# P3 - Logical ERD Model

Formula 1 Team Management System
Group-8

## Overview

This document presents the revised Logical ERD Model for the Formula 1 Team Management System, following feedback from the instructor. The updated model ensures data normalization (3NF), elimination of redundant data, removal of many-to-many relationships, and incorporation of additional entities for enhanced system functionality.

**The submission includes:**

1. Fine-tuned Logical ERD (3NF-compliant)
2. Summary of Changes from the Conceptual ERD
3. Public Links to Project Files (ERD, SQL Scripts, Design Document, etc.)

## Summary of Changes & Improvements

1. **Normalization & Data Optimization**

- Created DRIVER_CONTRACT table to separate contract details from DRIVER, ensuring historical tracking of contracts.
- Introduced LAP_TIMES table to record individual lap performances, removing redundancy from RESULTS.
- Standardized SPONSORSHIP_TYPE using a lookup table instead of storing string values in SPONSOR.

2. **Eliminating Many-to-Many Relationships**

- Refactored TEAM_SPONSOR to include Contract_ID as a primary key, ensuring multiple sponsorship contracts over different seasons.
- Ensured RACE_ENTRY correctly connects DRIVER, CAR, and RACE to eliminate implicit many-to-many relationships.

3. **Enhancements for Better Data Integrity & Query Performance**

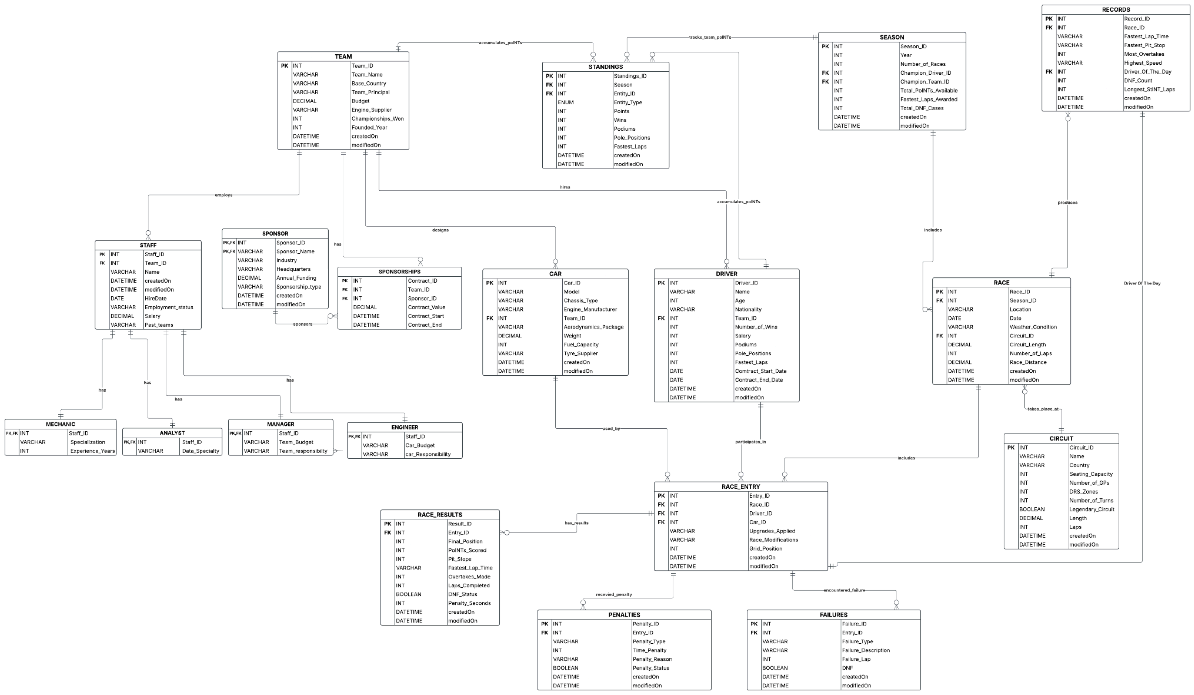
- Added Points_Awarded in RACE_ENTRY so race results dynamically calculate standings.
- Separated CONSTRUCTOR_STANDINGS from STANDINGS to track team points separately from drivers.
- Expanded PIT_STOPS table to store pit stop duration, tire changes, and strategic impact.

- Specify Staff into 4 different duties, and make sure each duty has its unique attributes.

## Logical ERD Compliance with 3NF

**This version ensures:**

- No multivalued attributes – Each column stores atomic values.
- No composite attributes – All attributes hold a single value.
- No many-to-many relationships – All M:N relationships have been converted into associative entities.
- Every entity has a Primary Key (PK) – Ensuring uniqueness.
- Every relationship has a Foreign Key (FK) – Maintaining referential integrity.



**TEAM**

| | | |
|---|---|---|
| PK | INT | Team_ID |
| | VARCHAR | Team_Name |
| | VARCHAR | Base_Country |
| | VARCHAR | Team_Principal |
| | DECIMAL | Budget |
| | VARCHAR | Engine_Supplier |
| | INT | Championships_Won |
| | INT | Founded_Year |
| | DATETIME | createdOn |
| | DATETIME | modifiedOn |

**STANDINGS**

| | | |
|---|---|---|
| PK | INT | Standings_ID |
| FK | INT | Season |
| FK | INT | Entity_ID |
| | ENUM | Entity_Type |
| | INT | Points |
| | INT | Wins |
| | INT | Podiums |
| | INT | Pole_Positions |
| | INT | Fastest_Laps |
| | DATETIME | createdOn |
| | DATETIME | modifiedOn |

**SEASON**

| | | |
|---|---|---|
| PK | INT | Season_ID |
| | INT | Year |
| | INT | Number_of_Races |
| FK | INT | Champion_Driver_ID |
| FK | INT | Champion_Team_ID |
| | INT | Total_PolNTs_Available |
| | INT | Fastest_Laps_Awarded |
| | INT | Total_DNF_Cases |
| | DATETIME | createdOn |
| | DATETIME | modifiedOn |

**RECORDS**

| | | |
|---|---|---|
| PK | INT | Record_ID |
| FK | INT | Race_ID |
| | VARCHAR | Fastest_Lap_Time |
| | VARCHAR | Fastest_Pit_Stop |
| | INT | Most_Overtakes |
| | VARCHAR | Highest_Speed |
| FK | INT | Driver_Of_The_Day |
| | INT | DNF_Count |
| | INT | Longest_StINT_Laps |
| | DATETIME | createdOn |
| | DATETIME | modifiedOn |

**SPONSOR**

| | | |
|---|---|---|
| PK,FK | INT | Sponsor_ID |
| PK,FK | VARCHAR | Sponsor_Name |
| | VARCHAR | Industry |
| | VARCHAR | Headquarters |
| | DECIMAL | Annual_Funding |
| | VARCHAR | Sponsorship_type |
| | DATETIME | createdOn |
| | DATETIME | modifiedOn |

**STAFF**

| | | |
|---|---|---|
| PK | INT | Staff_ID |
| FK | INT | Team_ID |
| | VARCHAR | Name |
| | DATETIME | createdOn |
| | DATETIME | modifiedOn |
| | DATE | HireDate |
| | VARCHAR | Employment_status |
| | DECIMAL | Salary |
| | VARCHAR | Past_teams |

**SPONSORSHIPS**

| | | |
|---|---|---|
| PK | INT | Contract_ID |
| FK | INT | Team_ID |
| FK | INT | Sponsor_ID |
| | DECIMAL | Contract_Value |
| | DATETIME | Contract_Start |
| | DATETIME | Contract_End |

**CAR**

| | | |
|---|---|---|
| PK | INT | Car_ID |
| | VARCHAR | Model |
| | VARCHAR | Chassis_Type |
| | VARCHAR | Engine_Manufacturer |
| FK | INT | Team_ID |
| | VARCHAR | Aerodynamics_Package |
| | DECIMAL | Weight |
| | INT | Fuel_Capacity |
| | VARCHAR | Tyre_Supplier |
| | DATETIME | createdOn |
| | DATETIME | modifiedOn |

**DRIVER**

| | | |
|---|---|---|
| PK | INT | Driver_ID |
| | VARCHAR | Name |
| | INT | Age |
| | VARCHAR | Nationality |
| FK | INT | Team_ID |
| | INT | Number_of_Wins |
| | INT | Salary |
| | INT | Podiums |
| | INT | Pole_Positions |
| | INT | Fastest_Laps |
| | DATE | Comtract_Start_Date |
| | DATE | Contract_End_Date |
| | DATETIME | createdOn |
| | DATETIME | modifiedOn |

**RACE**

| | | |
|---|---|---|
| PK | INT | Race_ID |
| FK | INT | Season_ID |
| | VARCHAR | Location |
| | DATE | Date |
| | VARCHAR | Weather_Condition |
| FK | INT | Circuit_ID |
| | DECIMAL | Circuit_Length |
| | INT | Number_of_Laps |
| | DECIMAL | Race_Distance |
| | DATETIME | createdOn |
| | DATETIME | modifiedOn |

**MECHANIC**

| | | |
|---|---|---|
| PK,FK | INT | Staff_ID |
| | VARCHAR | Specialization |
| | INT | Experience_Years |

**ANALYST**

| | | |
|---|---|---|
| PK,FK | INT | Staff_ID |
| | VARCHAR | Data_Specialty |

**MANAGER**

| | | |
|---|---|---|
| PK,FK | INT | Staff_ID |
| | VARCHAR | Team_Budget |
| | VARCHAR | Team_responsibilty |

**ENGINEER**

| | | |
|---|---|---|
| PK,FK | INT | Staff_ID |
| | VARCHAR | Car_Budget |
| | VARCHAR | car_Responsibility |

**CIRCUIT**

| | | |
|---|---|---|
| PK | INT | Circuit_ID |
| | VARCHAR | Name |
| | VARCHAR | Country |
| | INT | Seating_Capacity |
| | INT | Number_of_GPs |
| | INT | DRS_Zones |
| | INT | Number_of_Turns |
| | BOOLEAN | Legendary_Circuit |
| | DECIMAL | Length |
| | INT | Laps |
| | DATETIME | createdOn |
| | DATETIME | modifiedOn |

**RACE_ENTRY**

| | | |
|---|---|---|
| PK | INT | Entry_ID |
| FK | INT | Race_ID |
| FK | INT | Driver_ID |
| FK | INT | Car_ID |
| | VARCHAR | Upgrades_Applied |
| | VARCHAR | Race_Modifications |
| | INT | Grid_Position |
| | DATETIME | createdOn |
| | DATETIME | modifiedOn |

**RACE_RESULTS**

| | | |
|---|---|---|
| PK | INT | Result_ID |
| FK | INT | Entry_ID |
| | INT | Final_Position |
| | INT | PolNTs_Scored |
| | INT | Pit_Stops |
| | VARCHAR | Fastest_Lap_Time |
| | INT | Overtakes_Made |
| | INT | Laps_Completed |
| | BOOLEAN | DNF_Status |
| | INT | Penalty_Seconds |
| | DATETIME | createdOn |
| | DATETIME | modifiedOn |

**PENALTIES**

| | | |
|---|---|---|
| PK | INT | Penalty_ID |
| FK | INT | Entry_ID |
| | VARCHAR | Penalty_Type |
| | INT | Time_Penalty |
| | VARCHAR | Penalty_Reason |
| | BOOLEAN | Penalty_Status |
| | DATETIME | createdOn |
| | DATETIME | modifiedOn |

**FAILURES**

| | | |
|---|---|---|
| PK | INT | Failure_ID |
| FK | INT | Entry_ID |
| | VARCHAR | Failure_Type |
| | VARCHAR | Failure_Description |
| | INT | Failure_Lap |
| | BOOLEAN | DNF |
| | DATETIME | createdOn |
| | DATETIME | modifiedOn |