

Lean Six Sigma Logistics

Supply Chain Management

Supply Chain Management encompasses the **planning** and management of all activities involved in **sourcing** and **procurement**, conversion, and all **Logistics Management** activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, Supply Chain Management **integrates** supply and demand management within and **across companies**.

Logistics Management

Logistics Management is that part of Supply Chain Management that **plans, implements, and controls** the **efficient, effective** forward and reverse **flow and storage** of goods, services and related **information** between the point of origin and the point of consumption in order to **meet customers' requirements**.

Section 1 > Seeing the Whole

Lean Six Sigma Logistics Seeing the Whole

House of Lean

Customer Focus: Hoshin Planning, Takt, Teamwork, CI

JIT

1. Pull
2. Leveled Flow
3. Frequency
4. Lot Size
5. Lead Time
6. Returnables
7. Integration

Teamwork

1. Collaboration
2. Best Practices
3. Go See
4. Time and Motion

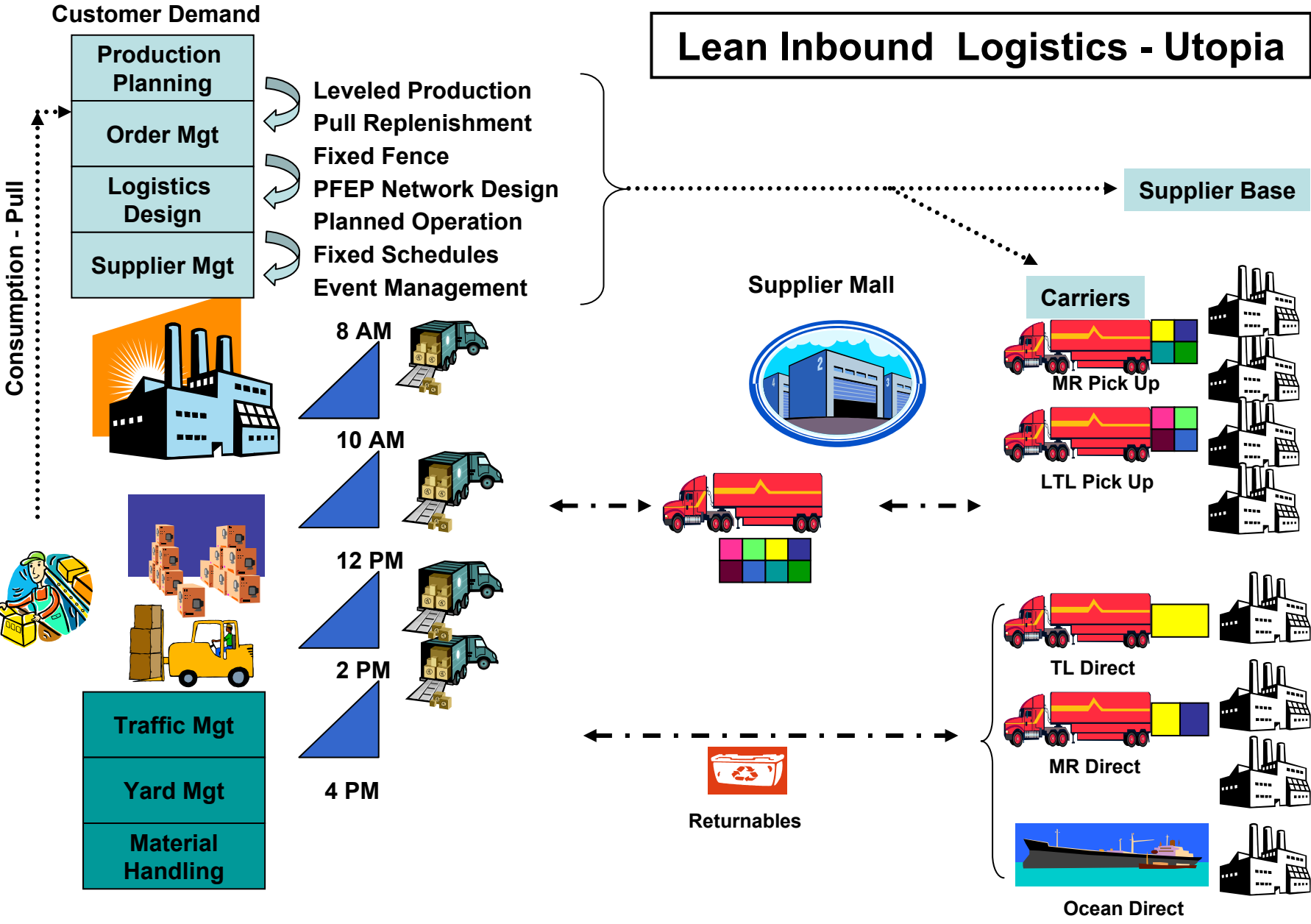
QAS

1. Plan vs. Actual
2. Visual Control
3. Poka-yoke
4. Five W's
5. Five Why's
6. PDCA
7. No Waste

Standardization – Standardized Work, 5S, A3 Thinking

Stability – Variation reduction – TPM-Visibility

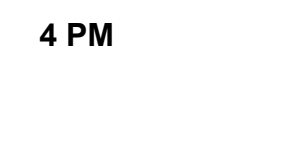
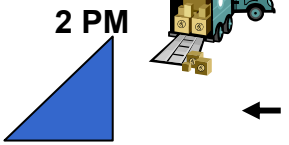
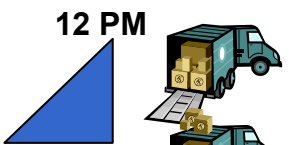
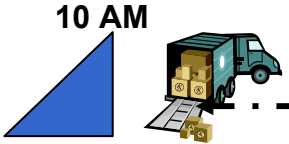
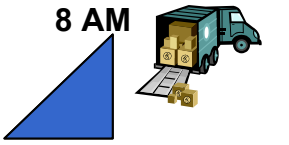
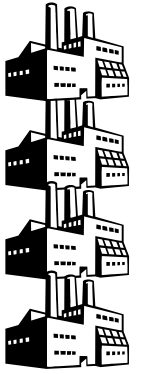
Lean Inbound Logistics - Utopia



Lean Outbound Logistics - Utopia

- Leveled Production
- Pull Replenishment
- Fixed Fence
- PFEF Network Design
- Planned Operation
- Fixed Schedules
- Event Management

| | |
|------------------|---|
| Customer Service | ↔ |
| Order Mgt | ↔ |
| Logistics Design | ↔ |
| Customer Mgt | ↔ |



DC

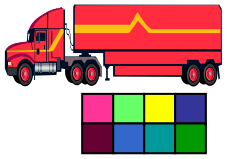
Carriers



MR Pick Up



LTL Pick Up



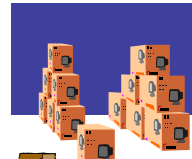
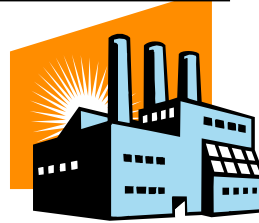
TL Direct



MR Direct

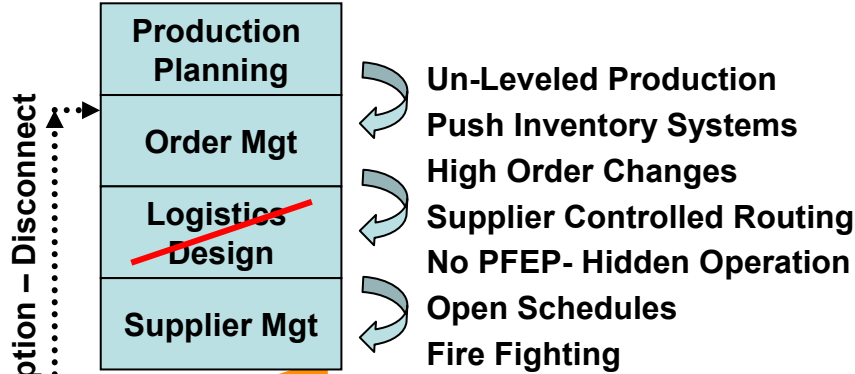


Returnables

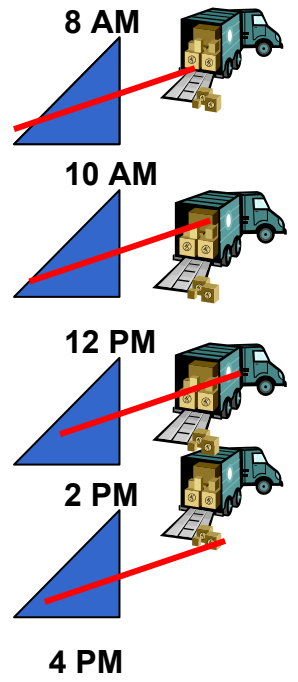
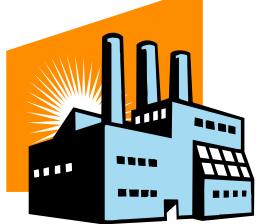


| |
|-------------------|
| Traffic Mgt |
| Yard Mgt |
| Material Handling |

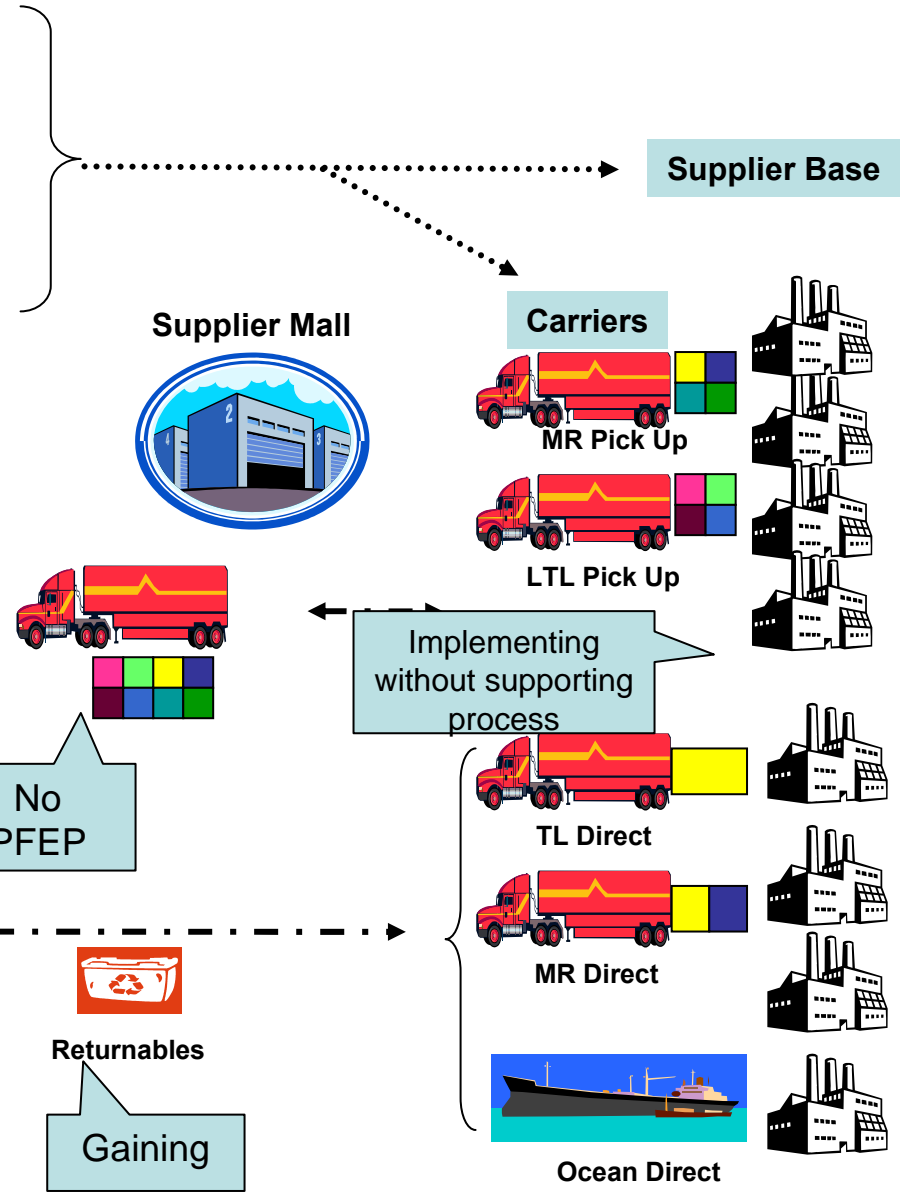
Customer Demand Variance



Consumption - Disconnect

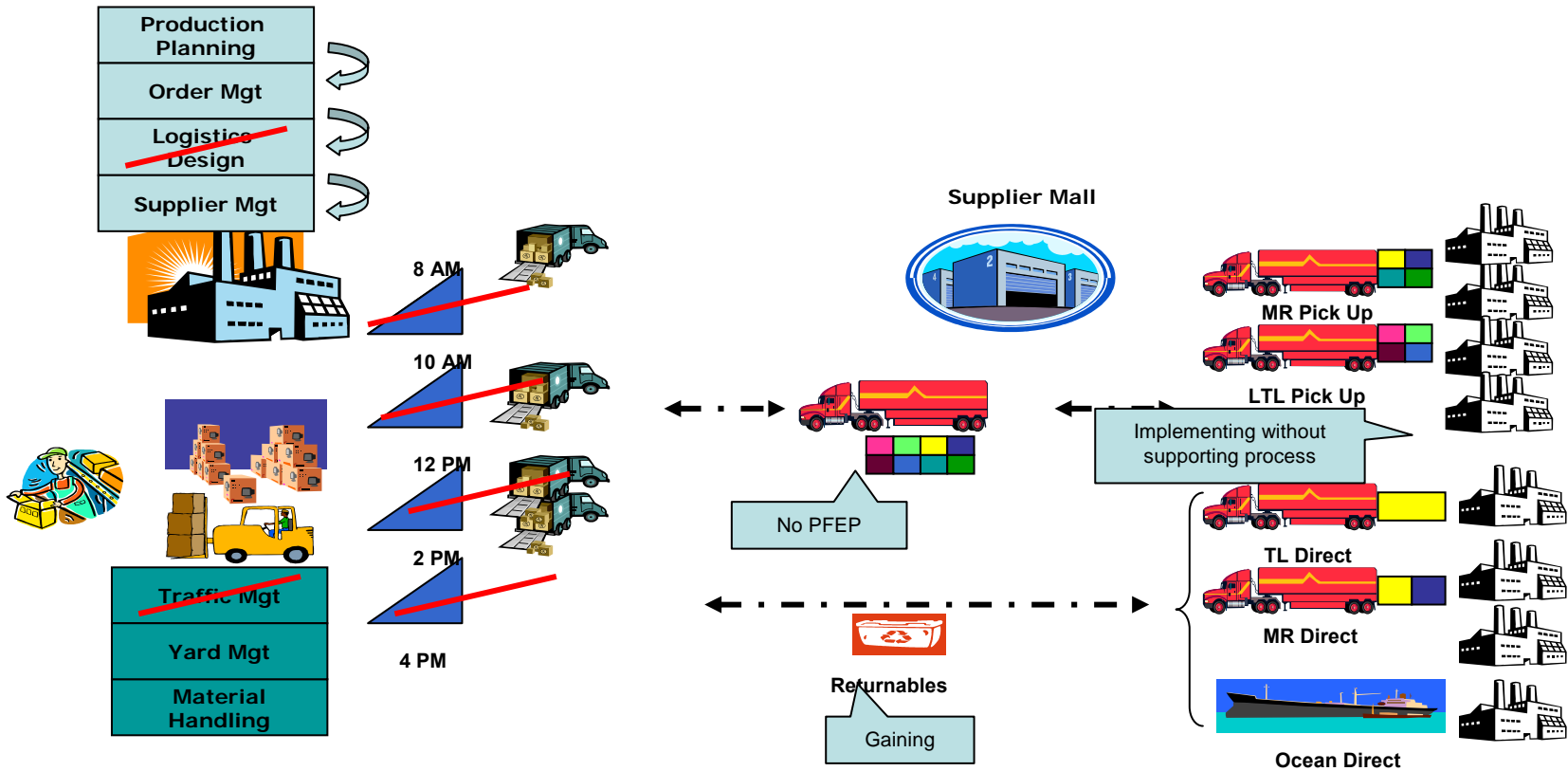


Logistics - Reality

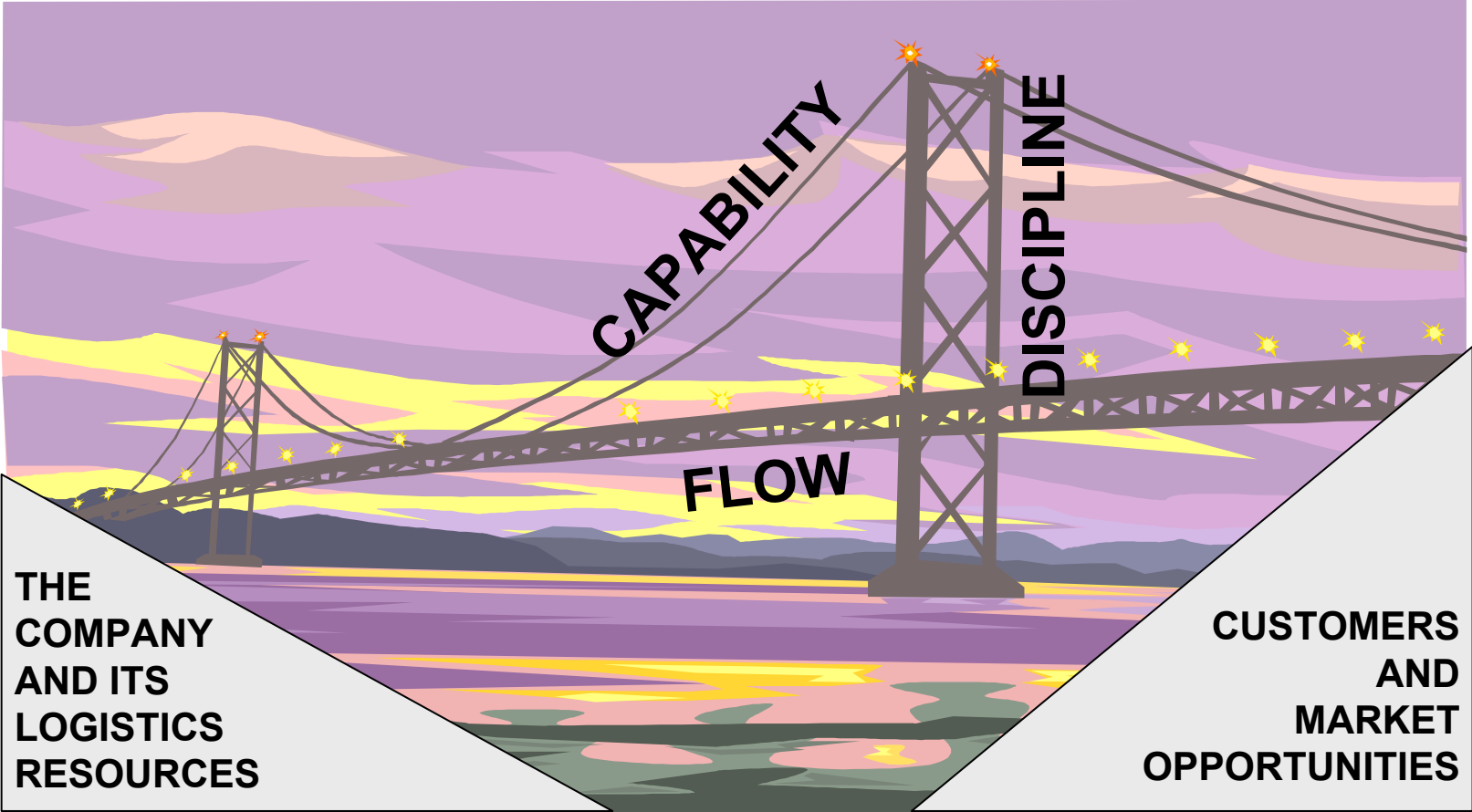


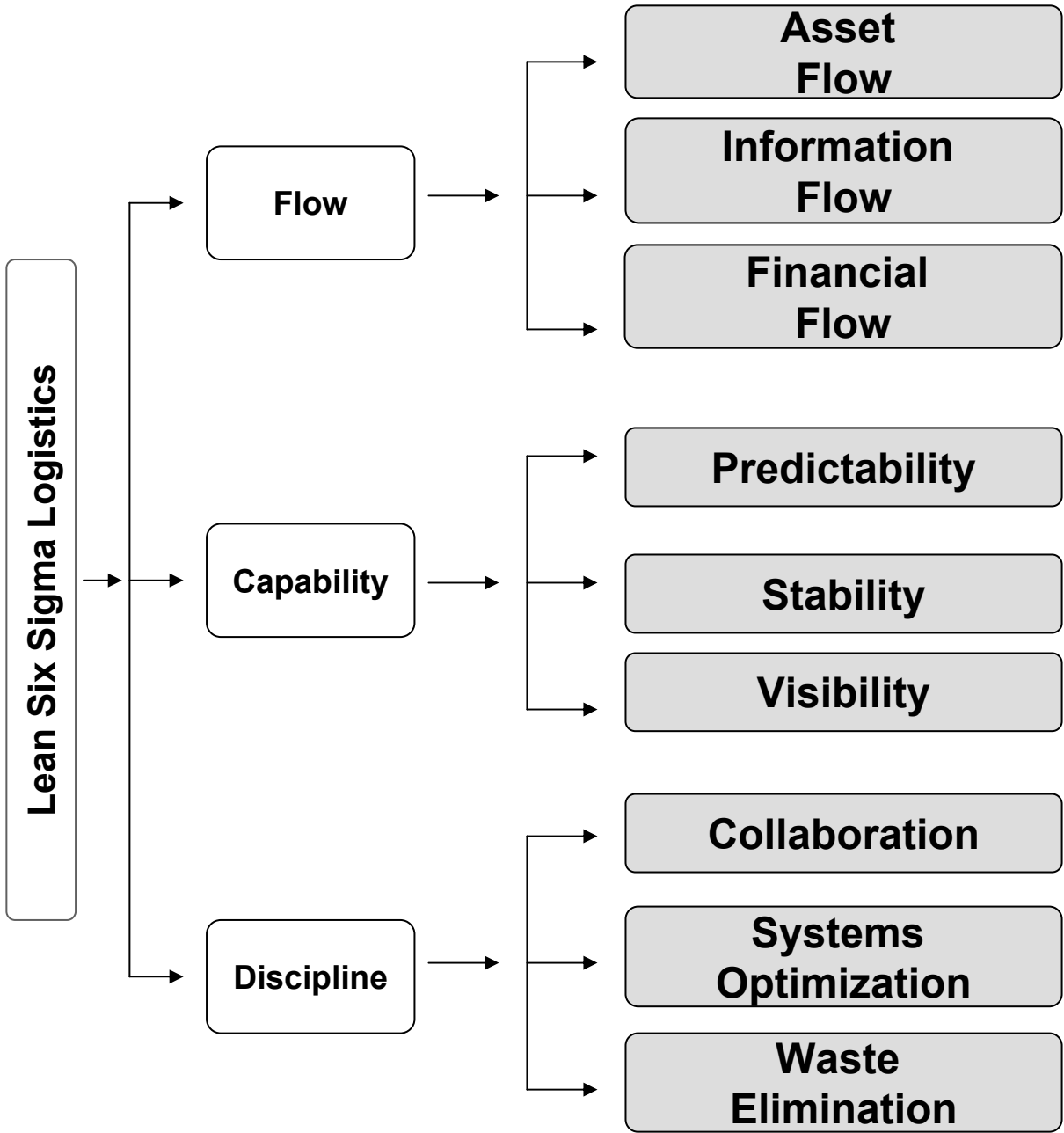
Logistics Waste

| Inventory | Transportation | Time | Space | Knowledge, Admin, Pkg. |
|--|---|--|---|---|
| Excess Inventory Safety Stock Obsolete Inventory | Unit Cost Tone/Mile Expedites | Order to Supplier Ship Ship to Plant Receive Plant Receive to Consumption | # Stocking Locations Packaging Storage Systems | Process Complexity Variation Complexity Correction |
| Lean Best Practice PFEP 5S - Visual Control Pull -Leveled Flow | Lean Best Practice Network Ownership Network Integration Logistics Design | Lean Best Practice Value Stream Map Sleep Time Reduction Process Improvement | Lean Best Practice Reduced Stocking Points Returnable Containers Flow Racks | Lean Best Practice Quality at Source Error Proofing Standardization |

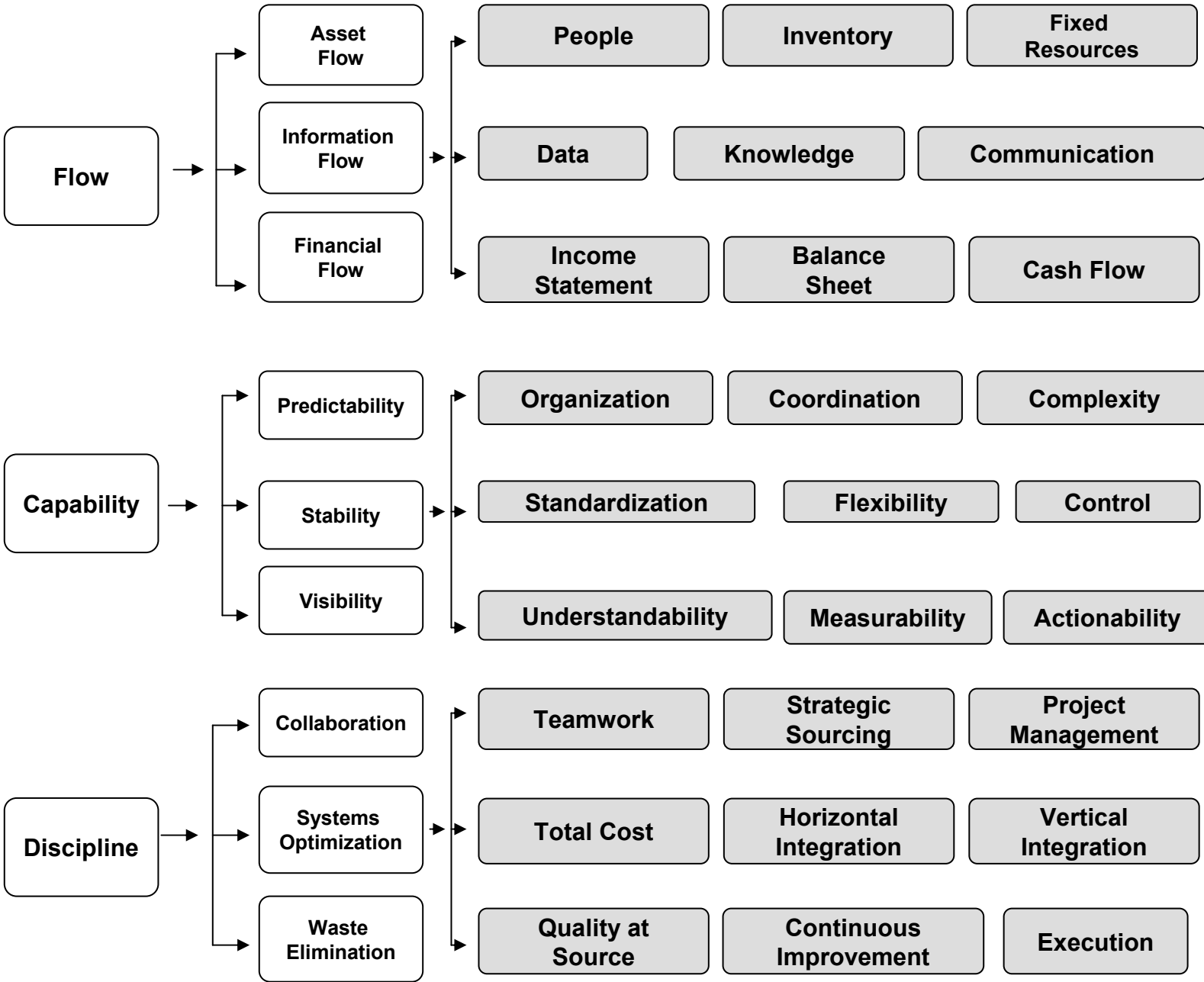


Logistics Bridge Model



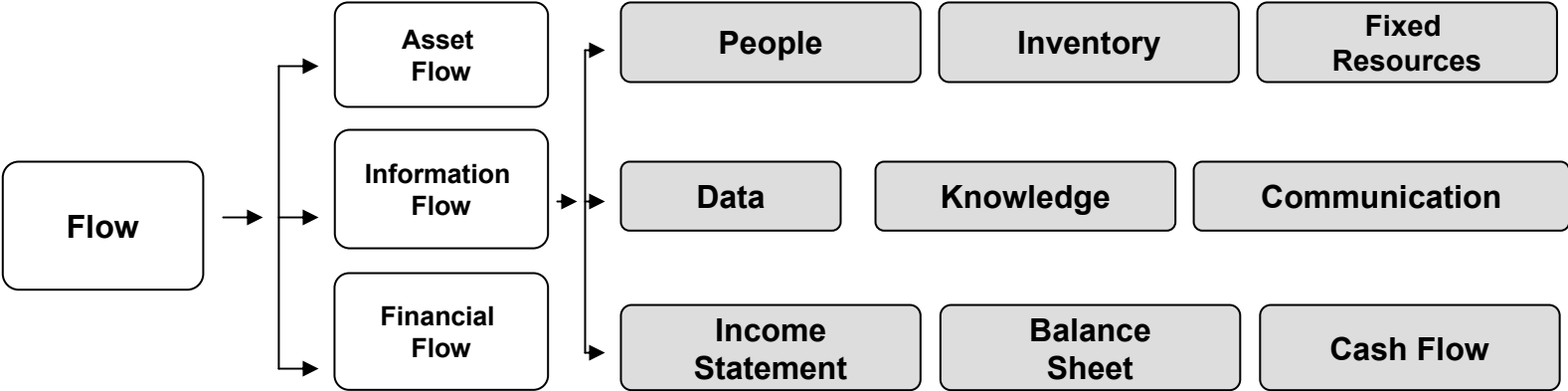


Lean Six Sigma Logistics



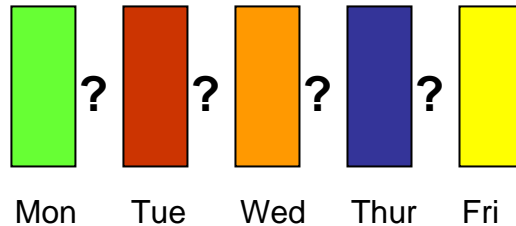
Section 2 > Flow

Flow



The Three Types of Operational Dynamics

Mass Manufacturer
Level 1- Large Batch
No Scheduling

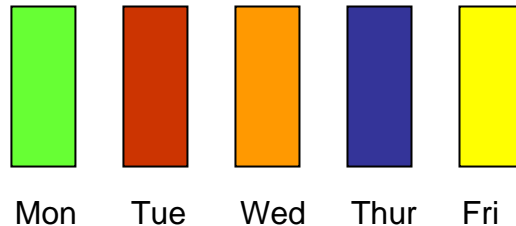


Logistics Plan

1. Inventory
2. All parts arrive by Monday

Lean 6 σ Strategy: 5S,
Network Ownership, Standardization

JIT Manufacturer
Level 2- Large Batch
Fixed Scheduling

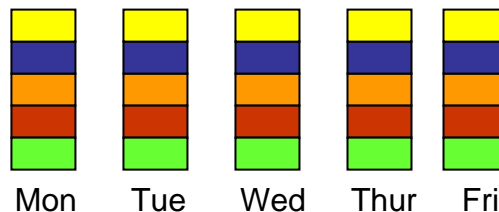


Logistics Plan

1. MRP - JIT
2. Sequenced Deliveries

Lean 6 σ Strategy: Visibility, Lead Time,
Lot Size, Transportation Mgt

Lean Manufacturer
Level 3- Small Batch
Leveled Scheduling



Logistics Plan

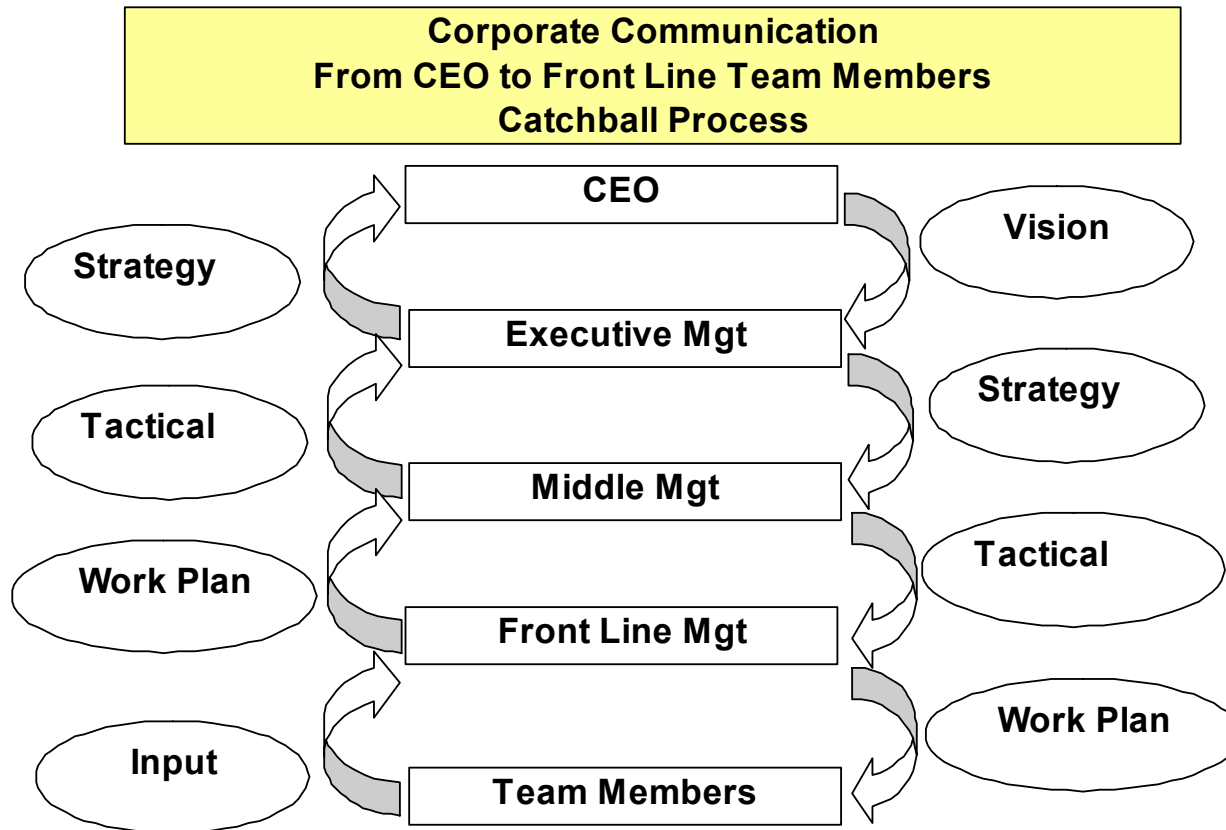
1. Pull Replenishment
2. Kanban

Lean 6 σ Strategy: Flow,
Capability, Discipline

Supplier-Customer Development Hierarchy of Needs

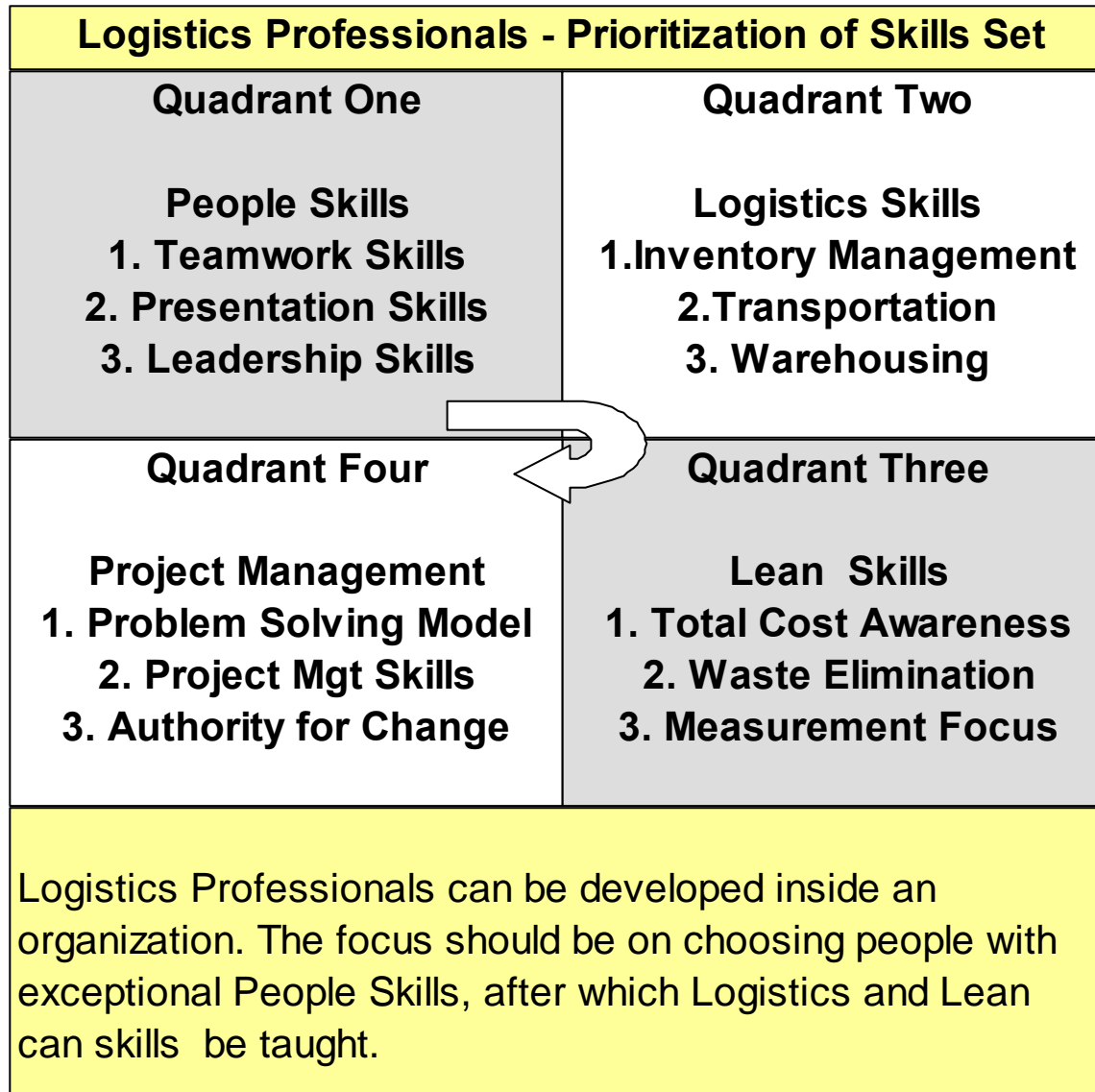


Flow > Information > Communication



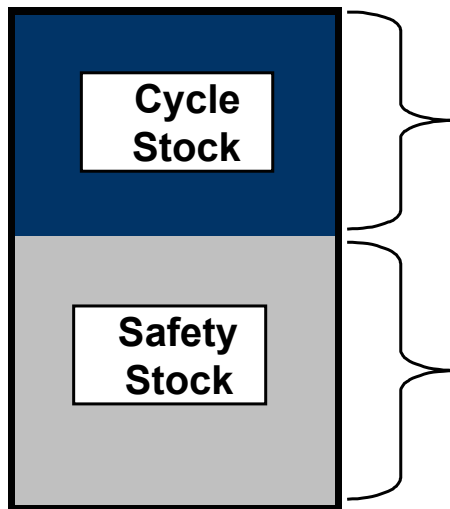
Logistics strategy should be an iterative process that starts with a vision and involves all levels of management.

Flow > Asset > People



Flow > Asset > Inventory

| Type of Inventory | Reason to Hold | Variability |
|----------------------|--|-------------|
| Cycle Stock | Balance Supply and Demand | low |
| In-Transit | Necessary | low |
| Safety/ Buffer Stock | Protect against uncertainties in demand or lead time and act as a buffer at interfaces | medium-high |
| Speculative Stock | Economies of scale | high |
| Seasonal Stock | Economies of scale | high |
| Dead Stock | Specialization in Mfg. | high |

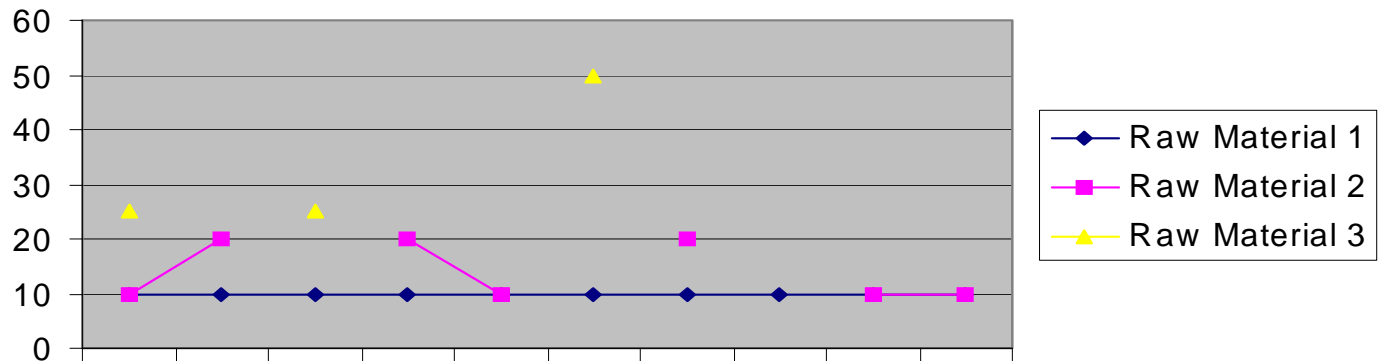


1. Order Materials when Required
2. Increase Frequency of Delivery
3. Control Variability of Consumption

1. Reduce Supplier Manufacturing Lead Time
2. Reduce Transportation Lead Time
3. Reduce Variability of Demand
4. Reduce Variability of Quality

Flow > Asset > Inventory

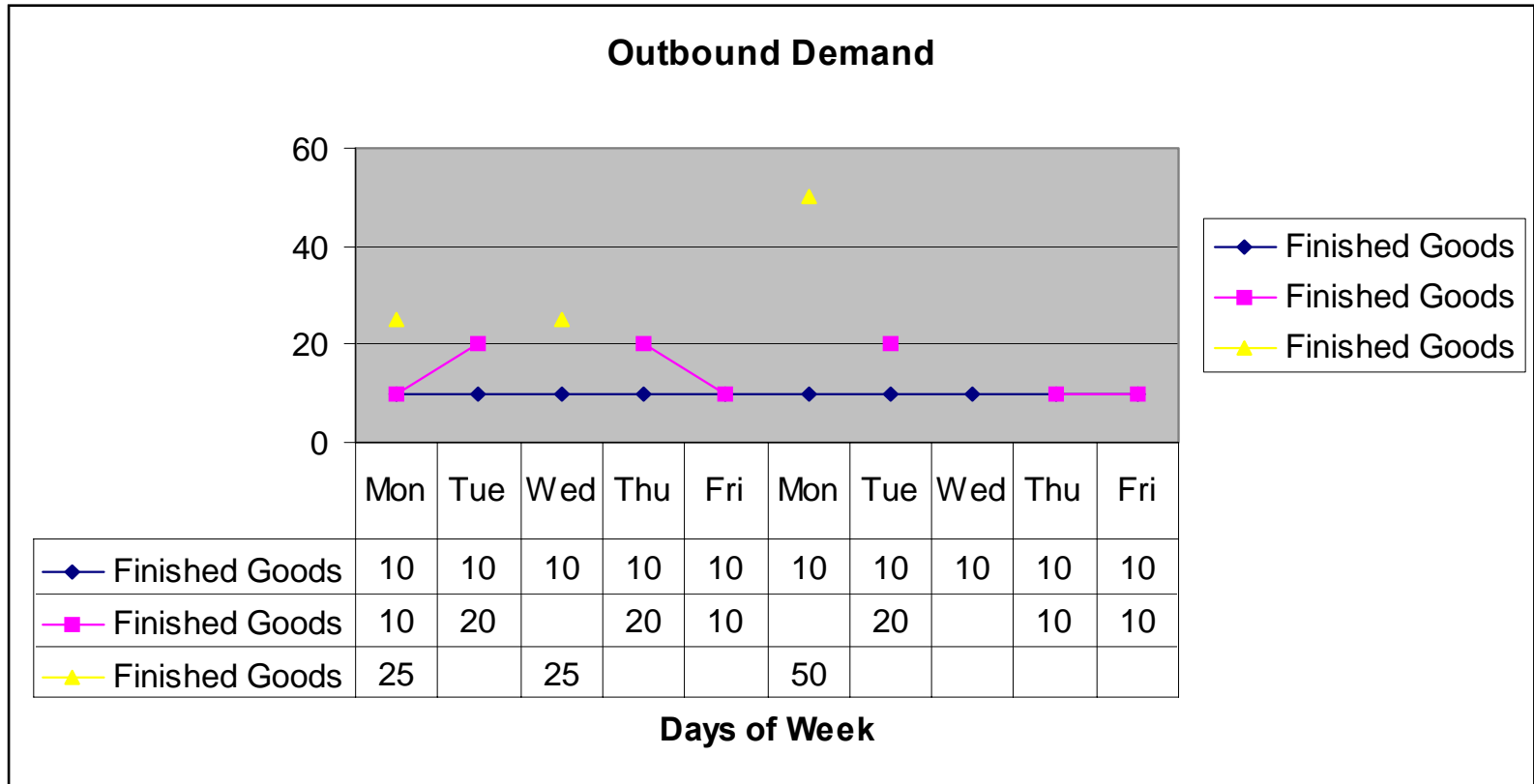
Inbound Material Demand



| | Mon | Tue | Wed | Thu | Fri | Mon | Tue | Wed | Thu | Fri |
|----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Raw Material 1 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Raw Material 2 | 10 | 20 | | 20 | 10 | | 20 | | 10 | 10 |
| Raw Material 3 | 25 | | 25 | | | 50 | | | | |

Days of Week

Flow > Asset > Inventory

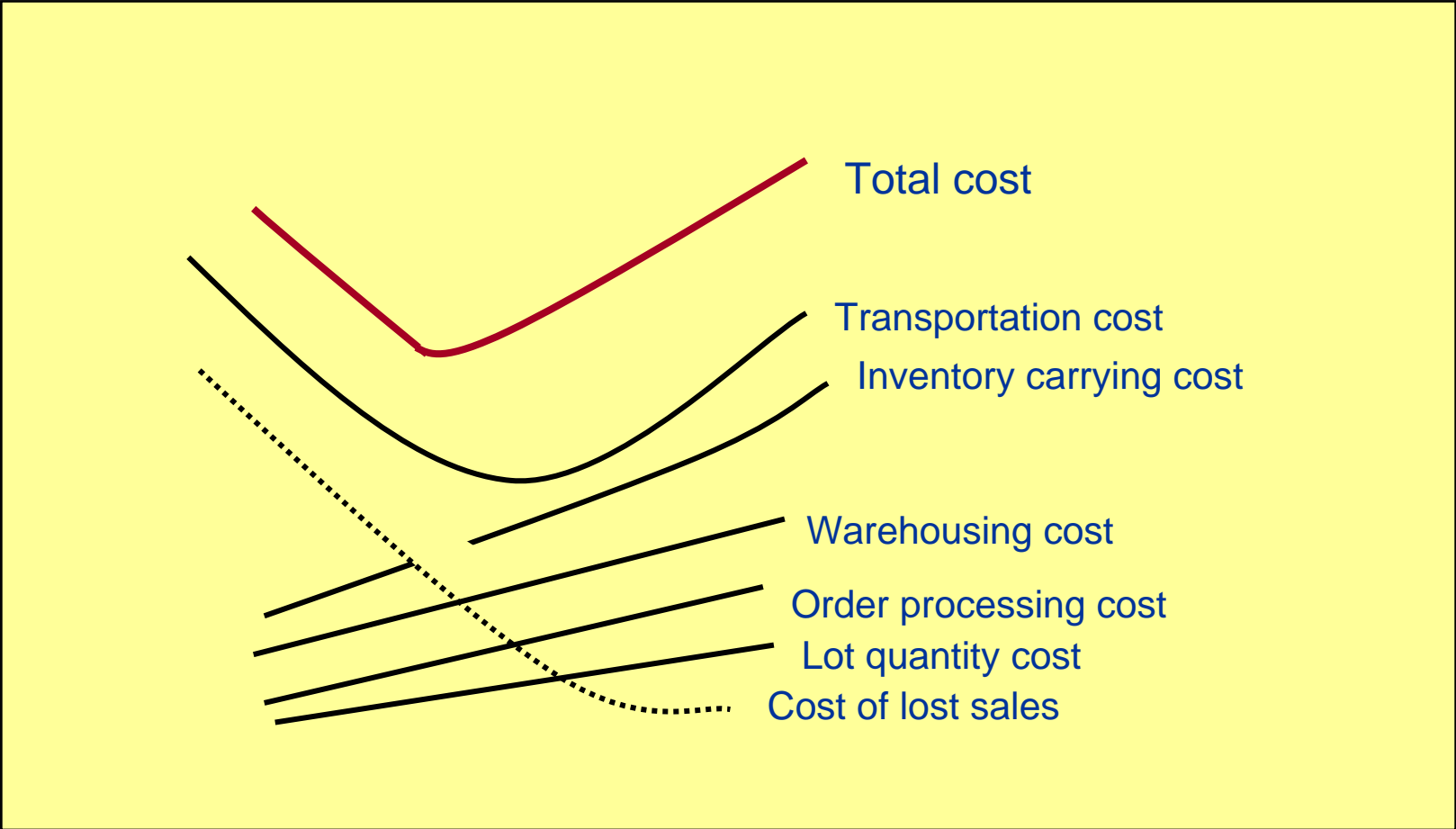


Work Out





Inventory and Demand Patterns

1. What is the effect on the logistics systems ?
2. What can be done to level demand ?

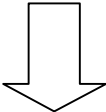
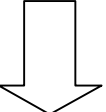
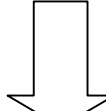

Section 3 > Total Cost



Flow > Financial > Income Statement

| Example Income Statement And Logistics Drivers | | |
|--|--|---|
| Revenues | | Customer Satisfaction Order Fill Rate Order Cycle Time On-Time Delivery Pipeline Visibility |
| Goal  | | |
| Less Cost Of Goods Sold | | Inbound Transportation Lot Size Frequency Inventory carrying Costs Lead Time |
| Goal  | | |
| Equals Gross Margin | | XXXX |
| Less Operating Expenses | | Warehousing Costs Shuttle Transportation Costs Outbound Transportation Costs Inventory Carrying Costs Logistics Administrative Technology Costs Lead Time |
| Goal  | | |
| Equals Operating Profit | | XXXXX |
| Less Interest and Taxes | | Inventory Financing Fleet and Equipment Financing Facility Financing Technology Financing |
| Goal  | | |
| Equals Net Income | | XXXXXX |

Flow > Financial > Balance Sheet

| Example Balance Sheet and Logistics Drivers | |
|--|---|
| Cash | XXXXXX |
| Inventory | Raw Materials WIP Finished Goods - Plant In Transit Warehouse Cycle Stock Safety Stock |
| Goal  | |
| Accounts Receivable | Delivery Lead Time Invoice Processing Terms of Sale |
| Goal  | Aging from disputed deliveries Aging from OS&D |
| Total Current Assets | XXXXXX |
| Fixed Assets | Transportation Equipment Material Handling Equipment Warehouses and Facilities Racking Systems Hardware and Software Communications Equipment |
| Goal  | |
| Other Assets | XXXXXX |
| Total Assets | XXXXXXXX |
| Accounts Payable | Payment / Discount Terms Inbound Lead Time |
| Goal  | Raw Material Inventory Strategy |
| Other Liabilities | |
| Equity | |
| Total Liabilities & Owners Equity | XXXXXX |

Flow > Financial > Cash Flow

| Cash Drivers and Cash Flow Implication | Logitics and Supply Chain Value |
|---|--|
| Accounts Payable | |
| <ol style="list-style-type: none"> 1. Payables = Cash Out 2. Timing between receipt, payment, and use of goods 3. Timing between receipt, payment, and use of services | <ol style="list-style-type: none"> 1. Increase working capital 2. Reduce order to build lead time 3. Reduce service to build lead time |
| Accounts Receivable | |
| <ol style="list-style-type: none"> 1. Receivables = Cash In (waiting for cash) 2. Timing between customer receipt and payment 3. Accuracy of order and invoice | <ol style="list-style-type: none"> 1. Increase working capital 2. Reduce order to delivery to invoice lead time 3. Increase perfect order rate and invoice accuracy |
| Capital Expenditure | |
| <ol style="list-style-type: none"> 1. Capital Expenditure = Cash Out 2. Must relate CAPEX with strategy 3. Strategic use of outsourcing | <ol style="list-style-type: none"> 1. Conserve cash 2. Focus attention on core competencies 3. Invest cash on core competencies |
| Revenue Growth | |
| <ol style="list-style-type: none"> 1. Increased Revenue = Cash In 2. New markets determine growth 3. Current customer satisfaction drives growth | <ol style="list-style-type: none"> 1. Increase sales 2. Create supply new markets 3. Meet critical to quality measures |
| Gross Margin | |
| <ol style="list-style-type: none"> 1. Sales-COGS=Gross Margin=Cash In 2. Reduce COGS = Cash In 3. Focus on reduced COGS | <ol style="list-style-type: none"> 1. Increase bottom line impact 2. Reduce operating expenses 3. Develop optimized logistics infrastructure |
| Sales-General+Administrative | |
| <ol style="list-style-type: none"> 1. SGA = Cash Out 2. SGA must be value added 3. Need to focus on waste reduction | <ol style="list-style-type: none"> 1. Increase bottom line impact 2. Reduce operating expenses 3. Develop optimized logistics infrastructure |
| Inventory | |
| <ol style="list-style-type: none"> 1. Opportunity cost of holding inventories = Cash Out 2. Services Costs = Space, Insurance, Taxes, Transportation 3. Risk Costs = Obsolescence, Shrinkage, Pilferage = Cash Out 4. Overproduction = Cash Out | <ol style="list-style-type: none"> 1. Increase working capital 2. Reduce inventory service costs 3. Reduce inventory risk costs 4. Reduce overproduction |

Total Logistics Cost Concept

- Reduce *Total* Logistics Systems Costs
 - Cost trade-offs
 - Total Cost Analysis
 - + Transportation
 - + Warehousing
 - + Order Processing
 - + Lot Quantity
 - + Inventory Carrying
-
- Total Logistics Costs**



- Average Days of inventory on-hand = 10
- Raw Material Spend = \$250,000,000
- Inbound Transportation Budget = \$9,000,000
- Productivity Improvement = 0%

| | | | | |
|------------------------------------|---------------|----------------|-------------------------|--------------|
| Ordering | 1.00% | of Total Cost | \$ | 128,571.43 |
| Supplier Management | 0.50% | of Total Cost | \$ | 64,285.71 |
| Logistics Design | 0.00% | of Total Cost | | |
| Logistics Operations | 70.00% | of Total Cost | \$ | 9,000,000.00 |
| Yard Control | 1.00% | of Total Cost | \$ | 128,571.43 |
| Receiving Management | 3.00% | of Total Cost | \$ | 385,714.29 |
| Raw Material Storage | | | | |
| (Inventory Carrying Cost) | | | | |
| Admin. Overheads | 2.00% | of Avg RM OH | \$ | 200,000.00 |
| Cost of Capital | 9.00% | of Avg RM OH | \$ | 900,000.00 |
| Damage | 1.00% | of Avg RM OH | \$ | 100,000.00 |
| Insurance | 1.00% | of Avg RM OH | \$ | 100,000.00 |
| Interplant Shuttles | 1.00% | of Avg RM OH | \$ | 100,000.00 |
| Obsolescence | 3.00% | of Avg RM OH | \$ | 300,000.00 |
| Shrinkage | 2.00% | of Avg RM OH | \$ | 200,000.00 |
| Space | 8.50% | of Avg RM OH | \$ | 850,000.00 |
| Storage Systems | 1.00% | of Avg RM OH | \$ | 100,000.00 |
| Taxes | 3.00% | of Avg RM OH | \$ | 300,000.00 |
| | 28.50% | | \$ | 3,150,000.00 |
| Total Inventory Costs | 24.50% | | | |
| Total Logistics Costs | | 100.00% | \$ 12,857,142.86 | |

• Average Days of inventory on-hand = 5

• Raw Material Spend = \$250,000,000

• Inbound Transportation Budget = \$9,000,000

• Productivity Improvement = 0%

| | | | | |
|---|----------------|---------------|-----------|----------------------|
| Ordering | 1.11% | of Total Cost | \$ | 128,571.43 |
| Supplier Management | 0.56% | of Total Cost | \$ | 64,285.71 |
| Logistics Design | 4.32% | of Total Cost | \$ | 500,000.00 |
| Logistics Operations | 77.71% | of Total Cost | \$ | 9,000,000.00 |
| Yard Control | 1.11% | of Total Cost | \$ | 128,571.43 |
| Receiving Management | 3.33% | of Total Cost | \$ | 385,714.29 |
| Raw Material Storage (Inventory Carrying Cost) | | | | |
| Admin. Overheads | 2.00% | of Avg RM OH | \$ | 100,000.00 |
| Cost of Capital | 9.00% | of Avg RM OH | \$ | 450,000.00 |
| Damage | 1.00% | of Avg RM OH | \$ | 50,000.00 |
| Insurance | 1.00% | of Avg RM OH | \$ | 50,000.00 |
| Interplant Shuttles | 1.00% | of Avg RM OH | \$ | 50,000.00 |
| Obsolescence | 3.00% | of Avg RM OH | \$ | 150,000.00 |
| Shrinkage | 1.00% | of Avg RM OH | \$ | 50,000.00 |
| Space | 8.50% | of Avg RM OH | \$ | 425,000.00 |
| Storage Systems | 1.00% | of Avg RM OH | \$ | 50,000.00 |
| Taxes | 3.00% | of Avg RM OH | \$ | 150,000.00 |
| | 28.50% | | \$ | 1,525,000.00 |
| Total Inventory Costs | 11.87% | | | |
| Total Logistics Costs | 100.00% | | \$ | 11,582,142.86 |

• Average Days of inventory on-hand = 5

• Raw Material Spend = \$250,000,000

• Inbound Transportation Budget = \$9,000,000

• Productivity Improvement = 10%

| | | | | |
|---|----------------|---------------|-----------|----------------------|
| Ordering | 1.09% | of Total Cost | \$ | 115,714.29 |
| Supplier Management | 0.55% | of Total Cost | \$ | 57,857.14 |
| Logistics Design | 4.71% | of Total Cost | \$ | 500,000.00 |
| Logistics Operations | 76.33% | of Total Cost | \$ | 8,100,000.00 |
| Yard Control | 1.09% | of Total Cost | \$ | 115,714.29 |
| Receiving Management | 3.27% | of Total Cost | \$ | 347,142.86 |
| Raw Material Storage (Inventory Carrying Cost) | | | | |
| Admin. Overheads | 2.00% | of Avg RM OH | \$ | 100,000.00 |
| Cost of Capital | 9.00% | of Avg RM OH | \$ | 450,000.00 |
| Damage | 1.00% | of Avg RM OH | \$ | 50,000.00 |
| Insurance | 1.00% | of Avg RM OH | \$ | 50,000.00 |
| Interplant Shuttles | 1.00% | of Avg RM OH | \$ | 50,000.00 |
| Obsolescence | 3.00% | of Avg RM OH | \$ | 150,000.00 |
| Shrinkage | 1.00% | of Avg RM OH | \$ | 50,000.00 |
| Space | 8.50% | of Avg RM OH | \$ | 425,000.00 |
| Storage Systems | 1.00% | of Avg RM OH | \$ | 50,000.00 |
| Taxes | 3.00% | of Avg RM OH | \$ | 150,000.00 |
| | 28.50% | | \$ | 1,525,000.00 |
| Total Inventory Costs | 12.96% | | | |
| Total Logistics Costs | 100.00% | | \$ | 10,611,428.57 |

Summary

| Avg. Days On Hand | Productivity | Inventory Cost | Total Cost | % Reduction |
|-------------------|--------------|----------------|-----------------|-------------|
| 10 | 0.0% | \$3,150,000.00 | \$12,857,142.86 | |
| 5 | 0.0% | \$1,525,000.00 | \$11,582,142.86 | 9.9% |
| 5 | 10.0% | \$1,525,000.00 | \$10,611,428.57 | 17.5% |

Estimate Effect To Bottom Line:

- Total Inbound Costs as Percentage of Revenue = 2.0%
- Overall Benefit to Contribution = 17.5% X 2.0% = 0.35 %

Work Out

Total Logistics Cost

1. What data points do you need?
2. What data exists today and where is it?
3. What can you do to complete the TLC model?