Requirements specification for “Rental of the electric scooters” business process

1. General description of business process

    a) A general description of the business process and a description of the performance metrics generated by this process, possible current analytical problems.

    The process of scooter rental looks as follows: Customers open a special smartphone app prepared by a rental company. Customer navigates to the map with highlighted locations of scooters available to rent. He locates the preferred vehicle and finds out its exact location. Then he needs to walk closely to the scooter. A device has an QR code on its aluminum frame. Client has to open the mobile app, choose an option to scan device QR code and direct the device camera in the direction of the code. The app automatically recognizes the vehicle and starts the process of unlocking it. The system checks if the user has sufficient funds credited or if he has any connected debit/credit card. System charges user PLN10 at the start of the ride. If the verification results are successful, the start of rental is recorded in the system, device unlocks and is prepared for the ride. Users are allowed to travel within the specific area in the city and park vehicles in any safe place. Also, the user has real-time information about this rental in his mobile app. The end of the rental is resolved by clicking the “end rental” button in the app. At this moment, the system calculates the whole charge for the service and decides if it needs to charge the customer more money to line up with the charge, or if it needs to refund the part of funds. It makes appropriate operation on the user’s e-wallet or credit card and sends a bill to the connected email account. Device locks, it is not able to ride further. User receives the confirmation of the successful operation in the app. The information about the ride is saved to the database.

    There is a rise in the monthly number of rentals at a level not lower than 0.25% per month.
    There is a monthly increase of 0.10% in average rental time of one scooter daily.

    b) Typical questions

    1. What is the average rental duration for scooters?
    2. Which cities see the highest demand for scooter rentals?
    3. What is the average number of rentals per age?
    4. How many rentals does a scooter have per day on average?
    5. Which day of the week has the highest scooter usage?

6. What is the average travel distance per rental?
7. What is the average battery life remaining on a scooter at the start of each rental?
8. What is the average battery life remaining on scooters at the end of each rental?
9. Give the average number of rentals per user per month.
10. Compare the numbers of rentals between various models of scooters.
11. Compare the number of rentals of the current month with the number of rentals of the previous month.
12. Compare the number of rentals between cities.
13. Show the number of rentals from each month for the last year.

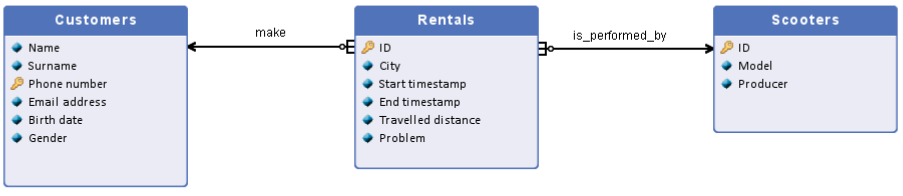
c) Data

Data originates from two primary sources: the mobile application used by customers and the scooter management system employed internally. Details about the rental, user information (optional), and app usage are examples of the data collected from the mobile app. Vehicles ids, their location, battery levels, maintenance history, operational status are all tracked by the internal management system. External data is also used when it comes to maps displayed to users in the mobile app and the weather information.

2. Data sources structures

THE MOBILE APP DATABASE

ER Diagram:



Entities descriptions:

Entity set: Customers
Description: Person registered in the rental system, identified by an unique phone number

Name of a key	Part of PK?	Type	Description
Phone number	+	NVARCHAR(13)	Phone number of the customer, unique, only one account can be created with a specific phone number. Format : the “+” at the beginning with 2 digits associating number with a country, then 9 or 10 digit numbers depending on a country
Name	-	NVARCHAR(25)	First name of the customer
Surname	-	NVARCHAR(35)	Surname of the customer
Gender		NVARCHAR(9)	Gender of customer. Allowed values: “Male”, “Female” or “Different”
Email address	-	NVARCHAR(50)	Email address of the customer, unique, only one account can be created with a specific email address.
Birth date	-	DATE	Date of birth of the customer

Entity set: Scooters
Description: Specific vehicle identified by its ID number with assigned model and producer.

Name of a key	Part of PK?	Type	Description
ID	+	INT	Serial number of the vehicle (*business key*)
Model	-	NVARCHAR(10)	The specific model of the scooter
Producer	-	NVARCHAR(15)	The producer of the specific scooter

Entity set: Rentals

Description: A registered event of a rental of a particular vehicle identified with its own ID number that took place in a specific city.

Name of a key	Part of PK?	Type	Description
ID	+	INT	Automatically generated number starting from 1 with increment 1
City	-	NVARCHAR(15)	City in which the rental was started
Start timestamp	-	DATETIME	Timestamp - date and time of the start of rental with an accuracy to a single second.
End timestamp	-	DATETIME	Timestamp - date and time of the end of rental with an accuracy to a single second.
Traveled distance	-	DECIMAL(5,3)	Distance traveled on a scooter by customer during the rental shown in meters
Problem	-	BIT	“1” if there was a problem during the rental and it ended because of that problem, “0” if not

Relationship description:

Name	Entity 1	Entity 2	Type	Description
make	Customers	Rentals	1 : 0..n	Customers are making rentals by the mobile app
is_performed_by	Rentals	Scooters	0..n : 1	Every rental is performed by a specific scooter

RDB:

Customers (Name, Surname, Phone number, Email address, Birth date, Registration date, Gender)
Rental (ID, City, Start timestamp, End timestamp, Traveled distance, Problem, Phone number REF Customers, ID REF Scooters)
Scooters (ID, Model, Producer)

SCOOTER MANAGEMENT SYSTEM REPORTS (CSV FILES)

We have 14 historical files (one is adequate to data collected during one day). Therefore we have 14 days of data about all of the scooters. One file contains

multiple records with data about vehicles. One record describes a single remote readout of the vehicle state with scooter ID, location (latitude & longitude coordinates), timestamp of the readout, battery percentage, status, expected travel distance left (in meters). It is autogenerated by a management system every time when the state of the vehicle has changed. If the device didn't have a status change that day, it has one automatic record with its actual status (at the end of the day). First row of the file contains headers, below is the data.

Column A - *Scooter ID* (integer, serial number of the vehicle - *business key*),
Column B - *Timestamp* (integer),
Column C - *Battery percentage* (integer),
Column D - *Status* (text - "rented", "free", "unavailable"),
Column E - *Expected travel distance left* (float),
Column F - *Location latitude* (float),
Column G - *Location longitude* (float).

Note: In the system, if there are 14 already existing files already and a new file is about to appear - the oldest one is removed. However, there are no contraindications to backup those files before deletion.

3. Scenarios of analytical problems

Why was there an increase / decrease in the number of rentals?

1. Which cities see the highest demand for scooter rentals for the analyzed month compared to the previous month?
2. What is the number of rentals per age group for the analyzed month and for the previous month?
3. Give the average number of rentals per user, per month.
4. Show the total number of rentals from each month for the last year.
5. Compare the number of rentals between cities for the last 30 days.
6. Show the monthly average percentage of scooters that are available for customers' usage during the day compared to three previous months.
7. Give the average battery life remaining on a scooter at the start of each rental in the current and previous month.
8. Compare the percentage distribution of rentals depending on gender for the current month with the number of rentals of the previous month.
9. Compare the average number of rentals per 10,000 residents in each city.

What influences the vehicle daily utilization?

1. Compare the average expected travel distance at the end of the rental between cities.
2. What is the average rental duration this month compared to the previous month?
3. Give the average battery life remaining on scooters at the end of each rental.
4. What is the average travel distance per rental from each month for the last year?

5. Which day of the week has the highest scooter usage for the last month?
6. How many rentals does a scooter have on average per day in the current and previous month?
7. Compare the share of rentals between various models of scooters for the last year.
8. Compare the number of rentals preceded by a 15 minutes reservation with the number of rentals without a reservation.
9. Compare the number of rentals between various areas in cities.

4. Data needed for analytical problems

Analytical problem: Why was there an increase / decrease in the number of rentals?

1. Which cities see the highest demand for scooter rentals for the analyzed month compared to the previous month?
    - **number of rentals** - *THE MOBILE APP DATABASE*, table *Rentals*
    - **city of rental** - *THE MOBILE APP DATABASE*, table *Rentals*, column *City*
    - **month of rental** - *THE MOBILE APP DATABASE*, table *Rentals*, column *End timestamp.* We extract only the name of the month.

2. What is the number of rentals per age group for the analyzed month and for the previous month?
    - **number of rentals** - *THE MOBILE APP DATABASE*, table *Rentals* - we count number of rentals for specific age and month.
    - **age of customer** - *THE MOBILE APP DATABASE*, table *Customers*, column *Birth date* - we calculated age of a customer by subtracting the customer's date of birth from today date and rounding it down to full years.
    - **month of rental** - *THE MOBILE APP DATABASE*, table *Rentals*, column *End timestamp.* We extract only the name of the month.

3. Give the average number of rentals per user, per month.
    - **average number of rentals per user** - We calculate it using two tables from *THE MOBILE APP DATABASE* - table *Rentals* and *Customers.* We are retrieving information about the number of rentals and the number of customers for a given month. Then we are dividing the number of rentals by the number of customers.
    - **month of rental** - *THE MOBILE APP DATABASE*, table *Rentals*, column *End timestamp.* We extract only the name of the month.

4. Show the number of rentals from each month for the last year.
    - **number of rentals** - *THE MOBILE APP DATABASE*, table *Rentals* - we count the number of rentals for a specific month.
    - **month of rental** - *THE MOBILE APP DATABASE*, table *Rentals*, column *End timestamp.* We extract only the name of the month.
    - **year of rental** - *THE MOBILE APP DATABASE*, table *Rentals*, column *End timestamp.* We extract only the year number.

5. Compare the number of rentals between cities in the last 30 days.
    - **city of rental -** *THE MOBILE APP DATABASE*, table *Rentals*, column *City*.
    - **number of rentals -** we count records in table *Rentals* using data source *THE MOBILE APP DATABASE* for particular cities.
    - **day -** *THE MOBILE APP DATABASE*, table *Rentals*, column *End timestamp*. We extract the full date in format “DD.MM.YYYY”.

6. Show the monthly average percentage of scooters that are available for customers’ usage during the day compared to 3 previous months.
    - **average percentage of available scooters** - *THE MOBILE APP DATABASE*, table *Scooters* - we count the number of all scooters; *SCOOTER MANAGEMENT SYSTEM REPORTS, Column D “Status”* - for a specific day, we count the number of scooters that had at least one readout with status *“free”* or *“rented”*. We take the average of that value for a specific month and then divide it by the total number of scooters.
    - **month of rental** - *THE MOBILE APP DATABASE*, table *Rentals*, column *End timestamp.* We extract only the name of the month.

7. Give the average battery life remaining on a scooter at the start of each rental in the current and previous month.
    - **average battery percentage** - *SCOOTER MANAGEMENT SYSTEM REPORTS, Column C - Battery percentage*
    - **month of rental** - *THE MOBILE APP DATABASE*, table *Rentals*, column *Start timestamp.* We extract only the name of the month.

8. Compare the percentage distribution of rentals depending on gender for the current month with the number of rentals of the previous month.
    - **gender** - *THE MOBILE APP DATABASE*, table *Customers,* column *Gender.*
    - **percentage distribution of rentals per gender** - We calculate it using two tables from *THE MOBILE APP DATABASE* - table *Rentals* and *Customers.* We are retrieving information about the number of rentals and the number of rentals for each gender for a given month. Then we divide the number of rentals for each gender by the general number of rentals and multiply by 100%.
    - **month of rental** - *THE MOBILE APP DATABASE*, table *Rentals*, column *End timestamp.* We extract only the name of the month.

9. Compare the average number of rentals per 10,000 residents in each city for each month of the previous year.
    - **city -** *THE MOBILE APP DATABASE*, table *Rentals*, column *City*.
    - **month -** THE MOBILE APP DATABASE, table Rentals, column *End timestamp*. We extract only the name of the month.
    - **average number of rentals per 10,000 residents -** *THE MOBILE APP DATABASE*, table *Rentals* - we count the number of records for the city and month and divide it by the number of residents of a particular city (no such information in our data sources, additional source is needed!) and then multiply by 10,000.

Analytical problem: What influences the vehicle daily utilization?

1. Compare the average expected travel distance at the end of the rental between cities.
    - **city of rental -** *THE MOBILE APP DATABASE*, table *Rentals*, column *City*.
    - **average expected travel distance -** we calculate it using the data from *SCOOTER MANAGEMENT SYSTEM REPORTS*, Column E *"Expected travel distance left"*.

2. What is the average rental duration this month compared to the previous month?
    - **month of rental -** *THE MOBILE APP DATABASE*, table *Rentals*, column *End timestamp.* We extract only the name of the month.
    - **average rental duration -** Rental duration is expressed in minutes. We calculate it using two columns from *THE MOBILE APP DATABASE* - table *Rentals* - columns *Start timestamp* and *End timestamp*. We define rental duration as a *"End timestamp - Start timestamp"*. Then we take the average for the values calculated for a specific month.

3. Give the average battery life remaining on scooters at the end of each rental in the current and previous month.
    - **average battery percentage** - *SCOOTER MANAGEMENT SYSTEM REPORTS, Column C - Battery percentage.*
    - **month of rental** - *THE MOBILE APP DATABASE*, table *Rentals*, column *End timestamp.* We extract only the name of the month.

4. What is the average travel distance per rental from each month for the last year?
    - **month of rental -** *THE MOBILE APP DATABASE*, table *Rentals*, column *End timestamp*. We extract only the name of the month.
    - **average travel distance -** Rental distance is expressed in meters. We calculate it using one table from *THE MOBILE APP DATABASE* - table *Rentals*. We take a value from the *traveled distance* column. Then, we take the average of the values for a specific month.

5. Which day of the week has the highest scooter usage for the last month?
    - **day of the week -** *THE MOBILE APP DATABASE*, table *Rentals*, column *End timestamp*. We extract only the name of the day of the week.
    - **total distance traveled** - We calculate it using one table from *THE MOBILE APP DATABASE*, table *Rentals*, column *Traveled distance*. We take the sum of the values for a specific weekday.

6. How many rentals does a scooter have on average per day in the current and previous month?
    - **month of rental -** *THE MOBILE APP DATABASE*, table *Rentals*, column *End timestamp*. We extract only the name of the month.
    - **average number of rentals -** We count records in table *Rentals* using data source *THE MOBILE APP DATABASE* for the specific month. Then we divide this count by the number of days of this month.

7. Compare the share of rentals between various models of scooters for the last year.
    - **scooter producer -** *THE MOBILE APP DATABASE*, table *Scooters*, column *Producer*.
    - **scooter model -** *THE MOBILE APP DATABASE*, table *Scooters*, column *Model*.
    - **share of rentals -** the summed amount of rentals (the count of records in *THE MOBILE APP DATABASE*, table *Rentals*) for each model in last year, divided by the total amount of rentals in last year.

8. Compare the number of rentals preceded by a 15 minutes reservation with the number of rentals without a reservation in the current and previous month.
    - **number of rentals with reservation -** no such information. Change in business process is required.
    - **number of rentals without reservation -** no such information. Change in business process is required.
    - **month of rental -** *THE MOBILE APP DATABASE*, table *Rentals*, column *Start timestamp.* We extract only the name of the month.

9. Compare the number of rentals between various areas in cities in this and previous month.
    - **number of rentals -** *THE MOBILE APP DATABASE*, table *Rentals* - counted amount of rentals
    - **area -** information that demands additional source (csv file with coordinates ranges for specific zones)
    - **month -** *THE MOBILE APP DATABASE*, table *Rentals*, column *End timestamp.* We extract only the name of the month.
    - **city -** *THE MOBILE APP DATABASE*, table *Rentals*, column *City*.

It is not possible to build BI system to support this company in completely solving those analytical problems without introducing additional steps in the process of scooter rental. We suggest introducing an option to make a 15 minutes reservation for the scooter before physically unlocking it (using the app). Therefore, no one else can take the vehicle while it is in the reserved state.

The information about reservations could be automatically uploaded to slightly changed *THE MOBILE APP DATABASE* (adding one column to the *Rentals* table, and additional table *Reservations*). Sample structure of the changes in the database:

RDB suggestion:
Customers (Name, Surname, Phone number, Email address, Birth date, Gender)
Reservations (ID, Start_timestamp, End_timestamp)
Rentals (ID, City, Start timestamp, End timestamp, Traveled distance, Problem, Phone number REF Customers, ID REF Scooters, ResID REF Reservations)
Scooters (ID, Model, Producer)