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**REQUIREMENT ANALYSIS REPORT: ROAD SIGN AND ROAD STATE MOBILE
NOTIFICATION APPLICATION**

GROUP 5

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ABSTRACT

This report presents a comprehensive requirements analysis for the Road Sign and Road State Mobile Notification Application, designed to enhance road safety in Cameroon. Grounded in a survey of 100 diverse road users conducted from April 11 to April 14, 2025, the analysis identifies key user needs: real-time hazard alerts (76% demand), road sign education (64% demand), and community-driven reporting (86% altruistic motivation). The report details functional, non-functional, user, system, and legal requirements. It outlines the methodology, test plan, ensuring a user-centric, accessible, and legally sound application tailored to Cameroon's unique road challenges, such as potholes (78%) and unclear signs (34%).

1 INTRODUCTION

The Road Sign and Road State Mobile Notification Application aims to improve road safety in Cameroon by delivering real-time hazard notifications and accessible road sign education. This requirements analysis report builds on a survey of 100 road users (extrapolated from 50), conducted from April 11 to April 14, 2025, capturing the needs of private car drivers, bus drivers, taxi drivers, traffic officers, motorbike riders, driving instructors, and pedestrians. Key challenges include potholes (78%), traffic congestion (70%), and missing or unclear road signs (34%). The app addresses these through features like voice alerts (76% demand), a road sign directory with photo-snap identification (64% demand), and crowd reporting (34% interest, 86% altruistic motivation).

This report, compiled by Group 5, details the planned functional, non-functional, user, system, and legal requirements, alongside the methodology and a proposed test plan. It ensures compliance with national regulations, providing a foundation for the future design and development of a user-centric, scalable application.

1.1 Objectives of Requirements Analysis

The objectives of this requirements analysis are:

- To identify and prioritize user needs based on survey insights and stakeholder feedback.
- To define the planned functional, non-functional, user, system, and legal requirements for the proposed application.
- To ensure alignment with Cameroon's road safety and data protection regulations. To propose a test plan to validate the application's functionality and usability upon development.
- To establish a clear framework for the design and development phases, addressing Cameroon's road challenges (e.g., potholes, unclear signs).

1.2 Methodology for Requirements Analysis

The requirements were identified through a structured approach:

- **Stakeholder Interviews:** We engaged with officials from local transport authorities and legal advisors to understand specific road safety and data compliance requirements.
- **Document Review:** We reviewed national road regulations, ICT laws, and data protection standards applicable in Cameroon. Supplementary references from similar international systems were also examined.
- **Comparative Legal Benchmarking:** We compared the Cameroonian legal environment with that of other African countries implementing smart mobility apps to identify gaps and adopt relevant measures.
- **Risk Assessment Workshops:** We conducted internal team workshops to assess potential legal and data privacy risks and mapped them to mitigation strategies (e.g., limiting data storage duration, anonymizing sensitive user data).
- **Requirement Specification Documentation:** All findings were documented and mapped into system requirements, forming a checklist against which the app's compliance can be continually tested during development.

2 FUNCTIONAL REQUIREMENTS

The functional requirements define the core features of the app to address Cameroon's road safety challenges, leveraging survey insights (e.g., 78% citing potholes, 34% noting unclear signs) and CADVAR's educational mission.

i. Road Sign Directory

- **Description:** A searchable database of road signs with images, explanations, and an exam-prep mode. Users can snap photos of

unfamiliar signs, and the app uses image recognition to identify and explain them.

- **Details:** Includes multilingual support (English, French, local languages) and a categorized directory (e.g., warning, regulatory signs). The photo-snap feature utilizes smartphone cameras for real-time learning.
- **Rationale:** 64% demand a sign directory, 40% prioritize education, and 28% report sign confusion. Onsite feedback highlighted faded signs (e.g., “Curve Ahead”), and the photo-snap feature enables instant clarification, supporting CADVAR’s focus on user education.

ii. Real-Time Alerts

- **Description:** Voice-based notifications for traffic congestion, accidents, blocked roads, construction, and weather-related hazards (e.g., flooding).
- **Details:** Integrates weather APIs (e.g., OpenWeather) for rain or fog alerts. Prioritizes critical alerts (e.g., accidents) to minimize distraction.
- **Rationale:** 76% prefer voice alerts, 56% want road-specific alerts, and 78% report potholes and 70% congestion. Weather alerts address 12% citing flooding, similar to Waze’s hazard notifications.

iii. Crowd Reporting

- **Description:** A one-tap interface to report potholes, accidents, hazards, or reckless driving, with optional photo upload and verification by moderators or AI.
- **Details:** Includes a “report reckless driving” option and a verification system (e.g., user ratings, AI analysis) to ensure reliability.
- **Rationale:** 34% support crowd reporting, and 86% are motivated by altruism. Peer reliance (60% for accidents) and 50% citing reckless driving justify this feature, with verification addressing 38% who want trusted reports.

iv. GPS Navigation

- **Description:** Navigation with local road updates, integrated with platforms like Google Maps, supporting rural and urban routes.
- **Details:** Offers offline map downloads and community-updated road data. Includes points of interest (e.g., repair shops).
- **Rationale:** 54% demand local GPS updates, and 44% dislike existing apps' rural inaccuracies. RoadSave's community-driven navigation in Africa supports this approach.

v. Customizable Notifications

- **Description:** Allows users to select alert types (e.g., accidents, potholes) and delivery methods (voice, vibration, icons).
- **Details:** Provides a dashboard to toggle alert frequency and a "quiet mode" for non-critical alerts.
- **Rationale:** 52% prefer control over alerts, reflecting diverse needs (e.g., traffic officers vs. taxi drivers). Waze's customizable settings enhance user satisfaction.

vi. Location Sharing

- **Description:** Enables users to share their location with emergency contacts or authorities when stuck or in danger.
- **Details:** Includes an automatic distress signal triggered by prolonged immobility (e.g., 10 minutes without movement).
- **Rationale:** 32% support location sharing. Onsite safety concerns and features like Google Maps' crash detection validate this enhancement.

vii. Offline Mode

- **Description:** Access to the road sign directory and pre-downloaded maps without internet connectivity.
- **Details:** Caches recent alerts for offline viewing and optimizes storage for low-end smartphones.

- **Rationale:** 26% demand offline access, critical for rural users (18% cited app inaccuracies). RoadSave's offline features ensure accessibility.

3 NON-FUNCTIONAL REQUIREMENTS

The non-functional requirements outline the planned quality attributes for the application.

i. **Performance:**

- Alerts must be delivered within 10 seconds to ensure timely hazard notifications.
- The app should remain functional under low connectivity (addressing rural challenges noted by 26% of users).

ii. **Security:**

- User-reported data (e.g., pothole locations) must be verified (38% of users emphasized verification).
- Secure authentication for traffic officers/police accessing hazard data.

iii. **Reliability:**

- GPS navigation must be accurate even in dense/remote areas (constraint identified in rural feedback).
- Crowdsourced reports should have a backup system to prevent data loss.

iv. **Usability:**

- Voice-first interface (76% preference) to minimize distractions while driving.
- Intuitive UI for users with varying tech literacy (94% smartphone penetration but diverse user roles).

v. **Compatibility:**

- Supports Android and iOS devices commonly used in Cameroon.
- Optimized for offline access to road sign directories (26% demand).

vi. Scalability:

- Designed to handle growing users in urban/rural areas (100% extrapolated survey sample).

4 SYSTEM REQUIREMENTS

i. Hardware/Software Environment:

- **Smartphones:** Minimum Android 8/iOS 12, GPS, and camera (94% of users own smartphones).
- **Backend:** Cloud storage for real-time alerts and crowd reports; local caching for offline mode.
- **APIs:** Integration with Google Maps (54% demand) and weather services for hazard alerts.

5 USER REQUIREMENTS

User requirements ensure the app is accessible, usable, and relevant for Cameroon's diverse road users, aligning with CADVAR's inclusive safety goals.

i. Accessibility

- **Requirement:** Support low-end smartphones, include voice narration for visually impaired users, and offer multilingual interfaces (English, French, local languages).
- **Rationale:** 94% smartphone penetration includes basic devices. CADVAR's campaigns and Waze's voice navigation emphasize accessibility.

ii. Usability

- **Requirement:** Intuitive UI with large buttons, clear visuals, and voice-first interactions, optimized for Android and iOS.

- **Rationale:** 76% prioritize voice alerts to minimize distraction, and onsite feedback stressed simplicity. Waze's driver-friendly design sets a benchmark.

iii. Localization

- **Requirement:** Incorporate Cameroon-specific road signs, local road conditions, and community-verified data.
- **Rationale:** 44% dislike global apps' inaccuracies, and 54% want local updates. RoadSave's localized data improves relevance.

iv. Reliability

- **Requirement:** Deliver alerts within 10 seconds and verify crowdsourced data to maintain trust.
- **Rationale:** 54% trust crowdsourcing, but 38% want verification. RoadSave's moderation ensures credibility.

v. Safety

- **Requirement:** Voice-first design and minimal screen interaction to reduce distraction.
- **Rationale:** 76% prefer voice alerts, and onsite feedback emphasized eye-on-road safety. NHTSA guidelines advocate distraction-free interfaces.

vi. Partnerships

- **Requirement:** Collaborate with CADVAR and traffic authorities to provide official road data and promote adoption.
- **Rationale:** Lack of centralized data requires partnerships. CADVAR's campaigns (e.g., school speed limits) show willingness to engage.

vii. Scalability

- **Requirement:** Handle a growing urban/rural user base under low-bandwidth conditions.
- **Rationale:** 94% smartphone use and rural connectivity issues (18%) require robust infrastructure. Waze's scalability supports millions globally.

6 PRIORITIZED REQUIREMENTS

- i. Voice Alerts for Traffic/Accidents:** Ensures immediate safety (76% demand, addresses 78% potholes, 70% congestion).
- ii. Road Sign Directory:** Drives education and compliance with photo-snap feature (64% demand, 40% priority, 28% confusion).
- iii. Real-Time Road Condition Alerts:** Mitigates dynamic hazards (56% demand, 22% accidents).
- iv. Crowd Reporting Interface:** Leverages community engagement (34% interest, 86% altruism).
- v. Offline Mode:** Ensures rural access (26% demand).

Prioritization Logic: Voice alerts lead for their safety impact and user preference. The directory, enhanced with photo-snap identification, addresses education and compliance, aligning with CADVAR's mission. Real-time alerts and crowd reporting tackle urgent hazards, while offline mode ensures inclusivity for rural users.

7 LEGAL AND REGULATORY REQUIREMENTS

The Road Sign and Road State Mobile Notification Application is planned to comply with legal and regulatory frameworks to ensure lawful operation and user trust. The following requirements are based on the provided test cases, focusing on data privacy, user consent, accessibility, emergency services, open-source compliance, and user data rights.

i. Compliance with Local Data Privacy Laws

- **Description:** The application will ensure secure data handling, restricted access, and logged user consent to comply with local data privacy regulations.
- **Details:** User data submissions will be protected, and unauthorized access attempts will be blocked, with consent logs maintained.

- **Rationale:** Aligns with test case LEGAL-01, ensuring access is restricted and consent is logged when data is submitted or access is attempted.

ii. User Consent for Location Sharing

- **Description:** The application will require explicit user consent before enabling location-sharing features, re-prompting if consent is declined.
- **Details:** Location sharing will be disabled without consent, and the app will request consent again if declined.
- **Rationale:** Supports test case LEGAL-02, ensuring location is not shared without consent and the app re-prompts as needed.

iii. Data Retention Policy

- **Description:** The application will implement a data retention policy, specifying how long user-generated data is stored and when it is purged
- **Details:** Data (e.g., reports) will be retained or deleted after 30 days per the policy.
- **Rationale:** Meets test case LEGAL-03, ensuring data is managed according to retention or purging policies.

iv. Accessibility Standards

- **Description:** The application will comply with accessibility standards to ensure usability for all users, including those with disabilities.
- **Details:** Will support screen readers and adjustable fonts, adhering to WCAG guidelines.
- **Rationale:** Addresses test case LEGAL-04, ensuring the app is usable with accessibility tools and complies with WCAG.

v. Emergency Service Compliance

- **Description:** The application will ensure emergency data is securely transmitted only to registered emergency services.
- **Details:** SOS data will be encrypted and sent only to authorized services (e.g., 112, 117, 119).

- **Rationale:** Conforms to test case LEGAL-05, ensuring encrypted data is sent only to registered services.

vi. Open Source License Compliance

- **Description:** The application will use properly licensed open-source libraries and dependencies.
- **Details:** All dependencies will be reviewed to ensure compliance with their respective licenses.
- **Rationale:** Meets test case LEGAL-06, ensuring all libraries are properly licensed.

vii. User Right to Data Deletion

- **Description:** The application will allow users to request deletion of their personal data, with confirmation of removal.
- **Details:** A settings option will enable data deletion, with permanent removal logged.
- **Rationale:** Supports test case LEGAL-07, ensuring data is permanently removed and logged upon user request.

8 ACCEPTANCE TEST PLAN

An Acceptance Test Plan is a formal document that outlines the criteria and test cases used to determine whether a software application meets the specified business and technical requirements. It defines the scope, approach, resources, and schedule of acceptance testing and ensures that the system behaves as expected from the user's perspective before final approval and release.

The objective of the acceptance test plan is:

- To ensure that the application meets the defined requirements and user expectations.

- To identify and fix any defects or issues before the application is deployed.
- To validate that the application works as expected under different scenarios and conditions.

8.1 Test Team Approach

- Preparation:** Define the acceptance criteria and design the test cases. Identify the test data and set up the test environment.
- Execution:** Execute the test cases and document the results. Compare the actual results with the expected results defined in the acceptance criteria.
- Reporting:** Report the test results to the stakeholders. This includes the pass/fail status for each test case and any defects identified.
- Retesting and Regression Testing:** If any defects are identified, they should be fixed and the affected test cases should be retested. Also, perform regression testing to ensure that the fixes have not introduced any new issues.
- Sign-off:** Upon successful completion of all tests, the stakeholders sign off on the acceptance of the application, indicating that it meets the defined requirements and is ready for deployment.

8.2 Test Cases

Functional Requirements

Test Case ID	Requirement	Test Steps	Expected Result
FUNC-01	Road Sign Directory	Access directory and search for 'Stop' sign	Displays correct image and explanation
FUNC-02	Photo Snap Recognition	Snap photo of road sign	Returns correct match with explanation
FUNC-03	Real-Time Alerts	Simulate accident event	Voice alert is triggered within 10 seconds
FUNC-04	Crowd Reporting	Submit pothole report with photo	Report visible after verification
FUNC-05	GPS Navigation	Set route in rural area	Route is correctly generated

FUNC-06	Customizable Notifications	Change settings to voice only	Only voice notifications received
FUNC-07	Location Sharing	Trigger distress alert	Location shared with emergency contact
FUNC-08	Offline Mode	Disable internet and open directory	Road signs and cached maps accessible

Non-Functional Requirements

Test Case ID	Requirement	Test Steps	Expected Result
NF-01	Performance	Trigger alert under normal network	Alert delivered within 10 seconds
NF-02	Security	Submit fake data	System flags or blocks unverified report
NF-03	Reliability	Use GPS in dense area	Navigation remains accurate
NF-04	Usability	Use voice interface	App responds via voice and minimizes distractions
NF-05	Compatibility	Run app on Android/iOS offline	App launches and road signs are accessible
NF-06	Scalability	Simulate 10,000 users	App remains stable and responsive

System Requirements

Test Case ID	Requirement	Test Steps	Expected Result
SYS-01	Minimum Smartphone Spec	Install app on Android 8/iOS 12 device	App runs without issues
SYS-02	Backend Cloud Storage	Submit hazard report	Data appears in backend storage
SYS-03	Offline Mode	Access road directory offline	Data loads from cache
SYS-04	API Integration	Trigger rain alert	Weather API sends rain warning

User Requirements

Test Case ID	Requirement	Test Steps	Expected Result
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USR-01	Accessibility	Use app on low-end phone	App remains usable and responsive
USR-02	Usability	Test interface with non-tech user	User can navigate without training
USR-03	Localization	Search for Cameroon road sign	Correct sign and meaning displayed
USR-04	Reliability	Report accident and verify alert	Report is visible to others
USR-05	Safety	Drive while receiving voice alerts	No need for visual interaction
USR-06	Partnerships	Check if CADVAR signs appear	Official data is integrated
USR-07	Scalability	Run app in rural area	App remains responsive and accurate

Legal and Regulatory Requirements

Test Case ID	Requirement	Test Steps	Expected Result
LEGAL-01	Compliance with Local Data Privacy Laws	Submit data and attempt unauthorized access	Access is restricted and consent is logged
LEGAL-02	User Consent for Location Sharing	Trigger sharing and decline consent	Location not shared; app requests consent again
LEGAL-03	Data Retention Policy	Submit report and check after 30 days	Data is retained or purged per policy
LEGAL-04	Accessibility Standards	Use screen reader and change font	App complies with WCAG and is usable
LEGAL-05	Emergency Service Compliance	Trigger SOS and monitor data	Encrypted data sent only to registered services
LEGAL-06	Open Source License Compliance	Review app dependencies	All libraries properly licensed
LEGAL-07	User Right to Data Deletion	Request deletion via settings	Data permanently removed and logged

9 CONCLUSION

This requirements analysis lays a strong foundation for the proposed Road Sign and Road State Mobile Notification Application to improve road safety in Cameroon. A survey of 100 road users (April 11–14, 2025) identified key issues: potholes (78%), congestion (70%), unclear signs (34%), and reckless driving (50%). The planned features—voice alerts (76% demand), a photo-snap road sign directory (64% demand), and crowd reporting (34% interest, 86% altruism)—address these, alongside GPS navigation (54% demand), customizable notifications (52% preference), location sharing (32% support), and offline access (26% demand) for inclusivity. A rigorous methodology ensures user-centric requirements, with compliance to Cameroon’s Highway Code and data protection laws. A proposed test plan will validate functionality upon development. High demo interest (86%) supports next steps: wireframe design, API integration, and user testing for a transformative, accessible safety solution.