



TSG LAB AG — USE CASE 7

Predictive Marketing & E-Commerce Optimization Suite

AI-Driven Revenue Intelligence for European Online Retailers

AI

NLP

DYNAMIC PRICING

DEMAND FORECASTING

GDPR COMPLIANT

01 Executive Summary

TSG Lab AG's Predictive Marketing & E-Commerce Optimization Suite is an AI-native platform purpose-built for European online retailers. Four interconnected intelligence modules — Sentiment Analysis, Competition Price Intelligence, Demand Forecasting & Inventory Optimization, and Revenue Optimization — transform raw market data into actionable pricing, inventory, and marketing decisions in real time.

European e-commerce (EUR 900+ billion annually) operates in one of the world's most competitive environments, with fragmented markets across 27 EU member states, intense price competition, demand volatility, rising customer acquisition costs, and stringent regulatory requirements. The platform provides a closed-loop optimization system that maximizes revenue per visitor, minimizes wasted inventory and marketing spend, and gives European retailers the data-driven agility to compete with global giants.

02 Business Challenge

- ▶ **Price War Pressure:** European consumers use comparison engines (Idealo, Google Shopping, PriceRunner) extensively. A 2% price premium can shift 15–20% of traffic to competitors, yet indiscriminate price matching destroys margins.
- ▶ **Demand Volatility:** Demand patterns are influenced by country-specific holidays, weather events, economic sentiment, and geopolitical developments — creating forecasting challenges single-country models cannot address.
- ▶ **Customer Acquisition Cost Inflation:** Digital advertising costs across European markets have increased 25–40% over three years, making inefficient marketing spend a survival-threatening issue for mid-sized retailers.
- ▶ **Sentiment Blind Spots:** Customer sentiment shifts rapidly on social media and review platforms — often weeks before the shift appears in sales data.
- ▶ **Multi-Market Complexity:** Operating across European markets requires managing multiple currencies, VAT regimes, shipping logistics, language-specific marketing, and distinct competitive landscapes.
- ▶ **Inventory Misallocation:** Over-stocking ties up capital and leads to margin-destroying markdowns; under-stocking loses sales. The average European retailer loses 8–12% of potential revenue to inventory misallocation.

03 Technical Solution

Module 1: Sentiment Analysis Engine

A multi-lingual NLP platform monitoring consumer sentiment across European digital channels — Twitter/X, Instagram, Reddit, Trustpilot, Amazon Reviews, Google Reviews, country-specific forums (Gutefrage.de, Aufeminin.fr, Foro Coches ES). Fine-tuned XLM-RoBERTa models support 24 EU languages with sentiment classification, aspect extraction (price, quality, delivery, service), and emerging trend detection.

Module 2: Competition Price Intelligence

An automated competitive intelligence system monitoring pricing, promotions, and stock availability across 5,000+ European online shops in 15+ countries. A price normalization engine handles multi-currency conversion (real-time ECB rates), VAT harmonization, shipping cost integration, and bundle decomposition. ML models identify competitor pricing patterns — loss leaders, anchor pricing, dynamic pricing algorithms — enabling predictive competitive response.

Module 3: Demand Forecasting & Inventory Optimization

Multi-signal demand prediction using 500+ signals: historical sales, web traffic, Google Trends by country, weather forecasts, economic indicators, event calendars, social media sentiment, and competitor stock-out alerts. Ensemble forecasting (Temporal Fusion Transformer, DeepAR, Prophet, LightGBM) with automatic meta-learner weighting. Multi-horizon predictions at daily (7-day), weekly (8-week), and monthly (6-month) horizons per SKU × market combination.

Module 4: Revenue Optimization Engine

Synthesizes insights from all modules into revenue-maximizing decisions: real-time dynamic pricing recommendations with EU Omnibus Directive compliance; AI-driven marketing budget allocation across Google Ads, Meta, TikTok, email, and affiliate; real-time personalization engine; and AI-generated promotional calendar optimizing timing, discount depth, and product selection.

04 Implementation Approach

Phase	Activities	Duration
Phase 1: Data Infrastructure	E-commerce platform integration (Shopify, Magento, WooCommerce), web analytics, historical data ingestion, scraping infrastructure	6–8 weeks
Phase 2: Sentiment Analysis	Multi-lingual NLP model fine-tuning, social media API integrations, review aggregator connections, brand health dashboard	6–8 weeks
Phase 3: Price Intelligence	Scraping fleet deployment across European markets, price normalization engine, competitor mapping, price position dashboard	6–8 weeks

Phase 4: Demand Forecasting	Feature engineering pipeline, model training across product categories and markets, forecast accuracy benchmarking	8–10 weeks
Phase 5: Revenue Optimization	Dynamic pricing engine, marketing budget optimizer, personalization engine, A/B testing framework	8–10 weeks
Phase 6: Integration & Launch	Unified dashboard, alert system, staff training, phased market rollout, continuous model retraining pipeline	6–8 weeks

05 Technology Stack

Layer	Technologies
Data Collection	Scrapy, Playwright (headless browser), residential proxy network, Twitter API v2, Google Trends API, Trustpilot API
Data Processing	Apache Kafka (streaming), Apache Spark (batch), Apache Airflow (orchestration), dbt (transformation), Snowflake/BigQuery
NLP / Sentiment	HuggingFace Transformers, XLM-RoBERTa, FinBERT, spaCy, custom fine-tuned models per language cluster
ML / Forecasting	PyTorch (TFT, DeepAR), Prophet (Meta), LightGBM, scikit-learn, Optuna (hyperparameter optimization), MLflow
Optimization	Google OR-Tools, cvxpy, Bayesian optimization (marketing spend), multi-armed bandit (pricing), Thompson Sampling
Visualization	Plotly Dash, Grafana, Apache Superset, custom Next.js dashboards, D3.js
Infrastructure	Kubernetes (GKE), NVIDIA T4/A10G GPUs, Terraform, GitHub Actions (CI/CD), Prometheus/Grafana
E-Commerce Integration	Shopify API, Magento REST API, WooCommerce API, Google Analytics 4 API, Meta Marketing API, Google Ads API

06 Key Features & Capabilities

- ✔ **Pan-European Coverage** — Monitors sentiment, pricing, and demand signals across 15+ European markets with native language support for 24 languages.
- ✔ **Real-Time Competitive Intelligence** — Automated monitoring of 5,000+ competitor shops with hourly price updates, promotion detection, and stock availability tracking.

- ✓ **Multi-Lingual Sentiment Analysis** — Aspect-level sentiment extraction across all major European languages, identifying product-specific and category-level consumer perception shifts.

- ✓ **Probabilistic Demand Forecasting** — Full probability distributions for demand (not just point estimates), enabling risk-aware inventory and pricing decisions.

- ✓ **Dynamic Pricing with Compliance Guard** — Real-time pricing recommendations ensuring compliance with EU Omnibus Directive, country-specific sale regulations, and GDPR.

- ✓ **Marketing Spend Optimization** — AI-driven budget allocation maximizing ROAS while respecting diminishing returns and cross-channel attribution.

- ✓ **Automated A/B Testing** — Continuous experimentation framework with statistical rigor, automatically graduating winning pricing and personalization variants.

- ✓ **Anomaly Detection & Alerting** — Real-time alerts for competitor price changes, sentiment spikes, demand anomalies, stock-out risks, and marketing performance degradation.

07 Business Benefits & ROI

Revenue Uplift

Dynamic pricing and personalization drive 8–15% revenue increase within the first 6 months of deployment

Margin Protection

Intelligent competitive pricing (vs. blanket price matching) preserves 2–4 percentage points of gross margin

Marketing Efficiency

AI-optimized budget allocation improves ROAS by 25–40%, reducing wasted spend and lowering effective CPA

Inventory Optimization

Demand-driven inventory management reduces overstock markdowns by 30% and stock-outs by 40%

Customer Acquisition Cost

Sentiment-informed targeting and personalized messaging reduce CPA by 15–25% across European markets

EU Regulatory Confidence

Automated compliance with Omnibus Directive, GDPR, and country-specific regulations eliminates manual compliance burden

08 Use Case Scenarios

Dynamic Pricing for Consumer Electronics

A German online electronics retailer integrates the platform across 12,000 SKUs. The Price Intelligence module detects a competitor dropped a best-selling laptop by 8% — likely a stock clearance. Rather than matching across the board, the Revenue Optimization Engine recommends matching only for that SKU in markets with traffic overlap, bundling with accessories at a combined margin-preserving price, and increasing Shopping bids on adjacent models. Result: EUR 180K in incremental revenue over 3 weeks without margin erosion.

Sentiment-Driven Product Launch

A French fashion retailer preparing a summer collection launch uses the Sentiment Analysis module to monitor color trends across France, Italy, and Spain. The system detects a rapidly emerging positive sentiment around a specific shade of green in Italian social media — three weeks before the trend reaches France. The retailer shifts 15% more green items to Italian fulfillment and front-loads Italian marketing campaigns. Result: 22% higher sell-through rate in Italy and EUR 340K in avoided markdown costs.

Cross-Market Demand Forecasting

A Scandinavian home goods retailer detects an unusual demand spike signal: colder-than-normal weather forecasts, rising 'hygge' social media content, and declining competitor stock levels for candles and blankets. Forecasts adjust upward by 35% across Denmark, Sweden, Norway, and Finland, triggering automated reorder recommendations. Result: 98% in-stock rate during the peak period, vs. 72% for competitors caught off-guard.

09 Security & Compliance

- **GDPR-First Architecture:** All personal data processing complies with GDPR from ingestion to deletion. Data minimization, purpose limitation, and automated consent management embedded in the data pipeline.
- **EU Omnibus Directive Compliance:** Automated 30-day price history tracking for every SKU, ensuring all advertised 'sale' prices reference the genuine lowest price in the preceding 30 days.
- **Data Residency:** All data stored within EU-based data centers (Frankfurt, Amsterdam) with no cross-border transfers outside EEA without appropriate legal basis.

- **Competitor Data Ethics:** Web scraping conducted in compliance with robots.txt directives, terms of service review, and EU Database Directive considerations.
- **Access Control:** Role-based access with SSO (SAML 2.0/OIDC), MFA enforcement, and audit logging for all pricing and marketing decisions.
- **Model Fairness:** Pricing and personalization algorithms tested for discriminatory bias with automated fairness audits.

10 Future Enhancements

Generative AI for Marketing Content: Multi-lingual LLMs to automatically generate localized product descriptions, ad copy, email campaigns, and social media content optimized for each European market.

Visual Commerce Intelligence: Computer vision analysis of competitor product imagery, social media visual trends, and user-generated content to extract visual merchandising insights.

Voice Commerce Optimization: Optimization for voice search (Alexa, Google Assistant) across European languages, adjusting product descriptions for conversational search patterns.

Sustainability-Driven Demand Modeling: Integration of ESG sentiment signals and carbon footprint data to predict demand shifts driven by sustainability-conscious consumer behavior.

Blockchain-Verified Supply Chain: Integration with TSG Lab AG's IoT-Blockchain Platform to provide consumers with verifiable product origin and supply chain data — an accelerating conversion driver in European markets.