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| Business Template  **Subway** |
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Contents

[1 Business Description 3](#_Toc62212630)

[1.1 Business background 3](#_Toc62212631)

[1.2 Problems. Current Situation 3](#_Toc62212632)

[1.3 The benefits of implementing a database. Project Vision 3](#_Toc62212633)

[2 Model description 3](#_Toc62212634)

[2.1 Definitions & Acronyms 3](#_Toc62212635)

[2.2 Logical Scheme 3](#_Toc62212636)

[2.3 Objects 3](#_Toc62212637)

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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Outdated infrastructure and maintenance issues.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) |

Comments on table relationships

1:N with Maintenance Records infrastructure\_id : infrastructure\_id

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 station\_id : start\_station\_id

1:N with Routes station\_id : end\_station\_id

1:N with Employees name : employee\_id

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(25) |
| open\_from\_hours | Working from | Time |
| open\_to\_hours | Working to | Time |

Comments on table relationships

1:N with Routes line\_id : line\_id

1:N with Line Requirements line\_id : line\_id

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 |
| Route\_distance | Distance of train route | DECIMAL(4,2) |

Comments on table relationships

N:1 with Lines line\_id : line\_id

N:1 with Stations end\_station\_id : station\_id, start\_station\_id : station\_id

1:N with Schedules route\_id : route\_id

M:N with Train Operations route\_id : route\_id

Example with data

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

Table Description

Schedules describe everything about train timetable

|  |  |  |  |
| --- | --- | --- | --- |
| Table Name | Field name | Field Description | Data Type |
| Schedules | schedule\_id | Schedule id, PK | Int |
| route\_id | Route id, FK | Int |
| departure\_time | Departure time | TIME |
| arrival\_time | Arrival time | TIME |

Comments on table relationships

N:1 with Routes route\_id : route\_id

N:1 with Train Operations schedule\_id : schedule\_id

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 information

|  |  |  |  |
| --- | --- | --- | --- |
| Table Name | Field name | Field Description | Data Type |
| Trains | Train\_id | Train id, PK | Int |
| Model\_name | Train model | VARCHAR(60) |
| capacity | Train capacity | INT |
| manufacture\_year | Manufacture year | INT |
| status | Train status | VARCHAR(20) |
| train\_number | Train number | INT |

Comments on table relationships

M:N with Train Operations train\_id : train\_id

M:N with Line Requirements train\_id : required\_train

Example with data

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

Table Description

Train Operation connect Train and Line Requirement tables and describe all information of train operions

|  |  |  |  |
| --- | --- | --- | --- |
| Table Name | Field name | Field Description | Data Type |
| Train Operation | operation\_id | Operation idPK | Int |
| train\_id | Train id, FK | INT |
| route\_id | Route id, FK | INT |
| schedule\_id | Schedule id, FK | INT |
| operator\_id | Employee id, FK | INT |

Comments on table relationships

M:N with Train train\_id : train\_id

N:1 with Route route\_id : route\_id

1:N with Schedule schedule\_id : schedule\_id

1:N with Employees operator\_id : employee\_id

Example with data

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

Table Description

The employees’ table describe all information of employees, name, id, role and etc.

|  |  |  |  |
| --- | --- | --- | --- |
| Table Name | Field name | Field Description | Data Type |
| Employees | employee\_id | Employee id, PK | Int |
| name | Employee name NOT NULL | VARCHAR(100) |
| role | Employee surname ,NOT NULL | VARCHAR(50) |
| contact\_number | Employee number | VARCHAR(20) |
| assigned\_station\_id | Employee assigned to the sation, FK | INT |

Comments on table relationships

N:1 with Stations assigned\_station : station\_id

N:1 with Train Operations employee\_id : operator\_id

1:N with Line Requirement assigned\_station\_id : required\_employees

1:N with Maintenance Records employee\_id : employee\_id

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 line\_id : line\_id

N:1 with Trains required\_trains : train\_id

N:1 with Employees required\_employees  : employee\_id

Example with data

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

Table Description

Tickets table describes the general information about ticket and tickets types.

|  |  |  |  |
| --- | --- | --- | --- |
| Table Name | Field name | Field Description | Data Type |
| Tickets | ticket\_id | Ticket id, PK | Int |
| type | Ticket type | VARCHAR(50) |
| price | Ticket price | Decimal(5,2) |
| discount\_id | Discount id, FK | Int |

Comments on table relationships

1:N with Ticket Sales ticket\_id : ticket\_id

N:1 with Passengers ticket\_id : ticket\_id

Example with data

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

Table Description

Discounts table describes all discount

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

Comments on table relationships

1:N with Tickets discount\_id : discount\_id

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 | Sale id, PK | Int |
| ticket\_id | Ticket id, FK | INT |
| purchase\_date | Ticket purchase date | DATETIME |
| station\_id | Station id, FK | Int |
| payment\_method | Payment method | VARCHAR(50) |

Comments on table relationships

N:1 with Tickets ticket\_id : ticket\_id

N:1 with Stations station\_id : station\_id

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 |
| Maintenance Records | maintenance\_id | Maintenance id, PK | Int |
| infrastructure\_id | Infrastructure id, FK | Int |
| employee\_id | Employee id, FK | Int |
| maintenance\_date | Maintenance date | DATE |

Comments on table relationships

N:1 with Infrastructure infrastructure\_id : infrastructure\_id

N:1 with Employees employee\_id  : employee\_id

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 ticket\_id : ticket\_id

Example with data

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

Table Description

Route Stops describe people who buy the tickets

|  |  |  |  |
| --- | --- | --- | --- |
| Table Name | Field name | Field Description | Data Type |
| Route Stops | stop\_id | Stop id, PK | Int |
| route\_id | Route id, FK | Int |
| station\_id | Station id, FK | Int |
| arrival\_time | Scheduled arrival time | TIME |
| departure\_time | |  | | --- | |  |  |  | | --- | | Scheduled departure time | | TIME |

Comments on table relationships

N:1 with Routes route\_id : route\_id

N:1 with Stations station\_id : station\_id

Example with data

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| stop\_id | route\_id | station\_id | arrival\_time | departure\_time |
| 1 | 2 | 44 | 14:25:11 | 14:32:11 |