I1.02 - Supply Chain Planning for Optimized Demand Fulfillment

TEXAS STATE INGRAM SCHOOL OF ENGINEERING

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Polímeros Ópticos™

Background

Polimeros Opticos (PO), leaders in the distribution and marketing of optical products such as frames (ophthalmic lenses), contact lenses and raw materials in Mexico

Problem statement

PO faces data inconsistencies across sources, causing delays in demand forecasting and higher costs due to manual processing

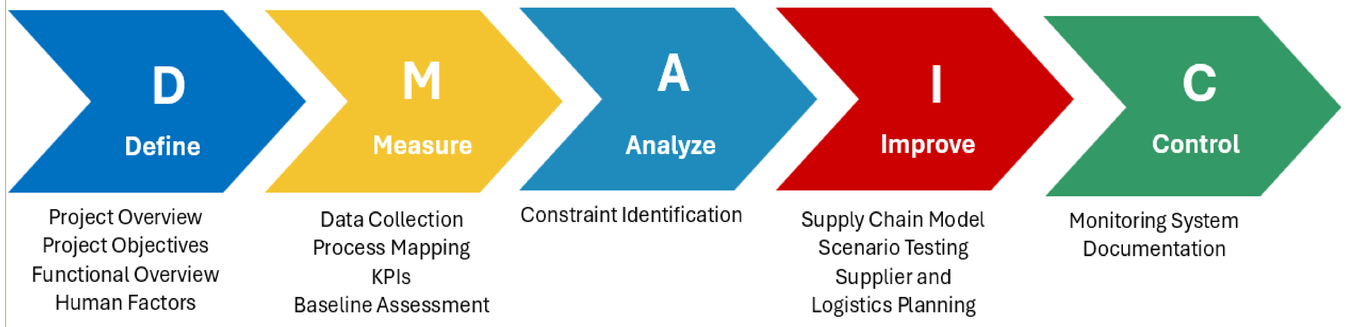
Deliverables

1. Forecast Model: Define Demand Scenarios for Planning Process (Two years, monthly).
2. Dashboard: Easy to create new scenarios every month with customizable views.
3. Guide & Training: New users can know how to use the app fast.

Benefits

- Streamlined operations
- Better demand forecasting
- Reduced costs and errors
- Enhanced decision-making
- Increased adaptability
- Faster user onboarding

Design Approach



Supply Chain Model

Sets and Indices

- $i \in \text{Products}$: Index and set of products.
- $j \in \text{Suppliers}$: Index and set of suppliers.
- $k \in \text{Customers}$: Index and set of customers.
- $t \in \text{Periods}$: Index for time periods (e.g., months).

Decision Variables

1. **Order Quantity** ($O_{i,j,t}$): Amount of product i ordered from supplier j in period t.
2. **Sales Quantity** ($S_{i,k,t}$): Quantity of product i sold to customer k in period t.
3. **Inventory** ($I_{i,t}$): Inventory level of product i in the distribution center at the end of period t.

Objective Function

- Maximize Profit:

$$\max \sum_t \sum_i \sum_k (P_{i,k,t} \cdot S_{i,k,t}) - \sum_t \sum_i \sum_j (TCost\_SB_{i,j,t} \cdot O_{i,j,t}) - \sum_t \sum_i \sum_k (TCost\_SC_{i,k,t} \cdot S_{i,k,t}) - \sum_t \sum_i H_{i,t} \cdot I_{i,t}$$

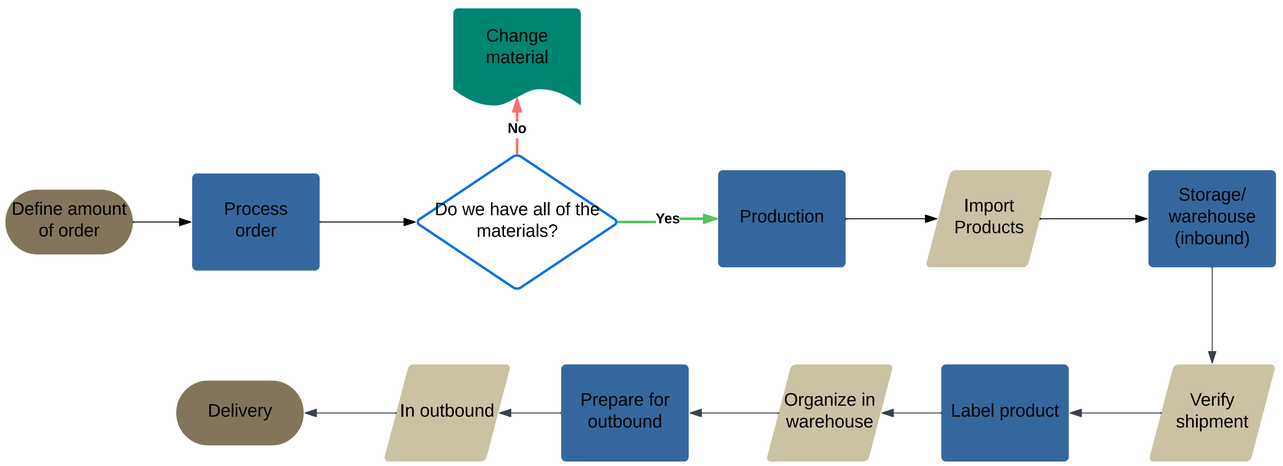
where:

- $P_{i,k,t} \cdot S_{i,k,t}$ is the revenue from sales.
- $TCost\_SB_{i,j,t} \cdot O_{i,j,t}$ is the cost of transporting products from suppliers to the border.
- $TCost\_SC_{i,k,t} \cdot S_{i,k,t}$ is the cost of transporting products from the distribution center to customers.
- $H_{i,t} \cdot I_{i,t}$ is the holding cost for inventory.

Constraints

1. **Demand Fulfillment**:
   - Ensure that the total sales to each customer meets their demand.
   $$S_{i,k,t} \geq \text{Dem}_{i,k,t} \quad \forall i,k,t$$
2. **Supply Capacity**:
   - Orders from each supplier cannot exceed their capacity for each product in each period.
   $$O_{i,j,t} \leq \text{Cap}_{i,j,t} \quad \forall i,j,t$$
3. **Inventory Balance**:
   - Inventory for each product at the distribution center should account for the previous inventory, orders placed, and sales.
   $$I_{i,t} = I_{i,t-1} + \sum_j O_{i,j,t} - \sum_k S_{i,k,t} \quad \forall i,t$$
   - Initial inventory $I_{i,0}$ can be set based on starting conditions.
4. **Cash Flow Constraint**:
   - The cost of orders placed must be within the cash flow available for each period.
   $$\sum_i \sum_j TCost\_SB_{i,j,t} \cdot O_{i,j,t} \leq \text{CashFlow}_t \quad \forall t$$
5. **Non-Negativity and Sign Restrictions:**
   - All decision variables should be non-negative.
   $$O_{i,j,t} \geq 0, \quad S_{i,k,t} \geq 0, \quad I_{i,t} \geq 0 \quad \forall i,j,k,t$$

Value Steam Map



Human Factors

- Reduce mental workload of key personnel
- Clear Reporting and Visualization
- Adaptability of Scenarios and Flexibility of Model
- Training and Decision Support
- Make better decisions according to business plan

Future Plans

- Model Refinement & Optimization
- Final Documentation & Reporting
- Scenario Management & Testing

Team Members