held on six circuits, starting in April. Races returned to the Okayama International Circuit, Sportsland Sugo, and Autopolis. Despite restrictions on the number of spectators all races were held in front of crowds thanks to the continued application of measures to prevent the spread of COVID-19 infection.

From the 2021 season, the name of the system that applies a weight handicap based on the number of drivers' championship points was changed to the Success-Weight System. The intention of this name change is to emphasize that the handicap is being applied to the teams with the most successful results, and is the same name used by other series, including events outside Japan. However, only the name of the system has been changed. The system itself and the weights applied to both classes remain unchanged from 2020.

This season also saw the introduction of the full course



Fig. 1 Super GT: AU Toms GR Supra⁽¹⁾

Table 1 Details and Results of Major Car Racing Categories in 2021

Category	Outline of races	Outline of vehicles	Participating Japanese manufacturers	2021 champions		Remarks		
				Drivers	Manufacturer			
World championships/FIA championships	F1	22 rounds (circuits: Styria, Silverstone, Monza, Bahrain, Abu Dhabi, etc.)	Dedicated race cars (formula) 1.6 -liter V6 turbocharged engines + energy regeneration	Honda	Max Verstappen (Red Bull Racing Honda)	Mercedes	The Japanese Grand Prix was cancelled due to the COVID-19 pandemic.	
	WEC	LMH	6 rounds (circuits: Bahrain, Spa, Monza, Circuit de la Sarthe in Le Mans, Portimão)	Dedicated race cars (hypercars and prototypes) 2 WD (HVs may be 4 WD) HVs: free engine design + energy regeneration Non HVs: free engine design	Toyota	Jose Maria Lopez Kamui Kobayashi Mike Conway (Toyota)	Toyota	The Japanese round was cancelled due to the COVID-19 pandemic and the Bahrain round turned into a double header.
		LM-GTE Pro	2 WD cars based on commercially available vehicles NA engines: max. 5.5-liter Turbocharged engines: max. 4.0-liter	—	James John Calado Alessandro Pier Guidi (Ferrari)	Ferrari		
	Rally	WRC class	12 rounds on general roads (Monaco, Finland, Croatia, Portugal, Italy, Kenya, Estonia, Belgium, Greece, Spain)	4 WD cars based on commercially available vehicles Max. 1.6 -liter turbocharged engines	Toyota	Sébastien Ogier/ Julien Ingrassia (Toyota)	Toyota	Rally Japan was cancelled due to the COVID-19 pandemic.
	FIA Formula E	15 rounds on specially designed courses in cities (Saudi Arabia, Italy, Spain, Monaco, Mexico, the U.S., the UK, Germany)	Dedicated race EVs Power units: motor-generator unit (MGU) (linked to rear axle, during race: 200 kW, during qualifying: 250 kW) Batteries: standardized	Nissan	Nyck de Vries (Mercedes)	Mercedes		
	Touring cars	WTCR	16 rounds at 8 venues (circuits: Nürburgring, Estoril, Aragón, Most, Pau, Adria, Sochi)	2 WD cars based on commercially available vehicles (FWD) 1.75 to 2.0 -liter turbocharged engines HVs not permitted.	Honda	Yann Ehrlacher (Lynk & Co.) (Toyota)		
International series	Super GT	GT500 class	8 rounds (circuits: Okayama, Fuji, Suzuka, Motegi, Suga, Autopolis)	Dedicated race cars Race cars with the same silhouette as commercially available GT cars 2.0 -liter inline 4 -cylinder turbocharged engines	Toyota Nissan Honda	Yuhi Sekiguchi Sho Tsuboi	Round 3 was postponed due to the COVID-19 pandemic.	
		GT300 class	FIA GT3 vehicles (modification not permitted) JAF-GT300 (unique modifications permitted based on commercially available vehicles) JAF-GT300 MC (mother chassis) Balanced competition created via performance adjustments	Toyota Nissan Honda Subaru	Takuto Iguchi Hideki Yamauchi (Subaru)			
	DTM	8 rounds (circuits: Assen, Hockenheim, Norisring, etc.)	FIA-GT3 cars based on commercially available vehicles	—	Maximilian Götz (Mercedes)	Mercedes		
	IndyCar	16 rounds on oval circuits (Indianapolis, etc.), road courses (Mid-Ohio, etc.), urban courses (Long Beach, etc.)	Dedicated race cars (formula) 2.2 -liter V6 twin-turbocharged engines E85 fuel (blend of 85 % ethanol and 15 % gasoline)	Honda	Álex Palou Montalbo (Honda)	Honda	The round in Toronto, Canada, was postponed due to the COVID-19 pandemic.	
Japanese championships	Super Formula	7 rounds (circuits: Fuji, Suzuka, Autopolis, Suga, Motegi)	Dedicated race cars (formula) 2.0 -liter inline 4 -cylinder direct-injection turbocharged engines	Toyota Honda	Tomoki Nojiri (Honda)			
	Super Formula Lights	17 rounds (circuits: Fuji, Suzuka, Autopolis, Suga, Motegi)	Dedicated race cars (formula) 2.0 -liter inline 4 -cylinder direct-injection NA engines	Toms (Toyota) Tomei Engine Toda Racing	Teppei Natori (Opel)		Round 9 was cancelled due to adverse weather and added to the 5th competition.	

Table 1 Details and Results of Major Car Racing Categories in 2021 (Continued).

Category	Outline of races	Outline of vehicles	Participating Japanese manufacturers	2021 champions		Remarks
				Drivers	Manufacturer	
Japanese championships	JRC 8 rounds on general roads (Shinshiro, Karatsu, Tango, Takasaki, Hokkaido, Takayama, Kumakogen)	Commercially available vehicles Divided into 6 classes (JN1 to JN6) based on displacement and layout (4 WD, 2 WD).	—	JN1 : Norihiko Katsuta/ Yusuke Kimura (Toyota) JN2 : Heikki Kovalainen/ Sae Kitagawa (Toyota) JN3 : Nao Otake/Megumi Fujita (Toyota) JN4 : Shintaro Nishikawa/ Takashi Motohashi (Suzuki) JN5 : Tomoyuki Amano/ Yukiko Inoue (Toyota) JN6 : Shota Yoshihara/ Genshu Sano (Toyota)		Rounds 1 and 8 were cancelled due to the COVID-19 pandemic.
Other	Dakar Rally The 2021 event was held in Saudi Arabia. Total length: 7,646 km Start/finish: Jeddah	Dedicated race cars and prototypes Commercially available vehicles and dedicated race vehicles (trucks) NA gasoline engines or turbo-charged diesel engines	Toyota Hino	Stephane Peterhansel/ Edouard Boulanger		

yellow (FCY) flag system, which was used for the first time during the second round held at Fuji Speedway.

The vehicle regulations for the GT300 class are formulated by the GT Association (GTA) and the cars are known as GT300 cars or GT300MC cars (MC: mother chassis). FIA GT3 cars continue to adopt the regulations recognized by the International Automobile Federation (FIA). In addition, starting in 2021, restrictions were placed on modifications to aerodynamic parts on GT300 and GT300MC cars, which reduced the advantage of these cars compared to FIA GT3 cars.

(2) Super Formula (Fig. 2)

The points system for the drivers' championship that was introduced in 2020 was maintained, recognizing the restrictions placed on people entering Japan from other countries due to the COVID-19 pandemic. Therefore, to support drivers unable to attend every race due to quarantine regulations or the like, the championship was decided based on the five best results of each driver from the seven races. Other measures put into place to prevent the spread of COVID-19 infection were also continued. However, the conventional schedule of qualifying on Saturday and race day on Sunday was reintroduced in 2021. In addition, the sixth round of the season, which was scheduled for the Okayama International Circuit, was cancelled and replaced with a race at Twin Ring Motegi.

(3) Super Formula Lights

2021 was the second season of this unique Japanese racing category. Similar to 2020, this series featured a



Fig. 2 Super Formula: Team Mugen⁽²⁾

drivers' championship fought between 14 cars (combining a single-make chassis and a sole tire supplier, with entrants allowed to select between three types of direct injection 2.0-liter engines designed specifically for racing) and 17 drivers.

Despite changes to the date and circuit of the final event and postponements due to adverse weather, a total of 17 races were held over six rounds. Fiercely competitive races living up to the reputation of Super Formula Lights as a feeder series resulted in a total of eight different winners, four in the Overall category and four in the Masters' Class.

(4) Japanese Rally Championship (Fig. 3)

In 2021, the Japan Rally Championship (JRC) continued to be affected by the state of emergency and measures required to address the COVID-19 pandemic. As a result, two out of the ten scheduled rounds were cancelled. Of the remaining eight rounds, six were held on tarmac (at Shinshiro in Aichi Prefecture, Karatsu in Saga Prefecture, Tango in Kyoto Prefecture, Takasaki in Gunma



Fig. 3 JRC: Norihiko Katsuta and Yusuke Kimura of Toyota Gazoo Racing⁽³⁾



Fig. 4 F1: Red Bull Racing Honda⁽²⁾



Fig. 5 WRC: Toyota Yaris⁽³⁾

Prefecture, Takayama in Gifu Prefecture, and Kumakogen in Ehime Prefecture) and two were held on gravel (Obihiro and Niseko in Hokkaido). Virtually all the events were held behind closed doors, with the seventh round in Niseko, Hokkaido, the first round for two years to be held in front of spectators, allowing people to see the power of these high-performance rally cars in action. Historically popular entrants such as the Mitsubishi Lancer Evolution and Subaru WRX STI were joined by new cars such as the Skoda Fabia R5 and Toyota GR Yaris, creating a completely new lineup for the JN1 class. Although the first round was won by a WRX STI as rival cars dropped out, subsequent rounds were taken by the Fabia R5 (four wins) and the GR Yaris (3 wins), creating a massive change in the competitive landscape. Although there were no major technical changes in 2021, talking points arose around the classification system and safety measures. The JRC places FIA R5, Gr-N, and RJ (under Japanese regulations) cars in the same JN1 class. However, because these cars may differ in weight by up to 200 kg, performance adjustments were proposed. Specific proposals were considered for next season. (It was finally decided to impose the Success-Weight System on the top three cars in 2022.) Safety measures became an issue after an accident at the first round in Shinshiro. The importance of a tracking system was debated, with the Japan Automobile Federation (JAF) strongly recommending the introduction of such a system to rally organizers in 2022.

(5) Super Taikyu Series

The Super Taikyu Series started in Japan in 1991 as an event primarily for cars based on mass-production models, and has a distinguished history as Asia's largest pro-am race series. It is a team sport that has developed through both cooperation and competition between professional drivers and amateurs that want to experience the lifestyle of a racing driver.

Participants in races enjoy friendly competition while emphasizing fairness and putting safety first. In addition to placings in races, the focus of the Super Taikyu Series is to help the motor sports community to develop and grow.

The 2021 season continued to be held under the shadow of the COVID-19 pandemic. Measures to prevent the spread of infection, such as PCR tests for all participants enabled a six-race series to be held, consisting of nine classes, 54 teams, and 262 entrants. This season was notable for the participation of carbon-neutral cars powered by hydrogen engines and biodiesel. Further initiatives to encourage carbon neutrality are expected in 2022.

2. 2. Trends outside Japan (Table 1)

Following on from 2020, official FIA world championships were held in the Formula 1 (F1), World Endurance Championship (WEC), World Rally Championship (WRC), and World Touring Car Cup (WTCR) categories. 2021 also saw the addition of Formula E as an official world championship. It was also the final year under the current F1 and WRC regulations, and saw the debut of new regulations in the WEC. The new regulations in each of these categories include specific measures to address environmental issues, strengthening the tendency of manufacturers to choose which championships to enter based on the internal policies of each company. Although the COVID-19 pandemic resulted in some changes to the dates and venues of the 2021 season, these championships managed to minimize reductions in the numbers of events. The virtual races that were organized to replace cancelled events in 2020 were held again in the off-season, and have begun to be appreciated as events that can liven up the non-racing calendar.

(1) FIA Formula One World Championship (F1) (Fig. 4)

Although affected by the COVID-19 pandemic, a total of 22 races were held in the 2021 F1 season, the highest



Fig. 6 WEC: Toyota GR010 Hybrid⁽³⁾



Fig. 7 WTCR: Honda Civic TCR⁽²⁾



Fig. 8 FIA Formula E: Nissan's Sebastien Buemi⁽⁴⁾

number in history.

With the revision of the chassis regulations, which had originally been planned for 2021, pushed back to 2022, teams brought minimal updates to the table. In contrast, every team incorporated updated power unit specifications.

As an experiment to liven up the race program, 100 km sprint qualifying races were held on the afternoon before the main race at three events. A further increase in the number of sprint qualifying races is being considered for 2022 to replace the conventional method of determining the starting grid of the main race by a knockout system.

In 2021, the Drivers' Championship went to Max Verstappen, who triumphed after a close battle that was almost unprecedented in recent history. The Constructors' Championship was won by the Mercedes-AMG Petronas F1 Team for the eighth consecutive year.

(2) FIA World Rally Championship (WRC) (Fig. 5)

Despite changes to the schedule due to the effects of the COVID-19 pandemic, the 2021 WRC season was held over twelve rounds. However, although Rally Japan was due to be held as the last round, it was decided to cancel this event in September.

In the final season under the current World Rally Car regulations that were introduced in 2017, Toyota took all three titles: the Manufacturers', Drivers', and Co-Drivers' Championships. The team of Sébastien Ogier and Julien Ingrassia won their eighth Drivers'/Co-drivers' titles.

In 2022, the WRC adopted the new Rally1 regulations. These regulations are notable for requiring a common hybrid unit to be fitted to the 1.6-liter turbocharged engine. Engines are also required to use a 100% sustainable non-fossil fuel. Rally1 became the first FIA motor sports world championship to adopt a sustainable fuel (consisting of a blend between synthetic and biofuels).

(3) FIA World Endurance Championship (WEC) (Fig. 6)

The 2021 season saw the replacement of the LMPI class with the new Le Mans Hypercar (LMH) class, alongside major changes in vehicle regulations. Although LMH cars are significantly heavier and larger than LMP1 cars, their maximum power is lower. Hybrid systems may be adopted, but only to drive the front wheels. The regulations also require the performance of each car to be adjusted. In this first season, Toyota (the only works team) was joined by Glickenhaus and Alpine. Toyota won all six races with its newly developed GR010 Hybrid, including the 24 Hours of Le Mans. In the future, Peugeot, Ferrari, Porsche, and Automobile plan to enter the WEC in either the LMH or Le Mans Daytona h (LMDh: governed by regulations defined by the International Motor Sports Association (IMSA) in North America) classes between 2022 and 2023. As a result, the WEC will regain its status as a stage for competition between automakers.

(4) FIA World Touring Car Cup (WTCR) (Fig. 7)

From 2021, the FIA WTCR mandated use of a new premium blended bio-gasoline fuel (E15). Originally scheduled events in Asia (Korea, China, and Macao) were cancelled and replaced with events in the Czech Republic, France, and Russia. Drivers' and teams' titles were awarded after sixteen races over eight rounds featuring front wheel drive (FWD) cars based on commercially available vehicles with a 1.75- to 2.0-liter turbocharged engine complying with the TCD regulations. In 2022, twenty races are planned over ten rounds, including events in Asia. In addition, 2022 will also see the inauguration of the FIA e Touring Car World Cup (FIA ETCR) fought between electric vehicles based on the TCR regulations. ETCR races will be held jointly with WTCR races at three events (France, Hungary, and Korea).



Fig. 9 IndyCar Series: Chip Ganassi Racing⁽²⁾

(5) FIA Formula E Championship (Fig. 8)

This, the seventh season of Formula E, was the first to be held as an official FIA world championship. Unchanged from 2020, 2021 saw the participation of twelve teams, twenty-four drivers, and ten manufacturers. Instead of the regular Formula E calendar that stretches across two different years, the COVID-19 pandemic resulted in the 2021 season starting in February in Saudi Arabia and ended in August in Germany. Rounds were held in seven countries primarily in Europe, but also in the U.S. and Mexico. A total of fifteen races were held, two in each round apart from Monaco. Season 7 was the third year of the Gen2 race car. It was announced that the Gen2 EVO car, which features modifications such as a facelifted cowl, would be introduced. However, its debut was cancelled due to the COVID-19 pandemic and the Gen2 car will be adopted until season 8 (2021 to 2022).

(6) IndyCar Series (Fig. 9)

Of the seventeen originally scheduled events, the Toronto race was cancelled due to the COVID-19 pandemic. However, the remaining sixteen rounds saw finely-balanced races in which nine different drivers came out as winners. The largest event in the series was the 105th running of the Indianapolis 500. The checkered flag was taken in front of 135,000 spectators by 46-year-old Helio Castroneves, the joint-oldest winner of the race and his fourth Indianapolis 500 crown. Alex Palou, who won the 2019 Super Formula series in Japan won the Drivers' Championship in his second year of participation in the IndyCar Series, and Honda took its fourth consecutive Manufacturers' Cup, a string of victories that started in 2018.

(7) Cooperation between the Automotive Industry and Esports (Fig. 10)

In 2021 vehicle-related esports became even more diverse and made further progress into the mainstream.



Fig. 10 Gran Turismo Sport: TM & © Sony Interactive Entertainment Inc. Developed by Polyphony Digital Inc.⁽⁵⁾

The Gran Turismo World Series entered its fourth season and Japan's National Prefectural Competitive Esports Championship was held for the third consecutive year, this time in Mie Prefecture. This event attracted 7,000 participants from 47 prefectures and regions around Japan. The age of participants ranged from 6 to 84, and the races drew an audience of 400,000 people. The Toyota Gazoo Racing GT Cup is a pioneering manufacturer-organized esports event. It also held a world championship in 2021, creating esports heroes in countries around the world. In addition, the Porsche Gran Turismo Cup, which is organized by Porsche Japan, achieved success by expanding its scope to the whole of the Asia/Pacific region. The Red Bull 5G esports event organized by Red Bull was held for the first time in two years and the Autobacs JeGT Grand Prix held its grand final during the Tokyo Auto Salon. Other esports events include the Tokyo Esports Festa in which participants competed for the Tokyo Governor's Cup and the Nissan Satio Saga GP organized by Nissan Satio Saga. This was a year that drew attention to the potential scope and cost scalability of esports.

3 Motorcycle Racing Trends (Table 2)

Table 2 lists the status and results of the main categories of motorcycle races held inside and outside Japan in 2021.

Although the racing schedule was partially revised and some events cancelled in 2021 as well, the COVID-19 pandemic had a lesser impact than in the previous year. Event organizers, manufacturers, and the media worked together to hold exciting races across every category.

The world road race championships maintained the same stringent COVID-19 protocols as in 2020 and held eighteen rounds of races, three more than the previous

Table 2 Details and Results of Major Motorcycle Racing Categories in 2021

Category		Outline of races	Outline of vehicles	Participating Japanese motorcycle manufacturers	2021 champions		
					Riders	Manufacturer	
World championships/FIM championships Road races	MotoGP	Competition for position by racing around a circuit (approximately 110 km).	Dedicated bikes for MotoGP with 4 -stroke max. 1,000 cc engines	Honda Yamaha Suzuki	Fabio Quartararo (Yamaha)	Ducati	
	Moto2	Races are held in different countries and the total of points awarded at each race determines the annual standings. Moto2 is the highest class.	Dedicated bikes combining a 4 -stroke 765 cc commercially available engine and bodies developed by each constructor	—	Remy Gardner (Kalex)	Kalex	
	Moto3	Same competition style as road racing, but uses a three-heat system of three races in each round.	Commercially available or dedicated racing bikes with a 4 -stroke 250 cc engine	Honda	Pedro Acosta (KTM)	KTM	
	Superbikes	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 (from 3 to 24 hours).	Bikes with a commercially available max. 1,000 cc engine (2 -cylinder bikes are permitted a max. displacement of 1,200 cc.)	Honda Yamaha Kawasaki	Toprak Razgatlioglu (Yamaha)	Yamaha	
	Endurance	Competition for position on a motocross (unpaved dirt or sand) track that lasts for 30 minutes + 2 laps (two-heat system).	Bikes with a commercially available max. 1,000 cc engine (2 -cylinder bikes are permitted a max. displacement of 1,200 cc.)	Honda Yamaha Suzuki	Kawasaki Gregg Black Xavier Simeon Sylvain Guintoli (Suzuki)	Yamaha	
	Motocross	MXGP	Races are held in different countries and the total of points over a year determines the standings.	Dedicated motocross bikes with a max. 4 -stroke 450 cc or 2 -stroke 250 cc engine	Honda Yamaha Kawasaki	Jeffrey Herlings (KTM)	KTM
		MX2	Competition for position on a specially prepared motocross course inside a stadium that lasts for 20 minutes + 1 lap. Races are held at different tracks mainly in North America and the total of points over a year determines the standings.	Dedicated motocross bikes with a max. 4 -stroke 250 cc or 2 -stroke 125 cc engine	Honda Yamaha Kawasaki	Maxime Renaux (Yamaha)	Yamaha
	Supercross	Competition to complete set courses within a time limit without touching the ground.	Dedicated trials bikes (no displacement restrictions)	Honda	Cooper Webb (KTM)	KTM	
	Trials	Competition for position by racing around a circuit. Races are held at different tracks and the total of points over a year determines the standings.	Dedicated motocross bikes with a max. 4 -stroke 450 cc or 2 -stroke 250 cc engine	Honda Yamaha Kawasaki	Toni Bou (Honda)	Honda	
	Japanese championships	Road races (JSB1000)	Competition for position by racing around a circuit. Races are held at different tracks and the total of points over a year determines the standings.	Bikes with a generally commercially available max. 1,000 cc engine (2 -cylinder bikes are permitted a max. displacement of 1,200 cc.)	Honda Yamaha Suzuki	Katsuyuki Nakasuga (Yamaha)	
ST1000		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.	Bikes with a generally commercially available max. 1,000 cc engine (scope of permitted modification restricted, sole tire supplier)	Kawasaki	Kazuma Watanabe (Honda)		
IA1 (motocross)		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)		
IA Super (trials)		Held in the Middle East (Saudi Arabia). Total length: 8,000 km	Dedicated rally motorcycles (prototypes) 2 -stroke max. 450 cc engines	Honda Yamaha	Kevin Benavides (Honda)		
Other							

year. Locations remained mainly in Europe where traveling distances are shorter. However, excitement began to return with more events allowing vaccinated spectators to attend races and the holding of the first Grand Prix of the Americas for two years.

The MotoGP class saw tight races with fifteen or more riders lapping within 1 second of each other. These finely balanced races were won by eight different riders. Fabio Quartararo (Yamaha) took his inaugural Riders' Championship by winning the most races (five), Yamaha's first



Fig. 11 2021 MotoGP Champion Fabio Quartararo (Yamaha)⁽⁶⁾

riders' title in six years (Fig. 11). Ducati won the Constructors' Championship for the second successive year. Fabio Quartararo won the fastest qualifier award after taking five pole positions. Jorge Martin (Ducati) was named Rookie of the Year and won a race during the season. Following on from the previous year, the best finish managed by Takaaki Nakagami (Honda) was fourth place in his fourth year in the top series. Hopes remain high for a podium finish in 2022. In addition, Valentino Rossi (Yamaha) announced his retirement at the end of 2021, bringing the curtain down on a career that contributed so much to motorcycle racing and included twenty-two years in the top class of the sport, seven Riders' Championships (2nd all time), 89 race victories (1st), and 199 podium finishes (1st).

In the Moto2 class, the championship was won by Remy Gardner (Kalex) with five wins. He plans to step up to MotoGP in 2022 alongside rookie Raul Fernandez (Kalex) who fought for the title until the last race, taking eight checkered flags along the way, more than any other rider. In his rookie season, Ai Ogura (Kalex) took the podium after finishing second after a powerful run in one event, finishing eighth in the final championship table.

In the Moto3 class, the championship was won by rookie Pedro Acosta (KTM) with six wins. He plans to step up to Moto2 in 2022. The highest finisher of the Japanese riders that participated in every event in this class was Ayumu Sasaki, who came ninth overall.

The Superbike World Championship (WSB) features bikes based on mass-market models. In 2021, thirty-seven races were held over thirteen rounds, including the first Argentinian Grand Prix in two years and the first-ever Indonesian Grand Prix. The final results saw Toprak Razgatlioglu (Yamaha) defeating Jonathan Rea (Kawasaki), who had won the last sixth successive titles. This was Yamaha's second riders' title and first for twelve years. All Japan JSB1000 champion Kota Nozane (Yamaha) struggled with unfamiliar tracks and tires, but managed to record a season's best result of seventh in the last race.

In the All Japan Road Race Championship, Katsuyuki Nakasuga (Yamaha) again demonstrated overwhelming dominance by winning every race in the JSB1000 class on the way to his tenth championship. The ST1000 class, which places strict limits on the scope of modifications, was won by a new champion, Kazuma Watanabe (Honda).



Fig. 12 Trials: Honda Cota 4RT⁽²⁾

In the Endurance FIM World Championship, Yoshimura SERT Motul, a joint team consisting of members of Yoshimura Japan and the Suzuki Endurance Racing Team (SERT) took the checkered flag in the first race, the storied 24 Hours of Le Mans, as well as at the 24-hour Bol d'Or. This was the first championship season for Yoshimura SERT Motul as a joint team. It was the seventeenth title for SERT and the second in a row. Yuki Takahashi (Honda), who won the ST1000 class in 2020, joined F.C.C. TSR Honda France. He won round two after the 12-hour race at Estoril, but could only finish fifth overall.

The MXGP class of the Motocross World Championship was won by Jeffrey Herlings of the KTM factory team after missing many races since 2020 due to injury. He won nine out of the eighteen races in the season, pushed all the way by Romain Febvre (Kawasaki) and 2020 champion Tim Gajser. This was Herlings' second championship and first for three years.

The 2021 AMA Supercross World Championship was won by Cooper Webb (KTM) in a fiercely fought series that came down to the last race. This was his second title and first in two years. Ken Roczen (Honda) took second place overall, followed by 2020 champion Eli Tomac (Kawasaki) in third. At 18-years old, Jo Shimoda won Japan's first Riders' Championship in the more junior 250SX class, taking second place overall.

The All Japan Motocross Championship was taken by Kei Yamamoto (Honda) by winning two out of the six rounds after a close season that went down to the final race. This was his third successive title. Only three points behind and second overall was Toshiki Tomita (Yamaha). The champion Kei Yamamoto went on to announce his retirement at the end of 2021.

The FIM Trial World Championship was won for an unprecedented fifteenth successive year by Toni Bou

(Honda), who showed overwhelming dominance by winning seven out of the nine rounds. Japan's first world champion (2004) in the event, Takahisa Fujinami (Honda), took sixth place overall with one victory and announced the end of his twenty-six-year-long career. In other series, the All Japan Trial Championship was won by Tomoyuki Ogawa (Honda) for the eleventh time. This was his tenth title in succession.

The Dakar Rally was held in Saudi Arabia for the second consecutive year. The 2021 course was designed to emphasize navigation skills over raw speed, creating an even more difficult race than usual. Chasing their second consecutive victory, all four members of the Honda factory were on top form and won stages (nine out of a total of twelve). Despite two of the team being forced to retire in the closing stages, Kevin Benavides took his first overall title in the event. Ricky Brabec, the winner in 2020, took second overall, Honda's first one-two finish since 1987.

As described above, motorcycle racing both inside and outside Japan continued to work hard to attract more fans in the 2021 season by harnessing the efforts of the whole industry, creating opportunities to raise media awareness throughout the season.

4 Motor Sport Tire Trends (Fig. 13) —

Most motor sports both inside and outside Japan continue to adopt a single tire supplier. No changes occurred to this trend in 2021. This is mainly to suppress rising costs caused by increasingly stiff competition over vehicle development.

However, 2021 also saw the beginning of parallel sustainable initiatives.

In addition to obvious vehicle-related trends such as electrification and the adoption of biofuels, tires are also an important target of environmentally friendly actions.

In the case of ordinary tires for passenger vehicles and the like, the need has arisen for sustainable resource-saving design and production activities, measures for sustainable consumption, and appropriate actions for recycling, regeneration, and reuse to reduce wasteful use of resources, lower the risk of environmental destruction, and build a so-called circular economic system. Although tire manufacturers are developing products to satisfy these requirements, pressure to do the same is finally being applied to motor sports tires, and race organizers have teamed up with tire manufacturers to start work-



Fig. 13 Super GT: Bridgestone Tires⁽⁷⁾

ing on this issue.

One possible measure is to reduce the number of tires used in races.

For example, Super GT, Japan's top category of car race, allows competition by multiple tire manufacturers to supply specialty tires. This creates fierce competition related to tire development.

As a result, tires are developed by these companies to realize ideal performance at the ambient temperature and road surface temperature of particular races. Competing tire manufacturers bring two or three compounds (rubber types) to each race and the teams select the appropriate one for the race conditions that day or their race strategy. This means that some tires are left unused during the race.

One sustainable initiative proposed by the GTA (the organizer of Super GT) was to limit the number of tire sets. In 2021, the upper limit of seven dry sets and nine wet sets per car that can be brought to a circuit for a 300 km race was reduced to six sets of dry tires.

Obviously, limiting the number of tire sets may adversely affect the tire strategy during race week. Although the development of long-mileage (low-wear) tires with a wide range of operating temperatures will be necessary in the future, tire manufacturers have already demonstrated ingenuity in cooperating with the restrictions on the number of tire sets in 2021.

Formula E provides a more progressive example. In Formula E, the number of tires that a car can use in a race week is limited to eight (two sets) and dry and wet tires are handled as the same. This is an example of a race series that has taken the lead in applying the concept of sustainability to tires rather than stopping at just electrification.

The organizer of the 24 Hours of Nürburgring endurance race has also announced restrictions in the number

of tire sets to tire manufacturers. Consequently, this trend is likely to continue in the future, particularly for endurance races. Further restrictions on the number of tire sets is likely, which will force tire manufacturers to develop tires capable of being used for longer and under a wider range of temperatures.

Material trends that are also likely to affect race tires in the near future include a switch away from the use of scarce raw materials to naturally derived materials, as well as the adoption of recyclable materials, something that is already happening in the development of ordinary tires.