ER Diagram:

The ER diagram contains several entities such as Vehicle, Department, Engine, and General Maintenance. Among these entities, some of them are classified as strong and weak entities. For example, a “vehicle” is a strong entity as its existence does not depend on any other entities. Every strong entity has a primary key as it is used to uniquely identify that tuple in a given relation. Since a “vehicle” entity is labeled as a strong entity, it has a primary key called “VIN number” to identify each car uniquely. The attributes of the Vehicle entity are year, make, model, mileage, life_expectancy, emission_data, initia_cost, and VIN. General_Maintance entity is also a strong entity and its attributes are maintenance_number, insurance_cost, and gallons_of_fuel. Another strong entity is Department and its primary key is Dname. The weak entity in the ER is General_Maintance entity. The attribute for the Engine entity is engine_type.

The relationship between two strong entities is represented by a diamond symbol. The relationship between one strong entity and a weak entity set is shown by a double diamond symbol. For instance, the relationship between Vehicle and Engine entities has a single diamond symbol; whereas, the Vehicle and General_Maintance entity sets have a double diamond symbol.

The ER diagram also contains subclass and superclass relations. A subclass is a class derived from the superclass and inherits all the properties of the superclass. For instance, Van_Passenger, Van_Cargo, Pick-UpTruck_lightduty, Passenger_Vehicle, Public_Safety_Vehicle, etc., are all subclasses of the superclass Vehicle. They all inherit common attributes from Vehicle such as year, make, model, mileage, emission data, vehicle index, life expectancy, etc.,

The ER also contains a disjointness constraint that is symbolized as “d”. The disjointness constraint states that all subclasses of the specialization must be disjoint. This constraint is relevant to our ER diagram because it indicates that a Van_Passenger cannot be a Low_Speed_Utility or Paasenger_Vehicle cannot be a Van_Cargo.

The ER diagram has a cardinality of 1:1 between Vehicle and Engine entities because each vehicle can only have one engine and each engine can only be owned by one vehicle. Another cardinality of 1: N is between Vehicle and Department entities; each vehicle is owned by only one department, and each department owns multiple vehicles. There is a 1:N cardinality between Vehicle and General_maintanance entity because each vehicle requires several maintenance; multiple maintenance are required to only one vehicle.

The Vehicle entity has total participation because every vehicle has an engine. On the other hand, the Engine entity also has a partial participation constraint because there might exist spare engines not currently installed in a vehicle. Additionally, the Department entity has total participation because each department manages a vehicle. The total participation between Vehicle entity and disjointness constraint indicates that all vehicles belong to at least one of the categories of the subclasses. All the total

participation constraints are shown by a double line; partial participation constraint is shown by a single line

The subset sign denoted as “U” in ER specifies all the subtypes such as van_passenger, van_cargo, passenger_vehicle, reduction, low_speed_untility, public_safety_vehivle, pickup_truck_light duty, and pickup_truck_heavy duty are all the subsets of the supertype Vehicle.

Relational Schema:

1. The *GM_Vin_Number* attribute in the GENERAL_MAINTENANCE table is a foreign key connecting it to the *Vin_Number* attribute (primary key) in the VEHICLE table
2. The *V_Engine_Type* attribute in the VEHICLE table is a foreign key connecting it to the *Engine_Type* attribute (primary key) in the ENGINE table
3. The *Dept_Name* attribute in the VEHICLE table is a foreign key connecting it to the *Dname* attribute (primary key) in the DEPARTMENT table

Estimates:

Database Size: Since there are currently 97 fleet vehicles logged on the fleet vehicle spreadsheet, there will be a total of 97 fleet vehicle entries in the database.