**Technical Specification (TS)**

**Project Title:** BI Dashboard for Traffic Accident and Congestion Monitorings  
**Client:** Traffic Safety Authorities (GIBDD) & Law Enforcement Agencies  
**Developer:** MAAB Innovation  
**Objective:** Develop a BI dashboard to monitor traffic accidents, congestion, and road conditions to identify high-risk areas, propose adjustments to traffic rules, and improve road safety. The ultimate goal is to reduce accidents and congestion to zero.

**1. Project Goals**

1. **Accident Monitoring:** Analyze traffic accident data (location, causes, severity).
2. **Traffic Congestion Monitoring:** Identify congested areas and analyze patterns leading to traffic jams.
3. **High-Risk Identification:** Pinpoint accident-prone and traffic-heavy regions, districts, and streets.
4. **Root Cause Analysis:** Determine causes of accidents and congestion, including driver behavior, road conditions, and infrastructure issues.
5. **Actionable Recommendations:** Propose solutions to reduce accidents and traffic jams through enforcement, infrastructure improvements, and optimized traffic rules.
6. **Progress Monitoring:** Track trends in accident reduction and congestion mitigation after interventions.

**2. Functional Requirements**

**2.1. Dashboard Sections**

**2.1.1. Traffic Accident Overview**

* **Purpose:** High-level view of accident frequency, severity, and geographic spread.
* **KPIs:**
  + Total Number of Accidents
  + Fatalities and Injuries Count
  + Accident Frequency by Location (City, District, Street)
  + Severity Rate (Minor, Major, Fatal)
  + Monthly and Yearly Trends
* **Visualizations:**
  + Heatmap: Accident Hotspots
  + Line Chart: Accident Trends Over Time
  + Bar Chart: Severity by Region
  + KPI Cards: Fatalities, Injuries, and Accidents

**2.1.2. Traffic Congestion Monitoring**

* **Purpose:** Identify traffic congestion hotspots and root causes.
* **KPIs:**
  + Average Traffic Speed per Road Segment
  + Peak Traffic Hours by Location
  + Congestion Duration (Time Spent in Traffic)
  + Vehicle Density per Kilometer
  + Road Capacity Utilization (%)
* **Visualizations:**
  + Heatmap: Congested Roads by Time of Day
  + Line Chart: Traffic Speed Variations Over Time
  + Bar Chart: Top 10 Most Congested Streets
  + KPI Cards: Average Congestion Duration and Peak Hours

**2.1.3. Geographic Risk Analysis**

* **Purpose:** Pinpoint regions, streets, and intersections with combined accident and congestion risks.
* **KPIs:**
  + Top Dangerous Intersections (Accidents + Traffic Jams)
  + Accident Count vs. Congestion Duration
  + Combined Risk Score per Road (Accidents + Speed Loss)
  + Vehicle Incident Rate (Accidents per 1,000 Vehicles)
* **Visualizations:**
  + Scatter Plot: Accidents vs. Traffic Congestion per Location
  + Map: High-Risk Intersections and Streets
  + Pareto Chart: Combined Risks by City/District

**2.1.4. Root Cause Analysis**

* **Purpose:** Analyze underlying causes of accidents and traffic congestion.
* **KPIs:**
  + Causes of Accidents (Driver Behavior, Road Conditions, Weather, Traffic Violations)
  + Congestion Causes (Signal Timing, Construction, Road Blockage, Peak Hours)
  + Traffic Rule Violation Rates
  + Accident and Congestion Trends by Weather
* **Visualizations:**
  + Pareto Chart: Top Causes of Traffic Issues
  + Bar Chart: Traffic Violations by Severity (Speeding, Red Light, DUI)
  + Scatter Plot: Weather Conditions vs. Accidents and Delays
  + Pie Chart: Congestion Causes Breakdown

**2.1.5. Recommendations and Monitoring**

* **Purpose:** Provide insights and monitor the impact of safety and congestion measures.
* **Insights:**
  + Propose infrastructure changes (traffic lights, lane expansions, road repairs).
  + Highlight areas needing traffic law enforcement (patrols, cameras).
  + Track improvements in accident reduction and traffic speed after interventions.
* **Visualizations:**
  + Before-and-After Analysis: Accident and Congestion Rate Changes
  + Table: Action Recommendations by Location
  + Line Chart: Progress Trends in Reducing Traffic Issues

**3. Data Structure**

| **Table Name** | **Description** | **Fields** |
| --- | --- | --- |
| **Accidents** | Traffic accident records. | AccidentID, DateTime, Location, Cause, Severity, Weather, Injuries, Fatalities |
| **Congestion** | Traffic congestion data. | CongestionID, DateTime, Location, Speed, Duration, VehicleCount, Cause |
| **Regions** | Location mapping. | RegionID, City, District, StreetName, Latitude, Longitude |
| **TrafficViolations** | Traffic rule violations. | ViolationID, AccidentID, Type, PenaltyAmount, VehicleType |
| **Infrastructure** | Road infrastructure details. | InfrastructureID, Location, Condition, ImprovementNeeded |
| **WeatherConditions** | Weather during incidents. | WeatherID, DateTime, Location, WeatherType, Visibility, Temperature |

**4. Key KPIs**

| **KPI** | **Description** | **Formula** |
| --- | --- | --- |
| Total Traffic Accidents | Total number of accidents. | COUNT(AccidentID) |
| Average Traffic Speed | Average speed across road segments. | SUM(Speed) / COUNT(Location) |
| Congestion Duration | Average time spent in traffic. | SUM(Duration) / COUNT(Location) |
| Combined Risk Score | Measure combining accidents and delays. | (AccidentCount \* Severity) + CongestionDuration |
| Traffic Violation Rate | Rate of rule violations causing issues. | COUNT(ViolationID) / COUNT(AccidentID) |

**5. Technical Requirements**

* **Mock Data Generation**: Students will simulate accident and congestion data using tools like:
  + **Excel/Google Sheets**
  + **Python Libraries** (Faker, Pandas)
  + **Mockaroo** for structured datasets.
* **Platform**: Microsoft Power BI or similar tools.
* **Performance**: Dashboard response time ≤ 30 seconds.
* **Accessibility**: Support both desktop and mobile devices.

**6. Implementation Roadmap**

1. **Data Generation**: Simulate traffic accident and congestion datasets with detailed locations, causes, and time periods.
2. **Data Modeling**: Design relational tables for accidents, congestion, violations, and infrastructure.
3. **Dashboard Development**: Build sections for accidents, congestion monitoring, root cause analysis, and recommendations.
4. **Testing and Validation**: Ensure KPI accuracy and visualization interactivity.
5. **Deployment**: Deliver the final BI solution for actionable insights.

**7. Expected Outcomes**

* A BI dashboard providing insights into traffic accident and congestion patterns.
* Identification of high-risk streets, intersections, and time periods.
* Actionable solutions for infrastructure improvements and rule enforcement.
* Progress tracking to achieve safer roads and smoother traffic flow.

***Note for Students:*** *Generate realistic mock data for accidents and traffic congestion. Expand the project by adding predictive analysis or proposing AI-driven solutions for traffic flow optimization. Think critically about real-world solutions to improve road safety and traffic efficiency!* 🚦