**Alternative Formula E Points Format Project**

Toby Culverwell

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# **Introduction**

The following document will detail my decisions relating to the design of the database as well as what data will be stored in it. I will cover the logical, conceptual, and physical design of the database and it is intended to be used with a MongoDB database management system.

I have always been fascinated by alternative points formats and how they differ to the current one a motorsport and one of the most unique points formats amongst the motorsport championships I follow is the BTCC, due to its multi-class structure and separate championships for Independent entrants along with the Jack Sears Trophy; a championship for drivers without an outright top 3 result in a race. I have chosen Formula E to try this points-format out for 4 reasons:

1. There are customer teams in Formula E who run a manufacturer's powertrain and which are similar enough to BTCC's Independent entrants
2. The weekend structure is similar to BTCC's (qualifying session, then into a full-distance race)
3. A grid size of 22 cars (2 cars per team) is small enough to so there isn't too many rows, but there aren't too little either
4. I can watch the races in full to keep track of who leads a lap, which is a bonus point available under BTCC’s regular points format

I had considered MotoGP and NASCAR Cup Series, as both have entrants that can easily be identified as having less resources (satellite teams and teams without Tier-1 manufacturer support respectively). However, both series have fundamental issues that prevent an easy integration of the points format. MotoGP has sprint races which aren't at full Grand Prix distance, so would need an adaptation of the points system to accommodate. NASCAR has at minimum 36 entrants for any points-paying race, which is too many rows and entrants if I ever decide to create tables for each driver. Also, I can only watch highlights of MotoGP and thus may miss a rider leading a lap, while NASCAR Cup races are usually 3 to 4 hours long and it would to time consuming keep track of every driver who leads a lap.

# **Format Implementation**

The points format, that the BTCC uses, awards points to the Top 15 as such:

|  |  |
| --- | --- |
| Finishing Position | Points |
| 1st | 20 |
| 2nd | 17 |
| 3rd | 15 |
| 4th | 13 |
| 5th | 11 |
| 6th | 10 |
| 7th | 9 |
| 8th | 8 |
| 9th | 7 |
| 10th | 6 |
| 11th | 5 |
| 12th | 4 |
| 13th | 3 |
| 14th | 2 |
| 15th | 1 |

It also awards bonus points for the driver who: wins the pole position, sets the fastest lap in the race, and leads a lap during the race.

## BTCC Championships

The BTCC has 6 championships: BTCC Championship for Drivers, BTCC Independents’ Trophy for Drivers, BTCC Championship for Manufacturers/Constructors, BTCC Championship for Teams, BTCC Independents’ Teams Championship, and The Jack Sears Trophy. All drivers and teams are entered into the Championship for Drivers and Teams respectively.

Independent teams are those that have less money and resources than the Manufacturer/Constructor backed entries and use the spec engine that TOCA, the organisation that runs the BTCC, provides, while Independent drivers are those who drive for an Independent team. The drivers eligible for the Jack Sears Trophy are those who have not earned top 3 result in a race (prior to any post-race investigations) and has not won the Jacks Sears Trophy previous.

## Formula E Integration

Formula E is an all-electric single seater world championship in which 6 manufacturers supply powertrains to 11 teams, thus some teams run as customer teams. The customer teams for 2024 were: Andretti Formula E, Envision Racing, NEOM McLaren Formula E Team, and ABT CUPRA Formula E Team and these teams (and drivers who drive for them) will be classed as Independent entrants. Maserati MSG Racing run the same powertrains as DS Penske albeit badged as a Maserati, so will not count as a customer team, but the parent company of the 2 brands, Stellantis, is entered into Formula E's Manufacturers' Cup and the entrants for this championship will be used in the equivalent Manufacturers/Constructors championship. No driver who would have won the Jack Sears Trophy prior to the 10th season (2023-2024) of Formula E will be excluded, but the winner from the 10th season will be for future implementations.

## Renamed Championships

The Championships will be renamed as such below with the original BTCC name in parenthesis:

Drivers’ Championship (Championship for Drivers), Teams’ Championship (Championship for Teams), Manufacturers’ Cup (Championship for Manufacturers/Constructors), Customer Trophy for Drivers (Independent Trophy for Drivers), Customer Teams’ Championship (Independents’ Team Championship) and Nelson Piquet Jr Trophy (Jack Sears Trophy).

# **Conceptual Design**

With regards to my design of the database, I have identified 3 initial Entities: Drivers, Teams and Manufacturers. They will be described in this data dictionary below:

|  |  |  |
| --- | --- | --- |
| Entity | Description | Occurrence |
| Drivers | Term refers to drivers who are on the entry list for a Formula E race and drive for a team | Each Driver drives for a team and is entered in the Drivers’ Championship and Customer Trophy for Drivers if they drive for Customer team |
| Teams | Term refers to a racing organisation who are on the entry list for a Formula E team and field 2 cars for that race | Each Team has 2 cars which will score points in the Teams’ Championship and Customer Teams Championship if they are Customer team |
| Manufacturers | Manufacturer who has signed up to the current technical regulations and supply teams with a powertrain | Each Manufacturer supplies at least 1 team and scores points in the Manufacturer’s Cup |

Normalisation Descriptions

This section will list the normalisation descriptions for all entities that will be used in the database and their attributes will be displayed in their own data dictionary.

Drivers

|  |  |  |
| --- | --- | --- |
| Attribute | Data Type | Description |
| Driver ID | Integer, Auto Incrementing, Primary key | A unique integer value that allows each driver to be identified easily |
| Name | Varchar (50) | The name of the driver, e.g. ‘Jake Dennis’ |
| Team | Varchar (50) | The name of the team which the driver drives for, e.g. ‘Andretti Formula E’ |
| Customer Driver Eligibility | Boolean | A simple true/false that shows whether the driver drives for a customer team |
| NPJT Eligibility | Boolean | A simple true/false that shows whether the driver is eligible for the Nelson Piquet Jr Trophy |
| Points | Integer | The number of points the driver has scored within the Drivers’ Championship so far in the season |
| Championship Position | Integer | Driver’s position in the Drivers’ Championship |
| Customer Points | Integer | The number of points the driver has scored within the Customer Trophy for Drivers Championship so far in the season |
| Customer Trophy Position | Integer | Driver’s position in the Customer Trophy for Drivers Championship |
| NPJT Points | Integer | The number of points the driver has scored within the Nelson Piquet Jr Trophy so far in the season |
| NPJT Position | Integer | Driver’s position in the Nelson Piquet Jr Trophy Championship |

This list of attributes is in 1st Normal form and can normalised to 2nd normal form by creating 2 new entities called Customer Drivers and NPJT Drivers, taking the Driver Name, Customer Points, and Customer Trophy Position attributes putting them into their own table and taking the Driver Name, NPJT Points, and NPJT Position as they are partially dependent on the Driver primary key.

Customer Drivers

|  |  |  |
| --- | --- | --- |
| Attribute | Data Type | Description |
| Customer Driver ID | Integer, Auto Incrementing, Primary key | A unique integer value that allows each customer driver to be identified easily |
| Name | Varchar (50) | The name of the driver, e.g. ‘Jake Dennis’ |
| Customer Points | Float | The number of points the driver has scored within the customer class so far in the season |
| Customer Trophy Position | Integer | Driver’s position in the Customer Trophy for Drivers Championship |

This list of attributes is in 2nd normal form and cannot be normalised any further as there are no partial dependencies.

NPJT Drivers

|  |  |  |
| --- | --- | --- |
| Attribute | Data Type | Description |
| NPJT Driver ID | Integer, Auto Incrementing, Primary key | A unique integer value that allows each NPJT driver to be identified easily |
| Name | Varchar (50) | The name of the driver, e.g. ‘Jake Dennis’ |
| NPJT Points | Float | The number of points the driver has scored within the Nelson Piquet Jr Trophy so far in the season |
| NPJT Position | Integer | Driver’s position in the Nelson Piquet Jr Trophy Championship |

This list of attributes is in 2nd normal form and cannot be normalised any further as there are no partial dependencies.

Teams

|  |  |  |
| --- | --- | --- |
| Attribute | Data Type | Description |
| Team ID | Integer, Auto Incrementing, Primary key | A unique integer value that allows each team to be identified easily |
| Name | Varchar (100) | The name of the Team, e.g. ‘Andretti Formula E’ |
| Class | Varchar (10) | The class of the team: either ‘Customer’ or ‘Manufacturer’ |
| Manufacturer | Varchar (50) | Manufacturer who supplies the team’s powertrain |
| Points | Float | The Points the team has scored within the Teams’ Championship so far in the season |
| Championship Position | Integer | Team’s position in the Teams’ Championship |
| Customer Team Points | Integer | The number of points the team has scored within the Customer Teams’ Championship so far in the season |
| Customer Team Position | Integer | Team’s position in the Customer Teams’ Championship |

This list of attributes is in 1st normal form and can be normalised by creating a new entity called Customer Teams, taking the Team Name, Customer Team Points, and Customer Team Position, as they partially dependent on the Team’s primary key.

Customer Teams

|  |  |  |
| --- | --- | --- |
| Attribute | Data Type | Description |
| Customer Team ID | Integer, Auto Incrementing, Primary key | A unique integer value that allows each Customer Team to be identified easily |
| Name | Varchar (100) | The name of the Team, e.g. ‘Andretti Formula E’ |
| Customer Team Points | Integer | The number of points the team has scored within the Customer Teams’ Championship so far in the season |
| Customer Team Position | Integer | Team’s position in the Customer Teams’ Championship |

This list of attributes is in 2nd normal form and cannot be normalised any further as there are no partial dependencies.

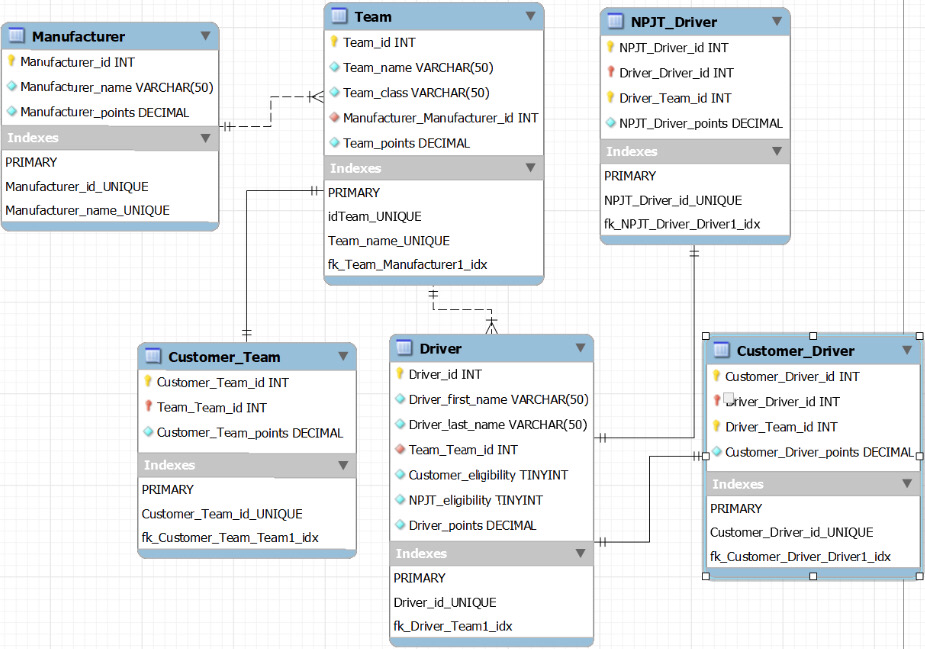
Manufacturers

|  |  |  |
| --- | --- | --- |
| Attribute | Data Type | Description |
| Manufacturer ID | Integer, Auto Incrementing, Primary key | A unique integer value that allows each collection to be identified easily |
| Name | Varchar (100) | The name of the collection, e.g. ‘World War 2 Posters’ |
| Manufacturer Points | Float | The Points the manufacturer has scored within the Manufacturer’s Cup so far in the season |
| Manufacturer Cup Position | Integer | Manufacturer’s position in the Manufacturer’s Cup |

This list of attributes is in 1st normal form and cannot be normalised any further as there are no partial dependencies.

## E-R Diagram

Normalising the initial 3 Entities has given us a total of 6, with the relationships with each other shown in this E-R Diagram



The following Data Dictionary explains the relationships a bit further:

|  |  |  |  |
| --- | --- | --- | --- |
| Entity | Multiplicity | Relationship | Entity |
| Drivers | 1 … 1  1 … 1  \* … 1 | Is also  Is also  Drives for | Customer Driver  NPJT Driver  Team |
| Customer Drivers | 1 … 1 | Is also | Driver |
| NPJT Drivers | 1 … 1 | Is also | Driver |
| Teams | 1 … \*  1 … 1  \* … 1 | Employs  Is also  Supplied by | Driver  Customer Team  Manufacturer |
| Customer Teams | 1… 1 | Is also | Team |
| Manufacturers | 1 … \* | Supplies | Teams |

# **Logical Design**

This section will demonstrate the optimisation of the data I have made.

## Relationships

As shown by the E-R diagram, there are 2 different types relationships between the entities: identifying and non-identifying. I have decided that the relationships between Drivers and Customer Drivers, Drivers and NPJT Drivers, and Teams and Customer Teams are all identifying as Customer Drivers, NPJT Drivers and Customer Teams are weak entities. This is because Customer Drivers and NJPT Drivers can only exist while a Driver is eligible for each respective championship and a Customer Team only exists while a Team is eligible for the Customer Teams’ Championship.

Therefore, the relationships between Teams and Drivers as well as Manufacturers and Teams are non-identifying because Teams and Manufacturers can exist without existence of Drivers and Teams respectively.

The non-identifying relationships mention above are mandatory, disjointed relationships because they are all one-to-many relationships as well as their primary and foreign key are different. The identifying relationships mention above are

Keys

For the relationships to work, foreign keys are required, and all foreign keys must be a unique valued column in another table. As listed in earlier data dictionaries, all ‘ID’ attributes are primary keys and all but Customer Drivers, NPJT Drivers, and Customer Teams will be foreign keys as well. Which table they are foreign keys in are shown in the data dictionary below:

|  |  |  |
| --- | --- | --- |
| Entity | Primary Key | Foreign Key (Original Table) |
| Drivers | Driver ID | Team ID (Teams) |
| Customer Drivers | Customer Driver ID | Driver ID (Drivers) |
| NPJT Drivers | NPJT Driver ID | Driver ID (Drivers) |
| Teams | Team ID | Manufacturer ID (Manufacturers) |
| Customer Teams | Customer Teams ID | Team ID (Teams) |
| Manufacturers | Manufacturer ID |  |

This means that Customer Drivers, NPJT Drivers, and Customer Teams lose the name from it list of attributes but gains Driver ID and Team ID respectively instead.

Transactions

The transactions that a user can perform are entering the results of an e-Prix, adding a driver, displaying a Driver’s Championship, displaying a Teams’ Championship, and displaying the Manufacturers’ Cup. The processes are shown in these use cases:

Entering the Results of an e-Prix

|  |  |
| --- | --- |
| Use Case Name | e-Prix Results Entry |
| Actors | Program Administrator |
| Triggering Events | Points columns needs to be updated in database |
|  | |
| Assumptions | * Results are official * All drivers competing in the e-Prix have their details added to database |
| Description | The process is updating the database with the results from the most recent e-Prix. This information is: finishing position of a driver within their classes (customer and NPJT), any bonus points scored towards the overall championship (pole position, fastest lap, leading a lap), the finishing position of a team’s 2 cars within its class (customer and/or overall), the finishing position of 2 highest placed cars powered by a manufacturer. This process will be repeated for all drivers, teams, and manufacturers that compete in the e-Prix. |
| Total ETC | 30 minutes as any longer is too long to enter in data |
| Termination  Out Come | 1. Results are entered into the database  2. Results cannot be entered into database  3. The user gives up as the process is taking too long |
| Major Steps | |
| 1. The results from the most recent e-Prix are gathered. This data can be found on the Formula E website’s results page: <https://fiaformulae.com/en/results> as well as noting which drivers led a lap during e-Prix from the broadcast. 2. The user logs into the program and selects the add results option from the menu. 3. The user enters the driver’s name, their team, and their team’s manufacturer repeats until all drivers have been entered as well as who led a lap, who scored pole position, and who scored the fastest lap. The results are stored in 3 lists: driver, team, and manufacturer. 4. The program loops through the driver list and checks their eligibility towards customer and NPJT championships respectively and if they are, then add them to a temporary list for each championship. 5. The program loops through the team list and checks their eligibility towards the customer teams’ championship and adds them to a temporary list for that championship. 6. The program loops through the manufacturer list and notes the first 2 indexes in the list that the manufacturer appears in the list 7. The program updates the Points column in each table, except the manufacturer table, based on the index in which the driver or team is in the list and how much that position is worth according to the BTCC points format. Thus, the item in the first index will have 20 points added to the points column which matches the driver’s name. 8. The program updates the Points column of the manufacturer table by adding the points scored from the 2 indexes noted together and updating with that value. 9. The program updates the Points column of the driver’s table based on the bonus points scored across the grid. 10. The names and points total stored across all tables are displayed and are organized in descending order. | |

Adding a Driver

|  |  |
| --- | --- |
| Use Case Name | Adding a driver to database |
| Actors | Program Administrator |
| Triggering Events | Driver is set compete in an upcoming e-Prix, which is their first of the season |
|  | |
| Assumptions | Driver does not already exist in the database |
| Description | The process is adding the driver to the database with following information: first name, second name, team name, customer eligibility, and NPJT eligibility |
| Total ETC | 30 minutes as any longer is too long to input data |
| Termination  Out Come | 1. Data is entered into the database  2. Data cannot be entered into the database  3. The process takes too long and so the user gives up |
| Major Steps | |
| 1. The user logs into the program and selects add driver option from the menu. 2. The user enters the driver’s first name, second name, team name, customer eligibility, and NPJT eligibility. 3. The program searches the database for the team ID that corresponds with the entered team’s name. 4. The program adds the search result to new row in the driver table along with the data the user has already entered, except the team’s name. 5. If the customer eligibility is true, then repeat step 3 and 4 except replace the search for team ID with driver ID, do not add the driver’s first and second names and the data is added to the Customer driver table instead. 6. If the NPJT eligibility is true, then repeat step 5, except the data is added to the NPJT driver table instead. | |

Displaying a Drivers’ Championship

|  |  |
| --- | --- |
| Use Case Name | Displaying a Drivers’ Championship |
| Actors | Program Administrator  Public |
| Triggering Events | The current standings of a Drivers’ Championship (Drivers’ Championship, Customer Trophy for Drivers, Nelson Piquet Junior Trophy) needs to be viewed |
|  | |
| Assumptions | Up-to-date data can be found in the driver table, customer driver table, and the NPJT driver table |
| Description | The process is searching the driver table and the database outputting all the data stored, whilst organized by the points column in a descending order. |
| Total ETC | 5 minutes as any longer is too long to view data |
| Termination  Out Come | 1. The search conditions are fulfilled  2. Data cannot be found in the database  3. The process takes too long and so the user gives up |
| Major Steps | |
| 1. The user logs into the program and selects view a Drivers’ Championship option from the menu. The program administrator will have a different login compared to the public. 2. The user the selects the driver championship from a list of 3: Drivers’ Championship, Customer Trophy for Drivers, Nelson Piquet Junior Trophy. 3. If the Drivers’ Championship is selected the program searches the database and outputs all driver’s first names and second names, their team’s name, and their points total stored in the driver table. This is all organized in a descending order according to the points column in the driver table. 4. If the Customer Trophy for Drivers is selected the program searches the database and outputs all driver’s first names and second names, their team’s name, and their points stored in the customer driver table. This is all organized in a descending order according to the points column in the customer driver table. 5. If the Nelson Piquet Junior Trophy is selected the program searches the database and outputs all driver’s first names and second names, their team’s name, and their points total stored in the NPJT driver table. This is all organized in a descending order according to the points column in the NPJT driver table. 6. The user finishes looking at the data and returns to the menu and the results of the search are deleted. | |

Displaying a Teams’ Championship

|  |  |
| --- | --- |
| Use Case Name | Displaying a Teams’ Championship |
| Actors | Program Administrator  Public |
| Triggering Events | The current standings of a Teams’ Championship (Teams’ Championship, Customer Teams’ Championship) needs to be viewed |
|  | |
| Assumptions | Up-to-date data can be found in the team table and customer team table |
| Description | The process is searching either the driver table, the customer driver table or the NPJT table and the database outputting all the data stored, whilst organized by the points column in a descending order. |
| Total ETC | 5 minutes as any longer is too long to view data |
| Termination  Out Come | 1. The search conditions are fulfilled  2. Data cannot be found in the database  3. The process takes too long and so the user gives up |
| Major Steps | |
| 1. The user logs into the program and selects view a Teams’ Championship option from the menu. The program administrator will have a different login compared to the public. 2. The user the selects the driver championship from a list of 2: Teams’ Championship or Customer Teams’ Championship. 3. If the Teams’ Championship is selected the program searches the database and outputs all teams’ name, their powertrain manufacturer and their points total stored in the team table. This is all organized in a descending order according to the points column in the team table. 4. If the Customer Teams’ Championship is selected the program searches the database and outputs all teams’ name, their powertrain manufacturer and their points total stored in the customer team table. This is all organized in a descending order according to the points column in the customer team table. 5. The user finishes looking at the data and returns to the menu and the results of the search are deleted. | |

Displaying the Manufacturer’s Cup

|  |  |
| --- | --- |
| Use Case Name | Displaying a Manufacturer’s Cup |
| Actors | Program Administrator  Public |
| Triggering Events | The current standings of the Manufacturer’s Cup needs to be viewed |
|  | |
| Assumptions | Up-to-date data can be found in the manufacturer table |
| Description | The process is searching the manufacturer table and the database outputting all the data stored, whilst organized by the points column in a descending order. |
| Total ETC | 5 minutes as any longer is too long to view data |
| Termination  Out Come | 1. The search conditions are fulfilled  2. Data cannot be found in the database  3. The process takes too long and so the user gives up |
| Major Steps | |
| 1. The user logs into the program and selects view the Manufacturer’s Cup option from the menu. The program administrator will have a different login compared to the public. 2. The program searches the database and outputs all manufacturer’s name and their points total stored in the manufacturer table. This is all organized in a descending order according to the points column in the manufacturer table. 3. The user finishes looking at the data and returns to the menu and the results of the search are deleted. | |