Multi-Echelon Inventory Management for A Fresh Produce Retail Supply Chain

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Agenda

1. Overview
2. Methodology
3. Simulation Model
4. Results
5. Key Insights
6. Q & A
Chiquita Brands International Inc.

A leading producer and distributor of premium fresh produce

Challenges for a Fresh Produce Retail Supply Chain:
• Limited lifetime
• Multiple layers of inventory locations
• Volatile demand

Research Objective

To develop an inventory policy that minimizes costs while maintaining high customer service levels

1) What are the parameters for optimal inventory management depending upon product perishability, forecast accuracy, inventory carrying cost, lost sales and inventory shrinkage costs?

2) What is the trade-off between service level and inventory costs?

3) What is the impact of increased forecast accuracy on inventory-related costs?
**Research Scope**

- Fresh express supply chain for Chiquita’s largest customer, ABC Inc.
- ABC’s distribution center and retail stores
  - Significant portion of fresh express’s volume
  - Common characteristics shared by fresh express’ other supply chains

**Methodology**

- To replicate the Fresh Express Supply Chain
- Benefits of simulation model:
  - Cost-effective way to test different scenarios
  - Easier to keep track of inventory age
- Arena simulation model
  - A leading simulation software
  - User friendly and good interface with Microsoft Office
Chiquita’s Process Flow

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Model Inputs

- Target days on-hand inventory
- Shrinkage probability for each day (up to 14 days)
- Forecast errors
- Costs
  - Product unit cost
  - Lost sales cost
  - Inventory holding cost
  - Shrinkage cost
- Lead time
  - Transportation lead time from plant to DC
  - Production lead time at the plant

* Due to confidentiality concerns, all the numbers used throughout the presentation are for illustrative purposes only and are not necessarily indicative of actual performance at Chiquita.

Information Flow in the Model
Assumptions

- No capacity constraints
- Stochastic and normally distributed demand
- First-In-First-Out
- Transportation lead time from the DC to retail stores is one day
- Transportation lead time from the plant to the DC is deterministic and constant

Simulation Model in Arena

Multi-Echelon Inventory Management for a Fresh Produce Retail Supply Chain
Current Policy vs. Optimal Policy

**Current Policy:**
Target on-hand inventory 2.5 days at the retail stores, 1 day at the DC

**Optimal Policy:**
Target on-hand inventory 1.5 days at the retail stores, 0.5 days at the DC

The optimal policy reduces the Total Relevant Cost by 31% and maintains the Item Fill Rate (IFR) above the required 95% at all echelons.

Forecast Error vs. Total Relevant Cost

**Forecast Error vs. Total Relevant Cost for the System**

- SystemCost/DCForecastError
- SystemCost/RetailForecastError
Forecast Error vs. Total Relevant Cost

Forecast Error vs. Item Fill Rate

Forecast Error at DC Vs Item Fill Rate

Forecast Error at Retail Stores Vs Item Fill Rate
Key Insights

- **Optimal Policy:** 0.5 days at DC and 1.5 days at retail stores
  - Reduces the total relevant cost by **31%**
  - Reduces the shrinkage from **12.5%** to **4.5%**
  - Maintains the IFR above **95%** at all echelons

- **Forecast Accuracy:** Improve forecast accuracy at both the DC and retail stores
  - The costs for the system is more sensitive to the forecast errors at the DC
    - 20% forecast accuracy improvement at DC = **16%** cost reduction
    - 20% forecast accuracy improvement at retail stores = 7% cost reduction
  - The service level is more sensitive to the forecast errors at the retail stores

- **Transportation Lead Time:** Keep the transportation lead time as low as possible

Q & A

Questions?
Thank You