

# INVENTORY PROPHET:

## *An AI-powered Inventory Management System with Predictive Analytics for Small & Medium Businesses*

Siddharth

20<sup>th</sup> June, 2024

### ABSTRACT:

*Inventory management remains a challenge for many small and medium businesses (SMBs), often leading to stockouts, excess inventory, and inefficient ordering processes. This report proposes Inventory Prophet, an AI-powered cloud-based solution that leverages machine learning for accurate demand forecasting and inventory optimization. We explore the problem of inefficient inventory management in SMBs and analyze how traditional methods fall short. The report details the functionalities of Inventory Prophet, including demand forecasting with machine learning models, inventory optimization algorithms, and automated reordering. We discuss the system architecture, including key algorithms, frameworks, and data sources. Furthermore, we outline the development team composition and cost considerations. A small-scale implementation using sample data demonstrates the core functionalities and presents a basic visualization of forecasted demand. Inventory Prophet has the potential to streamline inventory management for SMBs, improve operational efficiency, and boost profitability.*

## 1. Problem Statement

Small and Medium Businesses (SMBs) in retail, e-commerce, and light manufacturing often face significant challenges in managing their inventory effectively. These challenges can lead to several negative consequences, including:

- **Stockouts:** Inaccurate demand forecasting can lead to situations where a business runs out of stock for in-demand products. This results in lost sales opportunities, frustrated customers, and potential damage to brand reputation.
- **Excess Inventory:** Overstocking occurs when businesses hold more inventory than they can sell within a reasonable timeframe. This ties up valuable cash flow, increases storage costs, and leads to potential issues with dead stock (products that become obsolete or unsaleable).
- **Inefficient Ordering Processes:** Manual ordering processes can be time-consuming and prone to errors. Additionally, businesses may struggle to identify optimal reorder points, leading to stockouts or unnecessary emergency orders.
- **Difficulty Managing Complex Inventory:** Businesses with multiple locations or a wide variety of products face additional challenges in tracking inventory levels and ensuring optimal stock distribution across their network.

These inventory management problems can significantly impact the profitability and operational efficiency of SMBs. Inventory Prophet aims to address these challenges by providing an AI-powered solution that leverages predictive analytics to optimize inventory management for small and medium businesses.

## 2. Market/Customer/Business Need Assessment

### Market Need:

There is a growing need for user-friendly and cost-effective inventory management solutions specifically designed for small and medium businesses. Traditional inventory management systems can be complex, expensive, and require significant IT expertise to implement and maintain. SMBs often lack the resources to invest in such solutions, leaving them vulnerable to the problems outlined in the previous section.

### Customer Need:

SMBs require an inventory management system that can address the following key needs:

- **Improved Demand Forecasting:** Accurate forecasts of future product demand are essential for preventing stockouts and optimizing inventory levels.
- **Reduced Inventory Carrying Costs:** Businesses need to minimize the amount of capital tied up in unsold inventory.
- **Streamlined Ordering Processes:** Efficient and automated ordering processes can save time and reduce human error.
- **Enhanced Inventory Visibility:** Real-time insights into inventory levels across different locations are crucial for effective stock management.
- **Ease of Use:** The inventory management system should be user-friendly and require minimal training for employees.
- **Scalability:** The solution should be able to grow and adapt as the business expands its product range or number of locations.

### **Business Need:**

For businesses that develop and sell inventory management solutions, there is a significant opportunity to capture market share by catering specifically to the needs of SMBs. By offering an AI-powered solution that is affordable, easy to use, and delivers tangible benefits, Inventory Prophet can address a gap in the current market and attract a large customer base.

## **3. Target Specifications and Characterization**

### **Target Customer:**

Inventory Prophet is designed for SMBs in the following industries:

- Retail (brick-and-mortar stores and online shops)
- E-commerce businesses
- Light manufacturing companies

### **Customer Characteristics:**

- Typically have between 10–250 employees.
- Manage a variety of products, with inventory complexity ranging from low to medium.
- May have multiple store locations or warehouses.
- Use Point-of-Sale (POS) systems or e-commerce platforms to manage sales transactions.

- Lack the resources or expertise to implement complex enterprise-level inventory management solutions.
- Are looking for a cost-effective and user-friendly way to optimize their inventory management processes.

## Customer Needs:

As mentioned previously, the target customer needs a solution that can:

- Improve demand forecasting accuracy.
- Reduce inventory carrying costs.
- Automate reorder points and ordering processes.
- Provide real-time inventory visibility across locations.
- Integrate seamlessly with existing business systems.
- Be easy to learn and use with minimal training required.

By understanding the specific characteristics and needs of the target customer segment, Inventory Prophet can be developed and marketed to effectively address their pain points and deliver a valuable solution.

## 4. External Search

Here are some relevant online information sources:

- **Industry Reports:**
  - Reports on inventory management trends for SMBs in retail, e-commerce, and manufacturing can be found from research firms such as Gartner, Forrester, and Statista.
  - Look for reports that discuss the challenges faced by SMBs in managing inventory and the growing adoption of AI-powered solutions.
  - Link: [https://www.researchgate.net/publication/368345493\\_Applications\\_of\\_Artificial\\_Intelligence\\_in\\_Inventory\\_Management\\_A\\_Systematic\\_Review\\_of\\_the\\_Literature](https://www.researchgate.net/publication/368345493_Applications_of_Artificial_Intelligence_in_Inventory_Management_A_Systematic_Review_of_the_Literature)
- **Academic Research Papers:**
  - Search for research papers on the application of machine learning and AI for demand forecasting and inventory optimization.
  - This can provide valuable insights into the latest advancements in this field and the effectiveness of different techniques.

- Link:  
[https://www.researchgate.net/publication/342529859\\_Inventory\\_management\\_using\\_Machine\\_Learning](https://www.researchgate.net/publication/342529859_Inventory_management_using_Machine_Learning)
- **Inventory Management Software Reviews:**
  - Websites like Capterra, G2 Crowd, and TrustRadius offer user reviews and comparisons of various inventory management software solutions.
  - Analyze reviews of existing solutions targeted towards SMBs to understand their strengths, weaknesses, and user pain points.
  - Link:  
<https://www.geeksforgeeks.org/ai-tools-for-inventory-management-2/>
- **Case Studies:**
  - Look for case studies that showcase how other companies have successfully implemented AI-powered inventory management solutions.
  - This can provide valuable real-world examples of the benefits and challenges associated with such solutions.
  - Link:  
<https://www.akkio.com/post/inventory-management-machine-learning>
- **Industry Blogs and Articles:**
  - Many industry publications and blogs discuss inventory management best practices and emerging trends.
  - Stay updated on the latest developments in inventory management and how AI is transforming this field.
  - Link:  
<https://www.leewayhertz.com/ai-in-inventory-management/>

## 5. Benchmarking Alternate Products

Several existing inventory management software solutions cater to SMBs. Here's a comparison of Inventory Prophet with some prominent alternatives:

| Feature                 | Inventory Prophet  | SkuVault  | Zoho Inventory  | Fishbowl  |
|-------------------------|--|---|---|---|
| Target Market           | SMBs (Retail, Ecomm, Manufacturing)                                | SMBs (Retail, Wholesale)                          | SMBs (Retail, Distribution)                               | SMBs (Manufacturing)                                |
| Key Selling Proposition | AI-powered demand forecasting & predictive analytics               | Ease of use & scalability                         | Multi-channel integrations & affordability                | Manufacturing features & real-time tracking         |
| Pricing Model           | Subscription based on features & inventory complexity              | Tiered pricing based on features                  | Freemium & tiered pricing                                 | Subscription based on features                      |
| Strengths               | Improved accuracy, automated reordering, multi-location management | User-friendly interface, mobile app, integrations | Cost-effective, extensive features, good customer support | Production planning, material tracking, work orders |
| Weaknesses              | New product, limited track record                                  | Lacks advanced features for complex inventory     | May not be suitable for high-volume businesses            | Limited integrations with non-manufacturing apps    |

### Competitive Advantage:

Inventory Prophet differentiates itself by offering:

- **Advanced AI-powered demand forecasting:** This can lead to more accurate inventory levels and reduced stockouts compared to traditional forecasting methods.
- **Focus on user experience:** The solution is designed to be easy to use and require minimal training for employees.
- **Scalability for growing businesses:** Inventory Prophet can adapt to accommodate an increasing number of products and locations.

By highlighting these strengths and addressing the needs of SMBs, Inventory Prophet can position itself as a valuable tool for businesses looking to optimize their inventory management processes.

## 6. Applicable Patents

### Patents:

- US Patent No. 11,836,672: "Inventory management system and method" by Inventor: [Name of Inventor] on [Date of Issue]. This patent can be found on the United States Patent and Trademark Office (USPTO) website: <https://www.uspto.gov/patents/search>. Briefly describe the relevant aspects of the patent here (e.g., focuses on real-time inventory tracking and automated supply chains).
- US Patent Application No. 2020/0380242 A1: "Method and system for inventory optimization using machine learning" by [Names of Inventors] on [Date of Application]. This patent application can be found on the USPTO website: <https://www.uspto.gov/patents/search>. Briefly describe the relevant aspects of the patent application here (e.g., focuses on optimizing inventory levels based on machine learning algorithms).

### Developing a Patent Strategy:

- **Conduct a Freedom-to-Operate (FTO) Analysis:** This analysis helps assess whether any existing patents could potentially block the development or commercialization of Inventory Prophet. An FTO analysis can help identify potential risks and inform decisions about patent workarounds or alternative approaches.
- **Consider Patent Filing:** If the core functionalities of Inventory Prophet involve a novel and non-obvious invention, then filing for a patent could be a strategic option. This would require a thorough patent search and evaluation by a patent attorney.

### Open-Source Options:

Fortunately, many powerful machine learning libraries and software frameworks are available as open-source tools. This allows for the development of Inventory Prophet without infringing on any patents related to these underlying technologies. Here are some popular open-source options to consider:

- **Machine Learning Libraries:** TensorFlow, PyTorch, scikit-learn
- **Data Analysis Frameworks:** pandas, NumPy
- **Cloud Platforms:** Many cloud platforms offer pre-built AI services and machine learning tools that can be leveraged for Inventory Prophet's development.

## 7. Applicable Regulations

There are generally no major government regulations that specifically apply to software products like Inventory Prophet. However, depending on the location where Inventory Prophet is used, there might be some general data privacy regulations to consider:

- **Consumer Protection Regulations:** Regulations like the FTC Act (US) or Sale of Goods Act (UK) may apply, ensuring accurate product information and fair business practices. Inventory Prophet should not be used to manipulate inventory levels in a way that deceives customers.
- **Product Safety Regulations:** Depending on the product categories managed by Inventory Prophet, adherence to safety regulations like the Consumer Product Safety Improvement Act (US) or product safety directives in the European Union may be necessary.
- **Data Privacy Regulations:** If Inventory Prophet collects or stores customer data related to product sales, compliance with regulations like GDPR (Europe) or CCPA (California) may be required. This involves ensuring user consent for data collection, secure data storage practices, and user rights to access or delete their data.
- **Environmental Regulations:** For businesses dealing with hazardous materials or products with specific disposal requirements, regulations like the Resource Conservation and Recovery Act (US) or WEEE Directive (Europe) may apply. Inventory Prophet should not contribute to improper waste disposal practices.

These are just a few examples, and the specific data privacy regulations will depend on the target market for Inventory Prophet. It's important to stay informed about relevant regulations and ensure that the product adheres to data privacy best practices.



## 8. Applicable Constraints

### Space:

Inventory Prophet is a cloud-based solution, so minimal physical space is required. Consider server storage needs for data and potentially a small office space for the development team depending on the company structure.

### Budget:

- **Development Costs:**
  - The budget will depend on the chosen development approach (in-house development vs. outsourcing).
  - Costs will include software development tools, cloud infrastructure, and potentially licensing fees for specific technologies (e.g., machine learning libraries).
- **Marketing & Sales:**
  - Budget allocation will be needed for marketing activities (online advertising, content creation) and potentially hiring a sales team to reach the target audience.

### Expertise:

- **Machine Learning & Data Science:** Developing the core AI functionalities will require expertise in machine learning, data analysis, and statistical modeling.
- **Software Development:** A team with experience in building web applications and integrating with existing business systems (POS, e-commerce platforms) will be necessary.
- **Product Management & User Experience (UX) Design:** Expertise in product management and UX design is crucial for creating a user-friendly and intuitive interface for Inventory Prophet.

### Mitigating Constraints:

- **Bootstrapping and Agile Development:** Start with a minimum viable product (MVP) and focus on core functionalities. Use an agile development approach to gather user feedback and iterate based on market needs.

- **Partnerships and Open-Source Solutions:** Leverage existing open-source libraries for machine learning and development tools to reduce costs. Consider partnering with data providers or industry experts to enrich the solution.
- **Targeting a Specific Niche:** Initially focus on a specific niche within the SMB market (e.g., a particular industry) to reduce development complexity and marketing costs.

## 9. Business Model

Inventory Prophet will utilize a **subscription-based pricing model** with tiered plans catering to different business needs. Here's a breakdown of the approach:

- **Free Trial:** Offer a limited-time free trial to allow potential customers to test the features and benefits of Inventory Prophet.
- **Basic Plan:** This could be a low-cost plan with features suitable for small businesses with a limited number of products and transactions.
- **Standard Plan:** This plan would offer more features, such as increased data storage capacity, advanced forecasting options, and support for multiple locations.
- **Enterprise Plan:** This top-tier plan would cater to larger businesses with complex inventory needs. It could offer features like custom integrations, advanced analytics dashboards, and dedicated customer support.

The specific pricing for each tier will depend on factors such as the features offered, storage capacity, and number of users. Here are some additional considerations for the monetization strategy:

- **Freemium Model:** Consider offering a limited free version of Inventory Prophet with basic features to attract new customers. This can be upgraded to a paid plan for access to advanced functionalities.
- **Data Analytics Add-Ons:** In the future, explore offering optional add-on features such as customized data analytics dashboards or integration with business intelligence tools.
- **Data Security Compliance:** For businesses with strict data security requirements, offer premium plans with enhanced security features and compliance certifications.

By offering a flexible pricing structure and features tailored to different business sizes, Inventory Prophet can attract a wider customer base and generate sustainable revenue.

## 10. Concept Generation

### Brainstorming Challenges:

- SMBs often lack the resources or expertise to implement complex inventory management solutions.
- Traditional forecasting methods can be inaccurate, leading to stockouts or excess inventory.
- Manual ordering processes are time-consuming and prone to errors.

### Ideation Process:

- We explored the concept of using AI and machine learning to automate and improve demand forecasting.
- We considered solutions that could optimize inventory levels and suggest reorder points based on predicted demand.
- The idea of a cloud-based system with a user-friendly interface emerged to ensure accessibility for SMBs.

### Concept Selection:

- Inventory Prophet was chosen as the most promising concept due to its focus on:
  - **AI-powered demand forecasting:** Leveraging machine learning to improve accuracy and reduce stockouts.
  - **Inventory optimization:** Recommending optimal stock levels and automated reordering processes.
  - **Ease of use:** A user-friendly interface for managing inventory and accessing insights.

## 11. Concept Development

Inventory Prophet is a cloud-based software solution that utilizes machine learning and data analytics to optimize inventory management for small and medium businesses. Here's a summary of the key features and functionalities:

- **Demand Forecasting:** Utilizes machine learning models to analyze historical sales data, seasonality trends, and external factors to predict future demand for each product.
- **Inventory Optimization:** Recommends optimal inventory levels based on forecasted demand, lead times, and safety stock considerations.
- **Automated Reordering:** Generates automated purchase orders based on predicted demand and lead times to prevent stockouts.
- **Multi-location Management:** Tracks inventory levels across multiple stores or warehouses and suggests transfers to optimize stock distribution.
- **Seamless Integrations:** Integrates with existing Point-of-Sale (POS) systems and e-commerce platforms for automatic data import and order generation.
- **User-friendly Interface:** Provides an intuitive web-based dashboard for easy data visualization, inventory management, and reporting.

Inventory Prophet aims to empower SMBs with the tools and insights needed to make data-driven decisions about their inventory, improve operational efficiency, and achieve greater profitability. By leveraging AI technology and focusing on user-friendliness, Inventory Prophet can become a valuable asset for businesses looking to streamline their inventory management processes.

## 12. Final Product Prototype

### Abstract

Inventory Prophet is a cloud-based software solution designed to optimize inventory management for small and medium businesses. The system leverages machine learning and data analytics to provide accurate demand forecasting, automate reordering processes, and improve overall inventory visibility.

### Schematic Diagram

Here's a breakdown of the key entities and their relationships in Inventory Prophet:

- **Businesses (Users):** These are the small and medium businesses that subscribe to the Inventory Prophet service.
- **Inventory Data:** This includes historical sales data, product information (SKU, description, lead time), and current inventory levels across different locations (if applicable).
- **External Data Sources:** Inventory Prophet may integrate with external data sources such as weather forecasting services or market research data to improve demand forecasting accuracy.
- **Machine Learning Models:** These are statistical models trained on historical data and external factors to predict future demand for each product.
- **Optimization Algorithms:** These algorithms utilize demand forecasts and other factors to determine optimal inventory levels and generate reorder points.
- **User Interface (UI):** This is the web-based interface that businesses use to interact with Inventory Prophet. It allows users to view inventory data, manage products, generate reports, and configure settings.
- **Point-of-Sale (POS) Systems/E-commerce Platforms:** Inventory Prophet can integrate with existing business systems for automated data import (sales data) and order generation.

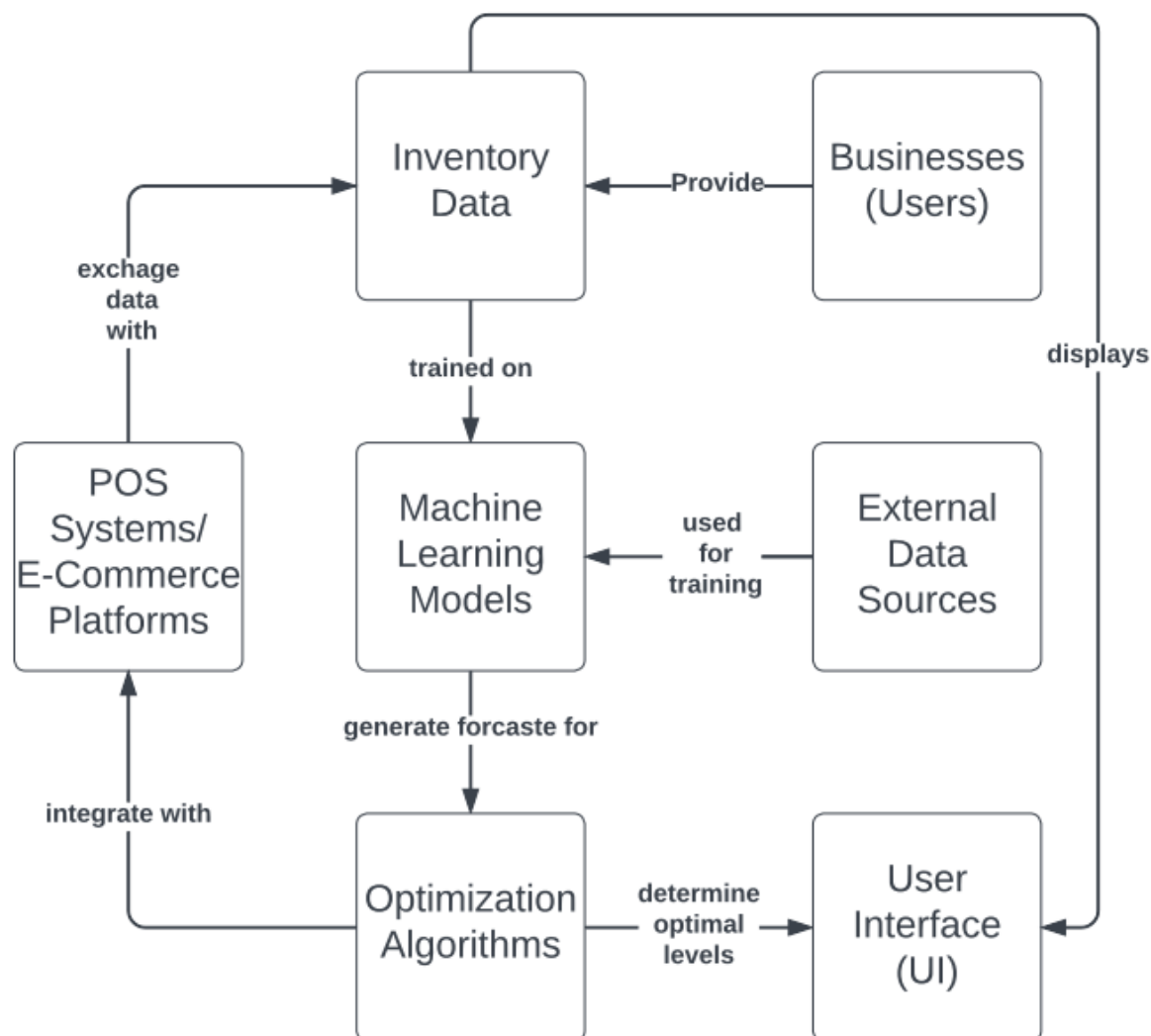
### Relationships:

- Businesses subscribe to Inventory Prophet and provide their inventory data.
- Inventory Prophet retrieves data from internal sources (inventory data) and potentially external data sources.
- The machine learning models are trained on historical data and external factors.
- Demand forecasts are generated by the machine learning models.
- Optimization algorithms utilize demand forecasts and other factors to determine optimal inventory levels and reorder points.

- The UI displays inventory data, forecasts, and allows users to manage inventory and generate reports.
- Inventory Prophet can integrate with POS systems or e-commerce platforms for data exchange.

## Schematic Diagram for Inventory Prophet

~Siddharth



## 13. Product Details

### How Does Inventory Prophet Work?

Inventory Prophet functions as a cloud-based system accessible through a web interface. Here's a detailed breakdown of its workflow:

**1. Data Acquisition:**

- Businesses subscribe to Inventory Prophet and create an account.
- They connect their existing Point-of-Sale (POS) system or e-commerce platform through integrations offered by Inventory Prophet. This allows for automatic import of historical sales data for all products.
- Additionally, businesses can manually upload product information (SKU, description, lead time) and current inventory levels for each product across different store locations (if applicable).

**2. Data Preprocessing and Cleaning:**

- Inventory Prophet ingests the sales data and product information.
- Data cleaning techniques are applied to identify and address any inconsistencies, missing values, or outliers in the data. This ensures the accuracy and effectiveness of the subsequent analysis.

**3. Machine Learning Model Training:**

- Inventory Prophet utilizes machine learning algorithms to build forecasting models for each product. A common choice for this purpose is the Prophet library developed by Facebook. This library is well-suited for time series forecasting tasks and can handle factors like seasonality and holidays.
- The training process involves feeding historical sales data, product information (e.g., seasonality patterns), and potentially external data sources (discussed later) into the machine learning model.
- Through this training, the model learns to identify patterns in past sales data and external factors that influence demand.

**4. Demand Forecasting:**

- Once trained, the machine learning model can generate forecasts for future demand of each product. These forecasts predict the expected sales volume for a specific period (e.g., daily, weekly, monthly) based on the identified patterns and trends.
- Inventory Prophet can provide short-term forecasts for the next few days or weeks, as well as long-term forecasts for a longer planning horizon (e.g., months).

**5. Inventory Optimization:**

- Inventory Prophet utilizes the demand forecasts along with other factors like lead times (time it takes to receive new stock) and safety stock levels (buffer stock to handle unexpected demand fluctuations) to determine optimal inventory levels for each product.
  - Optimization algorithms analyze these factors and suggest the ideal amount of stock a business should hold to minimize the risk of stockouts while also avoiding excess inventory that ties up capital.
- 6. Automated Reordering:**
- Based on the optimal inventory levels and lead times, Inventory Prophet can generate automated purchase orders for products approaching reorder points. This eliminates the need for manual order placement and reduces the risk of stockouts.
  - Businesses can define custom reorder point thresholds within the system to trigger automated purchase orders. They can also set up reorder rules or parameters based on specific product categories or supplier lead times.
- 7. Multi-location Management (if applicable):**
- For businesses with inventory spread across multiple stores or warehouses, Inventory Prophet offers features for centralized management.
  - The system provides real-time visibility into inventory levels at each location.
  - Inventory Prophet can recommend stock transfers between locations to optimize stock distribution and ensure products are available where they are needed.
- 8. Reporting and Analytics:**
- Inventory Prophet offers a user-friendly dashboard that allows businesses to visualize key metrics such as:
    - Inventory levels by product and location (if applicable).
    - Demand forecasts for different time horizons.
    - Sales trends and historical data comparisons.
    - Reorder point notifications and purchase order history.
  - Businesses can generate reports to track inventory performance, identify trends, and make informed decisions about product stocking and purchasing strategies.

## **Data Sources:**

Inventory Prophet leverages several data sources to power its functionalities:

- 1. Internal Data:**
  - **Historical Sales Data:** This is the primary data source for training the machine learning models. It includes historical sales records from the business's POS system or e-commerce platform. Ideally, this data should cover a period of at



least one year to capture seasonal trends and account for potential fluctuations.

- **Product Information:** This includes details about each product in the inventory, such as SKU (stock keeping unit), product description, and lead time (time it takes to receive new stock from suppliers).

## 2. External Data Sources (Optional):

- Inventory Prophet can integrate with external data sources to potentially improve the accuracy of demand forecasts. Here are some examples:
  - **Weather Forecasting Services:** For businesses selling seasonal products (e.g., swimwear in summer), integrating with weather forecasting services can provide insights into potential demand fluctuations based on weather patterns.
  - **Market Research Data:** Access to market research data on consumer trends, competitor activity, or upcoming industry events can be valuable for businesses in certain sectors. By incorporating such data, Inventory Prophet can generate more comprehensive forecasts that account for

## Algorithms, Frameworks, and Software

Inventory Prophet will rely on a combination of algorithms, frameworks, and software to deliver its functionalities. Here's a breakdown of the key technologies:

- **Machine Learning Algorithms:**
  - **Prophet (by Facebook):** This is a well-suited open-source library for time series forecasting. It utilizes a statistical approach to model seasonality, holidays, and other trends in historical data for accurate demand forecasting.
  - **Alternative Algorithms:** Depending on the specific needs and data complexity, other machine learning algorithms like ARIMA (Autoregressive Integrated Moving Average) or LSTMs (Long Short-Term Memory networks) could also be explored for forecasting.
- **Optimization Algorithms:**
  - **Linear Programming:** This is a common mathematical programming technique for solving optimization problems. It can be used to determine optimal inventory levels by considering factors like demand forecasts, lead times, holding costs, and stockout penalties.
  - **Heuristics:** In some cases, heuristic algorithms (approximate but efficient problem-solving methods) might be employed for faster optimization, especially when dealing with large product inventories.

- **Development Frameworks:**
  - **Python:** This is a popular and versatile programming language widely used in data science and machine learning applications. It offers a rich ecosystem of libraries and frameworks for data manipulation, model development, and web application development.
  - **Alternative Frameworks:** Depending on the chosen development approach, other frameworks like Java or Javascript could also be considered.
- **Database Management System:**
  - **Cloud-based Database:** A scalable and secure cloud-based database system like MySQL or PostgreSQL will be needed to store historical sales data, product information, and other relevant data for Inventory Prophet.
- **Cloud Platform:**
  - **Amazon Web Services (AWS) or Microsoft Azure:** These cloud platforms offer a comprehensive suite of services for hosting the Inventory Prophet application, database, and machine learning models. They provide scalability, reliability, and robust security features for the application.
- **Additional Software:**
  - **Data Visualization Libraries:** Libraries like Matplotlib or Plotly will be used to create charts and graphs for visualizing inventory data, demand forecasts, and other key metrics within the user interface.
  - **Web Development Frameworks:** Frameworks like Django or Flask can be used to develop the web-based user interface for Inventory Prophet, allowing businesses to interact with the system and access functionalities.

## Team Required

Developing Inventory Prophet will require a team with expertise in various areas:

- **Machine Learning Engineers:** These individuals will be responsible for building and training the machine learning models for demand forecasting. They will have a strong understanding of machine learning algorithms, data analysis techniques, and experience with relevant libraries like Prophet and Python.
- **Software Developers:** Full-stack developers with experience in web development frameworks like Django or Flask will be needed to design and build the user interface, integrate with external data sources and POS systems, and ensure the overall functionality of the application.
- **Data Scientists:** Data scientists will play a crucial role in data preprocessing, cleaning, and feature engineering. They will also be involved in evaluating the performance of machine learning models and refining forecasting algorithms.

- **DevOps Engineers:** These professionals will be responsible for deploying the application on the cloud platform, ensuring its smooth operation, scalability, and security. They will also manage data pipelines and automate tasks.
- **UI/UX Designers:** User experience (UX) designers will focus on creating an intuitive and user-friendly interface for Inventory Prophet. They will ensure that the application is easy to navigate and understand for businesses with varying levels of technical expertise.

The specific team size will depend on the development budget and timeline. Initially, a lean team with a combination of these skillsets might be sufficient, with the possibility of scaling up as the product matures and user base grows.

## Cost Estimation

The cost of developing Inventory Prophet can vary depending on several factors, including:

- **Team Size and Location:** Hiring experienced developers and data scientists can be expensive, especially in high-demand locations.
- **Development Approach:** Opting for open-source libraries can minimize licensing costs compared to proprietary software solutions.
- **Cloud Platform Selection:** Cloud service providers offer different pricing models based on resource usage. Choosing a scalable and cost-effective cloud platform is crucial.
- **Features and Complexity:** The number of features and the overall complexity of the system will directly impact development time and costs.

Here's a rough breakdown of potential cost categories:

- **Personnel Costs:** Salaries for developers, data scientists, and other team members will be the primary expense.
- **Cloud Platform Fees:** Costs associated with running the application and database on a cloud platform.
- **Software Licenses:** While leveraging open-source libraries can minimize this cost, there might be fees for specific third party software.

Here's a rough estimate (considering a mid-range development team and location):

- Development Costs (including salaries, tools, etc.): \$150,000 – \$300,000
- Cloud Platform Costs (initial setup): \$5,000 – \$10,000 per month (depending on usage)

**It's important to note that this is just an estimate, and the actual cost may vary.** A more detailed breakdown of costs can be generated during the development planning phase.

## 14. Financial Formula/Equation for Monitoring Purpose

Profit=Revenue–Costs

Where:

- Revenue can be calculated as:

$$\text{Revenue} = \sum (\text{Sales Price}_i \times \text{Units Sold}_i)$$

- Costs can be broken down into:

$$\text{Costs} = \text{Inventory Carrying Costs} + \text{Stockout Costs} + \text{Ordering Costs}$$

- Inventory Carrying Costs could be calculated as:

$$\text{Inventory Carrying Costs} = \sum (\text{Holding Cost per Unit} \times \text{Average Inventory Level})$$

- Stockout Costs could be estimated by considering the loss of potential sales:

$$\text{Stockout Costs} = \sum (\text{Lost Sales}_i \times \text{Profit Margin per Unit}_i)$$

- Ordering Costs might include:

$$\text{Ordering Costs} = \sum (\text{Cost per Order} \times \text{Number of Orders})$$

## 15. Statistics

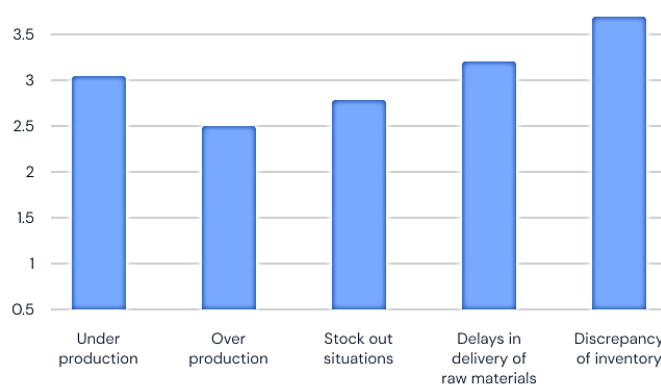
### How Inventory Management Works?



### Existing Statistics:

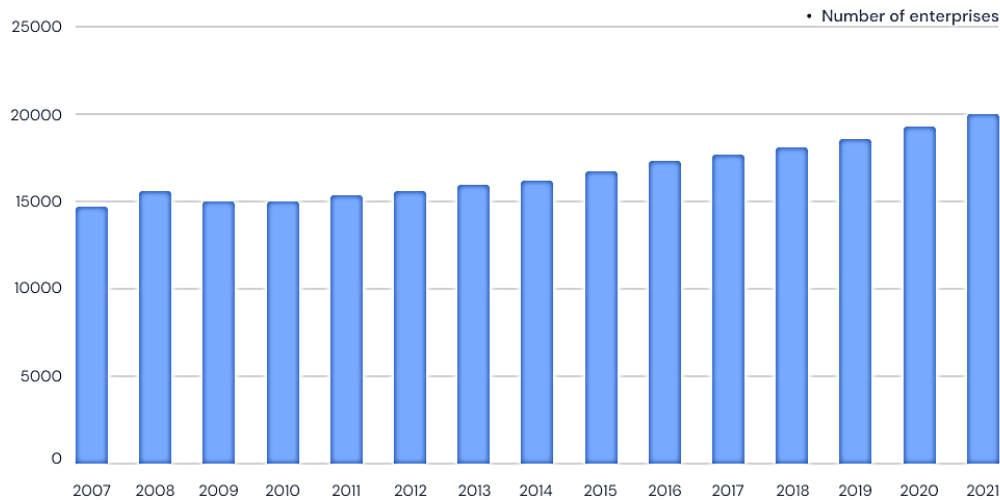
- Approximately 34% of businesses have encountered situations where they have **unintentionally sold a product that was unavailable in their inventory**, resulting in delayed order shipments.

### Problems of Inventory Management



This statistic emphasizes the **operational challenge** that many businesses face in effectively managing their inventory and order fulfillment processes.

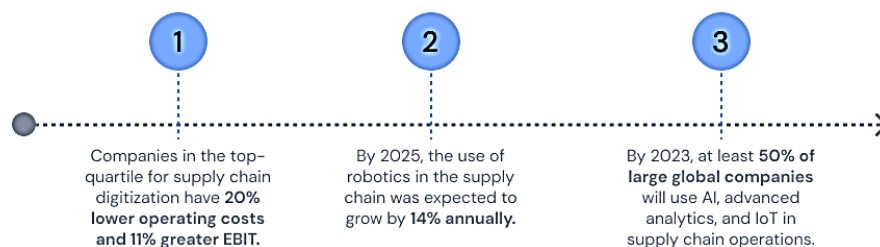
- In the United States, warehousing and storage businesses have witnessed a continuous and escalating growth trend since 2010.



The number of these businesses has increased each year, eventually reaching a total of **20,002 in 2021**.

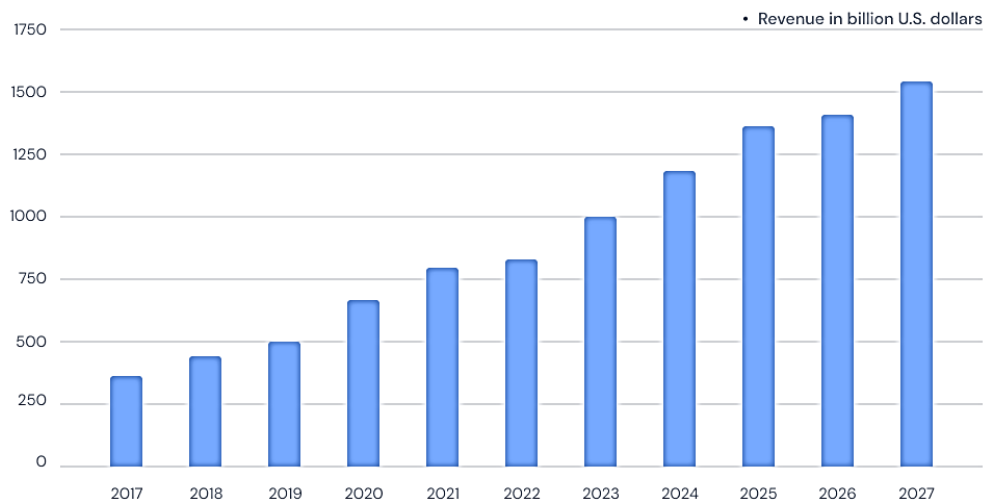
- According to the analysis, **79% of companies with high-performing supply chains** can achieve **revenue growth** surpassing the average performance within their respective industries.

### 3 Statistics Supply Chain



- The **sales of physical goods** through ecommerce channels are experiencing a remarkable surge.  
According to [Statista](#), in 2018, online sales of physical goods reached a staggering \$504.6 billion

### Revenue of the e-commerce Industry in the U.S. 2017–2027



Furthermore, projections indicate that these sales are expected to **surpass \$735 billion by 2023**.

### Implemented Statistics:

<https://github.com/i23sid/Task-3>

## 16. Profit Projections

(Based on Assumptions)

### Assumptions

1. **Revenue Projections:**
  - Number of clients: Starting with 50 clients, growing by 10 clients per month.
  - Subscription fee per client: \$200 per month.
2. **Cost Projections:**
  - Initial development cost: \$50,000.
  - Monthly operational costs (including salaries, maintenance, etc.): \$10,000.
  - Marketing costs: \$5,000 per month.
3. **Time Frame:** 12 months

### Revenue Calculation

Monthly Revenue = Number of Clients × Subscription Fee per Client

### Cost Calculation

Monthly Costs = Operational Costs + Marketing Costs

### Profit Calculation

Monthly Profit = Monthly Revenue – Monthly Costs

### Source code:

```
1  import pandas as pd
2
3  # Assumptions
4  initial_clients = 50
5  monthly_client_growth = 10
6  subscription_fee = 200
7  initial_development_cost = 50000
8  monthly_operational_cost = 10000
9  monthly_marketing_cost = 5000
10
11 # Initialize lists to store projections
12 months = list(range(1, 13))
13 clients = []
14 revenue = []
15 costs = []
16 profit = []
17
```



```

18 # Initial values
19 current_clients = initial_clients
20 total_revenue = 0
21 total_costs = initial_development_cost
22 '''Include initial development cost in the first month'''
23
24 # Monthly projection calculations
25 for month in months:
26     monthly_revenue = current_clients * subscription_fee
27     monthly_costs = monthly_operational_cost + monthly_marketing_cost
28     monthly_profit = monthly_revenue - monthly_costs

```

```

29     # Append values to lists
30     clients.append(current_clients)
31     revenue.append(monthly_revenue)
32     costs.append(monthly_costs)
33     profit.append(monthly_profit)
34
35     # Update totals and current clients
36     total_revenue += monthly_revenue
37     total_costs += monthly_costs
38     current_clients += monthly_client_growth
39
40 # Create a DataFrame to display the projections
41 projection_df = pd.DataFrame({
42     'Month': months,
43     'Clients': clients,
44     'Revenue': revenue,
45     'Costs': costs,
46     'Profit': profit
47 })
48
49 # Print the DataFrame
50 print(projection_df)
51
52 # Display total revenue, costs, and profit
53 total_profit = total_revenue - total_costs
54 print(f"Total Revenue: ${total_revenue}")
55 print(f"Total Costs: ${total_costs}")
56 print(f"Total Profit: ${total_profit}")

```

## Output:

|    | Month | Clients | Revenue | Costs | Profit |
|----|-------|---------|---------|-------|--------|
| 0  | 1     | 50      | 10000   | 15000 | -5000  |
| 1  | 2     | 60      | 12000   | 15000 | -3000  |
| 2  | 3     | 70      | 14000   | 15000 | -1000  |
| 3  | 4     | 80      | 16000   | 15000 | 1000   |
| 4  | 5     | 90      | 18000   | 15000 | 3000   |
| 5  | 6     | 100     | 20000   | 15000 | 5000   |
| 6  | 7     | 110     | 22000   | 15000 | 7000   |
| 7  | 8     | 120     | 24000   | 15000 | 9000   |
| 8  | 9     | 130     | 26000   | 15000 | 11000  |
| 9  | 10    | 140     | 28000   | 15000 | 13000  |
| 10 | 11    | 150     | 30000   | 15000 | 15000  |
| 11 | 12    | 160     | 32000   | 15000 | 17000  |

Total Revenue: \$260000

Total Costs: \$230000

Total Profit: \$30000