Transforming Walmart's Search Through Strategic Prioritization of Science Projects

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1 Introduction

In large-scale e-commerce, search relevance directly impacts revenue and sales. For Walmart, improving search required a structured approach to identifying and prioritizing relevance projects that had the highest business impact. This case study details how Walmart effectively leveraged data-driven insights and domain expertise to transform its search experience, leading to tangible business improvements.

2 Challenge: Identifying Business Problems and Search Inefficiencies

Walmart faced multiple challenges that are common across retail search systems:

- **Low Conversion Rates**: Users searched for products but did not make purchases due to poor result relevance.
- **Irrelevant Search Results**: Queries often surfaced items unrelated to user intent, reducing customer satisfaction.
- **Assortment and Availability Issues**: Items customers sought were missing due to gaps in inventory data integration.
- **Query Understanding Challenges**: Ambiguous queries, misspellings, and missing synonyms led to ineffective product retrieval.
- **Price Mismatch Problems**: Search results displayed items outside the expected price range for a query, reducing engagement.
- **Category and Intent Mismatch**: Some queries required returning a category page instead of product listings.

- **Business vs. Technology Problems**: A key challenge was distinguishing whether a search inefficiency stemmed from a business issue (e.g., missing inventory, pricing mismatches) or a technological limitation (e.g., poor ranking, weak synonym matching).

3 Strategic Approach: Identifying and Addressing Search Inefficiencies

To tackle these problems, Walmart implemented a structured **Relevance Project Prioritization Process**:

3.1 Defining Business Priorities with Data and Market Insights

- Leveraged six months of search traffic data to identify user behavior trends.
- Combined market knowledge with data analysis to detect issues not immediately visible in metrics.

3.2 Obtaining a Representative Sample of Queries

- Used **stratified sampling** to select 6,000 queries representing search patterns.
- Ensured that the sample reflected actual user behavior and traffic distribution.

3.3 Identifying Poorly Performing Queries

- **Crowdsourcing**: Human raters evaluated the relevance of top search results on a 0–4 scale.
- **Conversion Rate Analysis**: Queries in the bottom 20th percentile for conversions were flagged.
- **User Feedback Integration**: Included data from **Opinion Labs** and **Polaris feedback channels**.

3.4 Root Cause Analysis of Search Inefficiencies

- Categorized issues into **13 business-related issue categories**, including *assortment gaps, synonym mismatches, spelling errors, category misclassification, price mismatches, and ranking deficiencies*.

- Differentiated between **17 specific technical problems** affecting search performance, such as *concept detection failures, baseline ranking adjustments, query normalization issues, and attribute understanding errors*.

4 Ranking Challenges: Balancing Precision and Recall

- **Precision vs. Recall Tradeoff**: Improving precision (showing only the most relevant results) often reduces recall (showing a broad set of potentially relevant results). Walmart had to strike a balance to optimize user experience.
- **Baseline Ranking Adjustments**: Many queries suffered from inadequate ranking due to weak weight assignments to query components.
- **Concept Detection Failures**: Incorrect classification of user intent resulted in mismatches between search terms and returned products.
- **Re-ranking Mechanisms**: Implemented dynamic ranking strategies to improve the placement of top-performing products.

5 Defining Key Performance Indicators (KPIs) for Prioritization

- **Average NDCG@5**: Measures ranking quality of search results.
- **Precision and Recall Metrics**: Used to evaluate ranking effectiveness.
- **Percentage of Bad Queries**: Proportion of queries with relevance issues.
- **Traffic Volume Impact**: Percentage of total search traffic affected by poor queries.
- **Conversion Rate Improvement**: Measured the impact of search changes on purchases.

6 Results and Business Impact

The prioritization approach led to significant improvements in Walmart's search quality:

- **Reduction in Bad Queries**: From 30% of total queries flagged initially, systematic improvements brought this down significantly over successive quarters.
- **Improved Conversion Rates**: By refining search relevance, Walmart increased conversion rates across key product categories.
- **Higher Revenue Impact**: By aligning search enhancements with business objectives, Walmart maximized financial returns from search investments.

7 Conclusion

By systematically identifying and addressing search inefficiencies, Walmart transformed its search functionality, improving customer experience and driving business growth. This case study provides a blueprint for other retailers looking to enhance their search effectiveness through data-driven prioritization and targeted engineering solutions.