

# LEC001 Introduction to Supply Chain

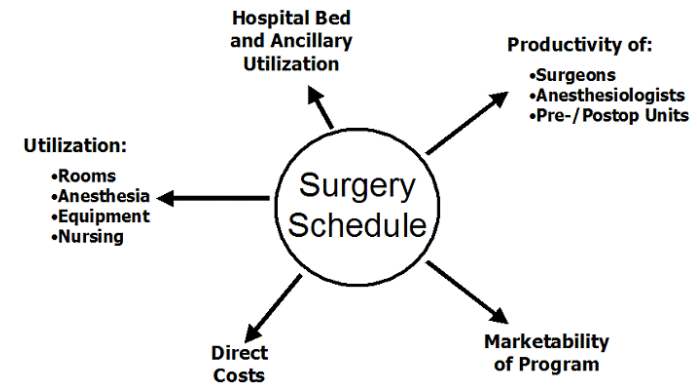
VG441 SS2021

Cong Shi  
Industrial & Operations Engineering  
University of Michigan

# About the Instructor

Instructor: Cong Shi 时聪, Associate Professor at UM

Research Areas: Supply Chain, Revenue Management, Service Operations

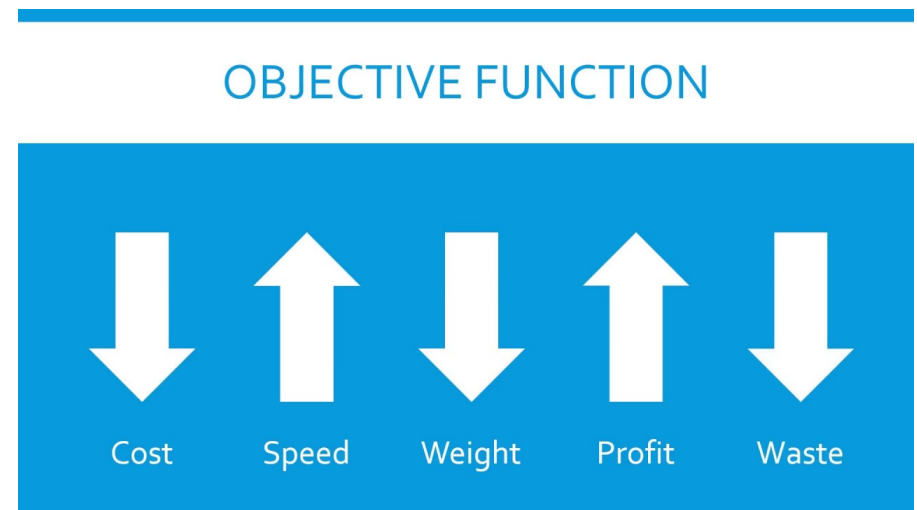
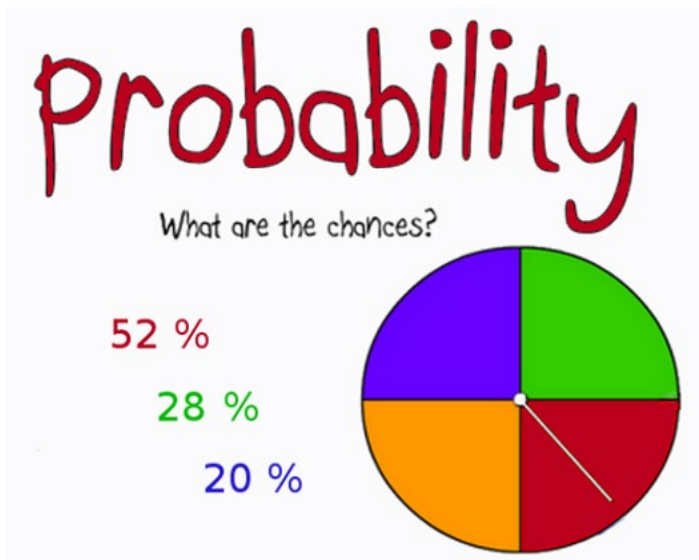


Methods: Optimization, Probability, Data Science, Learning Theory



# Course Objectives

- Goal 1: Learn terminologies and principle for SCM
- Goal 2: Learn algorithmic approaches for SCM



# What is Supply Chain?

All the activities and infrastructure whose purpose is to move products from where they are produced to where they are consumed



2020 Annual Business Logistics Cost ~ 2.6 trillion  
(~ 16% of total US GDP)

# What is Supply Chain?

- A supply chain consists of all stages involved, directly or indirectly, in fulfilling a customer request
- Its existence is to satisfy customer needs, in the process generating profits for itself
- It not only includes the manufacturer and suppliers, but also transporters, warehouses, retailers, and customers themselves

# What is Supply Chain Management?

SCM is the set of practices required to perform the functions of a SC and to make them

- ♦ more efficient
- ♦ more profitable
- ♦ more equitable
- ♦ less costly
- ♦ less wasteful
- ♦ less stressful

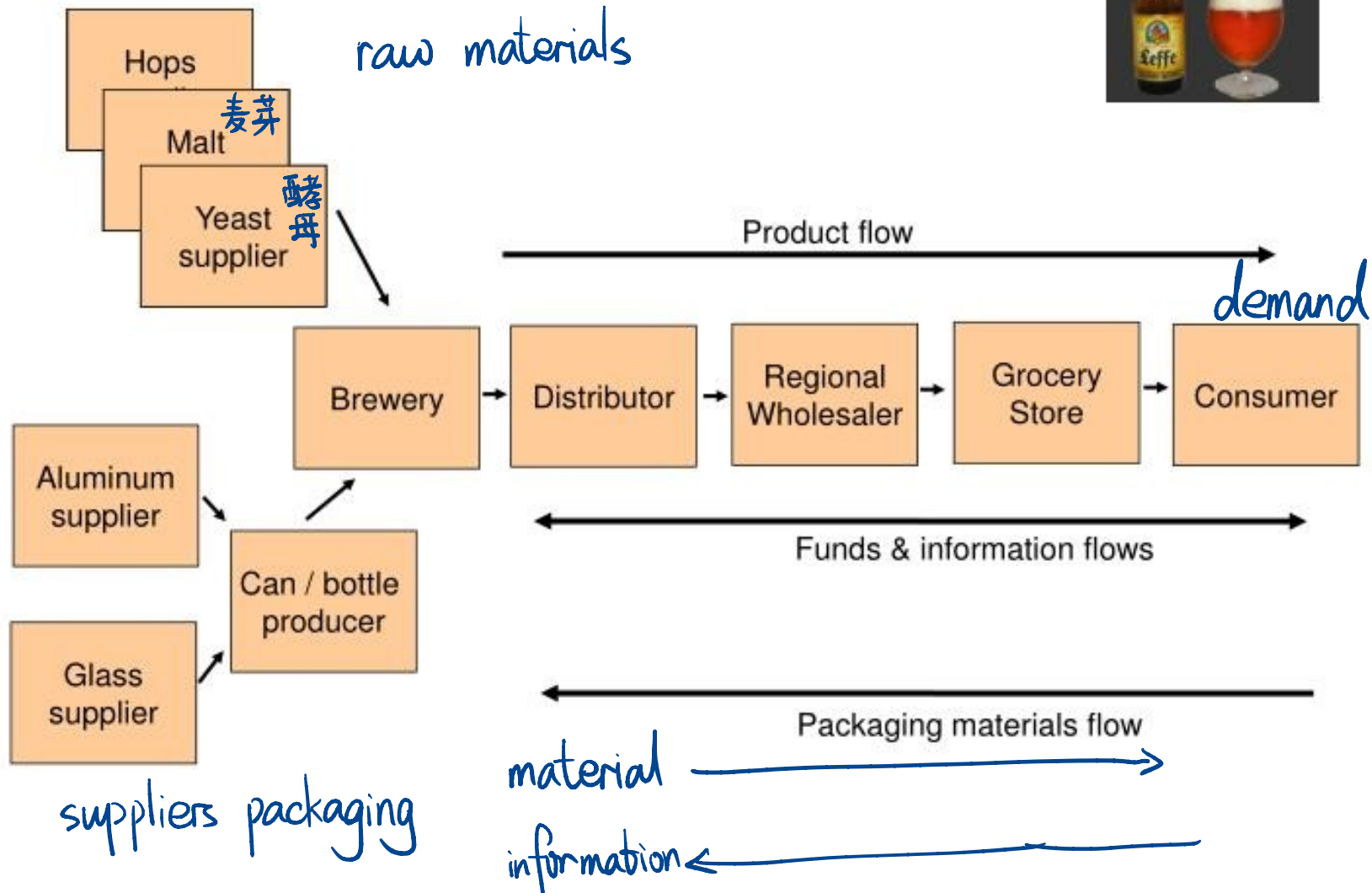


# An Example of SC

upstream suppliers

down stream

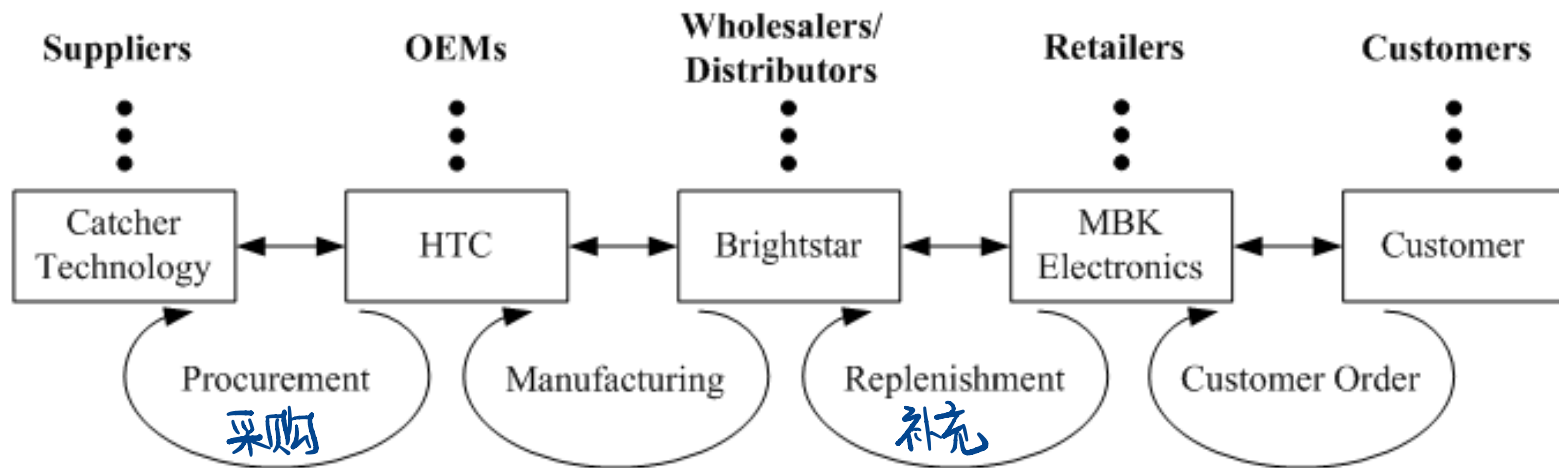
## Beer supply chain example



# Another Example of SC

"outsource"

memory  
chips  
modem



supply chain



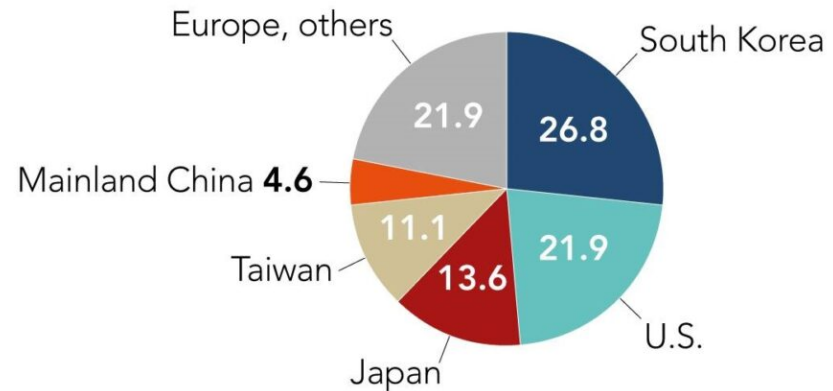
# Apple iPhone 12 <sup>pro</sup>

<https://www.apple.com/supplier-responsibility/pdf/Apple-Supplier-List.pdf>

(200+ suppliers, 1600 parts)



**iPhone 12 Pro component providers, by country and region** *(By value, in percent)*



*Total does not equal 100 due to rounding*

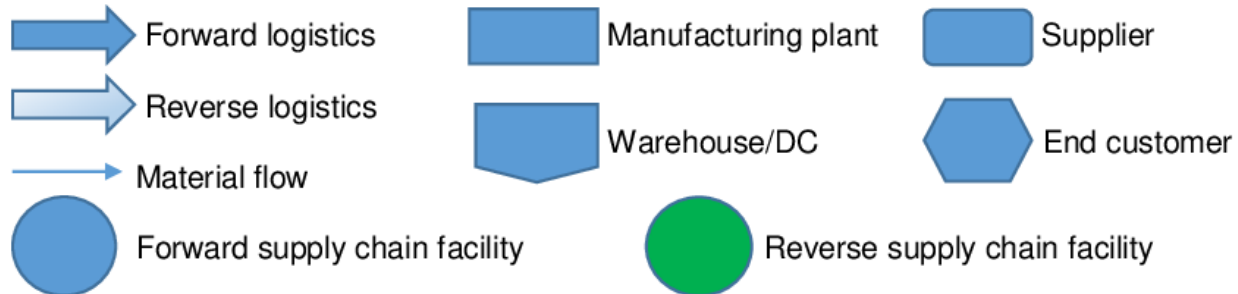
*Source: Ratios based on estimates by Fomalhaut Techno Solutions*

- iPhone 12 Pro OLED panel from Samsung– \$70 per unit
- Qualcomm Snapdragon X55 5G modem - \$90 per unit
- A14 Bionic – \$40 per unit
- SK Hynix DRAM – \$12.8 per unit
- Samsung flash memory – \$19.2 per unit
- Sony CMOS sensors \$7.4 – \$7.9.

Cost of making an iPhone 12 = \$406

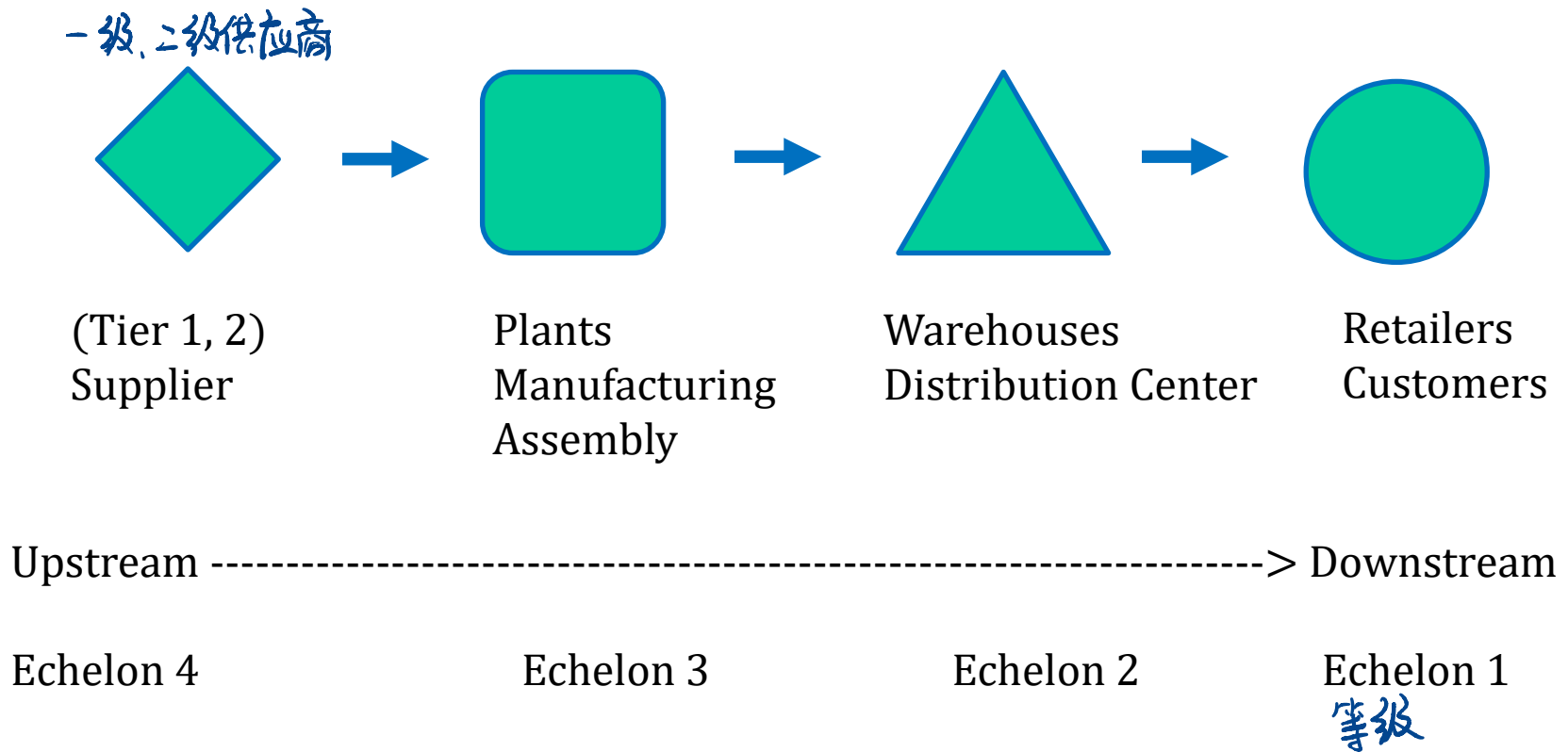
Selling Price = \$999 (42.5% gross margin)

$E_v < \text{sat lery supplier}$



10

# Schematic Diagram



# SC Objectives

- The objective of every supply chain is to maximize the overall value generated
- The value is the difference between what the final product is worth to the customer and the effort the supply chain expends in filling the customer's request
- The total profit, to be shared across all supply chain stages, is called supply chain profitability

# Typical Set of Practices

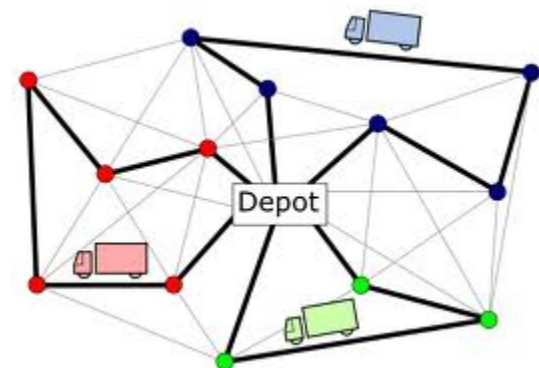
- Demand forecasting
- Production planning
- Inventory management
- Warehouse location (facility location)
- Supplier selection (sourcing)
- Transportation, shipping, last-mile delivery
- Revenue management (dynamic pricing)

优化  
Each part requires optimization!



# Decisions

- **Strategic** (long-term planning):
  - Location & sizes of warehouses
  - Location & capabilities of factories
  - Contracts with suppliers
- **Tactical** (medium-term planning): 战略 仓库
  - Assignments of customers to warehouses
  - Inventory policies at warehouses
- **Operational** (short-term planning):
  - Filling customer orders
  - Routing of delivery vehicles



# More Decisions

- On-Demand E-Hailing/Ride-Sharing Platform (Uber, Lyft, DiDi)
  - Demand Prediction
  - Dynamic Matching
  - Dynamic Pricing
- Airline (Network) Revenue Management
  - Inventory and Capacity Constraints
  - Dynamic Booking and Pricing
- Amazon Fresh
  - Perishable Inventory Systems
  - Order Fulfillment (Service Level)
- Online Algorithms and Online Reinforcement Learning

# Walmart Case

- Founded by Sam Walton in 1962 in Arkansas
- Focused on “Every Day Low Price”
- Focused on superb customer service



## Several supply chain innovations

- ♦ VMI
- ♦ Cross-docking strategy
- ♦ Sam's club



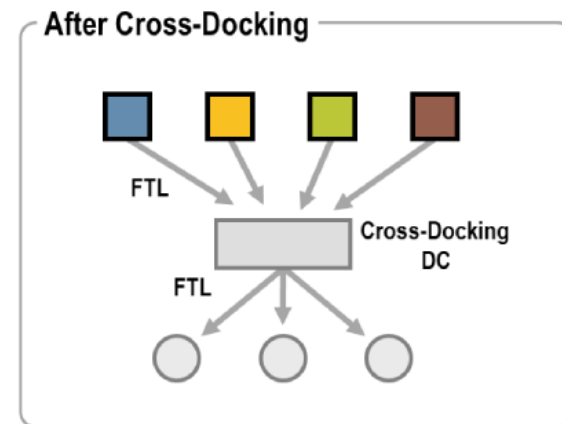
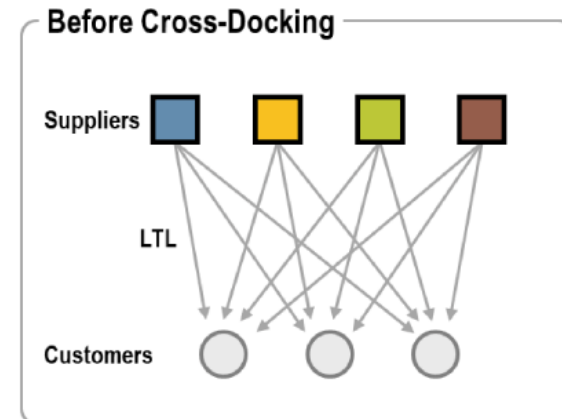
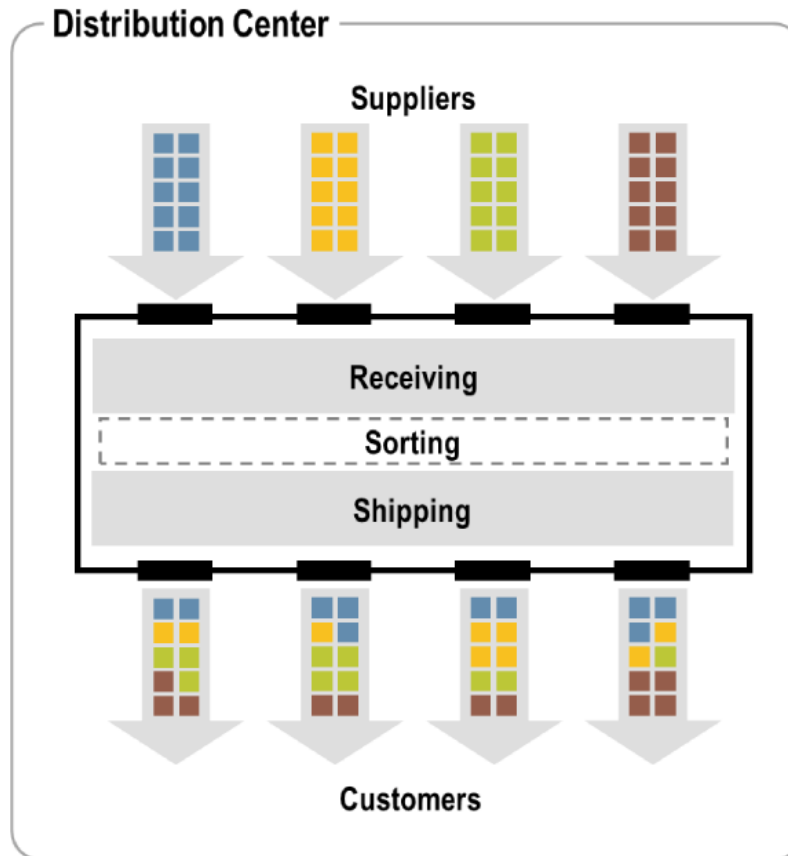
# VMI (Vendor Managed Inventory)

- Vendor employee is on-site of Walmart's facility
- Physically replenish inventory on a visit
- Vendor has (partial) access to Walmart's inventory system (MRP/ERP)

## Benefits:

- ♦ Protect vendor from under-stock and lost-sales
- ♦ Better inventory carrying costs
- ♦ Easy “decentralized” management for Walmart

# Cross-Docking Strategy



# Sam's Club



Membership Fee (Sam's club): \$45 basic, \$100 premium

Membership Fee (Costco): \$60 basic, \$120 executive (2% cashback)

Membership Fee accounts for 95% of net profit!!!

# Target (Failure) Case

- Expansion into Canada in 2013
- Had to close 133 stores and laid off 17600 employees
- Lost \$2.5 billion



## Problems:

- Wrong demand prediction (based on US sales)
- Poor SKU selection and inventory management
- Overstock and understock at the same time