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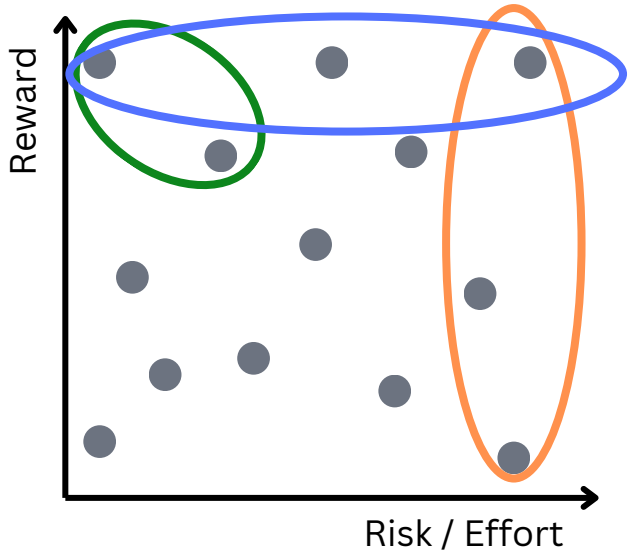
1.0 INITIATING IN-SEASON AERODYNAMIC PROJECTS IN FORMULA 1

In this article, we will explore the considerations involved in initiating aerodynamic projects in Formula 1, a critical task for managers in an aerodynamics department. They must make strategic decisions on how to allocate resources to maximise development.

In Formula 1, a team's success is determined by its constructors' position at the end of the season. Higher positions result in increased prize money and access to more lucrative sponsorship deals. Managers in the aerodynamics department aim to maximise the development rate within the existing constraints by making strategic decisions regarding effort and potential rewards to ensure the car is competitive.

As the season is already underway, most teams will be seeking items that offer high reward with low effort, represented by the green circle on the graph. The dots on the graph indicate upcoming projects, and the priority of these projects depends on various factors. For instance, when initiating the development of a new car under a new set of regulations, the focus is on long lead-time items such as chassis and cooling layout, which offer long-term development potential (depicted by the orange circle). Teams must commit to a strategic direction and carefully assess risks to enable long-term performance.



The uncertainty of outcomes inherently involves risks. A conservative approach may limit potential rewards, while excessive risk-taking can elevate the chance of failure. Every effort is made to gain a scientific understanding of flow structures, define performance metrics, and enhance correlation.

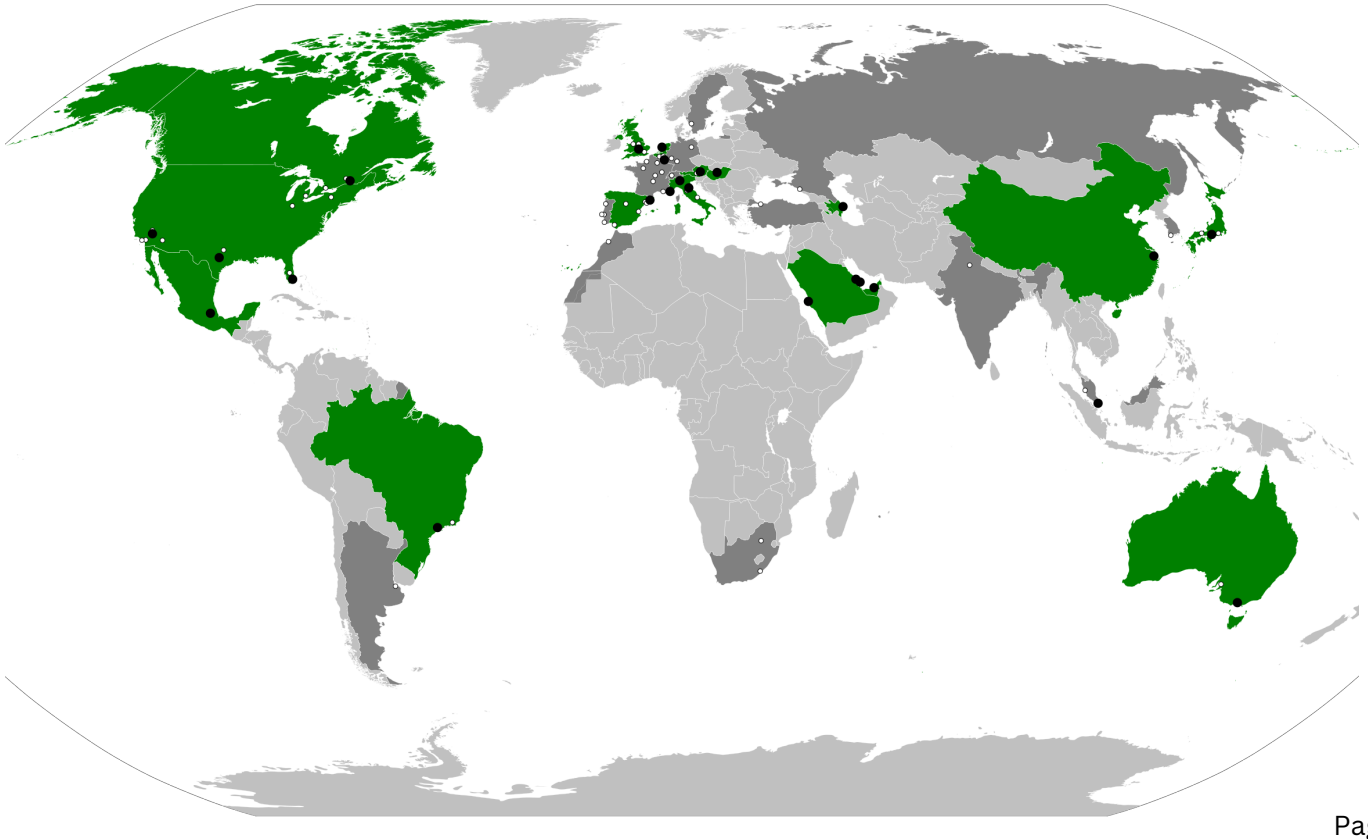
Below are the main reasons why aerodynamic projects are initiated:

1. Following the direction from previous tests.
2. Introducing a new concept or interpretation of regulations.
3. Addressing track-specific requirements (such as drag, cooling, aero balance, etc.).
4. Adapting to changes in regulations.
5. Leveraging changes in the flow field that present greater potential.
6. Improving features to make it more representative of the car on the track.
7. Addressing identified instabilities.
8. Implementing a strategic change in car setup.

1) Following the direction from previous tests is a valid reason for starting a new project and has traditionally been a cornerstone of development. This approach optimises existing features around the current flow field, but it's only a matter of time before the development rate slows down using this method.

2) A personal favorite for a new project is a "new concept or interpretation of regulations." This is easier to implement with a new set of regulations and becomes more challenging over time. This approach can lead to a significant development rate by controlling flow structures to increase car loading, as seen with the exhaust blown diffuser, double diffuser etc. Engaging in brainstorming discussions and meetings with a creative group can be productive in uncovering diverse interpretations of regulations.

3) Each race event presents different optimal drag and cooling requirements. Using the most demanding specification throughout the year would render the car non-competitive, so teams meticulously plan upgrades to align with the specific demands of each race. Given the changing race calendar each season, the logistical planning for ensuring timely part deliveries must be carefully managed to control costs. The image below shows the extent of how far the teams have to travel throughout the year. The black dots represent race events.



4) In Formula 1, a technical working group operates behind the scenes to explore changes in technical regulations. Sometimes, adjustments occur during the season for safety reasons; for example, the position of the mirrors has been altered in the past. Major regulatory changes are planned to enhance the spectacle of the sport, providing teams with opportunities to enhance competitiveness. More recently, teams are constrained to initiate the development of cars for new regulations within a year of being defined.

5) The aero development of the car is typically segmented into groups. The team responsible for the front wing consistently seeks to improve the management of the wheel wake while achieving aerodynamic balance targets. Enhancements in wheel wake control pave the way for other development areas to achieve their full potential, necessitating collaboration.

6) As a team's performance in Formula 1 is assessed by its position in the constructor table, every effort is dedicated to testing under conditions that closely

For example, in the past, teams used to manufacture wheels from rigid carbon fiber until tyre manufacturers began producing scaled-sized tires. The ongoing requirement to make test conditions more representative will enhance correlation.

7) Enhancing flow structures can sometimes lead to instability in downstream features. For instance, changes to the bodywork affecting the onset flow to the rear wing can cause separation, as depicted in the photo below, resulting in inconsistent car balance.

8) The car setup influences both mechanical grip and aerodynamic load. Understanding the optimal setup is refined throughout the season. For instance, a decision to increase rake shown below, will necessitate redevelopment of the front wing to ensure consistent, predictable operation from an aerodynamic standpoint.

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High rake setup

Low rake setup