Forrester Effect Solutions

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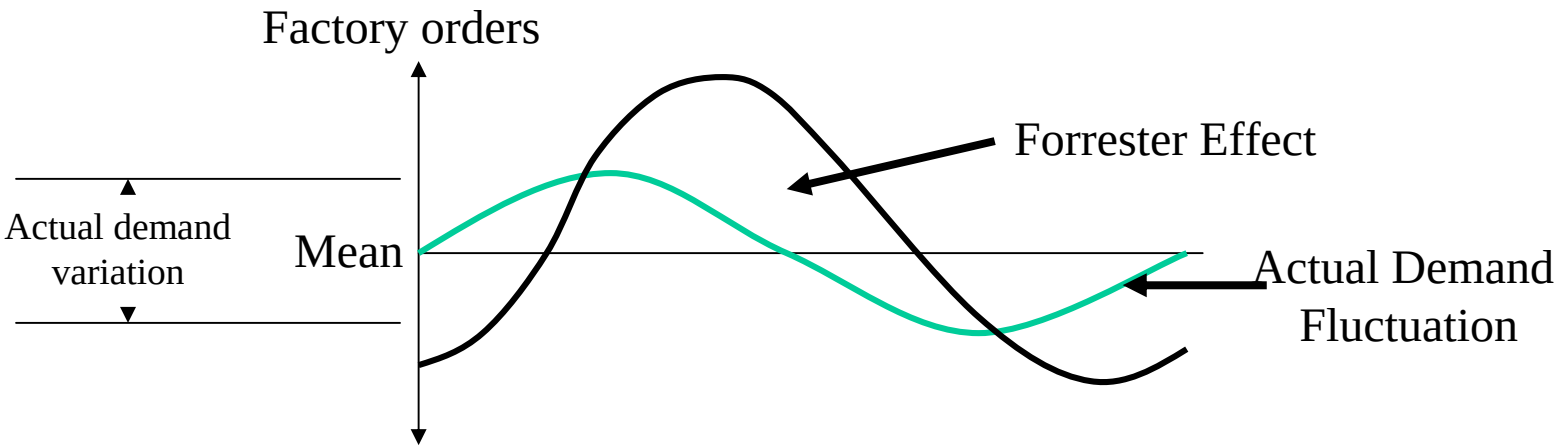
Agenda

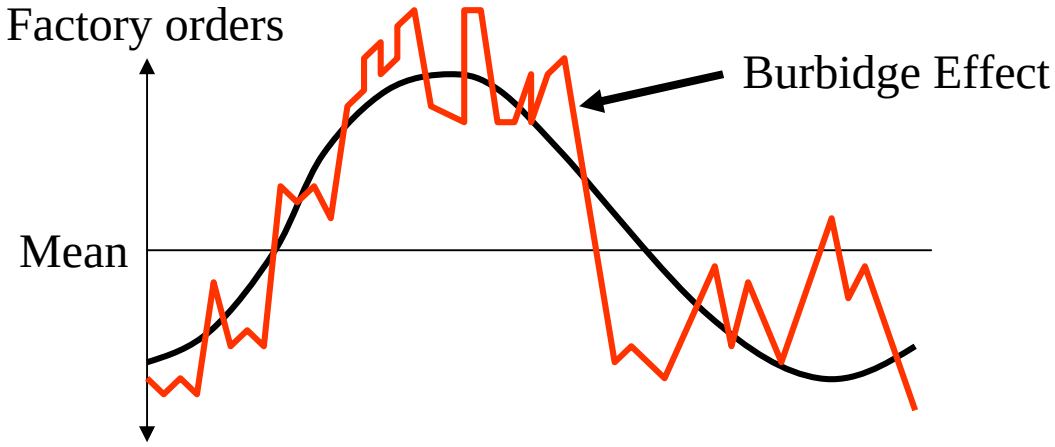
- Forrester Effect and Burbidge Effect
- Forrester Effect Causes
- Christopher's Model of Economic order quantities and economic batch quantities
- Batch Processing
- Heijunka
- Slack's Model of MRP logic

Forrester and Burbidge Effects

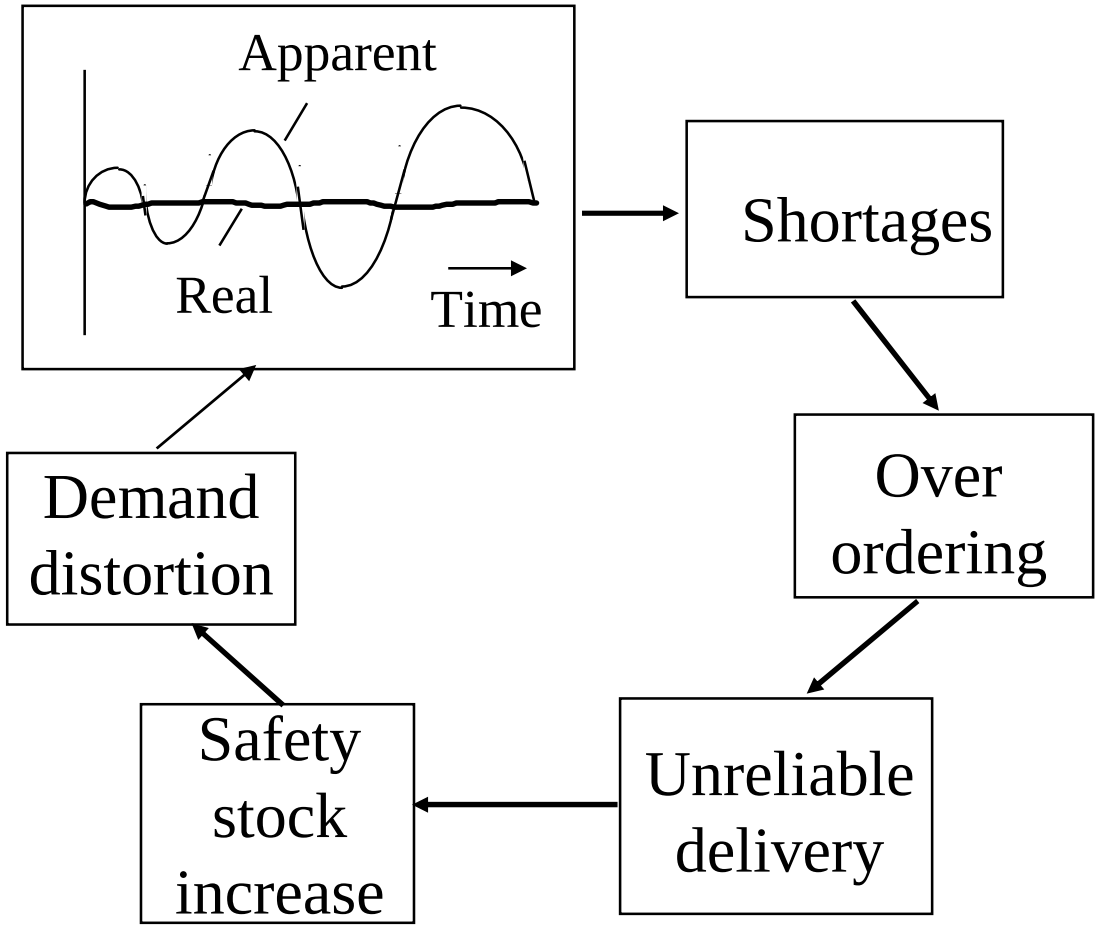
Amplified demand and low synchronisation



Effect of poor information flow and multi-phase ordering in a supply chain



The Consultants' 'Flywheel' Explanation of Supply Chain Demand Amplification

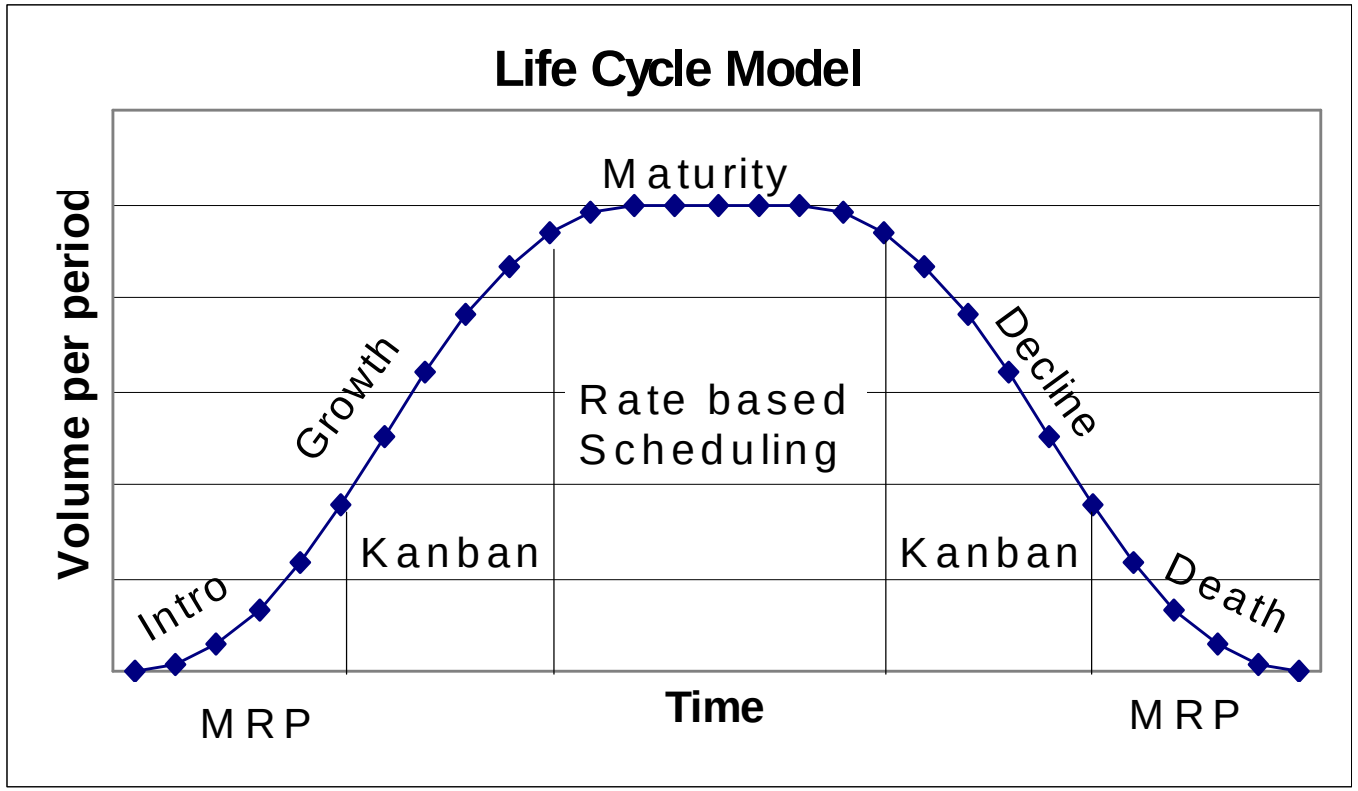


Forrester Effect Causes

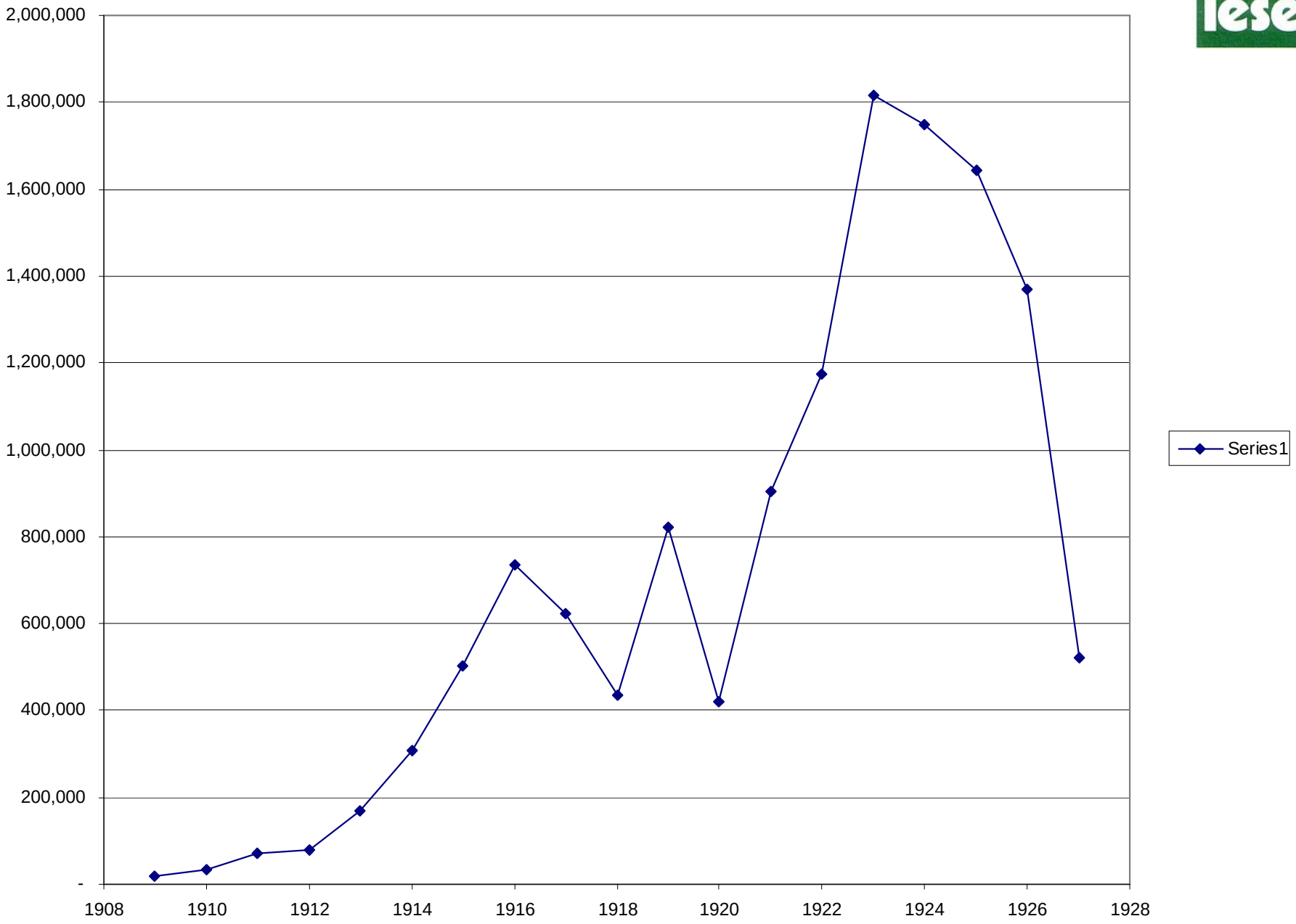
- Developing New Products - Justifications
- Forecasting – Smoothing, eliminating seasonality
- Over-Capacity – NPD Justification passed on
- Over Ordering & Over Estimating Demand
- Available (and used) Over-Capacity
- Process Yield & Shrinkage – Quality -> scrap
- Variable Lead -Times
- Unreliable Delivery
- Materials Requirements Reporting and Planning

Forrester Effect Causes

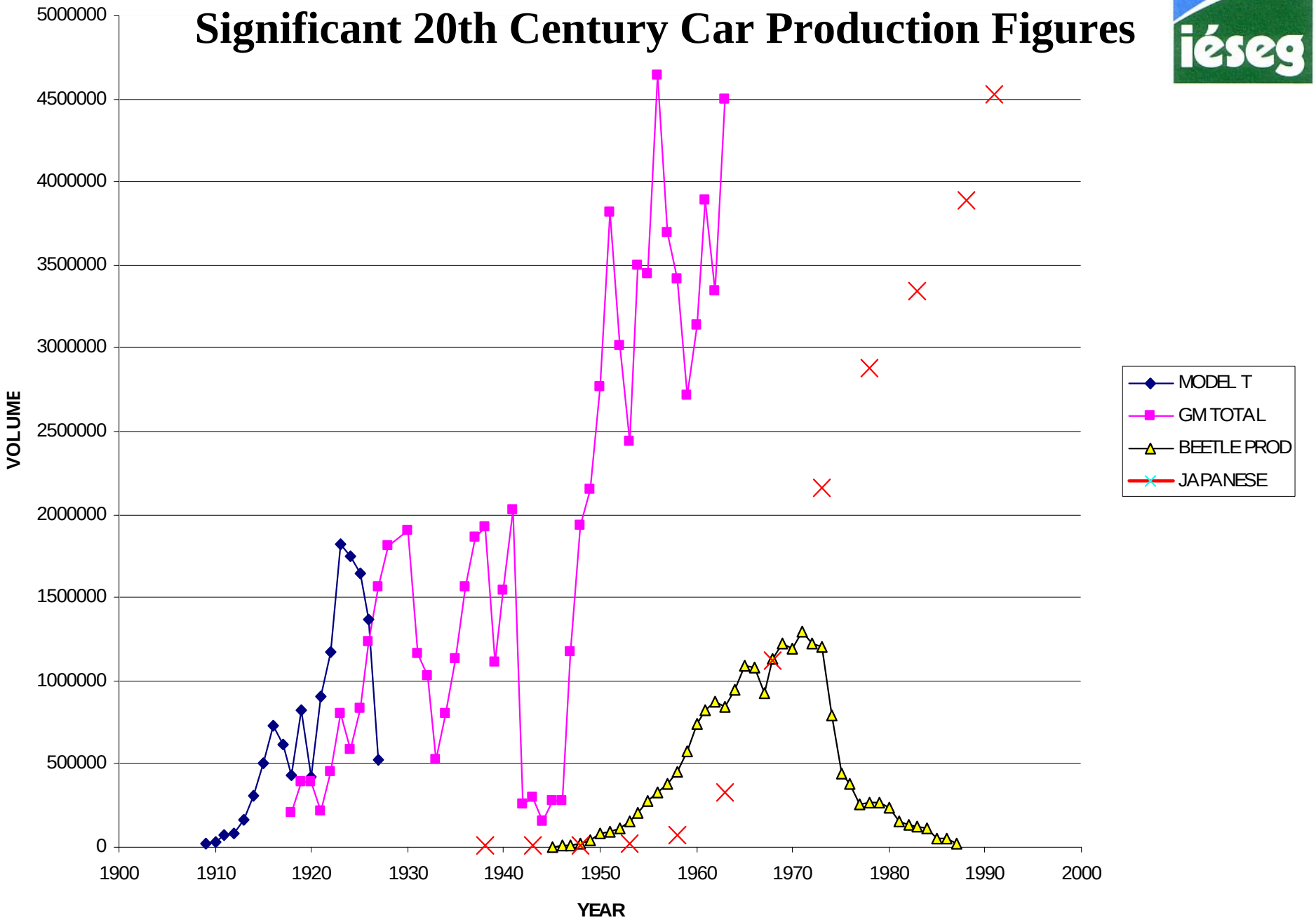
- Economic Order or Batch Quantities
- Low or No Visibility of Actual Sales
- Product Life Cycles
- Changing Planning and control system



Model T Production



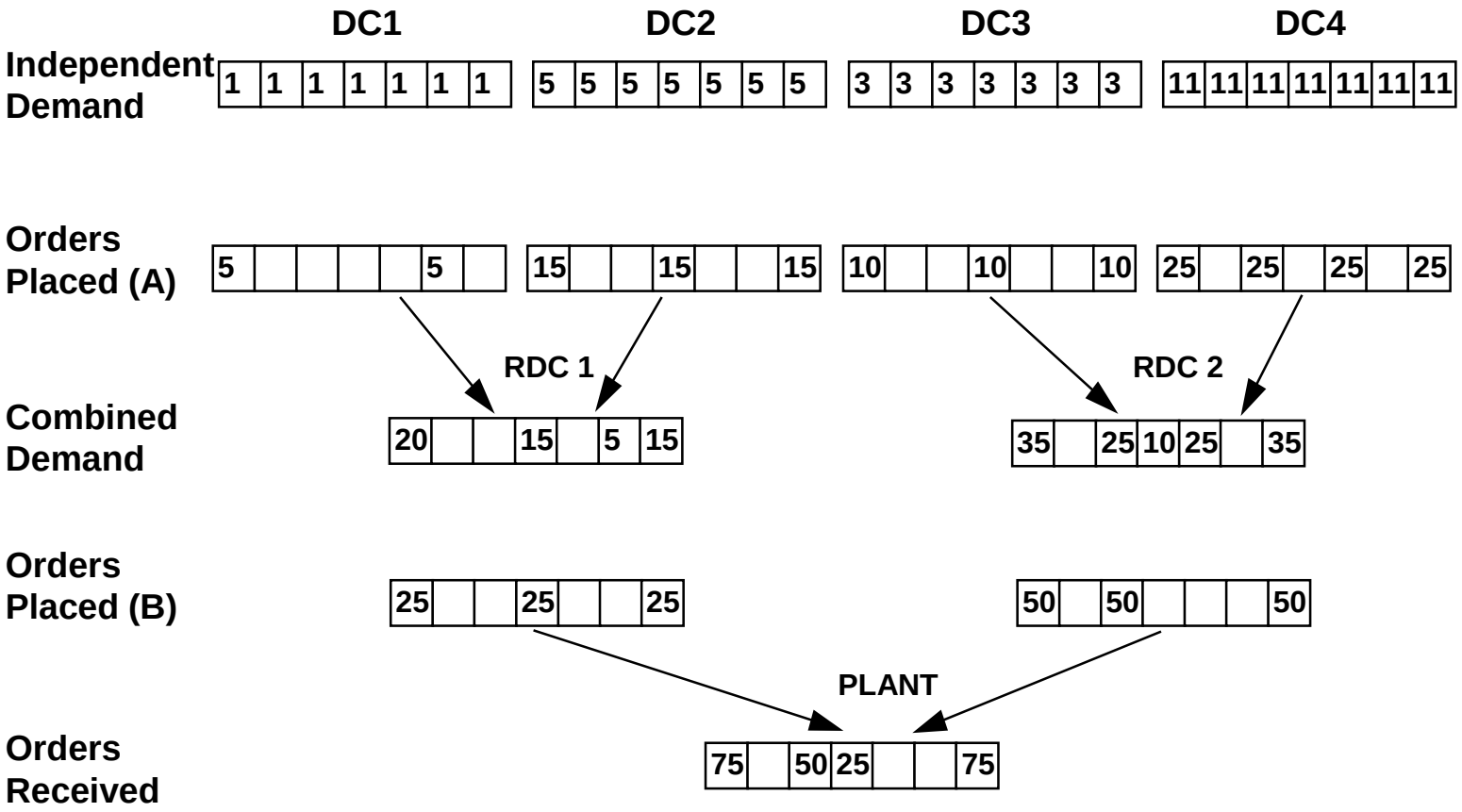
Significant 20th Century Car Production Figures



Forrester Effect Causes

- Plant Locations => Distance => Time => Materials SS
- KPI => Days of Supply
  - plant produces 20 000 per day
  - total amount of stock on order is 100 000,
  - 20 000 / 100 000 = 5 days of supply

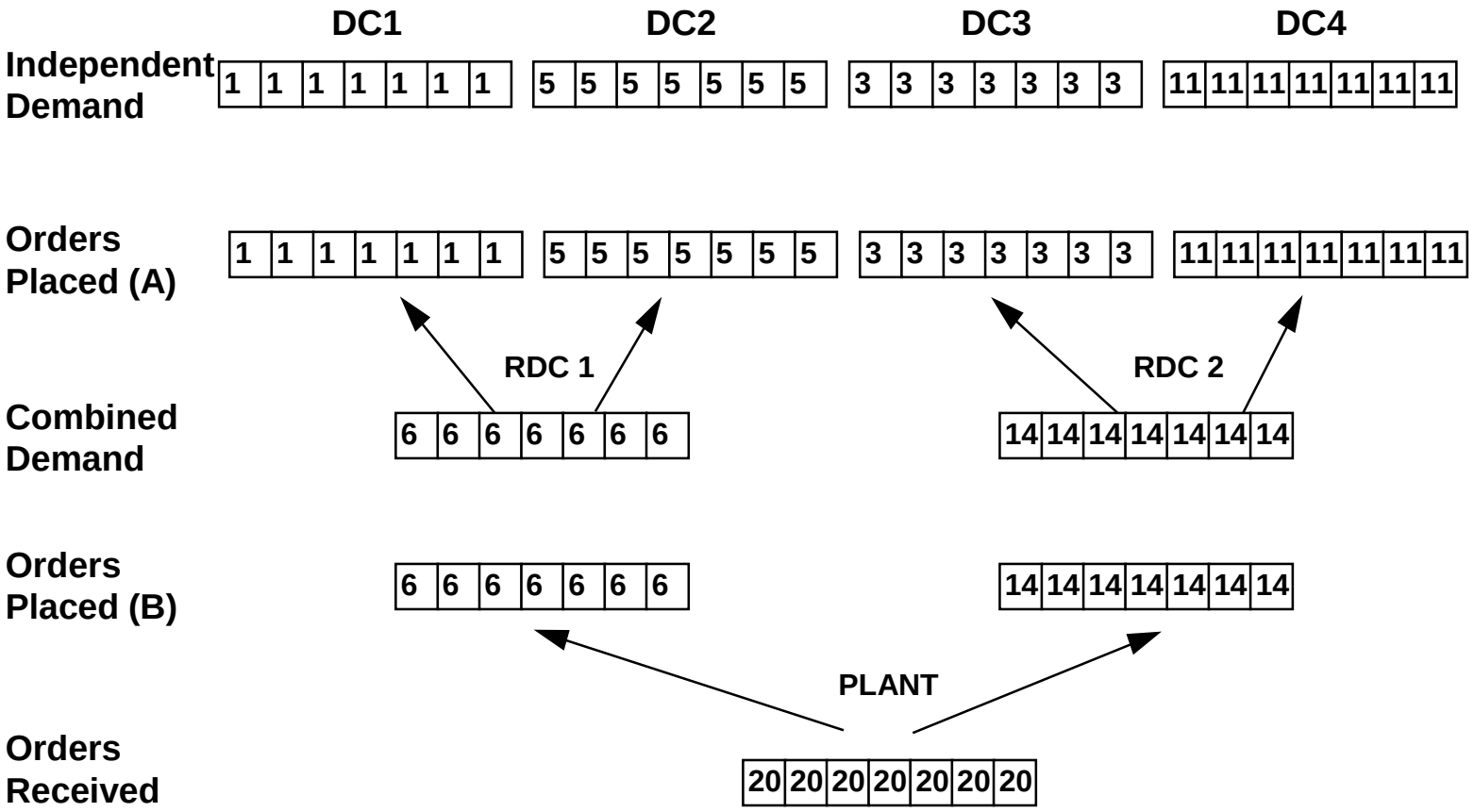
Causes of uneven demand at plant level



(A) Lot size replenishment policies in multiples of 5 (overpack quantity)
(B) Lot size replenishment policies in multiples of 25 (pallet/truck)

Economic order quantities and economic batch quantities

Idealised Make to Replenish



(A) Lot size replenishment policies - equals daily sales volume
(B) Lot size replenishment policies – equals regional consolidated actual replenishment volume

Batch Processing Example

Product requires three processes that take one minute each

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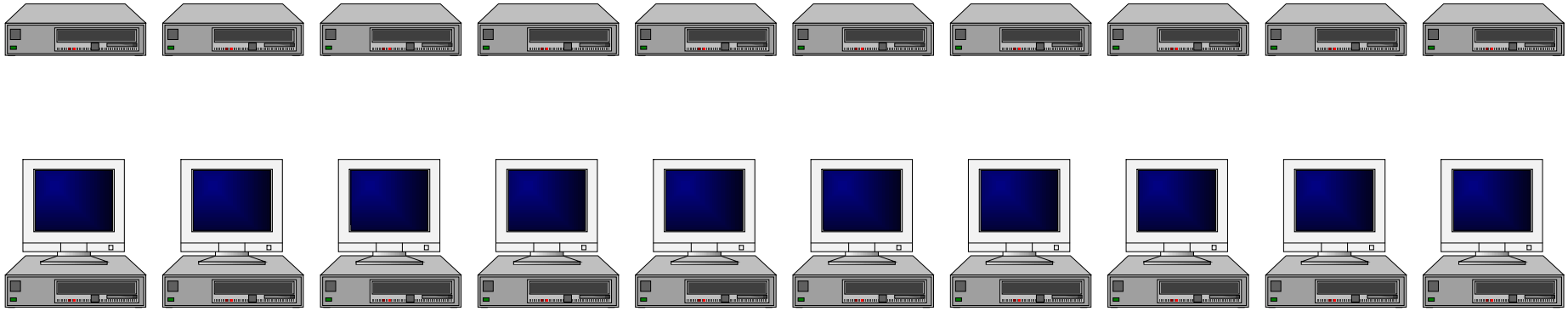


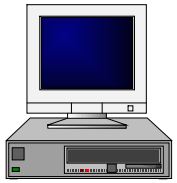
Batch Processing Example

Product requires three processes that take one minute each

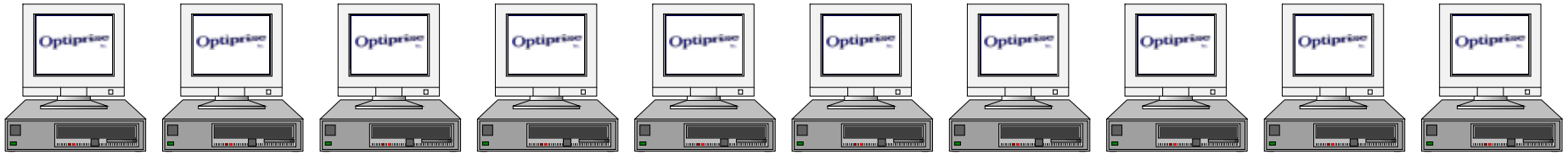
- Complete processing of first batch of 10 takes 30 minutes
- First good part out takes 21 minutes (plus transport time)
- There are at least 21 parts in-process

Continuous Flow Processing Example

Product requires three processes that take one minute each



- First part out in 3 minutes
- 10 completed in 12 minutes
- Only 2 sub-assemblies in process at a time.

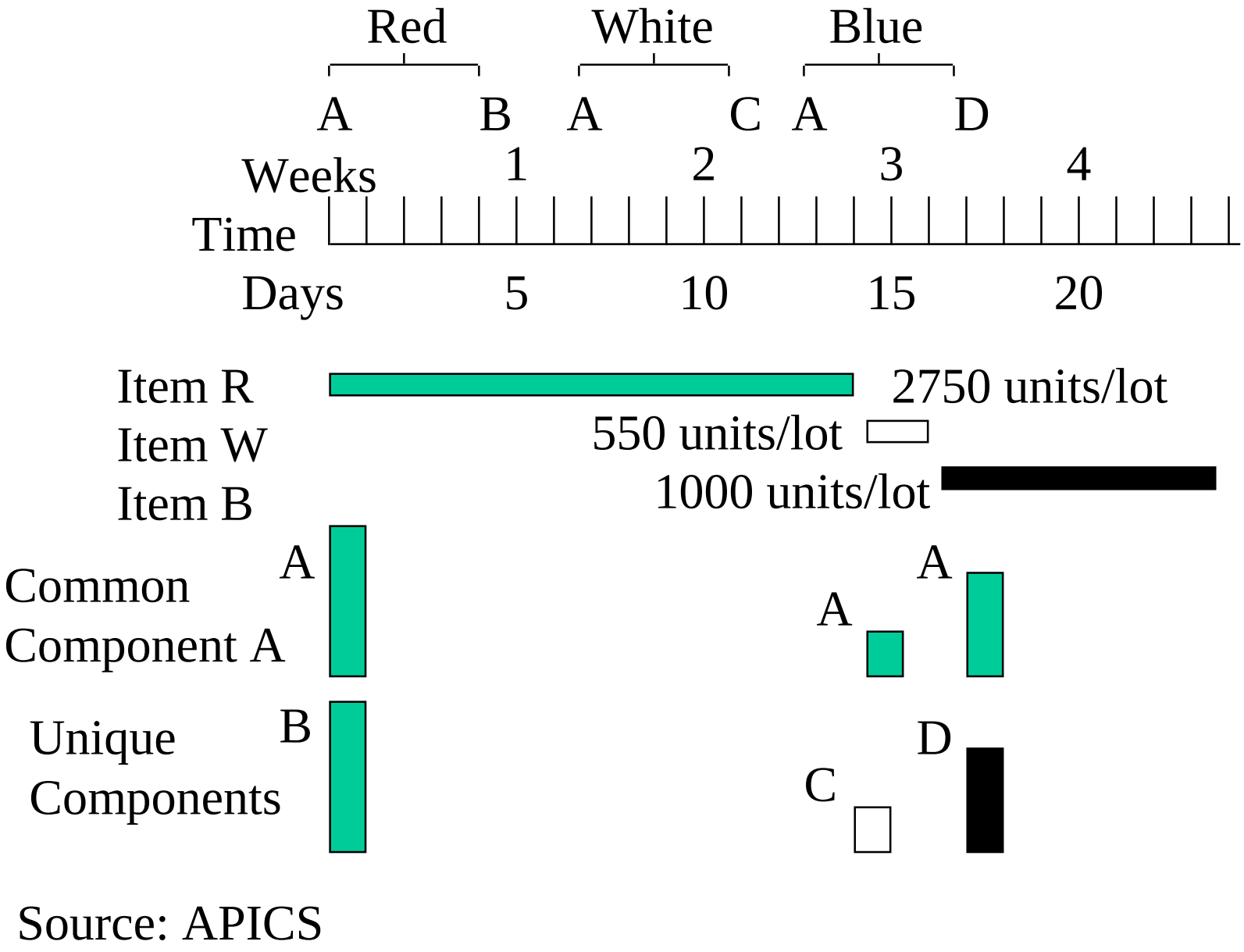


Heijunka = Leveling

Distribute work smoothly over a period of time.

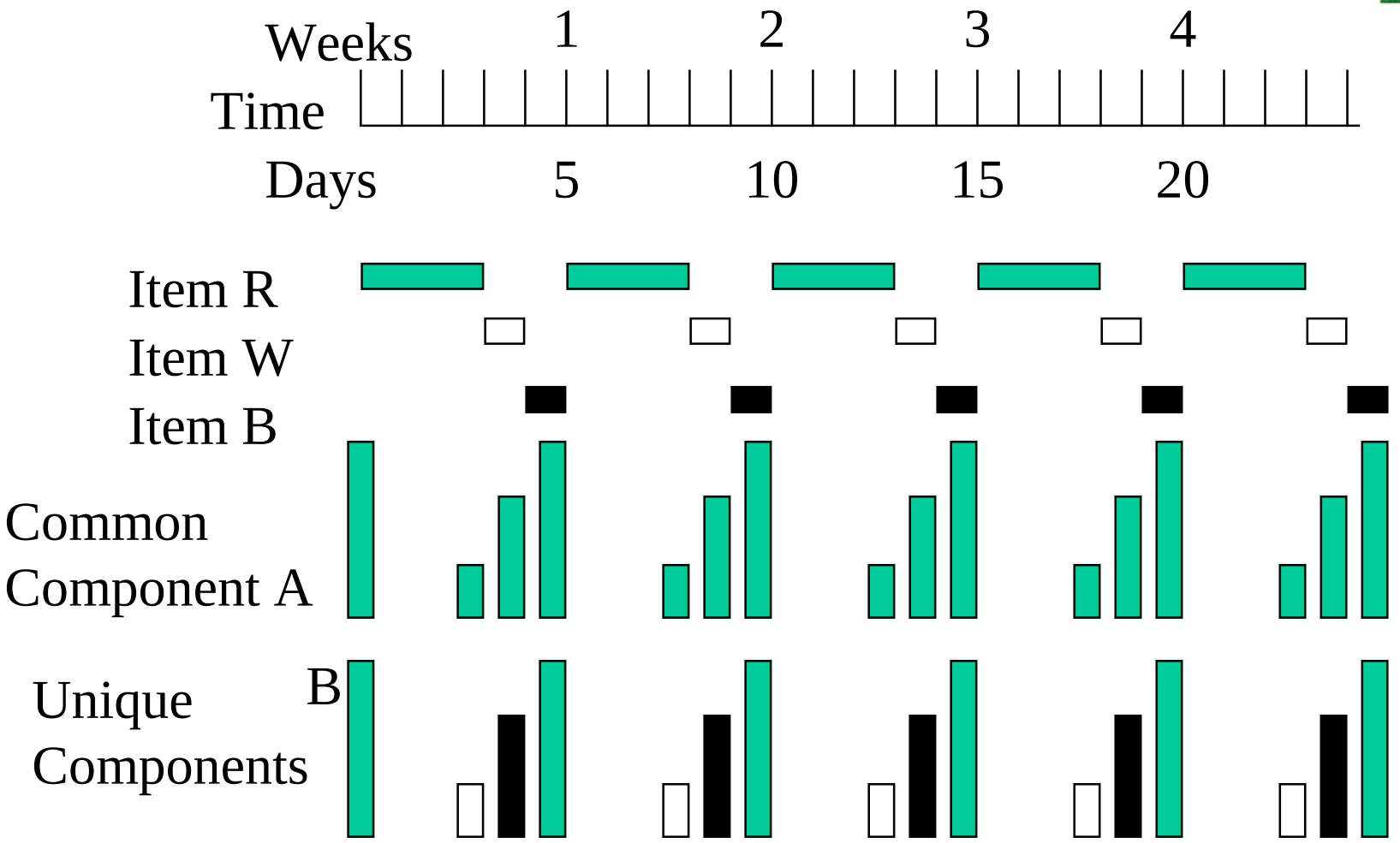
- Even distribution of work includes:
  - Total Volume
  - Model Mix
- Benefits are uniform resource requirements:
  - People
  - Material
  - Machinery
- Even workload demand on previous process

Effect on Components (Monthly Lots)



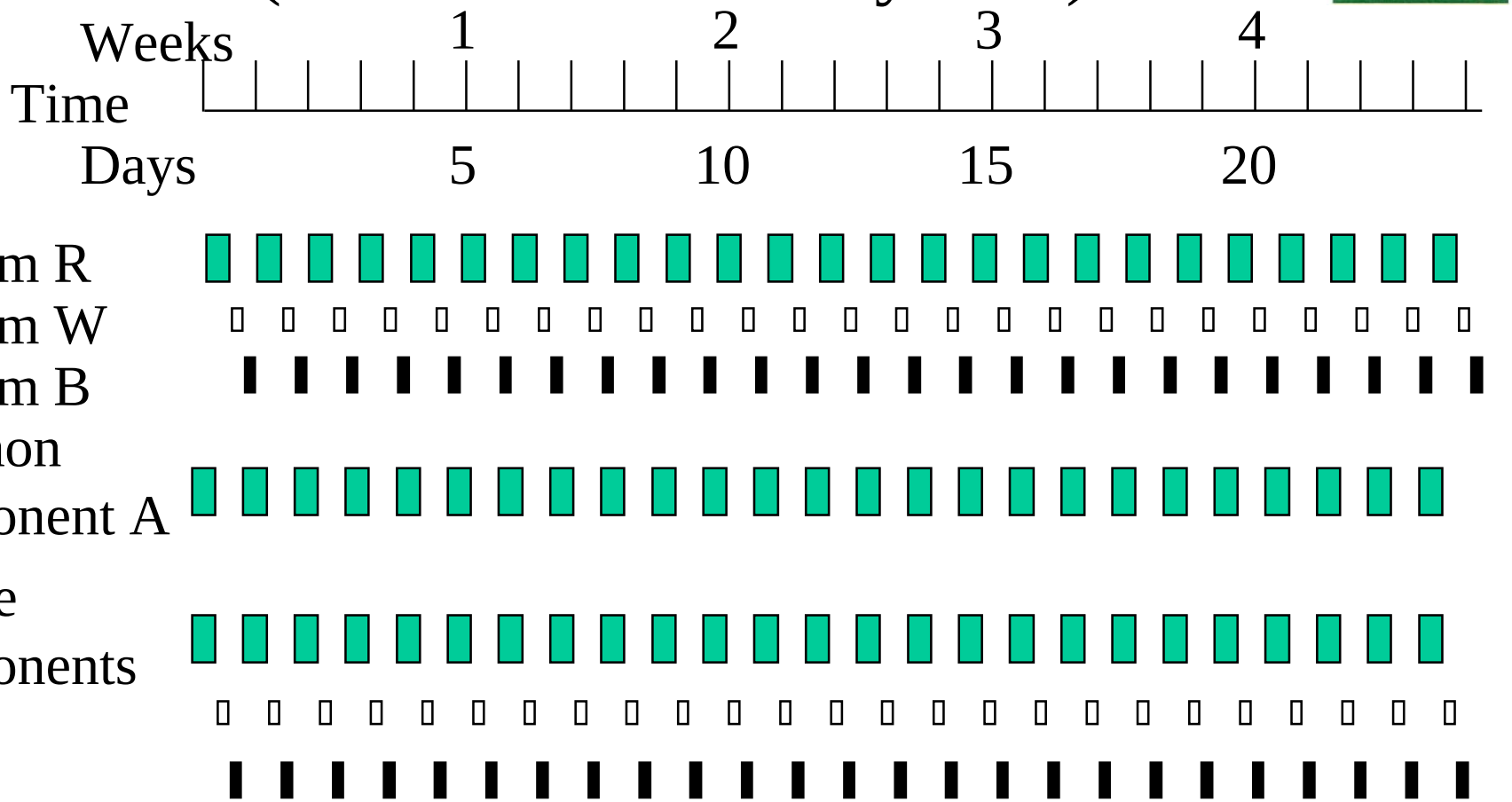
Source: APICS

Effect on Components (Weekly Lots)



Source: APICS

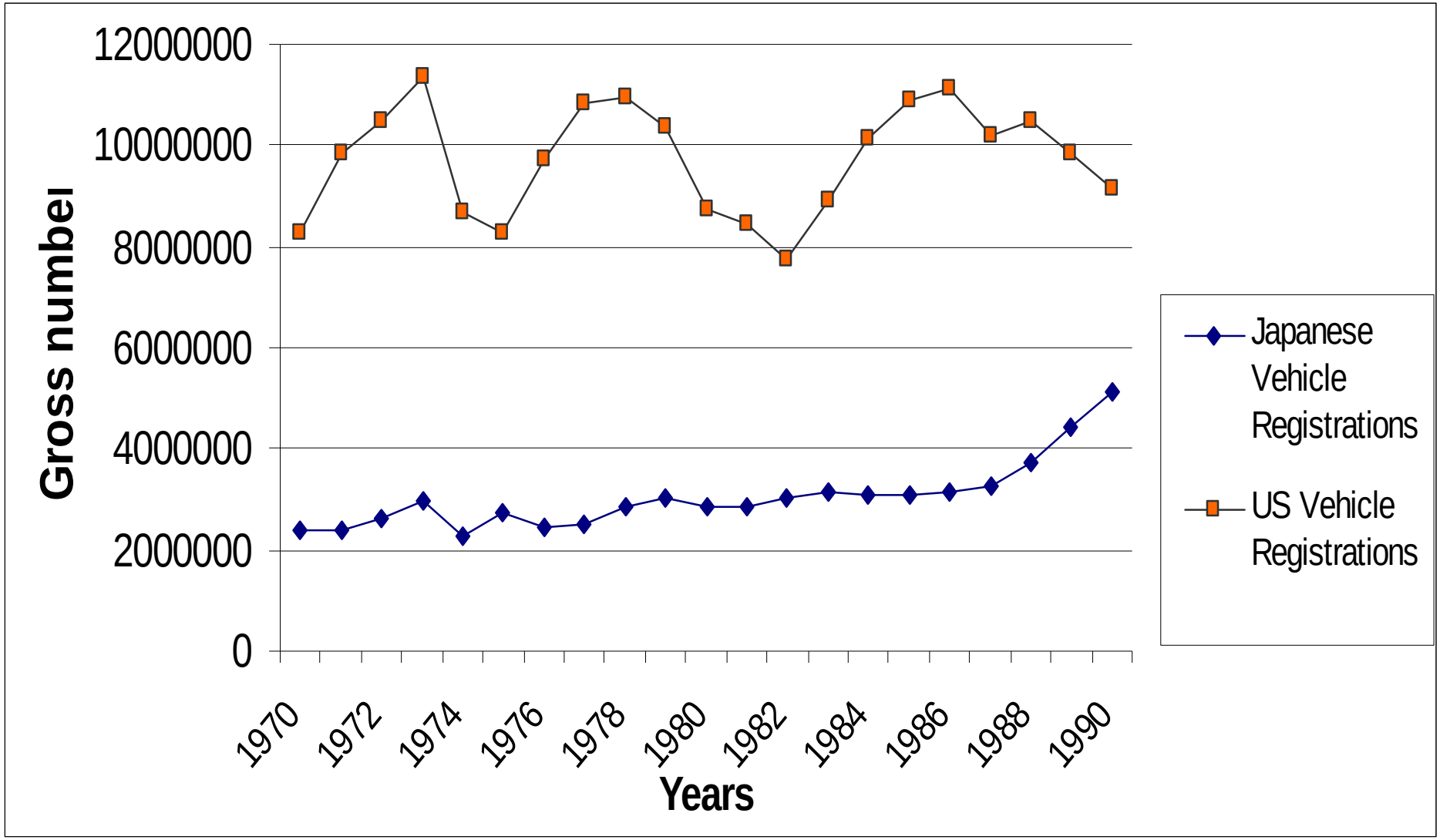
Effect on Components (Smoothed into Daily Lots)



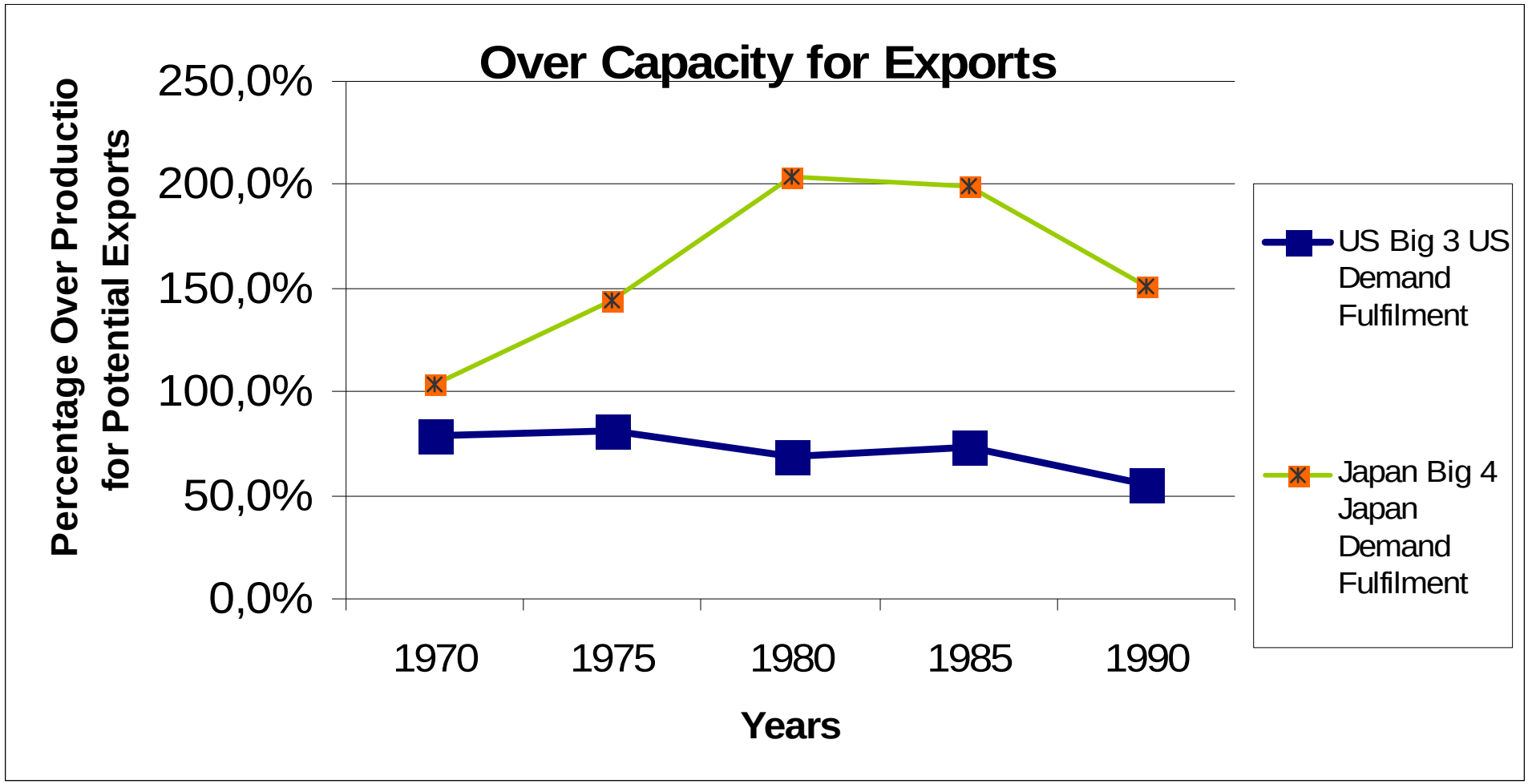
Daily smoothing assures a steady supply of the parent items and eliminates lumpy component demand.

Source: APICS

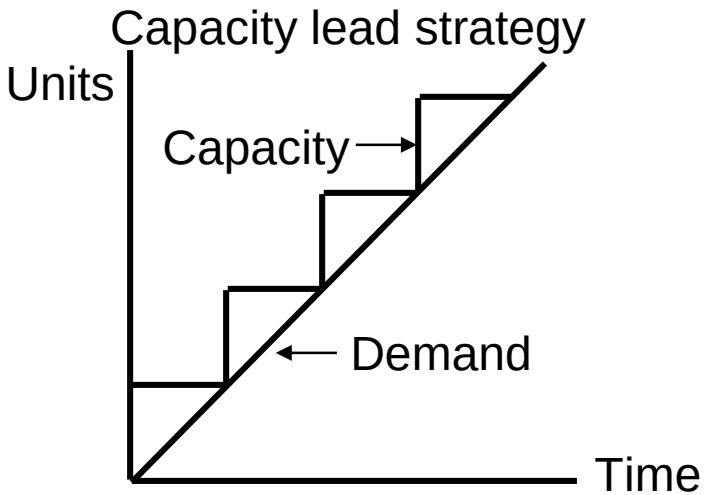
Registration of vehicles in Japan and the US (1970-1990).

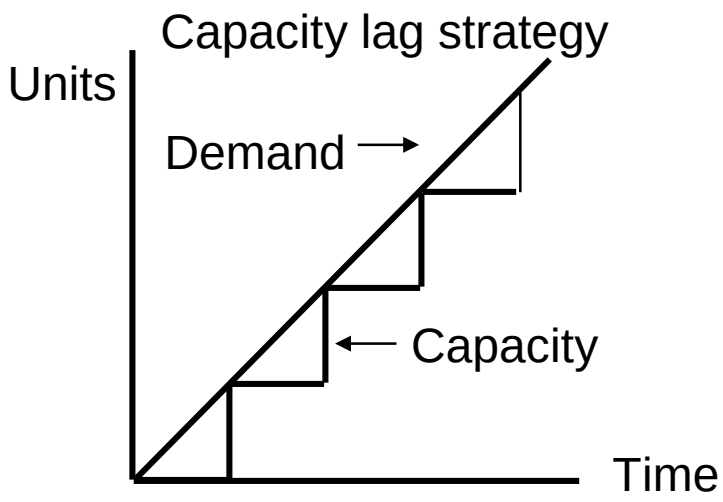


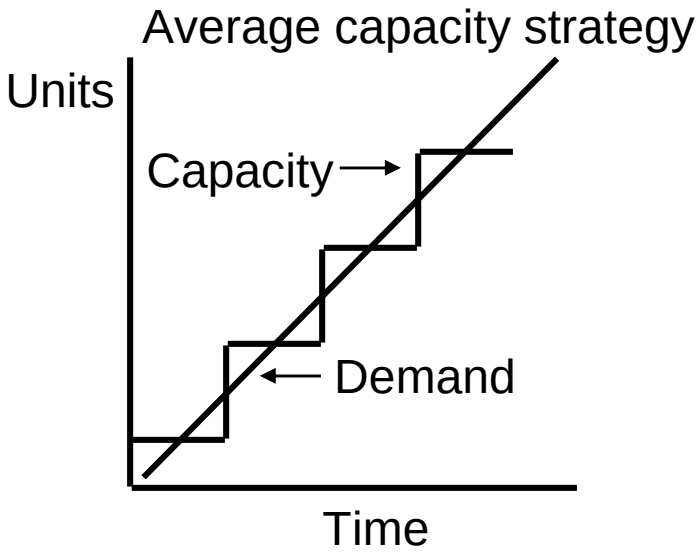
Japanese Big 4 Brands over production for exported.

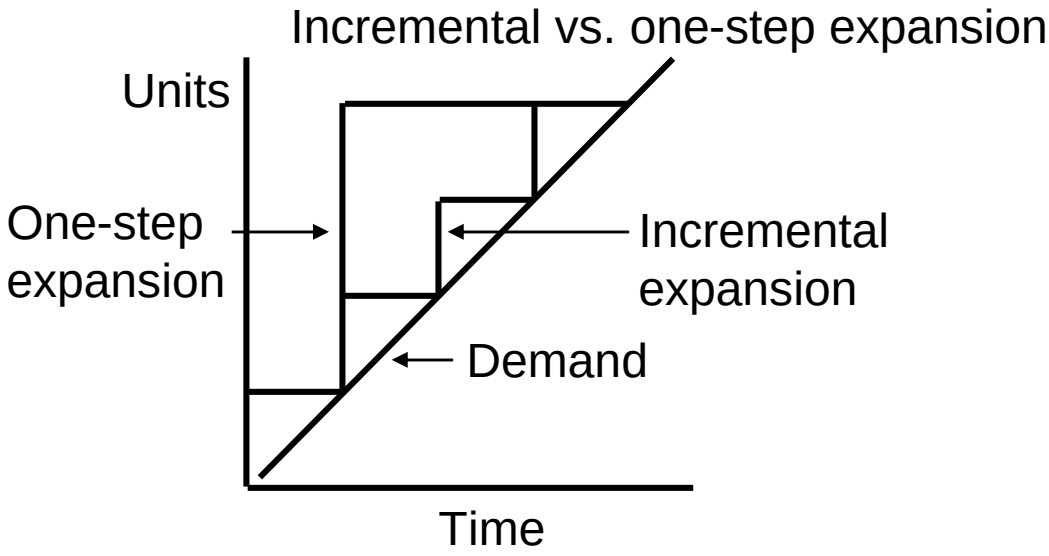


Capacity Expansion Strategies





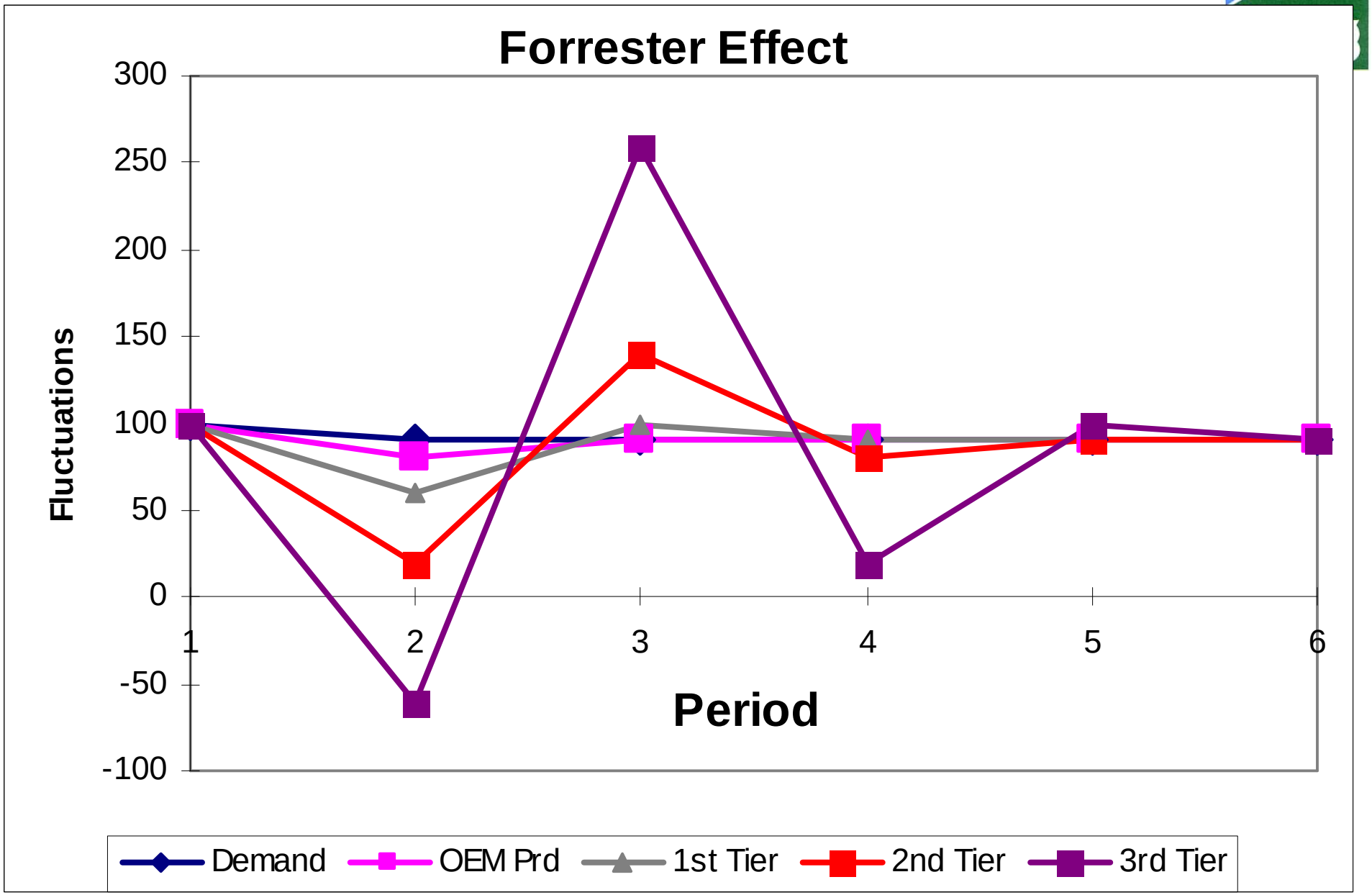




Forrester Effect

	Third Tier		Second Tier		First Tier		Original		
	Supplier		Supplier		Supplier		equipment mfg		
Period	Prodn	Stock	Prodn	Stock	Prodn	Stock	Prodn	Stock	Demand
		100		100		100		100	
1	100	100	100	100	100	100	100	100	100
		100		100		100		100	
2	-60	20	20	60	60	80	80	90	90
		20		60		80		90	
3	260	140	140	100	100	90	90	90	90
		140		100		90		90	
4	20	80	80	90	90	90	90	90	90
		80		90		90		90	
5	100	90	90	90	90	90	90	90	90
		90		90		90		90	
6	90	90	90	90	90	90	90	90	90

Source: Slack et al


Forrester Effect
300
250
200
150
100
50
0
-50
-100
Fluctuations
1
2
3
4
5
6
Period
Demand
OEM Prd
1st Tier
2nd Tier
3rd Tier

Forrester Effect

	Supplier		Supplier		Supplier		equipment mfg		
Period	Prodn	Stock	Prodn	Stock	Prodn	Stock	Prodn	Stock	Demand
		90		90		90		90	
1	90	90	90	90	90	90	90	90	90
		90		90		90		90	
2	250	170	170	130	130	110	110	100	100
		170		130		110		100	
3	-70	50	50	90	90	100	100	100	100
		50		90		100		100	
4	170	110	110	100	100	100	100	100	100
		110		100		100		100	
5	90	100	100	100	100	100	100	100	100
		100		100		100		100	
6	100	100	100	100	100	100	100	100	100

Source: After Slack et al

Damped fluctuations of production levels along a supply chain in response to small change in end-customer demand

	Third Tier		Second Tier		First Tier		Original		
	Supplier		Supplier		Supplier		equipment mfg		
Period	Prodn	Stock	Prodn	Stock	Prodn	Stock	Prodn	Stock	Demand
		100		100		100		100	
1	100	100	100	100	100	100	100	100	100
		100		100		100		100	
2	100	100	100	100	100	100	100	90	90
		100		100		100		90	
3	100	100	100	100	100	90	90	90	90
		100		100		90		90	
4	100	100	100	90	90	90	90	90	90
		100		90		90		90	
5	100	90	90	90	90	90	90	90	90
		90		90		90		90	
6	90	90	90	90	90	90	90	90	90

The only change between these two tables is from Original stock minus end stock to End stock minus original stock plus production. This allows for a buffer to be created if demand increases. Discuss the merits of the logic in both tables.

Damped fluctuations of production levels along a supply chain in response to small change in end-customer demand

	Third Tier		Second Tier		First Tier		Original		
	Supplier		Supplier		Supplier		equipment mfg		
Period	Prodn	Stock	Prodn	Stock	Prodn	Stock	Prodn	Stock	Demand
		90		90		90		90	
1	90	90	90	90	90	90	90	90	90
		90		90		90		90	
2	90	90	90	90	90	90	90	100	100
		90		90		90		100	
3	90	90	90	90	90	100	100	100	100
		90		90		100		100	
4	90	90	90	100	100	100	100	100	100
		90		100		100		100	
5	90	100	100	100	100	100	100	100	100
		100		100		100		100	
6	100	100	100	100	100	100	100	100	100

Planning Variables and Options

- Change the time period length for each supplier tier
  - Longer time periods for lower tiers
  - Shorter time periods for the assembler and first tier

- Use the modified logic for the assembler and 1st tier suppliers

- For lower tiers
  - Retain the existing MRP logic ?
  - Produce to capacity, adjust prices to stabilise demand

Questions ?