



The Greatest Formula 1 Driver of All Time

An objective assessment of the relative success and performance levels of drivers across the 70-year history of Formula 1

Carteret Analytics - Quantitative Analysis

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1. First, a little(ish) bit of science...

From investment banking to professional football to Formula 1

At **Carteret Analytics** we have developed the quantitative analysis utilised to good effect in investment banking for trading strategy, portfolio optimisation, derivatives pricing and hedging, and risk management by our sister corporate finance firm, Carteret Capital - and applied it to professional football. Carteret Analytics now provides cutting-edge quantitative analysis to a number of leading clubs around the world. Our work in football covers player recruitment, manager assessment (and recruitment), and team performance analysis (including opposition analysis).

Carteret Analytics has since expanded its quantitative analysis in sport to cover rugby union, rugby league, cricket, cycling and motorsport (including Formula 1).

Purely objective

An integral part of the analyses is to calculate a purely objective measure of the player's/cyclist's/driver's performance levels. In the case of a football player it rates and values the player's contribution to their team winning matches. In the case of motorsport, we objectively measure over 40 metrics for every driver, and for every race; and we have been able to apply the majority of these metrics in this *Research Paper* for every Formula 1 driver that has won a World Title since Formula 1's inception in 1950 (and, as you will read, Stirling Moss).

Carteret Rating

Irrespective of whether the athlete is a football player, rugby player, cricket player, cyclist or, in this case, a Formula 1 driver, they will receive a unique **Carteret Rating**. This is the proprietary and objective measure of the athlete's performance levels, and enables the club, team, athlete or the reader of this *Paper*, to compare one athlete directly to another. It completely cuts-through any subjective opinions.

Each athlete's **Carteret Rating** is highly accurate at predicting future performance. Ordinarily, the Carteret Analytics team will test the athlete's actual performance (after each match/event/race) against their **Carteret Rating** - and apply a **R-squared Value**. This allows us to assess the level of accuracy of the predictive aspect of the Carteret Rating over a respective period of time (usually a season in the case of a football player).

For Formula 1 drivers since 1950, we reconstructed this methodology so that we begin the quantitative analysis at the start of each driver's Formula 1 career - from his first Formula 1 race. We then measure a **Carteret Rating** in his first race, and then test the accuracy of that Rating after his next race, and then the next race... and so on. In each case, we test the **Carteret Rating** (and apply an **R-squared Value**) after every single race. The results of the **R-squared Value** test will then determine any alterations that need to be made to the underlying algorithms, to achieve a set of algorithms that have the best possible **R-squared Value** to accurately measure drivers, on a homogenous and objective basis, over different eras.

Key Race Events ("KREs")

In football, the **Carteret Rating** identifies key events in every match that have been objectively measured (with a high degree of accuracy) to contribute (in varying degrees) to the team achieving incrementally better outcomes. These are *Key Match Events*. We then measure every player's contribution to every

single *Key Match Event*, in every single match for which we have data, to produce a **Carteret Rating** that demonstrates, objectively, how good that player really is (at contributing to their team winning matches). It is a huge piece of analysis, and consequently Carteret Analytics has built the largest, and most accurate, data analysis model in world football.

Carteret Analytics has applied this same approach to **Formula 1**. Accordingly, we have identified a number of **Key Race Events (“KMEs”)** that have been objectively tested (and thus demonstrated) to increase a driver’s probability of winning a race. Of course, a driver does not necessarily go on to win a race for a wide variety of reasons and factors. However, through this unique quantitative analysis Carteret Analytics is able to take account of the contextual factors that might contribute to the driver’s probability of winning a race - both positive and negative - and which are out of his direct control or influence.

For instance, certain contextual factors (such as the driver’s constructor [recent] win levels; or contextual engine performance for the track at which the next race is taking place, relative to other engines) might influence a driver’s **Expected Win (xW)** attribute. The role of the Carteret Analytics team is to then measure the driver’s performance against the metrics and **KREs** that produce the **xW** attribute in the next race, to then determine how this will impact his **Carteret Rating**. This also illustrates that a driver’s **Carteret Rating** is dynamic, and will change with each race in which he has participated - and the quantitative model allows the team to go back in time and objectively measure the performance of past drivers in each of their races (after each race) as if we are measuring the performance of current F1 drivers after each race.

By applying the algorithms in this manner, it enables the Carteret Analytics team to, for example, effectively ‘equalise’ changes in technology to measure the same classification and model of performance levels in the context of equalised factors. To again use a driver’s **xW** as an example, the objective measure of a driver’s **xW** performance is not measured directly against drivers of different eras (with different technology, and other conditions and factors), it is the **xW** of the driver *at the margin* - in other words, the **xW** for the driver’s actual next race with contemporary rivals; not a hypothesised race.

The car, the engine and other equipment

It is often contended that certain F1 drivers could be just as good as other drivers (or better) if they had the same car, engine, and assorted other factors in common. The fact is that no two drivers have ever had exactly the same equipment, or identical circumstances - there will always be differences, even at a micro level. Some drivers might argue that it is unfair that they are not in the ‘best car’ or that they do not have the ‘best engine’, and to an extent (with a good degree of accuracy) the Carteret Analytics quantitative model enables the team to predict how a driver might perform if he was ‘transposed’ to using different equipment.

For the purposes of this *Research Paper*, the starting point is always to determine what each driver has achieved in terms of demonstrable success (such as World Titles). This cannot be ignored and should not be discounted simply because of subjective opinions about whether or not they had better equipment than other drivers. This *Paper* is, after all, identifying the best Formula 1 driver of all time.

However, if the only measure of the best Formula 1 driver of all time is World Titles then the joint best drivers are Michael Schumacher and Lewis Hamilton; if it is number of wins, then it is Lewis Hamilton; if it is World Titles per Grand Prix raced or wins per laps raced, then it is Juan Manuel Fangio. But, Hamilton has participated in more Grand Prix than Fangio (Fangio and his contemporaries raced in non-Championship races, and in other formula and sports cars) and it could be argued that Hamilton has had more opportunity to win more World Titles, and achieve more race wins.

We have to normalise these factors (as outlined above); and also combine a number of **KREs** to identify certain *Attributes* that provide a more rounded and objective picture of the performance levels of a driver, and which are not contingent on changes in technology and other era/period specific factors.

Attributes

Expected Wins (xW)

This *Attribute* is an adaptation of our measure for current drivers - to predict each driver's probability of winning the next race. It is based on a plethora of metrics/**KREs**, the driver's weighted performances to date, and key 'normalised' extraneous factors. In the context of this *Research Paper*, we have been able to reconstruct each driver's career (as outlined above) to build a complete series of **xW** measurements - just as we do for drivers that are currently competing in Formula 1. We can then objectively compare every driver (across 70 years) to determine how they performed against an extrapolated prediction/outcome.

For the purposes of this *Paper* the **xW** gives an objective indication of how each driver performed against his expected probability of winning races. Ultimately, the overriding objective of any F1 driver is to win races - and this is the best measure of the driver's relative success in that regard.

Speed (Success-adjusted)

This *Attribute* is not just a measure of a driver's raw speed. If that was the case, then a driver might score well under this *Attribute* with a number of fast laps but without succeeding in maximising the probability of winning races. This 'Speed' *Attribute* must have an element of adjustment for success that is, specifically, derived from the driver's speed. It is also 'normalised' across races, eras, constructors, engines, technology etc., so that it does not become simply an absolute measure of speed - which would be unfair on drivers from earlier eras.

The specific purpose of this *Attribute*, in the context of this *Research Paper*, is to isolate the relative measure of speed - and to identify which driver achieved the greatest measure of success from his relative speed.

Agility

This is an *Attribute* that addresses a driver's ability to transition between different [season-long] characteristics (that are outside of the driver's direct control). It goes some way to providing an objective insight into a driver's capability to adapt and achieve relative success in transitioning between changing and extraneous circumstances. It is important to note that this is not a measure of a driver's ability to adapt to short-term circumstances, such as changes in weather during a Grand Prix weekend (or during the Grand Prix itself) - these are taken into account for **KREs** within other *Attributes* (such as **xW** and **Success-adjusted Speed**), and in the driver's overall **Carteret Rating**.

Agility is more of an objective assessment of a driver's ability to achieve success with a period of transitioning between incrementally different power units/engines and chassis (which happens for every driver between seasons), as well as the more significant changes that a driver might experience in changing engine manufacturers and constructors.

Dominance

The **Dominance Attribute** is principally measured in actual results - whether they are World Titles, wins, podiums, pole positions, leading races... and a myriad of other indicators that provide a means of comparison, to enable us to determine if a driver is performing at an objective level that is relatively higher than all, or the majority, of his competitors. It is an important *Attribute* because to be the greatest Formula 1 driver of all time you need to do more than reach a [high] objective level sporadically. The greatest F1 driver should achieve demonstrable success over an extended period.

We recognise that any driver only has the opportunity to dominate Formula 1 (and his contemporaries) during the period of his career, and it is that level of **Dominance** which is measured in a *1st Tier algorithm*. We then adjust the respective *1st Tier algorithms* for every driver across the 70 years of Formula 1 to provide a level of homogeneity (removing era-based variables - for instance, technological changes, power units, points awarded for positions in a race, etc.). It is this homogeneous *2nd Tier algorithm* that we then apply to all the drivers to determine their objective level of **Dominance**.

Consistency

The **Consistency Attribute** helps us understand the ability of a F1 driver to consistently achieve high performance levels. It is distinct from **Dominance** because a F1 driver might dominate key metrics for a period of his career, but this could be materially impacted or enhanced by extraneous (contemporaneous) factors (although we do make allowances for extraneous factors that cause variability between eras).

A driver that, for example, consistently delivers titles, wins, pole positions, fastest laps, and leading laps over an extended period, particularly one that ranks highly in other *Attributes*, is likely to have a high **Carteret Rating**.

Note on attributes:

These *Attributes* are not cumulative. They are not measures that, when combined together, add-up to a driver's **Carteret Rating**. A driver's **Carteret Rating** involves six tiers of algorithms, with, inter alia, adjustments for success, era variability, contemporaneous conditions, race structure, championship structure, number and level of competitive drivers. The **Carteret Rating** is akin to a 'Moneyball' number - it is a single number that reflects the distillation of a huge amount of quantitative analysis to produce a rating that allows you to objectively compare one F1 driver with every other F1 driver (across eras and technological changes).

The purpose of the *Attributes* is to enable the reader to understand the different driving abilities and characteristics of a driver. It is not the total picture. For instance, **Fernando Alonso** is objectively rated as the 10th best F1 driver of all time, despite marking relatively lower than a number of the other drivers in the Top 20 across a number of these *Attributes*. **Alonso** has won two World Titles and has displayed very high scores in a number of specific metrics and **KREs** - and these are what have produced the 10th best **Carteret Rating**. By comparison, **Stirling Moss** did not win any World Titles but demonstrated incredible capabilities across these five *Attributes* - and particularly on **Agility** - and this has placed him as the 11th best F1 driver of all time despite not winning a World Title.

2. So, who is the Greatest F1 Driver of All Time?

The table at **Exhibit 1** (below) ranks the Top 20 F1 drivers of all time. As outlined in detail in **Section 1** (above), each driver's **Carteret Rating** provides a highly accurate and objective assessment of the performance levels of every driver over the 70 years of Formula 1. **Carteret Analytics'** quantitative methodology (again, as explained in **Section 1** above) is able to homogenise extraneous and time/era specific variables so that we can accurately compare one driver with every other driver over the whole 70 years of the sport.

Exhibit 1: Table outlining the Top 20 Formula 1 drivers of all time, based on their *Carteret Ratings*, together with their performance attributes

CarteretAnalytics		Top 20 Formula 1 Drivers of All Time						
Rank	Driver	Career	Carteret Rating	Expected Wins (xW)	Speed (Success-adjusted)	Agility	Dominance	Consistency
1	Juan Manuel Fangio	1950 - 1958	579.8	57.4	46.0	64.5	63.7	25.8
2	Lewis Hamilton	2007 - Present	571.4	46.2	32.0	25.0	58.9	21.2
3	Michael Schumacher	1991 - 2012	551.7	37.3	26.2	50.4	53.2	20.9
4	Alberto Ascari	1950 - 1955	510.7	68.1	48.2	27.8	66.7	39.0
5	Jim Clark	1960 - 1968	461.4	57.9	39.9	24.9	51.8	30.7
6	Ayrton Senna	1984 - 1994	439.7	48.7	29.0	44.7	48.5	23.6
7	Sebastian Vettel	2007 - Present	429.0	31.1	20.2	33.2	40.7	15.9
8	Alain Prost	1980 - 1993	404.0	29.2	20.9	59.9	41.1	13.9
9	Jackie Stewart	1965 - 1973	325.5	33.1	20.9	34.7	41.1	17.6
10	Fernando Alonso	2001 - 2018	315.8	12.1	8.6	42.4	19.5	5.1
11	Stirling Moss	1951 - 1961	306.1	37.1	26.6	61.0	33.9	17.4
12	Nigel Mansell	1980 - 1995	303.2	29.7	19.3	50.9	30.6	14.7
13	Niki Lauda	1971 - 1985	293.1	22.5	14.7	53.3	29.9	11.7
14	Nelson Piquet	1978 - 1991	273.4	15.4	11.0	55.0	24.4	8.0
15	Mika Hakkinen	1991 - 2001	266.3	22.6	15.3	24.2	27.6	12.6
16	Jack Brabham	1955 - 1970	241.5	17.3	11.2	44.7	26.4	10.2
17	Graham Hill	1958 - 1975	209.9	10.8	6.9	38.2	17.3	5.6
18	John Surtees	1960 - 1972	194.6	14.6	14.0	70.5	20.3	3.3
19	James Hunt	1973 - 1979	186.1	21.8	15.2	31.4	24.5	9.3
20	Emerson Fittipaldi	1970 - 1980	180.6	8.7	6.9	30.8	16.2	3.3

Headlines:

- Juan Manuel Fangio is objectively the greatest Formula 1 driver of all time.** Not only does he have the highest **Carteret Rating**, but he was consistently exceptional across all the *Attributes*: **Expected Wins (xW)**, **Success-adjusted Speed**, **Agility**, **Dominance** and **Consistency**.

- The quantitative analysis shows that **Lewis Hamilton is the second-best Formula 1 driver of all time**, and his **Carteret Rating (571.4)** is only a little lower than **Fangio (579.8)**.
- There are some rumours that **Hamilton** might retire at the end of the 2020 F1 Season, but assuming that he does not retire his current trajectory indicates that **he will become the greatest Formula 1 driver of all time within the course of the 2021 F1 Season**.
- Nevertheless, there is a balance to strike. If **Hamilton** extends his F1 career without a level of objective success that can be currently extrapolated from his performance levels over the last five seasons, then it could reduce his **Carteret Rating**.
- We have seen this, for example, with **Fernando Alonso**. An extended period of racing in F1 (which will be extended further in 2021), with much lower objective success in more recent years, has seen his **Carteret Rating (315.8)** fall over the last five seasons. It may yet fall further, and he is **currently the tenth best F1 driver of all time**.
- **Michael Schumacher is currently the third best F1 driver of all time with a Carteret Rating of 551.7**. This **Carteret Rating** is now locked-in, and it might yet prove a threat to **Lewis Hamilton** if Hamilton extends his career but with less success in forthcoming seasons.
- It is very interesting to see **Alberto Ascari** in fourth place (**Carteret Rating of 510.7**). **Ascari** is often referenced as an exceptional F1 driver, but, because he raced in the 1950s, it is difficult for current generations to appreciate his objective performance levels. His career was cut short by a fatal accident, and we can see from his extrapolated performance metrics that he had a strong possibility of being the best F1 driver ever.
- By a similar token, **Jim Clark's** career was cut short by a fatal accident, and he is objectively as the fifth best F1 driver of all time.
- **Ayrton Senna (439.7)** is often touted as the best F1 driver of all time by F1 fans, usually with an emphasis on his 'natural' and 'combative' driving style. **Senna is objectively the sixth best F1 driver of all time**, and the high ratings that he achieved in each of the five *Attributes* indicates that he did have exceptional levels of performance across the board.
- The objective analysis strongly indicates that **Senna's** performance trajectory would have seen him much higher in the rankings if he had been able to perform at an equivalent level for another four seasons. Indeed, with an additional two world titles, on the extrapolated trajectory for a further four seasons, **Senna could have been the greatest F1 driver of all time**.
- Another driver that is worthy of a mention is **Stirling Moss**. His **Carteret Rating of 306.1** positions him as the eleventh best F1 driver of all time - despite never winning a World Title. Nevertheless, it can be seen from **Moss'** high ratings in each of the *Attributes* that achieved exceptional performance levels across the board. **If Moss could have won one world title, he would have been in the Top 10; two world titles, and he could have been in the Top 5**.

Other Observations:

- **Exhibit 2** (below) provides a visual representation of the *Attributes* of each of the Top 20 F1 drivers.
- Some interesting observations include **Ascari, Clark, Hamilton** and **Fangio** have achieved the most success of the Top 20 from the speed of their driving.
- **Graham Hill, Alonso, Emerson Fittipaldi** and **John Surtees** all won World Titles and achieved significant objective success from the **Agility** of their driving, but interestingly none of them ranked especially highly - **Alonso** ranked the highest at tenth.
- **Hamilton's Dominance** over the last six years is clearly illustrated in the chart; and it is interesting to see the high **xW** levels for **Hamilton, Senna, Ascari** and **Clark**.

Exhibit 2: Stacked bar chart showing the Attribute Percentiles for all drivers

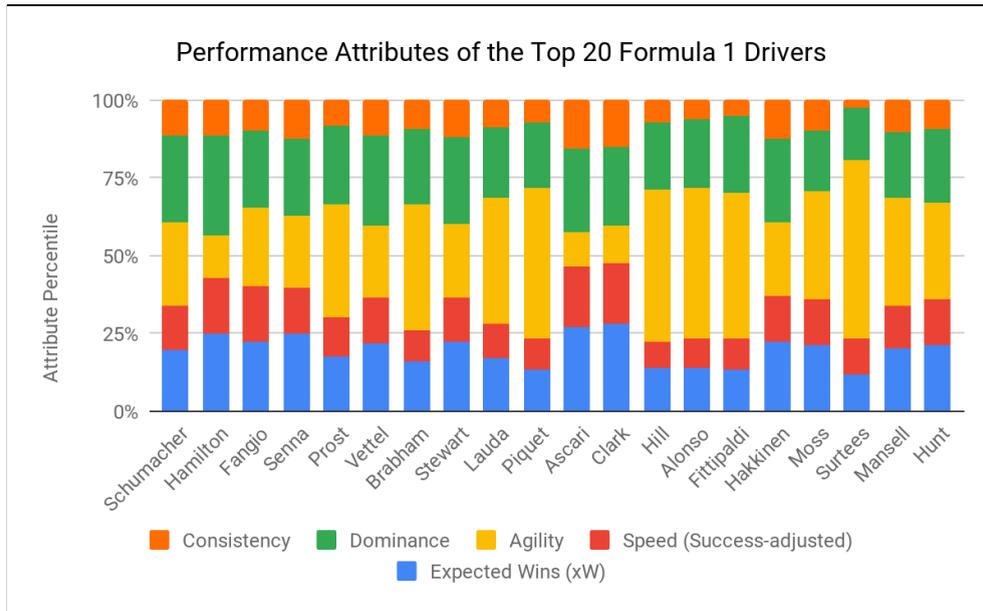


Exhibit 3 (below) provides an illustrative comparison of the performance Attributes of the Top 3 F1 drivers of all time.

Exhibit 3: Charts to showcase the breakdown in Performance Attributes for Hamilton, Fangio and Schumacher



Some Observations:

- **Hamilton** lacks **Agility** but is the most dominant of the three across all the *Attributes*.
- **Hamilton** closely matches **Fangio** for **Speed**, but both drivers have achieved greater success than **Schumacher** for this *Attribute*.
- As mentioned in the **Headlines** (above), the quantitative analysis suggests **Hamilton** can become the most successful F1 driver of all time during the 2021 Season, and this is illustrated in the highest **Expected Wins (xW)**.

Exhibit 4: Horizontal stacked bar chart illustrating Hamilton's Attribute Percentiles vs Schumacher and Fangio

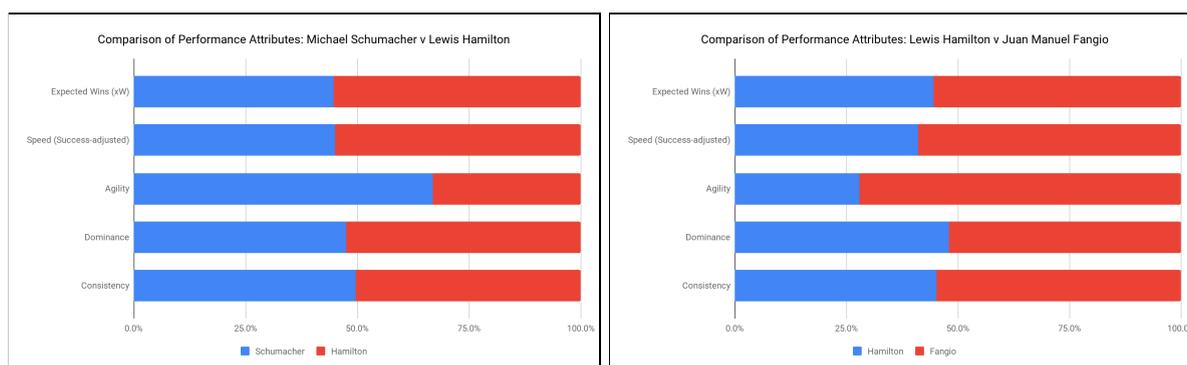


Exhibit 4 (above) also illustrates **Hamilton's** relative success in the key performance *Attributes*, compared with **Schumacher** and **Fangio**.

Some Observations:

- **Schumacher** and **Hamilton** have fairly consistent and comparable performance across the majority of the *Attributes*, although **Schumacher** demonstrates a higher level of **Agility** during his career compared to **Hamilton**.
- **Fangio** generally demonstrated stronger performance across all the *Attributes* during his career, than **Hamilton**.
- One of the key differences between **Fangio** and **Hamilton** is that **Fangio** won his five World Titles with four different constructors (Alfa Romeo, Maserati, Mercedes and Ferrari), each using different engines.
- **Fangio** is the only driver in F1 history to win four World Titles with four different constructors.

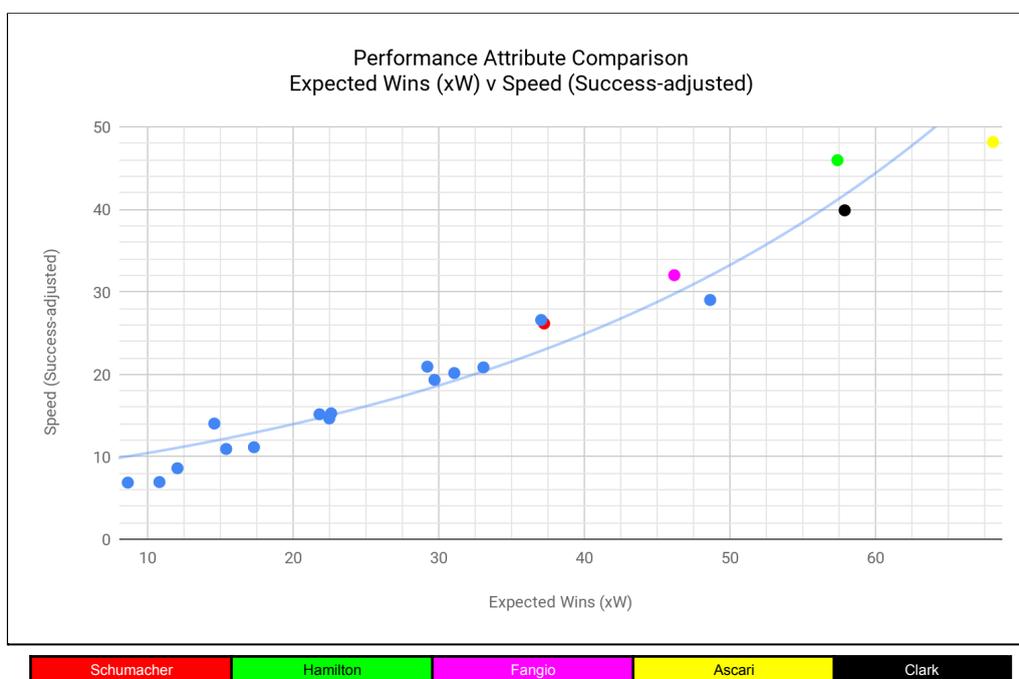
3. Performance Attributes

3.1 Expected Wins (xW)

Exhibit 5 (below) plots an interesting comparison of **xW** vs **Speed (Success-adjusted)** Attributes for the Top 5 drivers:

- **Ascari** was ultimately expected to win the most Grand Prix whenever he raced. The quantitative analysis suggests the level of **Speed** within his performances have played a considerable role in projecting his **win expectancy**.
- **Hamilton** sits above the line of trajectory which suggests that he may still be able to surpass **Ascari** in the future.
- Surprisingly, **Schumacher** was not expected to win as many races compared to the **Speed** of the other Top 5 drivers.

Exhibit 5: Scatter graph plotting Expected Wins (xW) vs Speed (Success-adjusted) for all drivers, highlighting the Top 5 ranked drivers by colour

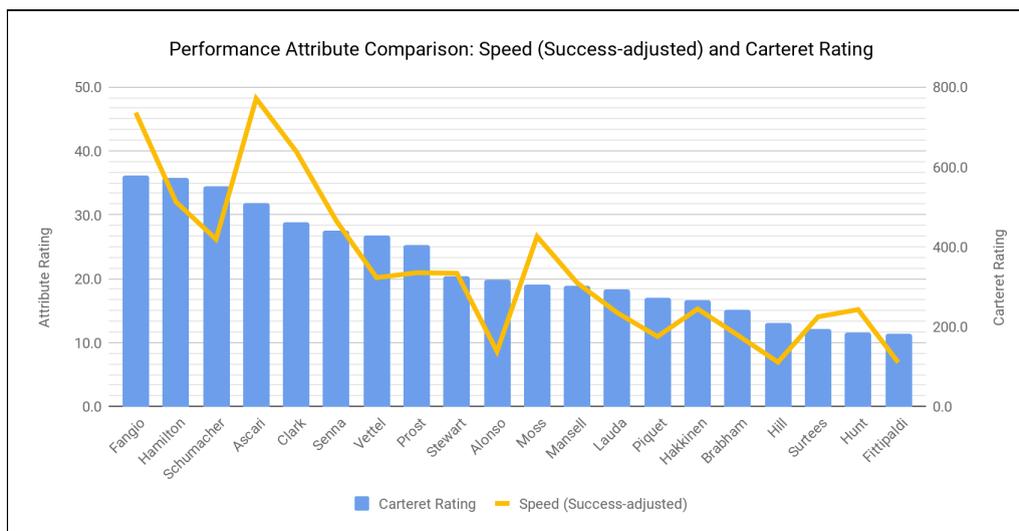


3.2 Speed (Success-adjusted)

Exhibit 6 (below) combines each driver's **Carteret Rating** (bars) with a comparator line for each driver's **Speed (Success-adjusted)** Attribute.

- The quantitative analysis indicates that **Ascari** was objectively the fastest driver in F1 history.
- Objectively **Moss** was also fast, and his **Carteret Rating** is lower due to his failure to win a World Title.
- **Alonso** is one of the Top 10 F1 drivers of all time, but the lack of success in the latter stages of his career has impacted on his **Carteret Rating** and **Speed (Success-adjusted)** Attribute.

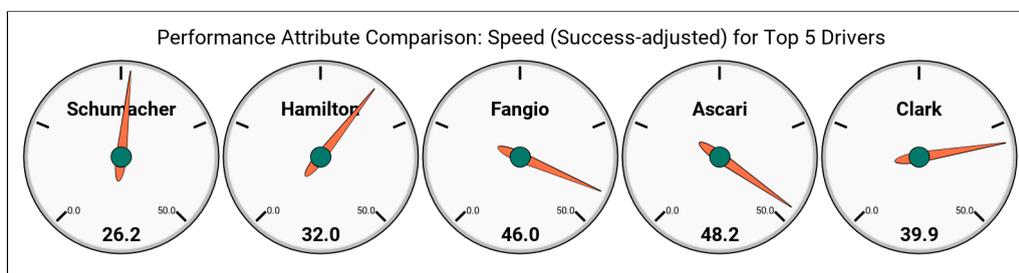
Exhibit 6: Combination chart comparing Speed (Success-adjusted) against their Carteret Rating for each of the 20 drivers



In **Exhibit 7** (below) we can visualise:

- **Ascari** is objectively the fastest driver in F1 history.
- **Hamilton** is objectively quicker than **Schumacher**, but slower than **Fangio**, **Ascari** and **Clark**, who all drove in a different era with considerably less technology involved.

Exhibit 7: Gauge chart expressing each of the top 5 driver's Speed (Success-adjusted) Attribute

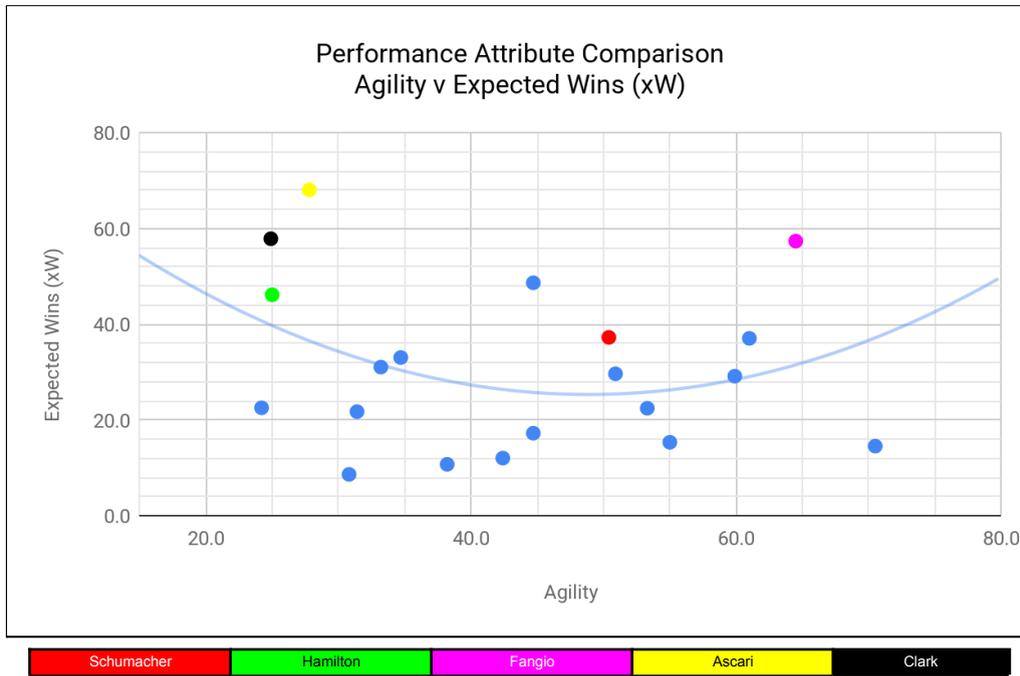


3.3 Agility

Exhibit 8 (below) is a performance *Attribute* comparison of **Agility** vs **xW**:

- The quantitative analysis suggests **Fangio** achieved significant success in his **Agility Attribute**, which also contributed to a very high **xW**.
- **Hamilton's** relatively lower level of success in the **Agility Attribute** may have contributed to a slightly lower **xW**.
- Nevertheless, three of the Top 5 drivers retain a high **Expected Win (xW)** rating, despite having a relatively low level of **Agility** performance.

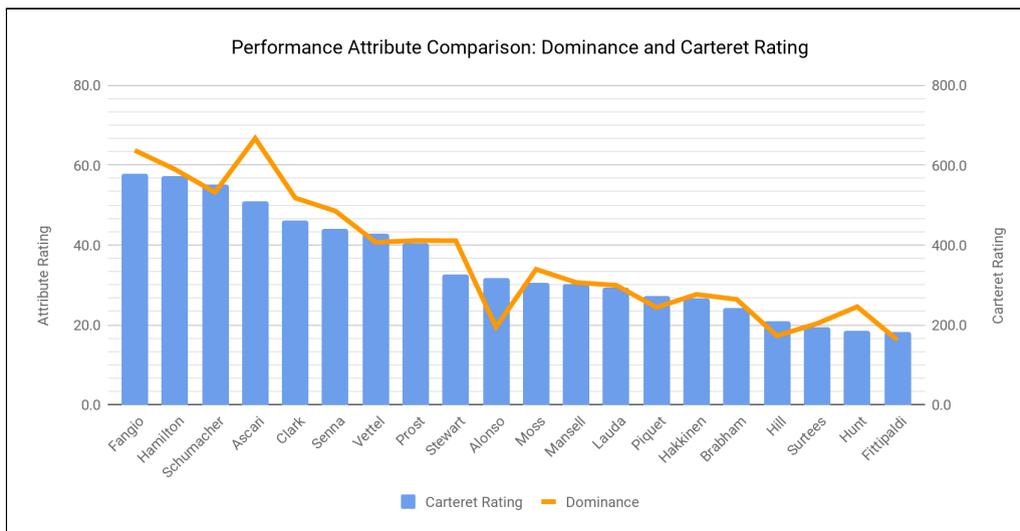
Exhibit 8: Scatter graph showing Agility vs Expected Wins (xW) for all 20 F1 drivers, highlighting the Top 5 ranked drivers by colour



3.4 Dominance

Exhibit 9 (below) combines each driver's **Carteret Rating** (bars) with a line comparison of their **Dominance Attribute**.

Exhibit 9: Combination chart presenting the Dominance Attribute for all drivers against their Carteret Rating



- There is a strong correlation between a driver's **Dominance Attribute** and their ability to achieve a high **Carteret Rating**.

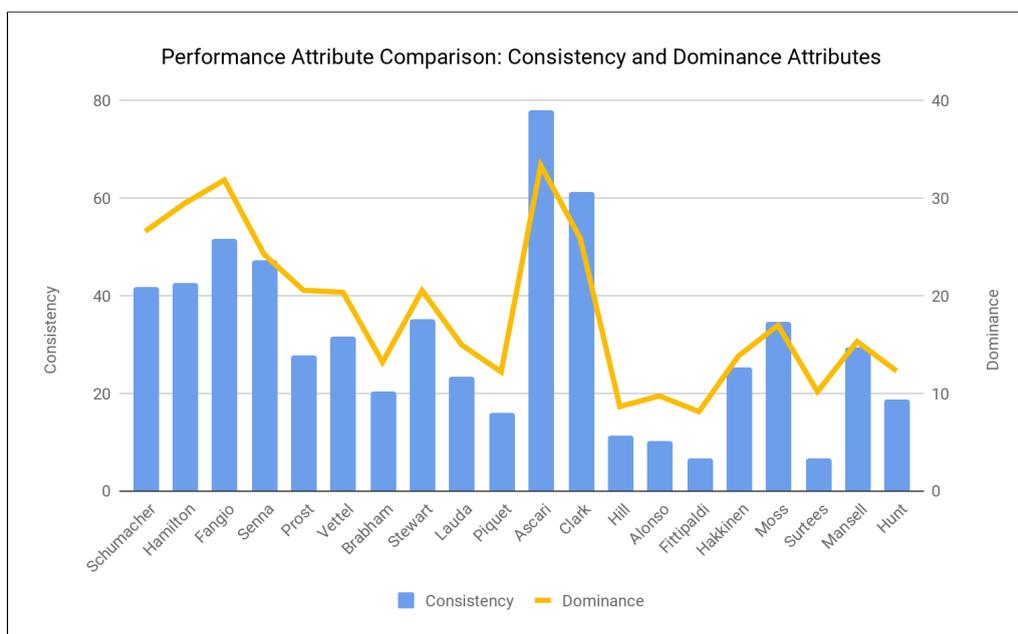
- **Ascari's** very high level of **Dominance** suggests that he could have continued to increase his **Carteret Rating** if he were able to have raced for a longer period of time.
- **Alonso** appears to be somewhat of an anomaly in the correlation, obtaining a lower **Dominance Attribute** but still placing within the Top 10 **Carteret Ratings**.

3.5 Consistency

Exhibit 10 (below) provides a similar combination, but in this instance is compares each driver's **Dominance** (bars) and **Consistency Attributes** (line):

- During his relatively short career **Ascari** demonstrated the highest level of **Consistency**.
- **Clark** won 25 of his 72 Grand Prix, during 9 seasons in the sport. This included 33 pole positions. **Clark** was on pole position in over 45% of the Grand Prix in which he was involved, and was on the podium in 44% of his races. These exceptional levels of **Consistency** (and **Dominance**) are illustrated clearly in **Exhibit 10**.
- **Hamilton** continues to demonstrate a high level of **Consistency**, and is objectively the most **Dominant** driver of the last 10 years.

Exhibit 10: Combination chart to show a comparison of the Consistency vs Dominance Attributes for all 20 F1 drivers



4. About Carteret Analytics

Carteret Analytics is part of the Carteret Group of companies, based in the City of London, New York and Geneva. It provides leading-edge quantitative analysis and commercial analytics to clients worldwide, with particular expertise in the sports sector. In football our work includes player rating and valuation, head coach assessment, team performance analysis, and applying proprietary analytics to transform commercial revenues.

Further information and contact details

If you have any questions, or would like to enquire about further services provided by the Carteret Group, then please feel free to contact one of the team members listed below.

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