Supply Chain Processes

Problems with Variability

$$TC(Q) = cD + c_t\left(\frac{D}{Q}\right) + c_e\left(\frac{Q}{2} + k\sigma_{DL} + LD\right) + B_{SO}\left(\frac{D}{Q}\right)\Pr[SO]$$

$$\sigma_{DL} = \sqrt{\mu_L\sigma_D^2 + \left(\mu_D\right)^2\sigma_L^2}$$

Two options to pursue:

- Reduce Variability
- Buffer against Variability

Reducing Supply Chain Variability

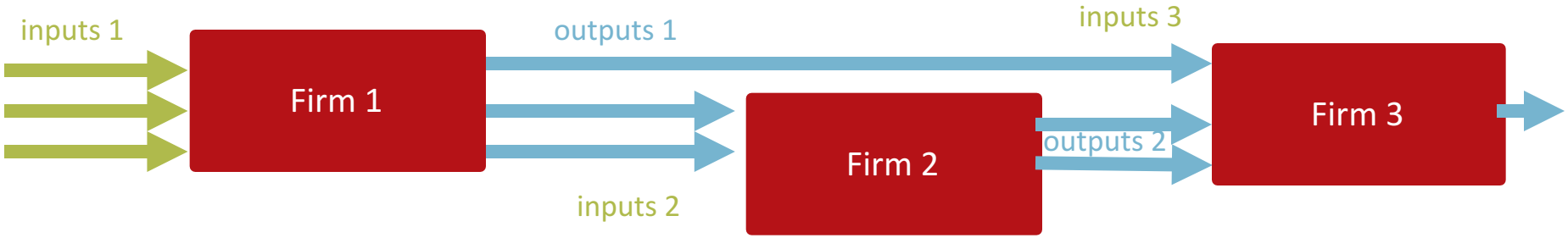
- Approaches for **Reducing Variability**
  - Identify & measure sources of variability and defects
  - Develop plans and courses of action
  - Segment customers, SKUs, suppliers, etc.
- Approaches for **Buffering against Variability**
  - Inventory
    - Traditional approach in most supply chains, implies high inventory levels
    - Flexible Inventory – modular parts, common platforms, generic stock
  - Capacity
    - Maintain excess capacity at facilities to handle peaks, implies low avg utilization
    - Flexible Capacity – cross-trained personnel, multi-use equipment/facilities
  - Time
    - Plan for time required for system to recover – implies very long wait times
    - Flexible Time – dynamically allocate waiting time across different customer segments (e.g., Available to Promise in production planning)

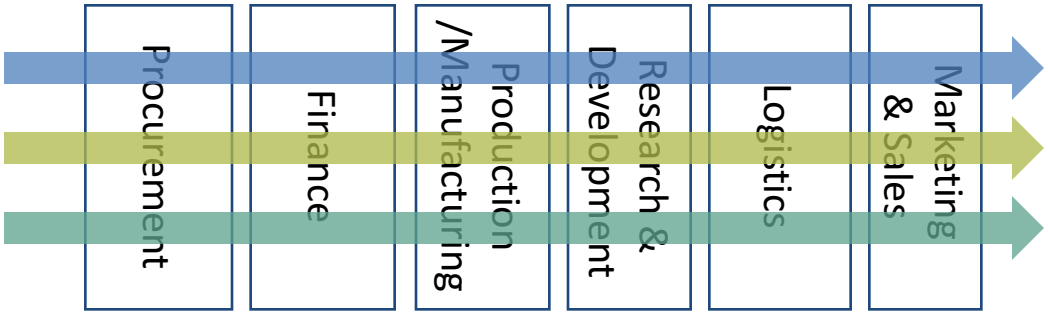
Roadmap for Lesson

- Core Supply Chain Processes
  - External Facing
  - Internal Facing
- Process Analysis Tools & Techniques
  - Process Mapping
  - Process Improvement

Core Supply Chain Processes

Process Perspective





Core Supply Chain Processes 1/2

- Customer Management Processes
  - Structure the relationship between firm and its customers to include segmentation, differentiation, and measurement
  - Customer Relationship Management vs. Customer Service Management
- Demand Management Processes
  - Balances the customers' requirements with the firm's capabilities and capacity (S&OP)
  - Forecasting demand and synchronizing with manufacturing, procurement, distribution, etc.
- Order Fulfillment Processes
  - Ensures the fulfillment of the physical product to customers
  - Integrates manufacturing, logistics, and marketing plans

Adapted from Lambert, D. et al (2014) Supply Chain Management: Processes, Partnerships, and Performance, SCMI.

Core Supply Chain Processes 2/2

- Manufacturing Flow Management Processes
  - Determines the manufacturing capabilities of the firm
  - Internal vs. External, Push/Pull, MTS/MTO/ATO/ETO
- Supplier Relationship Management Processes
  - Establishes how a firm interacts with its suppliers – mirror to CRM/CSM
  - Segmentation into tiers of suppliers – determine level of relationship
- New Product Development Processes
  - Develop, launch and commercialize new products and services
  - Manage stage-gate (funnel) process – who to invite when
- Returns Management Processes
  - Establish guidelines for handling all product returns
  - Includes avoidance, gatekeeping, and disposition policies and procedures

Adapted from Lambert, D. et al (2014) Supply Chain Management: Processes, Partnerships, and Performance, SCMI.

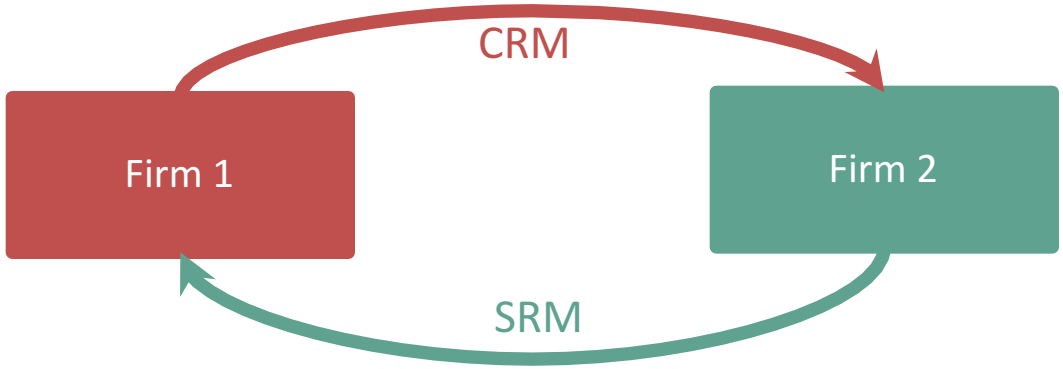
Core Supply Chain Processes

- External Facing Processes
  - Customer Management Processes
  - Supplier Relationship Management Processes
- Internal Facing Processes
  - Order Fulfillment Process
  - Demand Management Processes
  - Manufacturing Flow Management Processes
  - New Product Development Process
  - Returns Management
- All Supply Chain Processes
  - Cross functional siloes
  - Require cross-functional teams

Adapted from Lambert, D. et al (2014) Supply Chain Management: Processes, Partnerships, and Performance, SCMI.

External Facing Processes

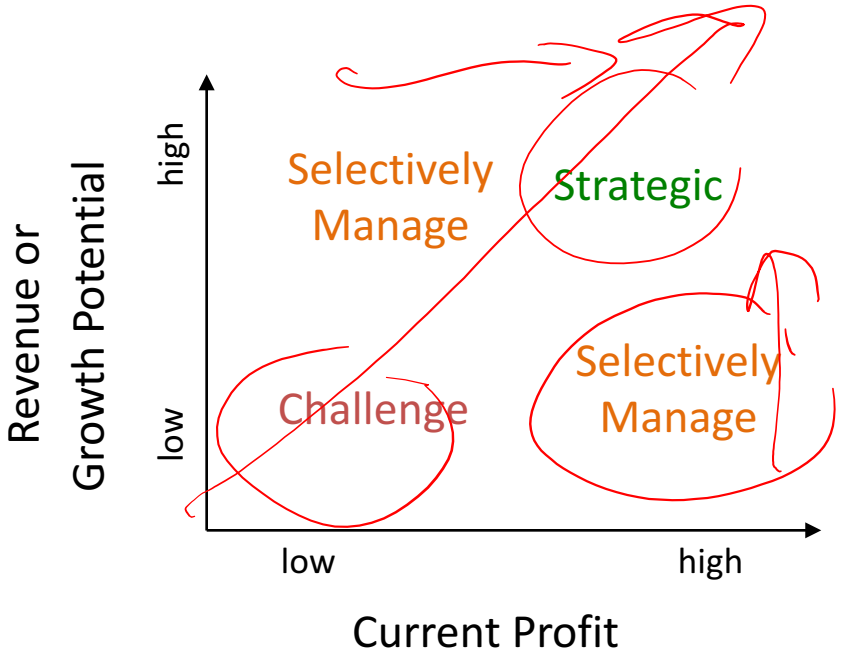
External Facing Processes (CRM & SRM)



- Critical links in the supply chain
- Mirror processes – to a large degree
- A rough process
  1. Review / align firm strategy
  2. Identify segmentation criteria
  3. Establish product and service agreement (PSA) guidelines for different segments
  4. Develop metrics – primarily profitability
  5. Create guidelines for sharing improvement benefits

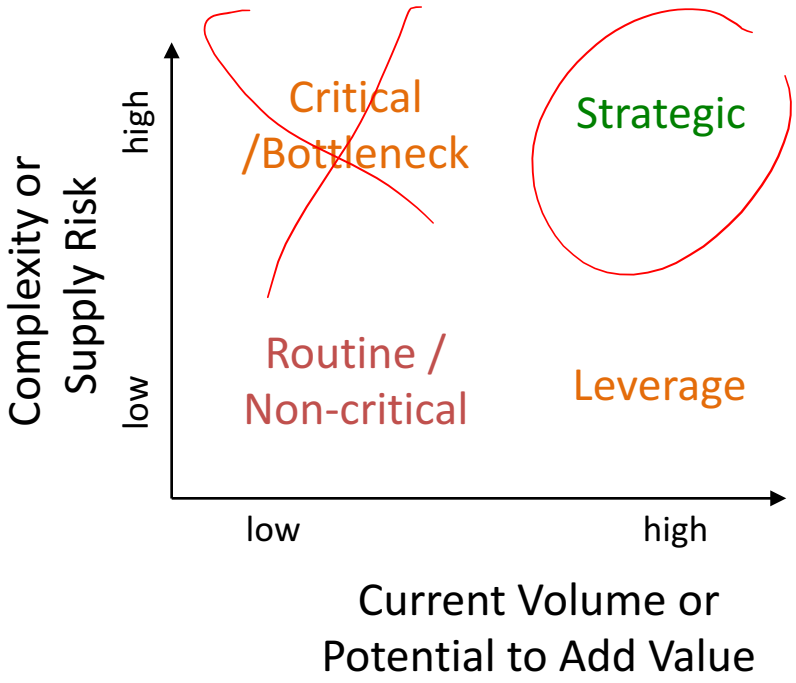
Customer Segmentation

- Potential Criteria
  - Profitability/Margin
  - Growth
  - Stability/Variability
  - Volume/Revenue
  - Competitive positioning
  - Buying behavior
  - Sophistication
  - Location
- Manage segments accordingly
  - A, B, C, D; Gold, Silver, Bronze, Lead; Level 1,2,3
  - Level of customization and coordination differs
  - Transactional versus partnership



Supplier Segmentation

- Potential Criteria
  - Profitability
  - Growth/Stability
  - Volume purchased
  - Criticality
  - Innovation
  - Quality
  - Sophistication
  - Potential to co-create value
- Other considerations . . .
  - Sustainability
  - Ethical practices & compliance
  - 2nd, 3rd, nth tiers



Demand Management Processes
Order Fulfillment Process
Manufacturing Flow Management Processes
New Product Development Process
Returns Management

Internal Facing Processes

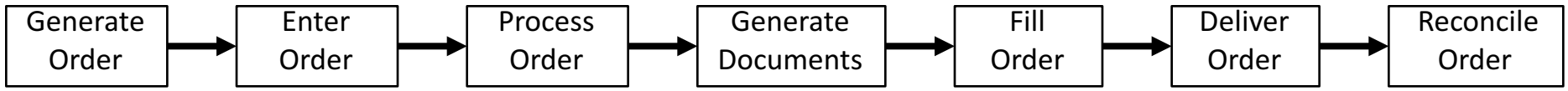
Demand Management

- Much has already been covered
  - Forecasting methods, procedures, and metrics – SC1x
  - Sales & Operations Planning (S&OP) and Synchronization – SC2x
- Potential Variability Drivers w/in Demand Management

Source	Potential Problems	Possible Solutions
Promotions	Creates lumpy demand; Cannibalizes future demand; Misdirects scarce resources	Plan and coordinate timing, duration, and level with operations and customers in advance.
Sales Metrics	Creates hockey stick effect at end of periods; Creates surges and lumpy demand	Design sales metrics to lessen end of quarter effect
Minimum Order Quantities	Creates lumpy demand; Increases potential for obsolescence and spoilage	Incorporate all costs when determining MOQ; Work to minimize the MOQ in order to speed inventory velocity

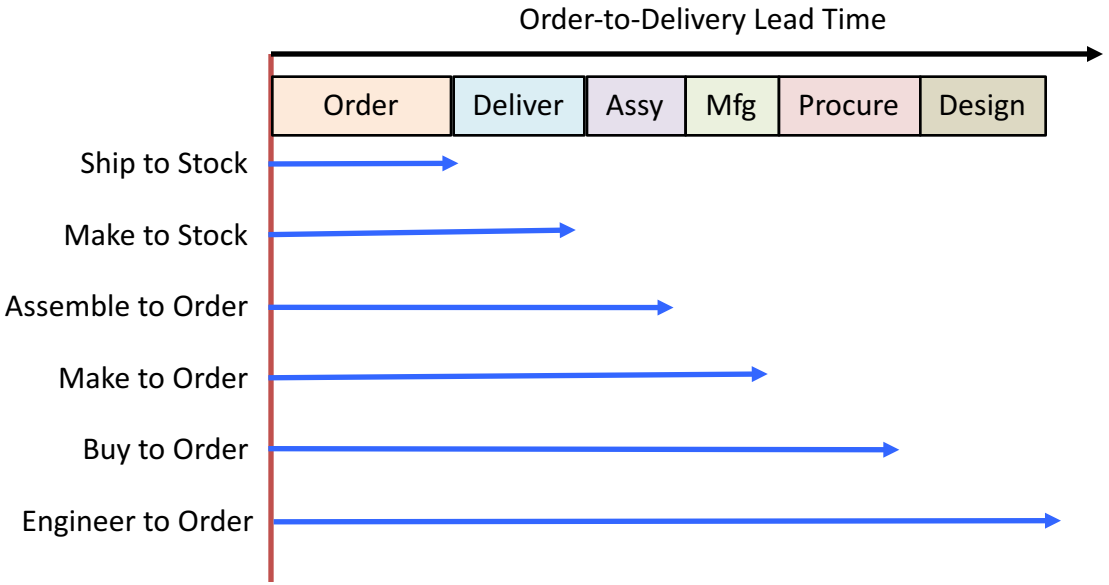
Order Fulfillment

- Strategic Tasks
  1. Review / align firm strategy
     - Coordinate with the CRM teams for customer and channel segmentation
  2. Define requirements
     - Establish specific lead-time and customer service requirements
  3. Evaluate network
     - Determine how and from where customers will be served
  4. Define Plan
     - Establish rules for allocating scarce product, information flow, etc.
  5. Develop metrics to monitor
     - Typically cash-to-cash cycle time, order fill rate, perfect orders, damage
- Operational Tasks

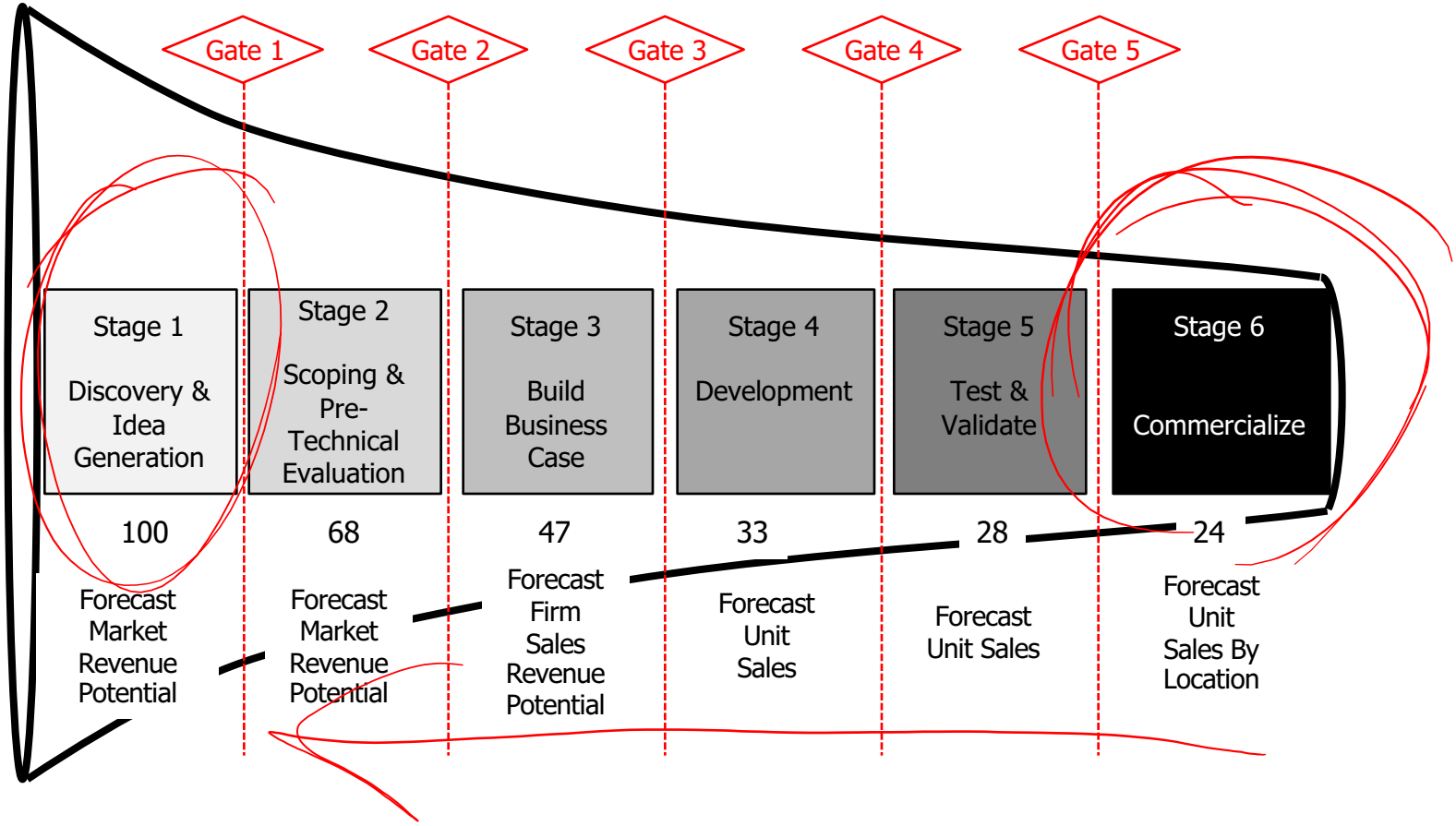


Manufacturing Flow Management

- Strategic Tasks
  1. Review / align firm strategy
  2. Determine level of flexibility required
  3. Determine Push/Pull boundaries
  4. Identify manufacturing constraints & capabilities
  5. Develop metrics to monitor

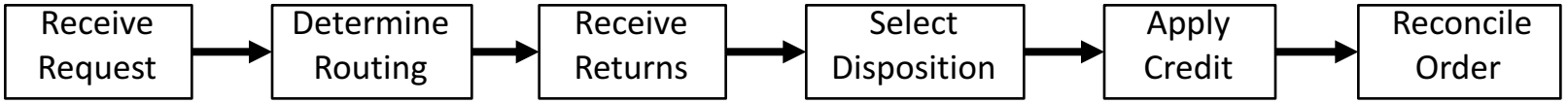


New Product Development



Returns Management

- Strategic Tasks
  1. Review / align firm strategy
     - Coordinate with the CRM teams & environmental/compliance regulations
  2. Define avoidance, gatekeeping, and disposition guidelines
     - Establish rules for minimizing effort, costs, and time required
  3. Create network for return flows
     - Determine whether to perform in-house or contracted out
  4. Define credit/refund rules
     - Policies for if, when, and how to credit customers with returns
  5. Develop metrics to monitor
     - Typically return rates, cost of disposition, etc.
- Operational Tasks



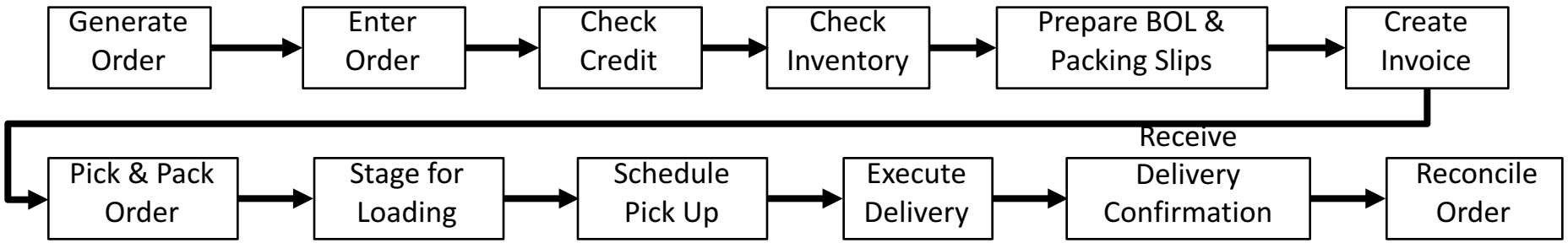
Process Mapping

Process Mapping

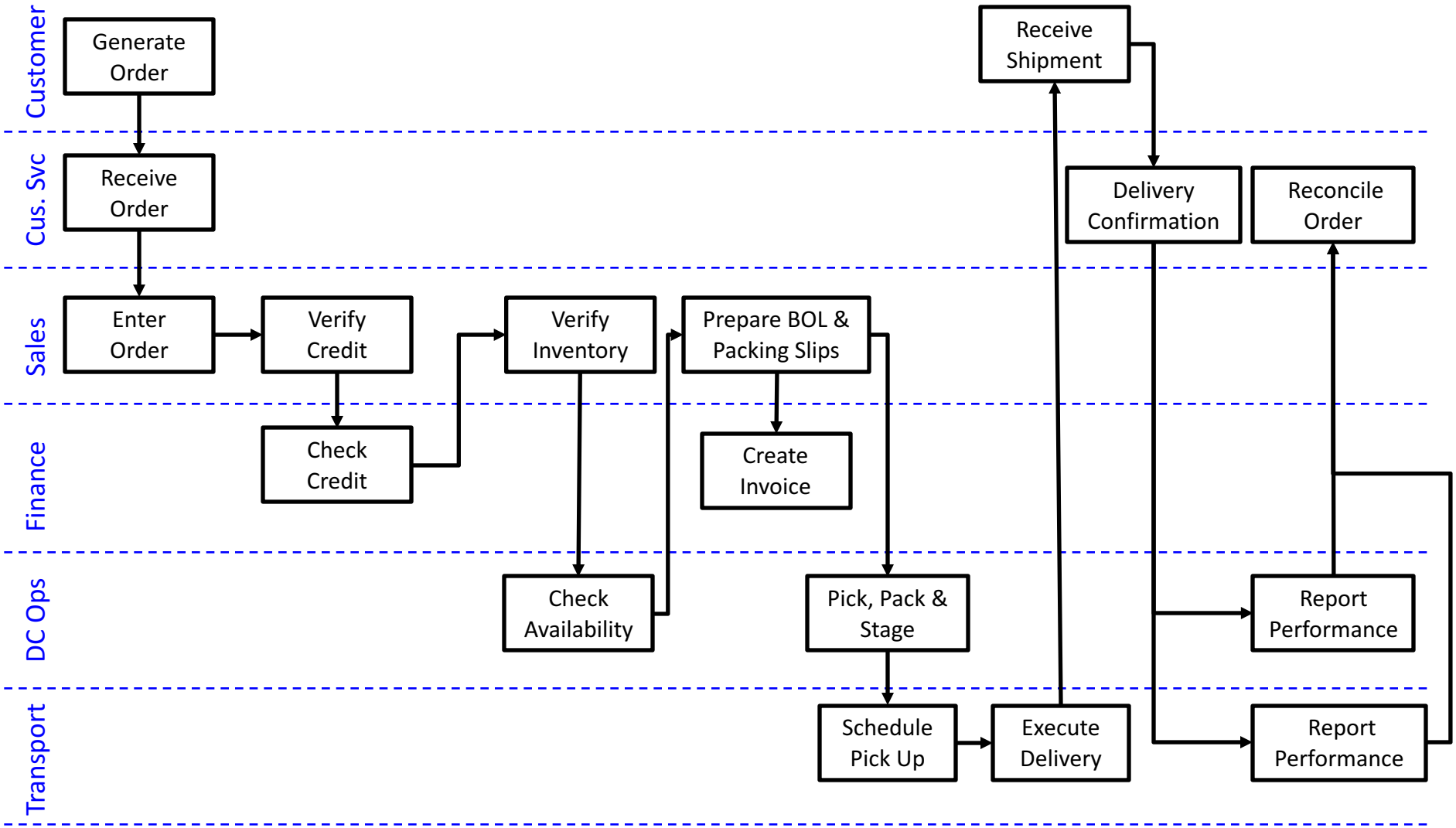
- Why map a process?
  - To better understand, communicate, level-set, codify, and converge on how a process works.
- What is a process map?
  - A model that is a symbolic representation of the workflow viewed as a process
  - Many different versions and types: flowcharts, relationship maps, cross-functional (swimlane) maps, value stream maps, etc.
- When are process maps used?
  - Creating a new workflow process from scratch
  - Trying to understand an "As-Is" process
  - Re-engineering a process for improvements
  - Developing software or other support systems

Adapted from Damelio, R. (2011) The Basics of Process Mapping, CRC Press.

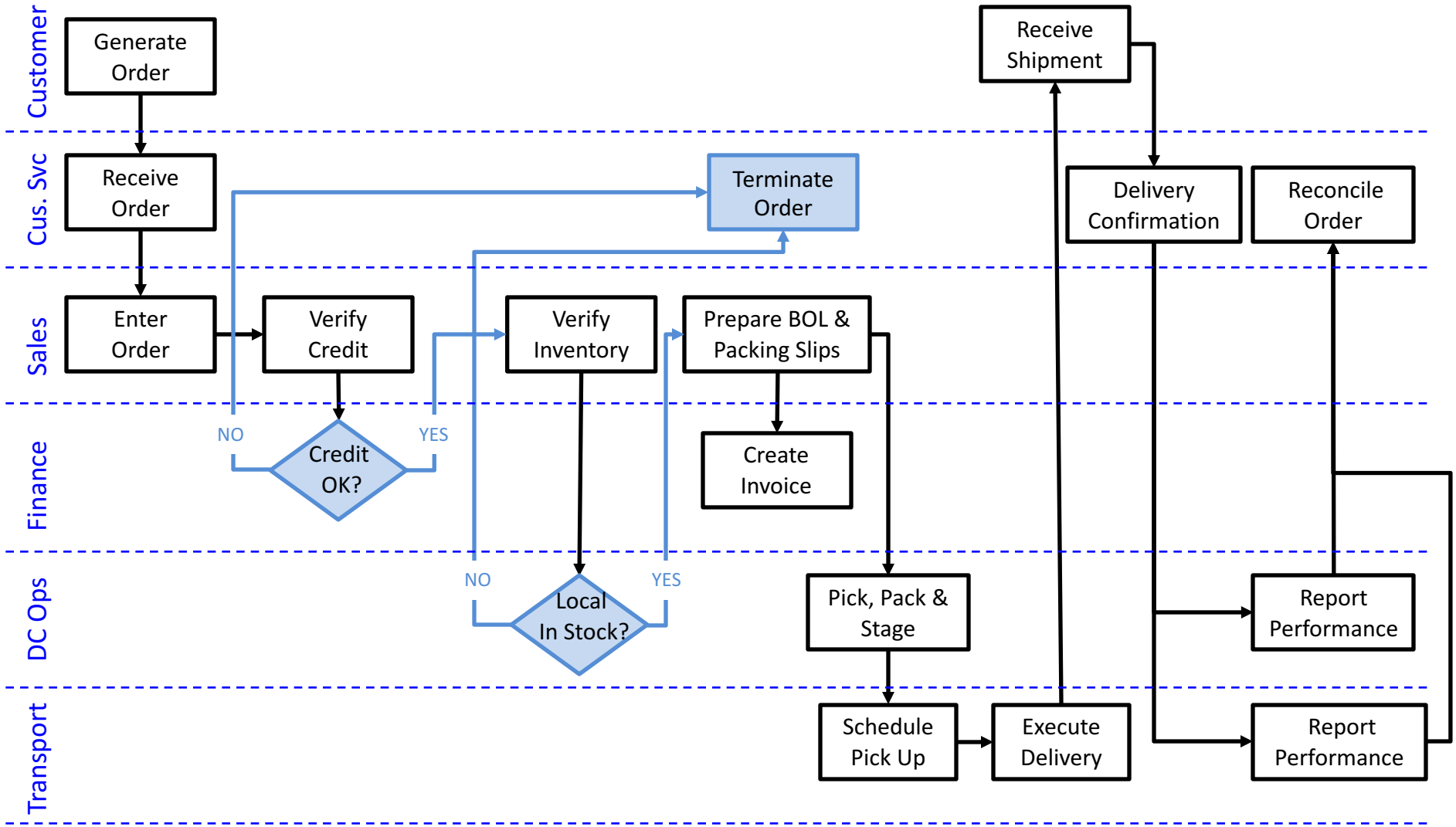
Process Mapping Example: Order Fulfillment



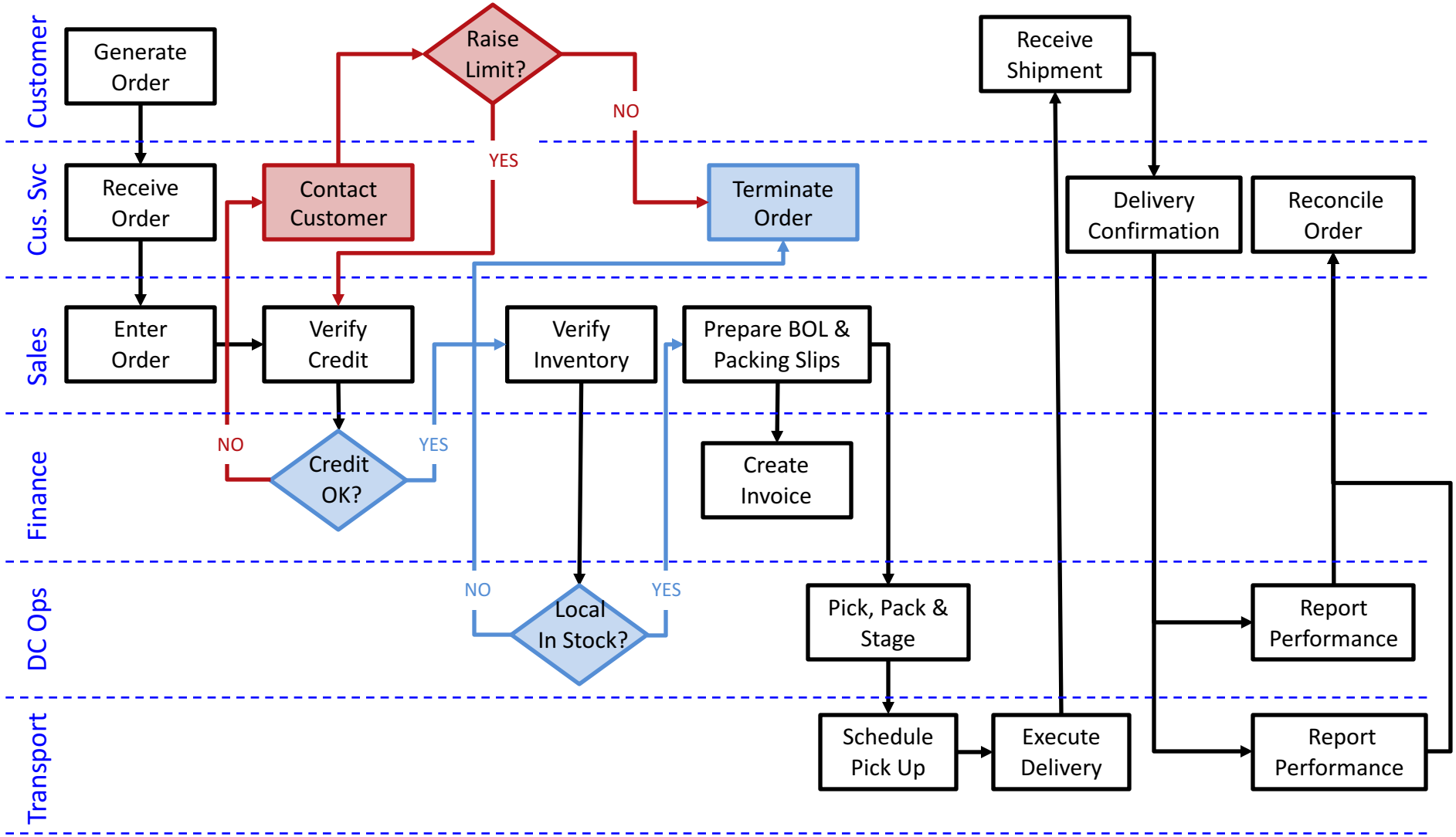
Order Fulfillment: Swimlane Diagram



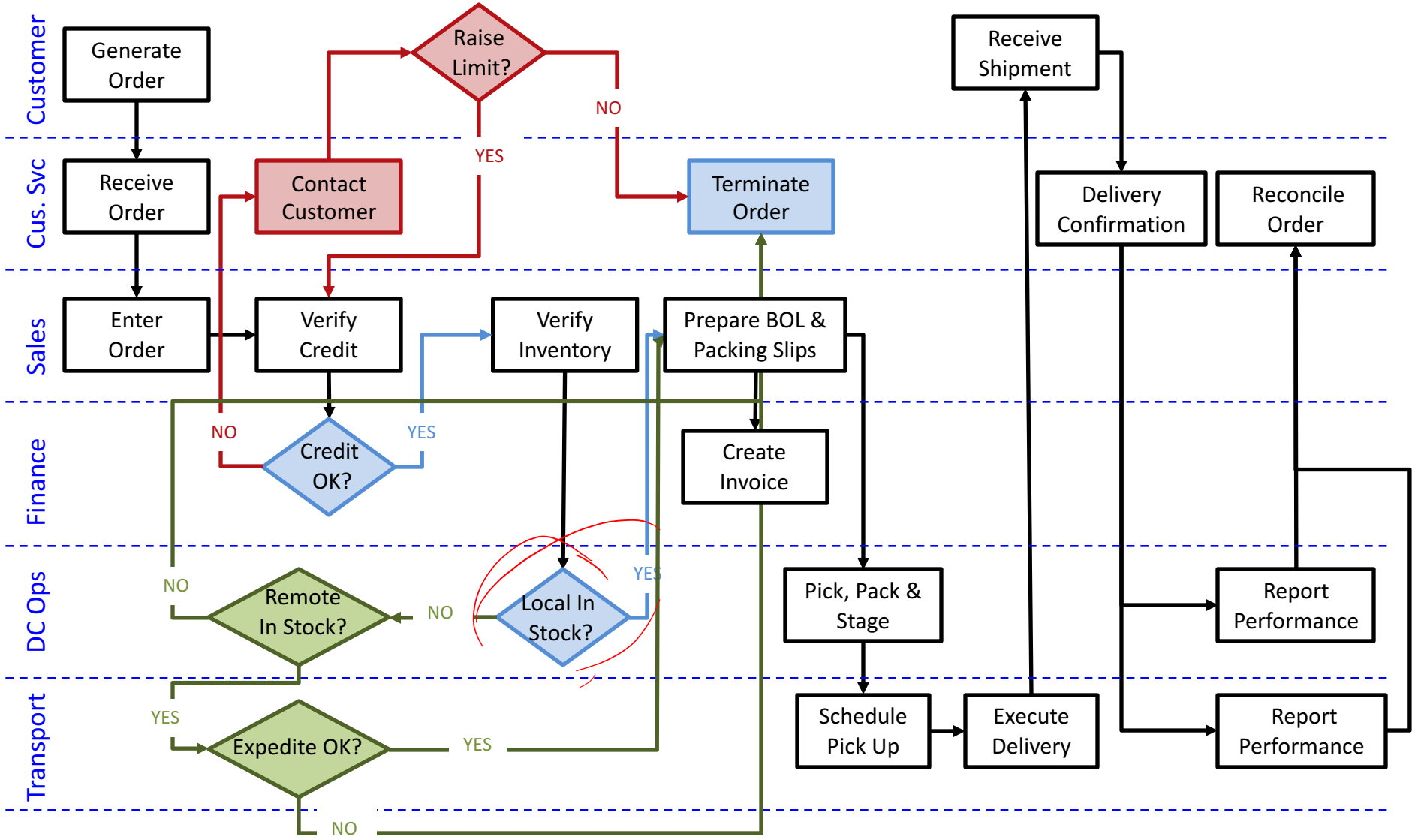
Order Fulfillment: AS-IS



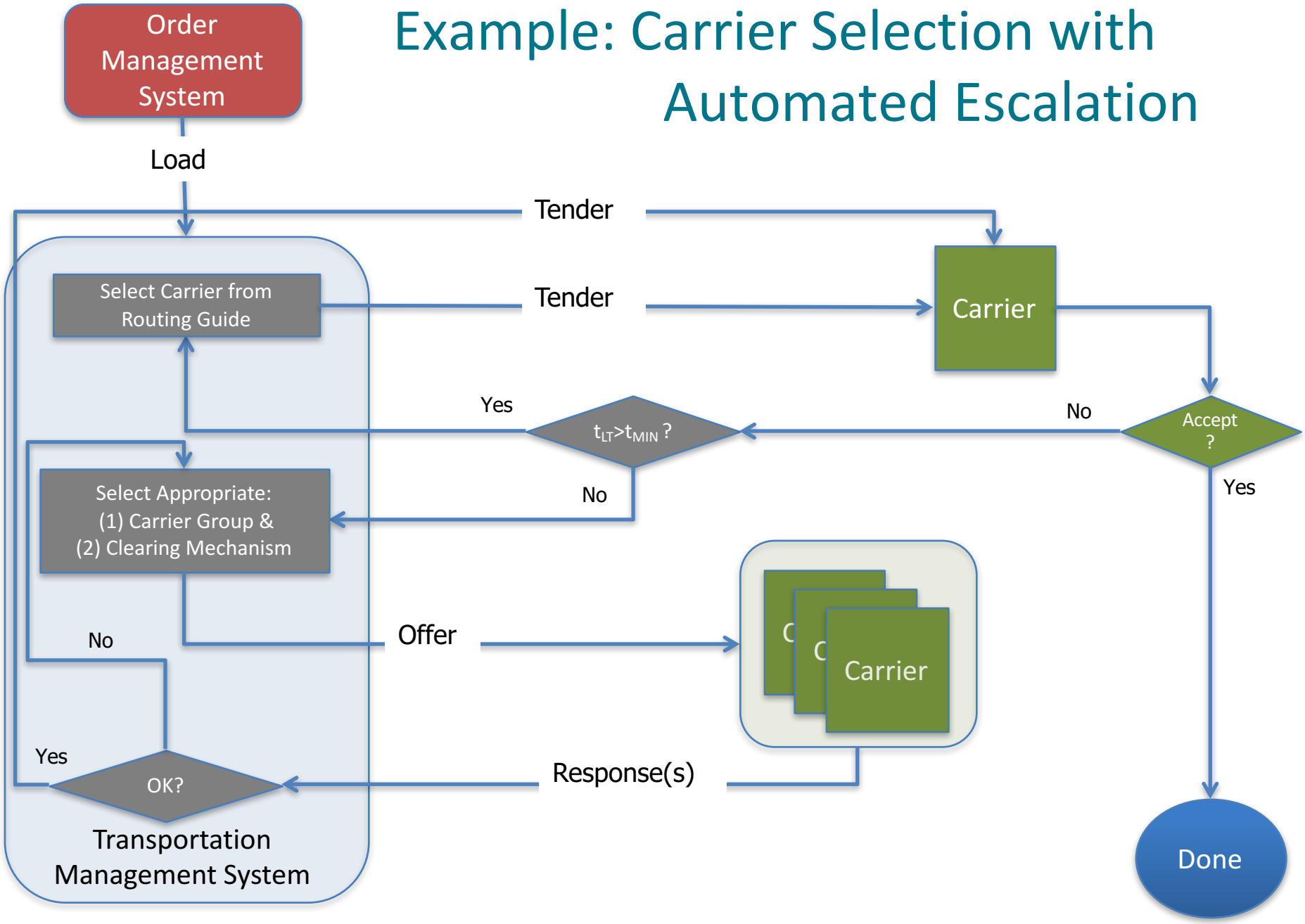
Order Fulfillment: Potential Change #1



Order Fulfillment: Potential Change #2



Example: Carrier Selection with Automated Escalation



Adapted from Maziarz, M, (2002) logistics.com.

Creating Process Maps: Rough Steps

1. Determine your scope and level of detail (this is hard!)
2. Based on scope, identify & list the people or functions involved (they should be part of this session!)
3. Brainstorm the steps involved with sticky pads
4. Work through the process chronologically, placing the sticky pads in the appropriate swim lanes (flip charts or whiteboards help)
5. Discuss/debate the draft process map and adjust accordingly
    1. Do functions touch the same items multiple times?
    2. Are their repeated and redundant handoffs?
    3. Are steps missing or extraneous?
6. Transfer the diagram to paper and date/version it

Creating Process Maps: Tips

- Place the customer in the top lane – for focus
- Use dashed lines to indicate informal communication
- Build the process in one direction, and then walk it backwards questioning each step.
- Be vigilant on the level of detail and scope – avoid the temptation to "map the world" or capture every keystroke!
- Use a "parking lot" to capture important ideas without disrupting the discussion
- Don't get hung up on specific symbols – focus on the process itself
- Use the opportunity to discuss methods of measuring the process
- For building As-Is process maps, try "stapling yourself to an order" – map how things *actually* flow, versus what people say they *should* flow
- Remember – its just a model! Use it as a communication tool!

Process Improvement Tools

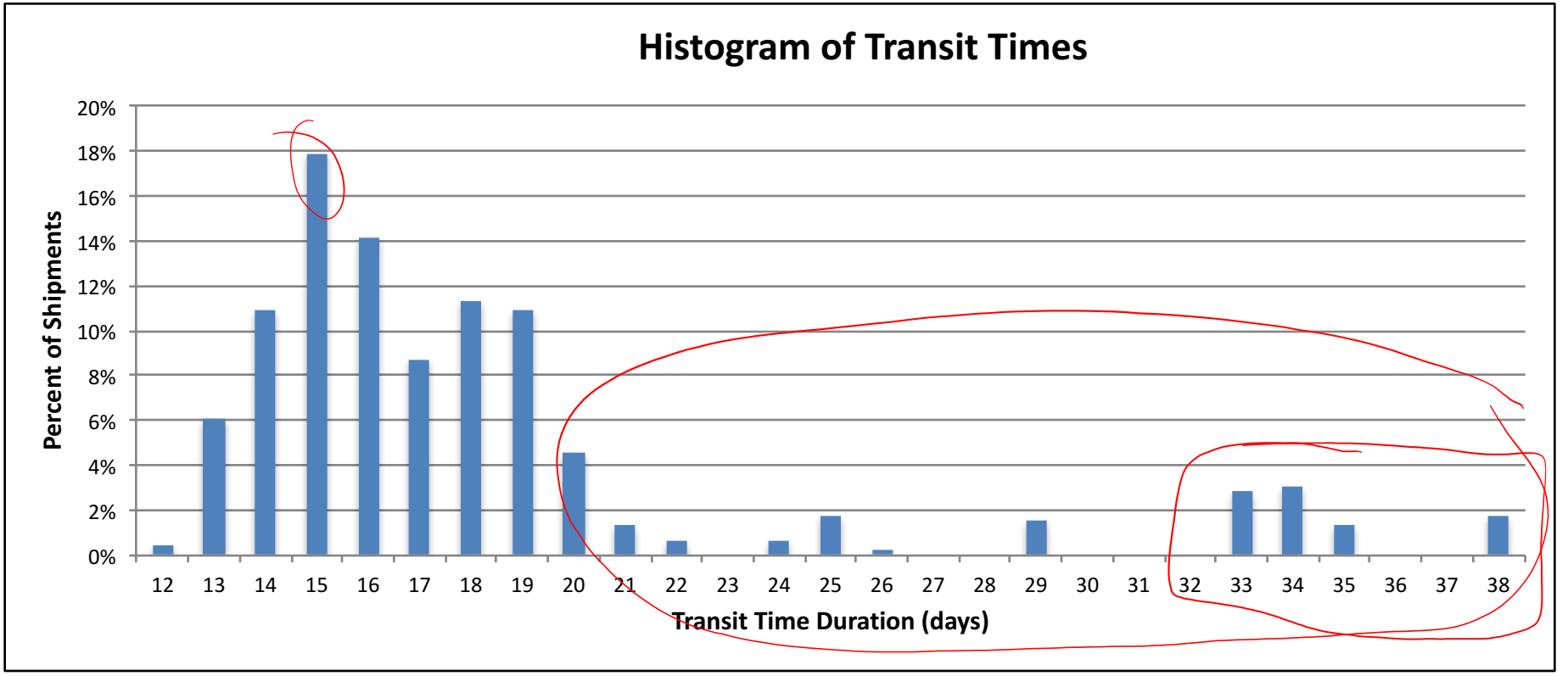
Process Improvement Tools

- Tools for Checking for Variability
  - Histograms
  - Time Series Charts
- Tools for Identifying Causes of Variability
  - 5 Whys
  - Cause and Effect Diagrams (Fishbone / Ishikawa)

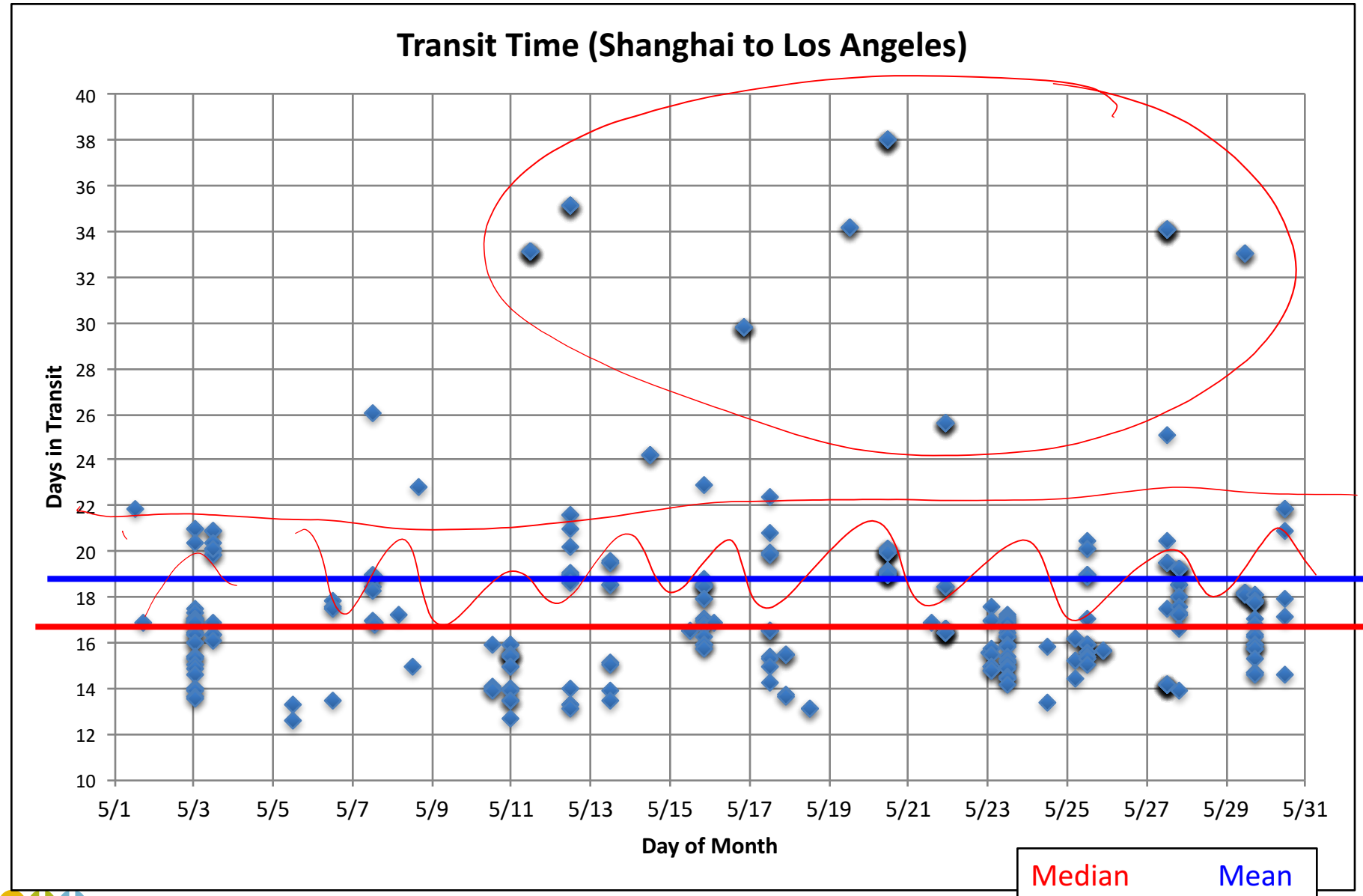
Checking for Variability: Histogram

Analysis of 470 Ocean container shipments from Shanghai to LAX

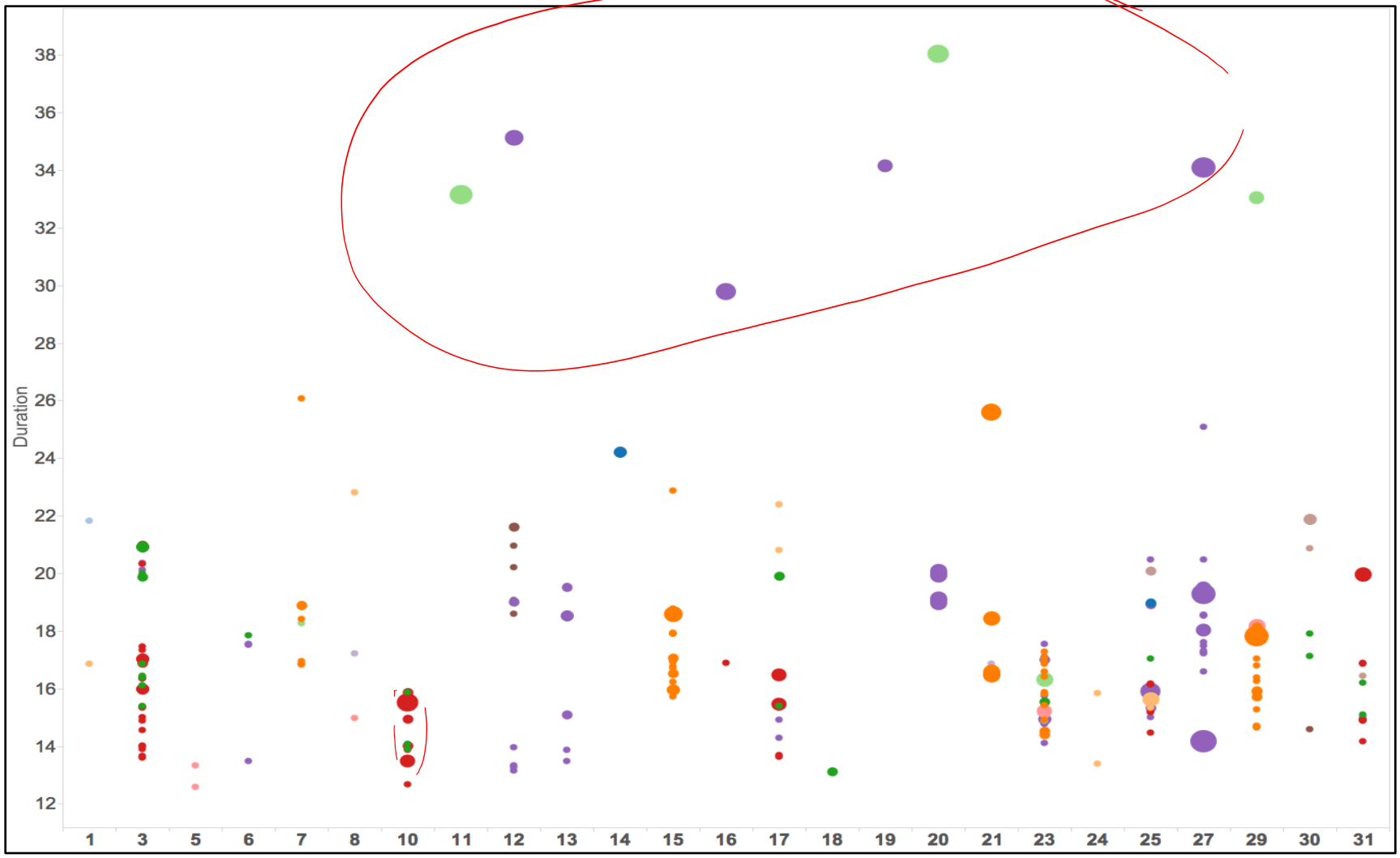
Minimum 12 days	Maximum 38 days
Median 17 days	Mean 19 days
Std. Dev = 5.7 days	CV = 0.30



Checking for Variability: Time Series Chart



Identify Sources of Variability: Visualization



Process Improvement Tools: 5 Whys

- What is it?
  - tool for encouraging brainstorming
  - forces team to look beyond superficial solutions
  - good excuse to act like an precocious 5 year old
- Procedure:
  1. Select a defect or issue
  2. Have the team ask why that certain outcome occurs
  3. Select one of those reasons, and ask why that outcome occurs
  4. Stop when you have reached a potential cause that is actionable

Long transit times on certain shipments

- Unplanned shipments need to use spot market
- Certain carriers deliver poor performance
- We are late to arrive at origin port
- . . .

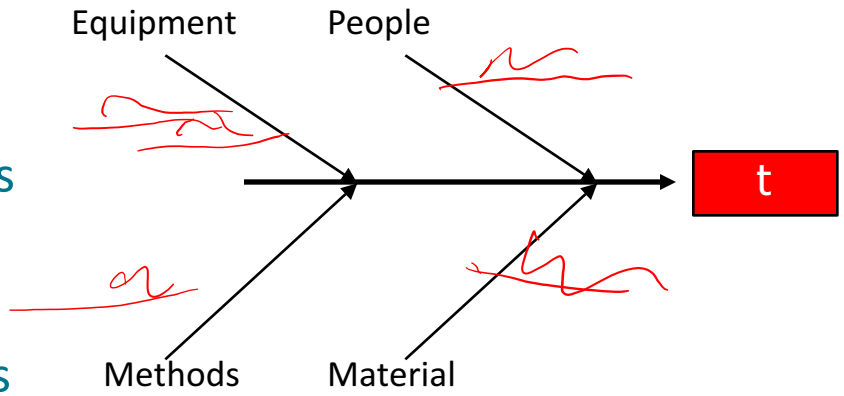
We do not have a strong relationship with these carriers

Our volume with these carriers is too low to be taken seriously

Action: Concentrate business to fewer carriers

Process Improvement Tools: Cause-Effect

- What is it?
  - tool that provides structure for understanding root causes
  - ensures that a balance list of ideas have been considered
- Procedure:
  1. Name the problem or effect
  2. Select the major categories for causes
  3. Brainstorm for more detailed causes and fill in diagram
  4. Review the diagram for completeness
  5. Develop plans for confirming the causes

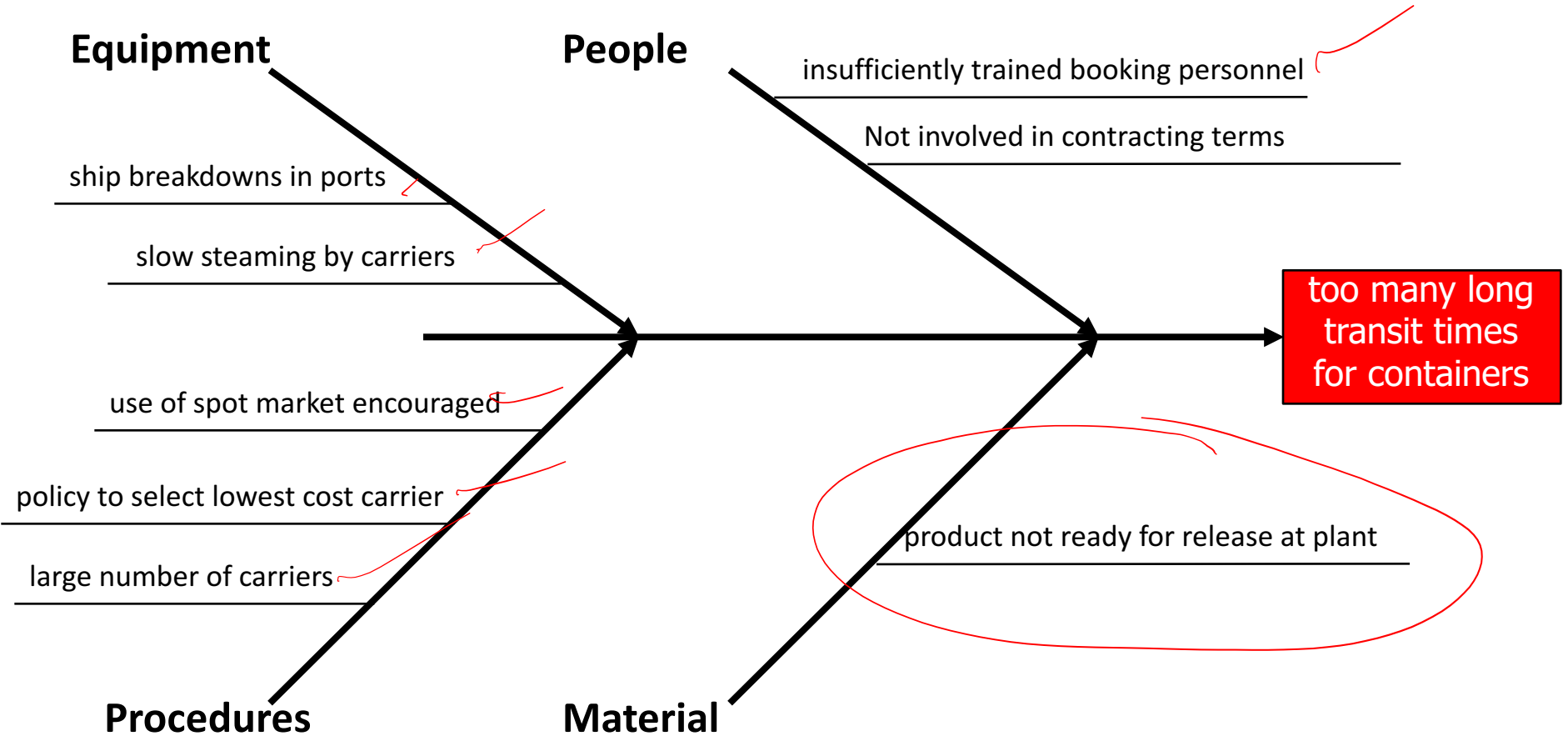


Common Categories
- People
- Equipment
- Methods/Processes
- Material

6Ms (Manufacturing)
- Machine
- Method
- Material
- Manpower
- Measurement
- Mother Nature

7Ps (Service)
- Product (service)
- Price
- Place
- Promotion
- People
- Process
- Physical Evidence

Cause – Effect Diagram



Process Improvement Tools

- Tools for Checking for Variability
  - Histograms
  - Time Series Charts
- Tools for Identifying Causes
  - 5 Whys
  - Cause and Effect Diagrams

This is barely the tip of the iceberg on process improvement tools!

Key Take Aways

Key Take Aways (1/2)

- Variability within Supply Chain Processes
  - Reduce it – segmentation or finding root causes
  - Buffer against it – inventory, capacity, and/or time - flexibility
- Core Supply Chain Processes
  - External Facing Processes
    - Customer Management Processes
    - Supplier Relationship Management Processes
  - Internal Facing Processes
    - Order Fulfillment Process
    - Demand Management Processes
    - Manufacturing Flow Management Processes
    - New Product Development Process
    - Returns Management

Key Take Aways (2/2)

- Process Analysis Tools & Techniques
  - Process Mapping – capture As-Is and Proposed
    - Flowchart diagrams – decisions and flow
    - Swimlane diagrams – ownership of tasks
  - Process Improvement – check & identify
    - Tools for Checking for Variability
      - Histograms & Time Series Charts
    - Tools for Identifying Root Causes
      - 5 Whys & Cause and Effect Diagrams

Questions, Comments, Suggestions?
Use the Discussion!

"Wilson ready to relax after a long day
of analyzing processes"

MIT Center for
Transportation & Logistics

caplice@mit.edu
ctl.mit.edu