

BUDT703

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Project Design

Brand/Team Name: KARY MetroWatch

Team Members (Last Updated Date:10/23):

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Mission Statement:

To analyze WMATA performance records related to crimes, assaults, injuries, and other safety-related incidents. Identify safety trends and patterns to provide insights that help improve overall passenger and employee safety across the transit system.

Mission Objectives:

- To analyze the difference in safety between the bus, rail, and MetroAccess transit systems.
- To identify which type of safety incident is most frequent within the transit system.
- To find the stations and areas with the highest frequency of daily incidents.
- To determine which offense types have the highest frequency in different stations to inform station-specific safety improvements.
- To identify high-risk periods by analyzing seasonal patterns and monthly variations in safety incidents.

Business

Business Terms:

- Station: WMATA's fixed facility where the train stops for passengers to get on and off between set locations. Stations have names, addresses, line names.
- Customer: Anyone using the WMATA services, including rail, bus and MetroAccess.
- Employee: Member of the WMATA staff.
- Daily Incident: A single police-reported event that is categorized as a crime. It includes date, time, disposition, location and one or more crime offenses.
- Offense: The action that occurred in the police-reported incident.
- Assault: An intentional attack on a person, categorized into physical and non-physical attacks.
- Injury: Harm to a person, categorized into customer injury and employee injury depending on the subject.
- Fatality: A reported death that occurs within WMATA services or facilities
- Rate: Number of events per standard unit.

Business Facts:

- AssaultOccur: Each record in the Assault table provides the number of assault events that occur within the time period defined by timeID.
- EmployeeInjuryOccur: Each record in the EmployeeInjury table provides the number of employee injury events that occur within the time period defined by timeID.
- CustomerInjuryOccur: Each record in the CustomerInjury table provides the number of customer injury events that occur within the time period defined by timeID.
- FatalityOccur: Each record in the Fatality table provides the number of fatality events that occur within the time period defined by timeID.
- CrimeOccur: Each record in the Crime table provides the number of crime events that occur within the time period defined by timeID.
- SafetyOccur: Each record in the safety table provides the number of safety events that occur within the time period defined by timeID.
- Record: The date, time and disposition of an incident in a day that occurs gets recorded.
- Locate: An incident contains one or more locations, specified through stations.
- Involve: An incident contains one or more offenses.

Note: The categories refer to Rail, Bus, Parking Lot, and Metro Access.

Business Attributes:**Station**

- stationID (Primary Key): Unique identifier for each of the 98 WMATA stations.
- stationName: Name of the WMATA station.
- stationAddress: Address of the WMATA station.
- stationLine: The WMATA line that the station belongs to (e.g., red, blue, etc.).

DailyIncident

- dailyIncidentID (Primary Key): Unique identifier for each daily incident record
- dailyIncidentDate: Date of the incident
- dailyIncidentTime: Time of the incident
- dailyIncidentDisposition: How the incident was handled (e.g., Arrest, Report, Citation, etc.)
- dailyIncidentOffense: The type of offense (e.g., Assault, Fare Evasion, etc.)

Offense

- offenseID (Primary Key): Unique identifier for the type of offense

- offenseDescription: Description of the offense

Time (dimension to link the tables)

- timeID (Primary Key): Unique key that represents month and year
- timeMonth: Month of the record
- timeYear: Year of the record

Crime

- crimeID (Primary Key): uniquely identifies each record and links to the Time table
- crimeRail: Number of rail crimes per month
- crimesParkingLot: Number of parking lot crimes per month
- crimeBus: Number of metro bus crimes per month
- crimeBusStop: Number of crimes near metro bus stops per month
- crimeOther: Number of other category crimes per month
- crimeRailRate: Number of rail crimes per million customers
- crimeBusRate: Number of bus crimes per million customers

Assault

- assaultID (Primary Key): uniquely identifies each record and links to the Time table
- assaultRailEmployee: Number of assaults involving rail employees per month.
- assaultRailCustomer: Number of assaults involving rail customers per month.
- assaultBusEmployee: Number of assaults involving bus employees per month.
- assaultBusCustomer: Number of assaults involving bus customers per month.
- assaultMetroAccessEmployee: Number of assaults involving MetroAccess employees per month.
- assaultMetroAccessCustomer: Number of assaults involving MetroAccess customers per month.
- assaultRailRate: Number of assaults per standard unit.
- assaultBusRate: Number of bus assaults per standard unit.
- assaultMetroAccessRate: Number of Metro Access assaults per standard unit.

Customer Injury

- customerInjuryID (Primary Key): uniquely identifies each record and links to the Time table.
- customerInjuryRate: Number of rail customer injuries reported per month.
- customerInjuryBus: Number of bus customer injuries reported per month.
- customerInjuryMetroAccess: Number of MetroAccess customer injuries reported per month.

- customerInjuryRailRate: Number of rail customer injuries per ten million miles driven.
- customerInjuryBusRate: Number of bus customer injuries per ten million miles driven.
- customerInjuryMetroAccessRate: Number of Metro Access customer injuries per ten million miles driven.

Employee Injury

- employeeInjuryID (Primary Key): Uniquely identifies each record and links to the Time table.
- employeeInjuryTotal: Number of employee injuries reported per month.
- employeeInjuryRate: Number of employees injured per 100 employees.

Fatality

- fatalityID (Primary Key): uniquely identifies each record and links to the Time table
- fatalityRail: Number of fatalities reported on rail services per month.
- fatalityBus: Number of fatalities reported on bus services per month.
- fatalityMetroAccess: Number of fatalities reported on MetroAccess services per month.

Safety

- safetyID (Primary Key): Unique identifier representing a specific month and year.
- safetyBusCollision: Number of bus collisions reported per month.
- safetyBusFire: Number of bus fire incidents reported per month.
- safetyBusHazardousMaterialSpill: Number of bus hazardous material spill incidents per month.
- safetyBusOtherEvent: Number of other bus-related safety events per month.
- safetyRailCollision: Number of rail collisions reported per month.
- safetyRailDerailment: Number of rail derailments reported per month.
- safetyRailFire: Number of rail fire incidents reported per month.
- safetyRailHazardousMaterialSpill: Number of rail hazardous material spill incidents per month.
- safetyRailOtherEvent: Number of other rail-related safety events per month.
- safetyRailEventRate: Number of rail safety events per standard unit
- safetyMetroAccessCollision: Number of MetroAccess collisions reported per month.
- safetyMetroAccessHazardousMaterialSpill: Number of MetroAccess hazardous material spill incidents per month.
- safetyMetroAccessOtherEvent: Number of other MetroAccess-related safety events per month.
- safetyMetroAccessOtherRate: Number of other metro access safety events per standard unit

Identifiers

Primary Keys

- stationID in Station
- incidentID in Daily Incident
- offenseID in Offense
- timeID in Time, Crime, Employee Injury, Customer Injury, Assault, Fatality, and Safety

Cardinalities

- **Station and Daily Incident**

One station can have 0 or many incidents. Each daily incident occurs only at one station.

- **Time and Daily Incident**

Each timeID (month, year) can include many daily incidents. Each daily incident belongs to only one timeID

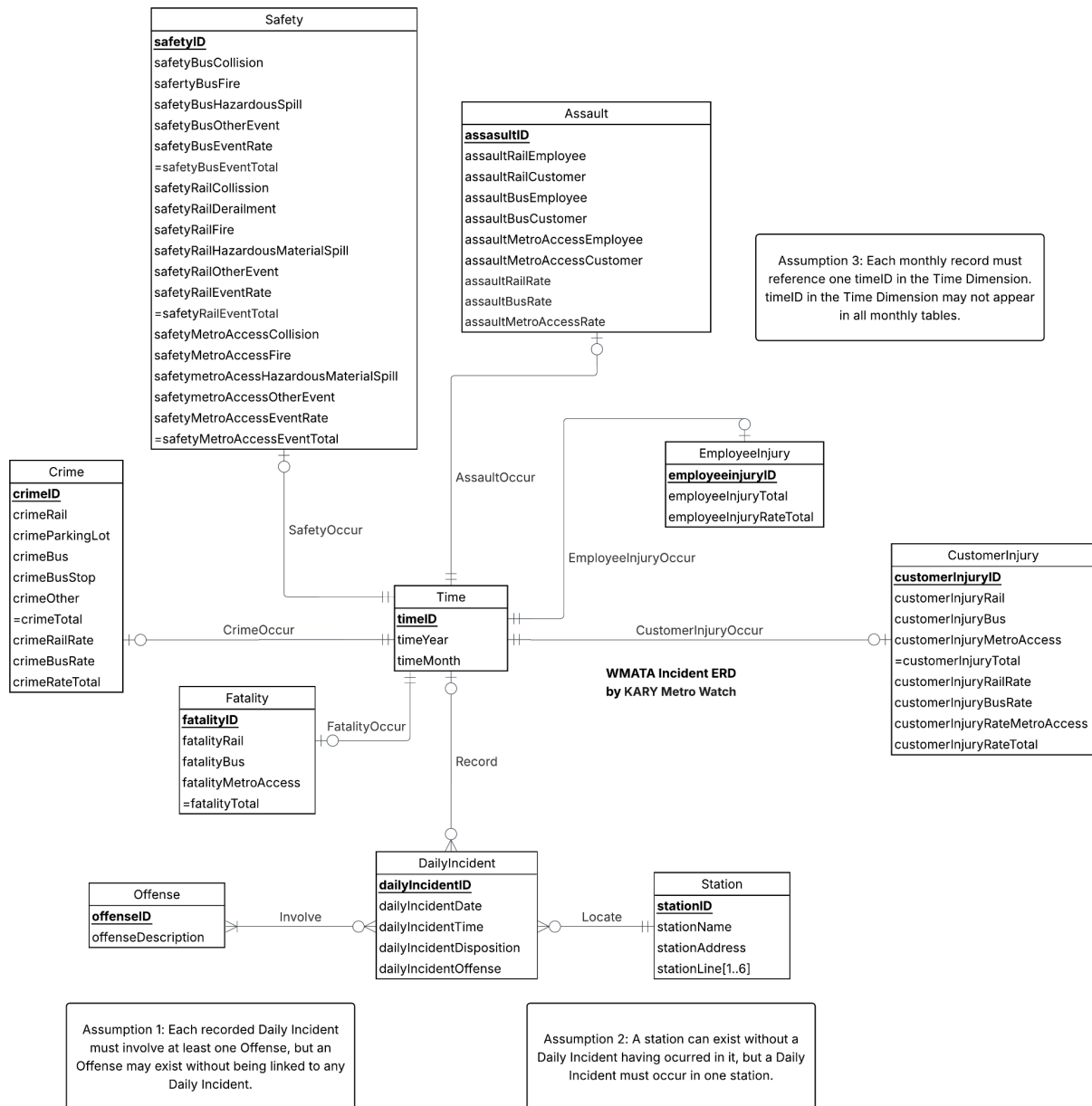
- **Daily Incident and Offense**

Each daily incident must have at least one offense. An offense may be associated with zero or many daily incidents.

- **Time and Crime, Employee Injury, Customer Injury, Assault, Fatality, Safety**

The relationship between Time and the monthly tables (Crime, Employee Injury, Customer Injury, Assault, Fatality, Safety) is mandatory one-to-optional one. Each record in these monthly tables must have one matching timeID in Time, while a timeID in Time may or may not be referenced in these tables.

ERD:



Relational Schema:

Time (timeID, timeYear, timeMonth)

Crime (crimeID, crimeRail, crimeParkingLot, crimeBus, crimeBusStop, crimeOthers, crimeRailRate, crimeBusRate, crimeTotalRate, timeID)

Assault (**assaultID**, assaultRailEmployee, assaultRailCustomer, assaultBusEmployee, assaultBusCustomer, assaultMetroAccessEmployee, assaultMetroAccessCustomer, assaultRailRate, assaultBusRate, assaultMetroAccessRate, assaultRateTotal, *timeID*)

CustomerInjury (**crimeID**, customerInjuryRail, customerInjuryBus, customerInjuryMetroAccess, customerInjuryRailRate, customerInjuryBusRate, customerInjuryMetroAccessRate, customerInjuryTotalRate, *timeID*)

EmployeeInjury (**employeeInjuryID**, employeeInjuryTotal, employeeInjuryTotalRate, *timeID*)

Fatality (**fatalityID**, fatalityRail, fatalityBus, fatalityMetroAccess, *timeID*)

Safety (**safetyID**, safetyBusCollision, safetyBusFire, safetyBusHazardousMaterialSpill, safetyBusOtherEvent, safetyBusEventRate, safetyRailCollision, safetyRailDerailment, safetyRailFire, safetyRailHazardousMaterialSpill, safetyRailOtherEvent, safetyRailEventRate, safetyMetroAccessCollision, safetyMetroAccessFire, safetyMetroAccessHazardousMaterialSpill, safetyMetroAccessOtherEvent, safetyMetroAccessEventRate, *timeID*)

DailyIncident (**dailyIncidentID**, dailyIncidentDate, dailyIncidentTime, dailyIncidentDisposition, *stationID*, *timeID*)

Offense (**offenseID**, offenseDescription)

Involve (*incidentID*, *offenseID*)

Station (**stationID**, stationName, stationAddress)

StationLine (*stationID*, *stationLine*)

Referential Integrity Actions:

Relation	Foreign Key	Base Relation	Primary Key	Business Rule	ON DELETE	Business Rule	ON UPDATE
Crime	timeID	Time	timeID	R1	No action	R2	Cascade
Assault	timeID	Time	timeID	R3	No action	R4	Cascade

Customer Injury	timeID	Time	timeID	R5	No action	R6	Cascade
Employee Injury	timeID	Time	timeID	R7	No action	R8	Cascade
Fatality	timeID	Time	timeID	R9	No action	R10	Cascade
Safety	timeID	Time	timeID	R11	No action	R12	Cascade
Daily Incident	stationID	Station	stationID	R13	No action	R14	Cascade
Daily Incident	offenseID	Offense	offenseID	R15	No action	R16	Cascade
Daily Incident	timeID	Time	timeID	R17	No action	R18	Cascade
Involve	dailyIncidentID	Daily Incident	dailyIncidentID	R19	Cascade	R20	Cascade
Involve	offenseID	Offense	offenseID	R21	Cascade	R22	Cascade
StationLine	stationID	Station	stationID	R23	No action	R24	Cascade

Business Rules:

[R1] The time information cannot be deleted from the database when there is already crime information in the database.

[R2] When time information is changed in the database, the crime information should be changed accordingly.

[R3] The time information cannot be deleted from the database when there is already assault information in the database.

[R4] When time information is changed in the database, the assault information should be changed accordingly.

[R5] The time information cannot be deleted from the database when there is already customer injury information in the database.

[R6] When time information is changed in the database, the customer injury information should be changed accordingly.

[R7] The time information cannot be deleted from the database when there is already employee injury information in the database.

[R8] When time information is changed in the database, the employee injury information should be changed accordingly.

[R9] The time information cannot be deleted from the database when there is already fatality information in the database.

[R10] When time information is changed in the database, the fatality information should be changed accordingly.

[R11] The time information cannot be deleted from the database when there is already safety information in the database.

[R12] When time information is changed in the database, the safety information should be changed accordingly.

[R13] The station information cannot be deleted from the database when there is already incident information in the database.

[R14] When station information is changed in the database, the incident information should be changed accordingly.

[R15] The offense information cannot be deleted from the database when there is already incident information in the database.

[R16] When offense information is changed in the database, the incident information should be changed accordingly.

[R17] The time information cannot be deleted from the database when there is already daily incident information in the database.

[R18] When time information is changed in the database, the daily incident information should be changed accordingly.

[R19] When incident information is deleted in the database, the involve information should be deleted accordingly.

[R20] When incident information is changed in the database, the involve information should be changed accordingly.

[R21] When offense information is deleted in the database, the involve information should be deleted accordingly.

[R22] When offense information is changed in the database, the involve information should be changed accordingly.

[R23] The station information cannot be deleted from the database when there is already station line information in the database.

[R24] When station information is changed in the database, the station line information should be changed accordingly.

https://lucid.app/lucidchart/2a5726d2-cbd7-465a-8737-f1220d37754d/edit?viewport_loc=144%2C32%2C1428%2C1113%2C0_0&invitationId=inv_3adc7c84-a585-4252-8ce1-379ab7fd4699

Sample Data

Station

("S01", "Branch Ave", "4704 Old Soper Road, Suitland, MD")

("S02", "Braddock Road", "700 N. West St., Alexandria, VA")

DailyIncident

("DI001", "2025-01-01", "10:51:00", "ARREST", "S1", "OFF01", "T01")

("DI002", "2025-04-28", "12:17:00", "SUMMONS/CITATION", "S2", "OFF04", "T02")

Offense

("OFF01", "ASSAULT")

("OFF02", "UNLAWFUL ENTRY")

Involve

("DI001", "OFF01")

("DI002", "OFF04")

StationLine

("S01", "green")

("S02", "blue")

Time

("T01", "2025", "01")

("T02", "2025", "02")

Crime

("T01", 36, 12, 20, 22, 15, 12.2, 6.3, 8.5)

("T02", 31, 22, 24, 18, 11, 14.1, 6.5, 9.2)

Assault

("T08", 2, 5, 3, 15, 2, 11, 7.2, 6.5, 3.2, 7.6)

("T10", 8, 4, 0, 7, 0, 0, 5.5, 6.1, 0.0, 7.2)

Customer Injury

("T05", 9, 24, 2, 35, 19.6, 70.2, 12.1, 36.3)

("T08", 13, 11, 1, 25, 32.4, 33.6, 5.8, 27.7)

Employee Injury

("T04", 67, 5.8)

("T08", 52, 5.1)

Fatality

("T24", 0, 0, 0)

("T26", 1, 0, 0)

Safety

("T45", 34, 4, 3, 52, 34.2, 5, 12, 14, 25, 34, 21.1, 43, 12, 54, 31, 15.3)

("T21", 31, 6, 2, 25, 21.2, 6, 10, 11, 31, 17, 15.4, 41, 21, 36, 22, 11.3)