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| Business Template  **Subway** |
|  |

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# Business Description

## Business background

The Subway (Metro) System plays a crucial role in urban mobility by offering a safe, efficient, and well-maintained transportation network. Managing schedules, train operations, ticketing, and maintenance effectively ensures smooth day-to-day operations while preparing for future expansion

## Problems. Current Situation

Outdated infrastructure and maintenance issues.

Inefficient train scheduling.

Poor passenger experience and complaint handling.

## the Benefits of implementing a database. Project Vision

Improved train scheduling and route optimization.

Secure and efficient ticketing system.

# Model description

## Definitions & Acronyms

Primary Key (PK) – A unique identifier for each record in a table.

Foreign Key (FK) – A reference to a primary key in another table, establishing relationships between entities.

Many-to-Many Relationship (M:N) – A relationship where multiple records in one table are associated with multiple records in another table (e.g., Trains assigned to multiple Routes).

## Logical Scheme

## Objects

Table Description

Infrastructure contains information about all the maintenance records for specific infrastructure.

|  |  |  |  |
| --- | --- | --- | --- |
| Table Name | Field name | Field Description | Data Type |
| Infrastructure | infrastructure\_id | Infrastructure id, PK | Int |
| type | Type of infrastructure, NOT NULL | VARCHAR(50) |
| status | Status of infrastructure | VARCHAR(20) |
| last\_maintenance\_date | Show last maintenance date | DATETIME |

Comments on table relationships

1:N with Maintenance Records

Example with data

|  |  |  |  |
| --- | --- | --- | --- |
| infrastructure | type | status | last\_maintenance\_date |
| 1 | railways | Operational | 2024-01-25 |

Table Description

Stations table describe of name, location and open date of the station

|  |  |  |  |
| --- | --- | --- | --- |
| Table Name | Field name | Field Description | Data Type |
| Stations | station\_id | Id of the station, PK | Int |
| name | Name of the station | VARCHAR(100) |
| location | Location of the station | VARCHAR(150) |

Comments on table relationships

1:N with Routes

1:N with Employees

Example with data

|  |  |  |
| --- | --- | --- |
| station\_id | name | location |
| 1 | West Oling | Western District |

Table Description

Lines describe the train lines.

|  |  |  |  |
| --- | --- | --- | --- |
| Table Name | Field name | Field Description | Data Type |
| Lines | line\_id | Id of the line, PK | Int |
| name | Name of the line | VARCHAR(100) |
| colour | Colour of the line | VARCHAR(20) |
| operating\_hours | Working hours | VARCHAR(50) |

Comments on table relationships

1:N with Routes,

1:N with Line Requirements

Example with data

|  |  |  |  |
| --- | --- | --- | --- |
| line\_id | name | colour | operating\_hours |
| 3 | Central line | Pink | 6:00 – 23:50 |

Table Description

Routes describe underground train path.

|  |  |  |  |
| --- | --- | --- | --- |
| Table Name | Field name | Field Description | Data Type |
| Routes | route\_id | Route id, PK | Int |
| line\_id | Line id, FK | Int |
| start\_station\_id | Start station id, FK | Int |
| end\_station\_id | End station id, FK | Int |
| total\_distance | Distance of train route | DECIMAL(5,2) |

Comments on table relationships

N:1 with Lines

N:1 with Stations

1:N with Schedules

M:N with Trains

Example with data

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| route\_id | line\_id | start\_station\_id | end\_station\_id | total\_distance |
| 4 | 3 | 22 | 14 | 25.7 |

Table Description

<description>

|  |  |  |  |
| --- | --- | --- | --- |
| Table Name | Field name | Field Description | Data Type |
| Table 1 | Field Name 1 | <description>, PK/FK | Int |
| Filed Name N | <description> | Text |

Comments on table relationships

Example with data

|  |  |  |  |
| --- | --- | --- | --- |
| Field Name 1 | Field name 2 | Field name 3 | Field name N |
| 1 | aaa | 123 | 1234 |

Table Description

Schedules describe everything about train timetable

|  |  |  |  |
| --- | --- | --- | --- |
| Table Name | Field name | Field Description | Data Type |
| Schedules | schedule\_id | PK | Int |
| route\_id | FK | Int |
| departure\_time |  | TIME |
| arrival\_time |  | TIME |

Comments on table relationships

N:1 with Routes

Example with data

|  |  |  |  |
| --- | --- | --- | --- |
| schedule\_id | route\_id | departure\_time | arrival\_time |
| 56 | 3 | 6:00 | 7:38 |

Table Description

Train table describe all the date about train status, number and all technical infromation

|  |  |  |  |
| --- | --- | --- | --- |
| Table Name | Field name | Field Description | Data Type |
| Trains | Train\_id | PK | Int |
| model |  | VARCHAR(50) |
| capacity |  | INT |
| manufacture\_year |  | INT |
| status |  | VARCHAR(20) |
| Train\_number |  | INT |

Comments on table relationships

Many-to-Many : Trains and Route

Example with data

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Train\_id | model | capacity | manufacture\_year | status | Train\_number |
| 1 | ‘Expo321L’ | 321 | 2012 | Active | 57 |

Table Description

Train Operation

|  |  |  |  |
| --- | --- | --- | --- |
| Table Name | Field name | Field Description | Data Type |
| Train Operation | operation\_id | PK | Int |
| train\_id | FK | INT |
| route\_id | FK | INT |
| schedule\_id | FK | INT |
| operator\_id | FK | INT |

Comments on table relationships

Many-to-Many between Trains and Route

Example with data

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| operation\_id | train\_id | route\_id | schedule\_id | operator\_id |
| 1 | 22 | 1 | 13 | 4 |

Table Description

Employees

|  |  |  |  |
| --- | --- | --- | --- |
| Table Name | Field name | Field Description | Data Type |
| Employees | employee\_id | PK | Int |
| name | NOT NULL | VARCHAR(100) |
| role | NOT NULL | VARCHAR(50) |
| contact\_number |  | VARCHAR(20\_ |
| assigned\_station\_id | FK | INT |

Comments on table relationships

N:1 with Stations

1:N with Line Requirements

Example with data

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| employee | name | role | contact\_number | assigned\_station\_id |
| 1 | Ben Lom | Train Operator | 1233555 | 12 |

Table Description

Line Requirements describe anything that needs to operate

|  |  |  |  |
| --- | --- | --- | --- |
| Table Name | Field name | Field Description | Data Type |
| Line Requirements | requirement\_id | PK | Int |
| line\_id | FK | INT |
| required\_trains | NOT NULL | INT |
| required\_employees | NOT NULL | INT |
| operating\_frequency\_minutes | NOT NULL | INT |

Comments on table relationships

N:1 with Lines

N:1 with Trains

N:1 with Employees

Example with data

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| requirement\_id | line\_id | required\_trains | required\_employees | operating\_frequency\_minutes |
| 4 | 2 | 4 | 111 | 124 |

Table Description

Tickets

|  |  |  |  |
| --- | --- | --- | --- |
| Table Name | Field name | Field Description | Data Type |
| Tickets | ticket\_id | PK | Int |
| type |  | Text |
| price |  | Decimal(6,2) |
| discount\_id | FK | Int |

Comments on table relationships

1:N with Ticket Sales

Example with data

|  |  |  |  |
| --- | --- | --- | --- |
| ticket\_id | type | price | discount\_id |
| 1 | One way | 1.5 | NULL |

Table Description

Discounts on tickets

|  |  |  |  |
| --- | --- | --- | --- |
| Table Name | Field name | Field Description | Data Type |
| Discounts | discount\_id | PK | Int |
| description |  | VARCHAR(100) |
| percentage |  | Decimal(5,2) |
| valid\_from |  | DATE |
| valid\_until |  | DATE |

Comments on table relationships

1:N with Tickets

Example with data

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| discount\_id | description | percentage | valid\_from | valid\_until |
| 1 | Senior discount | 25 | 2023-01-25 | 2025-01-25 |

Table Description

Ticket Sales describe when and where the ticket was bought

|  |  |  |  |
| --- | --- | --- | --- |
| Table Name | Field name | Field Description | Data Type |
| Ticket Sales | sale\_id | PK | Int |
| ticket\_id | FK | INT |
| purchase\_date |  | DATETIME |
| station\_id | FK | Int |
| payment\_method |  | VARCHAR(50) |

Comments on table relationships

N:1 with Tickets

N:1 with Stations

Example with data

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| sale\_id | ticket\_id | purchase\_date | station\_id | payment\_method |
| 1 | 2 | 2024-01-25 21:15:21 | 1234 | Cash |

Table Description

Maintenance Records

|  |  |  |  |
| --- | --- | --- | --- |
| Table Name | Field name | Field Description | Data Type |
| Table 1 | maintenance\_id | PK | Int |
| infrastructure\_id | FK | Int |
| employee\_id | FK | Int |
| maintenance\_date |  | DATE |

Comments on table relationships

N:1 with Infrastructure

N:1 with Employees

Example with data

|  |  |  |  |
| --- | --- | --- | --- |
| maintenance\_id | infrastructure\_id | employee\_id | maintenance\_date |
| 155 | 21 | 111 | 2024-01-28 |

Table Description

Passengers describe people who buy the tickets

|  |  |  |  |
| --- | --- | --- | --- |
| Table Name | Field name | Field Description | Data Type |
| Passengers | passenger\_id | PK | Int |
| name |  | VARCHAR(50) |
| surname |  | VARCHAR(50) |
| ticket\_id | FK | Id |

Comments on table relationships

1:N with Tickets

Example with data

|  |  |  |  |
| --- | --- | --- | --- |
| passenger\_id | name | surname | ticket\_id |
| 444 | Henry | Olba | 13 |