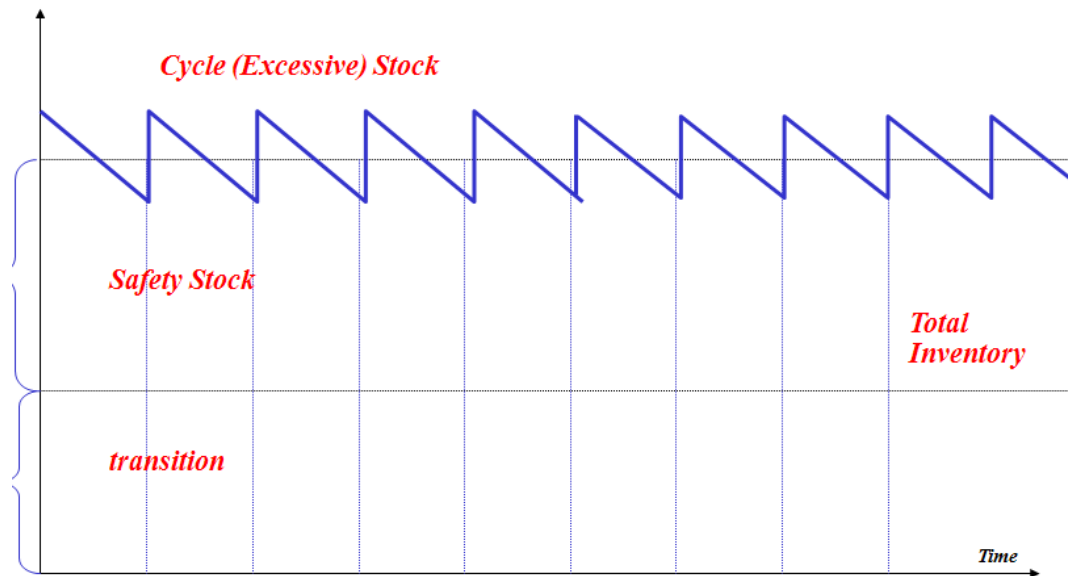# Supply Chain Management

HYUNSOO LEE

Supply Chain Management

- SCM

  - Supply Chain Management

  - Demand – Supply – Logistics ⬅ Manufacturing Process

    - PLM, CPC ➔ SCM

  - General Definition of Supply Chain

What is SCM?

1) Drive To Airport

illustration



- Work ~ Airport = 50 km
- Driving Speed = 50 km/hour
- Flight Check in Time = 11:00am

Q What time should you start to reach the airport by 11:00am?

A **In all cases,** your trip will take 60 minutes, so you **must start by 10:00am** in order to be at the airport by 11:00am.

Ideal Case: No Traffic Lights	*Time*	*Probability*
Mean Travel Time	60 min	-
Probability of Delay	-	0%
Best Case Scenario	60 min	100%
Worst Case Scenario	60 min	100%

1) Drive To Airport

illustration
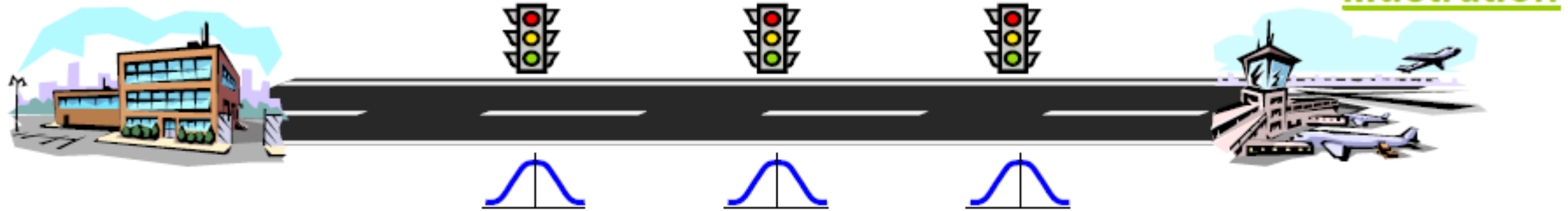
- **Change**: **Three traffic lights have been installed.** (each 5 minutes)

Q Now what time should you start to reach the airport by 11:00am?

A Minimum Trip time = 60 minutes.
Minimum Trip time = 75 minutes if you hit all three red lights.
To definitely reach the airport by 11am, you must start by 9:45 am. You may reach the airport 15 min early, depending on the lights.

Case 2: Three Traffic Lights	Time	Probability
Mean Travel Time	67.5 min	-
Probability of Delay	-	87.5%
Best Case Scenario	60 min	12.5%
Worst Case Scenario	75 min	12.5%

67.5 min

What is SCM?

1) Drive To Airport

illustration
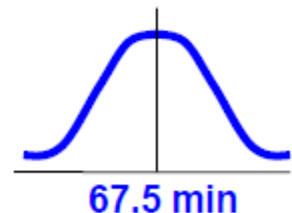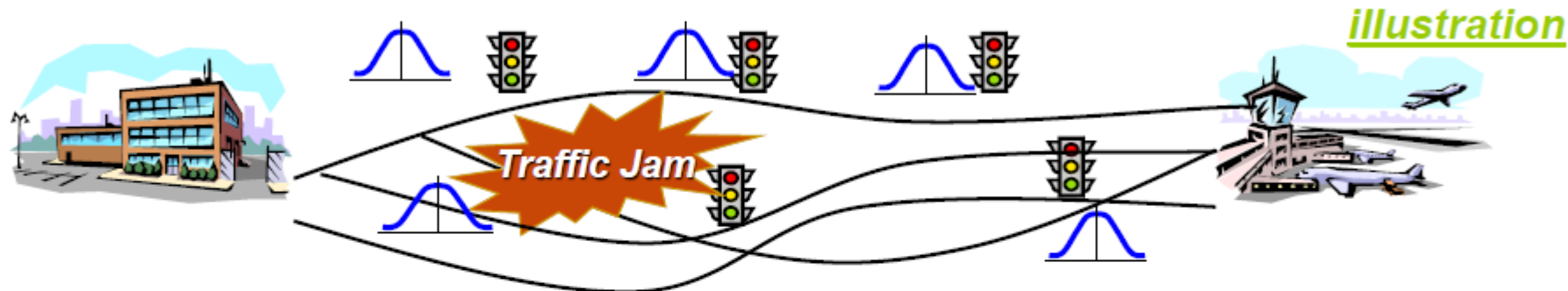
- *Change:* **Alternate routes with possible traffic jams. (Delay Unknown)**

Q | **Now** what time should you start to reach the airport by 11:00am?

A | Minimum Trip time = 60 minutes.
Trip time will be max. ?minutes if you hit all red lights and traffic jams.
To definitely reach the airport by 11am, you must start by ?am.
You start VERY EARLY(8 am?) due to many uncertainties.

Case 3: Many Uncertainties	Time	Probability
Mean Travel Time	? min	-
Probability of Delay	-	? %
Best Case Scenario	60 min	? %
Worst Case Scenario	? min	? %

?

1) Drive To Airport

illustration
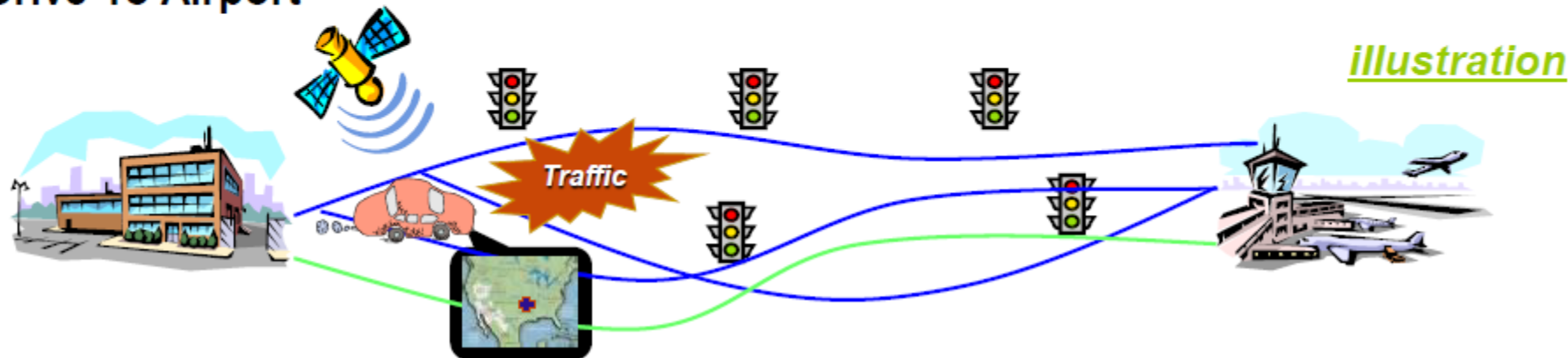
- **Visibility**: Road map, Navigator, Highway traffic data via satellites.
- **Velocity**: Shortest & fastest routing and dynamic rerouting along the way.
- **Complexity**: Automated green light sequencing. Modeling all signals, Possibility of traffic jam based on historical patterns, Speed limits.

Choose Route C to Start
Start by 10:05
Alter route as the Navigator tells you.
You will arrive by 10:50, with 99% reliability.

Why being great in SCM is important?

Map of Today's SCM transactions
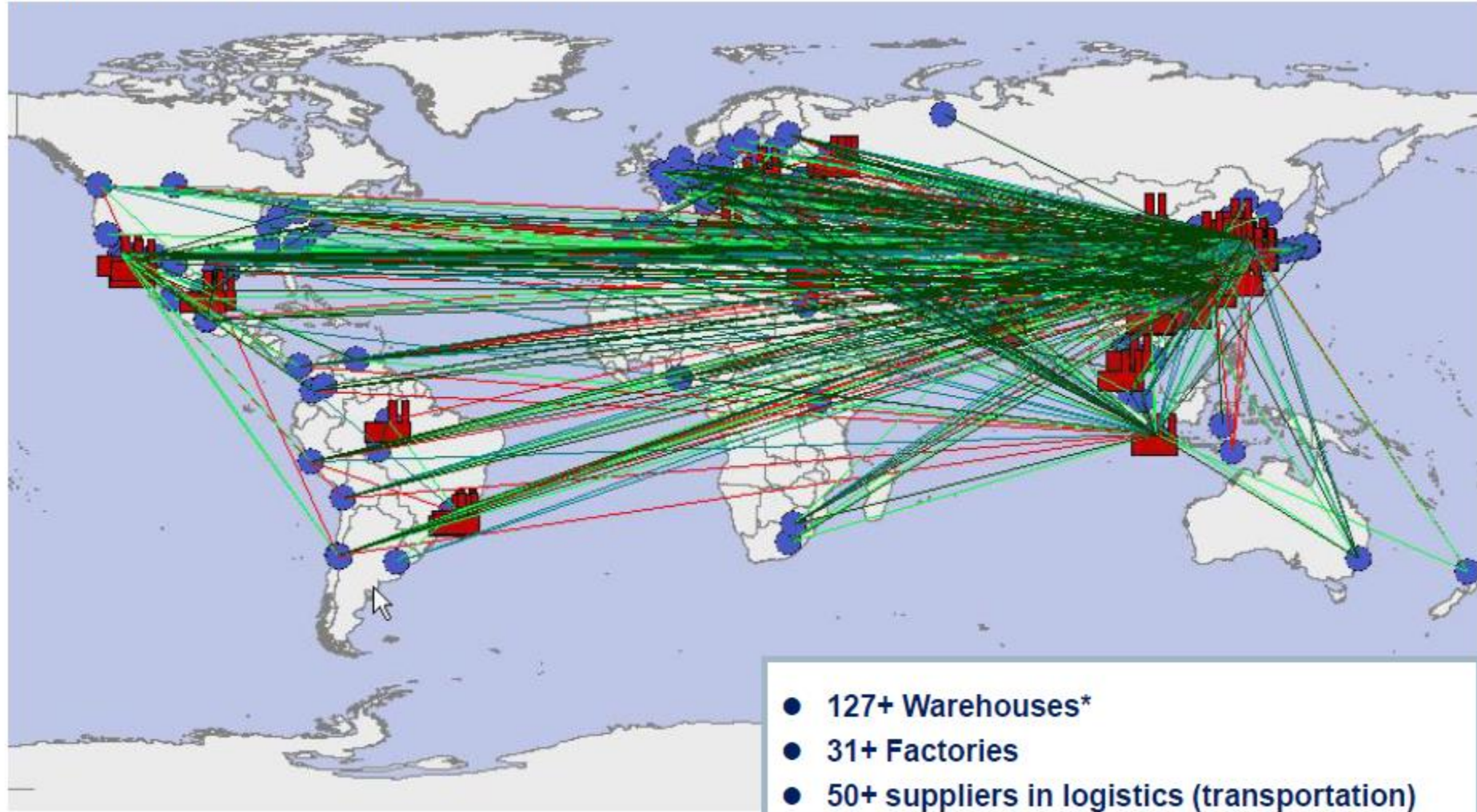
- 127+ Warehouses*
- 31+ Factories
- 50+ suppliers in logistics (transportation)
- 550+ "employees"
- 250K Vessel Containers, 60K Air Tonnage

* No. of Marketing Subsidiary warehouses

* Source: Companies' SCM teams, i2 simulations

What is SCM?

SCM이란 무엇인가? - 정의

A set of approaches utilized to efficiently integrate suppliers and clients (comprised of stores, retailers, wholesalers, warehouses, and manufacturers) so merchandise is produced and distributed _at the right quantities_, _to the right locations_, and _at the right time_, in order to _minimize system wide costs_ while satisfying service level requests.

: *Designing and Managing the Supply Chain*: D. Simchi-Levi, P. Kaminsky, E. Simchi-Levi

공급체인 관리는 고객서비스 수준을 만족시키면서 시스템 전반적인 비용을 최소화할 수 있도록 제품이 적절한 수량으로, 적절한 장소에, 적절한 시간에 생산과 유통이 가능하게 하기 위하여, 공급자, 제조업자, 창고.보관업자, 소매상들을 효율적으로 통합하는 데 이용되는 일련의 접근법이다.

Bullwhip effect

Industrial Engineering @ Kumoh National Institute of Technology

ORDER SIZE

Distributor Orders

Customer Demand

Retailer Orders

Production Plan

Time
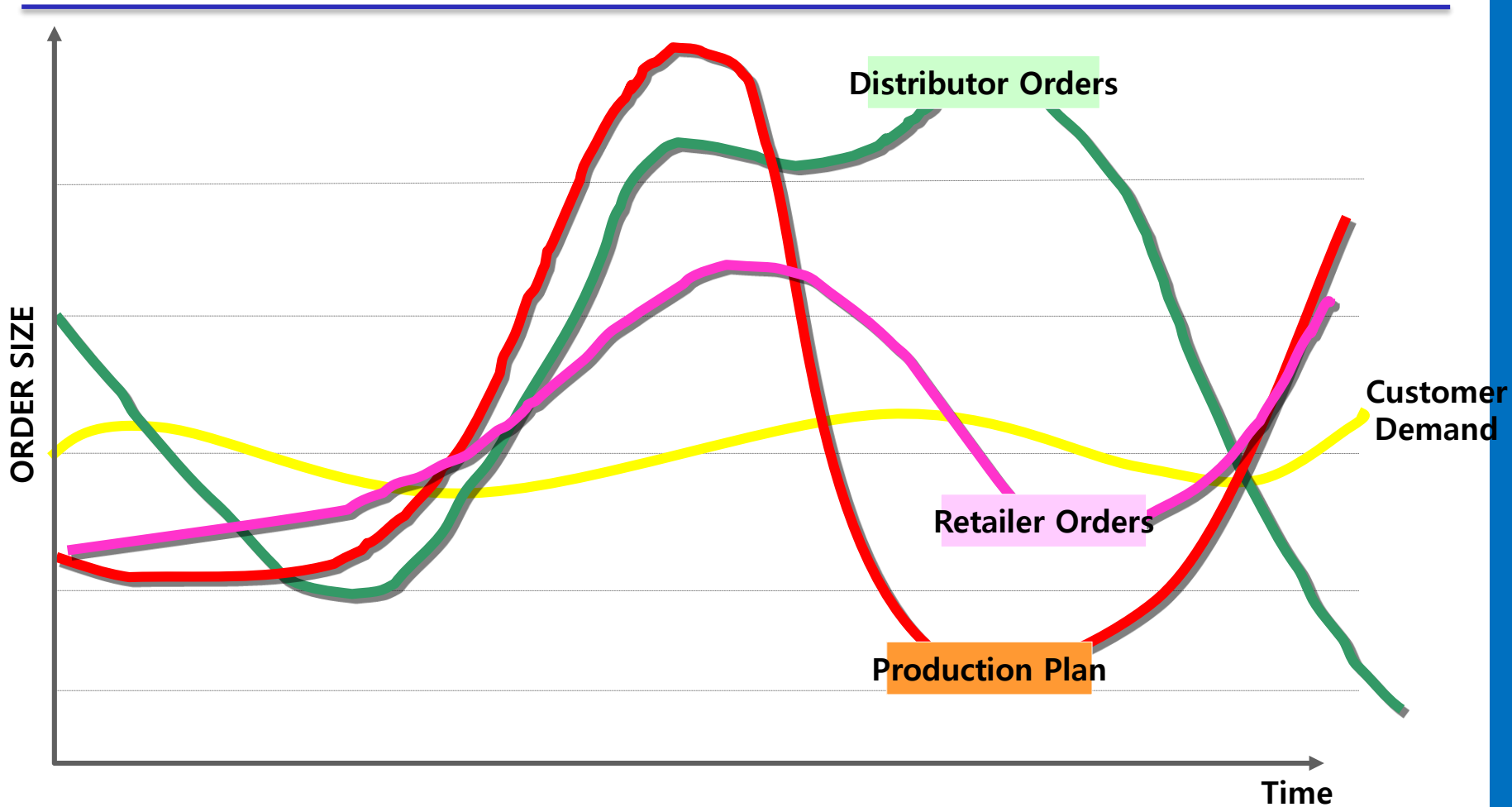
How to decrease Bullwhip effect (1)

- First answer ➔ Inventory
  - "Fluctuating Demand"
  - "Stable supply" ➔ "High Inventory Level"

  - However,

  - "What is the optimal Inventory amount?"

Inventory Model (1)
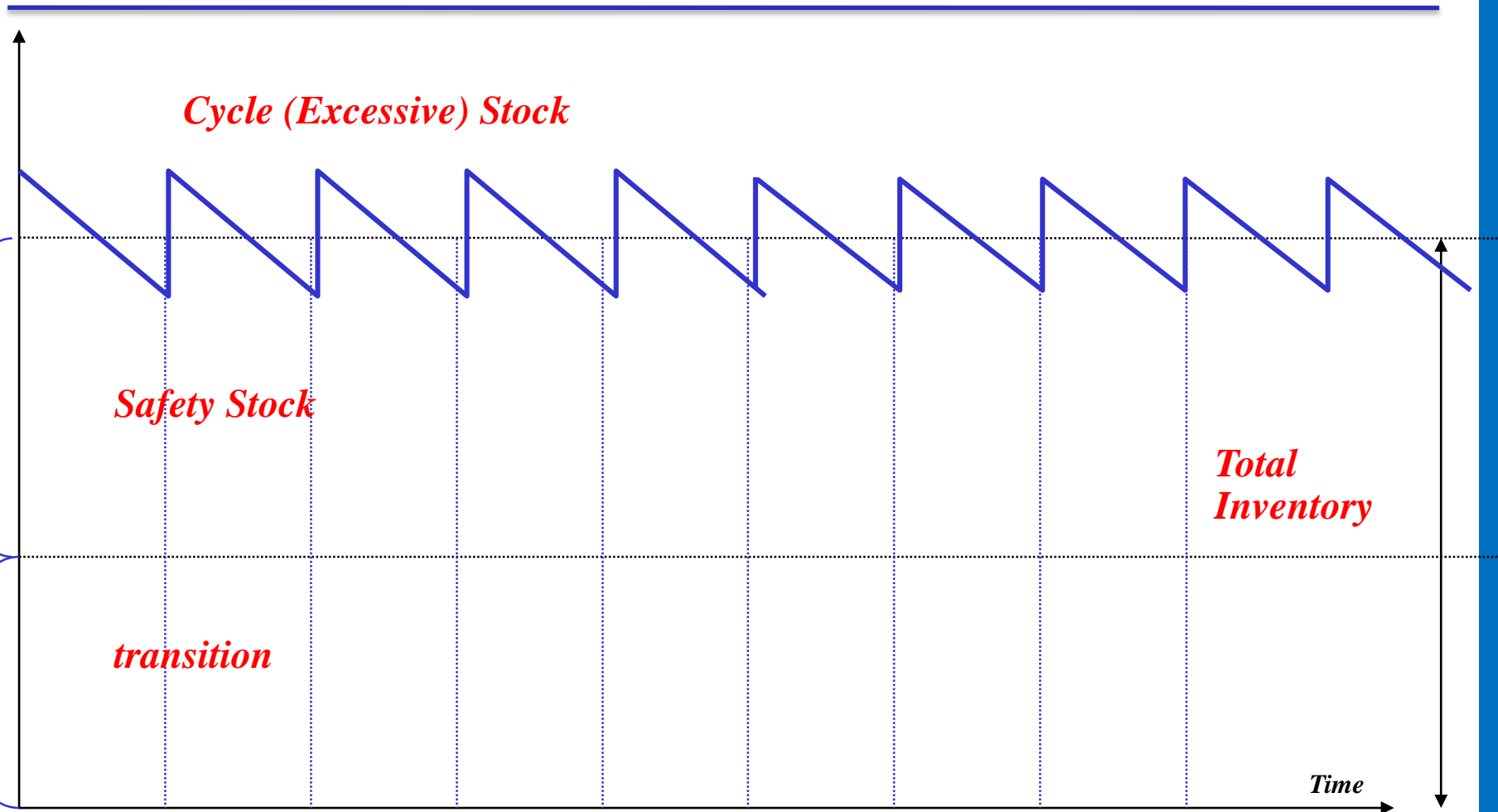
Inventory Model (2)

Inventory

Cycle (Excessive) Stock

Safety Stock

Total Inventory

transition

W1 2 3 4 5 6 7 8

Time
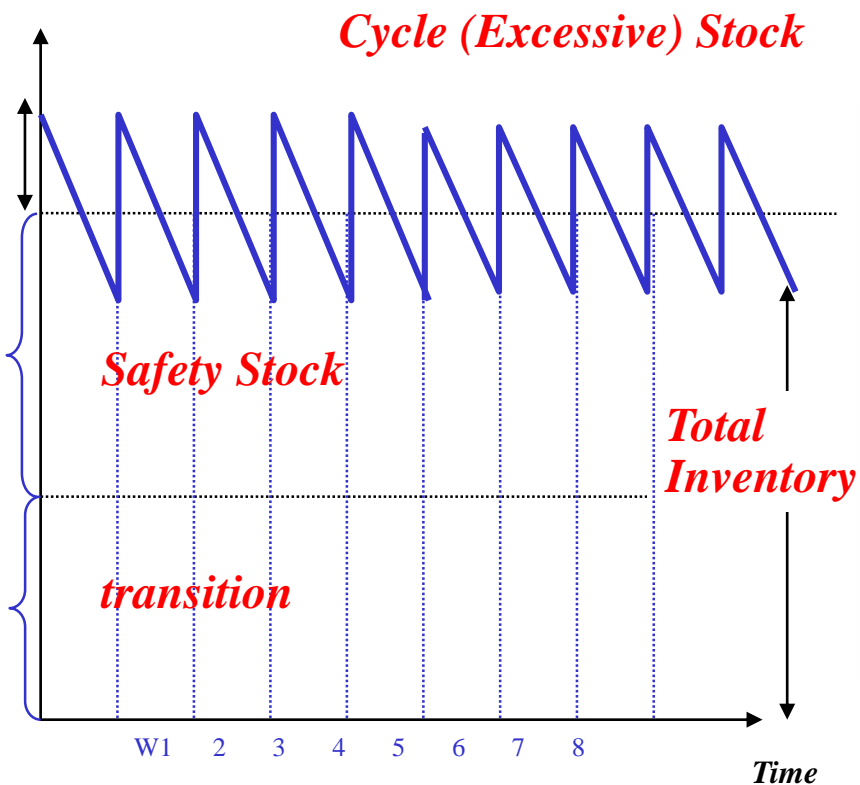
Logic

- **Weekly Operation**

  → **Sale FCST Update & Supply**

- Manually Set for Bill of Distribution Weeks &

  Set for Safety Stock Weeks

  → **Influence Fact for Shipment Q'ty**

- How to generate Shipment Q'ty

  → **Based on BOD + Production Frozen**

  Weeks

  Total Inventory = Safety +

  Transition Stock + *Excessive Stock*

Inventory Model (3)

Statistical Safety Stock Model

- Assume normal distribution -

Normal Distribution

$$\text{Required Safety Stock} = k \times \sqrt{(\sigma^2 \times L) + (D^2 \times s^2)}$$

- K : Customer Service level
- σ : Standard deviation of demand
- L : Transit Lead Time + Supply Frequency
- D : Average demand
- S : Standard deviation of supply lead time

Probability of late supply

Average Supply Lead Time

Recent a few week product forecast trend

Class	Target Customer Service level (Product Availability)
A	99%
B	95%
C	90%

Probability of over demand

Average Demand
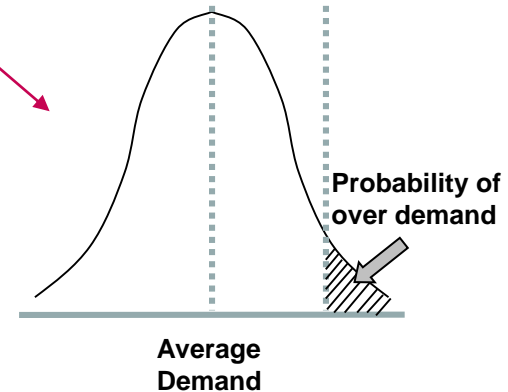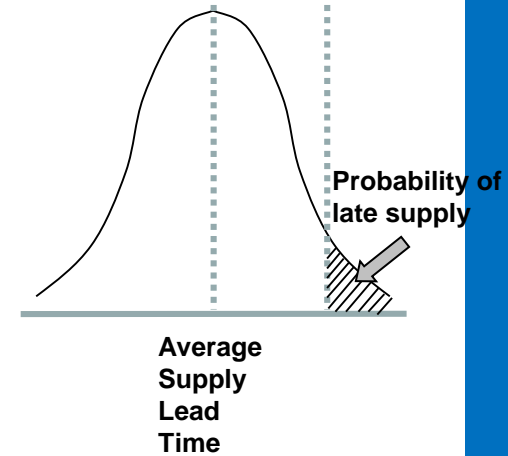
How to decrease Bullwhip effect (2)

- Another methods
    - Demand control → Demand shaping
    - Logistics control
    - Acute supply chain planning → Production Planning

Production Planning (1)

[PSI Creation Logic]

Assumption : Delivery L/T(1W), Safety Stock(0W), Frozen period(2W)

	Category	W-1	W0	W1	W2	W3	W4	W5
Sales Subsidiary	Forecast	100	200	300	400	500	600	700
	Sales Allocation	100						
	Shortage							
	Beginning On Hand	200						
	W/H In	70						
	Ending On Hand (BOH+W/H In-Sales Alloc.)	170						
	Shipment Plan	200						

Current Week ▼ (above W0)

New Frozen Period ▼ (above W3)

Production Planning (2)

[PSI Creation Logic]

Assumption : Delivery L/T(1W), Safety Stock(0W), Frozen period(2W)

Current Week   New Frozen Period

	Category	W-1	W0	W1	W2	W3	W4	W5
Sales Subsidiary	**Forecast**	100	200	300	400	500	600	700
	Sales Allocation	100						
	Shortage							
	Beginning On Hand	200	**170**					
	W/H In	70						
	Ending On Hand (BOH+W/H In-Sales Alloc.)	170						
	Shipment Plan	200						

Production Planning (3)

[PSI Creation Logic]

Assumption : Delivery L/T(1W), Safety Stock(0W), Frozen period(2W)

Current Week   New Frozen Period

Category	W-1	W0	W1	W2	W3	W4	W5
Forecast	100	200	300	400	500	600	700
Sales Allocation	100						
Shortage							
Beginning On Hand	200	170					
W/H In	70	200					
Ending On Hand (BOH+W/H In-Sales Alloc.)	170						
Shipment Plan	200						

Production Planning (4)

[PSI Creation Logic]

Assumption : Delivery L/T(1W), Safety Stock(0W), Frozen period(2W)

Current Week

New Frozen Period

	Category	W-1	W0	W1	W2	W3	W4	W5
Sales Subsidiary	Forecast	100	200	300	400	500	600	700
	Sales Allocation	100	200					
	Shortage		0					
	Beginning On Hand	200	170					
	W/H In	70	200					
	Ending On Hand (BOH+W/H In-Sales Alloc.)	170	170					
	Shipment Plan	200	50					

Production Planning (5)

[PSI Creation Logic]

Assumption : Delivery L/T(1W), Safety Stock(0W), Frozen period(2W)

Current Week

New Frozen Period

Category	W-1	W0	W1	W2	W3	W4	W5
Forecast	100	200	300	400	500	600	700
Sales Allocation	100	200					
Shortage		0					
Beginning On Hand	200	170	170				
W/H In	70	200	50				
Ending On Hand (BOH+W/H In-Sales Alloc.)	170	170					
Shipment Plan	200	50					

Sales Subsidiary

Production Planning (6)

[PSI Creation Logic]

Assumption : Delivery L/T(1W), Safety Stock(0W), Frozen period(2W)

Current Week

New Frozen Period

	Category	W-1	W0	W1	W2	W3	W4	W5
Sales Subsidiary	Forecast	100	200	300	400	500	600	700
	Sales Allocation	100	200	220				
	Shortage		0	80				
	Beginning On Hand	200	170	170				
	W/H In	70	200	50				
	Ending On Hand (BOH+W/H In-Sales Alloc.)	170	170					
	Shipment Plan	200	50					

Production Planning (7)

[PSI Creation Logic]

Assumption : Delivery L/T(1W), Safety Stock(0W), Frozen period(2W)

Current Week   New Frozen Period

	Category	W-1	W0	W1	W2	W3	W4	W5
Sales Subsidiary	**Forecast**	100	200	300	400	500	600	700
	Sales Allocation	100	200	220				
	Shortage		0	80				
	Beginning On Hand	200	170	170				
	W/H In	70	200	50				
	Ending On Hand (BOH+W/H In-Sales Alloc.)	170	170	0				
	Shipment Plan	200	50	300				

Production Planning (8)

[PSI Creation Logic]

Assumption : Delivery L/T(1W), Safety Stock(0W), Frozen period(2W)

Current Week   New Frozen Period

	Category	W-1	W0	W1	W2	W3	W4	W5
Sales Subsidiary	**Forecast**	100	200	300	400	500	600	700
	Sales Allocation	100	200	220	300			
	Shortage		0	80	100			
	Beginning On Hand	200	170	170	0			
	W/H In	70	200	50	300			
	Ending On Hand (BOH+W/H In-Sales Alloc.)	170	170	0	0			
	Shipment Plan	200	50	300				

Production Planning (9)

[PSI Creation Logic]

Assumption : Delivery L/T(1W), Safety Stock(0W), Frozen period(2W)

Current Week

New Frozen Period

	Category	W-1	W0	W1	W2	W3	W4	W5
Sales Subsidiary	**Forecast**	100	200	300	400	500	600	700
	Sales Allocation	100	200	220	300			
	Shortage		0	80	100			
	Beginning On Hand	200	170	170	0	0		
	W/H In	70	200	50	300			
	Ending On Hand (BOH+W/H In-Sales Alloc.)	170	170	0	0			
	Shipment Plan	200	50	300				

Production Planning (10)

[PSI Creation Logic]

Assumption : Delivery L/T(1W), Safety Stock(0W), Frozen period(2W)

Current Week

New Frozen Period

Category	W-1	W0	W1	W2	W3	W4	W5
Forecast	100	200	300	400	500	600	700
Sales Allocation	100	200	220	300	500		
Shortage		0	80	100	0		
Beginning On Hand	200	170	170	0	0		
W/H In	70	200	50	300			
Ending On Hand (BOH+W/H In-Sales Alloc.)	170	170	0	0			
Shipment Plan	200	50	300				

Sales Subsidiary

Production Planning (11)

[PSI Creation Logic]

Assumption : Delivery L/T(1W), Safety Stock(0W), Frozen period(2W)

Current Week　　　　**New Frozen Period**

Sales Subsidiary	Category	W-1	W0	W1	W2	W3	W4	W5
	Forecast	100	200	300	400	500	600	700
	Sales Allocation	100	200	220	300	500		
	Shortage		0	80	100	0		
	Beginning On Hand	200	170	170	0	0		
	W/H In	70	200	50	300	**500**		
	Ending On Hand (BOH+W/H In-Sales Alloc.)	170	170	0	0			
	Shipment Plan	200	50	300				

Production Planning (12)

[PSI Creation Logic]

Assumption : Delivery L/T(1W), Safety Stock(0W), Frozen period(2W)

	Category	W-1	W0	W1	W2	W3	W4	W5
Sales Subsidiary	Forecast	100	200	300	400	500	600	700
	Sales Allocation	100	200	220	300	500		
	Shortage		0	80	100	0		
	Beginning On Hand	200	170	170	0	0		
	W/H In	70	200	50	300	500		
	Ending On Hand (BOH+W/H In-Sales Alloc.)	170	170	0	0			
	Shipment Plan	200	50	300	**500**			

Current Week → (above W1)

New Frozen Period → (above W3)

Production Planning (13)

[PSI Creation Logic]

Assumption : Delivery L/T(1W), Safety Stock(0W), Frozen period(2W)

Current Week   New Frozen Period

	Category	W-1	W0	W1	W2	W3	W4	W5
Sales Subsidiary	**Forecast**	100	200	300	400	500	600	700
	Sales Allocation	100	200	220	300	500		
	Shortage		0	80	100	0		
	Beginning On Hand	200	170	170	0	0		
	W/H In	70	200	50	300	500		
	Ending On Hand (BOH+W/H In-Sales Alloc.)	170	170	0	0	0		
	Shipment Plan	200	50	300	500			

Some terms of SCM

- Terms
  - Supply / Demand
  - PSI
  - Bullwhip
  - BOD / BOM
  - Safety Stock
  - Planning Time Fence
  - EOQ