Business Analysis Requirements Document

Automaspec: AI-Powered Test Specification and Automation Platform

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1. Introduction

1.1 Purpose of the Document

This Business Analysis Requirements Document serves as a comprehensive specification for the Automaspec project, developed as part of diploma preparation. The document provides a structured overview of the business problem, proposed solution, functional and non-functional requirements, and implementation considerations.

The primary objectives of this document are to: - Define clear project boundaries and scope - Establish measurable success criteria and business objectives - Document functional requirements through user stories and use cases - Identify technical architecture and integration points - Assess risks, dependencies, and mitigation strategies - Provide a foundation for project evaluation and stakeholder alignment

1.2 Audience

This document is intended for: - **Academic reviewers and professors** evaluating the diploma project - **Project stakeholders** including development team members - **Technical evaluators** assessing architecture and design decisions - **Future maintainers** requiring comprehensive project understanding

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2. Vision

2.1 Vision Statement

Automaspec is an AI-powered test specification and automation platform that revolutionizes how development teams manage, document, and generate test cases. By combining intelligent test generation with collaborative specification management, Automaspec empowers QA engineers and developers to create comprehensive test coverage faster while maintaining centralized documentation and real-time synchronization with CI/CD pipelines.

2.2 Problem Statement

Modern software development teams face significant challenges in test management and documentation:

Current Problems: 1. **Scattered Documentation**: Test specifications are fragmented across multiple tools (Jira, Confluence, Excel, code comments), making it difficult to maintain a single source of truth 2. **Manual Test Creation**: Writing test code is time-consuming and repetitive, requiring developers and QA engineers to spend significant effort on boilerplate code 3. **Lack of Structure**: No standardized hierarchy for organizing test specifications leads to inconsistent documentation practices 4. **Poor Visibility**: Limited real-time visibility into test coverage and status across projects 5. **No AI Assistance**: Existing tools lack intelligent automation for test generation, forcing teams to write every test manually 6. **Integration Gaps**: Disconnect between test documentation and CI/CD execution results

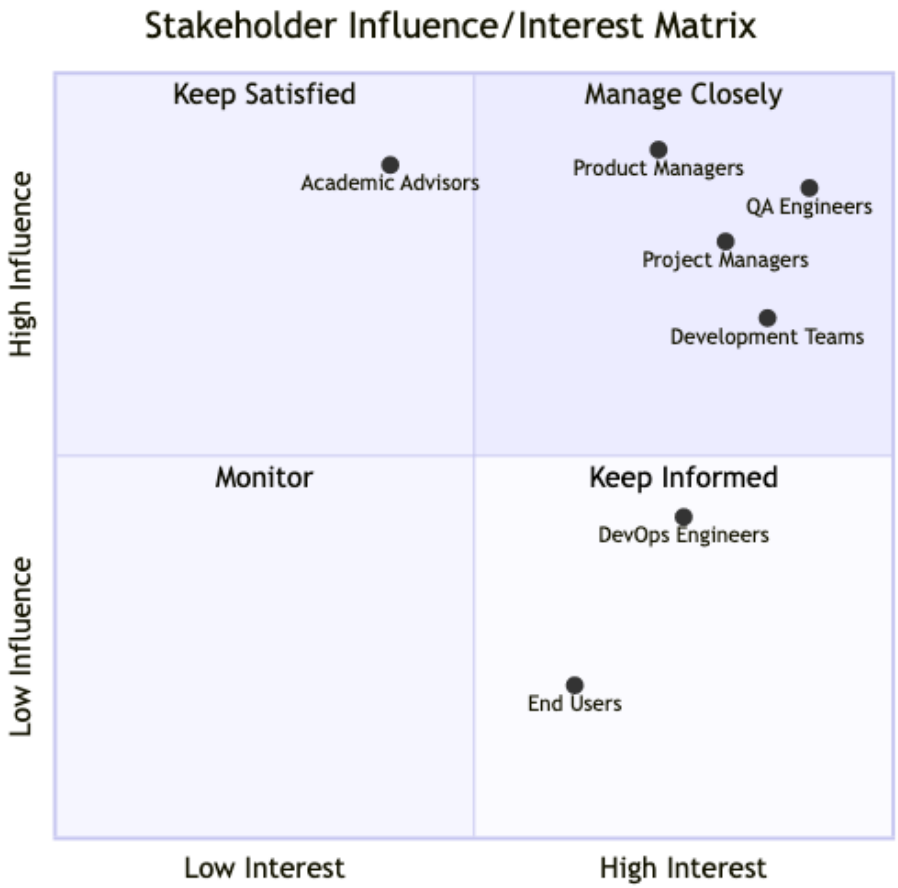
Business Impact: - Increased time-to-market due to slow test creation - Higher maintenance costs from scattered documentation - Reduced test coverage leading to quality issues - Team inefficiency from manual, repetitive work

2.3 Business Goals & Objectives

Primary Objectives: 1. **Centralize Test Documentation**: Provide a single platform for all test specifications with hierarchical organization 2. **Accelerate Test Creation**: Reduce test creation time by 20-30% using AI-powered code generation 3. **Improve Test Coverage Tracking**: Increase visibility into test coverage by 40% through automated status tracking and reporting 4. **Enable Team Collaboration**: Facilitate real-time collaboration between QA engineers and developers 5. **Automate CI/CD Integration**: Seamlessly sync test results from GitHub Actions to maintain up-to-date status

Secondary Objectives: - Establish standardized test documentation practices - Reduce technical debt in testing infrastructure - Improve team productivity and satisfaction - Create foundation for future multi-framework support

2.4 Stakeholders Analysis



Stakeholder Descriptions:

Stakeholder	Role	Interest	Influence	Engagement Strategy
QA Engineers	Primary Users	High	High	Direct involvement in requirements, beta testing, feedback sessions
Development Teams	Primary Users	High	High	Co-design features, continuous feedback, adoption champions
Product Managers	Decision Makers	Medium-High	High	Regular updates, demo sessions, ROI metrics

Stakeholder	Role	Interest	Influence	Engagement Strategy
Project Managers	Oversight	High	Medium-High	Status reports, risk management involvement
Academic Advisors	Evaluators	Medium	High	Documentation, milestone presentations, quality assurance
DevOps Engineers	Integration Support	Medium	Medium	Technical consultation for CI/CD integration
End Users (Team Members)	Indirect Users	Medium	Low	Training materials, user documentation

2.5 Success Criteria

Measurable KPIs:

1. **Test Creation Efficiency**
   - Target: 20-30% reduction in average time to create test code
   - Measurement: Time from requirement definition to completed test code
   - Baseline: Manual test creation time (pre-AI)
2. **Platform Adoption**
   - Target: 80% of invited users actively using platform within 2 months
   - Measurement: Monthly active users / Total registered users
   - Success threshold: >=5 organizations onboarded for beta
3. **Test Coverage Improvement**
   - Target: 40% improvement in test coverage visibility
   - Measurement: Percentage of specs with tracked status vs. undocumented
   - Success threshold: 90% of test specs have associated status tracking
4. **User Satisfaction**
   - Target: Net Promoter Score (NPS) >= 40
   - Measurement: User survey responses
   - Success threshold: >=70% users rate experience as "Good" or "Excellent"
5. **System Performance**
   - Target: Page load time < 2 seconds, AI generation < 60 seconds
   - Measurement: Performance monitoring metrics
   - Success threshold: 95th percentile within targets
6. **CI/CD Integration Success**
   - Target: Automated test result sync in >=80% of connected repositories
   - Measurement: Successful sync events / Total test runs

- Success threshold: Zero data loss, < 5-minute sync delay

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3. Scope

3.1 In-Scope

Core Functionality: 1. **Test Specification Management** - Hierarchical organization (Folders → Specs → Requirements → Tests) - CRUD operations for all entities - Drag-and-drop reordering - Rich text descriptions and documentation

2. **AI-Powered Test Code Generation**
   - Vitest framework support
   - AI SDK integration for intelligent code generation
   - Context-aware test generation based on requirements
   - Code review and editing capabilities
3. **Multi-Organization Support**
   - Organization creation and management
   - Role-based access control (Owner, Admin, Member)
   - Team invitation system
   - Organization-level isolation
4. **Test Status Tracking and Reporting**
   - Real-time status updates (passed, failed, pending, skipped, etc.)
   - Aggregated status at spec level
   - Visual status indicators
   - Basic reporting dashboards
5. **Authentication and User Management**
   - Email/password authentication via Better Auth
   - User profile management
   - Session management
   - Secure password handling
6. **CI/CD Integration (GitHub Actions)**
   - GitHub Actions API integration
   - Automated test result synchronization
   - Test status updates from CI/CD runs
   - Webhook support for real-time updates
7. **Docker Containerization**
   - Dockerfile for application deployment
   - Docker Compose for local development
   - Container optimization for cloud deployment

3.2 Out-of-Scope

Explicitly Excluded from Current Phase: 1. **Test Execution Engine** - Automaspec manages specifications and code, but does not run tests - Test execution handled by external test runners (Vitest, CI/CD)

2. **Mobile Applications**
   - No native iOS or Android applications
   - Responsive web design for mobile browsers only
3. **Multi-Framework Support** (Future Phase)
   - Current version supports Vitest only
   - Jest, Playwright, Cypress support planned for future releases
4. **Jira Integration** (Future Phase)
   - Integration with Jira for issue tracking
   - Bidirectional sync with Jira test management
   - Planned as post-MVP feature
5. **Advanced Analytics and Reporting** (Future Phase)
   - Custom report builders
   - Trend analysis and historical data
   - Predictive quality metrics

3.3 Assumptions

The project is built on the following key assumptions:

1. **User Competency**
   - Users have basic knowledge of software testing concepts
   - Users are familiar with Vitest testing framework
   - Users understand version control and CI/CD basics
2. **Technical Environment**
   - Organizations use Vitest for their testing needs
   - Users have access to modern web browsers (Chrome, Firefox, Safari, Edge)
   - GitHub Actions is available and accessible for CI/CD integration
   - Stable internet connection for cloud-based platform access
3. **AI Service Availability**
   - AI SDK and underlying LLM APIs remain available and stable
   - API rate limits are sufficient for expected usage
   - AI-generated code quality meets minimum standards
4. **Data and Security**
   - Users consent to storing test specifications in cloud database
   - Organizations accept shared hosting environment (multi-tenancy)
   - GDPR compliance measures are sufficient for target markets

3.4 Constraints

Technical Constraints: 1. **Hosting Platform Limitations** - Cloudflare free tier bandwidth and compute limits - Turso database storage and read/write quotas - Potential cold start delays on free hosting

2. **Team Resources**
   - Two-developer team limits development velocity
   - Limited time for extensive feature development

- No dedicated designer or UX specialist

3. **Database Technology**
   - Turso (SQLite) as primary database for MVP
   - SQLite limitations on concurrent writes
   - Limited advanced database features compared to PostgreSQL
4. **Framework Lock-in**
   - Initial version limited to Vitest framework
   - AI code generation templates specific to Vitest
   - Migration to multi-framework support requires significant refactoring

Business Constraints: 1. **Budget Limitations** - Free/low-cost services preferred (Cloudflare, Turso, Better Auth) - AI API costs must remain within reasonable limits - No budget for premium tools or services

2. **Timeline Pressure**
   - Diploma submission deadline drives development schedule
   - Must prioritize Must Have features
   - Limited time for user testing and iteration
3. **Compliance Requirements**
   - Must comply with GDPR for user data
   - Academic integrity requirements for diploma project
   - Open-source licensing considerations

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4. High-Level Solution Overview

4.1 Proposed Solution

Automaspec is a **web-based SaaS platform** built on modern technologies that addresses the test documentation and generation challenges through:

Key Solution Components:

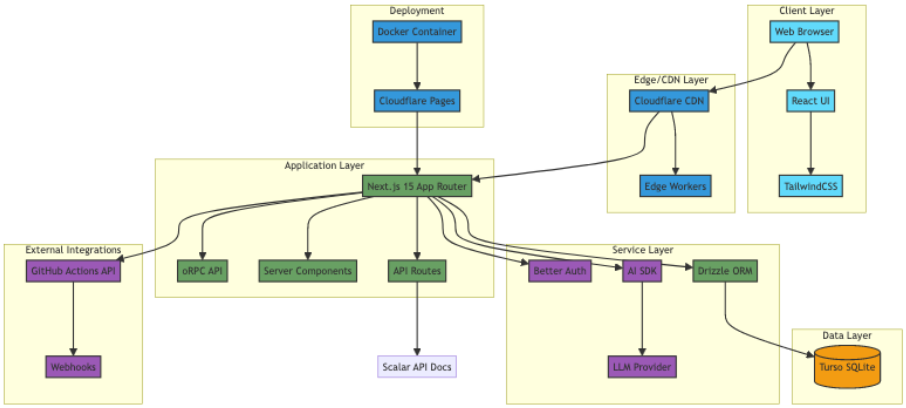
1. **Intelligent Test Generation Engine**
   - Leverages AI SDK to generate Vitest test code from natural language requirements
   - Context-aware generation considering folder structure and existing tests
   - Editable output allowing developers to refine AI suggestions
2. **Hierarchical Organization System**
   - Four-level hierarchy: Folders → Test Specs → Requirements → Tests
   - Drag-and-drop interface for intuitive organization
   - Unlimited nesting of folders for complex project structures
3. **Real-Time Collaboration Platform**
   - Multi-user support within organizations
   - Role-based permissions (Owner, Admin, Member)
   - Real-time updates using modern web technologies
4. **Automated CI/CD Synchronization**

- GitHub Actions integration for test result ingestion
- Automatic status updates on test execution
- Webhooks for real-time notification of CI/CD events

5. **Containerized Deployment**
   - Docker containerization for consistent deployment
   - Easy scaling and migration between hosting platforms
   - Simplified local development environment setup

Technical Foundation: - **Frontend**: React with Next.js 15 (App Router), TailwindCSS for styling - **Backend**: Next.js API routes with oRPC for type-safe RPC - **Database**: Turso (distributed SQLite) with Drizzle ORM - **AI**: AI SDK for LLM integration - **Authentication**: Better Auth for secure user management - **Hosting**: Cloudflare for global edge deployment - **CI/CD**: GitHub Actions for automated workflows - **Documentation**: Scalar for API documentation

4.2 Architecture / Integration Landscape



Architecture Description:

Client Layer: - Modern React-based UI with Next.js 15 framework - TailwindCSS for responsive, utility-first styling - Type-safe communication with backend via oRPC

Edge/CDN Layer: - Cloudflare CDN for global content distribution - Edge Workers for optimized routing and caching - SSL/TLS termination and DDoS protection

Application Layer: - Next.js 15 with App Router for server-side rendering and routing - oRPC for type-safe, validated API endpoints - Server Components for optimal performance - API Routes for external integrations and webhooks

Service Layer: - Better Auth: Secure authentication and session management - AI SDK: Unified interface for LLM providers (OpenAI, Anthropic) - Drizzle ORM: Type-safe database queries and migrations

Data Layer: - Turso: Distributed SQLite database with global replication - Automatic backups and point-in-time recovery

External Integrations: - GitHub Actions API for test result synchronization - Webhooks for real-time CI/CD event notifications

Deployment: - Docker containers for consistent deployment - Cloudflare Pages for hosting and continuous deployment

4.3 Alternatives Considered

Alternative 1: Standalone Desktop Application - **Description**: Electron-based desktop app with local storage - **Pros**: Offline capability, no hosting costs, faster performance - **Cons**: Limited collaboration, manual synchronization, no mobile access - **Decision**: Rejected due to limited accessibility and collaboration needs

Alternative 2: Immediate Jira Integration - **Description**: Built-in bidirectional sync with Jira from MVP - **Pros**: Seamless workflow for teams already using Jira - **Cons**: Significant complexity, vendor lock-in, extended development time - **Decision**: Postponed to future phase to focus on core features

Alternative 3: Google Sheets-Based Solution - **Description**: Google Sheets with Apps Script for automation - **Pros**: Familiar interface, easy setup, built-in collaboration - **Cons**: No structure enforcement, limited UI/UX, no AI capabilities - **Decision**: Rejected due to lack of structure and AI integration

Alternative 4: Traditional VPS Hosting (DigitalOcean, AWS EC2) - **Description**: Self-managed virtual private server - **Pros**: Full control, predictable pricing, no vendor limitations - **Cons**: Higher operational overhead, manual scaling, no edge network - **Decision**: Rejected in favor of Cloudflare for superior performance, automatic scaling, and reduced management overhead

Alternative 5: PostgreSQL Database - **Description**: Traditional PostgreSQL instead of Turso - **Pros**: More features, better for complex queries, widely adopted - **Cons**: Hosting costs, more complex setup, no edge distribution - **Decision**: Rejected in favor of Turso for free tier benefits and edge distribution

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5. Features & Requirements

5.1 Core Features (Epics)

Epic ID	Epic Name	Priority	Description
Epic 1	User Authentication & Organization Management	Must Have	User registration, login, organization creation, team invitations
Epic 2	Test Specification Hierarchy	Must Have	Folder/spec/requirement/test management with hierarchical structure
Epic 3	AI Test Generation	Must Have	AI-powered test code generation using AI SDK
Epic 4	Test Status Tracking	Must Have	Real-time test status tracking and aggregation
Epic 5	CI/CD Integration (GitHub Actions)	Must Have	Automated synchronization with GitHub Actions
Epic 6	Collaboration & Team Management	Should Have	Role-based access control and team collaboration features
Epic 7	Reporting & Analytics	Could Have	Test coverage reports and data export

5.2 Functional Requirements - Work Breakdown

Epic 1: User Authentication & Organization Management (Must Have) **US-1.1: User Registration** - **As a** new user - **I want to** sign up with email/password - **So that** I can access the platform and create test specifications

US-1.2: Organization Creation - **As a** registered user - **I want to** create an organization - **So that** I can manage my team's test specifications in an isolated workspace

US-1.3: Team Member Invitations - **As an** organization owner - **I want to** invite team members via email - **So that** they can collaborate on test specifications

US-1.4: User Profile Management - **As a** registered user - **I want to** update my profile information - **So that** my account details remain current

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Epic 2: Test Specification Hierarchy (Must Have) **US-2.1: Folder Creation and Organization** - **As a** QA engineer - **I want to** create folders with nested structure - **So that** I can organize test specs by feature/module/component

US-2.2: Test Spec Creation - **As a** developer - **I want to** create test specifications with name and description - **So that** I can document test scenarios for specific features

US-2.3: Requirement Definition - **As a** QA engineer - **I want to** add requirements to test specs - **So that** I can break down test coverage into granular testable units

US-2.4: Item Reordering - **As a** developer - **I want to** reorder folders, specs, and requirements via drag-and-drop - **So that** I can maintain logical structure that matches project organization

US-2.5: Bulk Operations - **As a** QA engineer - **I want to** move or copy multiple specs between folders - **So that** I can efficiently reorganize test documentation

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Epic 3: AI Test Generation (Must Have) **US-3.1: AI-Powered Code Generation** - **As a** developer - **I want to** generate Vitest test code from requirements using AI SDK - **So that** I can save time on writing boilerplate test code

US-3.2: Code Review Interface - **As a** QA engineer - **I want to** review AI-generated test code before saving - **So that** I can ensure code quality and correctness

US-3.3: Test Code Editing - **As a** developer - **I want to** edit generated test code directly in the platform - **So that** I can customize tests to match specific needs

US-3.4: Code Export - **As a** developer - **I want to** export generated test code to files - **So that** I can integrate tests into my codebase

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Epic 4: Test Status Tracking (Must Have) **US-4.1: Test Status Visualization** - **As a** QA engineer - **I want to** see test status (passed/failed/pending/skipped/missing) - **So that** I can track test coverage and identify failing tests

US-4.2: Aggregated Status at Spec Level - **As a** developer - **I want to** see aggregated status for entire test specs - **So that** I can quickly identify problematic areas

US-4.3: Status History - **As a** QA lead - **I want to** view status change history for tests - **So that** I can track test stability over time

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Epic 5: CI/CD Integration (GitHub Actions) (Must Have) **US-5.1: GitHub Actions Connection** - **As a** developer - **I want to** connect my GitHub repository to Automaspec - **So that** test results automatically sync from CI/CD runs

US-5.2: Automated Test Result Sync - **As a** developer - **I want to** have test results from GitHub Actions automatically update spec status - **So that** I don't need to manually track test execution results

US-5.3: Test Spec Export for CI/CD - **As a** developer - **I want to** export test specs in CI/CD-compatible format - **So that** I can integrate generated tests into GitHub Actions workflows

US-5.4: Failure Notifications - **As a** QA engineer - **I want to** receive notifications when tests fail in CI/CD - **So that** I can quickly respond to quality issues

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Epic 6: Collaboration & Team Management (Should Have) **US-6.1: Role-Based Access Control** - **As an** organization owner - **I want to** assign roles (Owner, Admin, Member) to team members - **So that** I can control who can modify test specifications

US-6.2: Real-Time Updates - **As a** team member - **I want to** see changes made by other users in real-time - **So that** I can collaborate effectively without conflicts

US-6.3: Activity Feed - **As an** organization admin - **I want to** view activity log of changes to specs - **So that** I can track team contributions and changes

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Epic 7: Reporting & Analytics (Could Have) **US-7.1: Test Coverage Reports** - **As a** project manager - **I want to** view test coverage reports and statistics - **So that** I can assess quality and identify coverage gaps

US-7.2: Specification Export - **As a** QA lead - **I want to** export test specifications to PDF/Excel - **So that** I can share documentation with stakeholders

US-7.3: Dashboard Widgets - **As a** developer - **I want to** customize dashboard with widgets showing key metrics - **So that** I can monitor important KPIs at a glance

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5.3 Priority Labelling (MoSCoW Method)

Must Have (Critical for MVP): - Epic 1: User Authentication & Organization Management - Epic 2: Test Specification Hierarchy - Epic 3: AI Test Generation - Epic 4: Test Status Tracking - Epic 5: CI/CD Integration (GitHub Actions)

Should Have (Important but not critical): - Epic 6: Collaboration & Team Management - Real-time updates and activity tracking - Advanced role-based permissions

Could Have (Desirable): - Epic 7: Reporting & Analytics - Custom dashboard widgets - Advanced export formats - Historical trend analysis

Won't Have (Future Phase): - Mobile native applications (iOS/Android) - Multi-framework support (Jest, Playwright, Cypress) - Jira integration - Advanced AI features (test case optimization, intelligent suggestions) - Custom theming and white-labeling

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5.4 Non-Functional Requirements

Performance Requirements: - **Page Load Time**: Initial page load < 2 seconds on 3G connection - **AI Generation Time**: Test code generation $<$ 60 seconds per requirement - **API Response Time**: 95th percentile < 500ms for CRUD operations - **Database Query Time**: 95th percentile < 100ms for standard queries - **Concurrent Users**: Support 50 concurrent users per organization

Security Requirements: - **Authentication**: Secure email/password authentication with bcrypt hashing - **Authorization**: Role-based access control with organization-level isolation - **Data Encryption**: HTTPS/TLS 1.3 for all data in transit - **Password Policy**: Minimum 8 characters, complexity requirements - **Session Management**: Secure session handling with automatic timeout - **API Security**: Rate limiting to prevent abuse (100 requests/minute per user) - **SQL Injection Protection**: Parameterized queries via Drizzle ORM - **XSS Protection**: Input sanitization and output encoding

Scalability Requirements: - **User Capacity**: Support 1,000 registered users in MVP phase - **Organization Capacity**: Support 100 organizations - **Data Storage**: Handle 10,000 test specifications per organization - **Horizontal Scaling**: Docker containers allow horizontal scaling - **Database Scaling**: Turso edge replication for read scalability

Usability Requirements: - **Intuitive UI**: User can create first test spec within 5 minutes without documentation - **Keyboard Shortcuts**: Common actions accessible via keyboard (Ctrl+N for new, etc.) - **Responsive Design**: Full functionality on desktop, tablet, and mobile browsers - **Accessibility**: WCAG 2.1 Level AA compliance for core features - **Error Handling**: Clear, actionable error messages - **Loading States**: Visual feedback for all async operations

Availability Requirements: - **Uptime**: 99% uptime SLA on Cloudflare hosting - **Recovery Time Objective (RTO)**: $<$ 4 hours - **Recovery Point Objective (RPO)**: $<$ 24 hours (daily database backups) - **Monitoring**: Real-time monitoring with alerting for downtime

Maintainability Requirements: - **Code Quality**: TypeScript for type safety, ESLint for code standards - **Documentation**: API documentation via Scalar, inline code comments - **Automated Testing**: Unit test coverage >= 70%, integration tests for critical paths - **Version Control**: Git with conventional commits - **CI/CD Pipeline**: Automated builds, tests, and deployments - **Database Migrations**: Versioned migrations via Drizzle Kit

Portability Requirements: - **Containerization**: Docker support for deployment flexibility - **Cross-Platform**: Runs on Linux, macOS, Windows via Docker - **Browser Compatibility**: Support Chrome, Firefox, Safari, Edge (latest 2 versions) - **Cloud Agnostic**: Can migrate between Cloudflare, Vercel, AWS, or self-hosted

Compatibility Requirements: - **Vitest Integration**: Compatible with Vitest v1.x and v2.x - **GitHub Actions**: Support GitHub Actions API v3 - **Modern Browsers**: ES2020 JavaScript features - **Database**: SQLite 3.x compatible (Turso)

5.5 Regulatory / Compliance Needs

GDPR Compliance (General Data Protection Regulation): - **Right to Access**: Users can download all their personal data - **Right to Deletion**: Users can request complete account deletion - **Right to Rectification**: Users can update personal information - **Data Minimization**: Collect only necessary user data - **Consent Management**: Clear consent for data collection and processing - **Data Portability**: Export user data in machine-readable format (JSON) - **Privacy Policy**: Clear privacy policy outlining data usage - **Data Retention**: Define and enforce data retention policies - **Breach Notification**: Process for notifying users of data breaches

Academic Integrity: - **Original Work**: All code and documentation are original work for diploma project - **Attribution**: Proper attribution for third-party libraries and frameworks - **Code Repository**: Public GitHub repository demonstrating development history - **Documentation**: Comprehensive documentation of design decisions

Open Source Licensing: - **License Selection**: MIT or Apache 2.0 license for core application - **Dependency Licensing**: Verify compatibility of all dependencies - **Attribution**: Maintain NOTICE file with third-party attributions

Data Residency: - **Turso Regions**: Data stored in Turso's closest edge location - **User Control**: Users can request specific region preferences (future)

5.6 Use Case Diagram

Use Case Descriptions:

Use Case	Actor(s)	Description
UC1: Sign Up	QA Engineer, Developer	Register new user account with email/password
UC2: Sign In	QA Engineer, Developer	Authenticate and access platform
UC3: Manage Profile	QA Engineer, Developer	Update user profile information
UC4: Create Organization	Org Owner	Create new organization workspace
UC5: Invite Members	Org Owner	Invite team members to organization
UC6: Manage Roles	Org Owner	Assign roles and permissions to members
UC7: Create Folder	QA Engineer	Create folder for organizing test specs
UC8: Create Test Spec	Developer	Create new test specification document
UC9: Add Requirements	QA Engineer	Define testable requirements within spec
UC10: Reorder Items	Developer	Reorganize folder/spec hierarchy
UC11: Generate Test Code	Developer, AI SDK	Generate Vitest code from requirements
UC12: Review Generated Code	QA Engineer	Review and validate AI-generated tests
UC13: Edit Test Code	Developer	Modify generated test code
UC14: Export Tests	Developer	Export test code to files
UC15: View Test Status	QA Engineer	Monitor test execution status
UC16: Track Spec Status	Developer	View aggregated status for specs
UC17: Connect GitHub Repo	Developer	Link GitHub repository for CI/CD sync
UC18: Sync Test Results	GitHub Actions	Automatically sync test execution results
UC19: Send Failure Alerts	System	Notify team of test failures
UC20: View Team Activity	Team Member	Monitor team changes and updates

Use Case	Actor(s)	Description
UC21: Real-time Updates	Team Member	Receive live updates from collaborators
UC22: Generate Reports	Org Owner	Create test coverage reports
UC23: Export Documentation	QA Engineer	Export specs to shareable formats

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6. Risks & Dependencies

6.1 Risks

Risk ID	Risk Description	Likelihood	Impact	Severity	Owner
R1	AI SDK API costs exceed budget due to high usage	Medium	High	High	Development Team
R2	Limited real user testing leads to usability issues	High	Medium	Medium	Development Team
R3	GitHub Actions integration complexity causes delays	Medium	Medium	Medium	Development Team
R4	Cloudflare/Turso free tier limitations impact performance	Low	Low	Low	Development Team
R5	AI-generated test quality is insufficient	Medium	High	High	Development Team
R6	Better Auth service outage disrupts authentication	Low	High	Medium	Third-party Service
R7	SQLite limitations cause performance bottlenecks	Low	Medium	Low	Development Team
R8	Scope creep delays MVP delivery	Medium	High	High	Project Management

Risk Matrix:

```
         Impact
        Low    Medium    High
High    R4      R2       R1, R5, R8
Medium  R7      R3, R6    -
Low      -       -        -
    Likelihood
```

6.2 Dependencies

Critical Dependencies:

1. **AI SDK and LLM API Availability**
   - **Type**: External Service
   - **Criticality**: High
   - **Description**: Platform relies on AI SDK for core test generation feature
   - **Contingency**: Implement fallback to manual test creation if AI unavailable
2. **Cloudflare Hosting Platform**
   - **Type**: Infrastructure
   - **Criticality**: High
   - **Description**: Application hosting and CDN services
   - **Contingency**: Docker containerization allows migration to alternative hosting
3. **Turso Database Service**
   - **Type**: Infrastructure
   - **Criticality**: High
   - **Description**: Primary data storage for all test specifications
   - **Contingency**: Regular backups, ability to migrate to self-hosted SQLite
4. **Better Auth Service**
   - **Type**: External Service
   - **Criticality**: High
   - **Description**: User authentication and session management
   - **Contingency**: Implement fallback to basic auth if service unavailable
5. **GitHub Actions API**
   - **Type**: External Integration
   - **Criticality**: Medium
   - **Description**: CI/CD test result synchronization
   - **Contingency**: Manual test result upload feature

Supporting Dependencies:

6. **Modern Browser Support**
   - **Type**: Client Requirement
   - **Criticality**: Medium

- **Description**: Platform requires modern browsers with ES2020 support
- **Contingency**: Progressive enhancement for older browsers

7. **Node.js Ecosystem**
   - **Type**: Development Dependency
   - **Criticality**: Medium
   - **Description**: Next.js, React, and build tools require Node.js
   - **Contingency**: Stable Node.js LTS version
8. **Vercel AI SDK Library**
   - **Type**: Software Dependency
   - **Criticality**: High
   - **Description**: Abstraction layer for LLM providers
   - **Contingency**: Direct API integration if SDK unavailable

6.3 Mitigation Strategies

Risk R1: AI SDK API Costs May Exceed Budget - **Prevention**: - Implement strict API request quotas per user/organization - Cache AI-generated code to avoid regeneration - Provide usage dashboard for cost monitoring - Set hard limits on generation requests per day - **Response**: - Implement tier-based pricing if costs escalate - Switch to more cost-effective LLM providers - Reduce AI context size to minimize token usage

Risk R2: Limited Testing with Real Users - **Prevention**: - Conduct early beta testing with 5-10 users from target audience - Create detailed test scenarios covering common workflows - Implement analytics to track user behavior - **Response**: - Rapid iteration based on feedback - Prioritize critical usability issues - Post-MVP user testing for continuous improvement

Risk R3: GitHub Actions Integration Complexity - **Prevention**: - Start with basic integration, iterate gradually - Use well-documented GitHub Actions APIs - Implement comprehensive error handling - Test with multiple repository types - **Response**: - Simplify integration scope if complexity exceeds estimates - Provide detailed integration documentation - Offer manual result upload as fallback

Risk R4: Cloudflare/Turso Free Tier Limitations - **Prevention**: - Implement aggressive caching strategies - Optimize database queries and indexes - Monitor usage metrics proactively - Implement request throttling - **Response**: - Upgrade to paid tier if necessary - Migrate to alternative hosting (Docker enables this) - Implement usage-based access controls

Risk R5: AI-Generated Test Quality is Insufficient - **Prevention**: - Implement AI prompt engineering best practices - Provide rich context to AI (folder structure, existing tests) - Add code review step before accepting generated code - Iterate on prompts based on output quality - **Response**: - Allow manual editing of all generated code - Provide templates and examples for better generation - Collect feedback on generation quality

Risk R6: Better Auth Service Outage - **Prevention**: - Monitor Better Auth status page proactively - Implement graceful degradation for auth features - Cache authentication tokens appropriately - **Response**: - Implement basic email/password auth as fallback - Communicate outage to users transparently - Consider self-hosted auth solution for critical situations

Risk R7: SQLite Limitations Cause Performance Bottlenecks - **Prevention**: - Optimize queries with proper indexes - Implement read replicas via Turso edge network - Use connection pooling - Profile slow queries regularly - **Response**: - Implement caching layer for frequently accessed data - Consider migration to PostgreSQL if bottlenecks persist - Optimize data model and normalization

Risk R8: Scope Creep Delays MVP Delivery - **Prevention**: - Strict adherence to MoSCoW prioritization - Weekly sprint reviews with scope validation - Maintain feature freeze 2 weeks before deadline - Say "no" to non-essential features - **Response**: - Cut Could Have features immediately if timeline at risk - Defer Should Have features to post-MVP - Focus exclusively on Must Have epics

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7. Appendix

7.1 Glossary

Term	Definition
AI SDK	Unified SDK for interacting with multiple LLM providers
Better Auth	Open-source authentication solution
CI/CD	Continuous Integration/Continuous Deployment
Cloudflare	Global CDN and edge computing platform
Drizzle ORM	TypeScript ORM for SQL databases
Epic	Large body of work that can be broken down into user stories
GitHub Actions	CI/CD platform integrated with GitHub
LLM	Large Language Model (e.g., GPT-4, Claude)
MoSCoW	Prioritization method: Must Have, Should Have, Could Have, Won't Have
MVP	Minimum Viable Product
Next.js	React framework for production applications
oRPC	Type-safe RPC framework
Scalar	API documentation tool
Test Spec	Test specification document containing requirements and tests
Turso	Distributed SQLite database platform
Vitest	Fast unit testing framework for Vite projects

7.2 References

1. **Business Analysis Body of Knowledge (BABOK)**
   - International Institute of Business Analysis (IIBA)
   - Requirements elicitation and documentation standards
2. **Technical Documentation**
   - Next.js Documentation: https://nextjs.org/docs
   - Turso Documentation: https://docs.turso.tech
   - AI SDK Documentation: https://sdk.vercel.ai
   - GitHub Actions API: https://docs.github.com/en/rest/actions
3. **Industry Standards**
   - ISO/IEC 25010: Systems and software quality models
   - IEEE 830: Software Requirements Specifications
   - WCAG 2.1: Web Content Accessibility Guidelines
4. **Regulatory Compliance**
   - GDPR (EU Regulation 2016/679): General Data Protection Regulation

7.3 Document Control

Version	Date	Author	Changes
1.0	2025-10-15	Development Team	Initial document creation

Document Prepared By:
Automaspec Development Team

Prepared For:
Academic Review Committee

Date:
October 15, 2025

Status:
Final for Review

This document represents the comprehensive business analysis for the Automaspec project, fulfilling the maximum requirements for diploma preparation. All sections adhere to industry-standard BA practices and academic requirements.