SEMBR-WTT Bike Rentals (Database Design)

This project will begin by presenting a case study that outlines the relevant tasks. The case study will be supplemented with additional information required for database design. Following this, the project will include the database design, which will encompass an Entity-Relationship Diagram (addressing normalization, cardinality, and optionality), a database prototype, and a data warehouse designed for business intelligence purposes. The data warehouse section will cover the star schema, data transformation processes, and business intelligence use cases. Any coding and figures referenced will be included in the appendix.

TASKS

Task 1: Create an Entity Relationship Diagram (ERD) for a relational database (showing keys, attributes, datatype, named relationships and optionality) to meet the case study requirements for the *new* system. (Appendix 1). You can normalise the document in Appendix 2 to inform your design.

Task 2: Design and develop a prototype database based on your ERD from task 1. You can use any tools (i.e., Microsoft SQL Management Studio / My SQL). You should show the SQL

for your queries and their results. Ensure that there is enough test data to adequately demonstrate the functionality.

Task 3: Design a Data Warehouse to support Business Intelligence (BI) for this company. Based on data from your ERD, design a star schema for a particular functional area of the business (your choice). Describe how the data will be transformed as it is moved into the data warehouse. Explain how the facts / measures could be used to improve the business.

You should state any assumptions that you make in your design and ensure that they do not contradict the (limited) information in the Case Study.

APPENDIX 1: CASE STUDY AND REQUIREMENTS

CASE STUDY

Southdowns Electric Mountain Bike Rental (SEMBR)

You are working for SEMBR, an electric bike hire company, similar to this company here: Cannonball Bikes.

Current System:

There is one rental centre in Eastbourne. They offer daily / weekly / monthly hire for electric bikes which allow people to ride on the South Downs (a national park). They have personal and business customers. SEMBR stores customer information, and many customers make repeat rentals. They currently stock two types of bike for hire:

- Full suspension (High Season £50 per day / Low Season £40 per day)
- Hardtail (High Season £40 per day / Low Season £30 per day)

Each bike hire is recorded separately (i.e., if someone want 3 bikes for one day, that is three hires). The cost of rental is more in the high season (May-August) than low season (September-April). This is based on the start date. All hirers must be over 18s (for insurance and safety reasons). Customers must produce photo ID to make a booking. Customers return bikes to the Eastbourne centre. Hires are recorded in an online booking diary system, using a spreadsheet template. There have been issues with double-booking / bikes being unavailable due to servicing and repairs etc.

New System:

SEMBR have been invited to partner with Walk The Trails (WTT), a company similar to this: Natural Adventure Company. WTT currently runs self-guided walking tours of the South Downs Way - a national trail for walking, biking, riding etc. that runs between Winchester and Eastbourne (160km). They wish to add self-guided bike tours to their offer. They will deal with supplying the accommodation bookings, route maps and daily luggage transfers as they do for their existing walking customers. There may be a small discount for bikes hired via WTT.

WTT would like SEMBR to supply electric mountain bikes. The bikes will need to be picked up and dropped off from both ends of the South Downs Way, as customers may travel the route in either direction. SEMBR will open a new rental centre in Winchester. They hope to minimise driving the bikes between locations. Staff will work across both locations as required. SEMBR will also offer support and emergency repairs over the route, fixing and replacing bikes along the trail, so that the tourist(s) can continue with their booked holiday. WTT will provide a holiday ID number for each bike booking (which may be for more than one bike). Other bookings will still be available to individual customers, as per the current system. The range of bikes may be extended e.g. different sized frames.

To achieve this, SEMBR will need to update their information system. A feasibility report has concluded that the company should use a relational database with a web front-end for their new system.

It is your job to write a design report for the database element.

APPENDIX 1: CASE STUDY AND REQUIREMENTS

The new system should support the following requirements:

1. Register customers for first use, including name, address, dob. A photo ID must be human-verified human to check age – this can be completed by WTT or SEMBR staff.
2. Record information for each bike, including type (currently two types, may be more in future), unique frame number (UFN), service history and overall condition.
3. Show location of the bike – currently and on any given future date (based on bookings).
4. Record information about any emergency repairs (WTT bikes only), including whether SEMBR issued a replacement bike. Include the holiday number from WTT.
5. Calculate the total number of bikes on hire for a given period.
6. Calculate the total income from hired bikes for a given period – split this between WTT and other hires.

APPENDIX 2: EXAMPLE DOCUMENT FOR NORMALISATION

CUSTOMER and HIRE record for normalisation

This is the prototype view of a customer record showing their hire history.

It will not contain all required data – you will need to add to what is here in your design (but should normalise just this data to inform your data model). Note that the earlier hires for this customer are via WTT, but the later ones are individual bookings.

CUSTOMER INFORMATION
CustomerID: *AAA1111*:
Forename: *Jennie*
Surname: *Harding* DOB: *13/07/1969*
Tel mobile: *07782632485*
Tel home: *012330522649*
Address: *45 Madeup Street, Brighton*
Postcode: *BN4 5GH*

ID VALIDATION
ID Type: *passport / driving license / other* Date Verified: *04/08/2023*
Verified By (staffID): *GR2r*
Staff Name: *Gill Roller*

ID SCAN

UFN	BIKE TYPE	RENTAL START *	PICKUP LOCATION	DAYS	COST PER DAY (£)	TOTAL PAID	RETURN LOCATION	RETURN SIGNOFF	SIGNOFF BY	WTT REF (OPTIONAL)
F14	Full suspension	01/08/2023	Eastbourne EB12 8RG	10	50	500	Winchester WC8 2LR	yes	GR2 Gill Roller	WTT123
F22	Full suspension	01/08/2023	Eastbourne EB12 8RG	10	50	500	Winchester WC8 2LR	yes	GR2 Gill Roller	WTT123
H86	Hardtail	18/09/2023	Winchester WC8 2LR	5	30	150	Winchester WC8 2LR	no**	LW8 Lee Wilson	
F22	Full suspension	12/10/2023	Eastbourne EB12 8RG	2	40	80	Eastbourne EB12 8RG	***NULL	NULL	

*note: varying price for same type of bike between August and October – this will change each year

**note: bike damaged this hire, so it would have had to be repaired (details not shown here)

***note: bike not yet returned (hire still in progress)

SEMBR-WTT ELECTRIC BIKE RENTALS DATABASE DESIGN

Task 1: Entity Relationship Diagram (ERD)-Normalisation

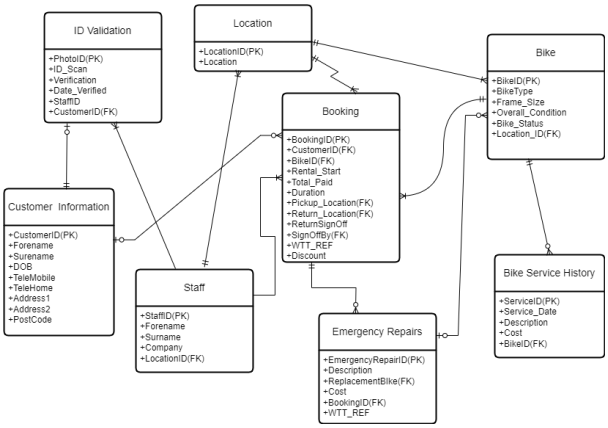
Below is a Third Normal Form (3NF) of the information taken from the case study. It is a database design principle that removes unwanted dependencies in relational databases that helps to: Reduce data redundancy, Avoid data anomalies, Ensure referential integrity, and Simplify data management. 3NF builds on the first normal form (1NF) and second normal form (2NF). It ensures that each non-key column in a table is directly tied to the primary key. 3NF does this by removing transitive dependencies, which is when non-key attributes depend indirectly on the primary key.

UNF	1NF	2NF	3NF	TABLES
CustomerID	**CustomerID**	**CustomerID**	**CustomerID**	**Customer**
Forename	Forename	Forename	Forename	**CustomerID**
Surname	Surname	Surname	Surname	Forename
DOB	DOB	DOB	DOB	Surname
Tel mobile	Tel mobile	Tel mobile	Tel mobile	DOB
Tel home	Tel home	Tel home	Tel home	Tel mobile
Address	Address	Address	Address	Tel home
Postcode	Postcode	Postcode	Postcode	Address
ID Type				Postcode
ID SCAN			**PhotoID**	**ID Validation**
Date Verified	***CustomerID**	***CustomerID**	ID Type	**PhotoID**
Verified By (staffID)	**UFN**	**UFN**	Date Verified	ID Type
Staff Name	Verified By (staffID)	BIKE TYPE		Date Verified
UFN	ID Type	RENTAL START	***CustomerID**	**Booking**
BIKE TYPE	Date Verified	PICKUP LOCATION	**UFN**	***CustomerID UFN**
RENTAL START	Staff Name	DAYS	**Verified By(staffID)**	**Verified By (staffID)**
PICKUP LOCATION	BIKE TYPE	TOTAL PAID	RENTAL START	RENTAL START
DAYS	RENTAL START	RETURN LOCATION	PICKUP LOCATION	PICKUP LOCATION
COST PER DAY	TOTAL PAID	RETURN SIGNOFF	DAYS	DAYS
TOTAL PAID	PICKUP LOCATION	WTT REF	TOAL PAID	TOTAL PAID
RETURN LOCATION	DAYS		RETURN LOCATION	RETURN LOCATION
RETURN SIGNOFF	RETURN LOCATION	**Verified By (staffID)**	RETURN SIGNOFF	RETURN SIGNOFF
SIGNOFF BY	RETURN SIGNOFF	ID Type	WTT REF	WTT REF
WTT REF	SIGNOFF BY	Date Verified	**Verified By (staffID)**	**Staff**
	WTT REF	SIGNOFF BY	**PhotoID**	**Verified By (staffID)**
		Staff Name	SIGNOFF BY	SIGNOFF BY
			Staff Name	Staff Name
			UFN	**Bike**
			BIKE TYPE	**UFN**
				BIKE TYPE

1 - Figure 1: Normalisation

Some of the Assumptions from normalised attributes (figure1):

1. WTT_REF is referring to a table of WTT
2. Each booking has a unique identifier, e.g., BookingID.
3. ID Type and Date Verified referring to Validation column with CustomerID as FK
4. With the normalised data and information from the case study, some attributes and tables are added to make Entity-Relationship Diagram.



2 - Figure 2: Entity Relationship Diagram

Cardinality and Optionality:

1. **A Customer can make zero, one, or more Bookings (One-to-Many):**
    a. Optionality: Optional on the "many" side (a customer might not have any bookings).
2. **A Booking is associated with one Bike, and a Bike can be associated with multiple Bookings (Many-to-One):**
    a. Optionality: Mandatory on the "many" side (each booking must be associated with a bike).
3. **Each Bike is associated with a specific Location (Many-to-One):**
    a. Optionality: Mandatory on the "many" side (each bike must be associated with a location).
4. **Staff work at a specific Location (Many-to-One):**
    a. Optionality: Mandatory on the "many" side (each staff member must work at a location).
5. **EmergencyRepairs are associated with a Booking (Many-to-One):**
    a. Optionality: Mandatory on the "many" side (each emergency repair must be associated with a booking).
6. **A Booking can be associated with multiple EmergencyRepairs (One-to-Many):**
    a. Optionality: Optional on the "many" side (a booking might not have any emergency repairs).
7. **One customer can have many ID validations. (One-to-Many):**
    a. Optionality: Mandatory on the "many" side (a customer must have ID validations).
8. **An emergency repair can have zero, one, or more replaced bikes (One to Many):**
    a. Optionality: Optional on the "many" side (an emergency repair might not have any replaced bikes).
9. **One Bike can have zero, one, or more service histories (One to Many):**
    a. Optionality: Optional on the "many" side (a bike might not have any service histories).
10. **One location (pickup/return) can deal with many bookings (One to Many):**
    a. Optionality: Mandatory on the "many" side (each location must deal with bookings).

11. **One Staff can handle many validations (One to Many):**

    a. Optionality: Mandatory on the "many" side (each validation must be staff verified).

See Appendix E, Data Types (Figure 1-8), for a detailed breakdown of the attributes mentioned earlier. It dives into specifics like data types, keys, NULL, default settings, and other key traits. (Nationalarchives.gov.uk, 2021)

Task 2: Database Prototype (Based on ERD)

The entities outlined in the database schema (refer to Appendix E: Data Types Figure 1-8) have been designed to align with the specified requirements of the database. Subsequently, these entities have been enriched with illustrative dummy data, as evidenced in Appendix D: Dummy Data Figure 1-8. A comprehensive representation of the database prototype, including primary keys, attributes, and inter-entity relationships, is demonstrated in Appendix C: Prototype.

Query / Requirement (database focus)	MET
1. Register customers for first use, including name, address, dob. A photo ID must be human-verified human to check age – this can be completed by WTT or SEMBR staff. *(See Appendix D. Dummy Figure 3 & 8)*	YES
2. Record information for each bike, including type (currently two types, may be more in future), unique frame number (UFN), service history and overall condition. *(See Appendix D. Dummy Figure 1 & 5)*	YES
3. Show location of the bike – currently and on any given future date (based on bookings). *(See Appendix C. Queries Figure 1)*	PARTIAL
4. Record information about any emergency repairs (WTT bikes only), including whether SEMBR issued a replacement bike. Include the holiday number from WTT. *(See Appendix D. Dummy Figure 4)*	YES
5. Calculate the total number of bikes on hire for a given period. *(See Appendix C. Queries Figure 2)*	YES
6. Calculate the total income from hired bikes for a given period – split this between WTT and other hires. *(See Appendix C. Queries Figure 3)*	YES

3 - database requirements

Task 3: Data Warehouse for Business Intelligence

To design a star schema for a Data Warehouse supporting **Business Intelligence (BI)** (Harding, n.d.) for SEMBR, I will focus on the functional area related to bike rentals. The central fact table will be the "Booking" table, and the dimension tables will include "CustomerInformation",”ID_Validation”, "Location", "Bike", "Bike_Service_History", ”Emergency_Repairs”, ”Staff”.

Star Schema Design:

- **Fact Table: Booking**
  - **BookingID (Primary Key):** Unique identifier for each rental transaction.
  - **CustomerID (Foreign Key):** References the CustomerInformation dimension.

- **BikeID (Foreign Key):** References the Bike dimension.
- **Rental_Start:** Date when the rental was initiated.
- **Total_Paid:** Total earning per booking.
- **Duration:** Duration of the rental in days.
- **Pickup_LocationID (Foreign Key):** References the Location dimension for pickup.
- **Return_LocationID (Foreign Key):** References the Location dimension for return.
- **Return_SignOff:** Sign-off status for bike return (YES/NO), NULL if still in the process.
- **SignOffBy (Foreign Key):** References the Staff dimension for sign-off.
- **WTT_REF:** Reference number for Walk The Trails bookings.
- **Discount:** Discount applied to the rental via WTT.

- **Dimension Tables: CustomerInformation Dimension:**
  - **CustomerID (Primary Key):** Unique identifier for each customer.
  - **Forename:** First name of the customer.
  - **Surname:** Last name of the customer.
  - **DOB:** Date of Birth of the customer.
  - **TeleMobile:** Mobile phone number of the customer.
  - **TeleHome:** Home phone number of the customer.
  - **Address1:** First line of the customer's address(street).
  - **Address2:** Second line of the customer's address(city).
  - **PostCode:** Postal code of the customer's address.

- **ID_Validation Dimension:**
  - **PhotoID (Primary Key):** Unique identifier for each photo ID validation.
  - **VerificationStatus:** Verification status (Verified/Not Verified).
  - **ID_Scan:** Image of customer ID's.
  - **Date_Verified:** Verification date.
  - **CustomerID:** References to Customer dimension table.

- **StaffID:** References to Staff dimension table.

- **Bike Dimension:**
  - **BikeID (Primary Key):** Unique identifier for each bike.
  - **BikeType:** Type of the bike (Full suspension/Hardtail).
  - **Frame_Size:** Size of the bike frame (Small/Medium/Large).
  - **Overall_Condition:** Overall condition of the bike (Good/Excellent/Bad).
  - **Bike_Status:** Current status of the bike (Booked/Available/In-Service).
  - **LocationID:** References to Location dimension table.
- **Bike_Service_History Dimension:**
  - **ServiceID (Primary Key):** Unique identifier for each bike service entry.
  - **ServiceDate:** Date of the bike service.
  - **Description:** Description of the service.
  - **Cost:** Cost of the service.
  - **BikeID:** References to Bike dimension table.
- **EmergencyRepairs Dimension:**
  - **Emergency_RepairID (Primary Key):** Unique identifier for each emergency repair entry.
  - **Description:** Description of the emergency repair.
  - **ReplacementBike (Foreign Key**): References the Bike dimension for the replacement bike.
  - **Cost:** Cost of the emergency repair.
  - **BookingID:** References Booking fact table.
  - **WTT_REF:** Reference number for Walk The Trails bookings.
- **Location Dimension:**
  - **LocationID (Primary Key):** Unique identifier for each location.
  - **Location:** Name of the location (Winchester/Eastbourne).
- **Staff Dimension:**
  - **StaffID (Primary Key):** Unique identifier for each staff member.
  - **Forename:** First name of the staff.

- **Surname:** Last name of the staff.
- **Company:** Company the staff belongs to (WTT/SEMBR).
- **LocationID (Foreign Key):** References the Location dimension.

Data Transformation:

1. **ETL Process (Extract, Transform, Load)** (Connolly and Begg, 2015):
    a. **Extract:** Data will be extracted from the operational database tables (CustomerInformation, Location, Bike, Booking, Bike_Service_History, ID_Validation, Staff, EmergencyRepairs).
    b. **Transform:** Data will be transformed to fit the structure of the star schema, including data cleansing, formatting, and the creation of derived attributes (e.g., Total Cost, Total Paid).
    c. **Load:** Transformed data will be loaded into the corresponding dimension and fact tables in the data warehouse.
2. **Data Quality and Consistency** (Connolly and Begg, 2015)
    a. Implement data validation checks during the ETL process to ensure data quality.
    b. Handle missing or inconsistent data by applying default values or cleaning mechanisms.
3. **Indexing:**
    a. Create appropriate indexes on foreign keys and other columns to optimize query performance.

Example: Let's discuss how data transformation could occur for the ***CustomerInformation*** dimension based on the attributes provided:

1. **Cleaning and Validation:**
    a. Ensure that all required fields, especially the **CustomerID** and **DOB**, are present and not null.
    b. Validate that the **DOB** falls within the specified range, in this case, not later than '2005-11-27'.
2. **Standardization:**
    a. Standardize phone numbers to a consistent format (e.g., remove special characters, ensure a specific country code format).
    b. Standardize the **PostCode** to a consistent format if needed.

3. **Derivation of Additional Attributes:**
    a. Create a new attribute for age based on the **DOB** to provide additional insights into customer demographics.
4. **Handling Missing or Default Values:**
    a. Set default values for optional fields like **TeleMobile**, **TeleHome**, **Address1**, **Address2** if they are missing.
5. **Data Type Conversion:**
    a. Ensure that data types are consistent with the target schema. For example, if the original data uses a different date format for **DOB**, convert it to match the required format.
6. **Data Quality Checks:**
    a. Implement checks to identify and handle any outliers or anomalies in the data

BI Use Cases (facts/measures):

1. **Rental Analysis:**
    a. Analyse rental patterns by location, bike type, and time to identify peak seasons and popular bike choices.
    b. Evaluate the effectiveness of marketing strategies and discounts.
2. **Customer Behaviour Analysis:**
    a. Understand customer preferences, repeat rental behaviour, and demographics.
    b. Identify and target specific customer segments for promotions.
3. **Location Performance Analysis:**
    a. Evaluate the performance of rental centres in Winchester and Eastbourne.
    b. Optimize bike allocation and servicing based on location demand.
4. **Booking Sign-off Analysis:**
    a. Monitor and analyse the efficiency of bike return sign-off processes.
    b. Identify any patterns related to late returns or damaged bikes.
5. **WTT Partnership Impact:**
    a. Analyse the impact of the partnership with Walk The Trails on rental volumes and revenue.

b. Evaluate the effectiveness of any discounts offered through WTT.

Implementing this star schema will provide a solid foundation for BI, enabling SEMBR to gain valuable insights into their bike rental operations and make informed business decisions.

References

1. Connolly, T.M. and Begg, C. (2015). *Database systems: a practical approach to design, implementation and management*. Harlow: Pearson Education Limited.

2. Harding, J. (n.d.). *Data Management.* [Lecture] Data Modelling, SQL Review - Database Design Testing, Business Intelligence, Data Security / Legal and Ethical Considerations.

3. Nationalarchives.gov.uk. (2021). Available at: https://webarchive.nationalarchives.gov.uk/ukgwa/+/http://www.cabinetoffice.gov.uk/media/254290/GDS%20Catalogue%20Vol%

4. GDPR (2018). *General Data Protection Regulation (GDPR)*. [online] General Data Protection Regulation (GDPR). Available at: https://gdpr-info.eu/. (GDPR, 2018)

5. Banerjee, D. (2022). *What is SQL ENUM?* [online] Scaler Topics. Available at: https://www.scaler.com/topics/enum-sql/. (Banerjee, 2022)

6. Atlassian (n.d.). *Auto Increment Primary Key in SQL Server*. [online] Atlassian. Available at: https://www.atlassian.com/data/admin/how-to-define-an-auto-increment-primary-key-in-sql-server#:~:text=CREATE%20TABLE%20books%20(%20id%20INT%20NOT%20NULL%20IDENTITY%20PRIMARY%20KEY [Accessed 14 Dec. 2023]. (Atlassian, n.d.)

APPENDICES

Appendix B. Data Types

```
CREATE TABLE Bike(
    BikeID VARCHAR(5) NOT NULL PRIMARY KEY,
    BikeType VARCHAR(15)
       CHECK(BikeType IN('Full suspension','Hardtail')),
    Frame_Size VARCHAR(6)
       CHECK(Frame_Size IN('Small','Medium','Large')),
    Overall_Condition VARCHAR(9)
       CHECK(Overall_Condition IN('Good','Excellent','Bad')),
    Bike_Status VARCHAR(10)
       CHECK(Bike_Status IN('Booked','Available','In-Service')) DEFAULT 'Available',
        LocationID VARCHAR(8) REFERENCES Location(LocationID)
);
```

4 - Figure 1: Bike

```
CREATE TABLE Booking(
    BookingID VARCHAR(10) NOT NULL PRIMARY KEY,
    CustomerID VARCHAR(10) REFERENCES CustomerInformation(CustomerID),
    BikeID VARCHAR(5) REFERENCES Bike(BikeID),
    Duration INT,
    Rental_Start DATE,
    Total_Paid DECIMAL,
    Pickup_Location VARCHAR(8) REFERENCES Location(LocationID),
    Return_Location VARCHAR(8) REFERENCES Location(LocationID),
    ReturnSignOff VARCHAR(3)
       CHECK(ReturnSignOff IN('YES','NO')) DEFAULT NULL,
    SignOffBy VARCHAR(5) REFERENCES Staff(StaffID),
    WTT_REF VARCHAR(10),
    Discount DECIMAL
);
```

5 - Figure 1: Booking

```
CREATE TABLE EmergencyRepairs(
    Emergency_RepairID INT IDENTITY NOT NULL PRIMARY KEY,
    Description TEXT,
    ReplacementBike VARCHAR(5) REFERENCES Bike(BikeID),
    Cost DECIMAL,
    BookingID VARCHAR(10) REFERENCES Booking(BookingID),
    WTT_REF VARCHAR(10)

);
```

6 - Figure 3: Emergency Repairs

```
CREATE TABLE CustomerInformation(
    CustomerID VARCHAR(10) NOT NULL PRIMARY KEY,
    Forename VARCHAR(50),
    Surname VARCHAR(50),
    DOB DATE NOT NULL CHECK(
        DOB IS NOT NULL
        AND
        DOB <= '2005-12-15'),
    TeleMobile VARCHAR(15),
    TeleHome VARCHAR(15),
    Address1 VARCHAR(50),
    Address2 VARCHAR(50),
    PostCode VARCHAR(8)
);
```

7 - Figure 4: Customer

```
CREATE TABLE ID_Validation(
    PhotoID VARCHAR(12) NOT NULL PRIMARY KEY,
    ID_Scan Image,
    StaffID VARCHAR(5) NOT NULL REFERENCES Staff(StaffID),
    VerificationStatus VARCHAR(12) CHECK(VerificationStatus IN ('Verified', 'Not Verified')) DEFAULT 'Not Verified',
    Date_Verified DATE,
    CustomerID VARCHAR(10) REFERENCES CustomerInformation(CustomerID)
);
```

8 - Figure 5: ID Validation

```
CREATE TABLE Location(
    LocationID VARCHAR(8) NOT NULL PRIMARY KEY
       CHECK(LocationID IN('WC8 2LR','EB12 8RG')),
    Location VARCHAR(10)
       CHECK(Location IN('Winchester','Eastbourne'))
);
```

9 - Figure 6: Location

```
CREATE TABLE Bike_Service_History(
    ServiceID INT IDENTITY NOT NULL PRIMARY KEY,
    Service_Date DATE,
    Description TEXT,
    Cost DECIMAL,
    BikeID VARCHAR(5) REFERENCES Bike(BikeID)

);
```

10 - Figure 7: Bike Service History

```
CREATE TABLE Staff (
    StaffID VARCHAR(5) NOT NULL PRIMARY KEY,
    Forename VARCHAR(50),
    Surname VARCHAR(50),
    Company CHAR(5)
       CHECK(Company IN('WTT','SEMBR')),
    LocationID VARCHAR(8) REFERENCES Location(LocationID)

);
```

11 - Figure 8: Staff

Appendix C. Queries

Note that, because all data are artificial, some query results might seem illogical.

```
SELECT
    Booking.BikeID,
    Bike.Bike_Status,
    Booking.BookingID,
    Booking.Rental_Start,
    Location.Location AS CurrentLocation
FROM
    Bike
JOIN
    Booking ON Booking.BikeID = Bike.BikeID
JOIN
    Location ON Location.LocationID = Booking.Pickup_Location
WHERE
    Bike.Bike_Status = 'Booked'
ORDER BY
    Booking.Rental_Start DESC -- If there are multiple booking
```

Results | Messages

BikeID	Bike_Status	BookingID	Rental_Start	CurrentLocation
F14	Booked	BK004	2023-04-20	Winchester
F14	Booked	BK001	2023-01-05	Winchester

```
SELECT
    Bike.BikeID,
    Bike.Bike_Status,
    Location.Location AS FutureLocation
FROM
    Bike
JOIN
    Booking ON Bike.BikeID = Booking.BikeID
JOIN
    Location ON Booking.Return_Location = Location.LocationID
WHERE
    Bike.Bike_Status = 'Booked'
    AND  DATEADD(DAY, Duration, Rental_Start)  = @TargetDate
ORDER BY
    Booking.Rental_Start DESC;
```

Results | Messages

BikeID	Bike_Status	FutureLocation
F14	Booked	Eastbourne

12 - Figure 1: Current and future Location

```
DECLARE @StartDate_ DATE = '2023-01-01';
DECLARE @EndDate_ DATE = '2023-12-01';

SELECT
    COUNT(DISTINCT BikeID) AS TotalBikesOnHire
FROM
    Booking
WHERE
    Rental_Start < DATEADD(DAY, Duration, @EndDate_)
    AND DATEADD(DAY, Duration, Rental_Start) >= @StartDate_;
```

Results | Messages

TotalBikesOnHire
3

13 - Figure 2: Total number of bikes on hire

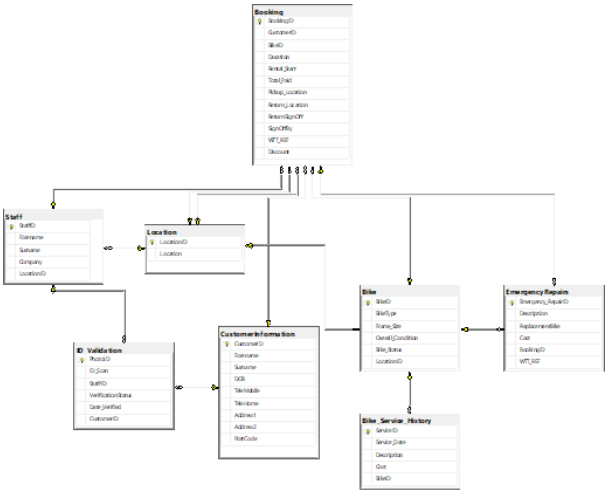
```
DECLARE @StartDate DATE = '2023-01-01';
DECLARE @EndDate DATE = '2023-08-31';

SELECT
    SUM(Total_Paid) AS TotalIncome,
    SUM(CASE WHEN WTT_REF IS NOT NULL THEN Total_Paid * 0.35 ELSE 0 END) AS WTTIncome,
    SUM(CASE WHEN WTT_REF IS NOT NULL THEN Total_Paid * 0.65 ELSE 0 END) AS SEMBRIncome,
    SUM(CASE WHEN WTT_REF IS NULL THEN Total_Paid ELSE 0 END) AS SEMBRIncome
FROM Booking
WHERE Rental_Start BETWEEN @StartDate AND @EndDate;
```

Messages

TotalIncome	WTTIncome	SEMBRIncome	SEMBRIncome
1580	395.50	734.50	450

14 - Figure 3: SEMBR and WTT income

Appendix C. prototype



15 - Entity Relational Diagram from SSMS (derived from coding)

Appendix D. Dummy

Note that, all entities were loaded with 10 rows.

```
INSERT INTO Bike (BikeID, BikeType, Frame_Size, Overall_Condition, Bike_Status, LocationID)
VALUES
('F14', 'Full suspension', 'Medium', 'Excellent', 'Booked', 'EB12 8RG'),
('F22', 'Full suspension', 'Large', 'Good', 'Available', 'WC8 2LR'),
('H86', 'Full suspension', 'Small', 'Good', 'Available', 'WC8 2LR'),
('A01', 'Hardtail', 'Large', 'Excellent', 'Available', 'EB12 8RG'),
('B02', 'Hardtail', 'Medium', 'Excellent', 'Available', 'EB12 8RG'),
```

Messages

BikeID	BikeType	Frame_Size	Overall_Condition	Bike_Status	LocationID
A01	Hardtail	Large	Excellent	Available	EB12 8RG
B02	Hardtail	Medium	Excellent	Available	EB12 8RG
C03	Hardtail	Small	Good	Available	WC8 2LR
D04	Full suspension	Medium	Bad	In-Service	EB12 8RG
E05	Hardtail	Large	Excellent	Booked	EB12 8RG
F14	Full suspension	Medium	Excellent	Booked	EB12 8RG
F22	Full suspension	Large	Good	Available	WC8 2LR

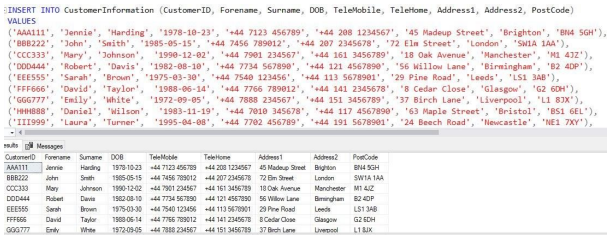
16 - Figure 1: Bike

```
INSERT INTO Booking (BookingID, CustomerID, BikeID, Rental_Start,Total_Paid ,Duration, Pickup_Location, Return_Locati
VALUES
    ('BK001', 'AAA111', 'F14', '2023-01-05',300 ,7, 'WC8 2LR', 'EB12 8RG', 'NO', NULL, 'WTT001', 3.00),
    ('BK002', 'BBB222', 'H86', '2023-02-10',200, 5, 'EB12 8RG', 'WC8 2LR', 'YES', 'GR2r', 'WTT002', 2.10),
    ('BK003', 'CCC333', 'F22', '2023-03-15',150, 3, 'EB12 8RG', 'EB12 8RG', 'NO', NULL, 'WTT003', 5.00),
    ('BK004', 'AAA111', 'F14', '2023-04-20',250, 6, 'WC8 2LR', 'WC8 2LR', NULL, NULL, 'WTT004', 7.15),
    ('BK005', 'EEE555', 'H86', '2023-05-25',180, 4, 'EB12 8RG', 'EB12 8RG', 'NO', NULL, 'WTT005', 6.20),
    ('BK006', 'FFF666', 'F22', '2023-06-30',100, 2, 'WC8 2LR', 'WC8 2LR', 'YES', 'LS4t', NULL, NULL),
    ('BK007', 'GGG777', 'H86', '2023-07-05',350, 8, 'EB12 8RG', 'WC8 2LR', 'NO', NULL, NULL, NULL),
    ('BK008', 'AAA111', 'F22', '2023-08-10',50, 1, 'WC8 2LR', 'EB12 8RG', 'YES', 'MP3u', 'WTT008', 9.25),
    ('BK009', 'III999', 'H86', '2023-09-15',290, 7, 'EB12 8RG', 'WC8 2LR', 'NO', NULL, 'WTT009', NULL),
    ('BK010', 'JJJ000', 'F22', '2023-10-20',260, 5, 'WC8 2LR', 'EB12 8RG', NULL, NULL, NULL, NULL);
```

Messages

BookingID	CustomerID	BikeID	Duration	Rental_Start	Total_Paid	Pickup_Location	Return_Location	ReturnSignOff	SignOffBy	WTT_REF	Discount
BK001	AAA111	F14	7	2023-01-05	300	WC8 2LR	EB12 8RG	NO	NULL	WTT001	3
BK002	BBB222	H86	5	2023-02-10	200	EB12 8RG	WC8 2LR	YES	GR2r	WTT002	2
BK003	CCC333	F22	3	2023-03-15	150	EB12 8RG	EB12 8RG	NO	NULL	WTT003	5
BK004	AAA111	F14	6	2023-04-20	250	WC8 2LR	WC8 2LR	NULL	NULL	WTT004	7
BK005	EEE555	H86	4	2023-05-25	180	EB12 8RG	EB12 8RG	NO	NULL	WTT005	6
BK006	FFF666	F22	2	2023-06-30	100	WC8 2LR	WC8 2LR	YES	LS4t	NULL	NULL
BK007	GGG777	H86	8	2023-07-05	350	EB12 8RG	WC8 2LR	NO	NULL	NULL	NULL
BK008	AAA111	F22	1	2023-08-10	50	WC8 2LR	EB12 8RG	YES	MP3u	WTT008	9
BK009	III999	H86	7	2023-09-15	290	EB12 8RG	WC8 2LR	NO	NULL	WTT009	NULL
BK010	JJJ000	F22	5	2023-10-20	260	WC8 2LR	EB12 8RG	NULL	NULL	NULL	NULL

17 - Figure 2: Booking



```
INSERT INTO CustomerInformation (CustomerID, Forename, Surname, DOB, TeleMobile, TeleHome, Address1, Address2, PostCode)
VALUES
('AAA111', 'Jennie', 'Harding', '1978-10-23', '+44 7123 456789', '+44 208 1234567', '45 Madeup Street', 'Brighton', 'BN4 5GH'),
('BBB222', 'John', 'Smith', '1985-05-15', '+44 7456 789012', '+44 207 2345678', '72 Elm Street', 'London', 'SW1A 1AA'),
('CCC333', 'Mary', 'Johnson', '1990-12-02', '+44 7901 234567', '+44 161 3456789', '18 Oak Avenue', 'Manchester', 'M1 4JZ'),
('DDD444', 'Robert', 'Davis', '1982-08-10', '+44 7734 567890', '+44 121 4567890', '56 Willow Lane', 'Birmingham', 'B2 4DP'),
('EEE555', 'Sarah', 'Brown', '1975-03-30', '+44 7540 123456', '+44 113 5678901', '29 Pine Road', 'Leeds', 'LS1 3AB'),
('FFF666', 'David', 'Taylor', '1988-06-14', '+44 7766 789012', '+44 141 2345678', '8 Cedar Close', 'Glasgow', 'G2 6DH'),
('GGG777', 'Emily', 'White', '1972-09-05', '+44 7888 234567', '+44 151 3456789', '37 Birch Lane', 'Liverpool', 'L1 8JX'),
('HHH888', 'Daniel', 'Wilson', '1983-11-19', '+44 7010 345678', '+44 117 4567890', '63 Maple Street', 'Bristol', 'BS1 6EL'),
('III999', 'Laura', 'Turner', '1995-04-08', '+44 7702 456789', '+44 191 5678901', '24 Beach Road', 'Newcastle', 'NE1 7XY'),
```

Results | Messages

CustomerID	Forename	Surname	DOB	TeleMobile	TeleHome	Address1	Address2	PostCode
AAA111	Jennie	Harding	1978-10-23	+44 7123 456789	+44 208 1234567	45 Madeup Street	Brighton	BN4 5GH
BBB222	John	Smith	1985-05-15	+44 7456 789012	+44 207 2345678	72 Elm Street	London	SW1A 1AA
CCC333	Mary	Johnson	1990-12-02	+44 7901 234567	+44 161 3456789	18 Oak Avenue	Manchester	M1 4JZ
DDD444	Robert	Davis	1982-08-10	+44 7734 567890	+44 121 4567890	56 Willow Lane	Birmingham	B2 4DP
EEE555	Sarah	Brown	1975-03-30	+44 7540 123456	+44 113 5678901	29 Pine Road	Leeds	LS1 3AB
FFF666	David	Taylor	1988-06-14	+44 7766 789012	+44 141 2345678	8 Cedar Close	Glasgow	G2 6DH
GGG777	Emily	White	1972-09-05	+44 7888 234567	+44 151 3456789	37 Birch Lane	Liverpool	L1 8JX

18 - Figure 3: Customer

```
INSERT INTO EmergencyRepairs (Description, ReplacementBike, Cost, BookingID,WTT_REF)
VALUES
    ('Flat tire repair', 'F14', 50.00, 'BK001','WTT001'),
    ('Brake replacement', NULL, 120.00, 'BK002','WTT002'),
    ('Chain repair', 'F22', 80.00, 'BK003','WTT001'),
    ('Gear adjustment', NULL, 40.00, 'BK004','WTT003'),
    ('Wheel alignment', 'F14', 60.00, 'BK005','WTT004'),
    ('Handlebar replacement', NULL, 90.00, 'BK006','WTT005'),
    ('Pedal repair', 'H86', 35.00, 'BK007','WTT006'),
    ('Suspension tuning', 'F14', 75.00, 'BK008','WTT007'),
```

esults | Messages

Emergency_RepairID	Description	ReplacementBike	Cost	BookingID	WTT_REF
2	Flat tire repair	F14	50	BK001	WTT001
3	Brake replacement	NULL	120	BK002	WTT002
4	Chain repair	F22	80	BK003	WTT001
5	Gear adjustment	NULL	40	BK004	WTT003
6	Wheel alignment	F14	60	BK005	WTT004
7	Handlebar replacement	NULL	90	BK006	WTT005
8	Pedal repair	H86	35	BK007	WTT006

19 - Figure 4: Emergency Repairs

```
INSERT INTO Bike_Service_History (Service_Date, Description, Cost, BikeID)
VALUES
('2022-01-15', 'Routine maintenance', 15.00, 'F14'),
('2022-03-22', 'Brake replacement', 30.00, 'H86'),
('2022-05-10', 'Tire change', 80.00, 'F22'),
('2022-07-18', 'Chain lubrication', 30.00, 'D04'),
('2022-09-05', 'Gear adjustment', 40.00, 'F14'),
('2022-11-12', 'Full service', 150.00, 'F22'),
('2023-02-08', 'Wheel truing', 60.00, 'G07'),
('2023-04-25', 'Handlebar upgrade', 90.00, 'F14'),
('2023-06-30', 'Pedal replacement', 35.00, 'I09'),
```

esults | Messages

ServiceID	Service_Date	Description	Cost	BikeID
2	2022-01-15	Routine maintenance	15	F14
3	2022-03-22	Brake replacement	30	H86
4	2022-05-10	Tire change	80	F22
5	2022-07-18	Chain lubrication	30	D04
6	2022-09-05	Gear adjustment	40	F14
7	2022-11-12	Full service	150	F22
8	2023-02-08	Wheel truing	60	G07

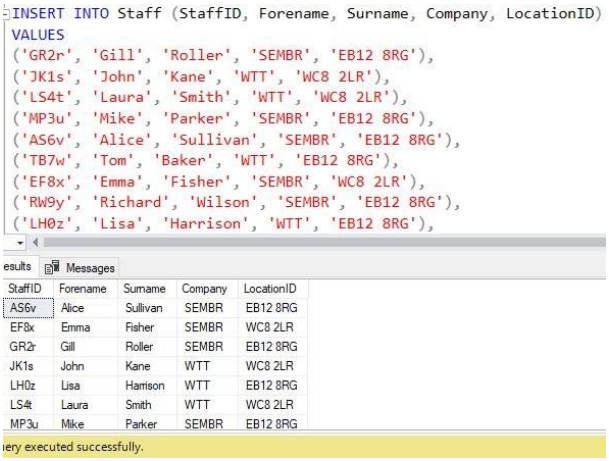
20 - Figure 5: Bike Service History

```
INSERT INTO Location (LocationID, Location)
VALUES
( 'EB12 8RG','Eastbourne'),
( 'WC8 2LR','Winchester');

SELECT*
FROM Location
```

esults | Messages

LocationID	Location
EB12 8RG	Eastbourne
WC8 2LR	Winchester

21 - Figure 6: Location



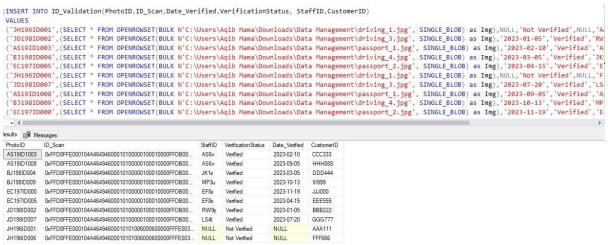
```
INSERT INTO Staff (StaffID, Forename, Surname, Company, LocationID)
VALUES
('GR2r', 'Gill', 'Roller', 'SEMBR', 'EB12 8RG'),
('JK1s', 'John', 'Kane', 'WTT', 'WC8 2LR'),
('LS4t', 'Laura', 'Smith', 'WTT', 'WC8 2LR'),
('MP3u', 'Mike', 'Parker', 'SEMBR', 'EB12 8RG'),
('AS6v', 'Alice', 'Sullivan', 'SEMBR', 'EB12 8RG'),
('TB7w', 'Tom', 'Baker', 'WTT', 'EB12 8RG'),
('EF8x', 'Emma', 'Fisher', 'SEMBR', 'WC8 2LR'),
('RW9y', 'Richard', 'Wilson', 'SEMBR', 'EB12 8RG'),
('LH0z', 'Lisa', 'Harrison', 'WTT', 'EB12 8RG'),
```

esults | Messages

StaffID	Forename	Surname	Company	LocationID
AS6v	Alice	Sullivan	SEMBR	EB12 8RG
EF8x	Emma	Fisher	SEMBR	WC8 2LR
GR2r	Gill	Roller	SEMBR	EB12 8RG
JK1s	John	Kane	WTT	WC8 2LR
LH0z	Lisa	Harrison	WTT	EB12 8RG
LS4t	Laura	Smith	WTT	WC8 2LR
MP3u	Mike	Parker	SEMBR	EB12 8RG

ery executed successfully.

22 - Figure 7: Staff



23 - Figure 8: ID Validation