

Supply Chain Fundamentals & Segmentation Analysis

Chris Caplice
ESD.260/15.770/1.260 Logistics Systems
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Massachusetts
Institute of
Technology

Supply Chain Management Definitions

“Supply Chain Management deals with the management of materials, information, and financial flows in a network consisting of suppliers, manufacturers, distributors, and customers.”

Prof. Hau Lee - Stanford Supply Chain Forum

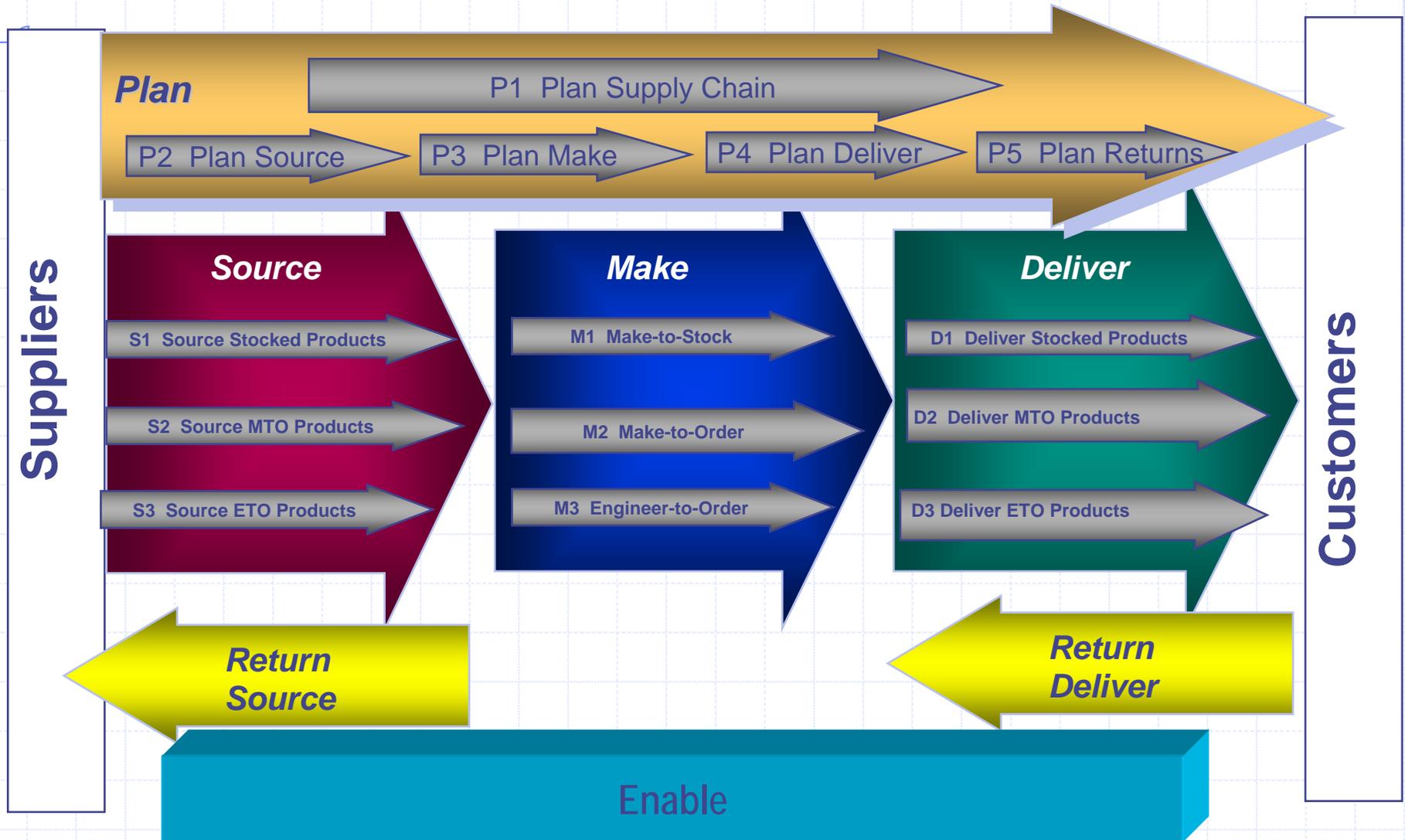
“Call it distribution or logistics or supply chain management. By whatever name it is the sinuous, gritty, and cumbersome process by which companies move material, parts, and products to customers.”

Fortune (1994)

So, what interesting Supply Chain / Logistics questions should I ask?

Images of athletic shoe and potato chip bag removed due to copyright restrictions.

Supply-Chain Operations Reference (SCOR) Model



Source: Supply Chain Council

Traditional Functional View

◆ Purchasing / Procurement

- What to buy from who
- Corporate vs Group

◆ Inventory Control

- How much to stock where
- Trigger points
- Replenishment plan

◆ Warehousing

- Storage, Mixing, Break bulk
- Pick Pack and Ship
- What to stock where in WH

◆ Materials Handling

- How to move product
- Packaging, containerization
- Storage layout

◆ Order Processing

- Receiving, Entry & Status
- Order Management

◆ Transportation

- Inbound versus Outbound
- Domestic versus International
- Modal control (Rail, TL, LTL, Parcel, Air, etc.)

◆ Customer Service

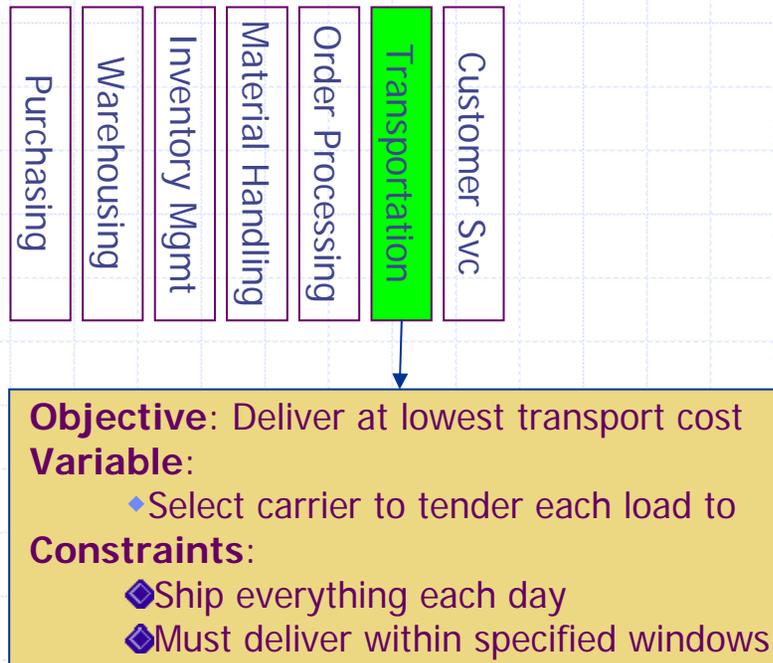
- Geographic
- Product Line Specific

◆ Planning Group

- Facility Location
- Network Design
- Demand Planning

Supply Chain as a System

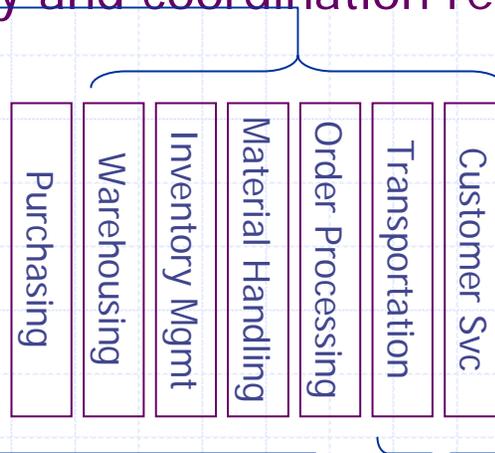
- ◆ Take an Engineering Systems Perspective
 - What is a variable and what is a constraint?
 - Continuous expansion of decision variables
 - Increases potential for improvement but increases both complexity and coordination requirements



Supply Chain as a System

◆ Take an Engineering Systems Perspective

- What is a variable and what is a constraint?
- Continuous expansion of decision variables
- Increases potential for improvement but increases both complexity and coordination requirements



Objective: Deliver at lowest total cost

Variables:

- ◆ Select carrier to tender each load to
- ◆ Select time windows to deliver
- ◆ Select when to ship what from where

Constraints:

- ◆ Deliver within negotiated time frame

Objective: Deliver at lowest transport cost

Variables:

- ◆ Select carrier to tender each load to
- ◆ Select time windows to deliver

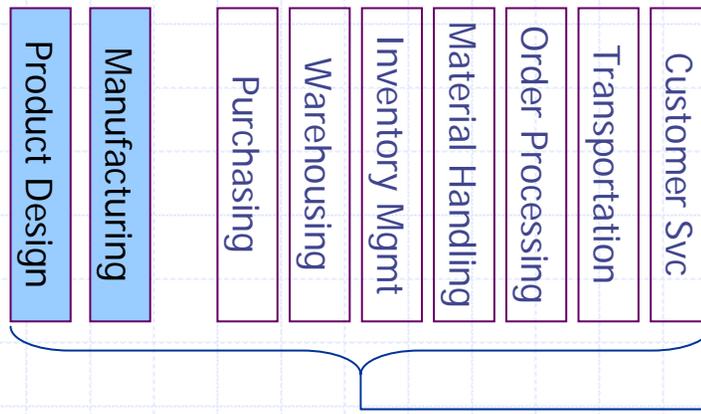
Constraints:

- ◆ Ship everything each day

Supply Chain as a System

◆ Take an Engineering Systems Perspective

- What is a variable and what is a constraint?
- Continuous expansion of decision variables
- Increases potential for improvement but increases both complexity and coordination requirements



Objective:

- ◆ Design, build, and deliver at lowest total cost

Variables:

- ◆ Select carrier to tender each load to
- ◆ Select time windows to deliver
- ◆ Select when to ship what from where
- ◆ Determine where to stock which form of product

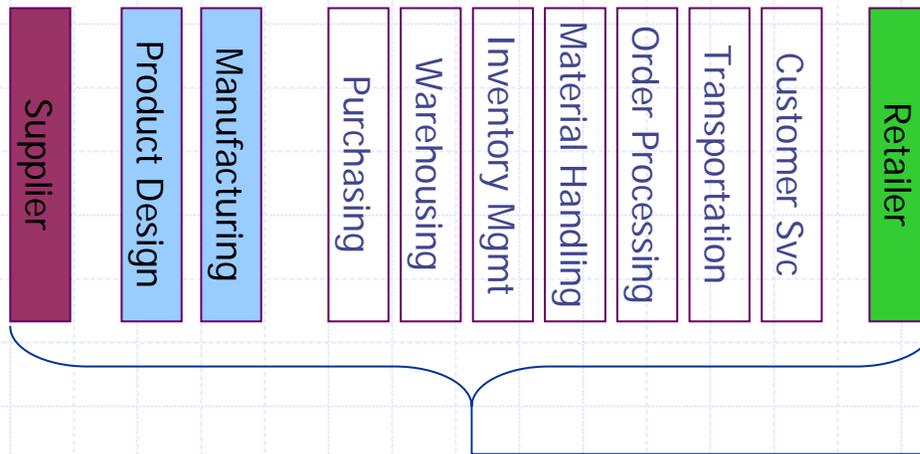
Constraints:

- ◆ Deliver within negotiated time frame

Supply Chain as a System

◆ Take an Engineering Systems Perspective

- What is a variable and what is a constraint?
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Why is this so hard to do?

Objective:

- ◆ Maximize on-shelf availability

Variables:

- ◆ Select carrier to tender each load to
- ◆ Select time windows to deliver
- ◆ Select when to ship what from where
- ◆ Determine where to stock which form of product
- ◆ Select contract relationships
- ◆ Select who should control replenishment
- ◆ Which channel member should perform which function

Constraints:

- ◆ Total delivered cost to shelf

How will the Supply Chains differ?

Images of athletic shoe and potato chip bag removed due to copyright restrictions.

Supply Chain Segmentation

- ◆ There is no such thing as a one-size-fits-all supply chain
- ◆ Most firms/business units operate multiple supply chains
- ◆ Different supply chains require different methods for:
 - Forecasting
 - Demand Planning
 - Inventory Planning
 - Transportation
 - Purchasing / Procurement
 - Inventory Control
 - Warehousing
 - Materials Handling
 - Order Management
 - Transportation
 - Customer Service
- ◆ Why segment?

Segmentation & Portfolio Management

◆ How many segments? (Rules of thumb)

- Homogenous- items within the segment are all similar
- Heterogeneous- items between segments should be very different
- Critical Mass - the segment should have enough number to make it worthwhile
- Pragmatic - the dimensions should be useful and communicable

◆ Segmentation in Supply Chain Management

- Customer, Product, Supplier
- More recently – combinations of these

Supply Chain Segmentation

◆ How can I segment my customers/vendors?

- Lead time requirements
- Service level requirements
- Purchase History
- Order Size and Volume
- Geographical
- Demographic
- Sales Trends
- Channel Segmentation

◆ How can I segment my products?

- Physical characteristics
- Demand characteristics
- Supplier characteristics

Product Segmentation

◆ Example: Grocery Store:

- ~8000 SKUs (only Dry Goods)
- Total SKUs sold within 1 year
 - ◆ 1.156 M items (SKUs) sold
 - ◆ Number of units sold per SKU
 - Mean 144
 - Median 72
 - Mode 0
 - Std Dev 355

◆ Biggest Sellers?

◆ Biggest Sales Day?

Top 10 Sellers!

1. EVAP MILK 12 OZ
2. ENFAMIL IRON POWDER
3. ENFAMIL W/IRON 13OZ
4. BATH TISS 1PLY
5. SCOT WHT BTH TT
6. P SPRING WTR 1 GALLN
7. SH GR SUGAR5LB FBLT
8. KR MAC N CHEESE
9. PAST KTCH RDY TOM
10. GEISHA SLD WHT TUNA

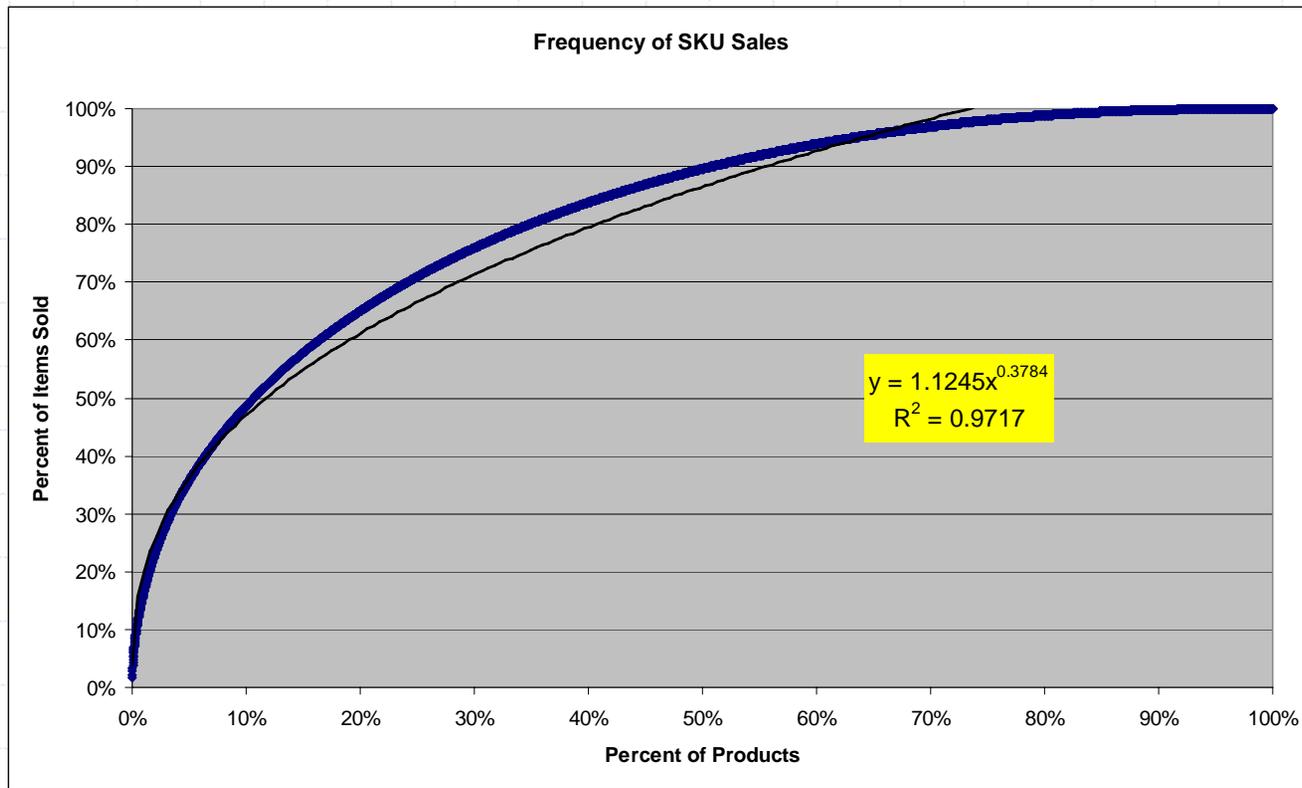
Top Sales Days!

1. 24 November 2004
2. 1 February 2004
3. 10 April 2004

How are products distributed in terms of sales volume?

Uniform? Normal? Other?

Segmentation



This is an example of the Power Law, $y = ax^k$
Why is this important?
Is this distribution unique?

Power Law ($y=ax^k$)

- ◆ Exceptionally common in physical and social systems
 - Severity of hurricanes and earthquakes
 - Failures of parts due to wear and tear
 - Income within a population (Pareto's Law)
 - Distribution of volume on traffic lanes
 - Questions from students
 - Visits to websites (Nielsen's Law) & blogs
 - Frequency of words in any language (Zipf's Law)
 - Frequency of digits within tables (Benford's Law)
 - Frequency of authors citations in literature (Lotka's Law)
 - Animals' metabolic rates wrt to mass (Kleiber's Law)
 - Profitability of customers & products
- ◆ The important few versus the trivial many

Fundamental Insight

Distribution of many phenomena across a population follow a Power Law relationship

Segmentation: ABC Analysis

Part ID	Price	Annual Demand	Annual \$ Value
5497J	\$ 2.25	260	\$ 585.00
3K62	\$ 2.85	43	\$ 122.55
88450	\$ 1.50	21	\$ 31.50
P001	\$ 0.77	388	\$ 298.76
2M993	\$ 4.45	612	\$ 2,723.40
3HHT8	\$ 6.10	220	\$ 1,342.00
56M4	\$ 3.10	110	\$ 341.00
89KE	\$ 1.32	786	\$ 1,037.52
45O3	\$ 12.80	14	\$ 179.20
55K2	\$ 24.99	334	\$ 8,346.66
978SD3	\$ 7.75	24	\$ 186.00
78HJQ2	\$ 0.68	77	\$ 52.36
23LK	\$ 0.25	56	\$ 14.00
990RT	\$ 3.89	89	\$ 346.21
58JH4	\$ 7.70	675	\$ 5,197.50
2340P	\$ 6.22	66	\$ 410.52
3784	\$ 0.85	148	\$ 125.80
38JQ2	\$ 0.77	690	\$ 531.30
56TT7	\$ 1.23	52	\$ 63.96
7UJS2	\$ 4.05	12	\$ 48.60
		4,677	\$ 21,983.84

- ◆ Identify the SKUs that management should spend time on
- ◆ Prioritize SKUs by their value to firm
- ◆ Create logical groupings
- ◆ Adjust as needed
- ◆ Example:
 - Sample of 20 SKUs
 - Total of 4,677 units
 - Total ~\$22k

Segmentation: ABC Analysis

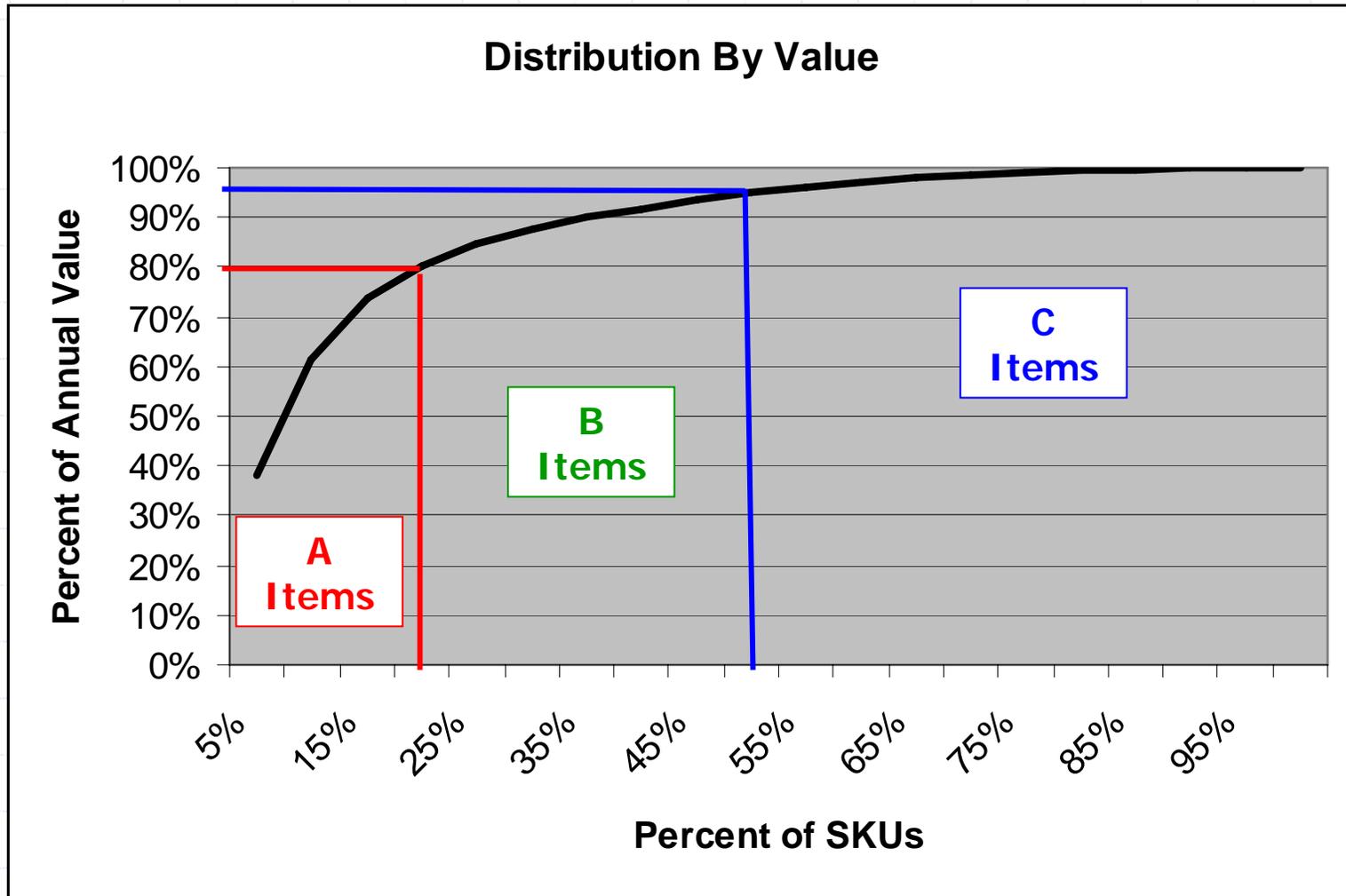
Part ID	Price	Annual Demand	Annual \$ Value	Cum \$ Value	Pct Ann \$ Value
55K2	\$ 24.99	334	\$ 8,347	\$ 8,347	38%
58JH4	\$ 7.70	675	\$ 5,198	\$ 13,544	62%
2M993	\$ 4.45	612	\$ 2,723	\$ 16,268	74%
3HHT8	\$ 6.10	220	\$ 1,342	\$ 17,610	80%
89KE	\$ 1.32	786	\$ 1,038	\$ 18,647	85%
5497J	\$ 2.25	260	\$ 585	\$ 19,232	87%
38JQ2	\$ 0.77	690	\$ 531	\$ 19,763	90%
2340P	\$ 6.22	66	\$ 411	\$ 20,174	92%
990RT	\$ 3.89	89	\$ 346	\$ 20,520	93%
56M4	\$ 3.10	110	\$ 341	\$ 20,861	95%
P001	\$ 0.77	388	\$ 299	\$ 21,160	96%
978SD3	\$ 7.75	24	\$ 186	\$ 21,346	97%
45O3	\$ 12.80	14	\$ 179	\$ 21,525	98%
3784	\$ 0.85	148	\$ 126	\$ 21,651	98%
3K62	\$ 2.85	43	\$ 123	\$ 21,773	99%
56TT7	\$ 1.23	52	\$ 64	\$ 21,837	99%
78HJQ2	\$ 0.68	77	\$ 52	\$ 21,890	100%
7UJS2	\$ 4.05	12	\$ 49	\$ 21,938	100%
88450	\$ 1.50	21	\$ 32	\$ 21,970	100%
23LK	\$ 0.25	56	\$ 14	\$ 21,984	100%
		4,677	\$ 21,984		

A Items:
80% of Value
20% of SKUs

B Items:
15% of Value
30% of SKUs

C Items:
5% of Value
50% of SKUs

Segmentation: ABC Analysis



Segmentation: ABC Analysis

◆ So, what is different between the classes?

■ A Items

- ◆ Very few high impact items are included
- ◆ Require the most managerial attention and review
- ◆ Expect many exceptions to be made

■ B Items

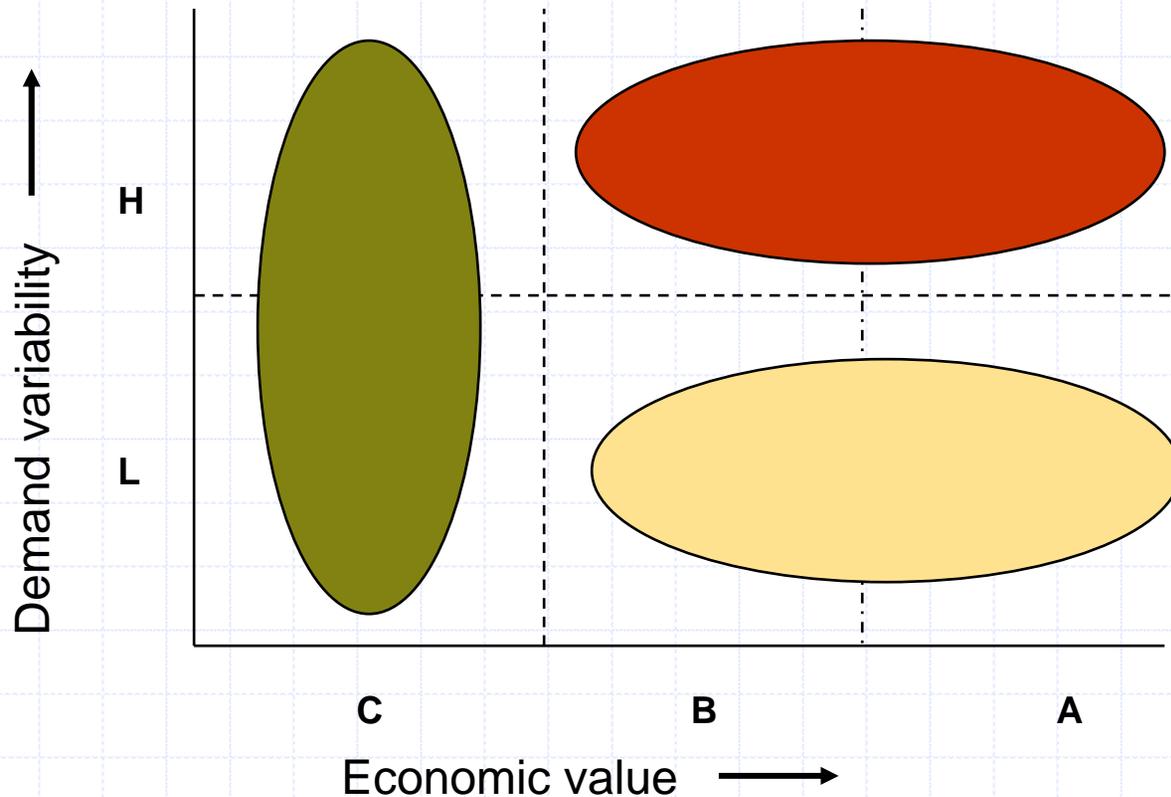
- ◆ Many moderate impact items (sometimes most)
- ◆ Automated control w/ management by exception
- ◆ Rules can be used for A (but usually too many exceptions)

■ C Items

- ◆ Many if not most of the items that make up minor impact
- ◆ Control systems should be as simple as possible
- ◆ Reduce wasted management time and attention
- ◆ Group into common regions, suppliers, end users

◆ But – these are arbitrary classifications

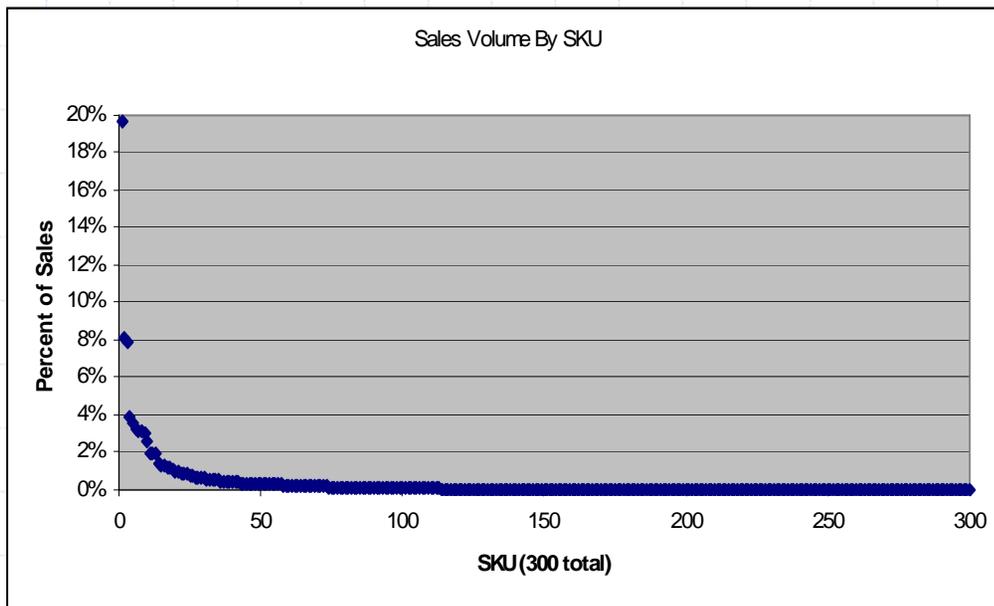
Segmentation: ABC Analysis



-  Volatile: Sophisticated techniques; frequent reviews
-  Stable: Less sophisticated techniques; less frequent reviews
-  Unimportant: Unsophisticated techniques; infrequent reviews

Segmentation: ABC Analysis

- ◆ So, what should we do with C items?
 - Traditional Approach
 - ◆ Handle as simply as possible to minimize cost
 - ◆ Eliminate if possible to be able to focus on A & B
 - Other thoughts?



Top 1% of products = 36% sales
Top 5% of products = 67% sales

Bottom 95% account for 33% sales

Segmentation: The Long Tail

◆ Examples:

■ Books

- ◆ Amazon.com stocks over 3 M titles
- ◆ Most brick & mortar stores stock between 40-100k
- ◆ 25% - 40% of Amazon.com sales are books not stocked in stores

■ Music / CDs

- ◆ Rhapsody offers >1.5 M tracks
- ◆ Wal*Mart offers ~4,500 CDs (or about 55,000 tracks)
- ◆ 40% of Rhapsody sales come from titles not stocked in stores

■ Movies / DVDs

- ◆ Netflix offers over 55,000 titles
- ◆ Blockbuster offers ~3,000 titles
- ◆ 21% of Netflix sales come from titles not stocked in stores
- ◆ While 80% of sales for a DVD occur within 2 months of release, margins actually increase for older releases!

◆ When does it make sense to expand the tail?

Sources:

- ◆ Brynjolfsson, Hu, and Smith, (2006) "From Niches to Riches: Anatomy of the Long Tail," MIT Sloan Management Review
- ◆ Anderson, (2006) The Long Tail, Hyperion Press.

Bottom Line(s)

- ◆ Supply Chain Management is . . .
 - An integrated activity,
 - ◆ X-functions, X-divisions, X-companies, etc.
 - ◆ Coordination of conflicting goals, metrics, etc.
 - Involves multiple flows,
 - ◆ Physical (raw materials, wip, finished goods)
 - ◆ Information (orders, status, contracts)
 - ◆ Financial (payment, credits, etc.)
 - Requires trade-offs,
 - ◆ Across different entities
 - ◆ Across metrics: Cost, Service, Time, Risk, Flexibility, etc.
 - Deals with uncertainty,
 - ◆ Uncertainty in supply, process, and demand
 - ◆ Consider both flexibility and robustness
 - Portfolio of approaches are usually needed.
 - ◆ There is no one size fits all anything in SCM
 - ◆ Knowing when to apply which approach is critical to success

Core Concepts of ESD.260

◆ Model Based Approach

- Use fundamental models to gain insights
- Analytical, not necessarily OR, approach
- Extensive use of real examples – but not case studies

◆ Total System Perspective

- Avoid the silo effect of traditional logistics
- Capture and integrate across different players in SC
- Service can be included

◆ Portfolio of Solutions

- Rarely is a single solution sufficient or practical
- A set of solutions is usually more applicable
- The context matters

◆ Management of Uncertainty

- Risk can be measured, monitored, and managed
- Impacts sourcing, contracting, pricing, incentives, etc.

Fit with Other MIT *SCMish* Classes

◆ Strategic –

- How does SCM fit into larger company issues?
- Classes:
 - ◆ ESD.261/15.771 – Case Studies in Logistics and SCM (Byrnes)
 - ◆ ESD.265/2.965 International Logistics (Marcus & Weiss)
 - ◆ 15.769 Operations Strategy (Rosenfield, Novak)
 - ◆ *ESD.267/15.762 – Supply Chain Planning (Graves & Simchi-Levi)*
 - ◆ *ESD.268/15.763 – Mfg System & SC Design (Graves & Simchi-Levi)*

◆ Analytical –

- How to answer specific, practical SCM questions using analytical tools?
- Classes:
 - ◆ ESD.260/15.770 – Logistics Systems (Caplice & Sheffi)

◆ Methodological –

- How and why do the underlying methodologies and approaches work?
- Classes:
 - ◆ ESD.273 – Logistics and SCM (Simchi-Levi)
 - ◆ 15.764 – Theory of Operations Management (Gallien)
 - ◆ 1.203/ESD216 – Log & Transp Planning Methods (Larson, Odoni, & Barnett)
 - ◆ 15.081, .082, .083, .084, .085 – ORC track for optimization & probability

Questions?
Comments?
Suggestions?



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