Software Requirements Specification (SRS)

Traffic & Road Construction Management System

Version: 1.0
Date: November 28, 2025
Prepared for: Road Planning and Traffic Department, Government of India

---

Table of Contents

---

1. Introduction

1.1 Purpose

This Software Requirements Specification (SRS) document provides a comprehensive description of the Traffic & Road Construction Management System. It details the functional and non-functional requirements for developers, project managers, testers, and stakeholders involved in the development and deployment of the system.

1.2 Scope

The Traffic & Road Construction Management System is a web-based platform designed to:

- Enable strategic planning of road construction projects with minimal traffic disruption
- Provide real-time traffic monitoring during construction activities
- Analyze and recommend alternative routes based on multiple parameters
- Facilitate communication between government departments and the public
- Reduce carbon emissions by minimizing traffic delays (aligned with UN SDG 13)
- Optimize resource allocation for road construction projects

Benefits:

- Reduction in economic losses (currently Rs. 1.5 Lakh Crores annually)
- Decreased carbon emissions from idle vehicles
- Improved traffic flow during construction periods
- Enhanced public awareness and route planning
- Data-driven decision making for infrastructure projects

1.3 Definitions, Acronyms, and Abbreviations

- **SRS:** Software Requirements Specification
- **SDG:** Sustainable Development Goals
- **API:** Application Programming Interface
- **UI:** User Interface
- **CRUD:** Create, Read, Update, Delete
- **AI/ML/DL:** Artificial Intelligence/Machine Learning/Deep Learning
- **Officer:** Road Planning Officer
- **Admin:** Main Government Administrator

1.4 References

- IEEE Std 830-1998 - IEEE Recommended Practice for Software Requirements Specifications
- UN Sustainable Development Goal 13: Climate Action
- Mapbox API Documentation
- ASP.NET Framework Documentation
- Python Backend Development Standards

1.5 Overview

The remainder of this document contains detailed descriptions of the system's functionality, constraints, and requirements organized into sections covering overall system description, specific functional requirements, interface requirements, and non-functional requirements.

---

2. Overall Description

2.1 Product Perspective

The Traffic & Road Construction Management System is a standalone web-based application that integrates with:

- Mapbox API for mapping and geospatial services

- Public mapping platforms for route updates
- Government notification systems
- Traffic monitoring infrastructure

System Context:

- Frontend: ASP.NET web interface
- Backend: Python-based server
- Database: MySQL for persistent storage
- Maps: Mapbox API integration
- AI/ML: Optional intelligent recommendation engine

2.2 Product Functions

The system provides the following major functions:

1. **Project Management Dashboard**
   - Display current ongoing construction projects
   - Show project progress and completion metrics
   - Track timeline and resource allocation
2. **Interactive Route Planning**
   - Map-based route selection for construction projects
   - Real-time display of route characteristics
   - Vehicle and traffic analysis
3. **Alternative Route Analysis**
   - Automated identification of alternative routes
   - Comparative analysis of route options
   - AI-powered route recommendations
4. **Traffic Strategy Selection**
   - Single lane usage recommendations
   - Diversion planning
   - Road expansion assessment
5. **Notification System**
   - Government administration alerts
   - Public user notifications

- Real-time traffic updates

6. **Real-time Monitoring**
    - Live traffic tracking
    - Seasonal traffic pattern analysis
    - Automated congestion alerts

2.3 User Classes and Characteristics

2.3.1 Road Planning Officer

- **Technical Expertise:** Moderate to high
- **Responsibilities:** Create and manage construction projects, analyze routes, select alternatives
- **Frequency of Use:** Daily
- **Access Level:** Full project management capabilities

2.3.2 Main Admin (Government)

- **Technical Expertise:** Moderate
- **Responsibilities:** Oversee all projects, receive notifications, approve decisions
- **Frequency of Use:** Regular monitoring
- **Access Level:** System-wide oversight and approval authority

2.3.3 Public Users (Implicit)

- **Technical Expertise:** Low to moderate
- **Responsibilities:** Receive notifications, view construction updates
- **Frequency of Use:** As needed
- **Access Level:** Read-only access to construction notifications and map updates

2.4 Operating Environment

- **Client-side:** Web browsers (Chrome, Firefox, Safari, Edge)
- **Server-side:** Linux/Windows server environment
- **Database:** MySQL 8.0 or higher
- **Network:** Internet connectivity required
- **External APIs:** Mapbox API integration
- **Development Environment:** Visual Studio Code

2.5 Design and Implementation Constraints

- Must use ASP.NET for frontend development
- Python required for backend implementation
- Mapbox API mandatory for mapping services
- MySQL database for data persistence
- Real-time data processing requirements
- Map coordinate precision requirements
- API rate limits and usage quotas
- Data privacy and security regulations

2.6 Assumptions and Dependencies

Assumptions:

- Reliable internet connectivity available
- Mapbox API services remain accessible
- Accurate traffic data available from monitoring systems
- Users have basic computer and web browsing skills
- Geographic data is current and accurate

Dependencies:

- Mapbox API availability and pricing
- Traffic monitoring infrastructure
- Government notification systems
- Public map platform integration capabilities
- Third-party data sources for traffic analysis

---

3. System Features and Requirements

3.1 Project Dashboard

3.1.1 Description

The dashboard provides a comprehensive overview of all ongoing road construction projects with real-time status updates and progress metrics.

3.1.2 Functional Requirements

FR-3.1.1: The system SHALL display a dashboard listing all current ongoing construction projects.

FR-3.1.2: The system SHALL show progress percentage for each project.

FR-3.1.3: The system SHALL display the number of days remaining until project completion.

FR-3.1.4: The system SHALL provide visual indicators (charts/graphs) for project status.

FR-3.1.5: The system SHALL allow filtering and sorting of projects by status, location, and date.

FR-3.1.6: The system SHALL update dashboard metrics in real-time or near real-time.

3.2 Route Selection and Analysis

3.2.1 Description

Officers can select construction routes on an interactive map and receive detailed analysis of the selected route's characteristics.

3.2.2 Functional Requirements

FR-3.2.1: The system SHALL provide an interactive map interface using Mapbox API.

FR-3.2.2: The system SHALL allow officers to select construction routes by clicking coordinates on the map.

FR-3.2.3: Upon route selection, the system SHALL display the following metrics:

- Length of selected route (in kilometers)
- Width of road (in meters)
- Type of road (Highway, City Road, Rural Road, etc.)
- Number of lanes (1, 2, 4, 8, or more)
- Current vehicle count
- Count by vehicle type:
  - Two-wheelers
  - Four-wheelers (cars)
  - Heavy vehicles (Trucks, Buses, Cranes, etc.)
- Current traffic count/density

FR-3.2.4: The system SHALL calculate route length automatically based on selected coordinates.

FR-3.2.5: The system SHALL retrieve road characteristics from map data or database.

FR-3.2.6: The system SHALL validate route selection to ensure it forms a continuous path.

3.3 Alternative Route Identification

3.3.1 Description

The system identifies and analyzes possible alternative routes to divert traffic during construction.

3.3.2 Functional Requirements

FR-3.3.1: The system SHALL provide a button to display possible alternative routes.

FR-3.3.2: The system SHALL identify all viable alternative routes between the start and end points of the construction route.

FR-3.3.3: For each alternative route, the system SHALL display:

- Length of alternative route (in kilometers)
- Width of road (in meters)
- Type of road
- Number of lanes
- Current vehicle count
- Vehicle type distribution
- Traffic count/density

FR-3.3.4: The system SHALL display alternative routes on a new view page with comparative metrics.

FR-3.3.5: The system SHALL provide side-by-side comparison of all alternative routes.

3.4 Route Recommendation Engine

3.4.1 Description

The system uses AI/ML algorithms to recommend the optimal alternative route based on multiple criteria.

3.4.2 Functional Requirements

FR-3.4.1: The system SHALL recommend the best alternative route from all available options.

FR-3.4.2: The recommendation algorithm SHALL consider:

- Shortest route length
- Lower traffic density
- Capacity to accommodate various vehicle types
- Road width and lane availability
- Historical traffic patterns

FR-3.4.3: The system SHALL rank all alternative routes based on suitability scores.

FR-3.4.4: The system SHALL provide justification for the recommended route.

FR-3.4.5: The system MAY use machine learning models for traffic prediction and route optimization.

3.5 Lane-Specific Analysis

3.5.1 Description

For multi-lane roads, the system provides lane-by-lane analysis to determine if single-lane usage is feasible.

3.5.2 Functional Requirements

FR-3.5.1: IF the selected construction route has more than 1 lane, the system SHALL display metrics for each individual lane:

- Lane width (in meters)
- Type of road surface
- Vehicle count per lane
- Vehicle type distribution per lane
- Traffic density per lane

FR-3.5.2: The system SHALL analyze if traffic can be accommodated using remaining lanes during construction.

FR-3.5.3: IF traffic volume is low enough, the system SHALL recommend single-lane usage as an option.

FR-3.5.4: The system SHALL calculate capacity requirements based on current and projected traffic.

3.6 Diversion and Expansion Planning

3.6.1 Description

When alternative routes are not viable, the system analyzes feasibility of creating diversions or road expansions.

3.6.2 Functional Requirements

FR-3.6.1: IF the road is single-lane OR alternative route length exceeds construction route by 3 km or more, the system SHALL analyze diversion/expansion options.

FR-3.6.2: For diversion/expansion planning, the system SHALL display:

- Available width of road
- Type of road surface

- Vehicle type distribution
- Traffic count
- Availability of 10-meter empty unconstructed space adjacent to the selected route

FR-3.6.3: The system SHALL check satellite/map data for available space beside the route.

FR-3.6.4: The system SHALL distinguish between diversion (temporary route) and expansion (widening) options.

FR-3.6.5: The system SHALL assess feasibility based on geographical and infrastructure constraints.

3.7 Traffic Management Strategy Selection

3.7.1 Description

Officers select the final traffic management strategy from recommended options.

3.7.2 Functional Requirements

FR-3.7.1: The system SHALL allow officers to select up to 3 alternative routes OR 1 diversion OR single-lane usage.

FR-3.7.2: The selection SHALL be based on:

- Type of road
- Vehicle type capacity
- Route length
- Traffic accommodation capability
- Congestion risk assessment

FR-3.7.3: The system SHALL validate that selected options are mutually compatible.

FR-3.7.4: The system SHALL save the officer's final selection for project implementation.

3.8 Notification System

3.8.1 Description

The system notifies government administration and public users about construction projects and traffic updates.

3.8.2 Functional Requirements

FR-3.8.1: The system SHALL allow officers to notify government administration about:

- Project details

- Number of construction days
- Selected alternative routes/strategies
- Expected traffic impact

FR-3.8.2: The system SHALL send notifications through the platform's messaging system.

FR-3.8.3: The system SHALL notify public users about:

- Ongoing construction sites
- Alternative route recommendations
- Construction timeline
- Expected delays

FR-3.8.4: The system SHALL update public mapping platforms with construction zone information.

FR-3.8.5: The system SHALL provide notification templates for consistent communication.

FR-3.8.6: The system SHALL maintain a log of all notifications sent.

3.9 Real-time Traffic Monitoring

3.9.1 Description

The system continuously monitors traffic conditions and triggers alerts when congestion thresholds are exceeded.

3.9.2 Functional Requirements

FR-3.9.1: The system SHALL monitor live traffic on construction routes and alternative routes.

FR-3.9.2: The system SHALL track seasonal traffic patterns for better planning.

FR-3.9.3: IF traffic levels exceed a predefined threshold, the system SHALL automatically notify the traffic department.

FR-3.9.4: The system SHALL provide real-time traffic visualization on dashboard.

FR-3.9.5: The system SHALL allow configuration of traffic threshold limits.

FR-3.9.6: The system SHALL generate alerts for prompt action to overcome congestion.

FR-3.9.7: The system SHALL log all traffic events and alerts for historical analysis.

3.10 Project Creation and Management

3.10.1 Description

Officers can create new construction projects with complete details and manage existing projects.

3.10.2 Functional Requirements

FR-3.10.1: The system SHALL allow officers to create new construction projects.

FR-3.10.2: Project creation SHALL include:

- Project name and description
- Construction route selection (via map)
- Estimated duration (number of days)
- Selected traffic management strategy
- Responsible personnel
- Budget and resources (if applicable)

FR-3.10.3: The system SHALL save all project details in the database.

FR-3.10.4: The system SHALL assign a unique project ID to each construction project.

FR-3.10.5: The system SHALL allow officers to edit project details before approval.

FR-3.10.6: The system SHALL require approval from Main Admin for project activation.

3.11 Scenario Differentiation (City vs Highway)

3.11.1 Description

The system handles different requirements and constraints for urban and highway construction scenarios.

3.11.2 Functional Requirements

FR-3.11.1: The system SHALL identify whether the construction route is in a city or on a highway.

FR-3.11.2: The system SHALL apply different analysis parameters based on scenario:

- **City Roads:** Higher traffic density, more alternative routes, shorter diversions
- **Highways:** Higher speeds, fewer alternatives, longer diversions acceptable

FR-3.11.3: The system SHALL adjust recommendation algorithms based on road type.

FR-3.11.4: The system SHALL consider different vehicle type distributions for city vs highway scenarios.

---

4. External Interface Requirements

4.1 User Interfaces

UI-4.1.1: The system SHALL provide a responsive web interface accessible via standard web browsers.

UI-4.1.2: The interface SHALL follow modern UI/UX design principles with intuitive navigation.

UI-4.1.3: The dashboard SHALL display information using charts, graphs, and maps.

UI-4.1.4: The map interface SHALL support zoom, pan, and route selection interactions.

UI-4.1.5: The system SHALL provide clear visual feedback for user actions.

UI-4.1.6: The interface SHALL be accessible on desktop and tablet devices.

UI-4.1.7: Color coding SHALL be used to indicate project status, traffic levels, and alerts.

4.2 Hardware Interfaces

HW-4.2.1: The system SHALL run on standard web servers (minimum 8GB RAM, quad-core processor).

HW-4.2.2: The system SHALL support standard input devices (mouse, keyboard, touchscreen).

HW-4.2.3: Database server SHALL have sufficient storage for map data and project records (minimum 100GB).

4.3 Software Interfaces

SW-4.3.1: The system SHALL integrate with Mapbox API for mapping services.

- API Version: Latest stable version
- Data Format: GeoJSON, Vector Tiles
- Communication: HTTPS REST API

SW-4.3.2: The system SHALL interface with MySQL database.

- Version: MySQL 8.0 or higher
- Communication: JDBC/ODBC connectors

SW-4.3.3: Frontend SHALL be developed using ASP.NET framework.

- Version: ASP.NET Core 6.0 or higher
- Language: C#

SW-4.3.4: Backend SHALL be implemented in Python.

- Version: Python 3.9 or higher
- Framework: Flask/Django/FastAPI

SW-4.3.5: The system SHALL integrate with public mapping platforms (Google Maps, etc.) for public updates.

SW-4.3.6: The system MAY integrate with AI/ML libraries (TensorFlow, scikit-learn) for intelligent recommendations.

4.4 Communication Interfaces

CM-4.4.1: The system SHALL use HTTPS protocol for secure communication.

CM-4.4.2: The system SHALL support RESTful API architecture for frontend-backend communication.

CM-4.4.3: The system SHALL use WebSocket connections for real-time traffic updates.

CM-4.4.4: The system SHALL implement JSON format for data exchange.

CM-4.4.5: Email/SMS gateways SHALL be used for external notifications (optional).

---

5. Non-Functional Requirements

5.1 Performance Requirements

NFR-5.1.1: The system SHALL load the dashboard within 3 seconds under normal network conditions.

NFR-5.1.2: Map rendering SHALL respond to user interactions within 1 second.

NFR-5.1.3: Alternative route calculation SHALL complete within 10 seconds for routes up to 50 km.

NFR-5.1.4: The system SHALL support at least 100 concurrent users without performance degradation.

NFR-5.1.5: Real-time traffic updates SHALL be refreshed every 5 minutes.

NFR-5.1.6: Database queries SHALL execute within 2 seconds for 95% of requests.

5.2 Safety Requirements

NFR-5.2.1: The system SHALL validate all route selections to ensure they are safe and feasible.

NFR-5.2.2: The system SHALL prevent selection of alternative routes that increase accident risk.

NFR-5.2.3: Critical alerts SHALL be highlighted prominently to prevent oversight.

NFR-5.2.4: The system SHALL maintain audit logs of all safety-critical decisions.

5.3 Security Requirements

NFR-5.3.1: The system SHALL implement role-based access control (RBAC).

NFR-5.3.2: All user sessions SHALL be encrypted using TLS 1.3 or higher.

NFR-5.3.3: User authentication SHALL require strong passwords (minimum 8 characters, mixed case, numbers, symbols).

NFR-5.3.4: The system SHALL implement session timeout after 30 minutes of inactivity.

NFR-5.3.5: Sensitive data in the database SHALL be encrypted at rest.

NFR-5.3.6: The system SHALL log all user actions for audit purposes.

NFR-5.3.7: API keys for Mapbox SHALL be stored securely and not exposed in client-side code.

NFR-5.3.8: The system SHALL protect against SQL injection, XSS, and CSRF attacks.

5.4 Software Quality Attributes

5.4.1 Reliability

NFR-5.4.1: The system SHALL have 99.5% uptime availability.

NFR-5.4.2: The system SHALL implement automatic error recovery mechanisms.

NFR-5.4.3: Critical functions SHALL have backup procedures in case of primary system failure.

5.4.2 Maintainability

NFR-5.4.4: Code SHALL follow standard coding conventions and be well-documented.

NFR-5.4.5: The system SHALL use modular architecture for easy updates and maintenance.

NFR-5.4.6: Database schema SHALL be designed for easy scalability.

5.4.3 Usability

NFR-5.4.7: The system SHALL be usable by officers with minimal training (less than 4 hours).

NFR-5.4.8: Error messages SHALL be clear and provide guidance for resolution.

NFR-5.4.9: The interface SHALL be intuitive and require no more than 3 clicks to access major features.

5.4.4 Scalability

NFR-5.4.10: The system SHALL be designed to handle up to 500 concurrent projects.

NFR-5.4.11: The database SHALL scale to store 10 years of historical data.

NFR-5.4.12: The system architecture SHALL support horizontal scaling.

5.4.5 Portability

NFR-5.4.13: The system SHALL be compatible with Windows and Linux server environments.

NFR-5.4.14: The web interface SHALL work on major browsers (Chrome, Firefox, Safari, Edge).

5.4.6 Interoperability

NFR-5.4.15: The system SHALL provide APIs for potential integration with other government systems.

NFR-5.4.16: Data export SHALL be available in standard formats (CSV, JSON, PDF).

---

6. Other Requirements

6.1 Legal and Regulatory Requirements

LR-6.1.1: The system SHALL comply with Government of India data protection regulations.

LR-6.1.2: The system SHALL adhere to accessibility standards (WCAG 2.1 Level AA).

LR-6.1.3: Map data usage SHALL comply with Mapbox terms of service.

LR-6.1.4: The system SHALL maintain data privacy for sensitive government information.

6.2 Environmental Requirements

ENV-6.2.1: The system SHALL track and report carbon emission reductions achieved through optimized traffic management.

ENV-6.2.2: The system SHALL support UN SDG 13 (Climate Action) objectives.

ENV-6.2.3: The system SHALL provide metrics on environmental impact of construction projects.

6.3 Operational Requirements

OP-6.3.1: System administrators SHALL perform daily database backups.

OP-6.3.2: The system SHALL provide administrative tools for user management.

OP-6.3.3: System logs SHALL be retained for at least 1 year.

OP-6.3.4: The system SHALL support scheduled maintenance windows with minimal user impact.

6.4 Documentation Requirements

DOC-6.4.1: User manuals SHALL be provided for Road Planning Officers and Admins.

DOC-6.4.2: Technical documentation SHALL include system architecture, API documentation, and database schema.

DOC-6.4.3: Training materials SHALL be developed for new users.

DOC-6.4.4: Help documentation SHALL be accessible within the application.

---

7. Appendices

7.1 Technology Stack Summary

Component	Technology
Frontend	ASP.NET Core
Backend	Python (Flask/Django/FastAPI)
Database	MySQL 8.0+
Maps API	Mapbox API
IDE	Visual Studio Code

Component	Technology
AI/ML	TensorFlow/scikit-learn (optional)
Version Control	Git
Web Server	IIS/Apache/Nginx

7.2 Data Dictionary

Project: A road construction initiative with defined route, timeline, and traffic management strategy.

Route: A path on the map defined by geographical coordinates representing a road segment.

Alternative Route: A different path between two points that can be used to divert traffic.

Diversion: A temporary route created to bypass construction area.

Lane Usage: Strategy where construction is limited to specific lanes while others remain operational.

Traffic Threshold: Predefined vehicle count or density level that triggers alerts.

Vehicle Type Categories:

- Two-wheeler: Motorcycles, scooters
- Four-wheeler: Cars, jeeps, vans
- Heavy Vehicle: Trucks, buses, cranes, construction equipment

7.3 Glossary

- **Congestion:** Traffic condition where vehicle density exceeds road capacity
- **GeoJSON:** Geographic data format based on JSON
- **Vector Tiles:** Map data format for efficient rendering
- **RBAC:** Role-Based Access Control
- **API Rate Limit:** Maximum number of API calls allowed per time period

---

8. Approval

This Software Requirements Specification has been reviewed and approved by:

Project Sponsor: _____ Date: _____

Project Manager: _____ Date: _____

Development Lead: _____ Date: _____

QA Lead: _____ Date: _____

Document Version History:

Version	Date	Author	Description
1.0	28-Nov-2025	System Analyst	Initial SRS document

End of Software Requirements Specification