Software Requirements Specification (SRS)

Smart Pricing Intelligence Platform for B2B Products

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Prepared By: Development Team
Project Duration: 6 Months

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1. Introduction

1.1 Purpose

This Software Requirements Specification (SRS) document provides a comprehensive description of the Smart Pricing Intelligence Platform for B2B Products. It defines the functional and non-functional requirements, system architecture, and implementation specifications for the development team.

1.2 Scope

The Smart Pricing Intelligence Platform is designed to:

- Automatically track competitor pricing across B2B industrial products
- Analyze demand signals and market trends
- Generate intelligent pricing recommendations using machine learning
- Provide real-time dashboard for pricing decision-makers

- Alert stakeholders of pricing opportunities and anomalies

1.3 Definitions and Abbreviations

- **API**: Application Programming Interface
- **B2B**: Business-to-Business
- **ML**: Machine Learning
- **ETL**: Extract, Transform, Load
- **SLA**: Service Level Agreement
- **CI/CD**: Continuous Integration/Continuous Deployment

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2. Overall Description

2.1 Product Perspective

The Smart Pricing Intelligence Platform operates as a standalone web-based system that integrates with external data sources and internal business systems to provide comprehensive pricing intelligence.

2.2 Product Functions

The system provides the following primary functions:

- Automated competitor price monitoring
- Demand signal analysis and processing
- Machine learning-based pricing optimization
- Interactive dashboard and reporting
- Administrative configuration management
- Real-time alerting and notifications

2.3 User Classes

1. **Pricing Analysts** - Primary users who analyze pricing data and make recommendations
2. **Executive Decision Makers** - Review pricing strategies and approve major changes
3. **System Administrators** - Configure system parameters and manage user access
4. **Data Engineers** - Maintain data pipelines and monitor system health

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3. System Features

3.1 Data Acquisition Module

3.1.1 Web Scraping Engine

Priority: High
Description: Automated system to collect competitor pricing data from various B2B websites and marketplaces.

Functional Requirements:

- FR-001: System shall scrape competitor websites every 4-6 hours
- FR-002: System shall handle JavaScript-rendered content
- FR-003: System shall implement rate limiting and respectful crawling
- FR-004: System shall detect and adapt to website structure changes
- FR-005: System shall store raw scraped data with timestamps
- FR-006: System shall validate data quality and flag anomalies

3.1.2 API Integration Layer

Priority: High
Description: Integration with external APIs for demand signals and market data.

Functional Requirements:

- FR-007: System shall integrate with Google Trends API
- FR-008: System shall process internal sales data via REST API
- FR-009: System shall handle API rate limits and authentication
- FR-010: System shall implement retry mechanisms for failed requests
- FR-011: System shall cache frequently accessed API data

3.2 Data Processing Module

3.2.1 Data Normalization Engine

Priority: High
Description: Processes and standardizes data from multiple sources.

Functional Requirements:

- FR-012: System shall normalize product names across different sources
- FR-013: System shall convert prices to common currency
- FR-014: System shall handle missing or incomplete data
- FR-015: System shall implement data quality scoring
- FR-016: System shall maintain data lineage tracking

3.2.2 Data Warehouse

Priority: High
Description: Centralized storage system for all processed data.

Functional Requirements:

- FR-017: System shall store historical pricing data for minimum 2 years
- FR-018: System shall implement data partitioning for performance
- FR-019: System shall provide data backup and recovery mechanisms
- FR-020: System shall support real-time and batch data ingestion

3.3 Machine Learning Module

3.3.1 Price Elasticity Analysis

Priority: High
Description: Analyzes price sensitivity and demand relationships.

Functional Requirements:

- FR-021: System shall calculate price elasticity coefficients
- FR-022: System shall identify optimal price points
- FR-023: System shall provide confidence intervals for predictions
- FR-024: System shall update models with new data automatically

3.3.2 Pricing Recommendation Engine

Priority: High
Description: Generates intelligent pricing suggestions using ML algorithms.

Functional Requirements:

- FR-025: System shall implement linear regression models
- FR-026: System shall implement reinforcement learning algorithms
- FR-027: System shall provide multiple pricing scenarios
- FR-028: System shall consider competitor pricing in recommendations
- FR-029: System shall factor in cost constraints and business rules

3.4 User Interface Module

3.4.1 Analytics Dashboard

Priority: High
Description: Interactive web interface for data visualization and analysis.

Functional Requirements:

- FR-030: System shall display real-time pricing trends
- FR-031: System shall provide competitor price comparisons
- FR-032: System shall show demand signal correlations
- FR-033: System shall offer customizable chart views
- FR-034: System shall support data export functionality
- FR-035: System shall provide drill-down capabilities

3.4.2 Administrative Interface

Priority: Medium
Description: Configuration and management interface for system administrators.

Functional Requirements:

- FR-036: System shall allow configuration of scraping targets
- FR-037: System shall enable setting of pricing rules and constraints
- FR-038: System shall provide user access management
- FR-039: System shall offer system monitoring dashboards
- FR-040: System shall support bulk configuration changes

3.5 Alerting and Notification Module

3.5.1 Alert Engine

Priority: Medium
Description: Automated notification system for pricing opportunities and anomalies.

Functional Requirements:

- FR-041: System shall detect significant competitor price changes
- FR-042: System shall identify pricing opportunities based on demand signals
- FR-043: System shall send notifications via email and dashboard
- FR-044: System shall allow customizable alert thresholds
- FR-045: System shall provide alert escalation mechanisms

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4. External Interface Requirements

4.1 User Interfaces

- Web-based responsive dashboard compatible with modern browsers
- Mobile-responsive design for tablet and smartphone access

- Accessibility compliance (WCAG 2.1 AA standards)

4.2 Hardware Interfaces

- Cloud-based deployment requiring no specific hardware
- Support for horizontal scaling across multiple server instances

4.3 Software Interfaces

- Integration with PostgreSQL database
- Integration with MongoDB for document storage
- REST API interfaces for external system integration
- Integration with Google Trends API
- Support for CSV file imports and exports

4.4 Communication Interfaces

- HTTPS for all web communications
- Secure API endpoints with authentication
- Email service integration for notifications

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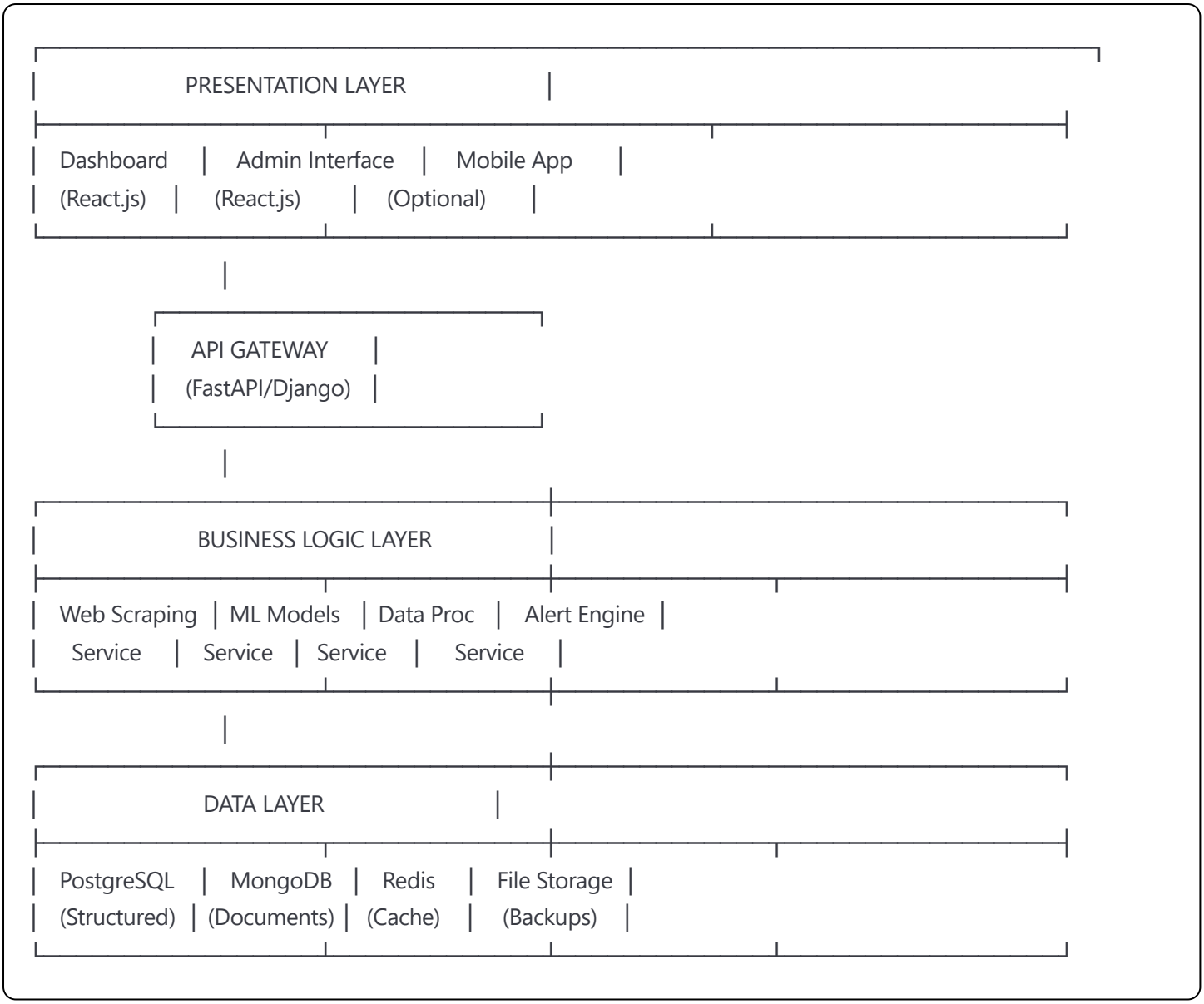
5. System Architecture

5.1 High-Level Architecture



5.2 Technology Stack

Frontend:

- React.js 18+ with TypeScript
- Tailwind CSS for styling
- Recharts for data visualization
- React Query for state management

Backend:

- FastAPI with Python 3.9+
- Pydantic for data validation
- SQLAlchemy for ORM
- Celery for background tasks

Database:

- PostgreSQL 14+ for relational data
- MongoDB 5+ for document storage
- Redis for caching and session management

Data Processing:

- Pandas for data manipulation
- BeautifulSoup/Scrapy for web scraping
- Apache Airflow for workflow orchestration

Machine Learning:

- scikit-learn for traditional ML
- XGBoost for gradient boosting
- TensorFlow for deep learning

Deployment:

- Docker containers
- GitHub Actions for CI/CD
- Cloud platform (AWS/GCP/Azure)

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6. Data Requirements

6.1 Data Sources

6.1 Data Sources

6.1.1 Primary B2B Marketplaces and Platforms

Primary B2B Marketplaces and Platforms (India-focused)

Indian B2B Marketplaces:

- **IndiaMART.com** - India's largest online B2B marketplace, connecting buyers with suppliers
- **TradeIndia.com** - India's largest B2B marketplace with over 10 million registered users
- **IndustryBuying.com** - India's largest marketplace for Industrial Goods, Business Supplies, MRO Products
- **mjunction.in** - India's largest B2B e-commerce company
- **rivexa.com** - B2B procurement platform from mjunction—a Tata Steel and SAIL joint venture
- **MSMEmart.com** - Indian B2B portal facilitating online marketing support to Indian MSMEs

Chinese Supplier Platforms (for Indian buyers):

- **Alibaba.com** - Primary platform for China-India trade
- **Made-in-China.com** - Chinese manufacturer direct pricing
- **GlobalSources.com** - Asian supplier marketplace with India focus
- **1688.com** - Alibaba's domestic Chinese platform (wholesale pricing)

International Platforms:

- **DirectIndustry.com** - Global B2B marketplace for industrial equipment
- **ThomasNet.com** - North American industrial suppliers (for comparison)
- **GlobalTradePlaza.com** - Global Trade Plaza connects importers and exporters globally

Specialized Industry Platforms:

- **Chemarc.com** - Chemical procurement platform for India
- **Chemical-distributors.com** - B2B chemical hub connecting the global chemical industry

6.1.2 Competitor Data Sources

Direct Competitor Websites:

- Manufacturer direct-to-buyer portals
- Distributor e-commerce platforms
- Regional supplier websites
- Industry-specific marketplaces

Pricing Intelligence Sources:

- Product names and descriptions
- Current pricing information
- Historical price changes
- Product availability status
- Promotional offers and discounts

6.1.2 Demand Signals

- Google Trends search volume
- Industry keyword performance
- Seasonal demand patterns
- Economic indicators
- Market research data

6.1.3 Internal Data

- Sales transaction history
- Product cost information
- Inventory levels
- Customer segmentation data
- Revenue and profit margins

6.2 Data Models

6.2.1 Product Entity

```
Product {
  product_id: UUID
  name: String
  category: String
  description: Text
  internal_cost: Decimal
  created_at: Timestamp
  updated_at: Timestamp
}
```

6.2.2 Price History Entity

```
PriceHistory {
  price_id: UUID
  product_id: UUID (FK)
  competitor_id: UUID (FK)
  price: Decimal
  currency: String
  timestamp: Timestamp
  source_url: String
  confidence_score: Float
}
```

6.2.3 Demand Signal Entity

```
DemandSignal {
  signal_id: UUID
  product_id: UUID (FK)
  signal_type: Enum
  value: Float
  timestamp: Timestamp
  source: String
  metadata: JSON
}
```

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7. Functional Requirements

7.1 Data Acquisition Requirements

FR-DA-001: Web Scraping Capability

- System shall scrape competitor pricing from at least 10 different B2B websites
- System shall handle dynamic content loading and JavaScript execution
- System shall implement respectful crawling practices with configurable delays
- System shall detect and bypass basic anti-bot measures
- System shall maintain success rate > 95% for active scraping targets

FR-DA-002: API Integration

- System shall integrate with Google Trends API for demand signal collection
- System shall support RESTful API endpoints for internal data ingestion
- System shall handle API authentication and token refresh automatically
- System shall implement exponential backoff for failed API requests
- System shall cache API responses to minimize external calls

FR-DA-003: Data Quality Assurance

- System shall validate scraped data against predefined schemas
- System shall flag price anomalies exceeding 50% variance from historical averages
- System shall implement duplicate detection and removal
- System shall maintain data completeness scores for each source
- System shall generate data quality reports daily

7.2 Data Processing Requirements

FR-DP-001: Data Normalization

- System shall normalize product names using fuzzy matching algorithms
- System shall convert all prices to USD using current exchange rates
- System shall standardize product categories using predefined taxonomy
- System shall handle missing data using configurable imputation strategies
- System shall maintain audit trail for all data transformations

FR-DP-002: Data Storage and Retrieval

- System shall store minimum 24 months of historical pricing data
- System shall support sub-second query response times for dashboard requests
- System shall implement data archiving for records older than 2 years
- System shall provide full-text search capabilities across product descriptions
- System shall support real-time data streaming for critical updates

7.3 Machine Learning Requirements

FR-ML-001: Price Elasticity Modeling

- System shall calculate price elasticity coefficients with 95% confidence intervals
- System shall update elasticity models weekly with new sales data
- System shall identify optimal price points considering demand response
- System shall provide elasticity forecasts for 30, 60, and 90-day periods
- System shall validate model accuracy using holdout test sets

FR-ML-002: Pricing Recommendation Engine

- System shall generate pricing recommendations using ensemble methods
- System shall consider competitor pricing, demand signals, and cost constraints
- System shall provide multiple pricing scenarios (conservative, moderate, aggressive)
- System shall explain recommendation rationale using interpretable features
- System shall track recommendation accuracy and business impact

FR-ML-003: Reinforcement Learning Implementation

- System shall implement multi-armed bandit algorithms for price testing
- System shall optimize for configurable business objectives (revenue, profit, market share)
- System shall provide A/B testing framework for pricing experiments
- System shall learn from pricing decisions and market responses
- System shall balance exploration of new prices with exploitation of known optimal prices

7.4 User Interface Requirements

FR-UI-001: Dashboard Functionality

- System shall display real-time pricing trends with interactive charts
- System shall provide competitor price comparison views
- System shall show pricing recommendations with confidence scores
- System shall support customizable dashboard layouts per user
- System shall enable data export in CSV, Excel, and PDF formats

FR-UI-002: Administrative Interface

- System shall allow configuration of scraping targets and schedules
- System shall provide user role and permission management
- System shall offer system health monitoring and alerting configuration
- System shall support bulk upload of product and cost data
- System shall maintain comprehensive audit logs of administrative actions

7.5 Alert and Notification Requirements

FR-AN-001: Alert Generation

- System shall detect competitor price changes exceeding configurable thresholds
- System shall identify pricing opportunities based on demand signal analysis
- System shall generate alerts for data quality issues and system anomalies
- System shall provide alert prioritization based on business impact
- System shall support custom alert rules using business logic expressions

FR-AN-002: Notification Delivery

- System shall send notifications via email, SMS, and in-app messaging
- System shall support notification escalation based on alert severity
- System shall provide notification templates for different alert types
- System shall maintain notification delivery status and acknowledgment tracking
- System shall offer notification preferences and frequency controls per user

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8. Non-Functional Requirements

8.1 Performance Requirements

NFR-PE-001: Response Time

- Dashboard page load time shall not exceed 3 seconds
- API response time for data queries shall not exceed 500ms for 95th percentile
- Pricing recommendation generation shall complete within 10 seconds
- Data export operations shall complete within 30 seconds for standard reports

NFR-PE-002: Throughput

- System shall support concurrent access by up to 100 users
- Data ingestion pipeline shall process at least 10,000 price points per hour
- ML model training shall complete within 2 hours for full dataset refresh

NFR-PE-003: Scalability

- System shall support horizontal scaling of web scraping workers
- Database shall handle up to 10 million price history records
- System shall accommodate 50% annual growth in data volume

8.2 Reliability Requirements

NFR-RE-001: Availability

- System shall maintain 99.5% uptime during business hours (8 AM - 8 PM EST)
- Planned maintenance windows shall not exceed 4 hours monthly
- System shall recover from failures within 15 minutes

NFR-RE-002: Data Integrity

- System shall implement database backup every 6 hours
- Data corruption incidents shall affect less than 0.01% of records
- System shall maintain complete audit trail of all data modifications

8.3 Security Requirements

NFR-SE-001: Authentication and Authorization

- System shall implement multi-factor authentication for all users
- System shall support role-based access control with minimum privilege principle
- Session timeout shall not exceed 8 hours of inactivity

NFR-SE-002: Data Protection

- All data transmission shall use TLS 1.3 encryption
- Sensitive data at rest shall be encrypted using AES-256

- System shall comply with GDPR and SOC 2 requirements

8.4 Usability Requirements

NFR-US-001: User Experience

- System shall provide intuitive navigation with maximum 3 clicks to reach any feature
- Dashboard shall be responsive and functional on tablets and mobile devices
- System shall provide contextual help and documentation

NFR-US-002: Accessibility

- System shall comply with WCAG 2.1 AA accessibility standards
- Interface shall support keyboard navigation
- System shall provide screen reader compatibility

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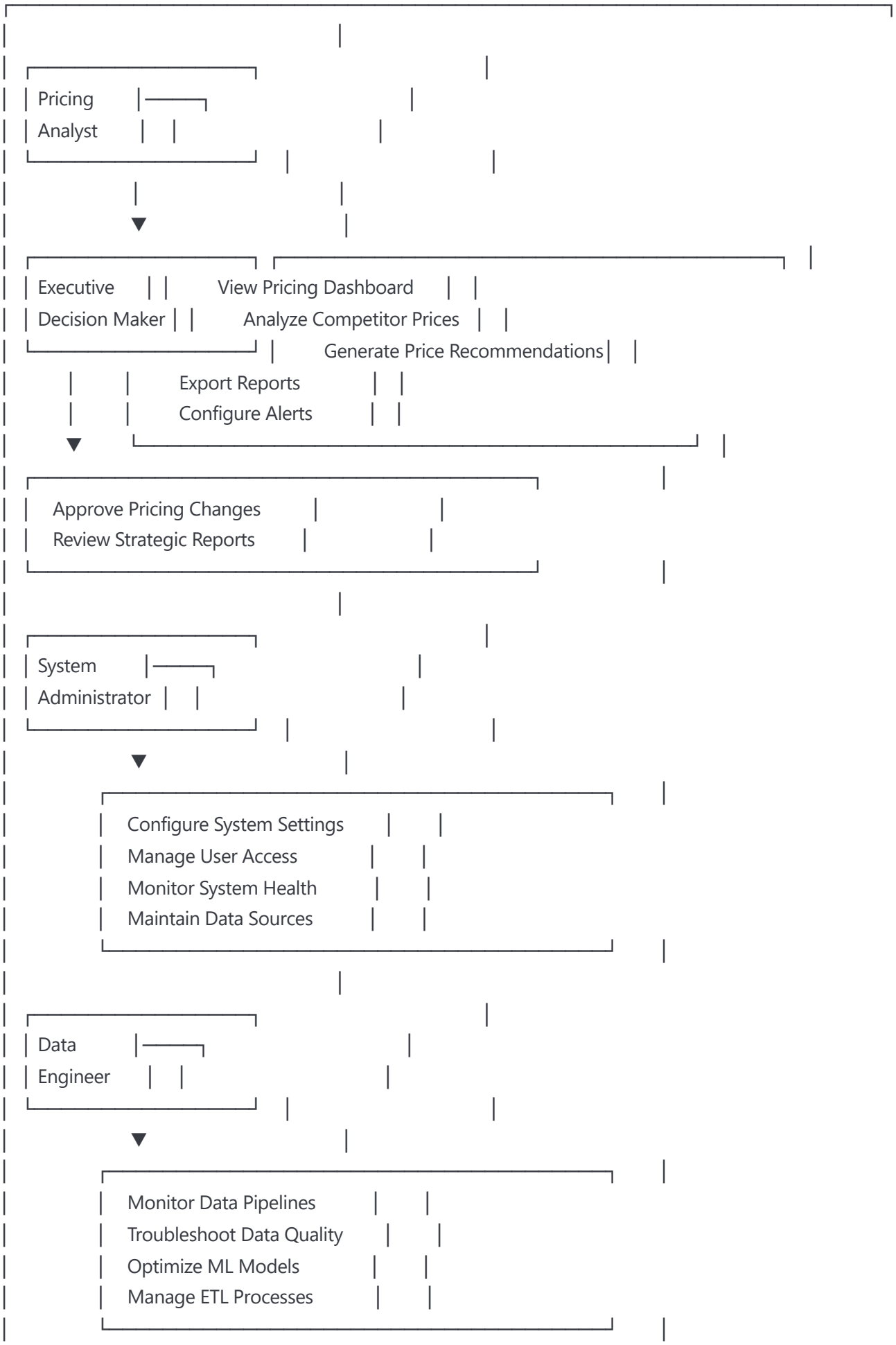
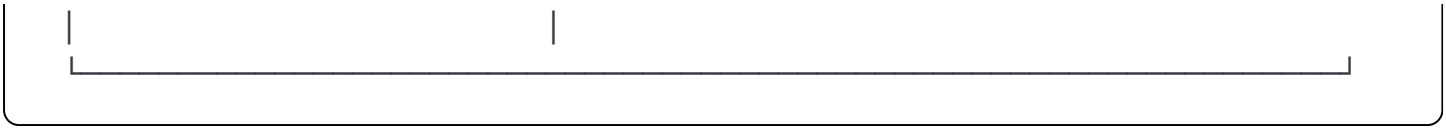
9. System Models

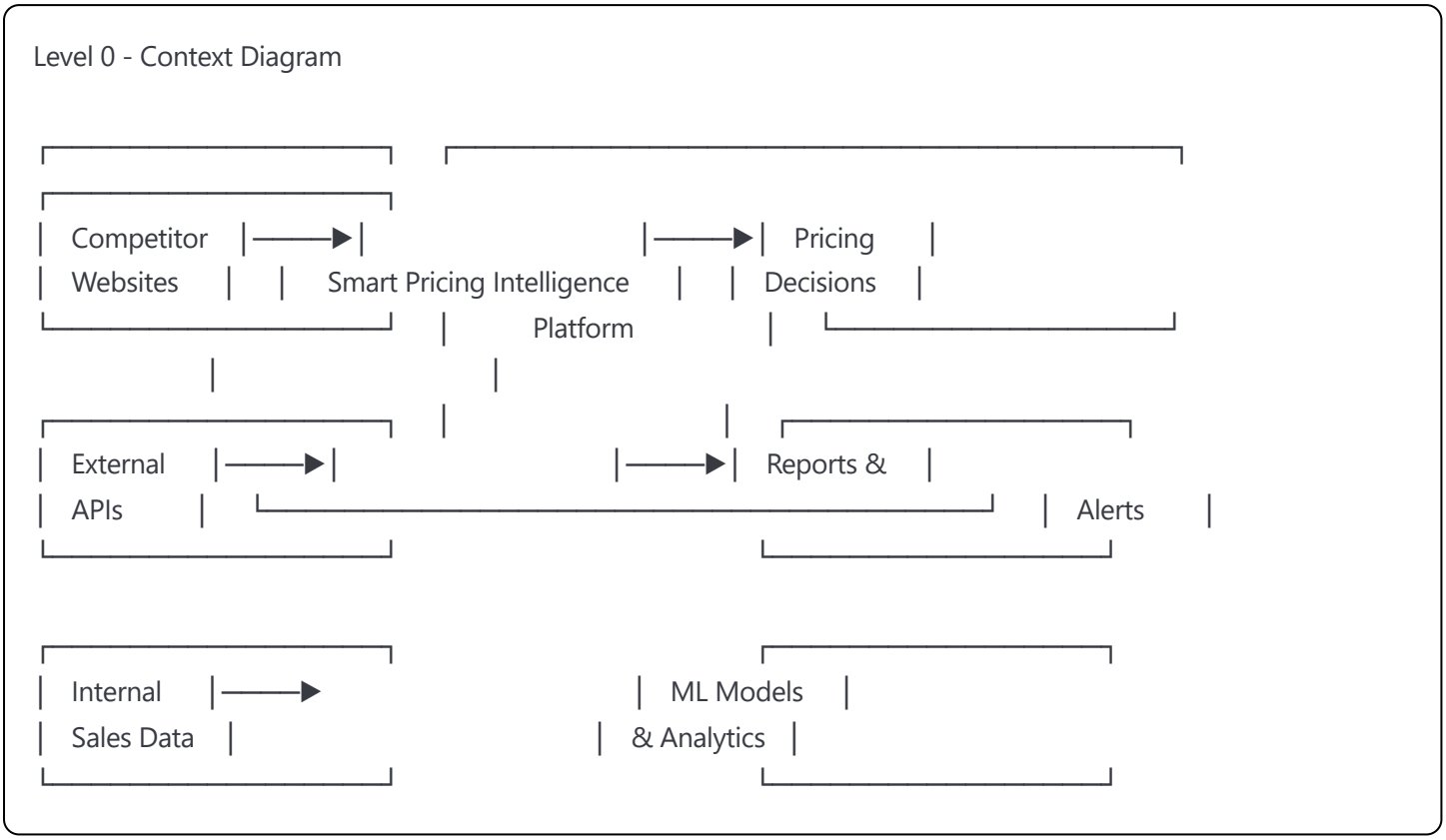
9.1 Use Case Diagram

Smart Pricing Intelligence Platform

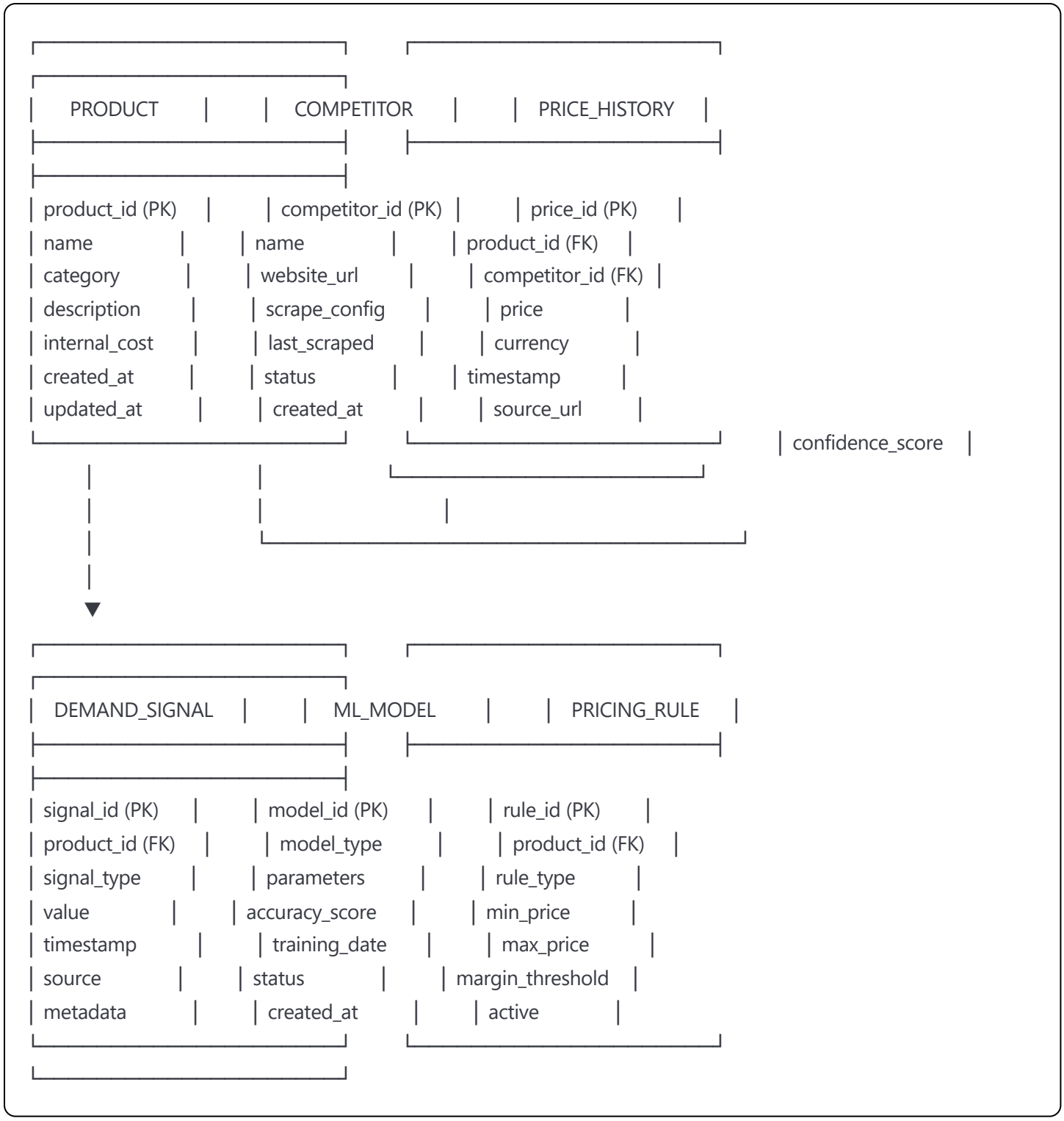




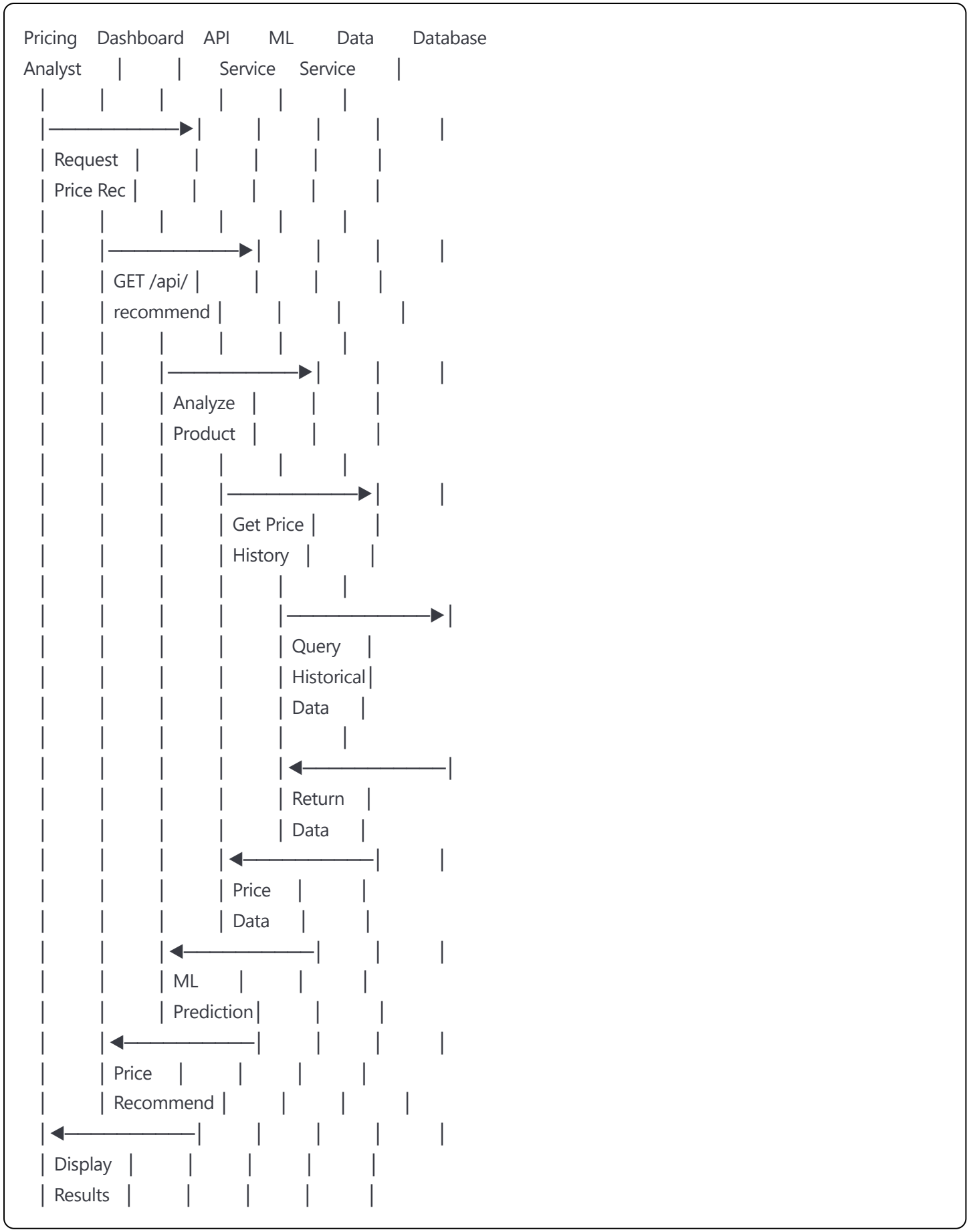
9.2 Data Flow Diagram



9.3 Entity Relationship Diagram



9.4 Sequence Diagram - Price Recommendation Flow



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10. Implementation Timeline

10.1 Project Phases

Phase 1: Foundation and Setup (Month 1)

Objectives: Establish project foundation and team alignment

Deliverables:

- Project setup and development environment configuration
- Database schema design and implementation
- Basic API framework setup
- Team training on technology stack
- Initial CI/CD pipeline setup

Key Activities:

- Requirements validation and refinement
- Technical architecture review
- Development environment standardization
- Database design and creation
- Basic authentication implementation

Success Criteria:

- All team members have functional development environments
- Database schema successfully deployed
- Basic API endpoints returning test data
- CI/CD pipeline successfully building and deploying to staging

Phase 2: Data Acquisition and Initial Dashboard (Month 2)

Objectives: Implement core data collection and basic visualization

Deliverables:

- Web scraping system for competitor pricing
- Basic dashboard showing price trends
- Data ingestion pipeline
- Initial data quality monitoring

Key Activities:

- Implement web scraping framework
- Develop data normalization processes
- Create basic dashboard components
- Set up data storage and retrieval systems

- Implement basic error handling and logging

Success Criteria:

- Successfully scraping data from at least 5 competitor websites
- Dashboard displaying real-time price trends
- Data ingestion pipeline processing 1000+ price points daily
- Data quality monitoring operational

Phase 3: Demand Signal Integration (Month 3)

Objectives: Integrate external demand signals and enhance data processing

Deliverables:

- Google Trends API integration
- Enhanced dashboard with demand correlations
- Internal sales data integration
- Advanced data processing capabilities

Key Activities:

- Implement external API integrations
- Develop demand signal processing algorithms
- Enhance dashboard with additional visualizations
- Integrate internal sales data sources
- Implement data caching and optimization

Success Criteria:

- Google Trends data successfully integrated
- Dashboard showing demand signal correlations
- Internal sales data flowing into system
- API response times under 500ms

Phase 4: Machine Learning Implementation (Month 4)

Objectives: Develop and deploy ML models for pricing optimization

Deliverables:

- Price elasticity analysis models
- Pricing recommendation engine

- Model validation and testing framework
- ML pipeline automation

Key Activities:

- Implement linear regression models
- Develop reinforcement learning algorithms
- Create model validation processes
- Build pricing recommendation system
- Implement model retraining automation

Success Criteria:

- ML models achieving 80%+ accuracy on test data
- Pricing recommendations generated within 10 seconds
- Model validation framework operational
- Automated model retraining successful

Phase 5: Integration and Testing (Month 5)

Objectives: Complete system integration and comprehensive testing

Deliverables:

- Fully integrated system
- Comprehensive test suite
- Performance optimization
- Security implementation
- User acceptance testing

Key Activities:

- End-to-end integration testing
- Performance optimization and tuning
- Security implementation and testing
- User acceptance testing coordination
- Bug fixes and refinements

Success Criteria:

- All system components integrated successfully
- Performance requirements met

- Security vulnerabilities addressed
- User acceptance criteria satisfied

Phase 6: Deployment and Documentation (Month 6)

Objectives: Production deployment and knowledge transfer

Deliverables:

- Production deployment
- Comprehensive documentation
- User training materials
- Monitoring and alerting setup
- Project handover

Key Activities:

- Production environment setup
- Documentation creation
- User training delivery
- Monitoring implementation
- Final system validation

Success Criteria:

- System successfully deployed to production
- All documentation completed
- Users trained on system functionality
- Monitoring and alerting operational

10.2 Resource Allocation

Role	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
Data Engineer	40%	60%	70%	30%	40%	20%
ML Specialist	20%	20%	40%	80%	60%	30%
Frontend Developer	30%	50%	60%	40%	50%	40%
Backend & DevOps	50%	70%	50%	40%	70%	80%

10.3 Risk Mitigation

High-Risk Items:

1. **Web Scraping Reliability** - Implement multiple scraping strategies and backup data sources
2. **ML Model Accuracy** - Establish baseline models and iterative improvement process
3. **Data Quality Issues** - Implement comprehensive validation and monitoring systems
4. **Performance Requirements** - Conduct early performance testing and optimization

Medium-Risk Items:

1. **API Integration Challenges** - Develop robust error handling and fallback mechanisms
2. **User Adoption** - Conduct regular user feedback sessions and iterative improvements
3. **Security Compliance** - Engage security experts for review and validation

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11. Appendices