Successful Adoption of a ML-Based Solution

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Use Case and Evaluation

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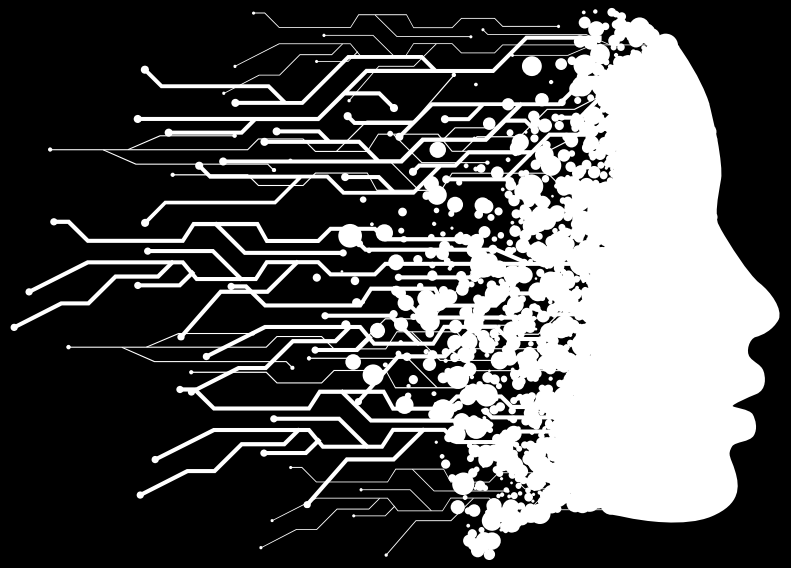
Introduction and Welcome

Agenda



- Current Processes and Limitations
- The Potential of Machine Learning
- Success Rate and Feasibility Study
- Use Case Explanation and the Power of ML
- Organizational Management Change
- ML Implementation Plan
- Performance Evaluation and Monitoring
- Conclusion and Q&A

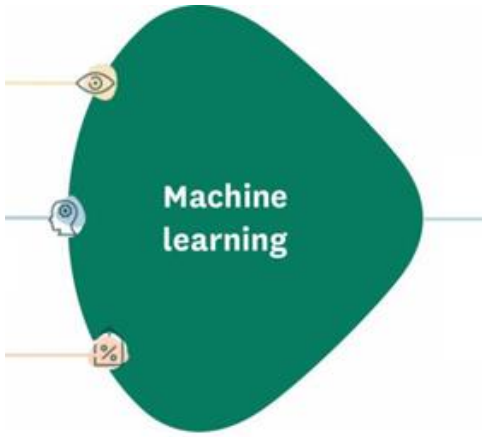
Problematic: Challenges and Limitations

Manual processes in the supermarket chain for inventory tracking, order assembly, and approval.

Costly operations with employees spending significant time on manual tasks.

Large gaps in shelves due to out-of-stock situations and high perishable food waste.

The Potential of Machine Learning[1]



By Implementing machine learning in our replenishment processes, we can:

- Improve demand forecasting accuracy, leading to optimized stock levels and reduced stockouts, enhanced customer satisfaction and revenue.
- Automate replenishment order generation, saving time, and minimizing errors.
- Optimize logistics management, including route optimization, prioritization, and cost reduction.
- Enhance visibility across the supply chain, enabling data-driven decision-making [7][10][12].

Success Rate

Walmart: By implementing an ML-based demand forecasting system, Walmart experienced a 10% reduction in out-of-stock items and a remarkable 16% increase in sales [1][2][3][4][5][6][7].

Tesco: Tesco, a prominent UK supermarket chain, achieved a 28% waste reduction and improved product availability by 1-2% through the application of machine learning. Automation of the replenishment process ensured shelves were consistently stocked with the right products [8][3].

Kroger: As one of the largest supermarket chains in the United States, Kroger leveraged machine learning to reduce the time required for shelf auditing and restocking, streamlining their operations [3][9][10][11].

Industry Studies and Reports: Studies conducted by McKinsey, Deloitte, and Harvard Business Review provide further evidence of the benefits of machine learning in supermarket replenishment [1].

McKinsey: Optimizing inventory levels through ML algorithms can result in a 20-50% reduction in stockouts and a 20-30% decrease in excess inventory. [1].

Gartner: By 2026, over 75% of commercial supply chain management application providers will deliver artificial intelligence (AI) and data science solutions [7].

Feasibility Study

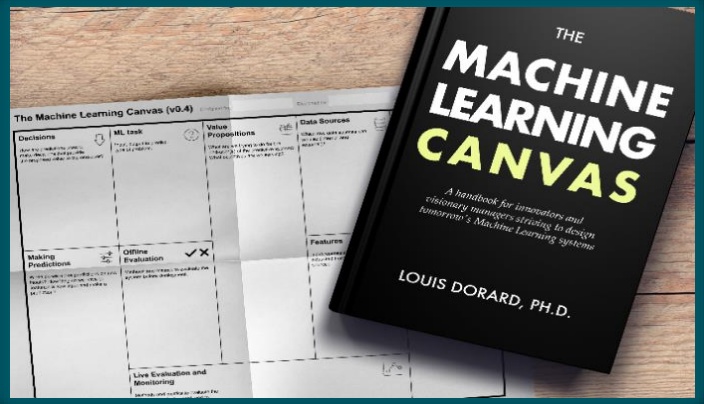
We have partnered with expert data science providers who will:

- Lead the development and training of machine learning models specifically tailored for supermarket replenishment
- Provide expertise in algorithm selection, feature engineering, and model optimization
- Guide the integration, performance evaluation, and monitoring of the machine learning solution

Challenges and Confidence in Implementation

- Software costs, Data quality and quantity, Talent acquisition, and Employee concerns

Use-Case Explanation and the Power of ML Solution [16]



The Machine Learning Canvas (v0.4)

Designed for: | Designed by: | Date: | Iteration:

Decisions
- Ordering decisions
- Stock replenishments (upon out-of-stock criteria situations and triggering restocking)
- Supplier Selection
- Inventory Allocation: Distribute available stock among different store locations based on demand patterns and sales forecast
- Promotional Planning

ML task
- Regression: Used for demand forecasting, shelf replenishment, optimization, deliver times, pricing accuracy…
- Regression, clustering techniques (used for inventory optimization
- Logistic regression and decision trees (used out-of-stock detection)
- Classification models used for suppliers (excellent, good,…)

Value Propositions
- Optimized Inventory Management by: Accurately Forecasting Demand and Ordering Decisions. Reducing Out-Of-Stock Situations, and Minimizing Excess Inventory
- Real-Time Demand Insights
- Identify reliable and cost-effective
- suppliers to ensure on-time deliveries and freshness, reducing lead times, and ensuring reliable supplier relationships
- Customer Satisfaction (Providing a positive shopping experience, reducing Customer Frustration, and Increasing Sales)
- Cost Savings

Data Sources
- Sales Data, Historical demand, promotions data
- In-store Cameras, shelves images
- Supplier information, past performance data

Collecting Data
- Point of sales
- Data Inventory System
- Supplier and wholesale data
- External Data Sources (Weather, Holiday, Events data)
- Manual Dat Collection
- Customer Loyalty Programs

Making Predictions
- Stock Levels replenished following the predictions
- Reorder Point Prediction: ML models can analyze inventory levels and automatically generate reorder points
- Waste Reduction: By analyzing Sales Patterns, expiration dates, and other factors
- Price Optimization
- Shelf Replenishment Optimization

Offline Evaluation
- Out-Of-Stock Situations
- Perishable Food Waste

Features
- Sales history
- Promotions
- Seasonality
- External Factors

Building Models
- Periodic ML prediction models training using historical data
- Developing and fin-tuning ML algorithms
- Create and update new models

Live Evaluation and Monitoring
- Monitor Model Performance
- Replenishments Metrics
- Financial Metrics
- Customer Satisfactions
- Supplier Performance
- Operational Metrics

Organizational Change Management [13][14]

Our integration of the ML solution requires organizational change:

- Empower employees through training and upskilling
- Adapt processes for optimized workflow
- Foster data-driven decision-making
- Manage change with support and growth opportunities
- Ensure job security by avoiding layoffs or redundancies [13][12]

ML Implementation Plan

It starts by Collaboration between data scientists, IT professionals, and domain experts

Machine Learning Pipeline

Step No	Phase	Activities/Components	Tools & Utilities	Techniques	Description
1	Problem Definition	Identify Issues	Brainstorming Tools	SWOT Analysis	Define the replenishment problems that need solving.
2	Data Collection	Sales Data, Inventory Data	SQL, Excel	Data scraping, API calls	Gather relevant historical data.
3	Data Preprocessing	Data Cleaning, Normalization	Python (Pandas)	Imputation, One-Hot Encoding	Prepare data for machine learning.
4	Exploratory Data Analysis	Pattern Recognition	Python (Matplotlib, Seaborn)	Data Visualization	Conduct exploratory data analysis.
5	Feature Selection	Feature Engineering	Python (Scikit-learn)	LASSO, RFE	Choose and engineer relevant features.
6	Model Selection	Choose ML Models	Python (Scikit-learn)	Cross-validation	Decide on the machine learning models to use.
7	Training & Tuning	Hyperparameter Tuning	Python (Scikit-learn)	Grid Search, Random Search	Train and fine-tune the model.
8	Validation & Testing	Test Data Set	Python (Scikit-learn)	Confusion Matrix, AUC-ROC	Validate the model's predictions.
9	Performance Metrics	MAE, Inventory Turnover	Python (Scikit-learn, NumPy)	Mean Absolute Error	Assess model performance.
10	Deployment	Live Environment	Cloud Services (AWS, Azure)	CI/CD	Implement the model into the real-world system.
11	Monitoring & Maintenance	Performance Tracking	Monitoring Tools	Alerting, Dashboard Monitoring	Continuously monitor and update the model.
12	Feedback Loop	Adaptation	Version Control	Iterative Refinement	Constantly update the model based on performance.
13	Documentation	Reporting	Documentation Software	Technical Writing	Document the process, outcomes, and insights.

Performance Evaluation and Monitoring

- Tracking metrics, milestones and indicators for success
- Real-time monitoring and regular model evaluation: take necessary adjustments, retraining models or updating decision thresholds, to maintain optimal performance.
- Ongoing performance evaluation and monitoring: Stay updated with the latest advancements in the field of machine learning and explore new techniques

Metrics	Description
Out-of-Stock Rate	Percentage of products that are out of stock and unavailable for customers to purchase
Fill Rate	Percentage of customer orders that are successfully fulfilled
Order Accuracy	Percentage of ordered products that are accurately delivered
Waste Rate	Percentage of perishable food items that are wasted due to overstocking or expiry
Inventory Turnover Ratio	Number of times inventory is sold and replaced within a given period
Forecast Accuracy	Measure of how accurately demand forecasts align with actual sales
Stockout Duration	Average length of time a product remains out of stock

Conclusion

- In summary, implementing a machine learning-based solution for our supermarket chain replenishment has great advantages for our organization.
- By using ML technology, we can achieve cost savings, better inventory management, and happier customers

Questions & Answers

- Thank you for your attention
- Open Questions

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