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NGORONGORO CONSERVATION AREA AUTHORITY

Software Requirements Specification

NCAA Digital Transformation - Business Intelligence (BI) System

Version: 1.0

Date: 2025-11-12

https://www.ncaa.go.tz

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1 Document Information

Field	Value
Project Name	NCAA Digital Transformation - Business Intelligence (BI) System
Version	1.0
Date	2025-11-12
Project Manager	TBD
Platforms	['Web', 'Cloud Infrastructure', 'API Services']
Budget	$190,000
Module Code	BI_SYSTEM
Parent Project	NCAA Digital Transformation - Ngorongoro Gateway

2 Project Overview

2.1 What Are We Building

2.1.1 System Function

The NCAA Business Intelligence (BI) System serves as the central analytical and decision-support platform for the entire organization. It consolidates operational, administrative, and conservation data across all directorates, sections, and units—transforming dispersed information into actionable insights that enhance efficiency, accountability, and strategic planning.

2.1.2 Users

- Board of Directors: Strategic oversight and institutional performance monitoring
- Commissioner & Deputy Commissioners: Executive decision-making and organizational governance
- Departmental Heads: Directorate-level analytics (Conservation & Tourism, Corporate Services, Cross-cutting Units)
- Field Officers & Managers: Operational analytics and real-time performance tracking
- Finance & HR Teams: Budget utilization, staff performance, and resource allocation analytics
- ICT & Data Teams: System administration, data governance, and technical monitoring

2.1.3 Problem Solved

Fragmented data across departments leading to delayed reporting, inconsistent decision-making, manual data exchange, time-consuming report generation, and limited inter-departmental visibility. The BI system eliminates data silos, unifies decision-making, and introduces a culture of measurable performance across all NCAA departments.

2.1.4 Key Success Metric

100% unified data visibility across all departments, 95% reduction in manual reporting time, automated and standardized reporting processes, instant analytics availability, predictive and AI-driven decision-making capabilities, full accountability through shared dashboards and role-based access.

2.2 Scope

2.2.1 In Scope

- Enterprise-wide data integration from all NCAA systems (Gateway, Mobile App, Fleet, Surveillance, Finance, HR, Safari Portal)
- ETL (Extract, Transform, Load) pipeline for automated data ingestion and transformation
- Centralized data warehouse (PostgreSQL/Cloud-based) for all institutional data
- Departmental dashboards and performance analytics for all directorates
- Predictive analytics engine powered by Nasera AI
- Automated reporting and compliance module for statutory and management reports
- Data governance and security framework with role-based access control
- API-based integration framework for internal and external systems
- Real-time data synchronization with offline node support
- Cross-departmental reporting connecting Conservation, Tourism, Finance, HR, Procurement, Legal, ICT
- Comprehensive audit trails for transparency and compliance

2.2.2 Out Of Scope

- Development of new source systems (focuses on integration of existing systems)
- Direct field data collection (relies on existing systems for data capture)
- Replacement of existing departmental systems (augments and integrates with them)
- Manual data entry interfaces (emphasizes automated data flows)
- Standalone analytics tools outside the unified BI framework

3 User Requirements

3.1 Enterprise Data Integration

Feature Code	I Want To	So That I Can	Priority	Notes
FT-BI-INTEGRATION	Integrate data from all NCAA systems including Gateway, Mobile App, Surveillance, Fleet Management, Finance, HR, and Safari Portal	Have a single, reliable source of truth for all organizational operations and eliminate data silos	Must	API-based bidirectional connectivity with token-based authentication and encryption. Supports both internal and selected external systems.
FT-BI-ETL	Automate data ingestion, cleaning, and transformation through ETL pipelines	Ensure data quality, standardization, and timely availability for analytics without manual intervention	Must	Python ETL scripts with Airflow orchestration and RESTful API connectors. Maintains metadata catalogs for governance.

3.2 Departmental Analytics

Feature Code	I Want To	So That I Can	Priority	Notes
FT-BI-DASHBOARDS	Access customized dashboards for each directorate with relevant	Monitor departmental performance, track key metrics, and	Must	Covers Conservation & Tourism, Corporate Services, and Cross-cutting

Feature Code	I Want To	So That I Can	Priority	Notes
	KPIs and visualizations	make data-driven decisions		Units with drill-down capabilities.
FT-BI-CROSSDEPT	View cross-departmental reports that connect data from multiple directorates	Understand inter-departmental relationships and organizational-wide performance	Should	Unified reporting framework connecting all NCAA directorates and units.

3.3 Predictive Analytics

Feature Code	I Want To	So That I Can	Priority	Notes
FT-BI-PREDICT	Access predictive analytics for visitor trends, revenue forecasts, and resource allocation	Plan proactively and make strategic decisions based on data-driven forecasts	Must	Powered by Nasera AI's integrated data-science models with seasonal trends and forecasting capabilities.
FT-BI-PRESCRIPTIVE	Receive prescriptive recommendations for resource optimization and operational improvements	Take action based on AI-driven insights and best practice recommendations	Should	AI-powered recommendations based on historical patterns and organizational goals.

3.4 Reporting Compliance

Feature Code	I Want To	So That I Can	Priority	Notes
FT-BI-AUTOREPORT	Generate automated	Ensure timely submission and	Must	Reduces manual reporting cycles

Feature Code	I Want To	So That I Can	Priority	Notes
	statutory and management reports for oversight bodies	compliance with internal and national reporting standards		by 95% with integrated audit trails for compliance.
FT-BI-AUDIT	Access comprehensive audit trails for all data transactions and system decisions	Maintain transparency, accountability, and compliance with NCAA operational standards	Must	Every transaction and dataset change is logged with timestamp and user information.

3.5 Data Governance Security

Feature Code	I Want To	So That I Can	Priority	Notes
FT-BI-RBAC	Control data access based on user roles and responsibility levels	Ensure data security and that users only access information relevant to their roles	Must	Role-based access control with encrypted communication and multi-factor authentication.
FT-BI-GOVERNANCE	Manage data validation, versioning, and integrity verification	Ensure data quality and compliance with NCAA and national data protection standards	Must	Built-in data governance tools with validation rules and access control protocols.

3.6 System Accessibility

Feature Code	I Want To	So That I Can	Priority	Notes
FT-BI-REALTIME	Access real-time data and analytics	Make timely decisions based on current	Must	Secure authenticated access via web

Feature Code	I Want To	So That I Can	Priority	Notes
	through web and mobile interfaces	operational status		and mobile-optimized interfaces.
FT-BI-OFFLINE	Continue data collection and synchronization during network connectivity issues	Maintain continuous operations in low-connectivity environments	Must	Node-based synchronization ensures continued access and updates even in remote areas.

4 Technical Requirements

4.1 Performance

4.1.1 Dashboard Load Time

< 3 seconds for standard dashboards

4.1.2 Data Refresh Rate

Real-time for critical metrics, 5-minute intervals for standard analytics

4.1.3 Query Response Time

< 2 seconds for standard queries, < 10 seconds for complex analytics

4.1.4 Etl Processing Time

< 2 minutes for incremental updates, < 30 minutes for full daily processing

4.1.5 Concurrent Users

Support for 200+ concurrent users across all departments

4.2 Platforms Supported

4.2.1 Web Browsers

Chrome 90+, Firefox 88+, Safari 14+, Edge 90+

4.2.2 Operating Systems

Windows 10+, macOS 11+, Linux (Ubuntu 20.04+)

4.2.3 Mobile Platforms

iOS 12+ and Android 8+ (responsive web interface)

4.2.4 Cloud Infrastructure

AWS, Google Cloud, or Azure with scalable architecture

4.3 Data Storage

4.3.1 Primary Database

PostgreSQL 13+ or cloud-based (AWS Redshift, Google BigQuery)

4.3.2 Data Warehouse Capacity

Scalable cloud storage with minimum 5TB initial capacity

4.3.3 Backup Frequency

Hourly incremental backups, daily full backups

4.3.4 Data Retention

7 years for transaction data, 3 years for operational logs

4.3.5 Archival Strategy

Automated data archival to cold storage after 2 years

4.4 Security Requirements

4.4.1 Encryption At Rest

AES-256 encryption for all stored data

4.4.2 Encryption In Transit

TLS 1.3 for all API communications

4.4.3 Authentication

OAuth 2.0 with JWT tokens, multi-factor authentication for admin access

4.4.4 Authorization

Role-based access control (RBAC) with granular permissions

4.4.5 Api Security

Token-based authentication, SSL encryption, API-level rate limiting

4.4.6 Compliance

NCAA ICT policies and Tanzania national data governance standards

4.5 Integration Requirements

4.5.1 Api Architecture

RESTful APIs with JSON data format

4.5.2 Api Authentication

Token-based with HTTPS encryption

4.5.3 Data Sync Frequency

Real-time for critical systems, 5-minute intervals for others

4.5.4 Supported Integrations

- Ngorongoro Gateway
- NCAA Mobile Application
- Fleet Management System
- Surveillance System
- Safari Portal
- Finance Systems
- HR Systems
- Nasera AI

5 External Dependencies

5.1 Third Party Services

Service Name	Purpose	Criticality	Alternatives
Cloud Infrastructure Provider	Hosting data warehouse and BI platform	High	AWS, Google Cloud, or Azure
Power BI / Metabase	Dashboard visualization and analytics	High	Tableau, Looker, or custom React-based dashboards
Apache Airflow	ETL pipeline orchestration	Medium	Apache NiFi, Luigi, or custom Python schedulers

5.2 Internal Systems

System Name	Integration Method	Data Frequency	Criticality
Ngorongoro Gateway	RESTful API	Real-time	High
NCAA Mobile Application	RESTful API	Real-time	High
Nasera AI	RESTful API + Direct Database Access	Real-time	High
Fleet Management System	RESTful API	5-minute intervals	Medium
Surveillance System	RESTful API	Real-time	Medium

6 Release Planning

6.1 Phase 1

6.1.1 Name

Discovery & Architecture

6.1.2 Duration

4-6 weeks

6.1.3 Deliverables

- Data source identification and analysis across all NCAA systems
- Data warehouse design and schema definition
- API integration architecture and security framework
- ETL pipeline design and data flow documentation

6.2 Phase 2

6.2.1 Name

Core Platform Development

6.2.2 Duration

6-12 months

6.2.3 Deliverables

- ETL pipeline development and automated data ingestion
- Data cleaning and transformation algorithms
- Dashboard and report development for all directorates
- Advanced analytics modules (predictive and prescriptive)
- User access and security framework implementation

- API development for system integrations

6.3 Phase 3

6.3.1 Name

Deployment & Training

6.3.2 Duration

2-3 months (ongoing)

6.3.3 Deliverables

- System deployment on cloud infrastructure
- User training and documentation for all departments
- Post-launch support and optimization
- Continuous monitoring and performance tuning

7 Risks Assumptions

7.1 Risks

Risk	Mitigation	Probability	Impact
Data quality issues from legacy systems	Implement comprehensive data validation and cleaning in ETL pipeline	Medium	Medium
Resistance to data-driven culture change	Comprehensive training program and change management support	Medium	Low
API integration delays with external systems	Phased integration approach with fallback to manual data imports	Low	Medium
Cloud infrastructure costs exceeding budget	Implement cost monitoring and optimization, negotiate reserved instances	Low	Medium

7.2 Assumptions

- All NCAA source systems will expose or develop APIs for data integration
- Departmental staff will be available for training and knowledge transfer
- Cloud infrastructure provider will maintain 99.9% uptime SLA
- NCAA ICT team will provide ongoing support for system maintenance
- Data governance policies will be established and enforced across all departments

8 Market Specific Considerations

8.1 Tanzania Context

- Alignment with Tanzania's Digital Economy Strategic Framework
- Support for government digital transformation initiatives in tourism sector
- Compliance with Tanzania Data Protection Act and ICT regulations
- Integration capabilities with national tourism databases and regulatory platforms

8.2 Conservation Sector

- Best practices from international conservation organizations (IUCN, WWF)
- Integration with global conservation monitoring systems
- Support for UNESCO World Heritage Site reporting requirements
- Collaboration framework with Tanzania National Parks Authority (TANAPA)

8.3 Low Connectivity Adaptation

- Node-based synchronization for distributed gate operations
- Offline data caching with automatic sync on reconnection
- Low-bandwidth optimized API communications
- Local processing capabilities at remote locations

9 Sign Off

9.1 Prepared By

SkyConnect Development Team

9.2 Reviewed By

TBD - NCAA ICT Department

9.3 Approved By

TBD - NCAA Management

9.4 Date

2025-11-12

9.5 Version

1.0

10 Detailed Feature Requirements

10.1 Ft Bi Integration

10.1.1 Feature Name

Enterprise-Wide Data Integration

10.1.2 Description

Comprehensive API-based integration framework connecting all NCAA internal and external systems

10.1.3 User Stories

- As a data administrator, I want to configure API connections to all source systems so that data flows automatically into the BI platform
- As a department head, I want to see data from my department integrated with other directorates so that I understand cross-functional relationships
- As an executive, I want a unified view of all organizational data so that I can make strategic decisions

10.1.4 Acceptance Criteria

- All internal systems (Gateway, Mobile, Fleet, Surveillance) successfully integrated via API
- Finance, HR, and Safari Portal data synchronized at least every 5 minutes
- External systems integration capability with token-based authentication
- Error logging and retry mechanisms for failed API calls
- API monitoring dashboard showing integration health status

10.1.5 Test Cases

Test Id	Description	Preconditions	Steps	Expected Result	Priority
TC-BI-INT-001	Verify real-time data sync	Gateway system operational	1. Create new entry in Gateway 2.	New entry visible in BI dashboard	High

Test Id	Description	Preconditions	Steps	Expected Result	Priority
	from Gateway system	with active transactions	Wait 30 seconds 3. Check BI dashboard	within 30 seconds	
TC-BI-INT-002	Verify API authentication and security	API endpoints configured	1. Attempt API call without token 2. Attempt with invalid token 3. Attempt with valid token	Calls 1 and 2 rejected, call 3 successful	High
TC-BI-INT-003	Verify data sync during connectivity loss	Node-based system with offline capability	1. Disconnect network 2. Create entries 3. Reconnect network 4. Check sync	All offline entries synchronized within 2 minutes of reconnection	Medium

10.2 Ft Bi Etl

10.2.1 Feature Name

Automated ETL Pipeline

10.2.2 Description

Comprehensive data extraction, transformation, and loading pipeline with quality assurance

10.2.3 User Stories

- As a data engineer, I want automated ETL pipelines so that data is ingested and transformed without manual intervention
- As a data analyst, I want clean and standardized data so that my analytics are accurate and reliable

- As an administrator, I want to monitor ETL processes so that I can identify and resolve issues quickly

10.2.4 Acceptance Criteria

- Automated data ingestion from all configured sources
- Data validation and cleaning rules applied to all incoming data
- Data transformation to standard formats and schemas
- Metadata catalog maintenance for all datasets
- ETL monitoring dashboard with error alerts
- Incremental processing < 2 minutes, full daily processing < 30 minutes

10.2.5 Test Cases

Test Id	Description	Preconditions	Steps	Expected Result	Priority
TC-BI-ETL-001	Verify data validation rules enforcement	ETL pipeline configured with validation rules	1. Submit data with invalid formats 2. Submit data with missing fields 3. Submit valid data	Invalid data rejected with error messages, valid data processed successfully	High
TC-BI-ETL-002	Verify incremental data processing performance	ETL pipeline operational	1. Submit 1000 new records 2. Measure processing time 3. Verify data in warehouse	Processing completes in < 2 minutes, all records in warehouse	High
TC-BI-ETL-003	Verify metadata catalog updates	Metadata catalog system active	1. Add new data source 2. Run ETL pipeline 3. Check	New data source documented in catalog with schema	Medium

Test Id	Description	Preconditions	Steps	Expected Result	Priority
			metadata catalog	and lineage information	

10.3 Ft Bi Dashboards

10.3.1 Feature Name

Departmental Dashboards and Analytics

10.3.2 Description

Customized interactive dashboards for each NCAA directorate with drill-down capabilities

10.3.3 User Stories

- As a Conservation Director, I want to see visitor flow, revenue, and ecological indicators in one dashboard
- As a Corporate Services Director, I want to track budget utilization, staff performance, and procurement cycles
- As a department manager, I want to drill down into specific metrics to understand underlying trends

10.3.4 Acceptance Criteria

- Separate dashboards for Conservation & Tourism, Corporate Services, and Cross-cutting Units
- Customizable KPI widgets for each directorate
- Drill-down capability from summary to detailed views
- Interactive visualizations (charts, graphs, maps)
- Export functionality for reports and presentations
- Dashboard load time < 3 seconds

10.3.5 Test Cases

Test Id	Description	Preconditions	Steps	Expected Result	Priority
TC-BI-DASH-001	Verify Conservation & Tourism dashboard displays all KPIs	User logged in with Conservation role	1. Navigate to dashboard 2. Verify visitor flow widget 3. Verify revenue widget 4. Verify ecological indicators	All widgets display current data with accurate values	High
TC-BI-DASH-002	Verify drill-down functionality	Dashboard displaying summary data	1. Click on revenue summary 2. Select specific gate 3. Select date range	Detailed revenue breakdown displayed for selected gate and date range	High
TC-BI-DASH-003	Verify dashboard performance with 50 concurrent users	Load testing environment configured	1. Simulate 50 users accessing dashboards 2. Measure load time 3. Check system resources	All dashboards load in < 3 seconds, system remains stable	Medium

10.4 Ft Bi Predict

10.4.1 Feature Name

Predictive Analytics Engine

10.4.2 Description

AI-powered forecasting for visitor trends, revenue, and resource allocation

10.4.3 User Stories

- As an operations manager, I want to see predicted visitor numbers for next month so that I can plan staffing accordingly
- As a finance director, I want revenue forecasts so that I can prepare budget projections
- As a resource planner, I want to know optimal resource allocation based on historical patterns

10.4.4 Acceptance Criteria

- Seasonal visitor trend predictions with 80%+ accuracy
- Revenue forecasting for 1, 3, and 6 month horizons
- Resource allocation recommendations based on predictive models
- Integration with Nasera AI for model training and inference
- Confidence intervals displayed for all predictions
- Model retraining on monthly basis with new data

10.4.5 Test Cases

Test Id	Description	Preconditions	Steps	Expected Result	Priority
TC-BI-PRED-001	Verify visitor trend prediction accuracy	Historical data for at least 2 years available	1. Generate prediction for last month 2. Compare with actual data 3. Calculate accuracy	Prediction accuracy > 80% for monthly visitor numbers	High
TC-BI-PRED-002	Verify revenue forecast generation	Predictive model trained and deployed	1. Request 3-month revenue forecast 2. Review forecast details 3.	Forecast generated with values for each month and confidence	High

Test Id	Description	Preconditions	Steps	Expected Result	Priority
			Check confidence intervals	intervals displayed	
TC-BI-PRED-003	Verify model retraining process	New month of data available	1. Trigger model retraining 2. Monitor training progress 3. Validate new model	Model retrained successfully, accuracy maintained or improved	Medium

10.5 Ft Bi Autoreport

10.5.1 Feature Name

Automated Reporting and Compliance

10.5.2 Description

Automated generation of statutory and management reports with audit trails

10.5.3 User Stories

- As a compliance officer, I want automated report generation so that I meet all regulatory deadlines
- As a board secretary, I want management reports ready before meetings without manual compilation
- As an auditor, I want complete audit trails so that I can verify all reported data

10.5.4 Acceptance Criteria

- Automated generation of monthly, quarterly, and annual reports
- Customizable report templates for different stakeholders
- Scheduled report delivery via email or dashboard
- Complete audit trails with timestamp and user information
- 95% reduction in manual reporting time
- Reports comply with NCAA and national reporting standards

10.5.5 Test Cases

Test Id	Description	Preconditions	Steps	Expected Result	Priority
TC-BI-REP-001	Verify automated monthly report generation	End of month data available	1. Trigger monthly report 2. Review report content 3. Verify data accuracy 4. Check audit trail	Report generated with all required sections, data accurate, audit trail complete	High
TC-BI-REP-002	Verify scheduled report delivery	Report schedule configured for Board meetings	1. Configure weekly report 2. Wait for scheduled time 3. Check email delivery	Report delivered automatically at scheduled time to configured recipients	High
TC-BI-REP-003	Verify audit trail completeness	Multiple data transactions completed	1. Access audit trail interface 2. Filter by date range 3. Review transaction logs	All transactions logged with timestamp, user, and change details	Medium

11 Additional Context

11.1 System Architecture

11.1.1 Data Source Layer

Collects data from all digital platforms and legacy systems via secured endpoint APIs with token-based authentication, SSL encryption, and data validation

11.1.2 Etl Pipeline

Automated data ingestion and transformation powered by Python ETL scripts, Airflow orchestration, and RESTful API connectors

11.1.3 Data Warehouse

Centralized repository on PostgreSQL or cloud-based (AWS Redshift/Google BigQuery) optimized for high-speed analytics

11.1.4 Analytics Visualization

Power BI and Metabase dashboards integrated with Nasera AI for natural language queries

11.1.5 Security Access

Role-based access control (RBAC), encrypted communication, API rate limiting, multi-factor authentication

11.1.6 Node Synchronization

Distributed Gate Nodes sync with BI system through secure APIs for real-time updates in low-connectivity environments

11.2 Integration Approach

11.2.1 Data Ingestion

All internal and external systems expose secured endpoint APIs transmitting encrypted data to BI server

11.2.2 Transformation Storage

Data cleaned, aggregated, and stored in BI warehouse for real-time and historical analysis

11.2.3 Processing Analytics

BI engine processes datasets and feeds dashboards and predictive models

11.2.4 Ai Enhancement

Nasera AI interprets trends, detects anomalies, enables natural language queries

11.2.5 Distribution

Dashboards and reports delivered securely via authenticated web and mobile interfaces

11.3 Key Benefits

11.3.1 Data Accessibility

From fragmented and delayed to centralized, real-time access via APIs - achieving unified visibility

11.3.2 Decision Making

From periodic reports to predictive and AI-driven insights - enabling data-informed decisions

11.3.3 Data Exchange

From manual uploads to automated API-based synchronization - achieving 100% automation

11.3.4 Reporting

From time-consuming and inconsistent to automated and standardized - achieving 95% time reduction

11.3.5 Transparency

From limited inter-departmental view to shared dashboards with role-based access - achieving full accountability

11.4 Total Budget Breakdown

11.4.1 Discovery Architecture

$40,000 (Data source analysis and warehouse design)

11.4.2 Data Engineering Etl

$30,000 (ETL development and data transformation)

11.4.3 Bi Analytics Platform

$90,000 (Dashboards, advanced analytics, user access)

11.4.4 Deployment Training Support

$30,000 (System deployment, training, post-launch support)

11.4.5 Total

$190,000