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The implementation of Drag Reduction Systems (DRS) in modern
Formula 1 Racing

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1 Introduction

This report investigates the implementation of the Drag Reduction System (DRS) in modern Formula 1 Racing and how it has changed the way cars operate and race in modern Formula 1 Grand Prix race weekends.

1.2 Aims

An examination on how the Drag Reductions System has been implemented into modern Formula 1 cars. A detailed investigation into why this implementation has been made and how this relatively new concept to formula 1 has changed the way the Formula 1 cars operate and complete overtakes.

1.3 Objectives

The objective of the report is to use information supported by research, to find why the Drag reduction system was first introduced to Formula 1 and how since the introduction it has changed the way the cars are developed.

2 Literature Review

2.1 What is DRS

DRS also known as the Drag Reduction System is a driver-operated system used for aid in overtaking to increase the chance of wheel-to-wheel racing in F1. DRS was introduced to Formula 1 in the year 2011 to improve straight-line speed while overtaking (AUTOSPORT, 2022), DRS would make it easier for a driver to gain an advantage on the car defending from the overtake. The drag reduction system requires the driver to open a part of the rear wing to decrease the level of drag while accelerating in a straight line, this can only be done while the car is within one second of the car in front (AUTOSPORT, 2022).

2.2 implementation of DRS

The Drag reduction system was introduced into Formula 1 in 2011 to combat the dirty and turbulent air that was coming off the cars while a driver was attempting to overtake. Turbulent air would cause the driver to be stuck behind a car and would increase the difficulty of attempting an overtake. Turbulent air caused unpredictable handling and increased tyre wear due to the car sliding, this was caused by air moving around one car and hitting the car behind on the front wing (AUTOSPORT, 2022). This effected the cars while attempting an overtake as the front wing is responsible for creating most of the downforce on the car and controls the wake of the front wheels behind it (Newey, 2017).

The implementation of the Drag Reduction System was made to Formula 1 to decrease the amount of drag acting on the car while a driver was attempting an overtake on track. Drag is the aerodynamic force which is created when an object is moving through air. In formula 1 it takes away the strength from the power unit and causes the car to lose speed (Newey, 2017).

The implementation of DRS also introduced DRS zones to Formula 1 racetracks with most tracks having between 2 or 3 DRS zones, this however excludes the circuit de Monaco (Monaco) and Autodrome Enzo e Dino Ferrari (Imola) as they only include 1 DRS zone due to the lack of straight-line speed opportunities. DRS zones are accompanied by DRS detection zones. DRS detection zones are marked by a white line going across the track, this is to signify the detection zone where you must be one second or less behind the car that is in front. Following the detection zone is the activation zone where the driver can then enable DRS (Howson, 2020).

The use of DRS does not guarantee that the driver will complete a overtake but is instead used to increase the chance of an overtake and decrease the distance between the drivers.

2.3 influence of DRS

Figure 1 – Full overtaking data from 1990-2016 (Barretto, 2016)

Year	Overtakes	Races	Average per race
1990	494	16	30.9
1991	495	16	30.9
1992	406	16	25.4
1993	392	16	24.5
1994	289	16	18.1
1995	297	17	17.5
1996	186	16	11.6
1997	265	17	15.6
1998	207	16	12.9
1999	260	16	16.3
2000	279	16	16.4
2001	230	17	13.5
2002	235	17	13.8
2003	303	16	18.9
2004	287	18	16.2
2005	207	19	10.9
2006	291	18	16.2
2007	270	17	15.9
2008	267	18	14.8
2009	211	16	13.2
2010	452	19	23.8
2011	821	19	43.2
2012	870	20	43.5
2013	760	19	40.0
2014	636	19	33.5
2015	509	19	26.8
2016	866	21	41.2

DRS has created a major influence on wheel-to-wheel racing and overtaking since its implementation to the sport in 2011. Data collected on overtaking in F1 from 1990-2016 shows this influence, this can be seen in (Figure 1). Figure 1 shows the comparison of data collected between the F1 seasons and gives an average of overtakes completed per race for each season . From this data it shows that prior to the implementation of DRS the average overtakes per race never exceeded 30.9 overtakes (1990/91). 2005 was the lowest average with only 10.9 overtakes per race. This data collected gradually shows the result that

turbulent air had on the cars from 1990 to 2005 as overtaking decreased by 67.6% in 15 years. The Formula 1 season of 2011 was the year that DRS was first implemented to try and decrease the effect that turbulent air had on the cars. Data gathered from the 2011 season shows that the average overtakes per race was 43.2 this was an increase of 44.9% in overtaking compared to the previous season of 2010 which only had an average of 23.8. The 2012 season followed up with an increased average again to 43.5 overtakes and held the record of most overtakes in a season with 870 overtakes completed throughout (Barretto, 2016).

The drag reduction system has had a profound influence on Formula 1 since its introduction, however not all its influence on the sport has been good. DRS allows the driver to attempt a better chance at overtaking while being one second or less behind the car in front, with this implementation comes the effect of the driver being able to follow the car in front with more ease. The effect that is caused by DRS is known as a DRS Train (Shovlin, 2022); this is when a group of drivers are stuck behind one another all whom of which are using DRS. For example, if Lewis Hamilton is second place, and struggles to keep pace with Max Verstappen in first, Hamilton will become the lead of the train. As he struggles with pace and other drivers will form behind him and begin a train. Each driver behind also has DRS but due to them all being in a train the effect is cancelled out and overtaking becomes more difficult (Nichol, 2022). Formula 1 has tried to combat the effect of the DRS train by further developing the aerodynamics of the cars making it easier to follow one another in turbulent air and decreasing the chance of a DRS train happening, however this problem still arises with similar performing cars in the midfield teams.

3 Results and Discussion

From all the information gathered and discussed about so far, it is clear to see that the implementation of the Drag Reduction system has had a clear effect to modern Formula 1. The data above shows how since its implementation in 2011 overtaking in Formula 1 has increased by a significant amount (Figure 1). The implementation of the Drag Reduction System of course did not come with some drawbacks in the form of DRS trains (Shovlin, 2022). The results from the data collected show that there have been problems with DRS however the beneficial effects that DRS have on Formula 1 racing outweigh these drawbacks. These beneficial effects can be seen throughout the data collected. Formula 1 drivers do think it has made a good impact on the sport with Charles Leclerc stating that “DRS needs to stay for now otherwise races would be boring” (Leclerc, 2022). Carlos Sainz also made a comment on DRS saying that “without DRS it’s almost impossible to overtake nowadays” (Sainz, 2022) The Formula 1 drivers also think that DRS has had a positive impact on the complications with turbulent air with Max Verstappen commenting “cars are better to follow” (Verstappen, 2022) (Cooper, 2022). These statements

from the drivers can be compared to the data collected to reinforce the effect of DRS.

4 Conclusion

The research and findings show that the implementation of DRS has worked in Formula 1, and the implementation has done what it was meant to do by increasing wheel-to-wheel racing and creating more opportunities to overtake. While also being able to decrease the amount of turbulent air the cars were facing prior to the 2011 season. Data shows that overtaking increased by 44.9% in the first year it was implemented, the percentage continued to increase the following year in 2012 which also held the most overtakes in a season with 870 overtakes completed. Research and data also revealed that turbulent air had a considerable effect on the cars from 1990-2005 with overtaking decreasing by 67.6% in 15 years. Without the implementation of DRS data suggests that overtaking would be more difficult and there would be less overtakes without it, this can also be seen in the discussion above with the drivers' own opinions on DRS as well. The implementation of the Drag Reduction System was a well needed change that Formula 1 had to implement to reduce the effects of turbulent air was having on the cars while trying to attempt an overtake. It is without question that data shows if DRS had never been implemented there would be a decrease in overtaking in Formula 1 racing and the sport would be very different compared to what it is today with DRS.

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