项目文档

# Functional Requirement

1. Functional Requirements  
  
1.1 Data Processing and Analysis Function   
Function ID: FR-01   
Description: The system must process and analyze incoming Vehicle Infrastructure Integration (VII) data from various sources such as Probe Vehicles, Traffic Management Systems, Weather Stations, and Traveler Information Systems to generate actionable insights. This includes calculating traffic metrics, inferring incidents, and processing weather and road surface conditions.   
Input: Real-time data streams from Probe Vehicles, Traffic Management Systems, Weather Stations, and Traveler Information Systems.   
Output: Updated Traffic Metrics, Incident Details, Road Surface Conditions, and Weather Observations available for further use, alerts, and visualization.  
  
1.2 Traffic Data Collection Function   
Function ID: FR-02   
Description: The system must collect real-time traffic data from Probe Vehicles and other data sources. The data must be validated and integrated into the system for further analysis and dissemination.   
Input: Real-time data from Probe Vehicles including vehicle location, speed, and travel time.   
Output: Validated Traffic Data stored in the Oracle 10g database and updated in Traveler Information Systems.  
  
1.3 Traffic Metrics Analysis Function   
Function ID: FR-03   
Description: The system must analyze Traffic Data, Weather Data, and Road Condition Data to identify traffic patterns, congestion levels, travel times, and queue lengths. Analysis results must be formatted and disseminated to Traveler Information Systems.   
Input: Traffic Data, Weather Data, and Road Condition Data from the Oracle 10g database.   
Output: Analyzed Traffic Metrics, including congestion levels, travel times, and queue lengths, formatted for dissemination and stored in the Oracle 10g database.  
  
1.4 Traffic Incident Inference Function   
Function ID: FR-04   
Description: The system must detect and infer potential traffic incidents based on anomalies in traffic flow, such as sudden slowdowns or stops. Incident details must be extracted, classified, and disseminated to Traveler Information Systems and Traffic Management Systems.   
Input: Traffic Data, Weather Data, and Road Condition Data from Probe Vehicles, Traffic Management Systems, and Weather Stations.   
Output: Incident Details including location, severity, and description stored in the Oracle 10g database and published to Traveler Information Systems.  
  
1.5 Road Surface Condition Calculation Function   
Function ID: FR-05   
Description: The system must calculate road surface conditions based on data from Road Sensors, Weather Stations, and Probe Vehicles. The results must be integrated with Incident Details and Traffic Metrics to assess impacts on traffic flow.   
Input: Real-time data from Road Sensors, Weather Stations, and Probe Vehicles.   
Output: Calculated Road Surface Conditions stored in the Oracle 10g database and published to Traveler Information Systems.  
  
1.6 Weather Observation Processing Function   
Function ID: FR-06   
Description: The system must process real-time weather data from Weather Stations, including temperature, precipitation, and visibility. The data must be combined with Traffic Data and Road Condition Data to assess the impact on road safety and traffic flow.   
Input: Real-time Weather Data from Weather Stations.   
Output: Processed Weather Observations stored in the Oracle 10g database and integrated into traffic analysis and alert generation.  
  
1.7 Travel Demand Monitoring Function   
Function ID: FR-07   
Description: The system must monitor travel demand by analyzing data from Probe Vehicles, including origin, destination, and travel time. The results must be visualized on Map Displays and used to adjust traffic management strategies.   
Input: Travel Demand Data from Probe Vehicles and other data sources.   
Output: Travel Demand patterns stored in the Oracle 10g database and visualized on Map Displays.  
  
1.8 Data Quality Check Function   
Function ID: FR-08   
Description: The system must perform automated validation checks on incoming data to ensure accuracy, consistency, and completeness. Invalid or incomplete data must be logged and flagged for revalidation.   
Input: Traffic Data, Weather Data, Road Condition Data, and Incident Data from various sources.   
Output: Validated data passed to the next processing steps, or flagged data stored for revalidation.  
  
1.9 Dynamic Data Caching Function   
Function ID: FR-09   
Description: The system must implement dynamic data caching to temporarily store real-time data during high load or database unavailability. Cached data must be synchronized with the Oracle 10g database when the connection is restored.   
Input: Real-time data from Probe Vehicles, Traffic Management Systems, and Weather Stations.   
Output: Cached data stored in memory or local storage and synchronized with the Oracle 10g database.  
  
1.10 Long-Term Data Archiving Function   
Function ID: FR-10   
Description: The system must archive processed data, including Traffic Metrics, Road Condition Data, Incident Details, and Weather Observations, into the Oracle 10g database for long-term reference and historical analysis.   
Input: Processed data from DUAP, including Traffic Data, Weather Data, and Incident Data.   
Output: Archived data stored in the Oracle 10g database with structured indexing.  
  
1.11 Data Formatting for SAE J2354 Function   
Function ID: FR-11   
Description: The system must format processed data according to SAE J2354 standards for external system integration. The formatted data must be validated against the SAE J2354 schema.   
Input: Traffic Data, Weather Data, and Road Condition Data processed by the DUAP system.   
Output: SAE J2354-formatted data stored in the Oracle 10g database and ready for external system use.  
  
1.12 Data Formatting for TMDD Function   
Function ID: FR-12   
Description: The system must format processed data according to TMDD standards for integration with external traffic management systems. The data must be validated against the TMDD schema.   
Input: Traffic Data, Weather Data, and Road Condition Data processed by the DUAP system.   
Output: TMDD-formatted data stored in the Oracle 10g database and ready for external system use.  
  
1.13 Traffic Alert Publishing Function   
Function ID: FR-13   
Description: The system must publish traffic alerts based on analyzed data such as congestion levels, incidents, and road surface conditions. Alerts must be displayed on Web-Based User Interfaces and disseminated to Traveler Information Systems.   
Input: Incident Details, Traffic Metrics, and Road Surface Conditions from the DUAP system.   
Output: Traffic Alerts published to Web-Based User Interfaces and Traveler Information Systems and stored in the Oracle 10g database.  
  
1.14 Weather Alert Publishing Function   
Function ID: FR-14   
Description: The system must publish weather alerts based on hazardous weather conditions identified during processing. These alerts must be displayed on Web-Based User Interfaces and disseminated to Traveler Information Systems.   
Input: Weather Data and Road Condition Data processed by the DUAP system.   
Output: Weather Alerts published to Web-Based User Interfaces and Traveler Information Systems and stored in the Oracle 10g database.  
  
1.15 Asset Condition Alert Publishing Function   
Function ID: FR-15   
Description: The system must publish asset condition alerts, such as infrastructure failures or sensor malfunctions, to Web-Based User Interfaces and Traffic Management Systems. These alerts must be stored in the Oracle 10g database for historical tracking.   
Input: Asset Condition Data and Road Condition Data from the DUAP system.   
Output: Asset Condition Alerts published to Web-Based User Interfaces and Traffic Management Systems and stored in the Oracle 10g database.  
  
1.16 MI Drive Presentation Support Function   
Function ID: FR-16   
Description: The system must support the generation of MI Drive presentations by compiling real-time and historical data into a structured format. The presentation must include maps, icons, and textual summaries.   
Input: Traffic Data, Weather Data, and Road Condition Data processed and stored in the Oracle 10g database.   
Output: MI Drive Presentation data displayed on Map Displays and Icon Layers and stored in the Oracle 10g database.  
  
1.17 Traffic Information Browsing Function   
Function ID: FR-17   
Description: The system must allow the Administrator to browse real-time and historical traffic information, including congestion levels, travel times, and incident details, through Web-Based User Interfaces and Map Displays.   
Input: Traffic Data, Traffic Metrics, and Incident Details from the Oracle 10g database.   
Output: Traffic Information displayed on the Web-Based User Interface with filtering and visualization capabilities.  
  
1.18 Incident Information Browsing Function   
Function ID: FR-18   
Description: The system must allow the Administrator to browse incident data, including location, severity, and cause, through Web-Based User Interfaces and Map Displays.   
Input: Incident Details and Road Surface Conditions from the Oracle 10g database.   
Output: Incident Information displayed on the Web-Based User Interface with filtering and visualization capabilities.  
  
1.19 Traveler Information Browsing Function   
Function ID: FR-19   
Description: The system must allow the Administrator to browse traveler information, such as travel demand, traffic conditions, and weather alerts, through Web-Based User Interfaces and Map Displays.   
Input: Travel Demand Data, Traffic Data, and Weather Data from the Oracle 10g database.   
Output: Traveler Information displayed on the Web-Based User Interface with filtering and visualization capabilities.  
  
1.20 Asset Condition Information Browsing Function   
Function ID: FR-20   
Description: The system must allow the Administrator to browse asset condition data, including infrastructure status and sensor health, through Web-Based User Interfaces and Map Displays.   
Input: Asset Condition Data and Road Condition Data from the Oracle 10g database.   
Output: Asset Condition Information displayed on the Web-Based User Interface with filtering and visualization capabilities.  
  
1.21 Weather Information Browsing Function   
Function ID: FR-21   
Description: The system must allow the Administrator to browse weather-related data, including temperature, precipitation, and visibility, through Web-Based User Interfaces and Map Displays.   
Input: Weather Data and Weather Observations from the Oracle 10g database.   
Output: Weather Information displayed on the Web-Based User Interface with filtering and visualization capabilities.  
  
1.22 Map Display Function   
Function ID: FR-22   
Description: The system must display real-time and historical data in an interactive map format, including traffic, weather, and road condition data. Map layers must be configurable and support zooming and panning.   
Input: Traffic Data, Weather Data, Road Condition Data, and Incident Data from the Oracle 10g database.   
Output: Map Displays with real-time and historical data overlays and interactive capabilities.  
  
1.23 Icon Layer Management Function   
Function ID: FR-23   
Description: The system must allow the Administrator to manage icon layers on the map, including adjusting visibility, priority, and styling. Icon layers must be updated in real-time to reflect current data states.   
Input: Icon Layer configurations from the Oracle 10g database and real-time data from Probe Vehicles and Weather Stations.   
Output: Updated Icon Layers on the Map Displays with customized settings and real-time data reflection.  
  
1.24 De-Cluttering Capability Function   
Function ID: FR-24   
Description: The system must provide de-cluttering capabilities to improve map readability by reducing icon density in congested areas. De-cluttering settings must be configurable and saved for future use.   
Input: Map Display configurations and real-time data from Probe Vehicles and Weather Stations.   
Output: De-cluttered Map Displays with reduced icon density and real-time updates.  
  
1.25 Data Source Addition Function   
Function ID: FR-25   
Description: The system must allow the Administrator to add new data sources, such as Probe Vehicles, Weather Stations, or Road Sensors, and validate their data formats against predefined standards.   
Input: Details of the new data source, including type, location, and format.   
Output: New data source integrated into the system and stored in the Oracle 10g database.  
  
1.26 Algorithm Update Function   
Function ID: FR-26   
Description: The system must allow the Administrator to update or replace existing algorithms used for data processing and incident inference. Updated algorithms must be tested and activated in the processing pipeline.   
Input: New algorithm versions or custom algorithms provided by the Administrator.   
Output: Updated algorithm deployed in the DUAP system and stored in the Oracle 10g database.  
  
1.27 Output Format Modification Function   
Function ID: FR-27   
Description: The system must allow the Administrator to modify the output formats for data dissemination, such as changing from XML to JSON. The new format must be validated and applied to relevant modules.   
Input: New output format definitions for specific data types.   
Output: Modified output format applied to data streams and stored in the Oracle 10g database.  
  
1.28 Presentation Method Adjustment Function   
Function ID: FR-28   
Description: The system must allow the Administrator to adjust presentation methods for data visualization, including map themes, icon styles, and layer visibility. Adjustments must be applied in real-time to the Web-Based User Interfaces.   
Input: New presentation settings provided by the Administrator.   
Output: Updated presentation method applied to Map Displays and Icon Layers, stored in the Oracle 10g database.  
  
1.29 MDIT Standards Compliance Function   
Function ID: FR-29   
Description: The system must ensure all data processing, formatting, and dissemination functions comply with Michigan Department of Information Technology (MDIT) standards. Compliance checks must be logged for audit purposes.   
Input: Data entities processed by the DUAP system and compliance rules from MDIT standards.   
Output: Data formatted and structured to meet MDIT standards, stored in the Oracle 10g database and available for export.  
  
1.30 Java Software Foundation Integration Function   
Function ID: FR-30   
Description: The system must be built and run using the Java Software Foundation (JSF) to support a responsive and interactive Web-Based User Interface. JSF components must be used for dynamic data rendering and user interaction.   
Input: User interactions and data from Probe Vehicles, Weather Stations, and Traffic Management Systems.   
Output: Web-Based User Interface with dynamic components and real-time data updates.  
  
1.31 JDBC Database Connection Function   
Function ID: FR-31   
Description: The system must establish and maintain a JDBC connection to the Oracle 10g database to retrieve and store data entities. Connection details must be configurable and monitored for performance.   
Input: JDBC connection parameters provided by the Administrator.   
Output: Active JDBC connection to the Oracle 10g database with status and logs updated in the Web-Based User Interface.  
  
1.32 Oracle 10G Database Use Function   
Function ID: FR-32   
Description: The system must use the Oracle 10g database for long-term storage and retrieval of data entities, including Traffic Data, Weather Data, Incident Data, and Travel Demand Data.   
Input: Data entities to be stored or retrieved from the Oracle 10g database.   
Output: Data stored or retrieved from the Oracle 10g database, with logs and status updated for audit and troubleshooting.  
  
1.33 Standard SQL Query Execution Function   
Function ID: FR-33   
Description: The system must execute standard SQL queries on the Oracle 10g database to retrieve or modify data for analysis, reporting, or visualization. Query results must be formatted and displayed for the Administrator.   
Input: Standard SQL queries composed or selected by the Administrator.   
Output: Query results displayed on the Web-Based User Interface and stored in the Oracle 10g database.  
  
1.34 Michigan Geographic Framework Application Function   
Function ID: FR-34   
Description: The system must apply the Michigan Geographic Framework (MIGF) to align data with geographic coordinates and road networks for accurate spatial visualization.   
Input: Traffic Data, Weather Data, and Road Condition Data from the DUAP system.   
Output: Data aligned with MIGF and displayed on Map Displays for spatial analysis.  
  
1.35 User Role Management Function   
Function ID: FR-35   
Description: The system must allow the Administrator to manage user roles and permissions, ensuring that only authorized users can perform specific actions. Role changes must be logged for audit purposes.   
Input: User and role details provided by the Administrator.   
Output: Updated user role assignments stored in the Oracle 10g database and applied to the system components.  
  
1.36 System Security Maintenance Function   
Function ID: FR-36   
Description: The system must maintain system security by enforcing access controls, monitoring for unauthorized access attempts, and logging security-related activities for audit and compliance.   
Input: Security policies and user access requests.   
Output: Enforced security settings, logged access attempts, and real-time security alerts.  
  
1.37 System Performance Monitoring Function   
Function ID: FR-37   
Description: The system must monitor real-time system performance, including CPU usage, memory utilization, and database response time. Performance metrics must be displayed and logged for troubleshooting.   
Input: Performance data from system components and the Oracle 10g database.   
Output: Performance metrics visualized on the Web-Based User Interface and stored in the Oracle 10g database.  
  
1.38 Traffic Report Generation Function   
Function ID: FR-38   
Description: The system must generate traffic reports based on processed Traffic Data, Incident Data, and Weather Data. Reports must include visual and textual summaries and be exportable in standard formats.   
Input: Traffic Data, Incident Data, and Weather Data from the Oracle 10g database.   
Output: Traffic Report displayed on the Web-Based User Interface and stored in the Oracle 10g database.  
  
1.39 Weather Report Generation Function   
Function ID: FR-39   
Description: The system must generate weather reports based on processed Weather Data and Road Condition Data. Reports must include weather observations, road surface conditions, and traffic impact summaries.   
Input: Weather Data and Road Condition Data from the Oracle 10g database.   
Output: Weather Report displayed on the Web-Based User Interface and stored in the Oracle 10g database.  
  
1.40 Road Condition Report Generation Function   
Function ID: FR-40   
Description: The system must generate road condition reports based on processed Road Surface Conditions, Weather Observations, and Incident Details. Reports must be exportable and displayed for situational awareness.   
Input: Road Surface Conditions, Weather Observations, and Incident Details from the Oracle 10g database.   
Output: Road Condition Report displayed on the Web-Based User Interface and stored in the Oracle 10g database.  
  
1.41 Data Integrity Maintenance Function   
Function ID: FR-41   
Description: The system must maintain data integrity through continuous validation and consistency checks. Invalid or inconsistent data must be flagged and logged for revalidation.   
Input: Traffic Data, Weather Data, Road Condition Data, and Incident Data from data sources.   
Output: Validated data passed to processing modules or flagged for revalidation and stored in the Oracle 10g database.  
  
1.42 Data Source Status Tracking Function   
Function ID: FR-42   
Description: The system must track the status of all data sources, including Probe Vehicles, Weather Stations, and Road Sensors, to ensure they are transmitting data correctly. Status logs must be displayed for the Administrator.   
Input: Status data from Probe Vehicles, Weather Stations, and Road Sensors.   
Output: Data Source Status Dashboard displayed on the Web-Based User Interface and stored in the Oracle 10g database.  
  
1.43 Incident Detail Update Function   
Function ID: FR-43   
Description: The system must allow the Administrator to update Incident Details, such as severity or location, and synchronize the changes with the DUAP system and Traveler Information Systems.   
Input: Incident Details provided by the Administrator for modification.   
Output: Updated Incident Details stored in the Oracle 10g database and reflected in Web-Based User Interfaces.  
  
1.44 Outdated Data Deletion Function   
Function ID: FR-44   
Description: The system must allow the Administrator to delete outdated data from the Oracle 10g database based on a predefined data retention policy. Deletion logs must be recorded for audit.   
Input: Data retention policy and data to be deleted.   
Output: Outdated Data deleted from the Oracle 10g database with logs stored for audit.  
  
1.45 Traveler Information Modification Function   
Function ID: FR-45   
Description: The system must allow the Administrator to modify traveler information such as alerts, detour suggestions, and advisories. The changes must be disseminated to Traveler Information Systems and visualized on Map Displays.   
Input: Modified traveler information provided by the Administrator.   
Output: Updated Traveler Information stored in the Oracle 10g database and disseminated to connected systems.  
  
1.46 System Configuration Management Function   
Function ID: FR-46   
Description: The system must allow the Administrator to modify system configurations, including data thresholds, caching policies, and alert rules. Configuration changes must be applied and stored for future use.   
Input: System configuration parameters provided by the Administrator.   
Output: Updated system configuration stored in the Oracle 10g database and applied to the DUAP system.  
  
1.47 Historical Traffic Data Retrieval Function   
Function ID: FR-47   
Description: The system must allow the Administrator to retrieve historical traffic data for analysis, including congestion levels, travel times, and incident details.   
Input: Date range, location, and data type specified by the Administrator.   
Output: Historical Traffic Data displayed on the Web-Based User Interface and synchronized with Map Displays.  
  
1.48 Historical Weather Data Retrieval Function   
Function ID: FR-48   
Description: The system must allow the Administrator to retrieve historical weather data for analysis, including temperature, precipitation, and visibility.   
Input: Date range, location, and weather data type specified by the Administrator.   
Output: Historical Weather Data displayed on the Web-Based User Interface and synchronized with Map Displays.  
  
1.49 Historical Road Condition Data Retrieval Function   
Function ID: FR-49   
Description: The system must allow the Administrator to retrieve historical road condition data for analysis, including road surface conditions and incident details.   
Input: Date range, location, and data type specified by the Administrator.   
Output: Historical Road Condition Data displayed on the Web-Based User Interface and synchronized with Map Displays.  
  
1.50 DataRecord Management Function   
Function ID: FR-50   
Description: The system must allow the Administrator to manage DataRecords, including viewing, editing, deleting, and archiving. Changes must be synchronized with the Oracle 10g database.   
Input: DataRecord details provided by the Administrator for management.   
Output: Modified or archived DataRecords stored in the Oracle 10g database and reflected in the Web-Based User Interface.  
  
1.51 System Log Management Function   
Function ID: FR-51   
Description: The system must allow the Administrator to view, filter, search, export, and delete system logs for auditing, troubleshooting, or analysis.   
Input: Log queries and actions provided by the Administrator.   
Output: System Logs displayed and managed on the Web-Based User Interface and stored in the Oracle 10g database.  
  
1.52 UserSession Management Function   
Function ID: FR-52   
Description: The system must allow the Administrator to manage user sessions, including terminating, extending, or reviewing session logs. Session data must be stored in the Oracle 10g database.   
Input: Session management actions provided by the Administrator.   
Output: Updated UserSession status stored in the Oracle 10g database and displayed on the Web-Based User Interface.  
  
1.53 AlertConfiguration Management Function   
Function ID: FR-53   
Description: The system must allow the Administrator to configure, modify, or delete alert rules and thresholds. Changes must be applied to the DUAP system for real-time alerting.   
Input: Alert configuration parameters provided by the Administrator.   
Output: Updated AlertConfiguration stored in the Oracle 10g database and applied to alert generation logic.  
  
1.54 CacheEntry Management Function   
Function ID: FR-54   
Description: The system must allow the Administrator to manage cache entries, including viewing, modifying expiration policies, and manually deleting entries. Cache data must be synchronized with the Oracle 10g database when available.   
Input: CacheEntry management actions provided by the Administrator.   
Output: Updated CacheEntry status stored in the Oracle 10g database and reflected in the Web-Based User Interface.  
  
1.55 ArchiveEntry Management Function   
Function ID: FR-55   
Description: The system must allow the Administrator to manage archive entries, including viewing, editing, deleting, or restoring archived data. Archive changes must be logged for audit purposes.   
Input: ArchiveEntry management actions provided by the Administrator.   
Output: Updated ArchiveEntry status stored in the Oracle 10g database and displayed on the Web-Based User Interface.

# External Description

\*\*Chapter 2: External Interfaces\*\*  
  
This chapter defines the external interfaces that the system must interact with to fulfill its functional requirements. These interfaces include user interfaces, hardware interfaces, software interfaces, and communication interfaces. Each interface is described in terms of its role, format, and method of interaction with the system.  
  
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### \*\*2.1 User Interfaces\*\*  
  
The system provides a \*\*Web-Based User Interface (WUI)\*\* to support real-time and historical data visualization, administration, and configuration.  
  
- \*\*Description\*\*:   
 The Web-Based User Interface is the primary interface for the system Administrator and operators to interact with the system. It supports dynamic rendering of data, configuration settings, and real-time monitoring of system performance and data flows.  
  
- \*\*Role\*\*:   
 Facilitates user access to system data and controls, enabling data browsing, configuration management, and alert monitoring.  
  
- \*\*Interaction Method\*\*:   
 - Users interact with the system through browser-based forms, dashboards, and map displays.   
 - Data is dynamically rendered using \*\*Java Software Foundation (JSF)\*\* components.   
 - Real-time updates are provided via AJAX or WebSocket connections.   
 - Filtering, sorting, and visualization capabilities are integrated into the WUI for traffic, weather, and asset data.  
  
- \*\*Relevant Functional Requirements\*\*:   
 FR-17 (Traffic Information Browsing), FR-18 (Incident Information Browsing), FR-19 (Traveler Information Browsing), FR-20 (Asset Condition Information Browsing), FR-21 (Weather Information Browsing), FR-22 (Map Display), FR-23 (Icon Layer Management), FR-24 (De-Cluttering Capability), FR-28 (Presentation Method Adjustment), FR-37 (System Performance Monitoring), FR-46 (System Configuration Management), FR-51 (System Log Management), FR-52 (UserSession Management), FR-53 (AlertConfiguration Management), FR-54 (CacheEntry Management), FR-55 (ArchiveEntry Management)  
  
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### \*\*2.2 Hardware Interfaces\*\*  
  
The system interacts with various hardware devices to collect real-time data from the field.  
  
- \*\*2.2.1 Probe Vehicles\*\*   
 - \*\*Description\*\*:   
 Vehicles equipped with GPS and other sensors that provide real-time data on location, speed, travel time, and other parameters.   
 - \*\*Role\*\*:   
 Primary source of real-time traffic data and travel demand information.   
 - \*\*Interaction Method\*\*:   
 - Data is received via \*\*real-time data streams\*\* (e.g., TCP/IP or UDP protocols).   
 - The system validates and processes the data for integration into the Oracle 10g database.  
  
- \*\*2.2.2 Road Sensors\*\*   
 - \*\*Description\*\*:   
 Embedded or surface-mounted sensors that monitor road surface conditions (e.g., temperature, moisture, ice detection).   
 - \*\*Role\*\*:   
 Provide real-time data on road surface states to support road condition analysis and alerts.   
 - \*\*Interaction Method\*\*:   
 - Data is received via \*\*real-time data streams\*\* or \*\*modbus/RS-232\*\* serial communication.   
 - The system processes this data to infer road surface conditions and integrates it with other data sources.  
  
- \*\*2.2.3 Weather Stations\*\*   
 - \*\*Description\*\*:   
 Ground-based or remote sensing stations that collect environmental data such as temperature, precipitation, and visibility.   
 - \*\*Role\*\*:   
 Provide real-time weather data to support weather impact analysis on traffic and road conditions.   
 - \*\*Interaction Method\*\*:   
 - Data is received via \*\*real-time data streams\*\* or \*\*API calls\*\*.   
 - The system formats and stores the data in the Oracle 10g database for further use.  
  
- \*\*2.2.4 Map Displays\*\*   
 - \*\*Description\*\*:   
 Interactive digital displays used to visualize traffic, weather, and road condition data in a geographic context.   
 - \*\*Role\*\*:   
 Provide situational awareness to the Administrator and users via spatial data overlays.   
 - \*\*Interaction Method\*\*:   
 - Map data is rendered using \*\*Michigan Geographic Framework (MIGF)\*\*-aligned data.   
 - Map layers and icons are dynamically updated based on incoming data streams and system configurations.  
  
- \*\*Relevant Functional Requirements\*\*:   
 FR-02 (Traffic Data Collection), FR-05 (Road Surface Condition Calculation), FR-06 (Weather Observation Processing), FR-16 (MI Drive Presentation Support), FR-22 (Map Display), FR-23 (Icon Layer Management), FR-24 (De-Cluttering Capability), FR-34 (Michigan Geographic Framework Application)  
  
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### \*\*2.3 Software Interfaces\*\*  
  
The system interacts with various software systems and databases to process, store, and disseminate data.  
  
- \*\*2.3.1 Oracle 10g Database\*\*   
 - \*\*Description\*\*:   
 A relational database used for long-term data storage, retrieval, and indexing.   
 - \*\*Role\*\*:   
 Central repository for all processed data, including traffic metrics, incident details, road and weather conditions, and system logs.   
 - \*\*Interaction Method\*\*:   
 - The system uses \*\*JDBC (Java Database Connectivity)\*\* to establish and maintain a connection.   
 - Data is stored and retrieved using \*\*standard SQL queries\*\*.   
 - Data integrity and consistency are maintained through validation and caching mechanisms.   
 - Configuration data, logs, and alert settings are also stored in this database.  
  
- \*\*2.3.2 Traffic Management Systems (TMS)\*\*   
 - \*\*Description\*\*:   
 External systems responsible for managing traffic flow, controlling signals, and coordinating incident responses.   
 - \*\*Role\*\*:   
 Receive incident details and asset condition alerts for coordination of real-time traffic management.   
 - \*\*Interaction Method\*\*:   
 - Incident and asset condition data are \*\*published via standardized formats\*\* such as \*\*TMDD\*\* (Transportation Management Data Dictionary).   
 - Data is integrated into TMS for operational decision-making.  
  
- \*\*2.3.3 Traveler Information Systems (TIS)\*\*   
 - \*\*Description\*\*:   
 Systems that disseminate real-time traffic and weather information to travelers via digital signs, mobile apps, and web portals.   
 - \*\*Role\*\*:   
 Receive and display traffic alerts, incident details, and traveler advisories.   
 - \*\*Interaction Method\*\*:   
 - Data is \*\*pushed in real-time\*\* using \*\*SAE J2354\*\* and \*\*TMDD\*\* formats.   
 - The system ensures data is formatted and validated before dissemination.  
  
- \*\*2.3.4 Java Software Foundation (JSF)\*\*   
 - \*\*Description\*\*:   
 A Java-based framework used for building the system’s Web-Based User Interface.   
 - \*\*Role\*\*:   
 Enables dynamic rendering of user interface components and real-time data updates.   
 - \*\*Interaction Method\*\*:   
 - The system is \*\*built on the JSF architecture\*\*.   
 - Components are managed via \*\*JSF managed beans\*\* and \*\*Facelets templates\*\*.   
 - User interactions are processed through JSF lifecycle events and AJAX callbacks.  
  
- \*\*2.3.5 SAE J2354 Data Formatting\*\*   
 - \*\*Description\*\*:   
 A standard for exchanging traffic data between systems.   
 - \*\*Role\*\*:   
 Format processed data for integration with external systems and traveler information platforms.   
 - \*\*Interaction Method\*\*:   
 - Data is \*\*converted and validated against the SAE J2354 schema\*\*.   
 - Output is stored in the Oracle 10g database and sent to external systems for use.  
  
- \*\*2.3.6 TMDD (Transportation Management Data Dictionary) Data Formatting\*\*   
 - \*\*Description\*\*:   
 A standardized data format for traffic management system interoperability.   
 - \*\*Role\*\*:   
 Format and validate data for integration with Traffic Management Systems.   
 - \*\*Interaction Method\*\*:   
 - Data is \*\*converted and validated against the TMDD schema\*\*.   
 - Output is stored in the Oracle 10g database and sent to TMS for operational use.  
  
- \*\*2.3.7 Michigan Department of Information Technology (MDIT) Standards Compliance\*\*   
 - \*\*Description\*\*:   
 A set of state-defined standards for data formatting, storage, and dissemination.   
 - \*\*Role\*\*:   
 Ensure all data and system outputs comply with MDIT standards for audit and integration purposes.   
 - \*\*Interaction Method\*\*:   
 - Data is \*\*validated against MDIT compliance rules\*\* during processing.   
 - Compliance logs are stored in the Oracle 10g database for auditing.  
  
- \*\*Relevant Functional Requirements\*\*:   
 FR-02 (Traffic Data Collection), FR-03 (Traffic Metrics Analysis), FR-04 (Traffic Incident Inference), FR-05 (Road Surface Condition Calculation), FR-06 (Weather Observation Processing), FR-07 (Travel Demand Monitoring), FR-11 (Data Formatting for SAE J2354), FR-12 (Data Formatting for TMDD), FR-13 (Traffic Alert Publishing), FR-14 (Weather Alert Publishing), FR-15 (Asset Condition Alert Publishing), FR-29 (MDIT Standards Compliance), FR-30 (Java Software Foundation Integration), FR-31 (JDBC Database Connection), FR-32 (Oracle 10g Database Use), FR-33 (Standard SQL Query Execution), FR-46 (System Configuration Management), FR-47 (Historical Traffic Data Retrieval), FR-48 (Historical Weather Data Retrieval), FR-49 (Historical Road Condition Data Retrieval)  
  
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### \*\*2.4 Communication Interfaces\*\*  
  
The system communicates with external systems and services via various network protocols and message formats.  
  
- \*\*2.4.1 Real-Time Data Streams (TCP/IP or UDP)\*\*   
 - \*\*Description\*\*:   
 Network-based communication protocols used to receive live data from Probe Vehicles, Weather Stations, and Road Sensors.   
 - \*\*Role\*\*:   
 Enable the system to process and analyze real-time data for traffic and weather monitoring.   
 - \*\*Interaction Method\*\*:   
 - Data is \*\*received via socket-based communication\*\*.   
 - The system performs \*\*data validation and caching\*\* during high load or database unavailability.  
  
- \*\*2.4.2 API Calls for Weather Data\*\*   
 - \*\*Description\*\*:   
 External APIs used to fetch or validate weather data from Weather Stations or third-party weather services.   
 - \*\*Role\*\*:   
 Ensure the system can access up-to-date weather information for analysis and alert generation.   
 - \*\*Interaction Method\*\*:   
 - Weather data is \*\*retrieved via RESTful API calls\*\*.   
 - The system validates and integrates API responses into internal data models.  
  
- \*\*2.4.3 Message Publishing to Traveler Information Systems (TIS)\*\*   
 - \*\*Description\*\*:   
 Communication mechanism to send real-time alerts and traffic updates to TIS.   
 - \*\*Role\*\*:   
 Disseminate traffic alerts, weather advisories, and traveler information to the public.   
 - \*\*Interaction Method\*\*:   
 - Data is \*\*pushed via HTTP(S) or message queues\*\*.   
 - Output is formatted using \*\*SAE J2354\*\* or \*\*TMDD\*\* standards.  
  
- \*\*2.4.4 Web Browsing and Data Retrieval\*\*   
 - \*\*Description\*\*:   
 The system supports browsing and retrieving data via web-based interfaces.   
 - \*\*Role\*\*:   
 Allow users and administrators to access real-time and historical data remotely.   
 - \*\*Interaction Method\*\*:   
 - Users access the system via \*\*HTTP(S) web requests\*\*.   
 - Data is retrieved using \*\*standard SQL queries\*\* or \*\*predefined API endpoints\*\*.   
 - Web sessions are managed using \*\*UserSession\*\* data stored in the Oracle 10g database.  
  
- \*\*2.4.5 Email Notifications for System Alerts\*\*   
 - \*\*Description\*\*:   
 An optional communication method to notify administrators or stakeholders of critical system events.   
 - \*\*Role\*\*:   
 Provide real-time email alerts for incidents, weather hazards, and system issues.   
 - \*\*Interaction Method\*\*:   
 - The system \*\*sends email alerts via SMTP\*\* using predefined templates.   
 - Alert triggers are configured via \*\*AlertConfiguration\*\* settings.  
  
- \*\*2.4.6 Data Export and Import Interfaces\*\*   
 - \*\*Description\*\*:   
 Mechanisms to export and import data in standard formats for external use or integration.   
 - \*\*Role\*\*:   
 Enable data sharing with other departments or systems for reporting and analysis.   
 - \*\*Interaction Method\*\*:   
 - Data is \*\*exported in XML, JSON, or CSV\*\* based on user preferences.   
 - Import is supported via \*\*file uploads\*\* or \*\*API integrations\*\* for historical data or configuration updates.  
  
- \*\*Relevant Functional Requirements\*\*:   
 FR-02 (Traffic Data Collection), FR-05 (Road Surface Condition Calculation), FR-06 (Weather Observation Processing), FR-13 (Traffic Alert Publishing), FR-14 (Weather Alert Publishing), FR-15 (Asset Condition Alert Publishing), FR-25 (Data Source Addition), FR-30 (Java Software Foundation Integration), FR-33 (Standard SQL Query Execution), FR-38 (Traffic Report Generation), FR-39 (Weather Report Generation), FR-40 (Road Condition Report Generation), FR-51 (System Log Management)  
  
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### \*\*Summary of All Identified External Interfaces\*\*  
  
| Interface Name | Type | Description | Interaction Method | Related Functional Requirements |  
|----------------|------|-------------|---------------------|-------------------------------|  
| Web-Based User Interface | User Interface | Dynamic UI for data browsing, configuration, and monitoring | JSF with AJAX/WebSocket | FR-17 to FR-24, FR-46 to FR-55 |  
| Probe Vehicles | Hardware Interface | Provide real-time traffic data | TCP/IP, UDP, or API | FR-02, FR-07, FR-47 |  
| Road Sensors | Hardware Interface | Provide road surface condition data | TCP/IP, UDP, or serial communication | FR-05, FR-40 |  
| Weather Stations | Hardware Interface | Provide environmental and weather data | TCP/IP, UDP, or API | FR-06, FR-39 |  
| Map Displays | Hardware Interface | Visualize spatial data | MIGF-aligned rendering | FR-16, FR-22, FR-23 |  
| Oracle 10g Database | Software Interface | Central data storage and retrieval | JDBC, SQL queries | FR-02 to FR-10, FR-32 to FR-34, FR-47 to FR-55 |  
| Traffic Management Systems (TMS) | Software Interface | Receive and act on incident and asset data | TMDD-formatted data push | FR-04, FR-15 |  
| Traveler Information Systems (TIS) | Software Interface | Disseminate traffic and weather alerts | SAE J2354, TMDD-formatted data push | FR-13, FR-14, FR-16 |  
| Java Software Foundation (JSF) | Software Interface | UI framework for dynamic rendering | JSF managed beans and Facelets | FR-30 |  
| SAE J2354 Data Format | Software Interface | Standard for traveler information | Data formatting and schema validation | FR-11 |  
| TMDD Data Format | Software Interface | Standard for traffic management data | Data formatting and schema validation | FR-12 |  
| Michigan Geographic Framework (MIGF) | Software Interface | Spatial alignment and visualization | Coordinate mapping and overlay logic | FR-34 |  
| JDBC Connection | Software Interface | Database connectivity | JDBC driver and connection pooling | FR-31 |  
| Real-Time Data Streams | Communication Interface | Data from field devices | TCP/IP, UDP, or message queues | FR-02, FR-05, FR-06 |  
| API Calls | Communication Interface | Retrieve external data | RESTful or SOAP APIs | FR-06, FR-25 |  
| Message Publishing | Communication Interface | Send alerts to TIS | HTTP(S) or message queue | FR-13, FR-14, FR-15 |  
| Web Browsing | Communication Interface | Remote access to data | HTTP(S) requests | FR-17 to FR-21, FR-47 to FR-49 |  
| Email Notifications | Communication Interface | Alert administrators via email | SMTP-based email delivery | FR-13, FR-14, FR-15 |  
| Data Export/Import | Communication Interface | Share data with external systems | File export/import, API integration | FR-38, FR-39, FR-40, FR-46, FR-51 |  
  
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This section provides a comprehensive overview of all external interfaces the system must support. Developers and integrators can use this information to understand the system’s dependencies and to design appropriate integration points for each external component.

# Use Case

Use Case Name: Process and Analyze VII Data   
Use Case ID: UC-01   
Actors: Administrator, Traffic Management Systems, Weather Stations, Traveler Information Systems   
Preconditions:   
- The Vehicle Infrastructure Integration (VII) system is active and connected to data sources.   
- Data entities (Vehicle Data, Infrastructure Data, Weather Data, Road Condition Data, Incident Data, Travel Demand Data) are available and accessible.   
- The Data Use Analysis and Processing (DUAP) system is configured to process incoming data streams.   
  
Postconditions:   
- VII data is processed and analyzed to generate actionable insights.   
- Updated traffic metrics, congestion levels, travel times, and queue lengths are available for use.   
- Alerts and asset condition updates are triggered based on the analysis.   
- Data is cached dynamically and archived for long-term use.   
  
Main Flow:   
1. The Administrator initiates the data processing task in the DUAP system.   
2. The system receives real-time data from multiple sources, including Vehicle Data, Infrastructure Data, Weather Data, Road Condition Data, Incident Data, and Travel Demand Data.   
3. Data Quality Checks are performed to ensure the integrity and consistency of the incoming data.   
4. The system processes the data using predefined Data Standards (SAE J2354, TMDD).   
5. Traffic Metrics (Congestion Levels, Travel Times, Queue Lengths) are calculated based on the processed data.   
6. Incident Details and Road Surface Conditions are extracted and categorized.   
7. The system updates the Traveler Information Systems with the latest traffic and weather information.   
8. The processed data is stored in the database using JDBC and Oracle 10g technologies.   
9. The system generates alerts for asset conditions and traffic anomalies.   
10. The results are displayed on the Web-Based User Interfaces with Map Displays and Icon Layers.   
  
Alternative Flow:   
1. If data from any source is incomplete or invalid during the Data Quality Checks, the system logs the issue and triggers a data revalidation process.   
2. If the system detects a critical incident, it bypasses the standard processing flow to prioritize the incident data and immediately sends alerts to the Administrator and Traffic Management Systems.   
3. If the database connection fails, the system uses Dynamic Data Caching to temporarily store the processed data and retries the connection at a later time.   
4. If the system encounters an unexpected error during processing, it sends a notification to the Administrator and halts the current processing task until the issue is resolved.  
  
Use Case Name: Collect Traffic Data   
Use Case ID: UC-02   
Actors: Administrator, Probe Vehicles, Traffic Management Systems, Traveler Information Systems   
Preconditions:   
- The Traffic Data collection system is operational and connected to Probe Vehicles and other data sources.   
- The Vehicle Infrastructure Integration (VII) system is active and able to communicate with the DUAP system.   
- The Traffic Metrics and Road Condition Data entities are accessible and properly configured.   
- The Database (Oracle 10g via JDBC) is available to store collected data.   
  
Postconditions:   
- Traffic Data is successfully collected from Probe Vehicles and other sources.   
- The data is validated and integrated into the system for further analysis.   
- Traveler Information Systems are updated with the latest traffic information.   
- The collected data is stored in the database for long-term reference and processing.   
  
Main Flow:   
1. The Administrator starts the traffic data collection process via the Web-Based User Interface.   
2. Probe Vehicles transmit real-time data including vehicle location, speed, and travel time.   
3. The system receives the data and performs initial Data Quality Checks to ensure accuracy.   
4. The data is categorized and mapped to relevant entities such as Traffic Data, Road Condition Data, and Incident Data.   
5. The system updates the Traffic Metrics (e.g., Congestion Levels, Travel Times, Queue Lengths) based on the incoming data.   
6. The updated data is sent to Traveler Information Systems for public dissemination.   
7. The system archives the collected data using Long-Term Archiving and stores it in the Oracle 10g database.   
8. The system prepares the data for further analysis by the Data Use Analysis and Processing (DUAP) system.   
  
Alternative Flow:   
1. If Probe Vehicles fail to transmit data, the system logs the failure and attempts to reconnect or retrieve data at a later time.   
2. If the Data Quality Checks fail, the system triggers an alert to the Administrator and initiates a revalidation process.   
3. If a high-priority incident is detected during data collection, the system routes the data to the Incident Processing module for immediate handling.   
4. If the database connection is unavailable during archiving, the system caches the data temporarily and retries the storage operation when the connection is restored.   
5. If an unexpected system error occurs, the Administrator is notified, and the data collection process is paused until the issue is resolved.  
  
Use Case Name: Analyze Traffic Metrics   
Use Case ID: UC-03   
Actors: Administrator, Traffic Management Systems, Traveler Information Systems, Weather Stations   
Preconditions:   
- The Traffic Data collection system has completed the data gathering process.   
- The Data Use Analysis and Processing (DUAP) system is operational and ready to analyze data.   
- Traffic Data, Weather Data, and Road Condition Data are available and have passed initial quality checks.   
- The Web-Based User Interfaces and Map Displays are accessible for visualization.   
  
Postconditions:   
- Traffic Metrics (Congestion Levels, Travel Times, Queue Lengths) are analyzed and summarized.   
- Trends and patterns in traffic behavior are identified and reported.   
- Traveler Information Systems are updated with actionable insights for commuters.   
- The analysis results are stored in the Oracle 10g database for future reference.   
- Alerts are generated and sent to the Administrator and Traffic Management Systems if anomalies are detected.   
  
Main Flow:   
1. The Administrator selects the "Analyze Traffic Metrics" option from the Web-Based User Interface.   
2. The system retrieves the latest Traffic Data, Weather Data, and Road Condition Data from the database.   
3. The Data Use Analysis and Processing (DUAP) system processes the data using predefined Data Standards (SAE J2354, TMDD).   
4. Traffic Metrics are calculated and compared against historical data to identify trends and anomalies.   
5. The system extracts Incident Details and evaluates their impact on traffic flow.   
6. The analysis results are formatted and sent to Traveler Information Systems for public dissemination.   
7. The system generates alerts for significant traffic changes or potential incidents.   
8. The Administrator reviews the analysis results and can export them for further use.   
9. The processed metrics and insights are archived in the Oracle 10g database for long-term reference.   
10. Map Displays and Icon Layers are updated with the latest analysis results to support real-time decision-making.   
  
Alternative Flow:   
1. If the system detects missing or inconsistent data during retrieval, it logs the issue and performs a data revalidation process.   
2. If a major traffic anomaly is identified, the system sends an immediate alert to the Administrator and Traffic Management Systems, bypassing standard reporting delays.   
3. If the database is unavailable for archiving, the system caches the analysis results temporarily and retries the storage operation when the connection is restored.   
4. If the Web-Based User Interface fails to load the Map Displays or Icon Layers, the system provides a simplified view of the analysis results while troubleshooting the issue.   
5. If an unexpected error occurs during analysis, the system halts the process, notifies the Administrator, and provides an error log for investigation.  
  
Use Case Name: Infer Traffic Incidents   
Use Case ID: UC-04   
Actors: Administrator, Traffic Management Systems, Probe Vehicles, Traveler Information Systems, Weather Stations   
  
Preconditions:   
- The Vehicle Infrastructure Integration (VII) system is active and connected to Probe Vehicles and other data sources.   
- Traffic Data, Weather Data, Road Condition Data, and Vehicle Data are available and accessible.   
- The Data Use Analysis and Processing (DUAP) system is configured to detect and infer potential traffic incidents.   
- The Web-Based User Interfaces, Map Displays, and Icon Layers are ready for incident visualization.   
  
Postconditions:   
- Traffic Incidents are identified and categorized based on real-time data analysis.   
- Incident Details (e.g., location, severity, cause) are extracted and stored.   
- Traveler Information Systems are updated with incident-related alerts and detour suggestions.   
- The Administrator and Traffic Management Systems receive real-time alerts for incident response.   
- Incident data is archived in the Oracle 10g database for long-term use.   
  
Main Flow:   
1. The Administrator initiates the traffic incident inference process via the Web-Based User Interface.   
2. The system collects real-time data from Probe Vehicles, Traffic Management Systems, and Weather Stations.   
3. The Data Use Analysis and Processing (DUAP) system applies predefined algorithms to detect anomalies in traffic flow, such as sudden slowdowns or stops.   
4. Incident Details are inferred and classified (e.g., accident, road closure, weather-related).   
5. The system cross-references incident data with Road Surface Conditions and Weather Observations to enhance accuracy.   
6. The inferred incident information is sent to Traveler Information Systems for public alerts.   
7. Alerts are generated and sent to the Administrator and Traffic Management Systems for immediate action.   
8. Incident data is stored in the Oracle 10g database using JDBC.   
9. The system updates Map Displays and Icon Layers with the incident locations and statuses.   
10. The Administrator reviews the incident data and confirms its validity or initiates manual correction if needed.   
  
Alternative Flow:   
1. If the system detects incomplete or conflicting data during incident inference, it logs the discrepancy and triggers a revalidation process.   
2. If a high-severity incident is inferred, the system immediately sends an alert to the Administrator and Traffic Management Systems, bypassing standard processing delays.   
3. If the database connection fails during incident data storage, the system caches the data dynamically and retries when the connection is restored.   
4. If the Web-Based User Interface fails to display incident data on Map Displays, the system provides a simplified text-based summary for the Administrator.   
5. If an unexpected error occurs during the inference process, the system halts the operation, notifies the Administrator, and logs the error for troubleshooting.  
  
Use Case Name: Calculate Road Surface Conditions   
Use Case ID: UC-05   
Actors: Administrator, Traffic Management Systems, Weather Stations, Traveler Information Systems, Road Sensors   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system is active and integrated with data sources such as Road Sensors, Weather Stations, and Probe Vehicles.   
- Road Condition Data, Weather Data, and Vehicle Data are available and have passed initial Data Quality Checks.   
- The Traffic Data collection system has completed its process and provided updated metrics.   
- The Web-Based User Interfaces and Map Displays are accessible for visualization.   
  
Postconditions:   
- Road Surface Conditions (e.g., wet, icy, dry) are calculated and categorized based on real-time data analysis.   
- Updated Road Condition Data is stored in the Oracle 10g database for long-term reference.   
- Traveler Information Systems are updated with relevant road surface alerts and conditions.   
- Map Displays and Icon Layers reflect the latest road surface conditions for real-time decision-making.   
- The Administrator receives alerts for hazardous road conditions.   
  
Main Flow:   
1. The Administrator selects the "Calculate Road Surface Conditions" option from the Web-Based User Interface.   
2. The system retrieves real-time data from Road Sensors, Weather Stations, and Probe Vehicles.   
3. The Data Use Analysis and Processing (DUAP) system applies predefined algorithms and Data Standards (SAE J2354, TMDD) to evaluate road surface conditions.   
4. Road Condition Data is analyzed in conjunction with Weather Observations (e.g., temperature, precipitation) to determine current road surface states.   
5. The system categorizes and maps the calculated conditions to specific road segments.   
6. The results are integrated with Incident Details and Traffic Metrics to assess potential impacts on traffic flow.   
7. Traveler Information Systems are updated with alerts and visual representations of road surface conditions.   
8. The system archives the calculated road surface data in the Oracle 10g database using JDBC.   
9. Map Displays and Icon Layers are refreshed to reflect the latest road surface status.   
10. The Administrator reviews and validates the calculated road surface conditions if necessary.   
  
Alternative Flow:   
1. If data from Road Sensors or Weather Stations is missing or invalid, the system logs the issue and initiates a revalidation process.   
2. If a hazardous road condition (e.g., ice formation) is detected, the system immediately sends an alert to the Administrator and Traffic Management Systems, bypassing standard reporting delays.   
3. If the database connection is unavailable during data archiving, the system caches the results temporarily and retries the storage operation when the connection is restored.   
4. If the Web-Based User Interface fails to update Map Displays, the system provides a simplified textual summary of road surface conditions for the Administrator.   
5. If an unexpected error occurs during the calculation process, the system halts the operation, sends a notification to the Administrator, and logs the error for further investigation.  
  
Use Case Name: Process Weather Observations   
Use Case ID: UC-06   
Actors: Administrator, Weather Stations, Traffic Management Systems, Traveler Information Systems, DUAP System   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system is operational and configured to integrate Weather Data.   
- Weather Stations are transmitting real-time Weather Observations (e.g., precipitation, temperature, visibility).   
- The Traffic Data and Road Condition Data entities are available for cross-referencing with weather data.   
- The Web-Based User Interfaces, Map Displays, and Icon Layers are accessible for visualizing weather-related impacts.   
  
Postconditions:   
- Weather Observations are processed and integrated with traffic and road condition data.   
- Updated road surface conditions and traffic metrics are influenced by weather analysis.   
- Traveler Information Systems are updated with weather alerts and related travel advisories.   
- Alerts are generated for hazardous weather conditions affecting traffic.   
- Weather data is archived in the Oracle 10g database for historical analysis.   
  
Main Flow:   
1. The Administrator initiates the processing of Weather Observations via the Web-Based User Interface.   
2. The system receives real-time Weather Data from Weather Stations, including precipitation, temperature, and visibility.   
3. Data Quality Checks are performed to ensure the accuracy and consistency of the Weather Data.   
4. The DUAP system processes the Weather Data using predefined Data Standards (SAE J2354, TMDD).   
5. Weather data is combined with Traffic Data and Road Condition Data to assess potential impacts on traffic flow and road safety.   
6. The system calculates and updates road surface conditions based on weather patterns (e.g., icy roads during freezing rain).   
7. Weather-related alerts (e.g., reduced visibility, severe weather) are generated and sent to the Administrator and Traffic Management Systems.   
8. Traveler Information Systems are updated with weather alerts and recommended travel actions.   
9. The processed weather data is archived in the Oracle 10g database for long-term reference.   
10. Map Displays and Icon Layers are updated to show weather-affected road segments and traffic conditions.   
  
Alternative Flow:   
1. If Weather Observations are incomplete or invalid, the system logs the discrepancy and initiates a revalidation process.   
2. If the system detects a severe weather event (e.g., snowstorm), it sends immediate alerts to the Administrator and Traffic Management Systems, bypassing standard processing delays.   
3. If the database connection fails during data archiving, the system caches the weather data dynamically and retries the storage operation when the connection is restored.   
4. If the Web-Based User Interface fails to display weather-related updates on Map Displays, the system provides a simplified textual summary for the Administrator.   
5. If an unexpected error occurs during processing, the system halts the operation, notifies the Administrator, and logs the error for investigation.  
  
Use Case Name: Monitor Travel Demand   
Use Case ID: UC-07   
Actors: Administrator, Traffic Management Systems, Traveler Information Systems, Probe Vehicles, Weather Stations   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system is active and connected to Probe Vehicles and other data sources.   
- Travel Demand Data, Traffic Data, Weather Data, and Road Condition Data are available and have passed initial Data Quality Checks.   
- The Web-Based User Interfaces, Map Displays, and Icon Layers are accessible for visualizing travel demand patterns.   
- The Traffic Metrics and Incident Details are up to date for contextual analysis.   
  
Postconditions:   
- Travel Demand patterns are analyzed and visualized in real-time.   
- Traveler Information Systems are updated with demand-based insights and travel recommendations.   
- Traffic Management Systems receive alerts for potential congestion or route adjustments.   
- Travel Demand Data is archived in the Oracle 10g database for historical reference.   
- Map Displays and Icon Layers reflect the latest travel demand data for situational awareness.   
  
Main Flow:   
1. The Administrator selects the "Monitor Travel Demand" option from the Web-Based User Interface.   
2. The system retrieves real-time Travel Demand Data from Probe Vehicles, including origin, destination, and travel time.   
3. The DUAP system processes the data using predefined Data Standards (SAE J2354, TMDD) to identify trends.   
4. The system integrates Travel Demand Data with Traffic Metrics, Weather Observations, and Road Condition Data for comprehensive analysis.   
5. Demand patterns are visualized on Map Displays, showing high-traffic zones and peak travel times.   
6. The system generates alerts for the Administrator and Traffic Management Systems if abnormal demand is detected.   
7. Traveler Information Systems are updated with demand-related advisories and route suggestions.   
8. The processed travel demand data is stored in the Oracle 10g database using JDBC for long-term use.   
9. The Administrator reviews the demand visualization and adjusts traffic management strategies as needed.   
10. Dynamic Data Caching is used to ensure continuous monitoring during high data load periods.   
  
Alternative Flow:   
1. If Travel Demand Data is incomplete or invalid, the system logs the issue and triggers a revalidation process.   
2. If a sudden surge in travel demand is detected, the system sends an immediate alert to the Administrator and Traffic Management Systems, bypassing standard reporting delays.   
3. If the database connection is unavailable during data archiving, the system caches the results temporarily and retries the storage operation when the connection is restored.   
4. If the Web-Based User Interface fails to load the Map Displays or Icon Layers, the system provides a simplified view of the demand data for the Administrator.   
5. If an unexpected error occurs during demand monitoring, the system halts the operation, notifies the Administrator, and logs the error for troubleshooting.  
  
Use Case Name: Perform Data Quality Checks   
Use Case ID: UC-08   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Traffic Management Systems, Weather Stations, Probe Vehicles   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system is active and connected to relevant data sources.   
- Traffic Data, Weather Data, Road Condition Data, and Vehicle Data are available and being collected.   
- The Web-Based User Interfaces and Map Displays are accessible for monitoring data quality status.   
- The Oracle 10g database is available for logging and storing validated data.   
  
Postconditions:   
- All incoming data is validated for accuracy, consistency, and completeness.   
- Invalid or incomplete data is logged and flagged for revalidation.   
- Valid data is passed to the next processing steps for integration and analysis.   
- Data Quality reports are generated and displayed on the Web-Based User Interfaces.   
- Alerts are sent to the Administrator for any critical data quality issues.   
  
Main Flow:   
1. The Administrator initiates the Data Quality Check process via the Web-Based User Interface.   
2. The DUAP system retrieves incoming data streams from Probe Vehicles, Traffic Management Systems, Weather Stations, and other sources.   
3. The system performs automated validation checks against predefined Data Standards (SAE J2354, TMDD).   
4. Data integrity checks include consistency with historical data, range validity, and logical coherence.   
5. The system categorizes data as valid, incomplete, or invalid based on the results of the checks.   
6. Valid data is passed to subsequent use cases for further processing (e.g., traffic metrics, incident inference).   
7. Invalid or incomplete data is logged and reported to the Administrator for review.   
8. Quality check results are visualized on the Map Displays and Icon Layers for real-time monitoring.   
9. The system archives the quality check logs in the Oracle 10g database for audit and analysis.   
10. The Administrator can manually override or revalidate flagged data if needed.   
  
Alternative Flow:   
1. If the system detects a high volume of invalid data, it triggers an alert to the Administrator for urgent intervention.   
2. If a specific data source is found to be repeatedly failing checks, the system disables it and logs the issue for maintenance.   
3. If the database is unavailable for archiving quality logs, the system caches the logs temporarily and retries when the connection is restored.   
4. If the Web-Based User Interface fails to display the quality check results, the system provides a textual summary for the Administrator.   
5. If an unexpected system error occurs during data validation, the process is paused, and the Administrator is notified for resolution.  
  
Use Case Name: Implement Dynamic Data Caching   
Use Case ID: UC-09   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Traffic Data, Weather Data, Road Condition Data, Traffic Management Systems, Web-Based User Interfaces   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system is active and processing incoming data streams.   
- Traffic Data, Weather Data, and Road Condition Data are being collected and analyzed in real-time.   
- The system has sufficient memory and processing capacity to handle dynamic caching operations.   
- The Oracle 10g database is available for long-term data storage.   
- The Web-Based User Interfaces are accessible for monitoring cache status and performance.   
  
Postconditions:   
- Real-time data is cached dynamically based on system load and data priority.   
- Caching mechanisms improve system performance during high data load scenarios.   
- Cached data is synchronized with the Oracle 10g database when the connection is restored.   
- The Administrator can monitor the status and performance of the caching system via the Web-Based User Interface.   
- Data integrity is maintained throughout the caching and synchronization process.   
  
Main Flow:   
1. The Administrator configures the Dynamic Data Caching settings via the Web-Based User Interface.   
2. The DUAP system receives real-time data from multiple sources, including Traffic Data, Weather Data, and Road Condition Data.   
3. The system evaluates data volume and system performance to determine the need for dynamic caching.   
4. Based on predefined thresholds, the system activates the Dynamic Data Caching mechanism.   
5. Real-time data that cannot be immediately stored in the Oracle 10g database is temporarily cached in memory or local storage.   
6. The system continues processing and analyzing cached data to maintain real-time insights and alerts.   
7. The system periodically attempts to reconnect to the Oracle 10g database and transfers cached data to the database when the connection is stable.   
8. The Web-Based User Interface displays cache status, including data stored, pending transfers, and performance metrics.   
9. The system logs all caching and synchronization activities for audit and troubleshooting purposes.   
10. The Administrator reviews the caching performance and adjusts settings if necessary.   
  
Alternative Flow:   
1. If the system detects insufficient memory for caching, it prioritizes critical data (e.g., incident details, traffic metrics) for storage and discards or compresses non-critical data.   
2. If the database connection is restored during active caching, the system initiates an immediate data synchronization to minimize data loss.   
3. If the Web-Based User Interface fails to display caching metrics, the system provides a textual summary and logs the issue for resolution.   
4. If the system encounters a failure during data synchronization, it retries the operation after a predefined interval and sends a notification to the Administrator.   
5. If an unexpected error occurs in the caching module, the system halts caching, logs the error, and notifies the Administrator for investigation.  
  
Use Case Name: Archive Long-Term Data   
Use Case ID: UC-10   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Traffic Management Systems, Traveler Information Systems, Oracle 10g Database   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system has completed the data processing and analysis tasks.   
- Traffic Metrics, Road Condition Data, Incident Details, Weather Observations, and Travel Demand Data are available for archiving.   
- The Oracle 10g database is accessible and configured for long-term data storage.   
- The Administrator has the necessary permissions to initiate the archiving process.   
- The system is capable of handling large volumes of data for storage and retrieval.   
  
Postconditions:   
- Historical data is archived in the Oracle 10g database for future analysis and reporting.   
- The system ensures data consistency and integrity during archiving.   
- Archived data is indexed and organized for efficient retrieval.   
- The Administrator receives a confirmation of successful archiving.   
- The system logs archiving activities for audit and troubleshooting purposes.   
  
Main Flow:   
1. The Administrator selects the "Archive Long-Term Data" option from the Web-Based User Interface.   
2. The system identifies data entities (Traffic Data, Weather Data, Road Condition Data, Incident Data, Travel Demand Data) that are ready for archiving.   
3. The DUAP system applies Data Standards (SAE J2354, TMDD) to ensure data format consistency before archiving.   
4. The system initiates the archiving process, transferring data to the Oracle 10g database via JDBC.   
5. Data is indexed and stored in a structured format for long-term use.   
6. The system confirms the successful archiving of data to the Oracle 10g database.   
7. The Administrator is notified of the archiving completion.   
8. The system logs the archiving operation in the system audit trail.   
9. The Web-Based User Interface updates the archive status and provides access to historical data.   
10. The system prepares for future data retrieval and analysis by maintaining archive metadata.   
  
Alternative Flow:   
1. If the Oracle 10g database is temporarily unavailable, the system caches the data locally using Dynamic Data Caching and retries the archiving operation once the connection is restored.   
2. If the system detects an archive operation failure due to data corruption or format issues, it logs the error and notifies the Administrator for manual intervention.   
3. If the archive process exceeds predefined performance thresholds, the system pauses archiving and sends a performance alert to the Administrator.   
4. If the Web-Based User Interface fails to update the archive status, the system provides a textual confirmation of the archiving progress.   
5. If an unexpected error occurs during archiving, the system halts the operation, logs the error, and sends a notification to the Administrator for investigation.  
  
Use Case Name: Format Data for SAE J2354   
Use Case ID: UC-11   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Traffic Management Systems, Probe Vehicles, Weather Stations   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system is active and connected to Probe Vehicles, Traffic Management Systems, and Weather Stations.   
- Traffic Data, Weather Data, and Road Condition Data are available and have passed initial Data Quality Checks.   
- The system is configured to apply SAE J2354 standards for data formatting.   
- The Web-Based User Interfaces and Map Displays are accessible for monitoring formatted data.   
- The Oracle 10g database is available for storing formatted data.   
  
Postconditions:   
- Data from Probe Vehicles, Traffic Management Systems, and Weather Stations is formatted according to SAE J2354 standards.   
- Formatted data is ready for integration with external systems and long-term storage.   
- The Administrator can verify the formatted data through the Web-Based User Interface.   
- Formatted data is archived in the Oracle 10g database for future use.   
- The system ensures consistency and compliance with SAE J2354 during formatting.   
  
Main Flow:   
1. The Administrator selects the "Format Data for SAE J2354" option from the Web-Based User Interface.   
2. The system retrieves the latest Traffic Data, Weather Data, and Road Condition Data from the DUAP system.   
3. The Data Use Analysis and Processing (DUAP) system applies the SAE J2354 formatting rules to the data.   
4. The system validates the formatted data against the SAE J2354 schema to ensure compliance.   
5. The formatted data is stored in a temporary buffer and ready for external system integration.   
6. The system archives the formatted data in the Oracle 10g database for long-term reference.   
7. The Web-Based User Interface displays the status of the formatting process and any validation results.   
8. The Administrator reviews the formatted data and confirms its readiness for external use.   
9. The system logs the formatting and archiving activities for audit purposes.   
10. The formatted data is made available for export or sharing with third-party systems.   
  
Alternative Flow:   
1. If the system detects non-compliance with SAE J2354 standards during formatting, it logs the issue and notifies the Administrator for correction.   
2. If the data source fails to provide required data fields for SAE J2354 compliance, the system triggers a data revalidation process.   
3. If the Oracle 10g database is unavailable during archiving, the system caches the formatted data and retries the operation when the connection is restored.   
4. If the Web-Based User Interface fails to display the formatting status, the system provides a textual summary and logs the issue for resolution.   
5. If an unexpected error occurs during formatting, the system halts the process, logs the error, and sends a notification to the Administrator for investigation.  
  
Use Case Name: Format Data for TMDD   
Use Case ID: UC-12   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Traffic Management Systems, Probe Vehicles, Weather Stations   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system is active and connected to Probe Vehicles, Traffic Management Systems, and Weather Stations.   
- Traffic Data, Weather Data, and Road Condition Data are available and have passed initial Data Quality Checks.   
- The system is configured to apply TMDD standards for data formatting.   
- The Web-Based User Interfaces and Map Displays are accessible for monitoring formatted data.   
- The Oracle 10g database is available for storing and retrieving formatted data.   
  
Postconditions:   
- Data from Probe Vehicles, Traffic Management Systems, and Weather Stations is formatted according to TMDD standards.   
- Formatted data is ready for integration with external traffic management systems and long-term storage.   
- The Administrator can verify the formatting results via the Web-Based User Interface.   
- Formatted data is archived in the Oracle 10g database for historical and compliance purposes.   
- The system ensures data consistency and compliance with TMDD during the formatting process.   
  
Main Flow:   
1. The Administrator selects the "Format Data for TMDD" option from the Web-Based User Interface.   
2. The system retrieves the latest Traffic Data, Weather Data, and Road Condition Data from the DUAP system.   
3. The Data Use Analysis and Processing (DUAP) system applies TMDD formatting rules to standardize the data for external traffic systems.   
4. The system validates the formatted data against the TMDD schema to ensure compliance.   
5. The formatted data is stored in a temporary buffer for downstream integration or archiving.   
6. The system archives the TMDD-formatted data in the Oracle 10g database for long-term reference.   
7. The Web-Based User Interface displays the status of the TMDD formatting process and any validation results.   
8. The Administrator confirms the data is ready for export or integration with external traffic systems.   
9. The system logs all formatting and archiving activities for audit and troubleshooting.   
10. The formatted data is made available for transmission to compliant external systems.   
  
Alternative Flow:   
1. If the system detects non-compliance with TMDD standards during formatting, it logs the issue and notifies the Administrator for correction.   
2. If required TMDD data fields are missing or invalid, the system triggers a revalidation process for the affected data entities.   
3. If the Oracle 10g database is unavailable during archiving, the system caches the formatted data and retries the storage operation when the connection is restored.   
4. If the Web-Based User Interface fails to display the TMDD formatting status, the system provides a textual summary for the Administrator.   
5. If an unexpected error occurs during the formatting process, the system halts the operation, logs the error, and sends a notification to the Administrator for investigation.  
  
Use Case Name: Publish Traffic Alerts   
Use Case ID: UC-13   
Actors: Administrator, Traffic Management Systems, Traveler Information Systems, DUAP System, Probe Vehicles, Weather Stations   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system has completed traffic data analysis and identified anomalies or incidents.   
- Traffic Metrics, Incident Details, Road Surface Conditions, and Weather Observations are available and validated.   
- The Web-Based User Interfaces, Map Displays, and Icon Layers are accessible for alert visualization.   
- The Traveler Information Systems are operational and ready to receive and disseminate alerts.   
- The Oracle 10g database is available for logging and storing alert information.   
  
Postconditions:   
- Traffic Alerts are published and displayed on the Web-Based User Interfaces and Map Displays.   
- Traveler Information Systems are updated with real-time alerts for public dissemination.   
- Traffic Management Systems receive alerts for coordination and response actions.   
- Alert details are stored in the Oracle 10g database for historical reference.   
- The system logs the publishing process for audit and troubleshooting.   
  
Main Flow:   
1. The Administrator selects the "Publish Traffic Alerts" option from the Web-Based User Interface.   
2. The system retrieves the latest Incident Details, Traffic Metrics, and Road Surface Conditions from the DUAP system.   
3. The Data Use Analysis and Processing (DUAP) system formats the alerts according to standard templates and Data Standards (SAE J2354, TMDD).   
4. The system validates the alert content for accuracy and relevance based on predefined rules.   
5. The alerts are published to the Web-Based User Interfaces, where they are displayed on Map Displays and Icon Layers.   
6. The alerts are sent to Traveler Information Systems for public dissemination (e.g., mobile apps, road signs).   
7. Traffic Management Systems receive the alerts to coordinate traffic control and emergency response.   
8. The system archives the published alerts in the Oracle 10g database for long-term use.   
9. The Administrator reviews the published alerts and confirms their visibility and accuracy.   
10. The system logs the publishing and archiving activities for audit purposes.   
  
Alternative Flow:   
1. If the alert content fails validation, the system logs the issue and prompts the Administrator to manually review and correct the alert.   
2. If the Traveler Information Systems are temporarily unreachable, the system caches the alerts and retries transmission when the systems are back online.   
3. If the database connection is unavailable during archiving, the system uses Dynamic Data Caching to store the alerts locally and retries the operation later.   
4. If the Web-Based User Interface fails to display alerts on Map Displays, the system provides a textual summary for the Administrator to review.   
5. If an unexpected error occurs during alert publishing, the system halts the process, logs the error, and notifies the Administrator for resolution.  
  
Use Case Name: Publish Weather Alerts   
Use Case ID: UC-14   
Actors: Administrator, Weather Stations, Traffic Management Systems, Traveler Information Systems, DUAP System   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system has completed the processing of Weather Observations and identified hazardous weather conditions.   
- Weather Data, Road Condition Data, and Traffic Data are available and have passed Data Quality Checks.   
- The Web-Based User Interfaces, Map Displays, and Icon Layers are accessible for alert visualization.   
- The Traveler Information Systems are operational and capable of receiving and disseminating alerts.   
- The Oracle 10g database is available for logging and storing alert details.   
  
Postconditions:   
- Weather Alerts are published and displayed on the Web-Based User Interfaces and Map Displays.   
- Traveler Information Systems are updated with weather-related alerts for public dissemination.   
- Traffic Management Systems receive alerts to support proactive traffic control and incident response.   
- Alert details are archived in the Oracle 10g database for future reference and audit.   
- The system logs the publishing process and any associated errors or actions.   
  
Main Flow:   
1. The Administrator selects the "Publish Weather Alerts" option from the Web-Based User Interface.   
2. The system retrieves the latest Weather Observations, including temperature, precipitation, and visibility, from Weather Stations.   
3. The DUAP system processes the Weather Data using predefined Data Standards (SAE J2354, TMDD) and evaluates its impact on road conditions.   
4. The system identifies hazardous weather conditions (e.g., ice, flooding, extreme heat) and prepares corresponding alert messages.   
5. The alert content is validated for accuracy, relevance, and compliance with predefined templates.   
6. The system publishes the alerts to the Web-Based User Interfaces, where they are displayed on Map Displays and Icon Layers.   
7. The alerts are sent to Traveler Information Systems for dissemination to the public (e.g., mobile apps, digital signage).   
8. The system forwards the alerts to Traffic Management Systems for integration into traffic control strategies.   
9. Alert details are archived in the Oracle 10g database for historical tracking and compliance.   
10. The Administrator confirms the successful publication and visibility of the alerts.   
  
Alternative Flow:   
1. If the system detects missing or inconsistent weather data during alert preparation, it logs the issue and triggers a revalidation process.   
2. If a severe weather event (e.g., hurricane, blizzard) is identified, the system bypasses standard processing to immediately publish and distribute the alert.   
3. If the Traveler Information Systems are unavailable, the system caches the alerts and retries the transmission when the systems are back online.   
4. If the Oracle 10g database connection fails during archiving, the system uses Dynamic Data Caching to store the alerts locally and retries the operation later.   
5. If an unexpected error occurs during alert publishing, the system halts the process, logs the error, and sends a notification to the Administrator for investigation.  
  
Use Case Name: Publish Asset Condition Alerts   
Use Case ID: UC-15   
Actors: Administrator, Traffic Management Systems, Traveler Information Systems, DUAP System, Road Sensors, Weather Stations   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system has completed the analysis of asset conditions and identified anomalies or potential failures.   
- Asset Condition Data, Road Condition Data, Traffic Data, and Weather Data are available and have passed Data Quality Checks.   
- The Web-Based User Interfaces, Map Displays, and Icon Layers are accessible for visualization.   
- The Traveler Information Systems are active and capable of receiving and disseminating alerts.   
- The Oracle 10g database is available for logging and storing alert details.   
  
Postconditions:   
- Asset Condition Alerts are published and displayed on the Web-Based User Interfaces and Map Displays.   
- Traveler Information Systems are updated with alerts related to asset conditions (e.g., road closures, infrastructure failures).   
- Traffic Management Systems receive alerts for coordination and response actions.   
- Alert details are archived in the Oracle 10g database for historical reference and audit.   
- The system logs the publishing process for traceability and troubleshooting.   
  
Main Flow:   
1. The Administrator selects the "Publish Asset Condition Alerts" option from the Web-Based User Interface.   
2. The system retrieves the latest Asset Condition Data from the DUAP system, including infrastructure status, road maintenance needs, and sensor malfunctions.   
3. The DUAP system processes the data using predefined Data Standards (SAE J2354, TMDD) and evaluates its impact on traffic and safety.   
4. The system identifies critical asset conditions (e.g., bridge failure, signal malfunction) and prepares corresponding alert messages.   
5. The alert content is validated for accuracy, relevance, and compliance with predefined templates.   
6. The system publishes the alerts to the Web-Based User Interfaces, where they are displayed on Map Displays and Icon Layers.   
7. The alerts are sent to Traveler Information Systems for dissemination to the public (e.g., mobile apps, road signs).   
8. The system forwards the alerts to Traffic Management Systems for integration into traffic control strategies.   
9. Alert details are archived in the Oracle 10g database for historical tracking and compliance.   
10. The Administrator confirms the successful publication and visibility of the alerts.   
  
Alternative Flow:   
1. If the system detects missing or inconsistent asset data during alert preparation, it logs the issue and triggers a revalidation process.   
2. If a high-severity asset condition (e.g., bridge collapse) is identified, the system bypasses standard processing to immediately publish and distribute the alert.   
3. If the Traveler Information Systems are temporarily unreachable, the system caches the alerts and retries the transmission when the systems are back online.   
4. If the Oracle 10g database connection fails during archiving, the system uses Dynamic Data Caching to store the alerts locally and retries the operation later.   
5. If an unexpected error occurs during alert publishing, the system halts the process, logs the error, and sends a notification to the Administrator for investigation.  
  
Use Case Name: Support MI Drive Presentation   
Use Case ID: UC-16   
Actors: Administrator, MI Drive System, Data Use Analysis and Processing (DUAP) System, Traffic Data, Weather Data, Road Condition Data, Web-Based User Interfaces   
  
Preconditions:   
- The MI Drive Presentation system is configured and accessible via the Web-Based User Interface.   
- Traffic Data, Weather Data, and Road Condition Data have been processed and validated by the DUAP system.   
- The Oracle 10g database is available for retrieving and storing presentation-related data.   
- The Administrator has the necessary permissions to manage and generate MI Drive presentations.   
- The system has access to Map Displays and Icon Layers for visual representation of data.   
  
Postconditions:   
- MI Drive Presentation is generated and displayed with real-time and historical data integration.   
- The presentation includes Traffic Metrics, Weather Observations, and Road Condition Data for decision support.   
- The Administrator can customize the presentation content and layout.   
- The presentation data is archived in the Oracle 10g database for future reference.   
- The system logs the presentation generation and delivery process for audit and troubleshooting.   
  
Main Flow:   
1. The Administrator selects the "Support MI Drive Presentation" option from the Web-Based User Interface.   
2. The system retrieves the latest Traffic Data, Weather Data, and Road Condition Data from the Oracle 10g database.   
3. The Data Use Analysis and Processing (DUAP) system processes the data to ensure it is current, accurate, and formatted for presentation.   
4. The system compiles the data into a structured MI Drive Presentation format, including maps, icons, and textual summaries.   
5. The Administrator customizes the presentation (e.g., selects specific regions, metrics, or time frames) via the Web-Based User Interface.   
6. The system generates the final MI Drive Presentation and displays it on the Map Displays and Icon Layers.   
7. The presentation is exported or shared with the MI Drive system for real-time or scheduled delivery.   
8. The system archives the presentation data and metadata in the Oracle 10g database for long-term use.   
9. The Administrator reviews the presentation and confirms its readiness for delivery or further analysis.   
10. The system logs the presentation generation and delivery activities for audit purposes.   
  
Alternative Flow:   
1. If the system detects missing or outdated data during presentation preparation, it logs the issue and triggers a revalidation process from the DUAP system.   
2. If the MI Drive system is temporarily unavailable, the system caches the presentation data and retries delivery once the system is back online.   
3. If the database connection fails during archiving, the system uses Dynamic Data Caching to store the presentation data locally and retries the operation later.   
4. If the Web-Based User Interface fails to display the presentation on Map Displays, the system provides a textual summary for the Administrator to review.   
5. If an unexpected error occurs during presentation generation, the system halts the process, logs the error, and sends a notification to the Administrator for investigation.  
  
Use Case Name: Browse Traffic Information   
Use Case ID: UC-17   
Actors: Administrator, Traveler Information Systems, Web-Based User Interfaces, Traffic Management Systems, Map Displays, Icon Layers   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system has processed and analyzed current Traffic Data, including Traffic Metrics, Congestion Levels, Travel Times, Queue Lengths, and Incident Details.   
- The Web-Based User Interfaces are active and accessible for the Administrator to browse traffic information.   
- Map Displays and Icon Layers are configured to visualize traffic conditions and incidents.   
- The Oracle 10g database is available for retrieving historical and real-time traffic data.   
- The system has completed data quality checks and is ready to present validated traffic data.   
  
Postconditions:   
- Traffic Information (e.g., congestion, incidents, travel times) is displayed on the Web-Based User Interface and Map Displays.   
- The Administrator can interactively filter, zoom, and view detailed information about traffic conditions.   
- The system updates traffic information in real-time as new data is received.   
- Traffic data is cached dynamically to support fast and smooth browsing during high load.   
- The system logs the browsing activity and any user interactions for audit and system optimization.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Browse Traffic Information" option.   
2. The system retrieves real-time and historical Traffic Data, including Traffic Metrics, Congestion Levels, Travel Times, Queue Lengths, and Incident Details, from the Oracle 10g database and DUAP system.   
3. The retrieved data is processed and formatted for visualization on Map Displays and Icon Layers.   
4. The system displays the traffic information on the Web-Based User Interface, including interactive maps and real-time updates.   
5. The Administrator can filter data by time, location, or specific metrics (e.g., congestion levels, incident severity).   
6. The system supports zooming and panning on the Map Displays to explore traffic conditions in detail.   
7. Incident Details and Road Surface Conditions are highlighted using Icon Layers for quick identification.   
8. The system dynamically caches frequently accessed data to improve browsing performance.   
9. The Administrator reviews and confirms the accuracy of the displayed traffic information.   
10. The system logs the browsing session and any user actions for audit and future analysis.   
  
Alternative Flow:   
1. If the system detects missing or incomplete data during retrieval, it logs the issue and displays a warning to the Administrator, suggesting a manual revalidation.   
2. If the database connection is temporarily lost during data retrieval, the system uses Dynamic Data Caching to display the most recent available data and retries the connection.   
3. If the Map Displays fail to load due to a system error, the system provides a simplified textual summary of traffic conditions for the Administrator to review.   
4. If the Administrator requests an update while browsing, the system refreshes the data and updates the Map Displays and Icon Layers accordingly.   
5. If an unexpected error occurs during traffic information browsing, the system halts the operation, logs the error, and notifies the Administrator for further investigation.  
  
Use Case Name: Browse Incident Information   
Use Case ID: UC-18   
Actors: Administrator, Traveler Information Systems, Web-Based User Interfaces, Map Displays, Icon Layers   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system has processed and analyzed Incident Data, including details such as location, severity, and cause.   
- The Web-Based User Interfaces are active and accessible for the Administrator to browse incident information.   
- Map Displays and Icon Layers are configured to visualize incident locations and statuses.   
- The Oracle 10g database is available for retrieving incident-related data.   
- The system has completed data quality checks and is ready to present validated incident data.   
  
Postconditions:   
- Incident Information (e.g., location, severity, cause, time) is displayed on the Web-Based User Interface and Map Displays.   
- The Administrator can interactively filter, zoom, and view detailed information about incidents.   
- The system updates incident information in real-time as new data is received.   
- Incident data is cached dynamically to support fast and smooth browsing during high load.   
- The system logs the browsing activity and any user interactions for audit and system optimization.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Browse Incident Information" option.   
2. The system retrieves real-time and historical Incident Data, including Incident Details, Road Surface Conditions, and Weather Observations, from the Oracle 10g database and DUAP system.   
3. The retrieved data is processed and formatted for visualization on Map Displays and Icon Layers.   
4. The system displays the incident information on the Web-Based User Interface, including interactive maps and real-time updates.   
5. The Administrator can filter data by time, location, or incident type (e.g., accident, road closure).   
6. The system supports zooming and panning on the Map Displays to explore incidents in detail.   
7. Incident Details are highlighted using Icon Layers for quick identification and situational awareness.   
8. The system dynamically caches frequently accessed incident data to improve browsing performance.   
9. The Administrator reviews and confirms the accuracy of the displayed incident information.   
10. The system logs the browsing session and any user actions for audit and future analysis.   
  
Alternative Flow:   
1. If the system detects missing or incomplete incident data during retrieval, it logs the issue and displays a warning to the Administrator, suggesting a manual revalidation.   
2. If the database connection is temporarily lost during data retrieval, the system uses Dynamic Data Caching to display the most recent available incident data and retries the connection.   
3. If the Map Displays fail to load due to a system error, the system provides a simplified textual summary of incident details for the Administrator to review.   
4. If the Administrator requests an update while browsing, the system refreshes the incident data and updates the Map Displays and Icon Layers accordingly.   
5. If an unexpected error occurs during incident information browsing, the system halts the operation, logs the error, and notifies the Administrator for further investigation.  
  
Use Case Name: Browse Traveler Information   
Use Case ID: UC-19   
Actors: Administrator, Traveler Information Systems, Web-Based User Interfaces, Map Displays, Icon Layers   
  
Preconditions:   
- The Traveler Information Systems are active and integrated with the Data Use Analysis and Processing (DUAP) system.   
- Travel Demand Data, Traffic Data, Weather Data, and Road Condition Data are available and have passed Data Quality Checks.   
- The Web-Based User Interfaces are accessible for the Administrator to view and interact with traveler information.   
- Map Displays and Icon Layers are configured to visualize traveler-related data.   
- The Oracle 10g database is available for retrieving real-time and historical traveler information.   
  
Postconditions:   
- Traveler Information (e.g., travel demand, traffic conditions, weather alerts, detour suggestions) is displayed on the Web-Based User Interface and Map Displays.   
- The Administrator can interactively filter, zoom, and view detailed traveler-related data.   
- The system updates traveler information in real-time as new data is received.   
- Traveler data is cached dynamically to support fast and smooth browsing during high load.   
- The system logs the browsing activity and any user interactions for audit and system optimization.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Browse Traveler Information" option.   
2. The system retrieves real-time and historical Traveler Information, including travel demand, traffic conditions, and weather alerts, from the Oracle 10g database and the DUAP system.   
3. The retrieved data is processed and formatted for visualization on Map Displays and Icon Layers.   
4. The system displays the traveler information on the Web-Based User Interface, including interactive maps, traffic flow indicators, and weather-affected routes.   
5. The Administrator can filter data by location, time, or specific traveler metrics (e.g., high travel demand, affected routes).   
6. The system supports zooming and panning on the Map Displays to explore traveler information in detail.   
7. Traveler alerts and detour suggestions are highlighted using Icon Layers for quick identification.   
8. The system dynamically caches frequently accessed traveler data to improve browsing performance.   
9. The Administrator reviews and confirms the accuracy of the displayed traveler information.   
10. The system logs the browsing session and any user actions for audit and future analysis.   
  
Alternative Flow:   
1. If the system detects missing or incomplete traveler data during retrieval, it logs the issue and displays a warning to the Administrator, suggesting a manual revalidation.   
2. If the database connection is temporarily lost during data retrieval, the system uses Dynamic Data Caching to display the most recent available traveler data and retries the connection.   
3. If the Map Displays fail to load due to a system error, the system provides a simplified textual summary of traveler information for the Administrator to review.   
4. If the Administrator requests an update while browsing, the system refreshes the traveler information and updates the Map Displays and Icon Layers accordingly.   
5. If an unexpected error occurs during traveler information browsing, the system halts the operation, logs the error, and notifies the Administrator for further investigation.  
  
Use Case Name: Browse Asset Condition Information   
Use Case ID: UC-20   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Web-Based User Interfaces, Map Displays, Icon Layers   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system has processed and analyzed Asset Condition Data, including infrastructure status, maintenance needs, and sensor health.   
- The Web-Based User Interfaces are active and accessible for the Administrator to browse asset conditions.   
- Map Displays and Icon Layers are configured to visualize asset locations and statuses.   
- The Oracle 10g database is available for retrieving real-time and historical asset condition data.   
- The system has completed data quality checks and is ready to present validated asset information.   
  
Postconditions:   
- Asset Condition Information (e.g., infrastructure status, sensor health, maintenance alerts) is displayed on the Web-Based User Interface and Map Displays.   
- The Administrator can interactively filter, zoom, and view detailed information about asset conditions.   
- The system updates asset condition data in real-time as new data is received.   
- Asset data is cached dynamically to support fast and smooth browsing during high load.   
- The system logs the browsing activity and any user interactions for audit and system optimization.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Browse Asset Condition Information" option.   
2. The system retrieves real-time and historical Asset Condition Data, including infrastructure status, sensor health, and maintenance alerts, from the Oracle 10g database and the DUAP system.   
3. The retrieved data is processed and formatted for visualization on Map Displays and Icon Layers.   
4. The system displays the asset condition information on the Web-Based User Interface, including interactive maps showing asset locations and statuses.   
5. The Administrator can filter data by location, asset type, or specific conditions (e.g., critical alerts, maintenance needs).   
6. The system supports zooming and panning on the Map Displays to explore asset conditions in detail.   
7. Asset alerts and status changes are highlighted using Icon Layers for quick identification.   
8. The system dynamically caches frequently accessed asset data to improve browsing performance.   
9. The Administrator reviews and confirms the accuracy of the displayed asset condition information.   
10. The system logs the browsing session and any user actions for audit and future analysis.   
  
Alternative Flow:   
1. If the system detects missing or incomplete asset condition data during retrieval, it logs the issue and displays a warning to the Administrator, suggesting a manual revalidation.   
2. If the database connection is temporarily lost during data retrieval, the system uses Dynamic Data Caching to display the most recent available asset data and retries the connection.   
3. If the Map Displays fail to load due to a system error, the system provides a simplified textual summary of asset conditions for the Administrator to review.   
4. If the Administrator requests an update while browsing, the system refreshes the asset condition data and updates the Map Displays and Icon Layers accordingly.   
5. If an unexpected error occurs during asset condition information browsing, the system halts the operation, logs the error, and notifies the Administrator for further investigation.  
  
Use Case Name: Browse Weather Information   
Use Case ID: UC-21   
Actors: Administrator, Weather Stations, Traffic Management Systems, Traveler Information Systems, Web-Based User Interfaces, Map Displays, Icon Layers   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system has processed and analyzed real-time Weather Data, including temperature, precipitation, and visibility.   
- The Web-Based User Interfaces are active and accessible for the Administrator to browse weather-related information.   
- Map Displays and Icon Layers are configured to visualize weather-affected road segments and conditions.   
- The Oracle 10g database is available for retrieving historical and current weather data.   
- The system has completed data quality checks and is ready to present validated weather data.   
  
Postconditions:   
- Weather Information (e.g., temperature, precipitation, visibility, and weather-related road conditions) is displayed on the Web-Based User Interface and Map Displays.   
- The Administrator can interactively filter, zoom, and view detailed weather-related data.   
- The system updates weather information in real-time as new data is received.   
- Weather data is cached dynamically to support fast and smooth browsing during high load.   
- The system logs the browsing activity and any user interactions for audit and system optimization.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Browse Weather Information" option.   
2. The system retrieves real-time and historical Weather Data, including temperature, precipitation, visibility, and weather-related road conditions, from the Oracle 10g database and the DUAP system.   
3. The retrieved data is processed and formatted for visualization on Map Displays and Icon Layers.   
4. The system displays the weather information on the Web-Based User Interface, including interactive maps highlighting weather-affected areas.   
5. The Administrator can filter data by location, time, or specific weather metrics (e.g., temperature, precipitation intensity).   
6. The system supports zooming and panning on the Map Displays to explore weather conditions in detail.   
7. Weather alerts and road impact indicators are highlighted using Icon Layers for situational awareness.   
8. The system dynamically caches frequently accessed weather data to improve browsing performance.   
9. The Administrator reviews and confirms the accuracy of the displayed weather information.   
10. The system logs the browsing session and any user actions for audit and future analysis.   
  
Alternative Flow:   
1. If the system detects missing or incomplete weather data during retrieval, it logs the issue and displays a warning to the Administrator, suggesting a manual revalidation.   
2. If the database connection is temporarily lost during data retrieval, the system uses Dynamic Data Caching to display the most recent available weather data and retries the connection.   
3. If the Map Displays fail to load due to a system error, the system provides a simplified textual summary of weather conditions for the Administrator to review.   
4. If the Administrator requests an update while browsing, the system refreshes the weather information and updates the Map Displays and Icon Layers accordingly.   
5. If an unexpected error occurs during weather information browsing, the system halts the operation, logs the error, and notifies the Administrator for further investigation.  
  
Use Case Name: Display Map Views   
Use Case ID: UC-22   
Actors: Administrator, Web-Based User Interfaces, Map Displays, Icon Layers, Traffic Management Systems, Traveler Information Systems   
  
Preconditions:   
- The Web-Based User Interface is active and accessible to the Administrator.   
- Map Displays and Icon Layers are configured and integrated with real-time data sources.   
- Traffic Data, Weather Data, Road Condition Data, and Incident Data are available and have passed Data Quality Checks.   
- The Data Use Analysis and Processing (DUAP) system is operational and has processed the latest data for visualization.   
- The Oracle 10g database is available for retrieving historical and current data.   
  
Postconditions:   
- Map Views are displayed on the Web-Based User Interface, including real-time and historical traffic, weather, and road conditions.   
- Icon Layers reflect current statuses of incidents, asset conditions, and weather alerts.   
- The Administrator can interact with the map for detailed analysis and decision-making.   
- The system logs the map display session for audit and performance tracking.   
- The map is updated dynamically as new data is received from the DUAP system.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Display Map Views" option.   
2. The system retrieves real-time and historical data from the Oracle 10g database, including Traffic Metrics, Road Conditions, Weather Observations, and Incident Details.   
3. The Data Use Analysis and Processing (DUAP) system processes the data and formats it for map visualization.   
4. The system loads the base map and overlays relevant Icon Layers (e.g., incident markers, traffic flow indicators).   
5. The system updates the Map Displays with the latest traffic, weather, and road condition information.   
6. The Administrator can interact with the map, including zooming, panning, and selecting specific data layers for visibility.   
7. The system dynamically refreshes the map as new data streams in from Probe Vehicles, Weather Stations, and Road Sensors.   
8. The Administrator reviews the map for situational awareness and traffic management planning.   
9. The system archives the session details in the Oracle 10g database for future reference.   
10. The system logs the map display activity for audit and performance analysis.   
  
Alternative Flow:   
1. If the system detects missing or outdated data during map preparation, it logs the issue and displays a warning to the Administrator, suggesting a manual revalidation.   
2. If the database connection is temporarily lost during data retrieval, the system uses Dynamic Data Caching to display the most recent available map data and retries the connection.   
3. If the Map Displays fail to load due to a system error, the system provides a simplified textual summary of key data for the Administrator to review.   
4. If the Administrator selects a specific data layer (e.g., incidents or weather), the system highlights the relevant Icon Layers and filters the view accordingly.   
5. If an unexpected error occurs during map rendering, the system halts the display, logs the error, and notifies the Administrator for investigation.  
  
Use Case Name: Manage Icon Layers   
Use Case ID: UC-23   
Actors: Administrator, Web-Based User Interfaces, Map Displays, Traffic Management Systems, Traveler Information Systems   
Preconditions:   
- The Web-Based User Interface is active and accessible to the Administrator.   
- Map Displays are properly configured with the ability to overlay and manage Icon Layers.   
- Traffic Data, Weather Data, Incident Data, and Asset Condition Data are available and processed.   
- The Data Use Analysis and Processing (DUAP) system is operational and has updated relevant data for visualization.   
- The Oracle 10g database is available for retrieving and storing layer configuration data.   
  
Postconditions:   
- Icon Layers (e.g., traffic flow, incidents, weather alerts, asset conditions) are configured, displayed, or updated on the Map Displays.   
- The Administrator can customize the visibility, priority, and styling of each Icon Layer.   
- The system logs all layer management actions for audit and performance tracking.   
- The Web-Based User Interface reflects the current configuration of Icon Layers.   
- The system ensures data consistency and real-time synchronization of Icon Layers with the latest data sources.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and navigates to the "Manage Icon Layers" section.   
2. The system retrieves the current configuration of Icon Layers from the Oracle 10g database.   
3. The Administrator selects or creates a new Icon Layer (e.g., traffic congestion, incident markers, weather alerts).   
4. The system loads the selected Icon Layer onto the Map Displays, using real-time data from the DUAP system.   
5. The Administrator adjusts layer settings, such as visibility, color coding, and data filtering criteria.   
6. The system applies the updated settings to the Map Displays and Icon Layers.   
7. The system validates the updated layer configuration and ensures compatibility with existing data sources.   
8. The modified Icon Layer configuration is saved in the Oracle 10g database for future reference.   
9. The system logs the Administrator's actions and updates to the Icon Layers.   
10. The Administrator confirms the successful update of Icon Layers and reviews the map for visual consistency.   
  
Alternative Flow:   
1. If the system detects an invalid Icon Layer configuration (e.g., incorrect data mapping), it logs the issue and displays an error message to the Administrator.   
2. If the database is unavailable during configuration saving, the system caches the layer settings and retries the storage operation when the connection is restored.   
3. If the Map Displays fail to render the updated Icon Layer due to a system error, the system provides a simplified textual summary of the layer's content for the Administrator to review.   
4. If the Administrator cancels the configuration before saving, the system reverts to the previous Icon Layer settings and logs the cancellation.   
5. If an unexpected error occurs during layer management, the system halts the operation, logs the error, and notifies the Administrator for investigation.  
  
Use Case Name: Enable De-Cluttering Capabilities   
Use Case ID: UC-24   
Actors: Administrator, Web-Based User Interfaces, Map Displays, Icon Layers, Traffic Management Systems, Traveler Information Systems   
  
Preconditions:   
- The Web-Based User Interface is active and accessible to the Administrator.   
- Map Displays and Icon Layers are configured and integrated with real-time data sources.   
- Traffic Data, Weather Data, Incident Data, and Asset Condition Data are available and have passed initial Data Quality Checks.   
- The Data Use Analysis and Processing (DUAP) system is operational and has processed the latest data for visualization.   
- The Oracle 10g database is available for retrieving and storing map display configurations.   
  
Postconditions:   
- Map Displays are de-cluttered to improve readability and situational awareness.   
- The Administrator can control the visibility and density of Icon Layers based on user preferences or system conditions.   
- The system dynamically adjusts the display of data layers to avoid visual overload.   
- De-cluttering settings are saved in the Oracle 10g database for future use.   
- The system logs the de-cluttering process for audit and performance tracking.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Enable De-Cluttering" option.   
2. The system retrieves the current configuration of Map Displays and Icon Layers from the Oracle 10g database.   
3. The Administrator sets de-cluttering parameters, such as zoom level thresholds, icon density limits, or layer prioritization rules.   
4. The system evaluates the current state of the Map Displays, including the number and distribution of icons.   
5. The system applies the de-cluttering logic to reduce visual clutter by hiding or aggregating icons in congested areas.   
6. The updated Map Displays are rendered with reduced icon density and improved clarity.   
7. The Administrator can toggle de-cluttering on or off to compare visualizations.   
8. The de-cluttering settings are saved in the Oracle 10g database for future sessions.   
9. The system logs the de-cluttering operation and configuration changes.   
10. The Administrator confirms the effectiveness of the de-cluttered view and adjusts as needed.   
  
Alternative Flow:   
1. If the system detects that the de-cluttering logic conflicts with critical data visibility (e.g., hiding an incident marker), it displays a warning and allows the Administrator to override the setting.   
2. If the database is unavailable during configuration saving, the system caches the de-cluttering settings and retries the operation when the connection is restored.   
3. If the Map Displays fail to render the de-cluttered view due to a system error, the system provides a simplified textual summary of the data for the Administrator to review.   
4. If the Administrator cancels the de-cluttering configuration, the system reverts to the previous settings and logs the cancellation.   
5. If an unexpected error occurs during the de-cluttering process, the system halts the operation, logs the error, and notifies the Administrator for investigation.  
  
Use Case Name: Add New Data Sources   
Use Case ID: UC-25   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Traffic Management Systems, Probe Vehicles, Weather Stations, Road Sensors   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system is operational and accessible for data source integration.   
- The Administrator has the necessary permissions to configure and add new data sources.   
- The system is connected to the Oracle 10g database for logging and storing new data source configurations.   
- The Web-Based User Interface is active and supports data source configuration.   
- The system has a predefined set of Data Standards (SAE J2354, TMDD) to validate new data formats.   
  
Postconditions:   
- New Data Sources (e.g., Probe Vehicles, Weather Stations, Road Sensors) are successfully integrated into the system.   
- The system validates the data format and quality of the new sources against predefined Data Standards.   
- The Administrator is notified of the successful integration or any configuration issues.   
- The new data source configurations are stored in the Oracle 10g database for future reference.   
- The system logs the integration process and any validation results for audit and troubleshooting.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Add New Data Source" option.   
2. The system prompts the Administrator to provide details about the new data source, such as type, location, and data format.   
3. The Administrator inputs the data source information and selects the appropriate Data Standards (e.g., SAE J2354, TMDD) for validation.   
4. The system connects to the new data source and begins receiving sample data for initial validation.   
5. Data Quality Checks are performed to ensure the new data source meets system requirements for accuracy and consistency.   
6. The system maps the incoming data to relevant data entities (e.g., Traffic Data, Weather Data, Road Condition Data).   
7. The system updates the DUAP configuration to include the new data source in the data processing pipeline.   
8. The system stores the new data source configuration in the Oracle 10g database for long-term reference.   
9. The Administrator confirms the successful addition of the data source and reviews validation results.   
10. The system logs the integration process and configuration details for audit and performance tracking.   
  
Alternative Flow:   
1. If the data source fails initial validation due to format incompatibility, the system logs the issue and prompts the Administrator to adjust the configuration or correct the data source.   
2. If the data stream from the new source is inconsistent or incomplete, the system triggers a revalidation process and provides a summary of the discrepancies to the Administrator.   
3. If the Oracle 10g database is unavailable during configuration storage, the system caches the new data source settings and retries the operation when the connection is restored.   
4. If the Web-Based User Interface fails to display the new data source status, the system provides a textual summary for the Administrator.   
5. If an unexpected error occurs during integration, the system halts the process, logs the error, and notifies the Administrator for resolution.  
  
Use Case Name: Update Algorithms   
Use Case ID: UC-26   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Traffic Management Systems, Traveler Information Systems, Oracle 10g Database   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system is active and configured to support algorithm updates.   
- The Administrator has the necessary permissions to modify and deploy new algorithms.   
- The Web-Based User Interface is accessible for algorithm configuration and deployment.   
- The Oracle 10g database is available for storing updated algorithm metadata and logs.   
- The system has access to historical and real-time data for testing updated algorithms.   
  
Postconditions:   
- Updated algorithms are deployed and active in the DUAP system for data processing and analysis.   
- The system logs the algorithm update process and any associated errors.   
- The Administrator is notified of the success or failure of the update.   
- Algorithm metadata is stored in the Oracle 10g database for traceability.   
- The system continues to process data using the updated algorithms.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Update Algorithms" option.   
2. The system retrieves the current algorithm configuration and available algorithm versions from the Oracle 10g database.   
3. The Administrator selects the new algorithm version or uploads a custom algorithm for deployment.   
4. The system validates the new algorithm against predefined Data Standards (SAE J2354, TMDD) and compatibility requirements.   
5. The system deploys the updated algorithm to the DUAP system for execution.   
6. The system performs a dry run using sample data to verify the algorithm's functionality.   
7. If the dry run is successful, the system activates the updated algorithm in the processing pipeline.   
8. The system updates the algorithm metadata in the Oracle 10g database.   
9. The Administrator receives a confirmation of the successful algorithm update.   
10. The system logs the update process and metadata for audit and future reference.   
  
Alternative Flow:   
1. If the new algorithm fails validation due to format or compatibility issues, the system logs the error and prompts the Administrator to correct or replace the algorithm.   
2. If the dry run detects errors in the algorithm's output, the system halts deployment and allows the Administrator to review and fix the algorithm.   
3. If the Oracle 10g database is unavailable during metadata storage, the system caches the update information and retries the operation when the connection is restored.   
4. If the Web-Based User Interface fails to display the update status, the system provides a textual summary for the Administrator.   
5. If an unexpected error occurs during the update process, the system halts the operation, logs the error, and sends a notification to the Administrator for investigation.  
  
Use Case Name: Modify Output Formats   
Use Case ID: UC-27  
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Web-Based User Interfaces, Traveler Information Systems, Traffic Management Systems   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system is active and has completed data processing and analysis.   
- The Administrator has access to the Web-Based User Interface and the ability to modify output formats.   
- Traffic Data, Weather Data, Road Condition Data, and Incident Data are available for formatting.   
- The Oracle 10g database is accessible for storing and retrieving format configurations.   
- The system supports multiple output formats for data dissemination.   
  
Postconditions:   
- Output formats for data dissemination are customized and applied.   
- Traveler Information Systems and Web-Based User Interfaces display data in the updated format.   
- The modified format settings are saved in the Oracle 10g database.   
- The system logs the format modification process for audit and troubleshooting.   
- Traffic Management Systems receive data in the updated format for integration and control.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Modify Output Formats" option.   
2. The system retrieves the current output format settings from the Oracle 10g database.   
3. The Administrator selects or defines new output formats (e.g., JSON, XML, CSV) for specific data types (e.g., traffic metrics, incident details).   
4. The system validates the new format against supported standards and system capabilities.   
5. The system updates the DUAP system configuration to use the new output format for subsequent data processing.   
6. The system applies the new format to data being displayed on Web-Based User Interfaces and Map Displays.   
7. The system sends test output to Traveler Information Systems and Traffic Management Systems to confirm compatibility.   
8. The Administrator confirms the successful application of the new format and reviews the updated data views.   
9. The modified format settings are stored in the Oracle 10g database for future use.   
10. The system logs the format change and associated test results for audit purposes.   
  
Alternative Flow:   
1. If the selected output format is not supported by the system, an error is logged, and the Administrator is prompted to choose a valid format.   
2. If the test output fails due to format incompatibility, the system halts the change and notifies the Administrator for review and correction.   
3. If the Oracle 10g database is unavailable during configuration storage, the system caches the format settings and retries the operation when the connection is restored.   
4. If the Web-Based User Interface fails to display the updated format, the system provides a textual summary of the changes for the Administrator to review.   
5. If an unexpected error occurs during the format modification process, the system halts the operation, logs the error, and sends a notification to the Administrator for investigation.  
  
Use Case Name: Adjust Presentation Methods   
Use Case ID: UC-28   
Actors: Administrator, Web-Based User Interfaces, Map Displays, Icon Layers, Traveler Information Systems, Traffic Management Systems   
  
Preconditions:   
- The Web-Based User Interface is active and accessible to the Administrator.   
- Map Displays and Icon Layers are configured and integrated with real-time data sources.   
- Traffic Data, Weather Data, Incident Data, and Asset Condition Data are available and have passed initial Data Quality Checks.   
- The Data Use Analysis and Processing (DUAP) system is operational and has updated the latest data for visualization.   
- The Oracle 10g database is available for storing and retrieving presentation configuration data.   
  
Postconditions:   
- Presentation Methods (e.g., map views, icon layers, data visualization styles) are customized and applied.   
- The Administrator can modify the display settings to improve clarity and user experience.   
- Map Displays and Icon Layers reflect the updated presentation methods in real-time.   
- The system logs the configuration changes for audit and performance tracking.   
- Presentation settings are stored in the Oracle 10g database for future use.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Adjust Presentation Methods" option.   
2. The system retrieves the current presentation settings (e.g., icon styles, map themes, layer visibility) from the Oracle 10g database.   
3. The Administrator modifies the presentation settings, such as changing the map theme, adjusting icon size, or reordering data layers.   
4. The system applies the updated settings to the Map Displays and Icon Layers in real-time.   
5. The Administrator previews the changes to ensure the new presentation method is effective.   
6. The system validates the updated settings for compatibility with the current data visualization pipeline.   
7. The modified presentation settings are saved in the Oracle 10g database.   
8. The system logs the Administrator's actions and the new presentation configuration.   
9. The Administrator confirms the changes and reviews the updated visualizations.   
10. The system continues to render the adjusted presentation methods for subsequent data updates and user sessions.   
  
Alternative Flow:   
1. If the system detects an invalid or unsupported presentation setting (e.g., incorrect map theme), it logs the issue and displays an error message to the Administrator.   
2. If the database is unavailable during configuration saving, the system caches the updated presentation settings and retries the operation when the connection is restored.   
3. If the Map Displays fail to render the new presentation method due to a system error, the system provides a simplified textual summary for the Administrator to review.   
4. If the Administrator cancels the adjustment before saving, the system reverts to the previous settings and logs the cancellation.   
5. If an unexpected error occurs during the adjustment process, the system halts the operation, logs the error, and notifies the Administrator for investigation.  
  
Use Case Name: Comply with MDIT Standards   
Use Case ID: UC-29   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Traffic Management Systems, Traveler Information Systems, Weather Stations   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system is active and configured to comply with MDIT (Mobility Data Interoperability and Integration Task Force) standards.   
- Traffic Data, Weather Data, Road Condition Data, and Incident Data are available and have passed initial Data Quality Checks.   
- The Web-Based User Interfaces, Map Displays, and Icon Layers are accessible for monitoring compliance status.   
- The Oracle 10g database is available for storing and retrieving data in MDIT-compliant formats.   
- The system has access to MDIT standards documentation and validation tools.   
  
Postconditions:   
- All processed data is formatted and structured in accordance with MDIT standards.   
- Compliance checks are completed, and any issues are logged and addressed.   
- The system is ready to share or export data with external systems using MDIT-compliant formats.   
- The Administrator can verify compliance via the Web-Based User Interface.   
- Compliance-related metadata and logs are stored in the Oracle 10g database for audit and troubleshooting.   
  
Main Flow:   
1. The Administrator selects the "Comply with MDIT Standards" option from the Web-Based User Interface.   
2. The system retrieves the latest data entities (Traffic Metrics, Weather Observations, Road Conditions, Incident Details) from the DUAP system.   
3. The DUAP system applies MDIT formatting and structural rules to the data to ensure interoperability with external systems.   
4. The system validates the formatted data against MDIT standards using automated tools.   
5. If validation is successful, the system updates the data format in the Oracle 10g database.   
6. The system generates a compliance report for the Administrator to review.   
7. The Administrator confirms the compliance status and approves the data for external use.   
8. The system logs the compliance validation and configuration changes.   
9. The system prepares the data for export or integration with external systems using MDIT-compliant formats.   
10. The Web-Based User Interface updates to reflect the current compliance status of the system.   
  
Alternative Flow:   
1. If the system detects non-compliance with MDIT standards during validation, it logs the issue and prompts the Administrator to correct the data format.   
2. If required data fields for MDIT compliance are missing or inconsistent, the system triggers a revalidation process and alerts the Administrator.   
3. If the Oracle 10g database is unavailable during data storage, the system caches the compliance data and retries the operation when the connection is restored.   
4. If the Web-Based User Interface fails to display compliance status, the system provides a textual summary of the compliance check results.   
5. If an unexpected error occurs during the compliance process, the system halts the operation, logs the error, and notifies the Administrator for investigation.  
  
Use Case Name: Utilize Java Software Foundation   
Use Case ID: UC-30   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Web-Based User Interfaces, Traffic Management Systems, Traveler Information Systems   
  
Preconditions:   
- The Java Software Foundation (JSF) is installed and configured within the system environment.   
- The Web-Based User Interface is active and accessible to the Administrator.   
- The Data Use Analysis and Processing (DUAP) system is operational and integrated with the JSF-based application.   
- The Oracle 10g database is available for data storage and retrieval.   
- The system has access to real-time data sources, including Traffic Data, Weather Data, Road Condition Data, and Incident Data.   
  
Postconditions:   
- The system leverages JSF to provide a responsive and interactive Web-Based User Interface.   
- The Administrator can manage system functions through the enhanced UI.   
- Traffic, weather, and road condition data are displayed using dynamic components supported by JSF.   
- The system logs all user interactions and UI-related activities for audit and troubleshooting.   
- The system maintains compatibility and performance using JSF-based components.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and interacts with the system using JSF components.   
2. The system initializes the JSF framework to render dynamic UI elements such as data tables, input forms, and map views.   
3. The system loads real-time data (e.g., Traffic Metrics, Incident Details, Weather Observations) into the UI components using DUAP system outputs.   
4. The Administrator uses the UI to perform system actions (e.g., data analysis, alert publishing, map viewing).   
5. The system processes user input and updates the relevant data visualizations or configurations.   
6. Changes are synchronized with the Oracle 10g database to maintain persistent configurations and logs.   
7. The system updates the Web-Based User Interface to reflect the latest system state and data changes.   
8. The system logs the interaction and any configuration changes made by the Administrator.   
9. The Administrator confirms the updated UI and system behavior.   
10. The system continues to support dynamic interactions using JSF components for real-time monitoring and control.   
  
Alternative Flow:   
1. If the JSF framework fails to load, the system displays a fallback UI with basic functionality and logs the issue for resolution.   
2. If the database connection is unavailable during UI synchronization, the system caches the changes and retries the operation when the connection is restored.   
3. If the system detects an error in rendering a JSF component, it halts the UI update and displays an error message to the Administrator.   
4. If the Administrator cancels an action during UI interaction, the system reverts to the previous state and logs the cancellation.   
5. If an unexpected error occurs in the JSF-based application, the system halts the operation, logs the error, and notifies the Administrator for investigation.  
  
Use Case Name: Connect via JDBC   
Use Case ID: UC-31   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Oracle 10g Database, Web-Based User Interfaces   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system is active and ready to connect to the Oracle 10g database.   
- The JDBC driver for Oracle 10g is installed and properly configured in the system.   
- The Oracle 10g database is accessible and contains the required data entities (e.g., Traffic Data, Weather Data, Incident Data).   
- The Administrator has the necessary credentials and permissions to establish the JDBC connection.   
- The Web-Based User Interface is available for the Administrator to initiate and monitor the connection process.   
  
Postconditions:   
- A secure JDBC connection is established between the DUAP system and the Oracle 10g database.   
- The system is capable of retrieving and storing data through the JDBC interface.   
- Connection status and logs are updated in the Web-Based User Interface for monitoring.   
- Any connection-related issues are logged and reported to the Administrator.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Connect via JDBC" option.   
2. The system prompts the Administrator to input the JDBC connection details, including database URL, username, and password.   
3. The Administrator enters the required information and confirms the connection request.   
4. The system attempts to establish a JDBC connection to the Oracle 10g database using the provided credentials.   
5. If the connection is successful, the system verifies the availability of required data tables and logs the connection status.   
6. The system displays a success message on the Web-Based User Interface.   
7. The DUAP system can now use the JDBC connection to query or store data as needed.   
8. The system logs the connection details and timestamps for audit purposes.   
  
Alternative Flow:   
1. If the JDBC connection fails due to invalid credentials, the system logs the failure and prompts the Administrator to re-enter the correct details.   
2. If the Oracle 10g database is unreachable, the system logs the network issue and displays a warning to the Administrator.   
3. If the JDBC driver is missing or misconfigured, the system logs the error and suggests corrective actions, such as driver installation or configuration review.   
4. If the system detects a successful connection but no data is available, it logs the issue and prompts the Administrator to verify database content.   
5. If an unexpected error occurs during the connection process, the system halts the operation, logs the error, and notifies the Administrator for investigation.  
  
Use Case Name: Use Oracle 10G Database   
Use Case ID: UC-32   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Traffic Management Systems, Weather Stations, Traveler Information Systems   
Preconditions:   
- The Oracle 10g database is installed, configured, and accessible.   
- The Data Use Analysis and Processing (DUAP) system is active and integrated with the database via JDBC.   
- Traffic Data, Weather Data, Road Condition Data, Incident Data, and Travel Demand Data are available for storage or retrieval.   
- The Web-Based User Interfaces are active and configured to interact with the database.   
- The system has valid credentials for database access.   
  
Postconditions:   
- Data is successfully stored in or retrieved from the Oracle 10g database.   
- The system maintains data integrity and consistency during database transactions.   
- The Administrator is notified of the success or failure of the database operation.   
- The system logs all database interactions for audit and troubleshooting.   
- The data is available for use by other system components such as traffic analysis, alert generation, and visualization.   
  
Main Flow:   
1. The Administrator initiates a database operation (e.g., data retrieval or storage) via the Web-Based User Interface.   
2. The system verifies the database connection status and credentials.   
3. The system prepares the query or data payload using JDBC to communicate with the Oracle 10g database.   
4. The system executes the database operation (e.g., SELECT, INSERT, UPDATE) based on the request.   
5. The Oracle 10g database returns the query results or confirms the successful storage of data.   
6. The system processes the returned data and updates relevant components (e.g., Map Displays, Traveler Information Systems).   
7. The system logs the operation in the audit trail for traceability.   
8. The system confirms the operation to the Administrator through the Web-Based User Interface.   
  
Alternative Flow:   
1. If the database connection fails, the system logs the error and switches to Dynamic Data Caching until the connection is restored.   
2. If the database returns an error (e.g., invalid query, data conflict), the system halts the operation and provides an error message to the Administrator for correction.   
3. If the Administrator inputs incorrect credentials, the system denies access and prompts for valid credentials.   
4. If the database is temporarily unreachable, the system retries the operation after a delay and logs the attempt.   
5. If an unexpected error occurs during the operation, the system halts the process, logs the error, and sends a notification to the Administrator for investigation.  
  
Use Case Name: Execute Standard SQL Queries   
Use Case ID: UC-33   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Oracle 10g Database   
Preconditions:   
- The Oracle 10g database is accessible and properly configured for query execution.   
- The Administrator has the necessary permissions to execute SQL queries.   
- The Data Use Analysis and Processing (DUAP) system is active and connected to the database via JDBC.   
- The system has access to relevant data tables (e.g., Traffic Data, Incident Data, Weather Data).   
- The Web-Based User Interface is active and supports SQL query input and result visualization.   
  
Postconditions:   
- The SQL query is executed successfully on the Oracle 10g database.   
- Query results are retrieved and displayed for the Administrator.   
- The system logs the executed SQL query and its results for audit and troubleshooting.   
- If the query modifies data, the changes are reflected in the database and relevant system components.   
- The Administrator can export or further analyze the query results as needed.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and navigates to the SQL query input section.   
2. The Administrator composes or selects a Standard SQL query to be executed on the Oracle 10g database.   
3. The system validates the query syntax and ensures it complies with database security policies.   
4. The system sends the SQL query to the Oracle 10g database via the JDBC connection.   
5. The database processes the query and returns the results to the system.   
6. The system formats and displays the query results on the Web-Based User Interface.   
7. The system updates relevant visual components (e.g., Map Displays, Icon Layers) based on the query results if applicable.   
8. The system logs the executed query and results in the Oracle 10g database for future reference.   
9. The Administrator reviews the query output and confirms its accuracy or initiates further actions (e.g., data export).   
10. The system ensures data consistency and integrity after any data modification queries.   
  
Alternative Flow:   
1. If the SQL query syntax is invalid, the system logs the error and displays a message to the Administrator for correction.   
2. If the query attempts to access unauthorized or restricted data, the system denies the request and logs the unauthorized access attempt.   
3. If the Oracle 10g database is unavailable during query execution, the system caches the query and retries when the connection is restored.   
4. If the query results exceed predefined size limits, the system paginates the output or provides a summary for the Administrator.   
5. If an unexpected error occurs during query execution, the system halts the operation, logs the error, and sends a notification to the Administrator for resolution.  
  
Use Case Name: Apply Michigan Geographic Framework   
Use Case ID: UC-34   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Traffic Data, Weather Data, Road Condition Data, Web-Based User Interfaces, Map Displays, Icon Layers   
  
Preconditions:   
- The Michigan Geographic Framework (MIGF) is installed and properly configured in the system.   
- The Data Use Analysis and Processing (DUAP) system is active and has access to relevant data sources (e.g., Probe Vehicles, Weather Stations, Road Sensors).   
- Traffic Data, Weather Data, and Road Condition Data are available and have passed Data Quality Checks.   
- The Web-Based User Interface and Map Displays are accessible for geographic visualization.   
- The Oracle 10g database is available to store and retrieve geographic data.   
  
Postconditions:   
- The Michigan Geographic Framework is applied to visualize and manage data in a geospatial context.   
- Map Displays are enhanced with geographic alignment and layering.   
- The Administrator can interact with the geographic framework to manage data presentation and analysis.   
- The system logs the use of the geographic framework for audit and troubleshooting.   
- Data alignment with geographic features is stored in the Oracle 10g database for future reference.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Apply Michigan Geographic Framework" option.   
2. The system retrieves the latest Traffic Data, Weather Data, and Road Condition Data from the DUAP system.   
3. The system activates the Michigan Geographic Framework and aligns the data to the geographic coordinates and road networks.   
4. The system overlays the data onto Map Displays using the MIGF to ensure spatial accuracy.   
5. Icon Layers are updated to reflect the geographic positioning of incidents, traffic metrics, and weather impacts.   
6. The Administrator can interact with the map to zoom, pan, or select specific geographic regions for detailed analysis.   
7. The system logs the geographic framework application and any changes to map configurations.   
8. The system stores the geographic alignment metadata in the Oracle 10g database for future use.   
9. The Administrator confirms the successful application of the geographic framework and reviews the visualized data.   
10. The system ensures that all subsequent data updates are aligned with the Michigan Geographic Framework for consistency.   
  
Alternative Flow:   
1. If the geographic framework fails to load due to misconfiguration, the system logs the issue and displays an error message to the Administrator.   
2. If the system detects a mismatch between the geographic data and the Michigan Geographic Framework, it triggers a revalidation process and notifies the Administrator.   
3. If the Oracle 10g database is unavailable during metadata storage, the system caches the geographic alignment data and retries when the connection is restored.   
4. If the Web-Based User Interface fails to render the geographic framework on the Map Displays, the system provides a simplified view of the data for the Administrator to review.   
5. If an unexpected error occurs during geographic framework application, the system halts the process, logs the error, and sends a notification to the Administrator for investigation.  
  
Use Case Name: Manage User Roles   
Use Case ID: UC-35   
Actors: Administrator, Web-Based User Interfaces, Traffic Management Systems, Traveler Information Systems   
  
Preconditions:   
- The Web-Based User Interface is active and accessible to the Administrator.   
- The system is connected to the Oracle 10g database to store and retrieve user role information.   
- The Administrator has the necessary permissions to manage user roles and access system settings.   
- The Data Use Analysis and Processing (DUAP) system is operational and integrated with user access control.   
  
Postconditions:   
- User roles and permissions are updated and stored in the Oracle 10g database.   
- The Web-Based User Interface reflects the current role assignments and permissions.   
- Administrators and other users receive access updates based on role changes.   
- The system logs all role management activities for audit and troubleshooting.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and navigates to the "User Role Management" section.   
2. The system retrieves the current list of users and their assigned roles from the Oracle 10g database.   
3. The Administrator selects a user and modifies their role or permissions (e.g., add/remove access to traffic data or alert systems).   
4. The system validates the requested changes against predefined role policies and permissions.   
5. The updated role information is saved in the Oracle 10g database via JDBC.   
6. The system updates the Web-Based User Interface to reflect the new role assignments.   
7. The system applies the updated permissions to the relevant system components (e.g., Traffic Management Systems, Traveler Information Systems).   
8. The system logs the role modification and timestamps the change for audit purposes.   
9. The Administrator confirms the successful update of user roles and permissions.   
10. The system ensures that only authorized users can perform actions based on their assigned roles.   
  
Alternative Flow:   
1. If the requested role or permission is invalid or conflicts with system policies, the system logs the error and displays a message to the Administrator for correction.   
2. If the Oracle 10g database is unavailable during the update, the system caches the changes and retries when the connection is restored.   
3. If the system detects unauthorized role changes, it denies the request and logs the access attempt for security review.   
4. If the Web-Based User Interface fails to update the role view, the system provides a textual summary of the changes for the Administrator to review.   
5. If an unexpected error occurs during the role management process, the system halts the operation, logs the error, and sends a notification to the Administrator for investigation.  
  
Use Case Name: Maintain System Security   
Use Case ID: UC-36   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Web-Based User Interfaces, Traffic Management Systems, Traveler Information Systems   
  
Preconditions:   
- The system is configured with security policies and access controls.   
- The Administrator has authenticated and authorized access to system security settings.   
- The Web-Based User Interface is active and supports security management functions.   
- The Oracle 10g database is accessible for storing user credentials and access logs.   
- The Data Use Analysis and Processing (DUAP) system is integrated with security monitoring and alerting capabilities.   
  
Postconditions:   
- System access is restricted to authorized users based on defined roles and permissions.   
- Security policies are enforced for all system operations and data access.   
- Unauthorized access attempts are logged and alerts are generated.   
- The Administrator can monitor and manage system security settings.   
- The system logs all security-related actions for audit and compliance.   
  
Main Flow:   
1. The Administrator logs into the Web-Based User Interface and navigates to the "Maintain System Security" section.   
2. The system retrieves current user roles, access logs, and security policies from the Oracle 10g database.   
3. The Administrator reviews the existing security settings and modifies policies (e.g., enabling two-factor authentication, updating access permissions).   
4. The system validates the proposed changes against system compliance and security requirements.   
5. Validated changes are applied and stored in the Oracle 10g database using JDBC.   
6. The system updates access controls and permissions in the Data Use Analysis and Processing (DUAP) system and Web-Based User Interface.   
7. The Administrator confirms the changes and reviews the updated security configuration.   
8. The system logs the security update process and timestamps the changes for audit.   
  
Alternative Flow:   
1. If the proposed security changes conflict with existing policies, the system logs the error and prompts the Administrator for review and correction.   
2. If the Oracle 10g database is unavailable during policy update, the system caches the changes and retries the operation when the connection is restored.   
3. If an unauthorized access attempt is detected, the system triggers an alert to the Administrator and logs the event for investigation.   
4. If the system detects a failed login attempt, it logs the event and may initiate account lockout or alert the Administrator based on configured thresholds.   
5. If an unexpected error occurs during security maintenance, the system halts the process, logs the error, and sends a notification to the Administrator for resolution.  
  
Use Case Name: Monitor System Performance   
Use Case ID: UC-37   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Web-Based User Interfaces, Traffic Management Systems, Oracle 10g Database   
  
Preconditions:   
- The system is operational and all core components (DUAP, Oracle 10g, Web-Based UI) are active.   
- Performance metrics (e.g., CPU usage, memory utilization, data processing delays) are being monitored in real-time.   
- The Administrator has access to the system monitoring interface.   
- The Oracle 10g database is available for storing performance logs.   
  
Postconditions:   
- System performance data is collected and visualized for real-time monitoring.   
- Performance alerts are triggered for abnormal system behavior.   
- Performance logs are stored in the Oracle 10g database for historical analysis.   
- The Administrator is informed of system health and any potential bottlenecks.   
  
Main Flow:   
1. The Administrator navigates to the "Monitor System Performance" section of the Web-Based User Interface.   
2. The system retrieves real-time performance data from the DUAP system and other components (e.g., CPU usage, memory, database response time).   
3. Performance metrics are visualized on the Web-Based User Interface, including graphs and dashboards.   
4. The system compares current metrics to predefined thresholds to detect anomalies.   
5. If anomalies are detected (e.g., high CPU usage, slow database response), alerts are generated and displayed on the interface.   
6. The system logs all performance data and alerts into the Oracle 10g database for long-term reference.   
7. The Administrator reviews the performance dashboard and alerts for system optimization or troubleshooting.   
8. The system updates the performance visualization dynamically as new metrics are collected.   
9. The Administrator can export performance data for further analysis.   
10. The system continues to monitor and update performance status in real-time.   
  
Alternative Flow:   
1. If the system cannot access real-time performance data, it uses cached data to provide a temporary view until the data stream is restored.   
2. If the Oracle 10g database is unavailable for logging, the system caches the performance logs and retries when the connection is re-established.   
3. If the Web-Based User Interface fails to display the performance dashboard, the system provides a simplified textual summary for the Administrator.   
4. If the system detects a critical performance issue (e.g., system crash imminent), it sends an immediate alert to the Administrator and Traffic Management Systems.   
5. If an unexpected system error occurs during monitoring, the system halts the process, logs the error, and notifies the Administrator for investigation.  
  
Use Case Name: Generate Traffic Reports   
Use Case ID: UC-38   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Traffic Management Systems, Traveler Information Systems, Weather Stations   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system is active and has completed traffic data analysis.   
- Traffic Data, Weather Data, Road Condition Data, Incident Data, and Travel Demand Data are available and have passed Data Quality Checks.   
- The Web-Based User Interfaces are accessible for the Administrator to generate and view reports.   
- The Oracle 10g database is available for retrieving data and storing report metadata.   
- The system is configured to generate reports in standardized formats (e.g., PDF, HTML).   
  
Postconditions:   
- Traffic Reports are generated and displayed on the Web-Based User Interface.   
- The reports include Traffic Metrics, Incident Details, Weather Observations, and Road Condition Data.   
- The Administrator can export, view, or share the report with relevant stakeholders.   
- Report metadata is stored in the Oracle 10g database for future reference.   
- The system logs the report generation process for audit and troubleshooting.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Generate Traffic Report" option.   
2. The system retrieves the latest Traffic Data, Weather Data, Road Condition Data, and Incident Data from the Oracle 10g database and the DUAP system.   
3. The DUAP system processes the data and compiles a summary of key metrics such as congestion levels, travel times, and incident counts.   
4. The system formats the report using predefined templates and includes visual elements such as Map Displays and Icon Layers.   
5. The system applies the Michigan Geographic Framework to ensure accurate spatial representation.   
6. The report is displayed on the Web-Based User Interface with options to export or share.   
7. The system archives the report metadata in the Oracle 10g database for historical tracking.   
8. The Administrator confirms the report is complete and accurate.   
9. The system logs the report generation and export actions.   
10. The report is shared with Traffic Management Systems and Traveler Information Systems for distribution.   
  
Alternative Flow:   
1. If the system detects missing or inconsistent data during report compilation, it logs the issue and displays a warning to the Administrator.   
2. If the Oracle 10g database is unavailable during metadata storage, the system caches the report details and retries when the connection is restored.   
3. If the Web-Based User Interface fails to display the report, the system provides a simplified textual version for the Administrator.   
4. If the Administrator cancels the report before finalization, the system discards the draft and logs the cancellation.   
5. If an unexpected error occurs during report generation, the system halts the process, logs the error, and notifies the Administrator for investigation.  
  
Use Case Name: Generate Weather Reports   
Use Case ID: UC-39   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Weather Stations, Traffic Management Systems, Traveler Information Systems   
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system is active and has processed the latest Weather Data and related Road Condition Data.   
- Weather Observations (e.g., temperature, precipitation, visibility) are available from Weather Stations and have passed Data Quality Checks.   
- The Web-Based User Interfaces are accessible for the Administrator to generate and view reports.   
- The Oracle 10g database is available for retrieving data and storing report metadata.   
- The system is configured to generate reports in standardized formats (e.g., PDF, HTML).   
  
Postconditions:   
- Weather Reports are generated and displayed on the Web-Based User Interface.   
- The reports include Weather Observations, Road Surface Conditions, and traffic impact summaries.   
- The Administrator can export, view, or share the report with relevant stakeholders.   
- Report metadata is stored in the Oracle 10g database for future reference.   
- The system logs the report generation process for audit and troubleshooting.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Generate Weather Report" option.   
2. The system retrieves the latest Weather Data and Road Condition Data from the Oracle 10g database and the DUAP system.   
3. The DUAP system processes the data and compiles a summary of weather conditions and their impacts on road and traffic.   
4. The system formats the report using predefined templates and includes visual elements such as Map Displays and Icon Layers.   
5. The system applies the Michigan Geographic Framework to ensure accurate spatial representation of weather-affected areas.   
6. The report is displayed on the Web-Based User Interface with options to export or share.   
7. The system archives the report metadata in the Oracle 10g database for historical tracking.   
8. The Administrator confirms the report is complete and accurate.   
9. The system logs the report generation and export actions.   
10. The report is shared with Traffic Management Systems and Traveler Information Systems for distribution.   
  
Alternative Flow:   
1. If the system detects missing or inconsistent weather data during report compilation, it logs the issue and displays a warning to the Administrator.   
2. If the Oracle 10g database is unavailable during metadata storage, the system caches the report details and retries when the connection is restored.   
3. If the Web-Based User Interface fails to display the report, the system provides a simplified textual version for the Administrator.   
4. If the Administrator cancels the report before finalization, the system discards the draft and logs the cancellation.   
5. If an unexpected error occurs during report generation, the system halts the process, logs the error, and notifies the Administrator for investigation.  
  
Use Case Name: Generate Road Condition Reports   
Use Case ID: UC-40   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Road Sensors, Weather Stations, Traffic Management Systems, Web-Based User Interfaces   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system is active and has completed the analysis of Road Condition Data, Weather Data, and Traffic Data.   
- Road Surface Conditions, Weather Observations, and Incident Details are available and have passed Data Quality Checks.   
- The Web-Based User Interface is accessible for the Administrator to initiate and review reports.   
- The Oracle 10g database is available for retrieving data and storing report metadata.   
- The system is configured to generate reports in standardized formats (e.g., PDF, HTML).   
  
Postconditions:   
- Road Condition Reports are generated and displayed on the Web-Based User Interface.   
- The reports include Road Surface Conditions, Weather Observations, Incident Details, and Traffic Metrics.   
- The Administrator can export, view, or share the report with relevant stakeholders.   
- Report metadata is stored in the Oracle 10g database for future reference.   
- The system logs the report generation process for audit and troubleshooting.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Generate Road Condition Report" option.   
2. The system retrieves the latest Road Condition Data, Weather Data, and Traffic Data from the Oracle 10g database and the DUAP system.   
3. The DUAP system processes the data and compiles a summary of road conditions, including surface states, weather impacts, and incident details.   
4. The system formats the report using predefined templates and includes visual elements such as Map Displays and Icon Layers.   
5. The system applies the Michigan Geographic Framework to ensure accurate spatial representation of road segments.   
6. The report is displayed on the Web-Based User Interface with options to export or share.   
7. The system archives the report metadata in the Oracle 10g database for historical tracking.   
8. The Administrator confirms the report is complete and accurate.   
9. The system logs the report generation and export actions.   
10. The report is shared with Traffic Management Systems and Traveler Information Systems for distribution.   
  
Alternative Flow:   
1. If the system detects missing or inconsistent road condition data during report compilation, it logs the issue and displays a warning to the Administrator.   
2. If the Oracle 10g database is unavailable during metadata storage, the system caches the report details and retries when the connection is restored.   
3. If the Web-Based User Interface fails to display the report, the system provides a simplified textual version for the Administrator.   
4. If the Administrator cancels the report before finalization, the system discards the draft and logs the cancellation.   
5. If an unexpected error occurs during report generation, the system halts the process, logs the error, and sends a notification to the Administrator for investigation.  
  
Use Case Name: Maintain Data Integrity   
Use Case ID: UC-41   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Traffic Management Systems, Weather Stations, Probe Vehicles, Oracle 10g Database   
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system is active and integrated with data sources such as Probe Vehicles, Traffic Management Systems, and Weather Stations.   
- Traffic Data, Weather Data, Road Condition Data, Incident Data, and Travel Demand Data are being collected and processed.   
- The Oracle 10g database is available for data storage and retrieval.   
- The Web-Based User Interface is accessible for the Administrator to monitor and manage data integrity.   
- The system is configured with Data Standards (SAE J2354, TMDD) and Data Quality Check protocols.   
  
Postconditions:   
- Data integrity is ensured through validation, consistency checks, and error logging.   
- Invalid or inconsistent data is flagged and logged for revalidation.   
- Valid data is passed to subsequent processing stages for analysis and visualization.   
- The Administrator is notified of data integrity status and any critical issues.   
- The system logs all data integrity checks and results for audit and troubleshooting.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Maintain Data Integrity" option.   
2. The system retrieves incoming data from Probe Vehicles, Traffic Management Systems, and Weather Stations.   
3. The Data Use Analysis and Processing (DUAP) system performs Data Quality Checks to verify accuracy, consistency, and completeness.   
4. The system cross-references the data with historical records and predefined Data Standards (SAE J2354, TMDD).   
5. If data is valid, it is passed to the appropriate processing modules for further use.   
6. If data is invalid or inconsistent, the system logs the issue and triggers a revalidation process.   
7. The system updates the Web-Based User Interface with data integrity status and highlights flagged data.   
8. The Administrator reviews flagged data and initiates manual corrections if needed.   
9. The system stores validated data in the Oracle 10g database for long-term use.   
10. The system logs all integrity checks and actions taken for audit and performance tracking.   
  
Alternative Flow:   
1. If the system detects a high volume of invalid data, it generates an alert for the Administrator to investigate and resolve.   
2. If the Oracle 10g database is temporarily unavailable during storage, the system caches the valid data and retries when the connection is restored.   
3. If the Data Quality Check module encounters an error, the system halts the integrity check, logs the error, and notifies the Administrator.   
4. If the Web-Based User Interface fails to display integrity check results, the system provides a textual summary for the Administrator to review.   
5. If the system identifies a critical data integrity issue that impacts real-time operations, it triggers an emergency alert to Traffic Management Systems and Traveler Information Systems for immediate action.  
  
Use Case Name: Track Data Source Status   
Use Case ID: UC-42  
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Probe Vehicles, Weather Stations, Traffic Management Systems, Road Sensors   
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system is active and connected to all relevant data sources.   
- Probe Vehicles, Weather Stations, Road Sensors, and Traffic Management Systems are transmitting data.   
- The Web-Based User Interface is accessible for the Administrator to monitor data source statuses.   
- The Oracle 10g database is available to log and store data source status information.   
- The system is configured to perform real-time status tracking and alerting.   
  
Postconditions:   
- The status of each data source is monitored and logged for availability and performance.   
- The Administrator is alerted of any data source outages or anomalies.   
- Data source status information is displayed on the Web-Based User Interface.   
- Status logs are archived in the Oracle 10g database for audit and historical reference.   
- The system ensures continuous monitoring and updates the status in real-time.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Track Data Source Status" option.   
2. The system retrieves the current status of all data sources (e.g., Probe Vehicles, Weather Stations, Road Sensors) from the DUAP system.   
3. The DUAP system evaluates the health and connectivity of each data source, including data transmission frequency and quality.   
4. The system updates the Web-Based User Interface with a real-time dashboard showing the status of each data source (e.g., active, offline, degraded).   
5. If a data source is found to be offline or degraded, the system generates an alert for the Administrator.   
6. The system logs the status of each data source in the Oracle 10g database for historical tracking.   
7. The Administrator reviews the status dashboard and investigates any flagged issues.   
8. The system continues to monitor and update the status dashboard as data source conditions change.   
9. The Administrator can manually mark a data source as offline or reconnected if needed.   
10. The system archives all status tracking and alerting actions for audit and troubleshooting.   
  
Alternative Flow:   
1. If the system detects a data source has not transmitted data for a predefined threshold, it triggers an alert and logs the event for further investigation.   
2. If the Oracle 10g database is unavailable during logging, the system caches the status data and retries the storage operation when the connection is restored.   
3. If the Web-Based User Interface fails to load the status dashboard, the system provides a textual summary of the current data source statuses.   
4. If the DUAP system fails to evaluate a data source due to an internal error, the system halts the check, logs the error, and notifies the Administrator.   
5. If the Administrator manually overrides a data source status, the system updates the dashboard and logs the override action for audit purposes.  
  
Use Case Name: Update Incident Details   
Use Case ID: UC-43  
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Traffic Management Systems, Incident Data, Weather Stations, Road Sensors   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system is active and integrated with real-time data sources.   
- Incident Data is available and has been identified for modification.   
- The Web-Based User Interface is accessible for the Administrator to view and edit incident details.   
- The Oracle 10g database is available for storing updated Incident Data.   
- The system has completed initial Data Quality Checks to ensure data integrity.   
  
Postconditions:   
- Incident Details (e.g., location, severity, cause, time) are updated in the system.   
- The updated incident data is stored in the Oracle 10g database for long-term reference.   
- The Web-Based User Interface and Map Displays are updated to reflect the latest incident information.   
- The system logs the update process for audit and troubleshooting.   
- Traffic Management Systems and Traveler Information Systems are notified of updated incident details.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects an existing incident from the incident list.   
2. The system retrieves the incident details from the Oracle 10g database and displays them for editing.   
3. The Administrator modifies the incident details (e.g., updates severity, adds notes, or changes incident status).   
4. The system validates the updated data against predefined formats and Data Standards (SAE J2354, TMDD).   
5. The updated Incident Data is sent to the Data Use Analysis and Processing (DUAP) system for reintegration with traffic and weather data.   
6. The system updates the incident visualization on Map Displays and Icon Layers.   
7. The updated Incident Data is stored in the Oracle 10g database using JDBC.   
8. The system sends the updated incident details to Traffic Management Systems and Traveler Information Systems for real-time dissemination.   
9. The Administrator confirms the successful update and reviews the incident on the map.   
10. The system logs the incident update and related system actions for audit purposes.   
  
Alternative Flow:   
1. If the system detects invalid or incomplete data during validation, it logs the issue and prompts the Administrator to correct the input.   
2. If the Oracle 10g database is unavailable during storage, the system caches the updated incident data and retries the operation when the connection is restored.   
3. If the Web-Based User Interface fails to display updated incident data, the system provides a textual summary for the Administrator to review.   
4. If the Administrator cancels the update before finalization, the system reverts to the previous incident data and logs the cancellation.   
5. If an unexpected error occurs during the update process, the system halts the operation, logs the error, and sends a notification to the Administrator for investigation.  
  
Use Case Name: Delete Outdated Data   
Use Case ID: UC-44  
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Oracle 10g Database, Web-Based User Interfaces, Map Displays   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system is active and has access to historical and real-time data entities.   
- The Oracle 10g database is accessible and contains archived data for deletion.   
- The Administrator has the necessary permissions to manage data retention and deletion policies.   
- The Web-Based User Interface is operational and supports data deletion functionality.   
- The system has a predefined data retention policy to determine which data is considered outdated.   
  
Postconditions:   
- Outdated Data is deleted from the Oracle 10g database based on the defined retention policy.   
- The system maintains data consistency and integrity after deletion.   
- The Administrator is notified of the deletion status and any errors encountered.   
- Map Displays and Icon Layers are updated to reflect the current data state.   
- The system logs all data deletion activities for audit and troubleshooting.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Delete Outdated Data" option.   
2. The system retrieves the data retention policy and identifies data entities (e.g., Traffic Metrics, Incident Details, Weather Observations) that are candidates for deletion.   
3. The system queries the Oracle 10g database to locate and verify the outdated data.   
4. The Administrator confirms the list of data to be deleted and initiates the deletion process.   
5. The system executes the deletion operation using JDBC to remove outdated records from the database.   
6. The system updates the Map Displays and Icon Layers to reflect the removal of outdated data.   
7. The system logs the deletion operation and timestamps the action for audit purposes.   
8. The Administrator receives a confirmation message of the successful deletion.   
9. The system ensures that only outdated data is removed and that active data remains intact.   
10. The system archives the deletion logs and makes them available for review.   
  
Alternative Flow:   
1. If the system detects that the outdated data is still referenced by active components (e.g., open reports, ongoing analysis), it logs the issue and prompts the Administrator to resolve conflicts before deletion.   
2. If the Oracle 10g database is unavailable during deletion, the system caches the deletion request and retries when the connection is restored.   
3. If the data retention policy is misconfigured or missing, the system logs the issue and displays a warning to the Administrator for correction.   
4. If the Web-Based User Interface fails to display the deletion confirmation, the system provides a textual summary for the Administrator to review.   
5. If an unexpected error occurs during the deletion process, the system halts the operation, logs the error, and notifies the Administrator for investigation.  
  
Use Case Name: Modify Traveler Information   
Use Case ID: UC-45  
Actors: Administrator, Traveler Information Systems, Data Use Analysis and Processing (DUAP) System, Probe Vehicles, Weather Stations   
  
Preconditions:   
- The Traveler Information Systems are active and integrated with the DUAP system.   
- Real-time data from Probe Vehicles, Weather Stations, and Road Sensors is available and has passed Data Quality Checks.   
- The Web-Based User Interface is accessible for the Administrator to modify traveler-related information.   
- The Oracle 10g database is available for storing updated information.   
- The system has applied Data Standards (SAE J2354, TMDD) for data formatting and integration.   
  
Postconditions:   
- Traveler Information (e.g., alerts, detour suggestions, travel advisories) is updated and disseminated through Traveler Information Systems.   
- The updated information is stored in the Oracle 10g database for long-term reference.   
- The Web-Based User Interface and Map Displays reflect the updated traveler information.   
- The system logs all modifications for audit and troubleshooting purposes.   
- The Administrator is notified of the success or failure of the modification process.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Modify Traveler Information" option.   
2. The system retrieves the current traveler information, including alerts, detours, and advisories, from the Oracle 10g database and Traveler Information Systems.   
3. The Administrator edits the traveler information, such as updating alert messages, modifying detour routes, or adjusting advisory content.   
4. The system validates the modified information against predefined templates and Data Standards (SAE J2354, TMDD).   
5. The system updates the Traveler Information Systems with the revised content for public dissemination.   
6. The system updates Map Displays and Icon Layers to reflect the changes in traveler advisories or alerts.   
7. The modified information is stored in the Oracle 10g database using JDBC.   
8. The system logs the modification process, including the Administrator's actions and timestamps.   
9. The Administrator confirms the successful update and reviews the modified traveler information.   
10. The system ensures that the updated information is synchronized across all connected systems for consistency.   
  
Alternative Flow:   
1. If the system detects invalid or inconsistent traveler information during validation, it logs the issue and prompts the Administrator to correct the input.   
2. If the Traveler Information Systems are unavailable during update, the system caches the changes and retries the transmission when the systems are back online.   
3. If the Oracle 10g database is temporarily unreachable during storage, the system caches the modified information and retries the operation when the connection is restored.   
4. If the Web-Based User Interface fails to display the modified traveler information, the system provides a textual summary for the Administrator to review.   
5. If an unexpected error occurs during the modification process, the system halts the operation, logs the error, and notifies the Administrator for investigation.  
  
Use Case Name: Manage System Configuration   
Use Case ID: UC-46   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Traffic Management Systems, Web-Based User Interfaces, Oracle 10g Database   
  
Preconditions:   
- The system is operational and the Administrator has the necessary permissions to access configuration settings.   
- The Data Use Analysis and Processing (DUAP) system is active and integrated with the configuration module.   
- The Web-Based User Interface is accessible for the Administrator to modify and view system settings.   
- The Oracle 10g database is available for storing and retrieving configuration parameters.   
- The system has access to existing configuration data and is capable of applying changes to relevant modules.   
  
Postconditions:   
- System configuration settings (e.g., data thresholds, alert rules, caching policies) are updated and stored in the Oracle 10g database.   
- The DUAP system and other modules are updated to reflect the new configuration.   
- The Web-Based User Interface displays the current configuration for verification.   
- The system logs all configuration changes for audit and troubleshooting.   
- The Administrator is notified of the success or failure of the configuration update.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and navigates to the "System Configuration" section.   
2. The system retrieves the current configuration from the Oracle 10g database and displays it for review.   
3. The Administrator modifies one or more configuration parameters (e.g., alert thresholds, data sampling intervals, caching policies).   
4. The system validates the changes to ensure they conform to predefined rules and system constraints.   
5. Validated configuration changes are applied to the DUAP system and other relevant modules (e.g., Traffic Metrics, Incident Detection).   
6. The system updates the configuration records in the Oracle 10g database using JDBC.   
7. The system logs the configuration update, including the user and timestamp.   
8. The Web-Based User Interface refreshes to show the updated configuration.   
9. The Administrator confirms the changes and verifies the system behavior.   
10. The system continues to operate with the new configuration settings.   
  
Alternative Flow:   
1. If the system detects invalid configuration values, it logs the issue and prompts the Administrator to correct the input.   
2. If the Oracle 10g database is unavailable during configuration storage, the system caches the changes and retries the operation when the connection is restored.   
3. If the configuration update causes a system module to fail, the system reverts the change and logs the failure for review.   
4. If the Web-Based User Interface fails to load the configuration view, the system provides a textual summary of the current configuration.   
5. If an unexpected error occurs during configuration processing, the system halts the operation, logs the error, and notifies the Administrator for investigation.  
  
Use Case Name: Retrieve Historical Traffic Data   
Use Case ID: UC-47   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Traffic Management Systems, Web-Based User Interfaces, Oracle 10g Database   
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system is active and has completed the archiving of processed traffic data.   
- Historical Traffic Data, including Traffic Metrics, Congestion Levels, Travel Times, Queue Lengths, and Incident Details, is stored in the Oracle 10g database.   
- The Web-Based User Interface is accessible for the Administrator to request and view historical data.   
- The system has completed data quality checks and formatting for historical records.   
  
Postconditions:   
- Historical Traffic Data is retrieved and displayed on the Web-Based User Interface.   
- The Administrator can filter, sort, and export the data for further analysis.   
- The system logs the data retrieval activity for audit and performance tracking.   
- The retrieved data is synchronized with Map Displays and Icon Layers for contextual visualization.   
- The system ensures data consistency and availability after retrieval.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Retrieve Historical Traffic Data" option.   
2. The system prompts the Administrator to specify the date range, location, and data type (e.g., congestion levels, travel times).   
3. The system queries the Oracle 10g database for the requested historical data using JDBC.   
4. The Data Use Analysis and Processing (DUAP) system formats the retrieved data for visualization and analysis.   
5. The system displays the historical data on the Web-Based User Interface in a tabular or graphical format.   
6. The system overlays the historical data on Map Displays and Icon Layers for spatial context.   
7. The Administrator can export the data in a supported format (e.g., CSV, PDF) for external use.   
8. The system logs the retrieval request and display activity for audit purposes.   
9. The Administrator confirms the accuracy of the retrieved historical data.   
10. The system updates the interface to reflect the latest query results and settings.   
  
Alternative Flow:   
1. If the specified date range or location is invalid, the system logs the issue and displays an error message to the Administrator for correction.   
2. If the Oracle 10g database is unavailable during retrieval, the system caches the query and retries when the connection is restored.   
3. If the system detects missing or incomplete data in the database, it logs the issue and provides a warning to the Administrator.   
4. If the Web-Based User Interface fails to load the historical data, the system provides a textual summary for the Administrator to review.   
5. If an unexpected error occurs during data retrieval, the system halts the operation, logs the error, and notifies the Administrator for investigation.  
  
Use Case Name: Retrieve Historical Weather Data   
Use Case ID: UC-48  
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Weather Stations, Traffic Management Systems, Web-Based User Interfaces, Map Displays   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system is active and has completed archiving of weather-related data.   
- Historical Weather Data, including temperature, precipitation, visibility, and weather-related road conditions, is stored in the Oracle 10g database.   
- The Web-Based User Interface is accessible for the Administrator to request and view historical weather data.   
- The system has completed data quality checks and formatting for historical records.   
- The system supports integration with Map Displays for spatial visualization of historical weather patterns.   
  
Postconditions:   
- Historical Weather Data is retrieved and displayed on the Web-Based User Interface in a tabular or graphical format.   
- The Administrator can filter, sort, and export the data for analysis or reporting.   
- The system logs the retrieval activity for audit and performance tracking.   
- The retrieved weather data is synchronized with Map Displays and Icon Layers for contextual visualization.   
- The system ensures data consistency and availability after retrieval.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Retrieve Historical Weather Data" option.   
2. The system prompts the Administrator to specify the date range, location, and weather data type (e.g., temperature, precipitation, visibility).   
3. The system queries the Oracle 10g database for the requested historical weather data using JDBC.   
4. The Data Use Analysis and Processing (DUAP) system formats the retrieved data for visualization and analysis.   
5. The system displays the historical weather data on the Web-Based User Interface in a tabular or graphical format.   
6. The system overlays the historical weather data on Map Displays and Icon Layers for spatial context.   
7. The Administrator can export the data in a supported format (e.g., CSV, PDF) for external use.   
8. The system logs the retrieval request and display activity for audit purposes.   
9. The Administrator confirms the accuracy of the retrieved historical weather data.   
10. The system updates the interface to reflect the latest query results and settings.   
  
Alternative Flow:   
1. If the specified date range or location is invalid, the system logs the issue and displays an error message to the Administrator for correction.   
2. If the Oracle 10g database is unavailable during retrieval, the system caches the query and retries when the connection is restored.   
3. If the system detects missing or incomplete weather data in the database, it logs the issue and provides a warning to the Administrator.   
4. If the Web-Based User Interface fails to load the historical weather data, the system provides a textual summary for the Administrator to review.   
5. If an unexpected error occurs during data retrieval, the system halts the operation, logs the error, and notifies the Administrator for investigation.  
  
Use Case Name: Retrieve Historical Road Condition Data   
Use Case ID: UC-49   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Road Sensors, Weather Stations, Web-Based User Interfaces, Map Displays   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system is active and has completed archiving of road condition data.   
- Historical Road Condition Data, including Road Surface Conditions, Weather Observations, and Incident Details, is stored in the Oracle 10g database.   
- The Web-Based User Interface is accessible for the Administrator to request and view historical road condition data.   
- The system has completed data quality checks and formatting for historical records.   
- The system supports integration with Map Displays for spatial visualization of historical road conditions.   
  
Postconditions:   
- Historical Road Condition Data is retrieved and displayed on the Web-Based User Interface in a tabular or graphical format.   
- The Administrator can filter, sort, and export the data for analysis or reporting.   
- The system logs the retrieval activity for audit and performance tracking.   
- The retrieved road condition data is synchronized with Map Displays and Icon Layers for contextual visualization.   
- The system ensures data consistency and availability after retrieval.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Retrieve Historical Road Condition Data" option.   
2. The system prompts the Administrator to specify the date range, location, and data type (e.g., road surface conditions, weather impact).   
3. The system queries the Oracle 10g database for the requested historical road condition data using JDBC.   
4. The Data Use Analysis and Processing (DUAP) system formats the retrieved data for visualization and analysis.   
5. The system displays the historical road condition data on the Web-Based User Interface in a tabular or graphical format.   
6. The system overlays the historical road condition data on Map Displays and Icon Layers for spatial context.   
7. The Administrator can export the data in a supported format (e.g., CSV, PDF) for external use.   
8. The system logs the retrieval request and display activity for audit purposes.   
9. The Administrator confirms the accuracy of the retrieved historical road condition data.   
10. The system updates the interface to reflect the latest query results and settings.   
  
Alternative Flow:   
1. If the specified date range or location is invalid, the system logs the issue and displays an error message to the Administrator for correction.   
2. If the Oracle 10g database is unavailable during retrieval, the system caches the query and retries when the connection is restored.   
3. If the system detects missing or incomplete road condition data in the database, it logs the issue and provides a warning to the Administrator.   
4. If the Web-Based User Interface fails to load the historical road condition data, the system provides a textual summary for the Administrator to review.   
5. If an unexpected error occurs during data retrieval, the system halts the operation, logs the error, and notifies the Administrator for investigation.  
  
Use Case Name: Manage DataRecord   
Use Case ID: UC-50   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Web-Based User Interfaces, Oracle 10g Database, Traffic Management Systems, Traveler Information Systems   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system is active and has processed and stored relevant DataRecords in the Oracle 10g database.   
- The Web-Based User Interface is accessible for the Administrator to perform DataRecord management operations.   
- The Oracle 10g database is available for retrieving, updating, or deleting DataRecords.   
- The system has completed Data Quality Checks to ensure the integrity of stored DataRecords.   
- The Administrator has the necessary permissions to manage DataRecords, including viewing, editing, and archiving.   
  
Postconditions:   
- DataRecords (e.g., traffic data records, weather records, incident records) are managed based on the Administrator’s actions (view, edit, delete, or archive).   
- The Web-Based User Interface and Map Displays are updated to reflect changes in DataRecords.   
- Modified or archived DataRecords are stored in the Oracle 10g database.   
- The system logs all DataRecord management activities for audit and troubleshooting.   
- The Administrator is notified of the success or failure of the management operation.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Manage DataRecord" option.   
2. The system retrieves the list of available DataRecords from the Oracle 10g database, including records related to Traffic Data, Weather Data, Road Condition Data, and Incident Data.   
3. The Administrator selects a specific DataRecord to view, edit, delete, or archive.   
4. If editing, the Administrator modifies the DataRecord’s attributes (e.g., timestamps, values, status) and saves the changes.   
5. If deleting, the system prompts the Administrator to confirm the deletion and then removes the specified DataRecord from the database.   
6. If archiving, the system moves the DataRecord to a long-term archive within the Oracle 10g database and updates its status.   
7. The system updates the Web-Based User Interface to reflect the current state of DataRecords.   
8. The system synchronizes changes to Map Displays and Icon Layers to ensure visual consistency with the updated DataRecords.   
9. The system logs the DataRecord management action in the Oracle 10g database for audit purposes.   
10. The Administrator confirms the operation and reviews the updated DataRecord status.   
  
Alternative Flow:   
1. If the selected DataRecord is invalid or cannot be retrieved, the system logs the issue and displays an error message to the Administrator.   
2. If the Oracle 10g database is unavailable during a management operation, the system caches the request and retries when the connection is restored.   
3. If the system detects a conflict during an edit (e.g., duplicate DataRecord, invalid field values), it halts the operation and prompts the Administrator for correction.   
4. If the Web-Based User Interface fails to reflect changes in DataRecords, the system provides a textual summary of the modification for the Administrator to review.   
5. If an unexpected error occurs during DataRecord management, the system halts the operation, logs the error, and sends a notification to the Administrator for investigation.  
  
Use Case Name: Manage System Logs   
Use Case ID: UC-51   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Web-Based User Interfaces, Oracle 10g Database   
  
Preconditions:   
- The system is operational and has generated and stored various logs (e.g., data quality logs, alert logs, configuration logs, performance logs).   
- The Oracle 10g database is accessible and contains the system logs in structured tables.   
- The Administrator has the necessary permissions to access and manage system logs.   
- The Web-Based User Interface is active and supports log browsing, filtering, and management functions.   
- The system has completed initial logging configuration and is set to record system events.   
  
Postconditions:   
- System Logs are retrieved, filtered, reviewed, and managed based on the Administrator's actions.   
- The Administrator can view, search, and export logs for auditing, troubleshooting, or analysis.   
- The system ensures the security and integrity of log data during retrieval and modification.   
- Log management actions are recorded in the system audit trail.   
- The system provides visibility into critical system events and operational history.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Manage System Logs" option.   
2. The system retrieves the available system logs from the Oracle 10g database, including logs for data processing, alert generation, configuration changes, and performance monitoring.   
3. The system displays the logs in a structured format, allowing the Administrator to filter by log type, timestamp, severity, or associated system components.   
4. The Administrator can search for specific log entries using keywords, date ranges, or system modules.   
5. The system provides options to view detailed log information, including error messages, system actions, and timestamps.   
6. The Administrator can export selected logs in standard formats (e.g., CSV, PDF) for external review or reporting.   
7. The system updates the Web-Based User Interface to reflect the selected log entries and any applied filters.   
8. The Administrator can archive or delete outdated or sensitive logs as needed.   
9. The system logs the Administrator's management actions (e.g., log deletion, export) for audit purposes.   
10. The Administrator confirms the successful management of system logs and reviews the updated log interface.   
  
Alternative Flow:   
1. If the Oracle 10g database is unavailable during log retrieval, the system caches the request and retries the operation when the connection is restored.   
2. If the system detects unauthorized access attempts to the log data, it logs the event and sends an alert to the Administrator.   
3. If the Administrator attempts to delete a log that is referenced by an active report or analysis, the system displays a warning and prompts for confirmation.   
4. If the Web-Based User Interface fails to display the logs, the system provides a textual summary of the log content for the Administrator to review.   
5. If an unexpected error occurs during log management, the system halts the operation, logs the error, and notifies the Administrator for investigation.  
  
Use Case Name: Manage UserSession   
Use Case ID: UC-52   
Actors: Administrator, Web-Based User Interfaces, Authentication Module, Oracle 10g Database   
  
Preconditions:   
- The Web-Based User Interface is active and accessible to the Administrator.   
- The Authentication Module is operational and integrated with the system to manage user sessions.   
- The Oracle 10g database is available for storing and retrieving session-related information (e.g., login times, session status, user activity logs).   
- The system has a defined session management policy (e.g., session timeout, session tracking).   
- The Administrator has the necessary permissions to manage user sessions and view session logs.   
  
Postconditions:   
- UserSession information (e.g., login status, session duration, user activity) is managed and updated in the system.   
- The Web-Based User Interface displays the current status of active and inactive sessions.   
- The system logs all session-related actions (e.g., login, logout, session expiration) for audit and troubleshooting.   
- Unauthorized or expired sessions are invalidated and removed from the system.   
- The Administrator is notified of session management results and any security-related events.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Manage UserSession" option.   
2. The system retrieves the current list of active and inactive UserSessions from the Oracle 10g database.   
3. The system displays the session information on the interface, including user identifiers, login times, session duration, and activity status.   
4. The Administrator can perform actions such as terminating a session, extending a session, or reviewing session logs.   
5. If the Administrator selects to terminate a session, the system invalidates the session token and updates the session status in the database.   
6. If the Administrator selects to extend a session, the system updates the session expiration time and logs the action.   
7. The system provides a summary of session activity for the selected time frame and user criteria.   
8. The system archives all session management actions in the Oracle 10g database for future reference.   
9. The system updates the session tracking interface in real-time to reflect the latest session status.   
10. The Administrator confirms the session management actions and reviews the updated session status.   
  
Alternative Flow:   
1. If the Oracle 10g database is unavailable during session retrieval, the system caches the request and retries the operation when the connection is restored.   
2. If the system detects an unauthorized session management request (e.g., attempting to terminate another Administrator's session), it logs the event and denies the action.   
3. If a session timeout occurs automatically due to inactivity, the system updates the session status and logs the event without Administrator intervention.   
4. If the Web-Based User Interface fails to display session information, the system provides a textual summary of active and inactive sessions.   
5. If an unexpected error occurs during session management, the system halts the operation, logs the error, and sends a notification to the Administrator for investigation.  
  
Use Case Name: Manage AlertConfiguration   
Use Case ID: UC-53   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Traffic Management Systems, Traveler Information Systems, Oracle 10g Database   
  
Preconditions:   
- The Data Use Analysis and Processing (DUAP) system is active and configured to generate and manage alerts.   
- The Oracle 10g database is accessible and contains existing AlertConfiguration records for reference and modification.   
- The Administrator has the necessary permissions to configure, modify, and monitor alert rules and thresholds.   
- The Web-Based User Interface is active and supports the configuration of alert rules and parameters.   
- The system has access to real-time data sources (e.g., Traffic Metrics, Incident Details, Weather Observations) to apply and test alert configurations.   
  
Postconditions:   
- AlertConfiguration settings (e.g., alert thresholds, frequency, destinations, severity levels) are successfully created, modified, or deleted.   
- The DUAP system applies the updated configurations to alert generation logic.   
- Traffic Management Systems and Traveler Information Systems receive alerts based on the updated configurations.   
- The system logs all AlertConfiguration changes for audit and troubleshooting purposes.   
- The Web-Based User Interface reflects the current state of alert configurations for transparency and review.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Manage AlertConfiguration" option.   
2. The system retrieves the current AlertConfiguration records from the Oracle 10g database and displays them for review.   
3. The Administrator creates, modifies, or deletes an alert configuration, including defining thresholds (e.g., congestion level > 80%), alert severity (e.g., high, medium, low), and target systems (e.g., Traveler Information Systems, Traffic Management Systems).   
4. The system validates the configuration against predefined rules and data constraints (e.g., valid severity levels, acceptable threshold values).   
5. Validated configurations are updated in the DUAP system to affect alert generation logic.   
6. The system applies the updated configurations to incoming data streams to ensure alerts are generated according to the new rules.   
7. The modified AlertConfiguration is stored in the Oracle 10g database using JDBC for persistence.   
8. The system logs the AlertConfiguration changes, including the user who made the changes and the timestamp.   
9. The Administrator reviews the updated configurations and confirms their application through the Web-Based User Interface.   
10. The system ensures that all configured alerts are synchronized with the relevant modules for real-time alerting and reporting.   
  
Alternative Flow:   
1. If the system detects an invalid or conflicting AlertConfiguration (e.g., duplicate rule, invalid threshold), it logs the issue and prompts the Administrator for correction.   
2. If the Oracle 10g database is temporarily unavailable during configuration storage, the system caches the configuration changes and retries the operation when the connection is restored.   
3. If the DUAP system fails to apply a new alert configuration due to an error in the rule logic, the system halts the update and provides a detailed error message for the Administrator to resolve.   
4. If the Web-Based User Interface fails to display the updated AlertConfiguration, the system provides a textual summary of the current configuration for the Administrator to review.   
5. If an unexpected error occurs during AlertConfiguration management, the system halts the operation, logs the error, and sends a notification to the Administrator for investigation.  
  
Use Case Name: Manage CacheEntry   
Use Case ID: UC-54   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Web-Based User Interfaces, Dynamic Data Caching Module, Oracle 10g Database   
  
Preconditions:   
- The Dynamic Data Caching module is active and configured to handle real-time and historical data caching.   
- The Data Use Analysis and Processing (DUAP) system is operational and integrated with the caching module.   
- The Oracle 10g database is available for storing and retrieving cache metadata or archived data.   
- The Web-Based User Interface is accessible for the Administrator to view and manage CacheEntries.   
- The system maintains a record of cached data entities (e.g., Traffic Metrics, Incident Details, Weather Observations).   
  
Postconditions:   
- CacheEntry (e.g., cached data, expiration time, data priority) is managed according to the Administrator's instructions.   
- The Web-Based User Interface reflects the current state of CacheEntries for monitoring and control.   
- CacheEntries are either retained, expired, or manually deleted based on system policies or user actions.   
- The system logs all CacheEntry management actions for audit and troubleshooting.   
- Cache data is synchronized with the Oracle 10g database when the connection is available.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Manage CacheEntry" option.   
2. The system retrieves the list of current CacheEntries from the Dynamic Data Caching module and displays them for review.   
3. The Administrator can perform actions such as viewing CacheEntry details (e.g., data type, timestamp, size), modifying expiration policies, or manually deleting specific CacheEntries.   
4. The system validates the requested action to ensure it complies with caching policies and system constraints.   
5. If the Administrator modifies a CacheEntry's expiration time or priority, the system updates the metadata in the Dynamic Data Caching module.   
6. If the Administrator manually deletes a CacheEntry, the system removes the entry from the cache and logs the action.   
7. The system updates the Web-Based User Interface to reflect the current CacheEntry status after modifications.   
8. The system archives any deleted or expired CacheEntries in the Oracle 10g database for audit and reference.   
9. The system logs the CacheEntry management process, including timestamps and user actions.   
10. The Administrator confirms the CacheEntry modifications or deletions and reviews the updated cache status.   
  
Alternative Flow:   
1. If the system detects an invalid CacheEntry modification (e.g., setting an incorrect expiration time), it logs the issue and displays an error message to the Administrator for correction.   
2. If the Dynamic Data Caching module is temporarily unavailable, the system caches the CacheEntry management request and retries the operation when the module is restored.   
3. If the Oracle 10g database is unreachable during archiving of deleted or expired CacheEntries, the system caches the metadata and retries the operation when the connection is restored.   
4. If the Web-Based User Interface fails to display the CacheEntry status, the system provides a textual summary of the current cache entries for the Administrator to review.   
5. If an unexpected error occurs during CacheEntry management, the system halts the operation, logs the error, and notifies the Administrator for investigation.  
  
Use Case Name: Manage ArchiveEntry   
Use Case ID: UC-55   
Actors: Administrator, Data Use Analysis and Processing (DUAP) System, Oracle 10g Database, Web-Based User Interfaces, Long-Term Archiving Module   
  
Preconditions:   
- The Long-Term Archiving module is active and configured to store and manage historical data.   
- The Data Use Analysis and Processing (DUAP) system is operational and has processed and archived data in the Oracle 10g database.   
- The Oracle 10g database is accessible and contains ArchiveEntry records for management.   
- The Web-Based User Interface is active and supports ArchiveEntry browsing, modification, and deletion.   
- The Administrator has the necessary permissions to access and manage ArchiveEntry data.   
  
Postconditions:   
- ArchiveEntry data (e.g., archived Traffic Data, Weather Data, Incident Data, or Road Condition Data) is successfully managed based on the Administrator’s actions (view, edit, delete, or restore).   
- The Web-Based User Interface and associated modules reflect the updated ArchiveEntry status.   
- Modified or deleted ArchiveEntry records are logged for audit and troubleshooting.   
- The system ensures data integrity and consistency during ArchiveEntry management operations.   
- The Administrator is notified of the success or failure of the ArchiveEntry management process.   
  
Main Flow:   
1. The Administrator accesses the Web-Based User Interface and selects the "Manage ArchiveEntry" option.   
2. The system retrieves the list of ArchiveEntry records from the Oracle 10g database, including metadata such as data type, timestamp, and storage location.   
3. The Administrator selects a specific ArchiveEntry to view, edit, delete, or restore.   
4. If viewing, the system displays the ArchiveEntry details and allows the Administrator to export or analyze the data.   
5. If editing, the Administrator modifies the ArchiveEntry metadata (e.g., adding tags, changing description) and the system validates the changes.   
6. If deleting, the system prompts the Administrator for confirmation and then removes the ArchiveEntry from the database.   
7. If restoring, the system retrieves the archived data and makes it available for real-time or historical analysis.   
8. The system updates the Web-Based User Interface to reflect the current ArchiveEntry status after modifications.   
9. The system logs all ArchiveEntry management actions (e.g., deletion, restoration) in the Oracle 10g database for audit purposes.   
10. The Administrator confirms the ArchiveEntry management outcome and reviews the updated archive records.   
  
Alternative Flow:   
1. If the system detects an invalid ArchiveEntry request (e.g., non-existent record), it logs the issue and displays an error message to the Administrator for correction.   
2. If the Oracle 10g database is unavailable during ArchiveEntry retrieval or modification, the system caches the request and retries the operation when the connection is restored.   
3. If the Administrator attempts to delete an ArchiveEntry that is referenced by active reports or analyses, the system displays a warning and prompts for confirmation.   
4. If the Web-Based User Interface fails to display ArchiveEntry information, the system provides a textual summary of the archive records for the Administrator to review.   
5. If an unexpected error occurs during ArchiveEntry management, the system halts the operation, logs the error, and sends a notification to the Administrator for investigation.