Supply Chain Systems II: Supply Chain Modules

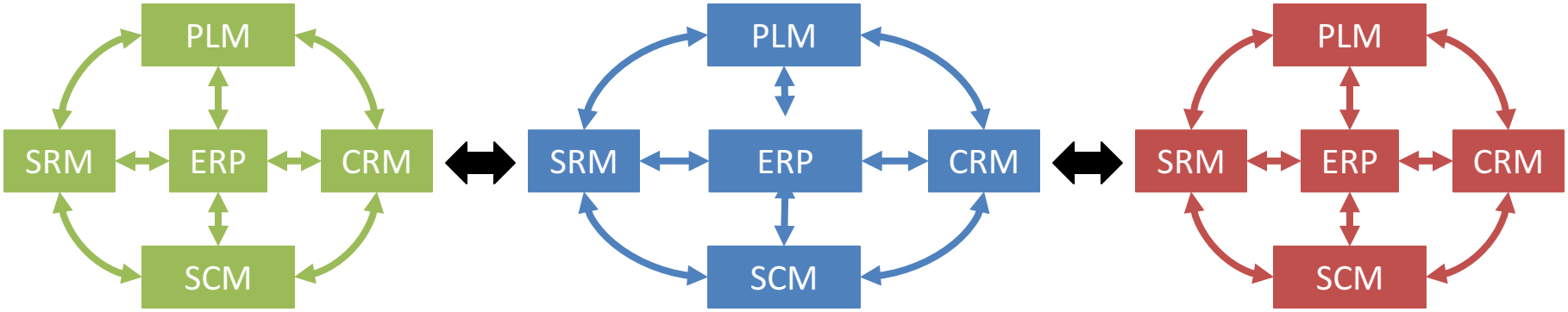
Evolution of Supply Chain Tools

- 1960-1970's
  - IBM developed a Bill of Materials Processor (BOMP)
  - Mainframe based database systems mainly to track materials for large manufacturers
  - Closed-loop (shop floor management) functionality added
  - MRP (material requirements planning) is essentially a time-phased order release system
- 1980's
  - MRP-II (manufacturing resource planning) introduced to integrate production with finance and marketing
  - Fit in with Just-In-Time (JIT) manufacturing methodology
  - Expanded ties to other functions: S&OP, master production planning, capacity planning, etc.
  - Precursor of the larger and more comprehensive ERP systems

Evolution of Supply Chain Tools

- 1990's
  - Most MRP-II functions absorbed into large ERP suites
  - Introduction of Advanced Planning Systems (APS)
  - Introduction of function specific optimization based decision support software (WMS, TMS, MES, Inventory Optimization, Procurement, etc.)
  - Wider spread adoption of ERP systems to small and mid-sized firms mainly due to potential Y2K issues
- 2000's
  - Introduction of web-based interfaces
  - Improvements in communication (XML, GPS positioning)
  - Wider adoption of shared or cloud based solutions (SaaS)
  - Consolidation of supply chain software vendors
  - Emergence of supply chain ecosystems or platforms
  - Expansion of ERP systems to include essentially all SCM functions

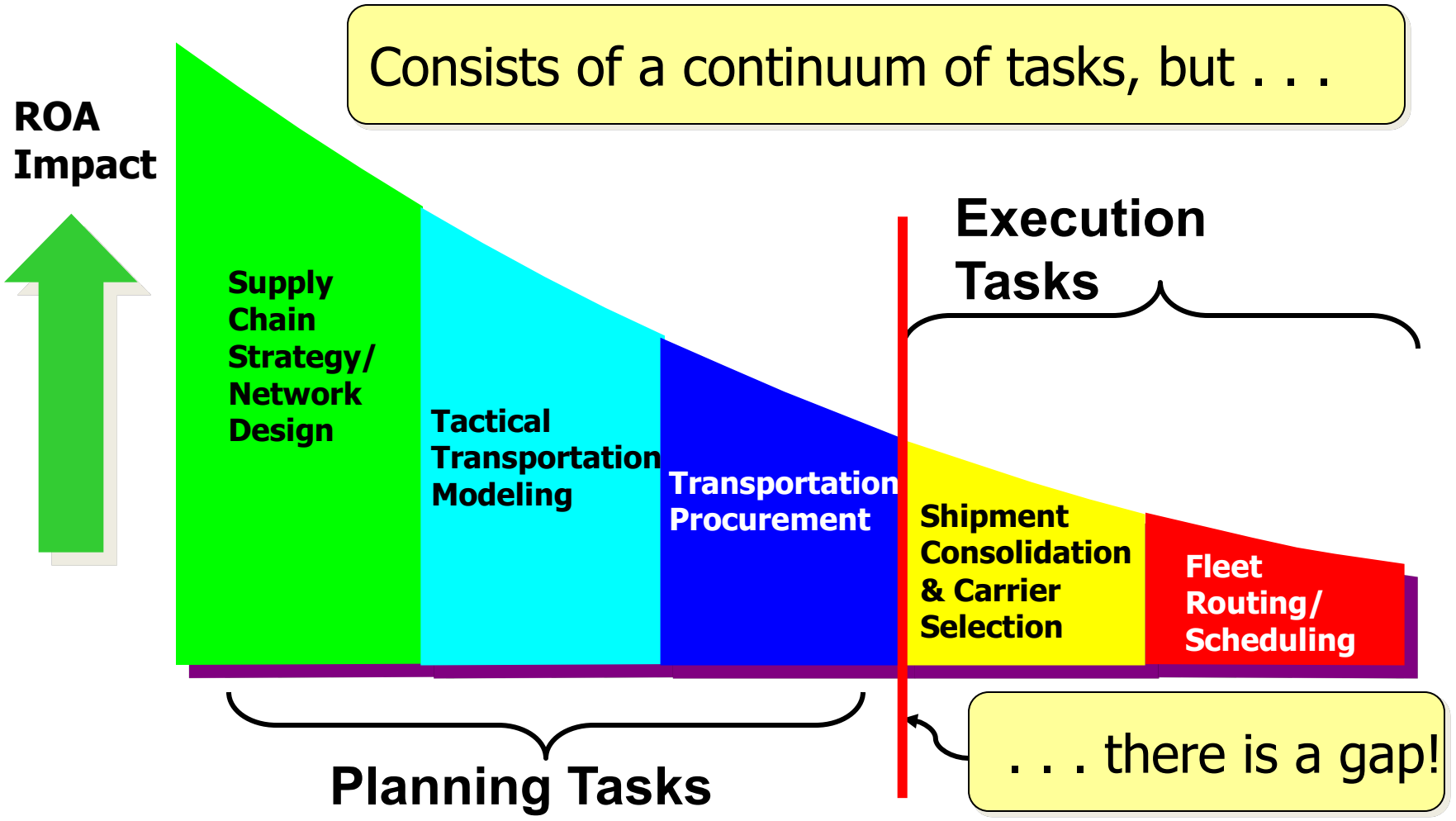
Extending the Enterprise



- Integrated supply chains span multiple companies
- Systems can be part of the ERP itself, a standalone application, or part of larger supply chain eco-system.
- We will focus on the functionality in this lesson.
  - Planning Applications
    - Production Planning (PP) and Advanced Planning Systems (APS)
  - Execution Applications
    - Warehouse Management Systems (WMS)
    - Transportation Management Systems (TMS)
    - Manufacturing Execution Systems (MES)

Planning vs. Execution

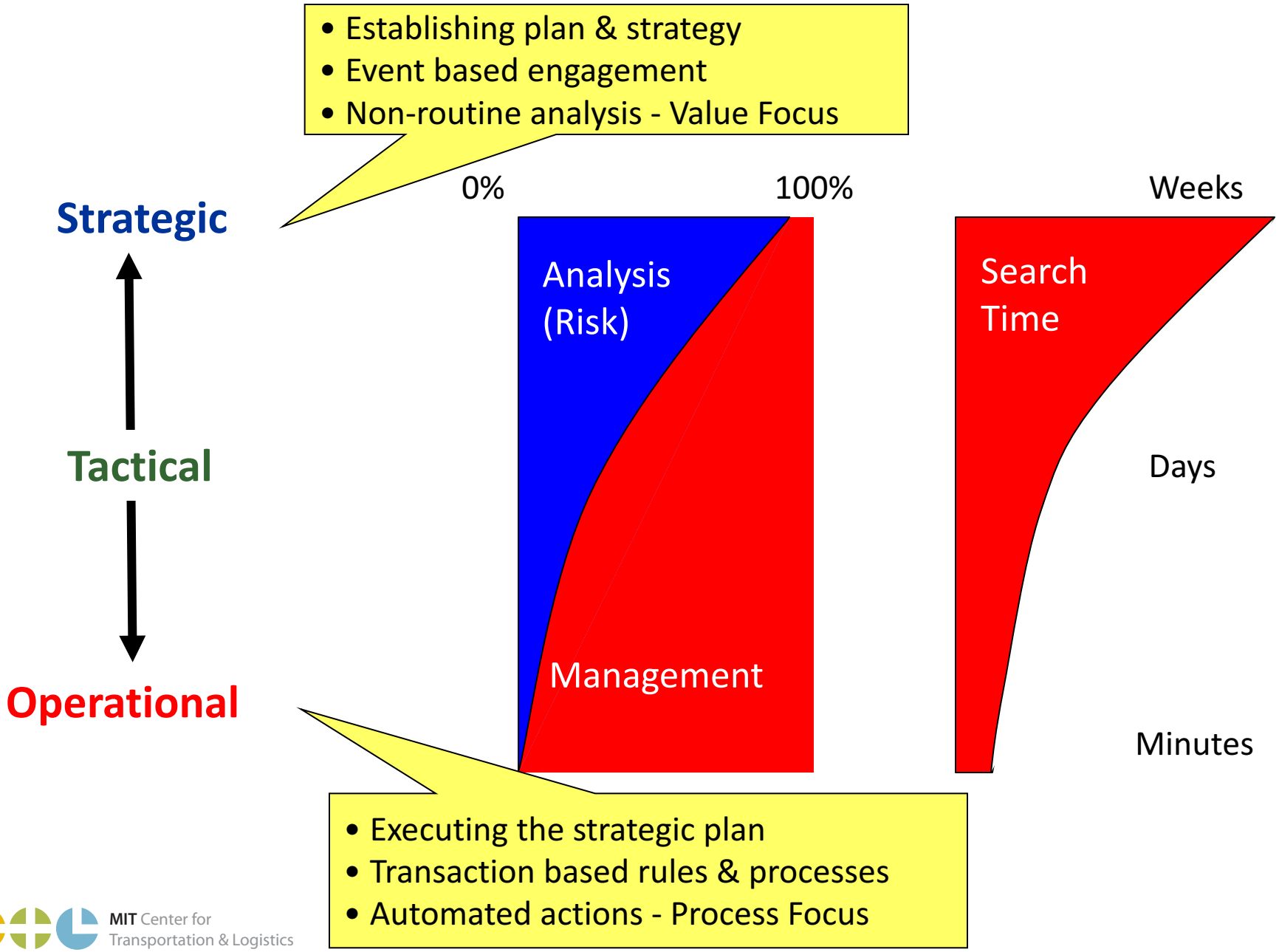
Planning vs. Execution



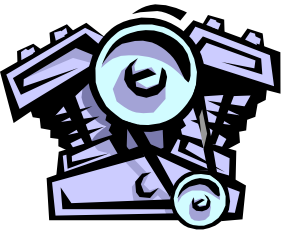
Questions Differ Based on Timeframe

Strategic	• What carriers should I partner with and how? • How should I flow my products? • Should I use pool points, cross-docks, or multi-stop routes? • Where should I use dedicated or private fleets, if any where at all? • Which carriers provided quality service in the past?
Tactical	• How can I quickly secure rates for a new DC/plant/lane? • What lanes are having performance problems? • Which carriers are complying to or exceeding their contracts? • Are site managers complying to the strategic plan? • Where should I establish a seasonal contract?
Operational	• Which carrier should I tender this load to? • How can I collaboratively source this weeks' loads? • How do I prevent Maverick/Rogue behavior? • Should I use a contract carrier or look at the spot market? • How can I best communicate with my carriers?

Approaches Differ Based on Timeframe



Technologies Differ Based on Timeframe



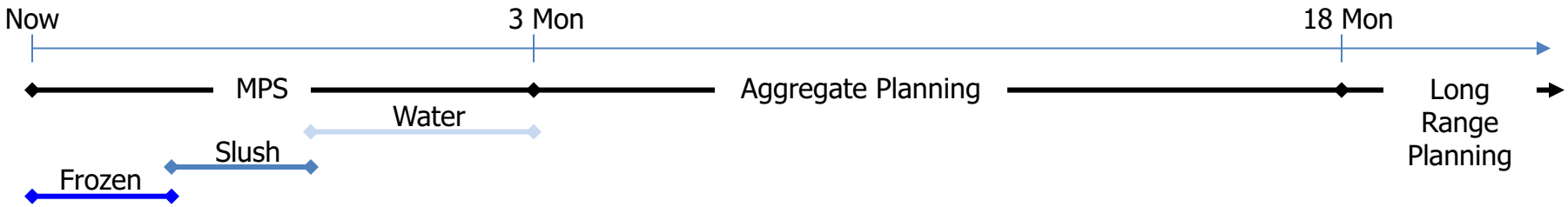
	Analysis Engine •Optimization •Simulation •Data Analysis	**Communication** •Web-based •File Exchange •Remote Access	**Workflow Software** •Compliance Tracking •Rules Engine •Transaction Processing
Strategic	X	X	
Tactical	X	X	
Operational		X	X

Advanced Planning Systems

Advanced Planning Systems

- Called different names by different vendors
- Most common functionality:
  - Network design,
  - Demand planning,
  - Production planning,
  - Production scheduling,
  - Distribution planning, and,
  - Transportation planning.
- Used primarily as decision support system
- Typically utilizes large scale mixed integer linear programs (MILPs) and sometimes simulation

Advanced Planning Scale & Scope



- Planning Horizons (rough guidelines – each firm differs)
  - <3 months out – Master Production Schedule (MRP, DRP)
    - <4 weeks out - Frozen MPS
    - 5 to 8 weeks out – Slush MPS – some changes allowed (+- 10%)
    - >8 weeks out – Water MPS – more changes are allowed (+- 30%)
  - 3-18 months out – Aggregated Planning
  - >18 months out – Long Range Planning – Network Design, etc.
- Longer range models used in “what if” analysis
- Often customized to specific industry

Advanced Planning System

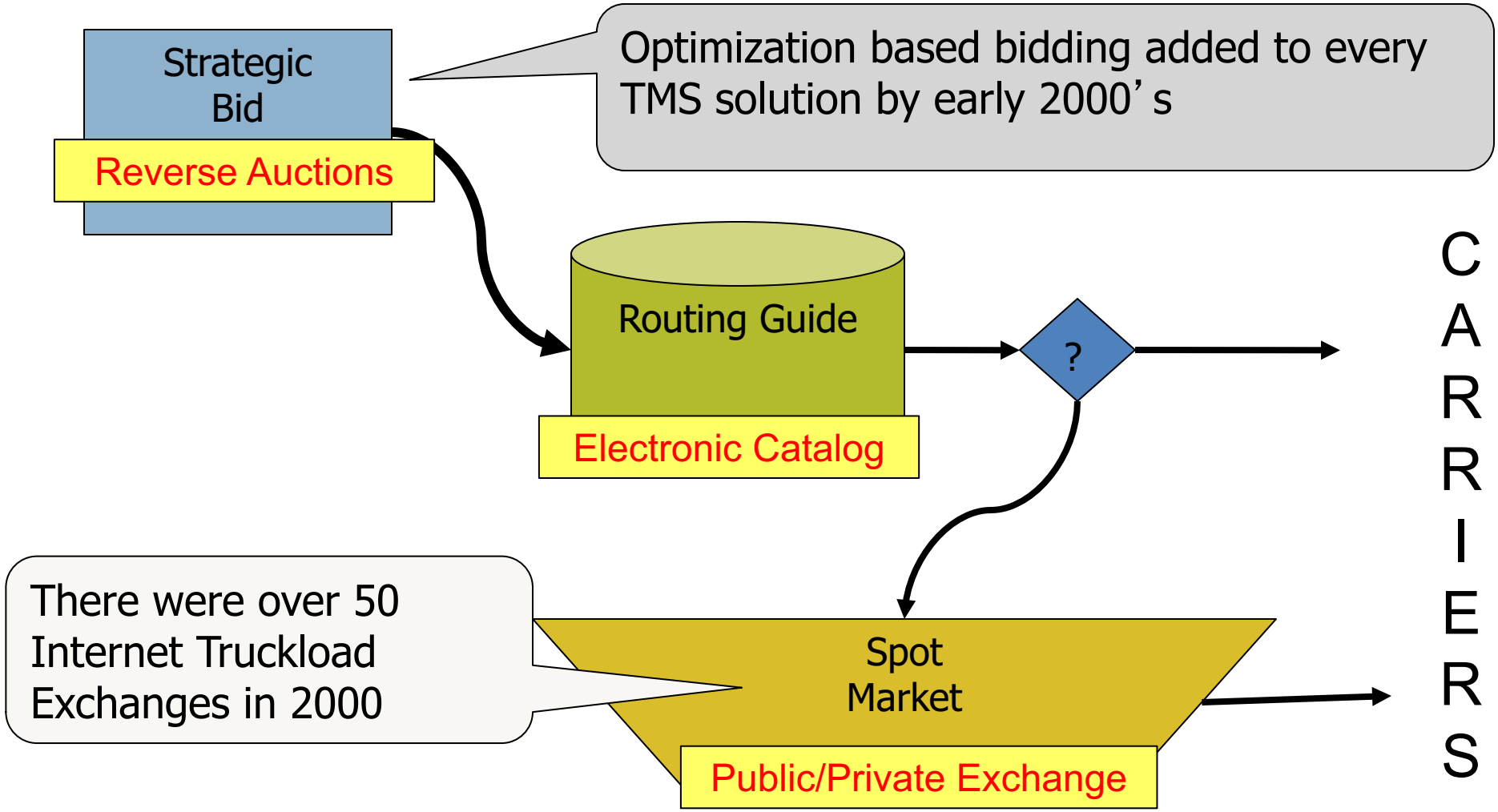
- Inputs (from ERP or other systems):
  - Current costs, manufacturing and storage capacities, consensus forecast, sales orders, production status, purchase orders, and inventory policy recommendations, etc.
- Decision Process:
  - Large scale optimization (MILP) across multiple facilities and time horizons in a single planning run
  - Generates unconstrained, constrained, and optimal plans
- Outputs:
  - Demand forecast and plan for meeting demand
  - A feasible production plan for future periods to include allocation of production to plants
  - Allocation of orders to suppliers
  - Identification of bottlenecks
  - Root Cause Analysis

Transportation Management Systems (TMS)

Transportation Management Systems (TMS)

- Definition:
  - TMS is software that facilitates (1) procurement of transportation services, (2) short-term planning and optimization of transportation activities, assets, and resources, and (3) execution of transportation plans. (Gonzalez, A. 2009)
  - Often segmented or specialized by geography (domestic, international) and/or mode (ocean, air, rail, full truckload, less-than truckload, parcel, private fleet etc.)
- Core Functionality (not all systems have all)
  - Transportation procurement
  - Mode and carrier selection
  - Carrier communication (EDI/XML/Web)
  - Routing guide generation and maintenance
  - Fleet management
  - Audit, payment, and claims
  - Appointment scheduling
  - Yard management
  - Route planning (multi-stop, continuous move)

TMS – Connecting Procurement & Execution



Transportation Execution

- Connects to Order Management Systems (OMS), Payment Systems, and the ERP
- Serves as the interface to the carriers
- Objective:
  - Move products from initial origin to final destination in most cost effective manner while meeting level of service standards
  - Executes the plan using the procured carriers based on real-time information

PLAN: Create Shipments from Orders

EXECUTE: Select and tender to Carriers

MONITOR: Visibility of the status of Shipments

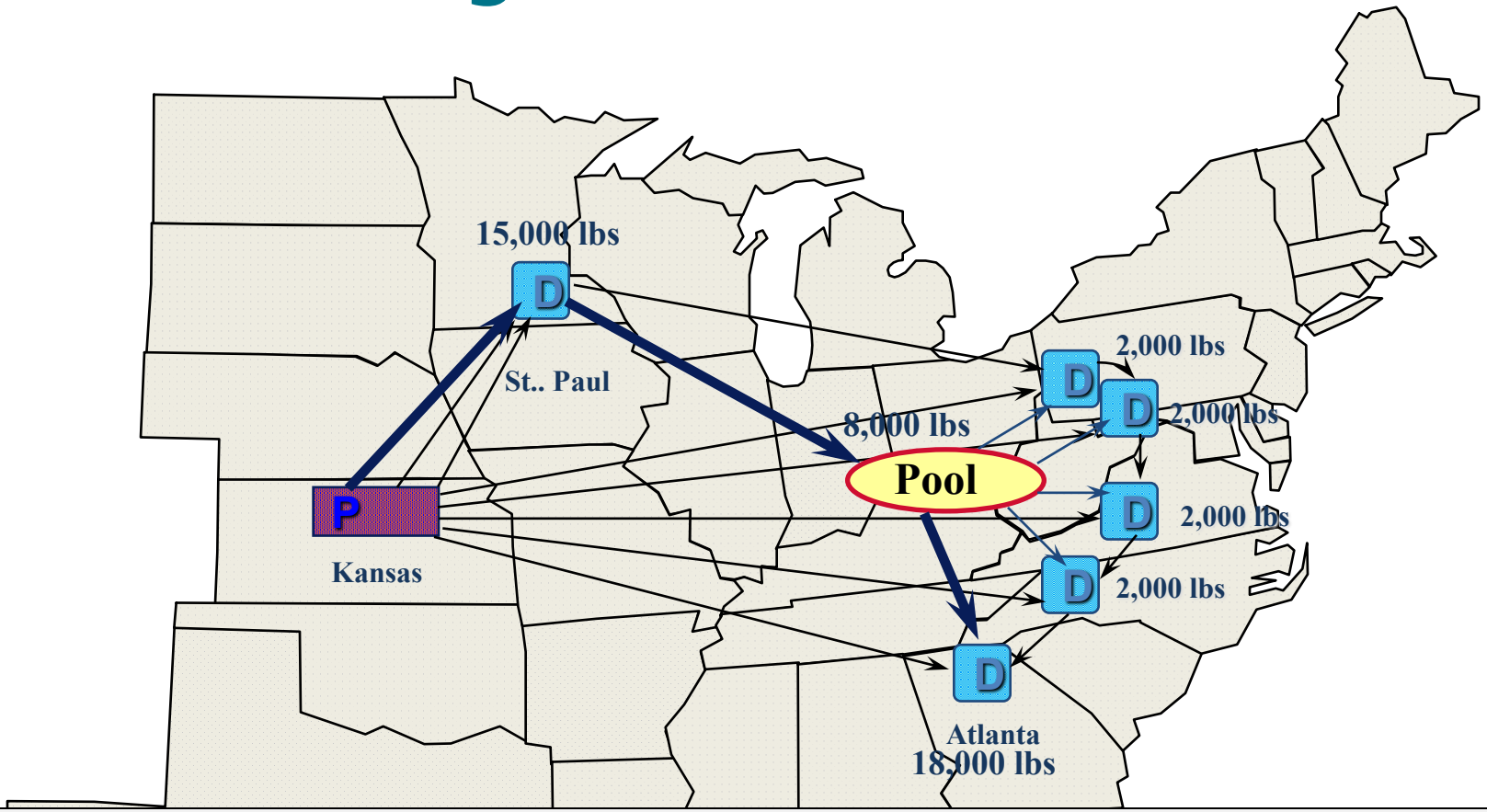
RECONCILE: Audit invoices and pay for Transportation

Execution Considerations

- Considerations
  - How do orders drop? Batched vs Continuous?
  - How much time is allowed between drop and must-ship? Weeks? Days? Hours? Minutes?
  - What percentage of orders change after release?
  - How do they change? Quantity? Mix? Destinations? Timing?
  - What is the length of haul?
  - How many orders are "in play" at any time?

- Key Decisions
  - Load Building (Consolidation & Routing)
  - Carrier Selection

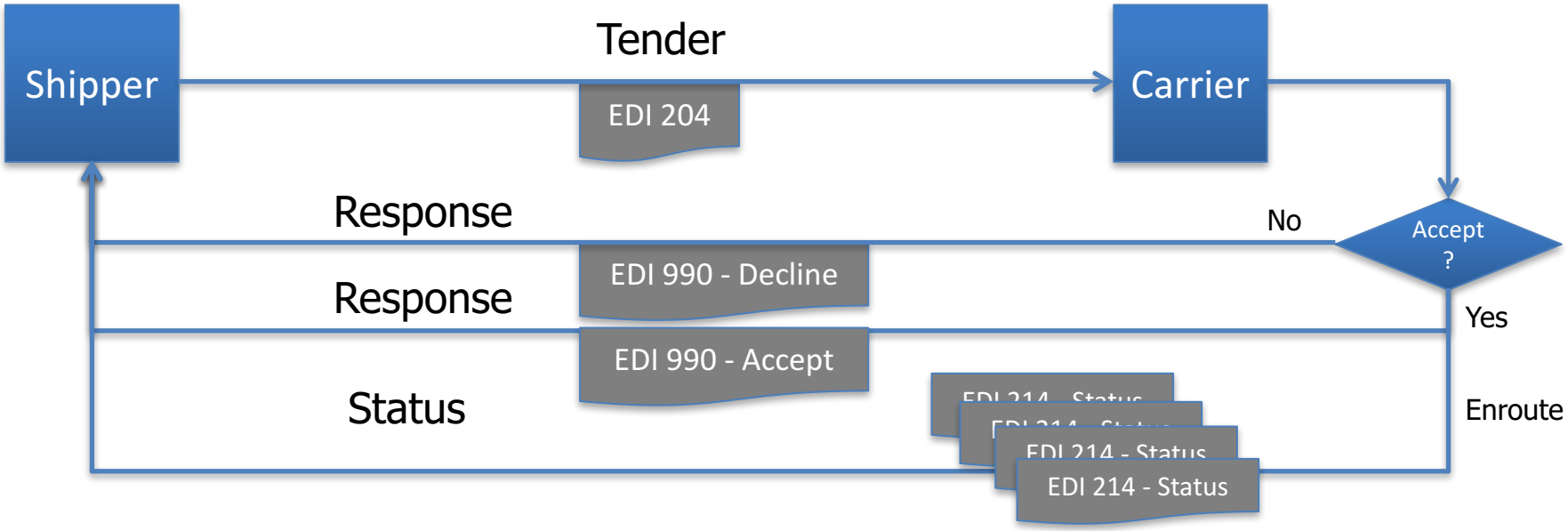
Load Building



1. Direct LTL from KC to 6 destinations
2. Multi-stop TL from KC to all locations
3. MSTL from KC to St. Paul to Pool Point (drop off 4 local LTL shipments) continue to Atlanta

TMS Carrier Communication & Selection

Primary EDI Transaction Sets



204 – Motor Carrier Load Tender

- Used by shippers to tender an offer for a shipment to a full truckload motor carrier. It may be used for creating, updating or replacing, or canceling a shipment.
- May contain info on: Carrier identification, Scheduling, Equipment requirements, Ship-to location, Contact at destination, Description of goods, and Shipping instructions

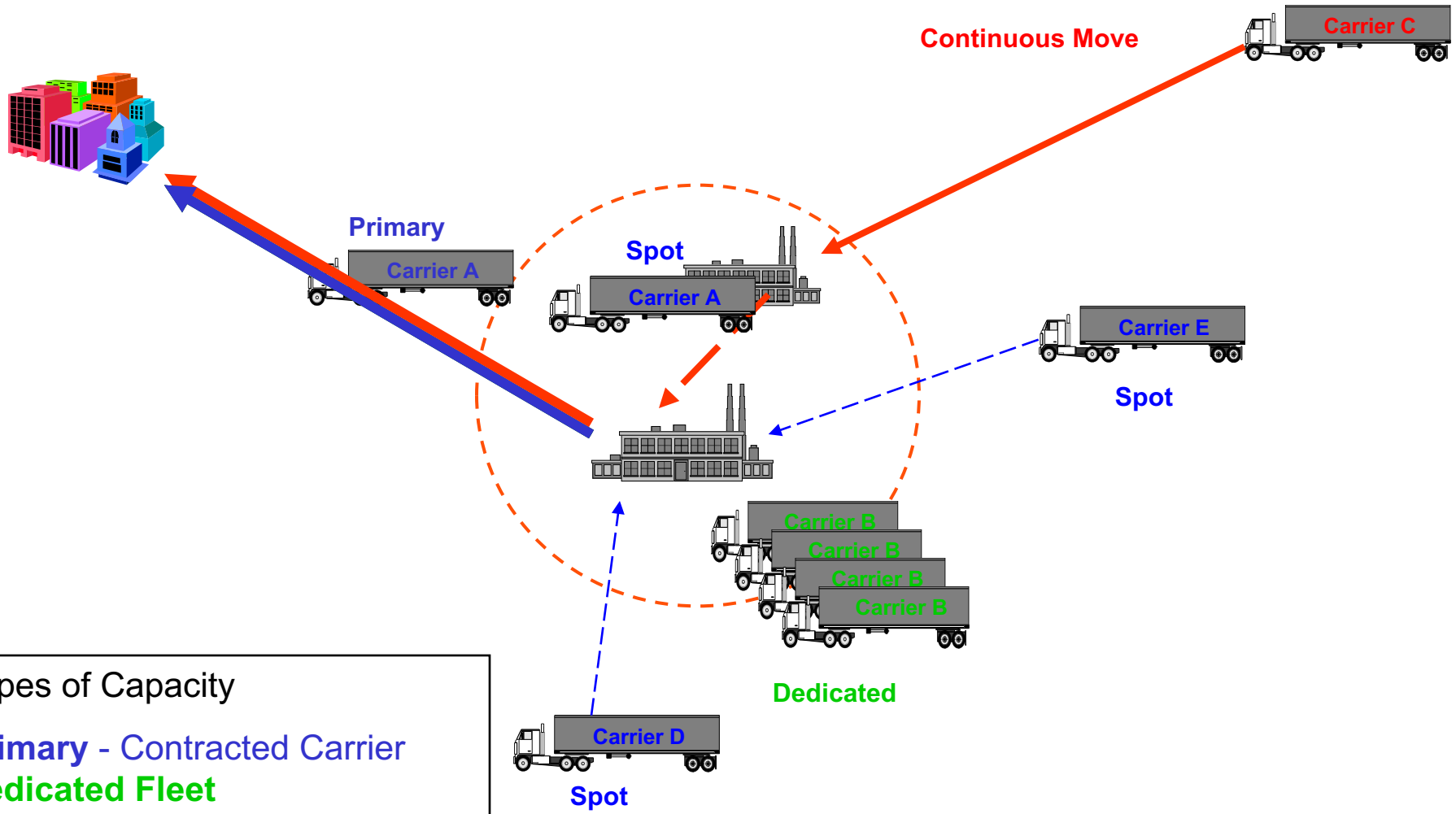
990 - Response to a Load Tender

- Used by motor carriers to indicate whether it will pick up a shipment offered by the shipper
- Five potential responses (Accepted, Declined, Accepted with conditions, Spot bid request accepted (w/ bid amount), Spot bid request declined

214 - Transportation Carrier Shipment Status Message

- Used by carriers to provide shippers and consignees with the status of their shipments.
- May contain info on: Origin, Current location, Dates and times for pickup and/or estimated delivery, Proof of delivery, Shipment status details to include reasons for exceptions, and Shipment description.

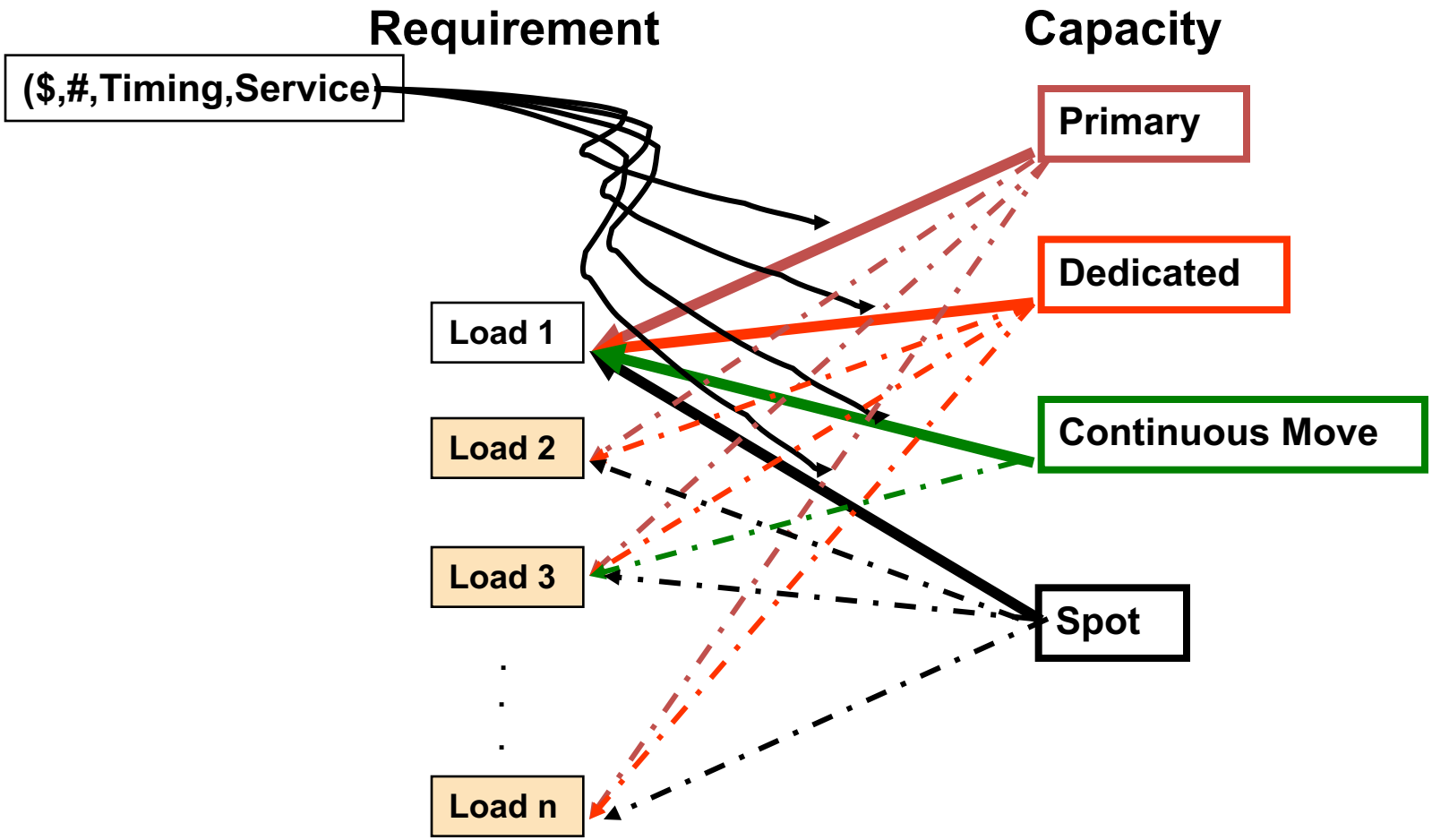
Carrier Selection



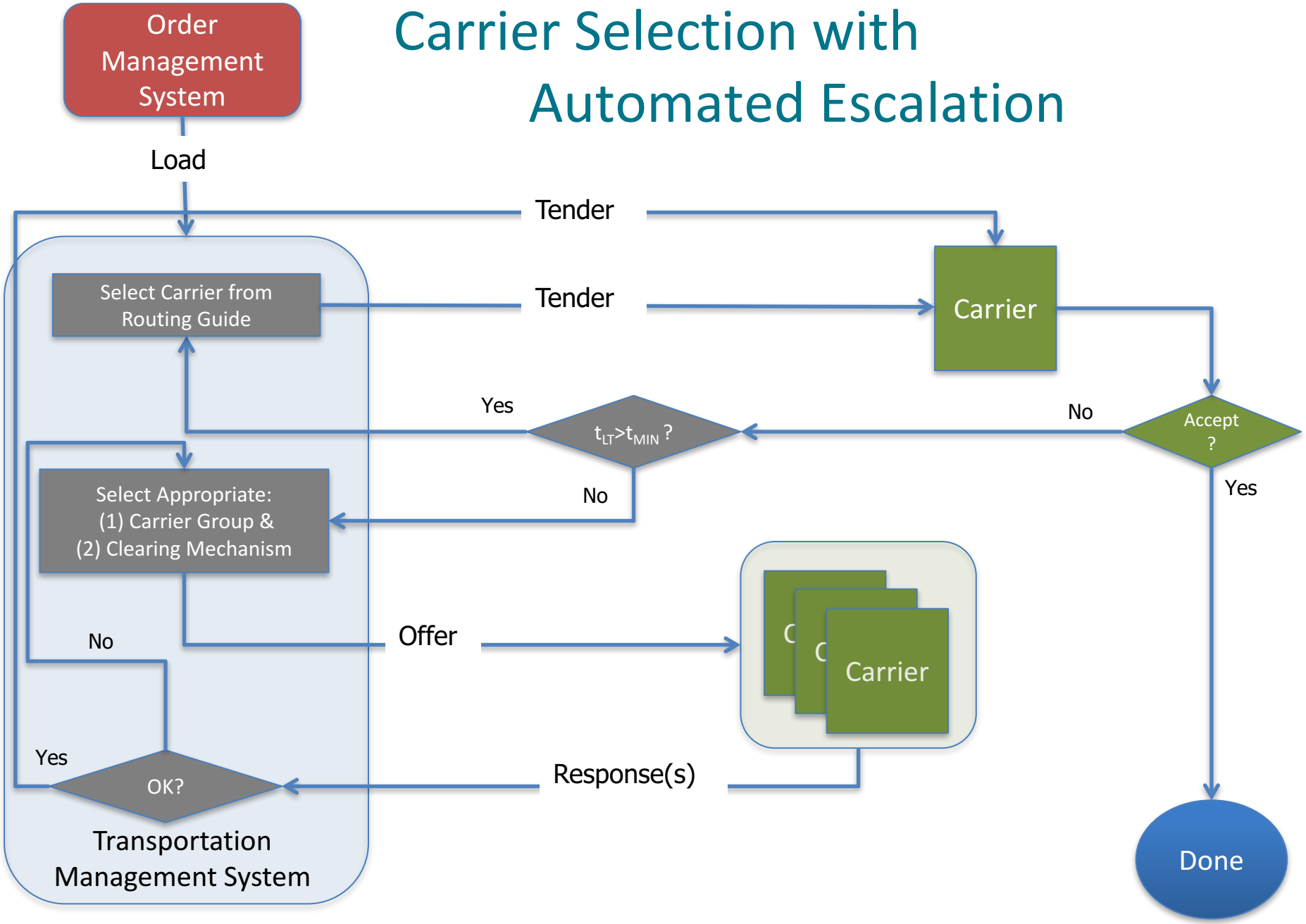
Types of Capacity

Primary - Contracted Carrier
Dedicated Fleet
Continuous Move
Spot Carrier

Carrier Selection

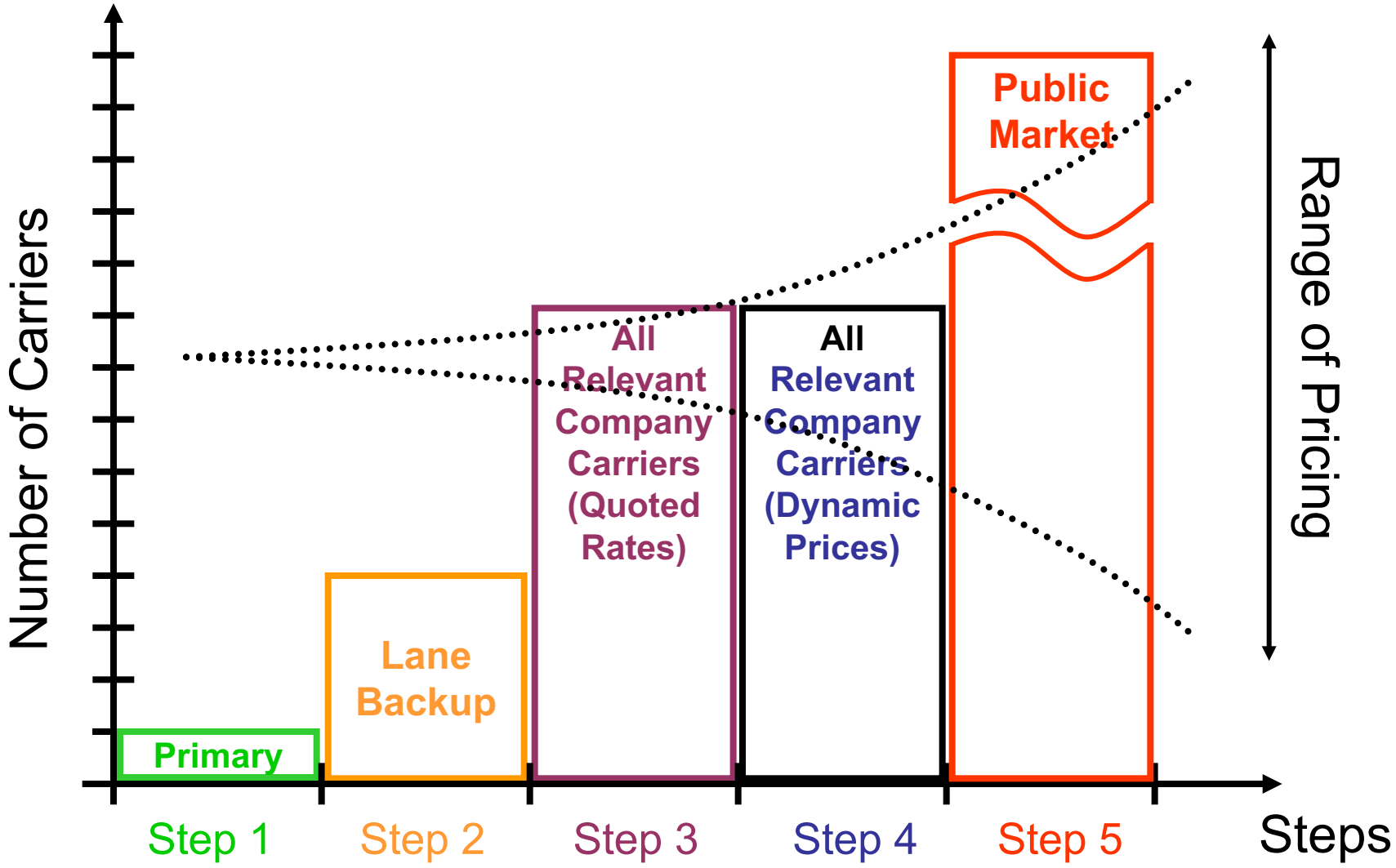


Carrier Selection with Automated Escalation

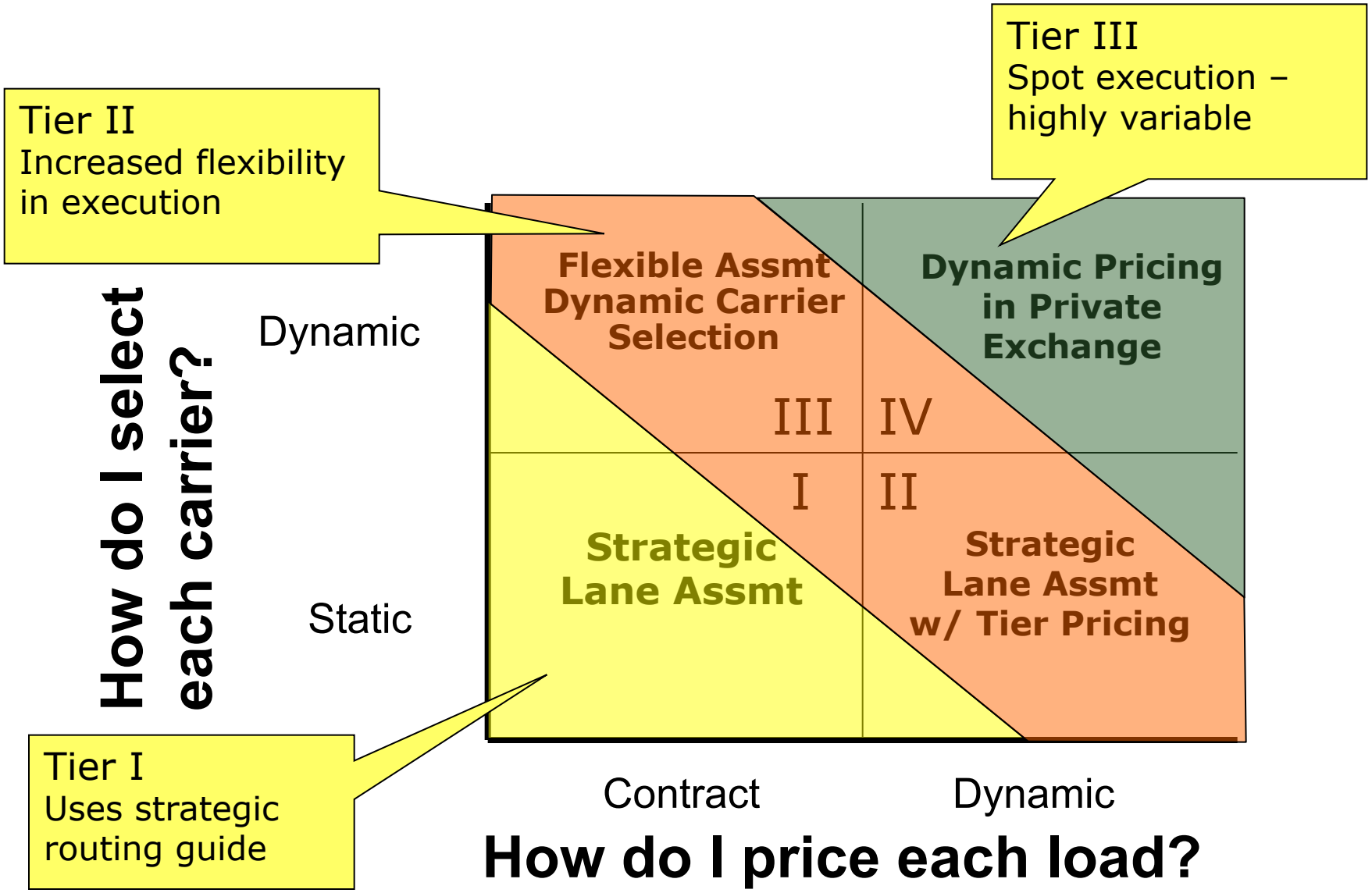


Adapted from Maziarz, M, (2002) logistics.com.

Automated Escalation Process



Approaches Must Be Linked

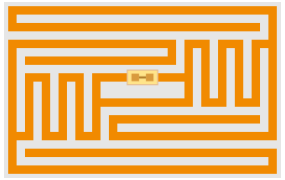


Warehouse Management Systems & Automation

Warehouse Management Systems (WMS)

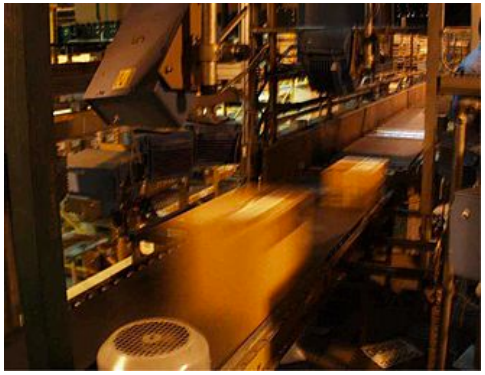
- Definition:
  - WMS is a software system that facilitates all aspects of operations within a warehouse or distribution center and integrates with other systems.
  - Not the same as inventory management systems that determine stocking levels and replenishment policies – they complement.
- Benefits of a WMS:
  - real-time stock visibility and traceability,
  - improved labor productivity,
  - reduction in mis-picks,
  - reduction in returns,
  - more accurate reporting,
  - improved responsiveness,
  - greater data visibility,
  - improved customer service, and
  - minimized paperwork.
- Closely connected to automation in terms of material handling and paperless device interfaces (identification and communication)

Warehouse Automation



- Automatic identification technologies
  - Bar codes and bar code scanners
  - Radio frequency tags (RFID) and antennae
  - Smart cards and magnetic stripes
  - Vision systems

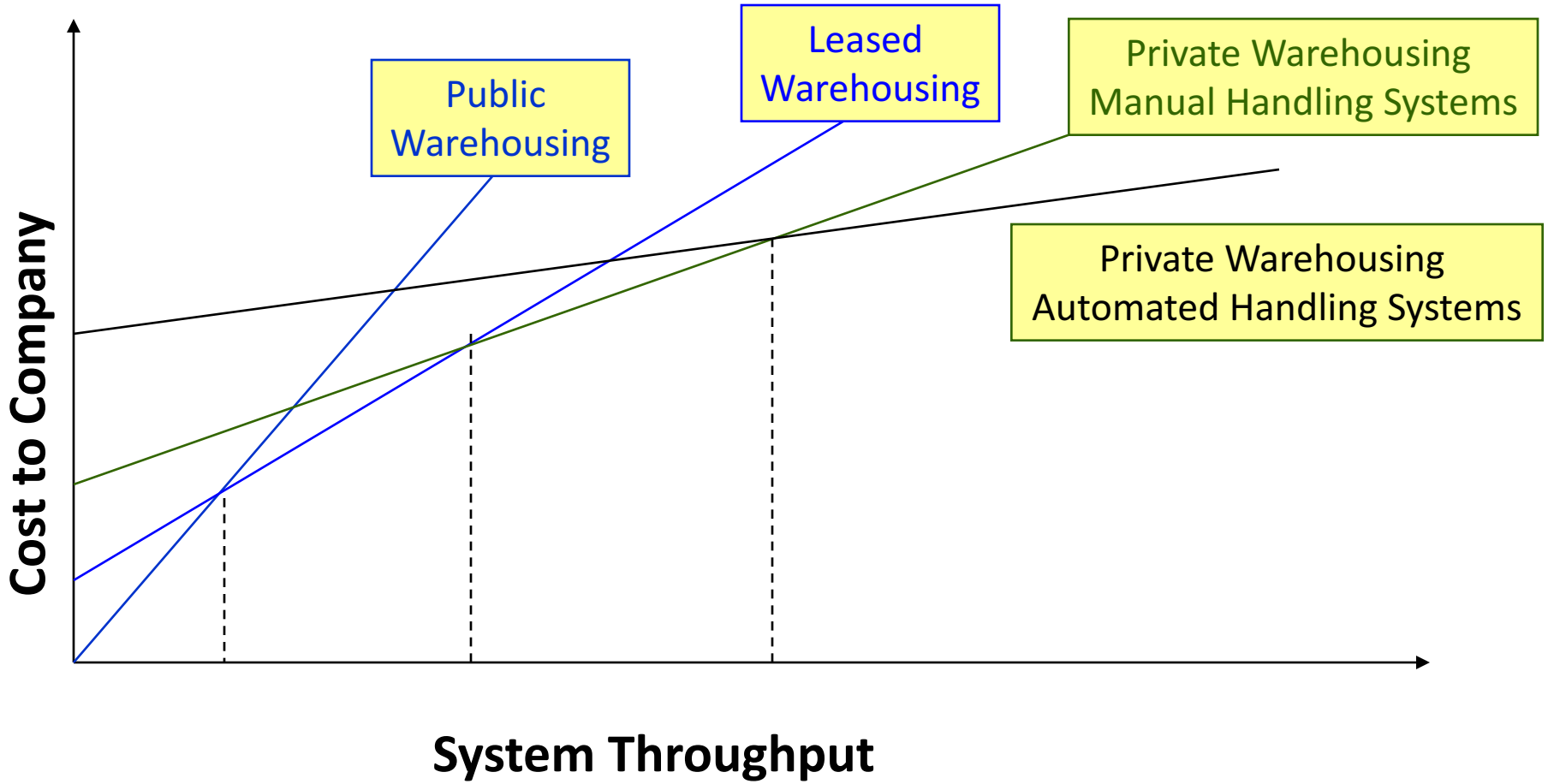
- Automatic communication technologies
  - Radio frequency data communications
  - Synthesized voice
  - Virtual displays
  - Pick to light / voice systems



- Automated material handling technologies
  - Carousels
  - Conveyors/robotics
  - Flow racks
  - AS/RS – Automated storage & retrieval systems

all images in public domain – sourced Wikipedia

Warehousing Options



WMS Software Components

- Order Processing
  - Order checking & batching
  - Allocation
  - Auto-replenishment
- Receiving
  - ASN planning
  - In bound tracking
  - Delivery appointment scheduling
  - PO verification
  - Returns processing
- Put-Away
  - Palletizing
  - Zoning and slotting
  - Random/directed put away
  - Routing for putaway & replenishment
- Picking
  - Batch/Wave/Zone/Directed picking
  - Carton/pallet select
  - Assembly/kitting
  - Pick-to-light/voice
- Shipping
  - Pallet sequencing & Load planning
  - Pallet layering
  - Trailer management
- Labor Management
  - Individual/team performance mgmt
  - Labor scheduling
  - Time standards
- Equipment Support
  - Interface to automated equipment
  - Equipment maintenance

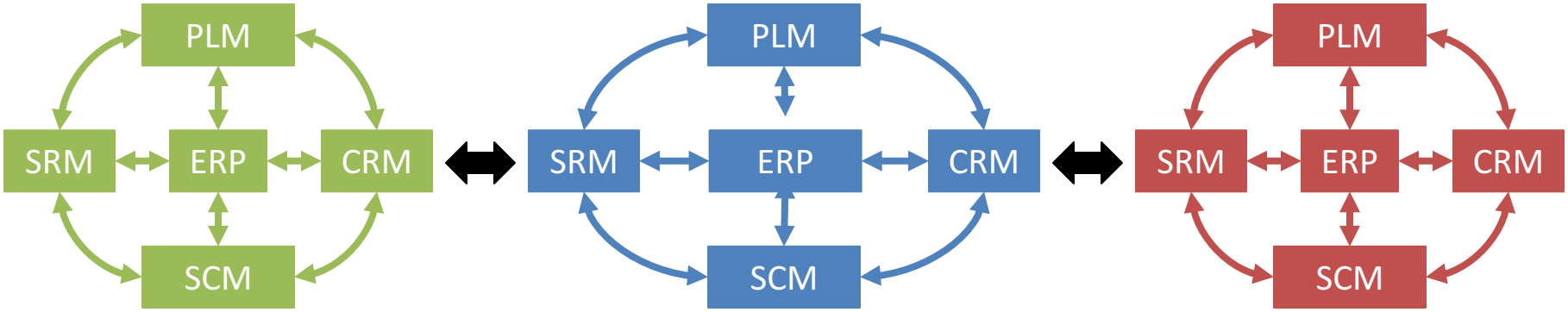
Manufacturing Execution Systems

Manufacturing Execution System (MES)

- Definition:
  - MES is a software system that manages and monitors all work-in-process (WIP) in the production process.
  - This includes integrating with an ERP to manage the execution of release of production orders to finished goods delivery, trigger supply chain replenishments, and enhance product traceability through manufacturing.
- Functionality within an MES:
  - Machine scheduling,
  - Process management,
  - Document control,
  - Labor management,
  - Inventory management,
  - Product (WIP) tracking,
  - Performance analysis,
  - Labor management,
  - Quality management,
  - Production reporting.
- More of an internal facing system – not usually connected to the larger supply chain network.

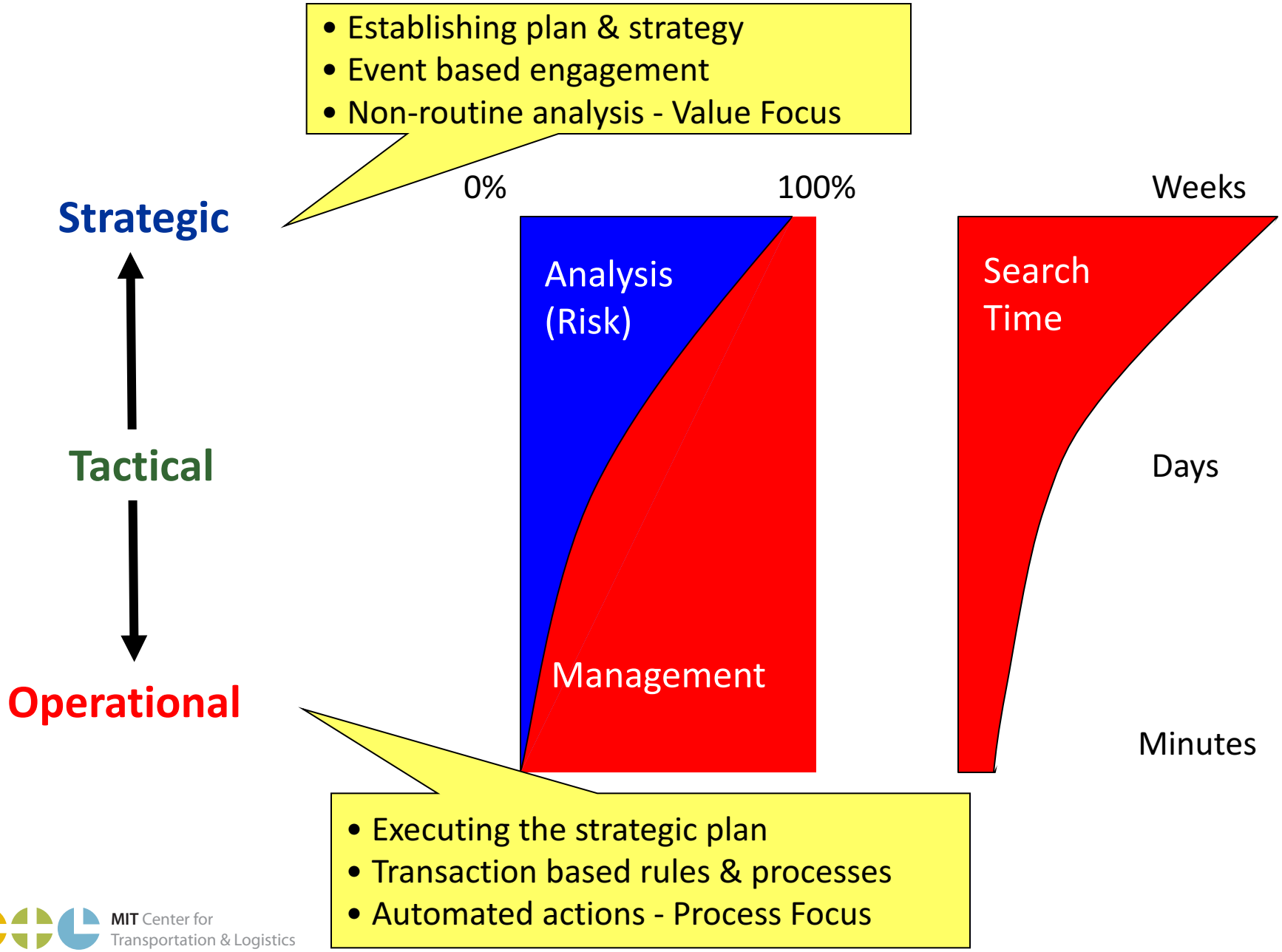
Key Points

SCM Applications Extend the Enterprise

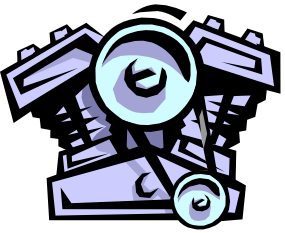


- Advanced Planning Systems (APS)
  - Long range, optimization-based decision support tools
- Execution Systems
  - Transportation Management Systems (TMS)
  - Warehouse Management Systems (WMS)
  - Manufacturing Execution Systems (MES)

Planning vs. Execution: Approaches



Planning vs. Execution: Technology



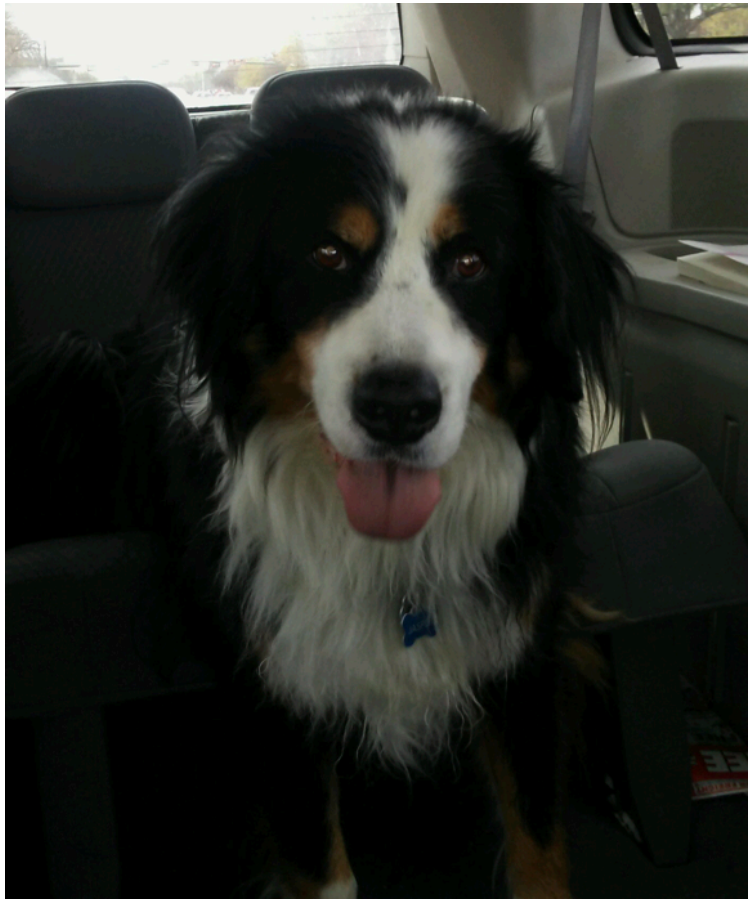
	Analysis Engine •Optimization •Simulation •Data Analysis	**Communication** •Web-based •File Exchange •Remote Access	**Workflow Software** •Compliance Tracking •Rules Engine •Transaction Processing
Strategic	X	X	
Tactical	X	X	
Operational		X	X

Top Supply Chain Planning Vendors

Top 20 supply chain management software suppliers SCM (SCE, SCP, Procurement) Total Software Revenue									
No.	Supplier	Web	2014 Revenue	2015 Revenue	SCP	WMS	MES/MRP	TMS	Procurement
1	SAP	sap.com	2,563.0	2,671.1	x	x	x	x	x
2	Oracle	oracle.com	1,454.2	1,449.4	x	x	x	x	x
3	JDA Software	jda.com	432.7	467.8	x			x	
4	Manhattan Associates	manh.com	187.6	209.3	x	x		x	
5	Epicor	epicor.com	163.5	162.1	x	x		x	x
6	Descartes Systems Group	descartes.com	140.3	146.6				x	
7	HighJump	highjump.com	91.6	131.0	x	x		x	
8	IBM	ibm.com	147.8	127.0	x				
9	Basware	basware.com	132.4	113.3					x
10	PTC	ptc.com	93.6	105.8	x				
11	Infor	infor.com	103.9	99.5	x	x	x	x	x
12	SciQuest	sciquest.com	80.0	82.2					x
13	Kewill Systems	kewill.com	81.0	76.6				x	
14	GTNexus	gtnexus.com	90.0	75.9	x			x	
15	Dassault Systemes	3ds.com	23.1	74.7	x		x	x	
16	IQNavigator	iqn.com	67.5	71.6					x
17	Coupa	coupa.com	43.8	67.0					x
18	Kinaxis	kinaxis.com	52.3	66.3	x		x	x	
19	e2open	e2open.com	66.0	57.7					
20	GEP	gep.com	45.0	55.0	x	x		x	x
Total			6,059	6,310					

Source: Trebilcock, B. (2016) Logistics Management, http://www.logisticsmgmt.com/article/top_20_software_suppliers

Questions, Comments, Suggestions?
Use the Discussion Forum!



"Jasper – just excited to be in the car"
photo courtesy Jennifer Sexton

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