Milestone 1: Requirements Analysis & Conceptual Design

Car Rental Company

A ***car rental company*** (CRC) rents cars through their subsidiaries. The CRC has one or multiple **subsidiaries**. Each subsidiary has an address, a number of employees and a turnover (as well as other performance-related figures) and employs multiple employees which each have a name, an unique ID, a phone number and the total sum of all sales they accrued, as a measure for their performance. Each **employee** can only work at one subsidiary and has one or more boss/es.

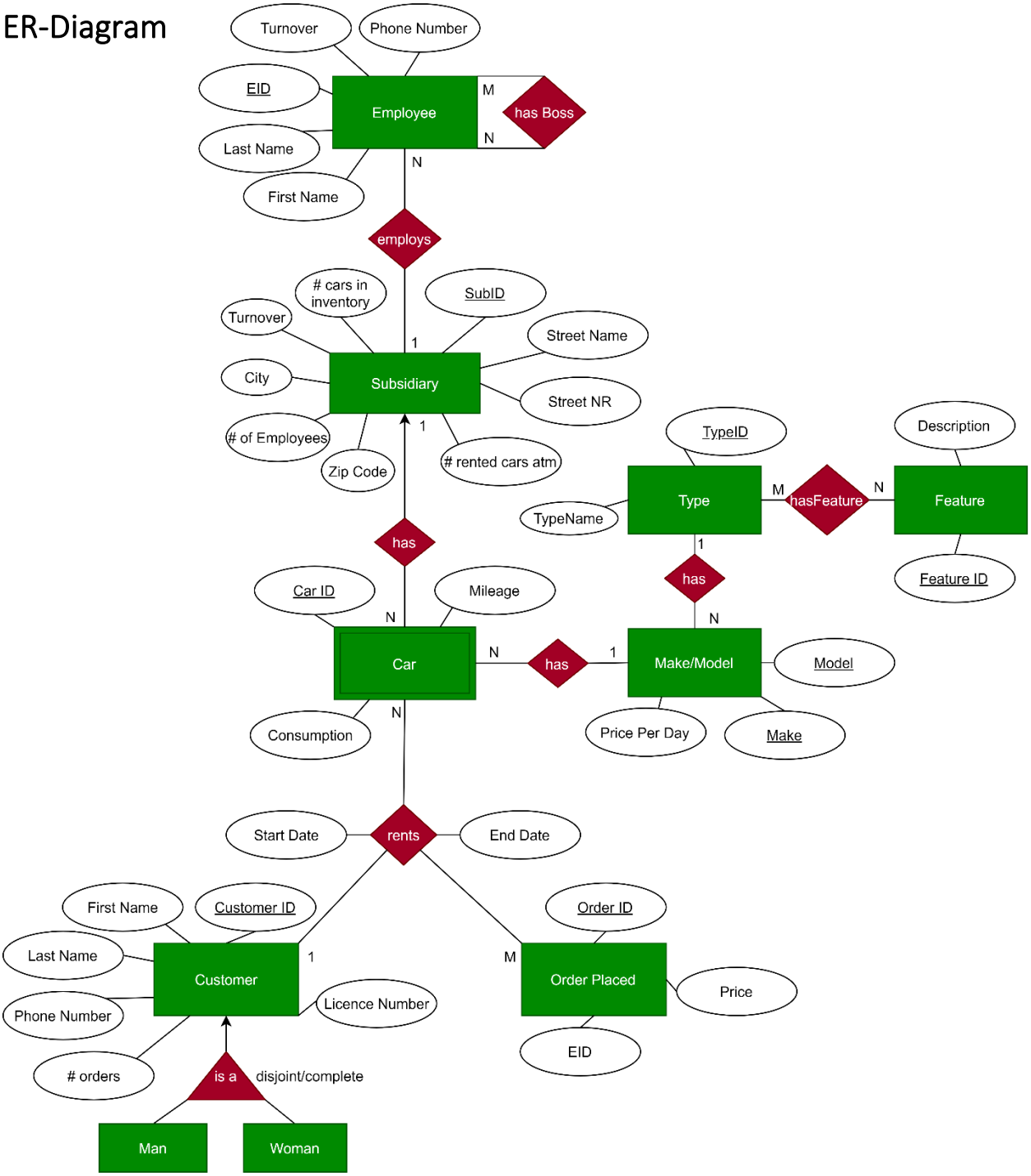
Each subsidiary has multiple cars in their inventory. Each **car** has an ID which is only unique in combination with the ID of the subsidiary, mileage, consumption and belongs to a **make** and **model** which together belong to a certain **type**. The particular combination of make and model have a price per day which is used to calculate the overall price of an order. Each type, such as SUVs or limousines, have their own set of features, such that every SUV has the same features, etc. Nonetheless, multiple types can share a common feature, e.g. every type has at least a navigation system and climate control.

Each **order** is placed by one **customer** and can contain up to three cars. This customer can order the same car again in a new order if they wish to. Every customer has an unique ID, a name, a phone number, a driving licence number and the number of orders they already placed as well as their gender which can be male or female. Both male and female customers share the same attributes, however.

The **order** has an ID, a start- and end date, the ID of the employee and a price, which is calculated from the duration of the order as well as the cars that are part of the order.

This implementation is meant as a **database access point** for the employees of the subsidiaries. With it they can update, insert, delete or search for existing data.

ER-Diagram


Turnover
Phone Number
EID
Employee
M
has Boss
N
Last Name
First Name
N
employs
cars in inventory
SubID
Turnover
1
Street Name
City
Subsidiary
Street NR
# of Employees
1
Zip Code
rented cars atm
TypeID
Description
Type
M
hasFeature
N
Feature
TypeName
1
Feature ID
has
has
Car ID
Mileage
N
N
Car
N
has
1
Make/Model
Model
N
Consumption
Price Per Day
Make
Start Date
rents
End Date
First Name
Customer ID
Order ID
Last Name
Customer
1
M
Order Placed
Price
Phone Number
Licence Number
EID
orders
is a
disjoint/complete
Man
Woman

Milestone 2: Logical Design

------- **Entities** ---------

Subsidiary(SubID, Street_Name, Street_Nr, ZIP_Code, City, # Employess, # Cars_in_Inventory, # Rented_Rars_atm, Turnover)
PK: SubID

Employee(EID, First_Name, Last_Name, Phone_Number, Turnover, *SubID*)
PK: EID
FK: Employee. SubID ◊ Subsidiary. SubID

Car(CarID, *SubID, Make, Model,* Mileage, Consumption)
CK: (CarID, SubID)
FK: Car. SubID ◊ Subsidiary. SubID, Car.Make ◊ Make_Model.Make, Car.Model ◊ Make_Model.Model

Make_Model(Make, Model, Price/Day, *TypeID*)
CK: (Make, Model)
FK: Make_Model.TypeID ◊ Type.TypeID

Type(TypeID, TypeName)
PK: TypeID

Feature(FeatureID, Description)
PK: FeatureID

OrderPlaced(OrderID, *EID*, Price)
PK: OrderID
FK: OrderPlaced.EID ◊ Employee.EID

Customer(CustomerID, Licence_Nr, FirstName, LastName, Phone_Number, # Orders, Gender)
PK: CustomerID

------- **Relations** --------

hasBoss (*EID1*, *EID2*)
CK: (EID1, EID2)
FK: hasBoss.EID1 ◊ Employee.EID, hasBoss.EID2 ◊ Employee.EID

hasfeature(*TypeID*, *FeatureID*)
CK: (TypeID, FeatureID)
FK: hasfeature.TypeID ◊ Type.TypeID, hasfeature.FeatureID ◊ Feature.FeatureID

rents(*OrderID, CarID, SubID, CustomerID,* Start_Date, End_Date)
CK: (OrderID, CarID, SubID)
FK: rents.CarID ◊ Car.CarID, rents. SubID ◊ Subsidiary. SubID, rents.OrderID ◊ OrderPlaced.OrderID, rents. CustomerID ◊ Customer. CustomerID

Milestone 4: Implementation

Documentation of the normalization process:

- ***FD: SubID → Zip_Code → City (!= 3NF)***

  Therefore **Subsidiary** was split into Subsidiary and **Location** via a 1-N relation, where Subsidiary inherited the Zip_Code as a foreign key:

  Location(ZIP_Code, City)
  PK: Zip_Code

  Subsidiary(SubID, Street_Name, Street_Nr, *ZIP_Code*, # Employess, # total_cars, # rented_cars_atm, turnover)
  PK: SubID
  FK: Subsidiary.Zip_Code ◊ Location.Zip_Code

- **FD: OrderID → Start_date, End_date. Not 2NF-conform!**

  Therefore, **rents** was split into two separate tables for orderIDs and start & end dates

- **FD: OrderID → CustomerID. Not 2NF-confrom!**

  Therefore, separate tables for orderIDs and customerIDs from **rents**:

  Both tables could be combined into the table ***OrderDetails*** because no NF-conditions were violated and to reduce unnecessary redundancy.

  rents(*OrderID, CarID, SubID*)
  CK: (OrderID, CarID, SubID)
  FK: rents.CarID ◊ Car.CarID, rents. SubID ◊ Subsidiary. SubID, rents.OrderID ◊ OrderPlaced.OrderID

  OrderDeatils(*OrderID, CustomerID,* Start_date, End_date)
  PK: OrderID
  FK: OrderDetails.CustomerID ◊ Customer.CustomerID, OrderDetails.OrderID ◊ OrderPlaced.OrderID