After Action Review (AAR) System Requirements Document

Executive Summary

This document outlines the requirements for developing a comprehensive After Action Review (AAR) system for military training exercises. Based on analysis of real training data containing 491 records from a 23-minute exercise involving 4 units, the system must provide multi-level analysis capabilities spanning individual soldier performance, squad effectiveness, and platoon-wide operations assessment.

1. System Overview

1.1 Purpose

Develop an automated AAR system that transforms raw training data into actionable insights across three operational levels:

- **Individual Soldier Level**: Personal performance metrics and safety analysis
- **Squad Level**: Team coordination and collective effectiveness
- **Platoon Level**: Overall mission success and resource management

1.2 Data Sources

The system shall process real-time data streams including:

- Soldier biometrics and activity sensors
- Network connectivity and communication systems
- GPS positioning and movement tracking
- Equipment status monitoring
- Casualty simulation systems

2. Functional Requirements by Analysis Domain

2.1 Soldier Safety Domain

2.1.1 Fall Detection and Response

Requirements:

- **REQ-SAFETY-001**: Real-time fall detection monitoring with immediate alert generation
- **REQ-SAFETY-002**: Correlation of fall events with casualty states and activity patterns
- **REQ-SAFETY-003**: Safety score calculation based on fall frequency and response time

- **REQ-SAFETY-004**: Historical fall pattern analysis for individual risk assessment

Implementation Notes:

- Current data shows 95 fall detection events for Unit_108, indicating high-risk scenarios
- System must distinguish between tactical movement (prone position) and actual falls

2.1.2 Medical Event Tracking

Requirements:

- **REQ-SAFETY-005**: Track casualty state transitions (GOOD → KILLED → RESURRECTED)
- **REQ-SAFETY-006**: Calculate survival time and mission effectiveness impact
- **REQ-SAFETY-007**: Generate safety recommendations based on casualty patterns
- **REQ-SAFETY-008**: Environmental correlation with medical events (temperature, terrain)

2.2 Network Performance Domain

2.2.1 Communication Effectiveness

Requirements:

- **REQ-NETWORK-001**: Monitor RSSI (Received Signal Strength Indicator) performance
  - Acceptable range: >20 dBm (current average: 20.1 dBm)
  - Alert threshold: <10 dBm for mission-critical communications
- **REQ-NETWORK-002**: Track MCS (Modulation and Coding Scheme) efficiency
  - Target range: 5-7 for optimal throughput (current average: 5.0)
- **REQ-NETWORK-003**: Network hop analysis and redundancy assessment
- **REQ-NETWORK-004**: Communication blackout identification and duration tracking

Critical Finding: 100% of records show some network connectivity issues, requiring immediate attention to communication infrastructure.

2.2.2 Data Transmission Quality

Requirements:

- **REQ-NETWORK-005**: Real-time data loss percentage calculation
- **REQ-NETWORK-006**: Latency measurement and threshold alerting
- **REQ-NETWORK-007**: Network coverage gap identification through GPS correlation
- **REQ-NETWORK-008**: Mesh network performance optimization recommendations

2.3 Soldier Activity and Performance Domain

2.3.1 Movement and Activity Analysis

Requirements:

- **REQ-ACTIVITY-001**: Step count tracking and movement pattern analysis
  - Normal activity range: 100-400 steps (observed range: 14-404 steps)
- **REQ-ACTIVITY-002**: Posture monitoring and tactical position analysis
  - Track Standing/Prone/Unknown positions for tactical assessment
- **REQ-ACTIVITY-003**: Rate of motion calculation from GPS coordinates
- **REQ-ACTIVITY-004**: Activity correlation with mission objectives and timeline

2.3.2 Physical Performance Metrics

Requirements:

- **REQ-ACTIVITY-005**: Endurance assessment through sustained activity periods
- **REQ-ACTIVITY-006**: Recovery time analysis between high-activity phases
- **REQ-ACTIVITY-007**: Individual fitness baseline establishment and tracking
- **REQ-ACTIVITY-008**: Comparative performance analysis within unit structures

2.4 Equipment Management Domain

2.4.1 Power and Battery Management

Requirements:

- **REQ-EQUIPMENT-001**: Battery level monitoring with predictive depletion alerts
  - Critical threshold: <40% battery (observed range: 0-101%)
  - Mission duration sustainability analysis
- **REQ-EQUIPMENT-002**: Power consumption pattern analysis by activity type
- **REQ-EQUIPMENT-003**: Equipment replacement timing recommendations
- **REQ-EQUIPMENT-004**: Power management best practices generation

2.4.2 Weapons and Munitions Tracking

Requirements:

- **REQ-EQUIPMENT-005**: Weapon usage logging and ammunition expenditure tracking

- **REQ-EQUIPMENT-006**: Hit accuracy analysis and marksmanship assessment
- **REQ-EQUIPMENT-007**: Equipment reliability and malfunction reporting
- **REQ-EQUIPMENT-008**: Load-out optimization recommendations

2.5 Environmental Monitoring Domain

2.5.1 Environmental Conditions

Requirements:

- **REQ-ENV-001**: Temperature monitoring and heat stress assessment
- **REQ-ENV-002**: Environmental impact on performance correlation
- **REQ-ENV-003**: Weather-based tactical recommendation system
- **REQ-ENV-004**: Seasonal training condition analysis

3. Multi-Level Analysis Requirements

3.1 Individual Soldier Level AAR

3.1.1 Personal Performance Dashboard

Requirements:

- **REQ-SOLDIER-001**: Individual performance scorecard with key metrics:
  - Combat effectiveness (deaths/resurrections ratio)
  - Safety compliance (fall incidents, equipment status)
  - Physical performance (step count, movement efficiency)
  - Communication reliability (network connectivity uptime)

Example Metrics from Current Data:

- Unit_108: 42 deaths, 22 resurrections, 95 falls - High-risk profile requiring intervention
- Unit_134: 0 casualties, 404 max steps - High-performance model

3.1.2 Personal Development Recommendations

Requirements:

- **REQ-SOLDIER-002**: Automated coaching recommendations based on performance gaps
- **REQ-SOLDIER-003**: Individual training plan adjustments
- **REQ-SOLDIER-004**: Risk factor identification and mitigation strategies

- **REQ-SOLDIER-005**: Performance trend analysis and goal setting

3.2 Squad Level AAR

3.2.1 Team Coordination Analysis

Requirements:

- **REQ-SQUAD-001**: Squad formation and movement coordination assessment
- **REQ-SQUAD-002**: Inter-team communication effectiveness measurement
- **REQ-SQUAD-003**: Collective task performance evaluation
- **REQ-SQUAD-004**: Squad leader effectiveness metrics

Current Limitation: All units marked as "UNKNOWN" squad - system must implement proper squad tagging.

3.2.2 Squad Resource Management

Requirements:

- **REQ-SQUAD-005**: Resource allocation and utilization analysis
- **REQ-SQUAD-006**: Equipment sharing and support patterns
- **REQ-SQUAD-007**: Squad-level safety incident correlation
- **REQ-SQUAD-008**: Team resilience and adaptability assessment

3.3 Platoon Level AAR

3.3.1 Mission Effectiveness Analysis

Requirements:

- **REQ-PLATOON-001**: Overall mission objective achievement assessment
- **REQ-PLATOON-002**: Resource utilization efficiency across all squads
- **REQ-PLATOON-003**: Command and control effectiveness evaluation
- **REQ-PLATOON-004**: Multi-squad coordination and synchronization analysis

3.3.2 Strategic Decision Support

Requirements:

- **REQ-PLATOON-005**: Training exercise design optimization recommendations
- **REQ-PLATOON-006**: Unit readiness assessment and deployment recommendations

- **REQ-PLATOON-007**: Long-term performance trend analysis
- **REQ-PLATOON-008**: Comparative analysis with historical exercises

4. Technical Implementation Requirements

4.1 Data Processing and Analytics

4.1.1 Real-Time Processing

Requirements:

- **REQ-TECH-001**: Sub-second data ingestion and processing capability
- **REQ-TECH-002**: Stream processing for continuous monitoring and alerting
- **REQ-TECH-003**: Scalable architecture supporting 100+ concurrent soldiers
- **REQ-TECH-004**: Edge computing capabilities for field deployment

4.1.2 Data Quality and Validation

Requirements:

- **REQ-TECH-005**: Automated data quality assessment and reporting
  - Current issues: 28.1% missing network data, 23.2% missing step data
- **REQ-TECH-006**: Data anomaly detection and correction algorithms
- **REQ-TECH-007**: Sensor calibration and validation systems
- **REQ-TECH-008**: Data backup and recovery mechanisms

4.2 User Interface and Reporting

4.2.1 Interactive Dashboards

Requirements:

- **REQ-UI-001**: Multi-level dashboard system (Soldier/Squad/Platoon views)
- **REQ-UI-002**: Real-time metric visualization and alerting
- **REQ-UI-003**: Historical data analysis and trend visualization
- **REQ-UI-004**: Mobile-responsive design for field use

4.2.2 Automated Reporting

Requirements:

- **REQ-UI-005**: Automated AAR report generation within 30 minutes of exercise completion

- **REQ-UI-006**: Customizable report templates for different stakeholder needs
- **REQ-UI-007**: Export capabilities (PDF, Excel, CSV formats)
- **REQ-UI-008**: Integration with existing military reporting systems

4.3 Security and Compliance

4.3.1 Data Security

Requirements:

- **REQ-SEC-001**: End-to-end encryption for all data transmission
- **REQ-SEC-002**: Role-based access control with military clearance integration
- **REQ-SEC-003**: Audit logging for all system access and data modifications
- **REQ-SEC-004**: Secure data storage with classification level support

4.3.2 Privacy and Ethics

Requirements:

- **REQ-SEC-005**: Personal data anonymization for non-essential personnel
- **REQ-SEC-006**: Consent management for biometric data collection
- **REQ-SEC-007**: Data retention policy compliance
- **REQ-SEC-008**: Cross-border data transfer restrictions compliance

5. Performance and Quality Requirements

5.1 System Performance

- **Response Time**: <2 seconds for dashboard updates
- **Throughput**: 1000+ data points per second per soldier
- **Availability**: 99.9% uptime during training exercises
- **Scalability**: Support for 500+ concurrent users

5.2 Data Accuracy

- **Location Accuracy**: ±3 meters GPS precision
- **Timestamp Accuracy**: ±1 second synchronization
- **Sensor Accuracy**: ±5% for physiological measurements
- **Network Metrics**: Real-time accuracy for RSSI/MCS measurements

6. Integration Requirements

6.1 External Systems

- **Training Management Systems**: Integration with existing training platforms
- **Medical Systems**: Connection to military health record systems
- **Communication Systems**: Integration with tactical communication networks
- **Geographic Information Systems**: Military mapping and terrain analysis

6.2 Hardware Compatibility

- **Soldier Systems**: Compatibility with standard military wearable devices
- **Network Infrastructure**: Integration with existing military communication hardware
- **Mobile Devices**: Support for ruggedized tablets and smartphones
- **Base Station Equipment**: Integration with training facility infrastructure

7. Acceptance Criteria

7.1 Functional Acceptance

- All specified metrics can be calculated and displayed in real-time
- System can process complete training exercise data within specified timeframes
- Reports generate automatically and contain all required analysis elements
- Multi-level views provide appropriate detail for each stakeholder group

7.2 Performance Acceptance

- System maintains specified response times under full load
- Data accuracy meets or exceeds specified tolerances
- System availability meets uptime requirements during critical training periods
- User interface responds appropriately across all supported devices

8. Future Enhancements

8.1 Artificial Intelligence Integration

- Machine learning models for predictive performance analysis
- Automated tactical recommendation generation
- Pattern recognition for identifying training effectiveness factors

- Natural language processing for automated report narrative generation

8.2 Advanced Analytics

- Predictive modeling for injury prevention
- Optimization algorithms for training exercise design
- Comparative analysis with other military units
- Integration with simulation and gaming systems

Document Version: 1.0
Date: July 16, 2025
Classification: For Official Use Only
Next Review: 90 days from implementation