Group-8

Formula 1 Team Management System

P2 - Conceptual ER Model

1. Business Problems Addressed

The Formula 1 Team Management System addresses critical challenges in one of the most data-intensive and competitive sports environments. By providing a centralized platform for managing team operations, the system supports real-time decision-making, effective resource allocation, and strategic planning. It ensures optimal performance by integrating all aspects of team management, from driver analytics to car maintenance.

Key business problems solved include:

1. **Driver Performance Analysis**: Centralized tracking of race statistics, historical performance, and lap-by-lap telemetry data.
2. **Car and Part Maintenance**: Detailed inventory management for car components, repairs, and lifecycle tracking.
3. **Sponsorship and Financial Management**: Overseeing sponsorship contracts, team budgets, and financial planning.
4. **Race Records and Leaderboards**: Comprehensive tracking of race results, championship standings, and season summaries.
5. **Team Staff Management**: Organizing staff roles (e.g., engineers, mechanics, managers) and their contributions to the team's success.

2. Entities and Relationships

Entities and Attributes:

1. **Team** *(Team_ID, Team_Name, Base_Location, Principal, Budget, Founded_Year)*
2. **Driver** *(Driver_ID, Name, Age, Nationality, , Championships_Won, Total_Points)*
3. **Race** *(Race_ID, Date, Location)*
4. **Race_Info** *(Circuit_Laps, Date, Weather_Condition, Circuit_Records)*
5. **Car** *(Car_ID, Model, Engine, Aerodynamics, Power_Unit)*
6. **Car_Parts** *(Part_ID, Part_Name, Manufacturer, Cost, Lifespan_Races)*
7. **Tires** *(Tire_ID, Manufacturer, Compound, Allowed_Usage_Weekends)*
8. **Season** *(Season_ID, Year, Number_of_Races)*
9. **Records** *(Record_ID, Fastest_Lap, Pole_Positions, Total_Wins)*
10. **Sponsor** *(Sponsor_ID, Sponsor_Name, Sponsorship_Amount, Contract_Years)*
11. **Driver_Standings** *(Standing_ID, Total_Points, Races_Won, Podiums, Championship_Won)*

12. **Team_Standings** *(Standing_ID, Total_Points, Races_Won, Championship_Won)*
13. **Team_Staff** *(Staff_ID, Name, Role, Salary, Start_Date, End_Date)*
    - **Subtypes:**
        - **Engineer** *(Specialization, Experience_Years, Certifications)*
        - **Mechanic** *(Expertise_Area, Tools_Specialized)*
        - **Strategist** *(Race_Experience, AI_Usage_Level)*
        - **Team_Manager** *(Leadership_Experience, Past_Teams)*

3. Relationships and Their Cardinalities

1. **Team - Driver (1:M)** → Each team has multiple drivers; each driver belongs to only one team.
2. **Team - Car (1:M)** → Each team owns multiple cars; each car belongs to one team.
3. **Driver - Records (1:M)** → A driver can hold multiple records across races.
4. **Race - Race Info (1:1)** → Each race occurs at one circuit.
5. **Race - Season (M:1)** → Multiple races belong to one season.
6. **Race - Driver (1:1) (Winner Relationship)** → Each race has one winner.
7. **Sponsor - Team (M:1)** → A team can have multiple sponsors.
8. **Car - Car_Parts (1:M)** → Each car consists of multiple parts.
9. **Records - Driver (1:1)** → One driver generates each Record.
10. **Tires - Car (M: M)** → Cars use multiple tire compounds; different cars can use the same tire.
11. **Race_Info - Race (1:1)** → A race generates one detailed race info entry.
12. **Season - Records (1:M)** → A season can have multiple records.
13. **Season - Driver_Standings (1:M)** → A season has multiple driver standings.
14. **Season - Team_Standings (1:M)** → A season has multiple team standings.
15. **Race_Info - Race (M:1)** → Each race has multiple results.
16. **Race_Info - Drivers (M:1)** → Each driver has one result per race.
17. **Race_Info - Teams (M:1)** → Each team has multiple race results.
18. **Race_Info - Driver_Standing (M:M)** → Each race information has multiple Driver standing info

4. Key Design Decisions

- **Normalization:** Data is structured to eliminate redundancy and maintain referential integrity.
- **Supertypes & Subtypes:** Implemented for **Team_Staff** to categorize different personnel roles.
- **Indexes on Key Fields:** Optimized for faster lookups (e.g., Driver_ID, Team_ID, Race_ID).
- **Many-to-Many Relationship Handling:** Used associative tables where necessary (e.g., **Tires and Cars**).
- **Scalability Considerations:** Designed for seamless expansion of new races, seasons, drivers, and teams over time.