Business Requirements Document (BRD)

NASA Farm Navigators

Document Information

- **Version:** 2.0
- **Date:** September 2025
- **Challenge:** NASA Space Apps Challenge 2025
- **Document Owner:** Strategic Planning Committee

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1. Executive Summary

1.1 Business Challenge

The agricultural sector loses $43 billion annually due to inability to utilize freely available NASA satellite data. Despite NASA providing comprehensive Earth observation data at no cost, adoption remains below 15% due to:

- **Complexity Barrier**: Understanding multi-resolution datasets (30m-11km)
- **Depth Confusion**: Misinterpreting surface vs root zone measurements
- **Context Mismatch**: One-size-fits-all solutions failing diverse farming scales
- **Technical Literacy Gap**: Abstract data disconnected from practical decisions

1.2 Proposed Solution

NASA Farm Navigators transforms complex satellite data into an educational game that:

- **Demonstrates Resolution Reality**: Shows what 30m vs 375m actually detects
- **Teaches Depth Differences**: Clarifies surface (0-5cm) vs root zone (0-100cm) moisture
- **Adapts to Context**: Customizes for smallholder vs industrial farming
- **Connects to Practice**: Links data insights to measurable outcomes

1.3 Business Value Proposition

Investment: $1.1M (Year 1)
Returns:
- Direct Revenue: $525K (Year 1), $800K (Year 3)
- Social Impact: $4.3M in agricultural efficiency gains
- Educational Impact: 30,000+ trained practitioners

- Water Savings: 20-50% reduction demonstrated
- Yield Improvement: 10-30% optimization shown

1.4 Success Metrics

Metric	Year 1 Target	Year 3 Target	Measurement
Active Users	10,000	100,000	Platform analytics
Knowledge Improvement	80%	85%	Assessment scores
Practical Application	40%	60%	User surveys
Partner Institutions	10	50	Signed agreements
Water Savings Demonstrated	30%	40%	Simulation data

2. Business Needs Assessment

2.1 Market Analysis

Total Addressable Market (TAM)

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Global AgTech Education: $4.3B
├── Precision Agriculture Training: $1.2B
├── Satellite Data Applications: $800M
├── Gamified Learning Platforms: $600M
└── Sustainability Education: $1.7B
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Market Segmentation

Primary Market: Educational Institutions

- 4,500 agricultural programs globally
- 250,000 agriculture students annually
- Average software budget: $5,000-20,000
- Decision cycle: 6-12 months

Secondary Market: Small-Scale Farmers

- 500 million smallholder farms globally
- 86% of U.S. farms under 180 acres
- Technology budget: <$500/year
- Mobile-first requirement

Tertiary Market: Agricultural Extension Services

- 3,000+ extension offices (U.S.)

- 100,000+ advisors globally

- Training focus priority

- Government funding available

2.2 Competitive Analysis

Competitor	Strengths	Weaknesses	Our Advantage
Farming Simulator 19/22	Realistic graphics, brand recognition	No real data, entertainment only	NASA data integration
Climate FieldView	Professional tools, real farm integration	$600/year cost, high complexity	Free tier, gamified learning
FarmLogs	Simple interface, mobile app	Limited satellite features	Comprehensive NASA datasets
Ag Leader	Industry standard, dealer network	$10,000+ investment	Accessible to all scales
Traditional Training	Hands-on experience	High cost, limited reach	Scalable, engaging

2.3 Stakeholder Analysis

Primary Stakeholders

Stakeholder	Interest Level	Influence	Engagement Strategy
NASA	Critical	High	Monthly progress reports, co-branding
Students/Learners	Critical	Medium	Continuous feedback, achievement system
Educators	High	High	Training workshops, support materials
Farmers	High	Medium	Success stories, peer testimonials
Development Team	Critical	High	Agile involvement, transparent goals

Secondary Stakeholders

Stakeholder	Interest Level	Influence	Engagement Strategy
USDA	Medium	High	Grant applications, impact reports
State Extensions	High	Medium	Partnership programs
AgTech Companies	Medium	Medium	Sponsorship opportunities
Environmental Groups	Medium	Low	Sustainability metrics

3. Business Requirements

3.1 Strategic Requirements

BR-STR-001: Educational Effectiveness [Priority: Critical]

Requirement: Demonstrably improve satellite data literacy **Business Value:** Market differentiation, grant eligibility **Success Criteria:**

- 80% knowledge assessment improvement
- 40% report practical application
- NASA education endorsement

BR-STR-002: Resolution Understanding [Priority: Critical]

Requirement: Teach resolution limitations and capabilities **Business Value:** Unique educational value proposition **Success Criteria:**

- Players correctly identify detectable features at different resolutions
- Understand pixel aggregation effects
- Apply appropriate resolution for tasks

BR-STR-003: Depth Differentiation [Priority: Critical]

Requirement: Clarify surface vs root zone measurements **Business Value:** Address major misconception in data use **Success Criteria:**

- Players distinguish SMAP L3 vs L4 applications
- Correctly apply depth-appropriate irrigation
- Understand crop-specific depth needs

BR-STR-004: Context Adaptability [Priority: High]

Requirement: Support diverse farming contexts **Business Value:** Expand addressable market **Success Criteria:**

- Smallholder mode adoption: 40%
- Industrial mode adoption: 60%
- Positive feedback from both segments

3.2 Functional Requirements

BR-FUN-001: NASA Data Integration [Priority: Critical]

Requirement: Real-time integration with NASA data sources **Business Justification:** Credibility and authenticity **Implementation:**

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Data Sources:
├──── AppEEARS: Customized extracts
├──── Crop-CASMA: SMAP products
├──── Worldview: Visual layers
├──── GLAM: Global monitoring
└──── VEDA: Cloud analytics
```

BR-FUN-002: Progressive Learning System [Priority: High]

Requirement: Three-tier complexity progression **Business Justification**: Accommodate diverse skill levels **Levels**:

1. **Beginner**: Single resolution, visual indicators

2. **Intermediate**: Multi-resolution, numerical data

3. **Expert**: All data, optimization challenges

BR-FUN-003: Offline Capability [Priority: High]

Requirement: 72-hour offline operation **Business Justification**: Rural market accessibility **Features**:

- Local data caching

- Offline gameplay

- Background sync

- Conflict resolution

BR-FUN-004: Performance Analytics [Priority: Medium]

Requirement: Comprehensive learning analytics **Business Justification**: Institutional sales, impact measurement **Metrics**:

- Time on task

- Error patterns

- Skill progression

- Knowledge retention

3.3 Operational Requirements

BR-OPS-001: Scalability [Priority: High]

Requirement: Support 10,000 to 1M users **Business Justification**: Growth strategy **Specifications**:

- Auto-scaling infrastructure

- CDN distribution

- Microservices architecture

- Load balancing

BR-OPS-002: Multi-language Support [Priority: Medium]

Requirement: English, Spanish, French minimum **Business Justification**: Global market reach
Implementation:

- i18n framework

- Cultural localization

- Regional content

- Local partnerships

BR-OPS-003: Support System [Priority: Medium]

Requirement: Tiered support structure **Business Justification**: User retention, satisfaction **Structure**:

- Self-service: FAQ, forums

- Community: Peer support

- Premium: Direct support

- Enterprise: Dedicated account

4. Business Process Impact

4.1 Current State Analysis

Traditional Agricultural Education

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Process Flow:
Classroom → Textbook → Limited Practice → Certification

Characteristics:
- Cost: $500-2000 per student
- Duration: 40-120 hours
- Completion: 20-30%
- Practical application: Limited
- Geographic constraints: High
```

Current Data Adoption

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Barriers:
├── Complexity: Abstract interfaces
├── Cost: $600-10,000/year
├── Training: 40+ hours required
├── Connectivity: Constant internet needed
└── Relevance: Unclear ROI
```

4.2 Future State Vision

Gamified Satellite Education

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Process Flow:
Game → Practice → Mastery → Real Application

Characteristics:
- Cost: Free to $50/student
- Duration: Self-paced
- Completion: 70% target
- Practical application: Immediate
- Geographic constraints: None
```

Enhanced Data Adoption

```
Enablers:
├── Simplicity: Intuitive gameplay
├── Accessibility: Free tier
├── Training: Learning through play
├── Offline: 72-hour capability
└── ROI: Demonstrated savings
```

4.3 Gap Analysis

Dimension	Current State	Future State	Gap to Bridge
Cost	$500-2000	Free-$50	Freemium model
Complexity	High technical barrier	Progressive disclosure	Gamification
Reach	Location-limited	Global	Web platform
Engagement	20% completion	70% completion	Achievement system
Application	Theoretical	Practical	Scenario-based

5. Cost-Benefit Analysis

5.1 Development Investment

Category	Year 1	Year 2	Year 3	Total
Development	$900,000	$400,000	$200,000	$1,500,000
Infrastructure	$50,000	$75,000	$100,000	$225,000
Marketing	$100,000	$150,000	$200,000	$450,000
Operations	$50,000	$100,000	$150,000	$300,000
Total	**$1,100,000**	**$725,000**	**$650,000**	**$2,475,000**

5.2 Revenue Projections

Stream	Year 1	Year 2	Year 3	Total
Institutional Licenses	$20,000	$100,000	$300,000	$420,000
Premium Subscriptions	$5,000	$50,000	$200,000	$255,000
Certifications	$0	$25,000	$100,000	$125,000
Grants/Sponsorships	$500,000	$200,000	$150,000	$850,000
Consulting/Training	$0	$25,000	$50,000	$75,000
Total	**$525,000**	**$400,000**	**$800,000**	**$1,725,000**

5.3 Return on Investment

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Financial ROI:
- Break-even: Month 30
- 3-Year NPV: -$750,000
- 5-Year NPV: $1,200,000 (projected)

Social ROI (3-Year):
- Water saved: 500M gallons ($2M value)
- Yield improved: 50,000 tonnes ($10M value)
- Farmers trained: 30,000 ($4.5M education value)
- Total Social Value: $16.5M
```

6. Implementation Roadmap

6.1 Phase 1: Foundation (Months 1-4)

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Milestones:
├── NASA data pipeline operational
├── Core game engine functional
├── Resolution comparison tool complete
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├──── Depth visualization working
└──── Alpha version ready
```

6.2 Phase 2: Education (Months 5-8)

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Milestones:
├──── Tutorial system complete
├──── 20 scenarios developed
├──── Assessment engine functional
├──── Educator tools ready
└──── Beta launch (500 users)
```

6.3 Phase 3: Scale (Months 9-12)

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Milestones:
├──── Public launch
├──── 10,000 users achieved
├──── 10 institutional partnerships
├──── Mobile optimization complete
└──── Year 1 revenue targets met
```

6.4 Phase 4: Growth (Year 2)

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Targets:
├──── 50,000 active users
├──── International expansion
├──── Advanced features
├──── API marketplace
└──── Break-even achievement
```

7. Risk Assessment

7.1 Business Risks

Risk	Probability	Impact	Mitigation
Low user adoption	Medium	Critical	Free tier, marketing, partnerships
NASA API changes	Low	High	Abstraction layer, multiple sources
Competitor entry	Medium	Medium	First-mover advantage, NASA relationship
Funding shortfall	Medium	Critical	Phased development, grant diversity
Educational effectiveness questioned	Low	High	Research validation, peer review

7.2 Technical Risks

Risk	Probability	Impact	Mitigation
Data accuracy issues	Medium	Critical	Expert validation, confidence intervals
Resolution confusion	High	High	Progressive education, clear visualization
Performance problems	Low	Medium	Scalable architecture, CDN
Offline sync failures	Medium	Medium	Robust conflict resolution

7.3 Compliance Risks

Risk	Regulation	Mitigation
Minor data privacy	COPPA	Age verification, parental consent
Educational records	FERPA	Data minimization, encryption
Accessibility	Section 508	WCAG compliance, testing
NASA data use	Usage policies	Legal review, attribution

8. Success Metrics & KPIs

8.1 Business Metrics

KPI	Definition	Year 1 Target	Year 3 Target
User Acquisition	Total registered users	10,000	100,000
MAU	Monthly active users	6,000	60,000
Revenue	Annual recurring revenue	$525,000	$800,000
CAC	Customer acquisition cost	<$50	<$20
LTV	Lifetime value	$75	$150
Churn	Monthly churn rate	<5%	<3%

8.2 Educational Metrics

KPI	Definition	Target	Measurement
Knowledge Gain	Pre/post test improvement	80%	Assessments
Skill Application	Users applying learned skills	40%	Surveys
Resolution Understanding	Correct resolution selection	75%	In-game metrics
Depth Comprehension	Proper depth application	70%	Task analysis
Context Adaptation	Appropriate context selection	85%	Usage patterns

8.3 Impact Metrics

KPI	Definition	3-Year Target	Validation
Water Efficiency	Reduction in water use	30%	Simulation data
Yield Optimization	Improvement in yields	20%	Model outputs

KPI	Definition	3-Year Target	Validation
Input Efficiency	Fertilizer reduction	25%	Game metrics
Sustainability Score	Composite metric	80/100	Algorithm

9. Governance Structure

9.1 Steering Committee

- NASA Education Representative (Chair)
- Agricultural Industry Leader
- Educational Institution Dean
- Technology Advisor
- User Representative

9.2 Advisory Board

- NASA Acres Program Manager
- NASA Harvest Consortium Member
- Precision Agriculture Farmer
- Climate Scientist
- Game Industry Expert

9.3 Decision Rights

Decision Type	Owner	Consulted	Informed
Strategic Direction	Steering Committee	Advisory Board	All Stakeholders
Feature Prioritization	Product Owner	Users, NASA	Development Team
Technical Architecture	Tech Lead	NASA IT	Steering Committee
Educational Content	Education Director	NASA SMEs	Advisory Board
Partnerships	Business Development	Legal, NASA	Steering Committee

10. Change Management

10.1 Organizational Changes

- Establish customer success team
- Create educator support function
- Develop content creation workflow
- Implement user feedback loops

10.2 Process Changes

- Agile development adoption
- Continuous deployment pipeline
- Data-driven decision making
- Regular stakeholder reviews

10.3 Communication Plan

- Monthly NASA updates
- Quarterly stakeholder reports
- Bi-weekly team standups
- User community forums
- Educator newsletters

11. Approval & Sign-off

Role	Name	Signature	Date
NASA Sponsor			
Project Manager			
Technical Lead			
Education Director			
Financial Officer			

Appendices

Appendix A: Market Research

Detailed market analysis, user surveys, and competitive intelligence.

Appendix B: Financial Models

Complete financial projections, sensitivity analysis, and funding scenarios.

Appendix C: Technical Specifications

System architecture, data flow diagrams, and integration requirements.

Appendix D: Educational Framework

Learning objectives, curriculum alignment, and assessment methodologies.

Appendix E: Risk Register

Comprehensive risk analysis with probability, impact, and mitigation strategies.