CSCP

CERTIFIED SUPPLY CHAIN PROFESSIONAL

MODULE 2:
GLOBAL SUPPLY CHAIN NETWORKS

Section A: Supply Chain Design and Optimization

APICS

ASCM

Section A Introduction

Section A Key Processes:

- Define and manage the supply chain network.
  - Design the supply chain network.
    - Determine business requirements, IT strategy, and cyber security.

Section A Topics:

- Topic 1: Supply Chain Design and Management
- Topic 2: Business and IT Requirements
- Topic 3: Technology Analysis and Optimization

Supply Chain Design: Technology Decisions

- Visibility and velocity enabler
- Theory of constraints also true for IT
- How often data is transferred and analyzed
- Support needs of the infrastructure, internet, and e-commerce
- Competitive strategy with IT and decision support systems

Network Configuration

- Number, location, and capacity of warehouses
- Location of plants and production levels per product
- Transportation (plant to warehouse, warehouse to retailer)
- Country-specific infrastructure assessment
- Inventory location and levels
  - Optimal levels of right kinds of inventory
  - Lowest inventory that meets customer service goals

Efficiency with Responsiveness, plus Resilience

Efficient Supply Chain

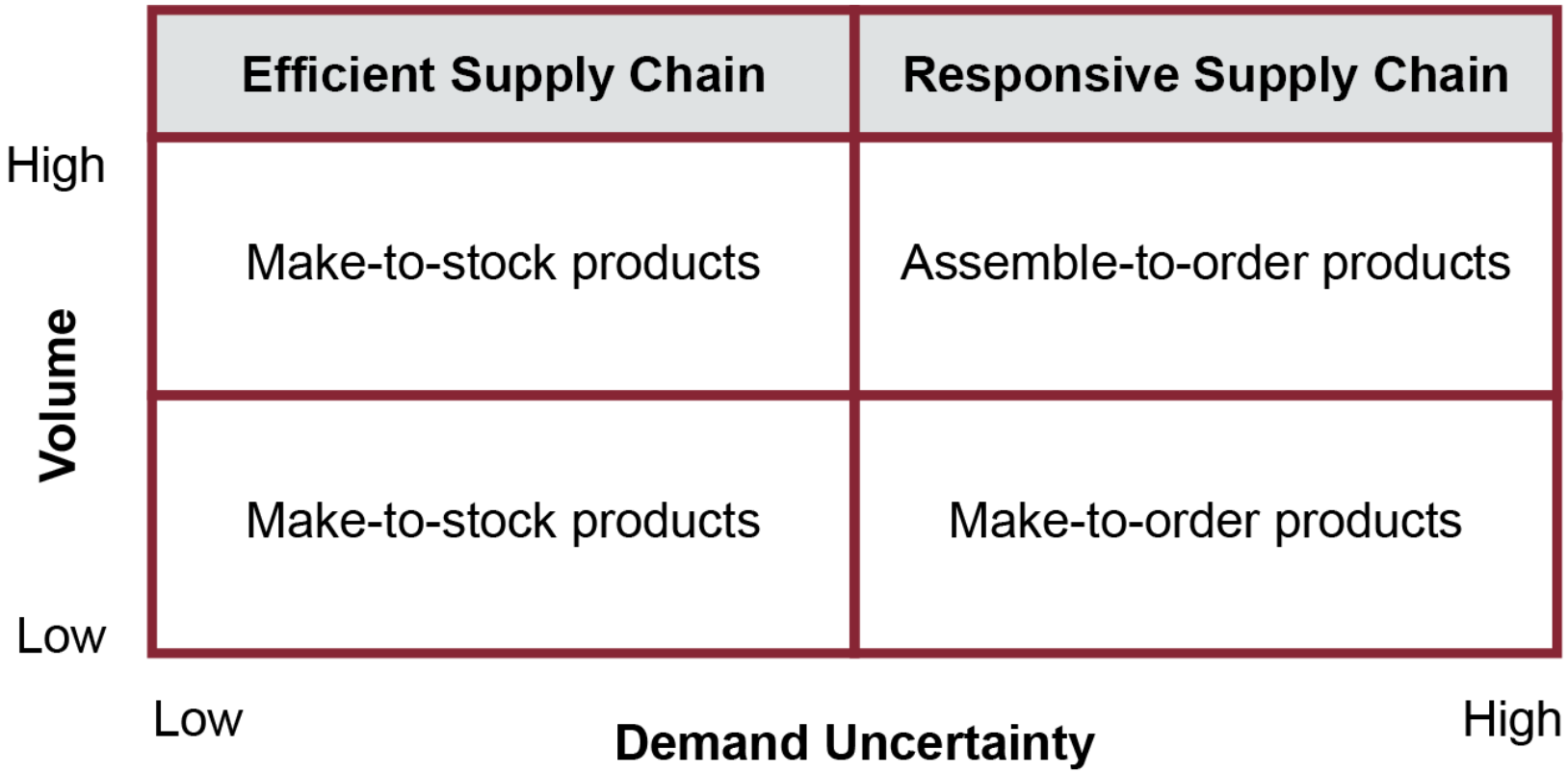
- Least-cost manufacturing/supply chain
- Relatively stable demand
- Reasonably accurate forecasts
- Make-to-stock strategy

Responsive Supply Chain

- Flexible in response to changing demand
- More volatile demand
- Uncertain forecasts
- Make-to-order or assemble-to-order strategy

Resilient Supply Chain

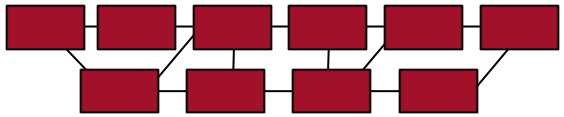
Fit Supply Chain Type to Product



Supply Chain IT Requirements and Benefits

Efficient transfer of secure information	SC velocity, agility, scalability
Massive data flow over internet	Cost-effective global visibility
Gather, integrate, report data	Avoid the bullwhip effect
Replace push with pull	Lean, cost-effective SCs
Strategic/tactical capabilities	Share knowledge with SC
Data entered only once	Data accuracy and straight-through processing
Remove “friction”	New relationships

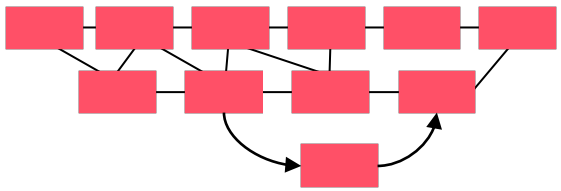
Throughout the extended supply chain



Sharing Information Helps Build Trust

Real-time information

Extended supply chain



Ad hoc links increase adaptability.

Sharing information builds trust and allows coordinated planning between partners.

Supply Chain IT Cost-Benefit Analysis

- Not a computer project; a business decision.
- Recipient, not IT, develops business case.
- Strategic IT investments should
  - Pay back in cost savings
  - Increase market share
  - Innovate product/service
  - Make company more adaptive to change
  - Match company's goals.
- Technology audits for justifications and pre- and post-implementation reviews.
  - Audience is upper management.

Benefits and Costs

Benefits		Costs
Tangible	**Intangible**	
• Lower maintenance costs • Faster implementation • Increased sales volume • Improved scheduling • Greater financial returns • Lower overhead • Reduced cash-to-cash cycle	• Customer retention • Customer service • Order status visibility • Workforce redeployment • Employee satisfaction and efficiency	• Hardware/software • Maintenance fees • Capital expenditures • Opportunity costs • Staff/consultant time • Configuration and customization

Benefit-Cost Analysis and ROI

$$\text{Benefit-Cost Analysis} = \frac{\text{Total Benefits}}{\text{Total Costs}}$$

$$= \frac{\text{US\$345,000}}{\text{US\$259,000}} = 1.33$$

$$\text{Return on Investment} = \frac{\text{Total Benefits} - \text{Total Costs}}{\text{Total Costs}}$$

$$= \frac{\text{US\$345,000} - \text{US\$259,000}}{\text{US\$259,000}} = 0.33 = 33\%$$

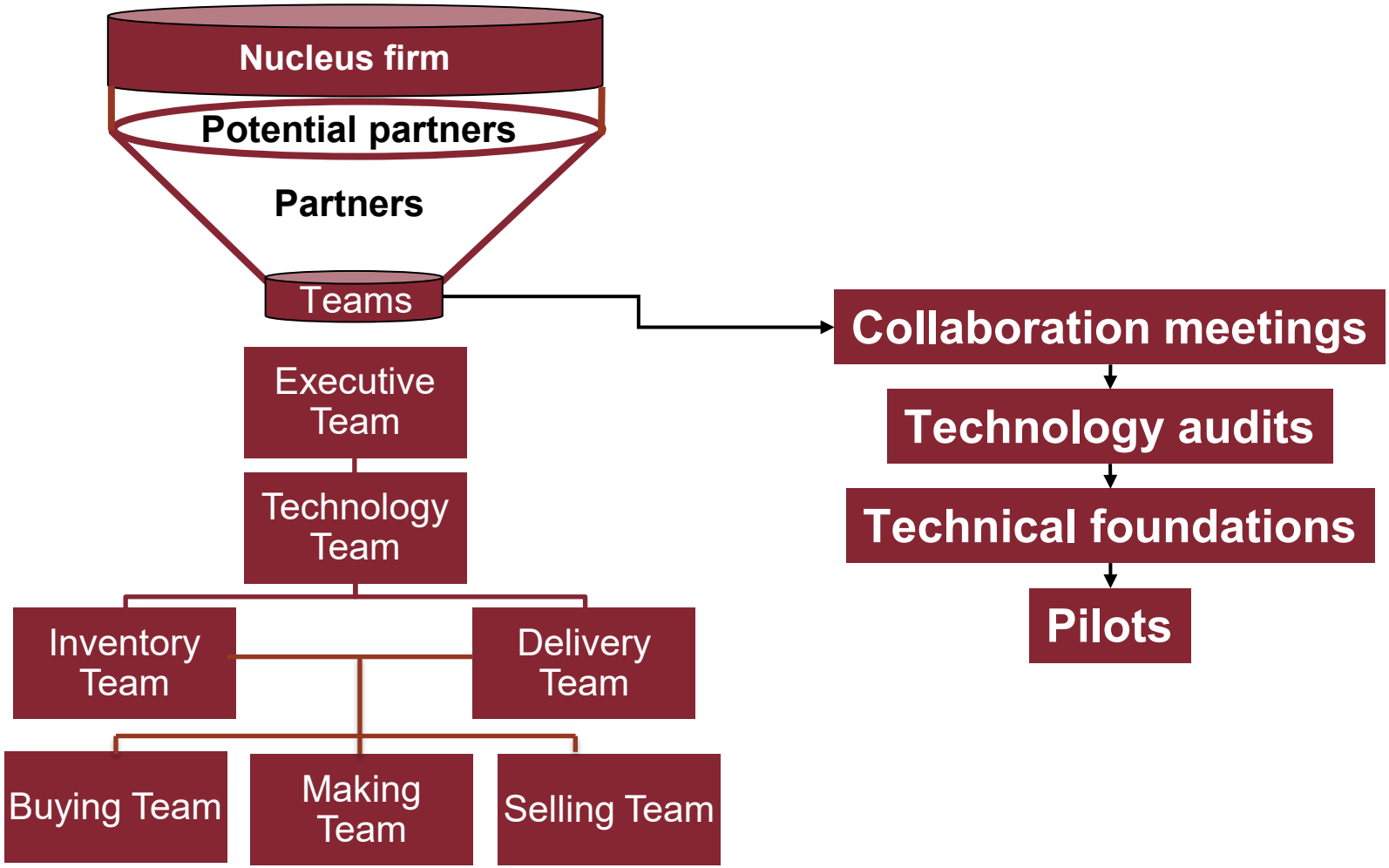
Stages of Supply Chain Network Technology Optimization

Stage / Capability	1: Multiple Dysfunction	2: Semi-Functional Enterprise	3: Integrated Enterprise	4: Extended Enterprise	5: Orchestrated SC
Internet	Static websites	Online catalogs	Intranets across all functions	E-commerce	Responsive; cybersecurity
Integration	None; no teamwork	Batch	Internal process integration; teams	SC networks; process integration	Closed gaps; automation, visibility
SC planning	Little information exchange	Informal; no initiative coordination	Formal/global; enhanced logistics	Integrated global planning; SC vs. SC. competition	Data driven analytics; cross-functional teams
Production scheduling	Basic MRP	MRP II	MRP—ERP	Externally integrated ERP	Automated demand data
Integration with suppliers	Fax/phone	EDI; seek low price	EDI with all large suppliers	VMI, online RFQ	Category strategies drive integration
Customer delivery	Research	Local inventory	ATP	CTP	Automated delivery quotes

Supply Chain Network Optimization Strategy

1. Determine goals and desired end state of SC.
2. Create cross-functional/cross-business teams.
3. Organize SC's operational processes and IT's mission.
4. Design in change management and training with stringent timetables.
5. Create conceptual model.
6. Establish technical infrastructure.

Role of Nucleus Firm/Cross-Functional Teams



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SECTION B:
END-TO-END CONNECTIVITY AND VISIBILITY

APICS

ASCM

Section B Introduction

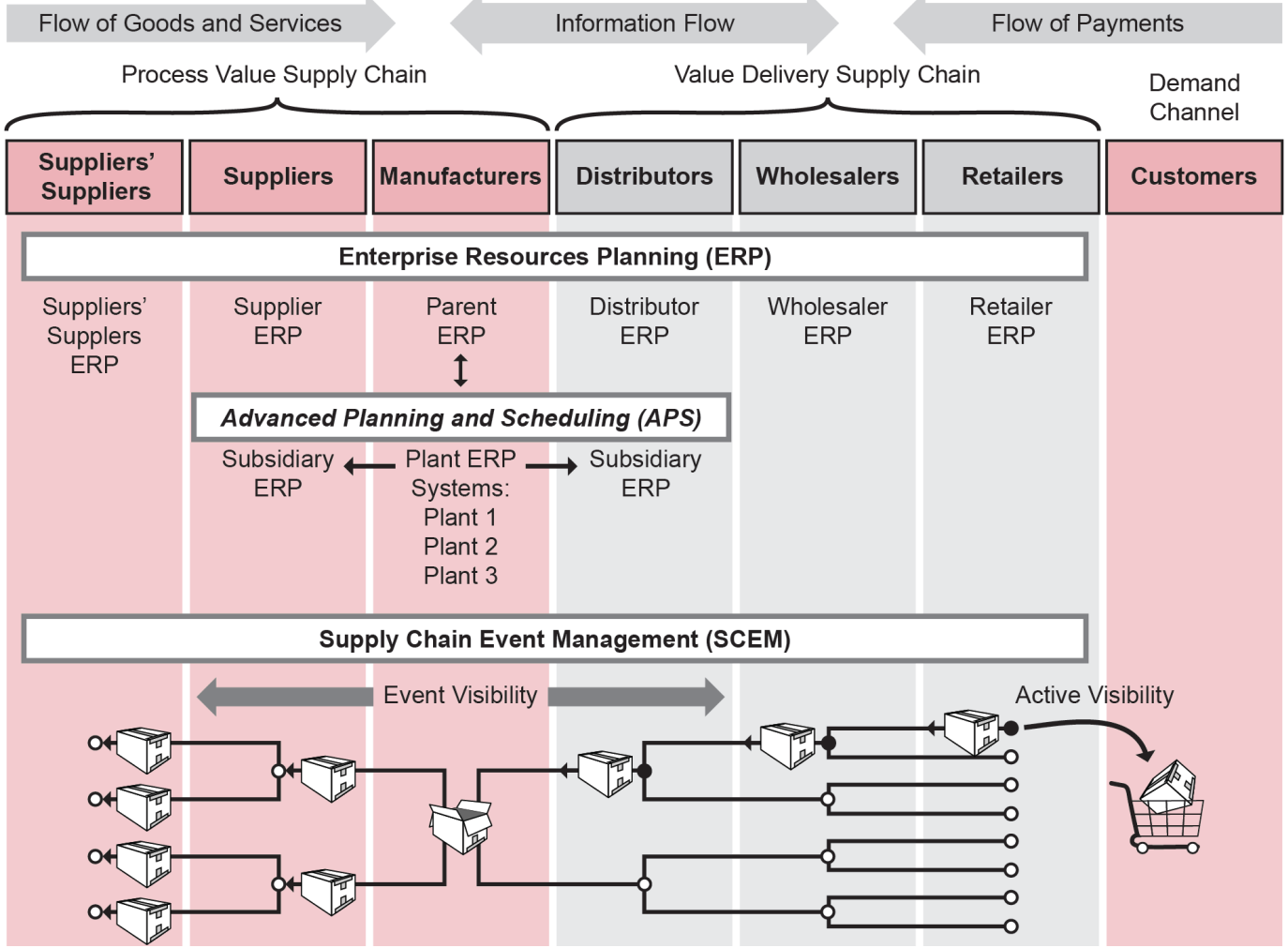
Section B Key Processes:

- Design and manage end-to-end supply chain connectivity and visibility.
  - Supply chain technology applications
  - Information sharing (e.g., data, status, and documents)
  - Legal requirements
- Manage customer, supplier, product/item, engineering, and logistics master data.
  - Create, update, cleanse, and retire data

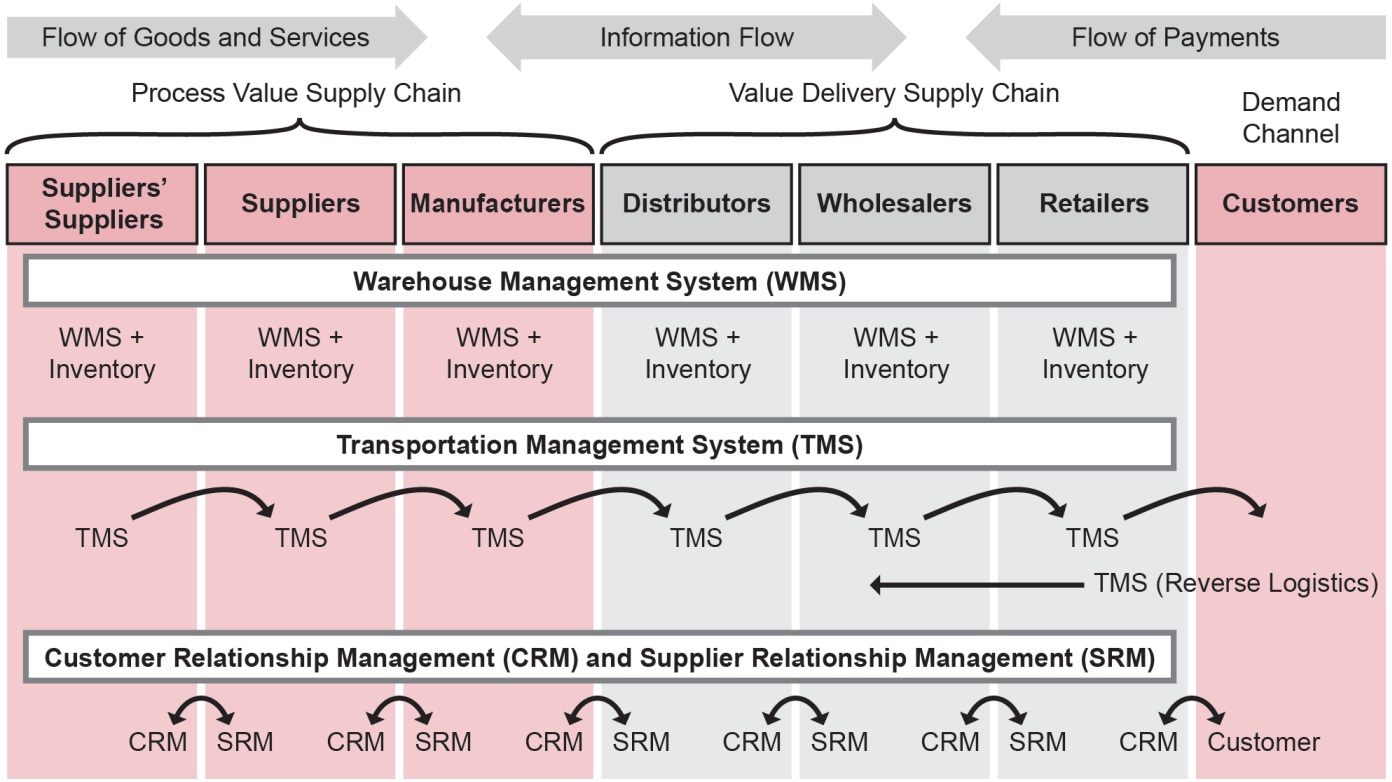
Section B Topics:

- Topic 1: Supply Chain Technology Applications
- Topic 2: Connectivity, Visibility/Sharing, and Legal
- Topic 3: Supply Chain Master Data

Comprehensive SC Management System



Comprehensive SC Management System (continued)

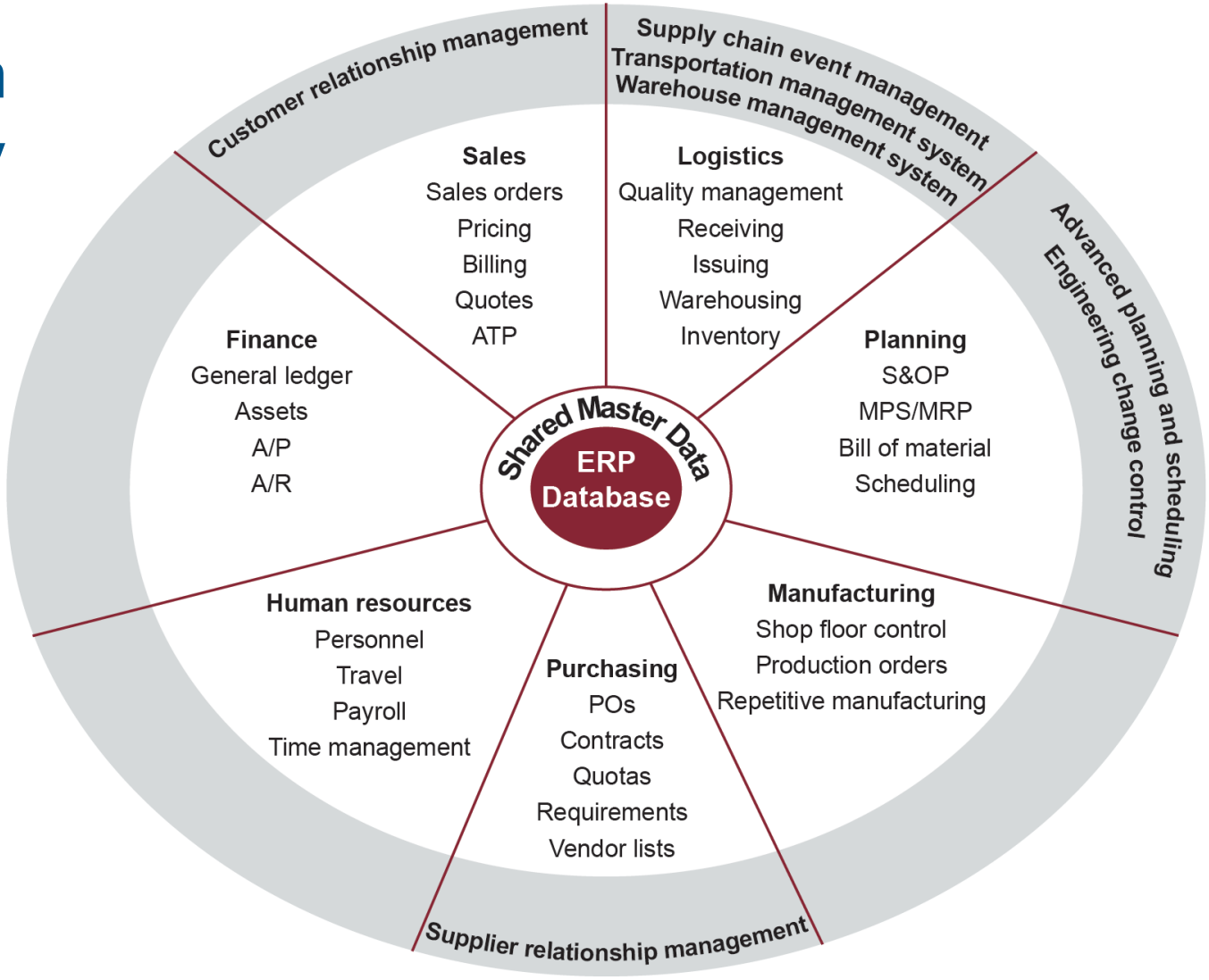


Enterprise Resources Planning (ERP) Systems

"Framework for organizing, defining, and standardizing the business processes necessary to effectively plan and control an organization so the organization can use its internal knowledge to seek external advantage." (*APICS Dictionary,* 16th edition)

- Modularized suite
- Automated interactions
- Common data source
- Challenge: linking supply chain partner ERP systems
- Need vision and direction for visibility and efficiency

ERP System Functionality



ERP System Evolution

Older ERP systems

Implicit business models (former best practices)

Begin with the end in mind.

Get full executive support.

Web-based ERP systems

ERP versus Best-of-Breed Systems

ERP Systems

- Simpler, better integration
- Leveraged ownership of enterprise data
- Shorter training
- Fewer vendors
- Support contracts
- Often lower total cost of ownership
- Vast development resources and staff

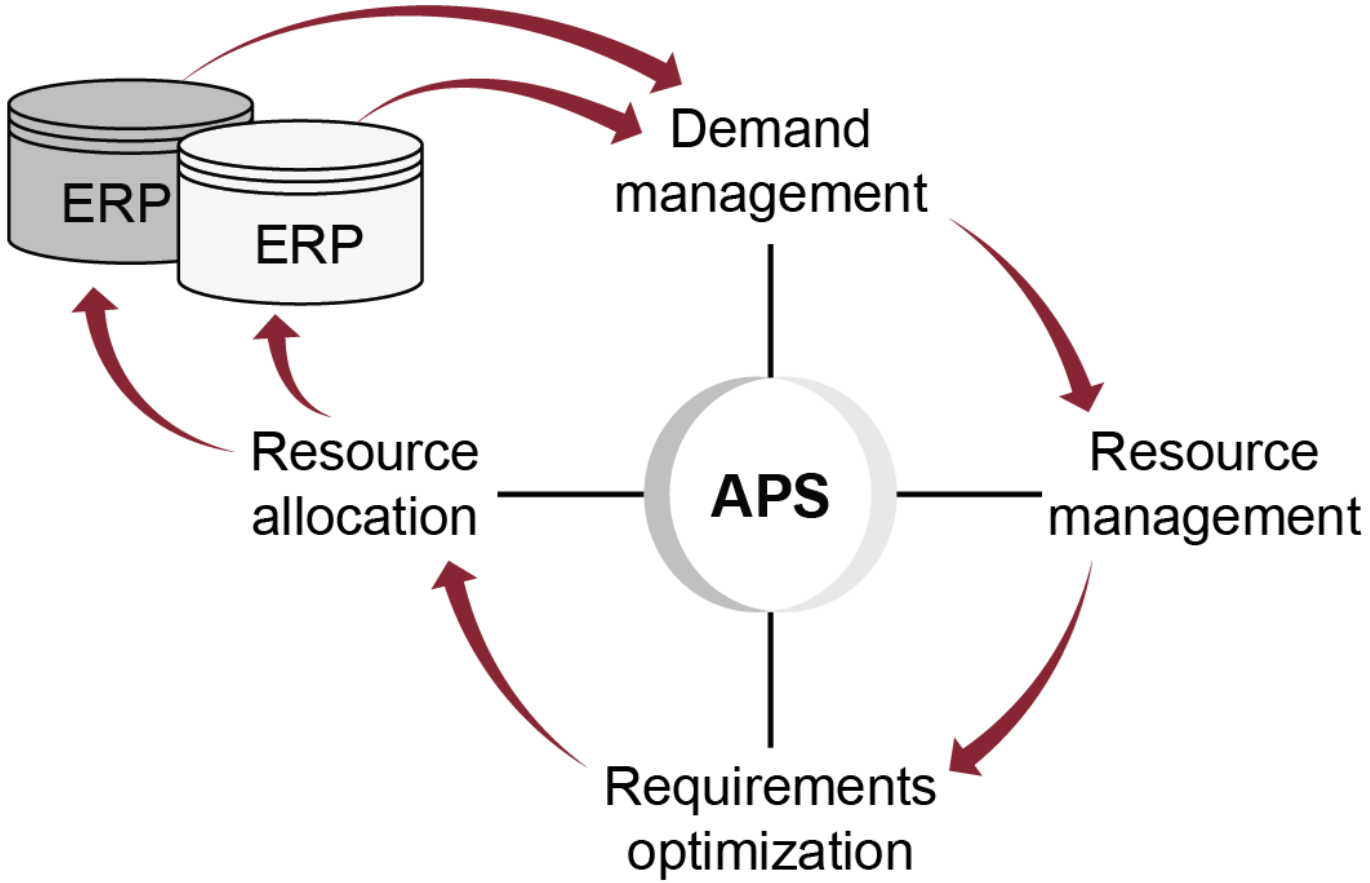
Best-of-Breed Systems

- Faster innovations
- Industry expertise
- Niche applications
- Functional area expertise (e.g., warehousing)

Upgrades, New Releases, New Modules

- Useful new upgrades, ERP releases, and modules:
  - Support an organization's top strategic issues
  - Have better open architecture
  - Provide speed and lower cost of future upgrades
  - Ease supply chain communications
  - Have better business information/metadata
  - Provide faster learning curve
  - Fully integrate currently disjointed systems
  - Are less expensive than increasing cost of old version.
- New system should match ≥ 80% functionality goals.
  - Customize only remaining 20% (or less), configuration for rest.

Advanced Planning and Scheduling (APS)

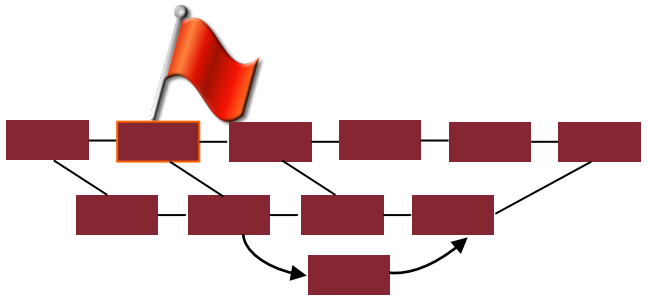


Supply Chain Event Management (SCEM)

- Flags SC events to trigger alerts or actions in other applications
- Monitors SC business processes
- Exception reporting to business intelligence software

Active visibility:

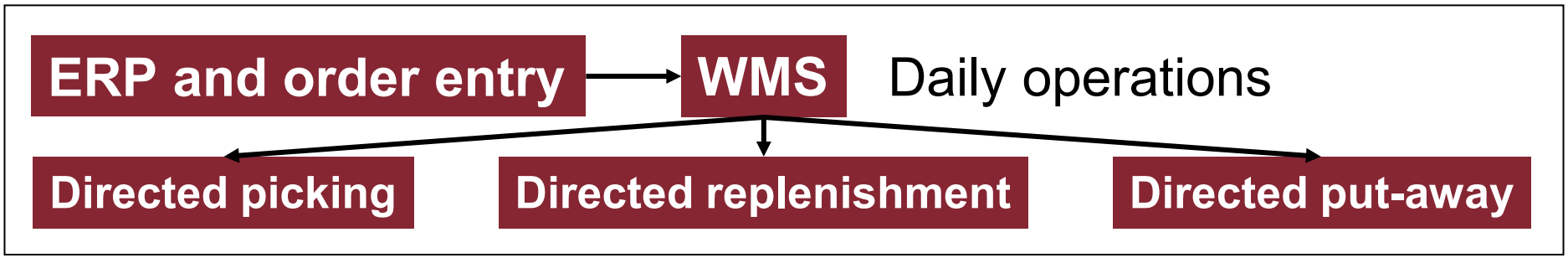
- Monitor
- Measure
- Notify
- Simulate
- Control



SCEM Benefits

- Faster response to supply/demand change
- Exception notices on portable devices
- Earlier marketing/sales demand reaction, better forecast
- Improved order accuracy, tracking, and cycle time
- Less management time on shipping/receiving
- Reduced inventories and total SC costs
- Greater labor efficiency and productivity
- Decentralized collaboration
- Increased customer responsiveness, fewer returns
- Real-time communications with ad hoc partners

WMS Functions



- Receiving
- Storage location management and optimization
- Cross-docking
- Inventory control
- Quality control
- Order selection and task management
- Automated replenishment
- Shipping
- Security
- Returns

WMS Interfaces and Benefits

WMS Interfaces or Portals

- Web-based interfaces/portals.
- Visibility and control:
  - Push and/or pull data and inventory.
- Enables merge-in-transit, cross-company warehousing, etc.

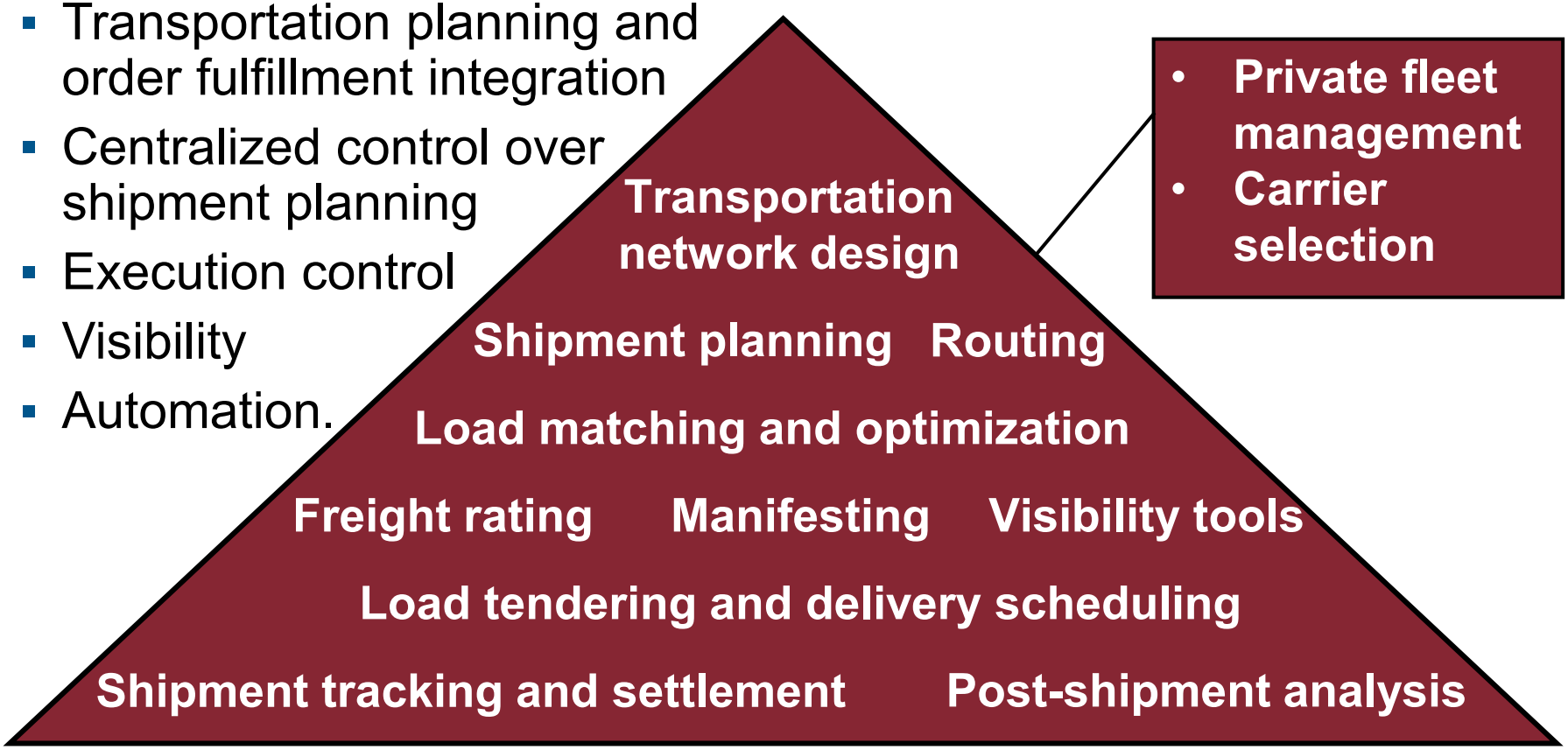
Benefits of WMS

- Productivity gains
- Fewer errors
- Competitive (e.g., cross-docking)
- Retail/international handling
- Automated put-away and pick accuracy
- Capacity and distribution efficiency (e.g., pallet discounts)
- Reduced cycle time/safety stocks
- Optimized use of space

TMS Functions

TMS must provide:

- Transportation planning and order fulfillment integration
- Centralized control over shipment planning
- Execution control
- Visibility
- Automation.



TMS Features

Web-Based Dynamic Updates

- Shipment costs
- Fuel costs
- Maps and routes
- Road conditions
- Traffic
- Weather
- Carrier availability

Shipper and Carrier Collaboration

Global Track/Trace

- Cellular GPS
- AIDC (RFID)
- Bills of lading
- Shipping labels
- SKU information
- Waybills
- Driver performance

Transportation Marketplaces (e.g., SaaS)

Benefits of TMS

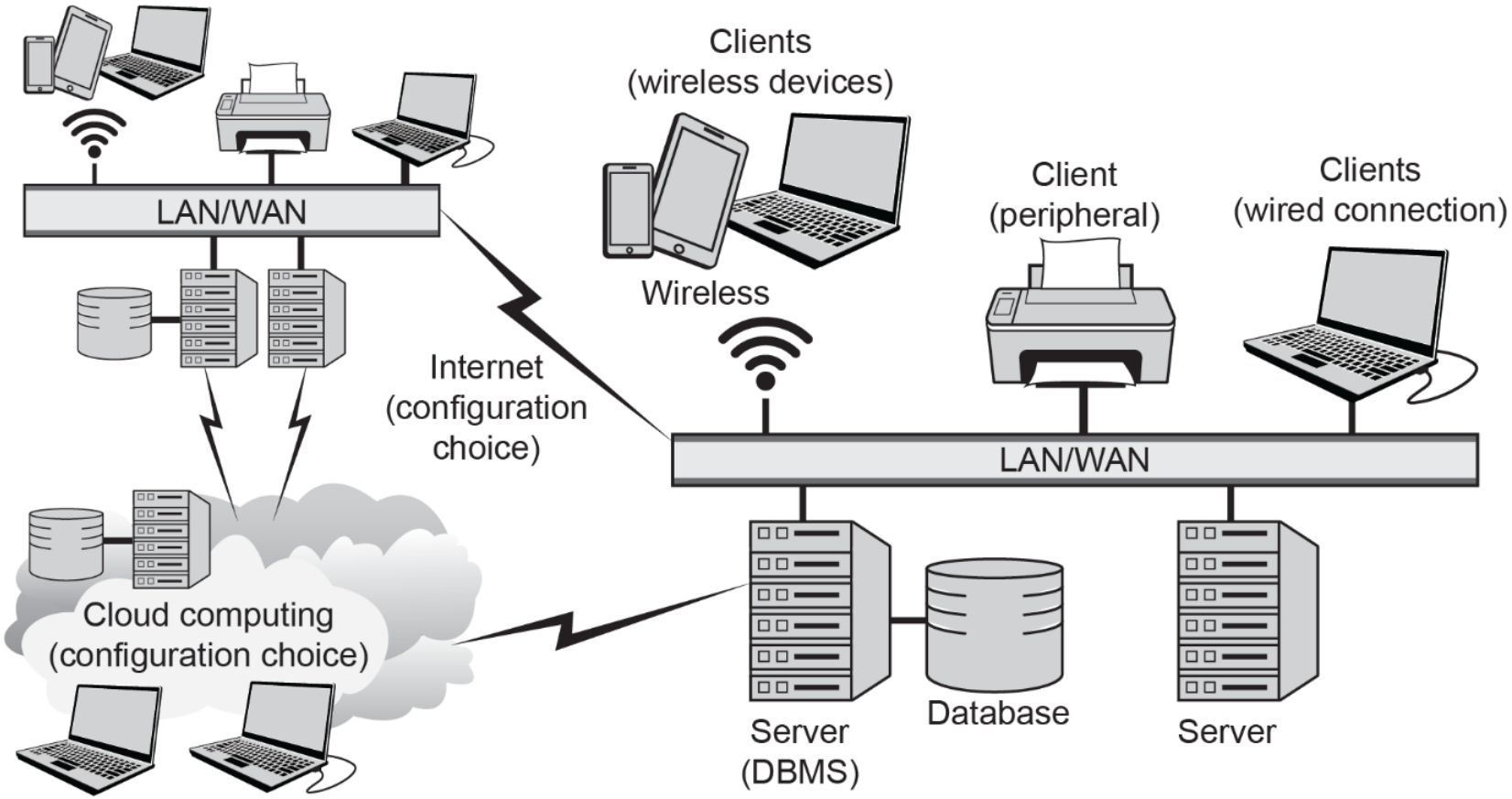
- Lower costs (less deadheading, demurrage, dwell time)
- Collaborative use of shipping
  - Linked communications
  - Aggregated volumes
  - Capacity procurement
  - Web-based visibility of information and planning
  - Distributed data access to reduce bottlenecks
- Centralized operations that lower support costs
- Real-time, accurate costs (faster, better decisions)

Information System Architecture Considerations

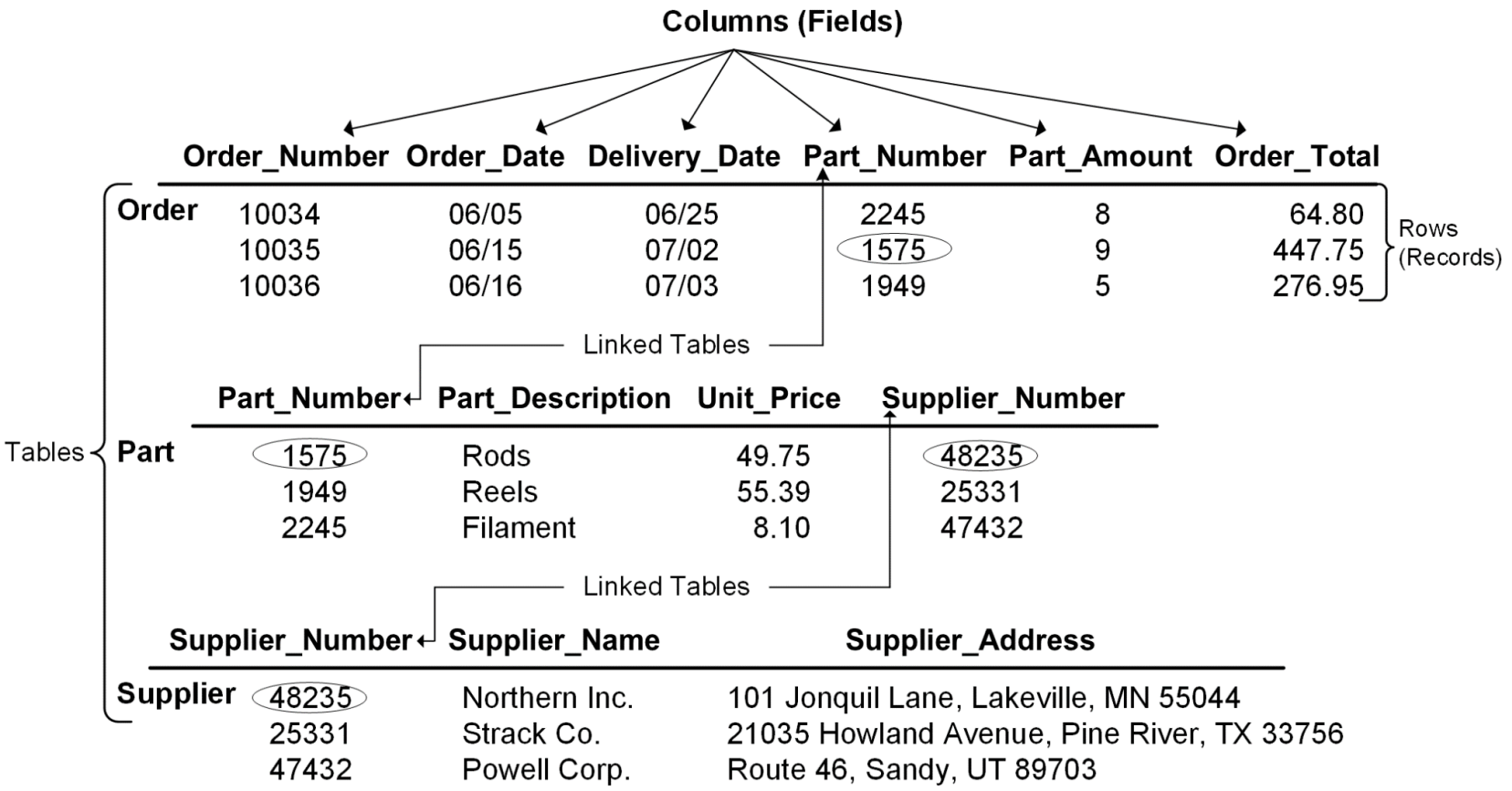
Information system architecture ***should align with*** **Architecture of the organization**

1. Organizational functions
2. Communication of coordination requirements
3. Data modeling needs
4. Management and control structures

Database, Networks, Software, Configuration



Databases and Database Management



Software as a Service (SaaS)

Basic Criteria

- Vendor
- Logic and data stored in central location
- End-user access to data and software, run and used over the internet

User Advantages

- Lower initial costs
- Immediate use
- Smaller storage requirements
- Fewer personnel

Supplier Advantages

- Continuous income
- Single version
- Reduced software piracy and unlicensed use

Cloud Computing

- The “cloud” is a network of data centers enabling computing resources to be accessed and shared as virtual resources.
- Secure and scalable.
- Can interface with ERP or cloud-only ERP exists.
- IaaS: Infrastructure
  - PaaS: Platform
    - SaaS: Software
- Hybrid solutions most common.
- ISO/IEC 17788:2014

Organizational and Information System Architecture

Organizational and Information Strategy

- Align strategies at organizational and extended supply chain levels.
- Translate organizational strategy into commitments to treat information as strategic investment.
- Set guiding principles, priorities, and common goals for network design.
- Envision high-level end-to-end IS structure for firm/SC.
- Do gap analysis.

Organizational and Information System Architecture

Information Content Definition

- What data to collect and how to gather, keep accurate, store, access, control, and analyze
- Business modeling for SC

Information Policies and Controls

- IS design, daily operations, and improvement policies
- Governance and audit
- SC communications and security

Organizational and Information System Architecture

Information Infrastructure Design

- Policies and controls translated into cohesive and cost-effective system
- Detailed decisions

Databases, Networks, Software, and Configuration

- Use of existing, adding, or upgrading
- Vendor search and selection
- Critical DBMS decisions

Organizational and Information System Architecture

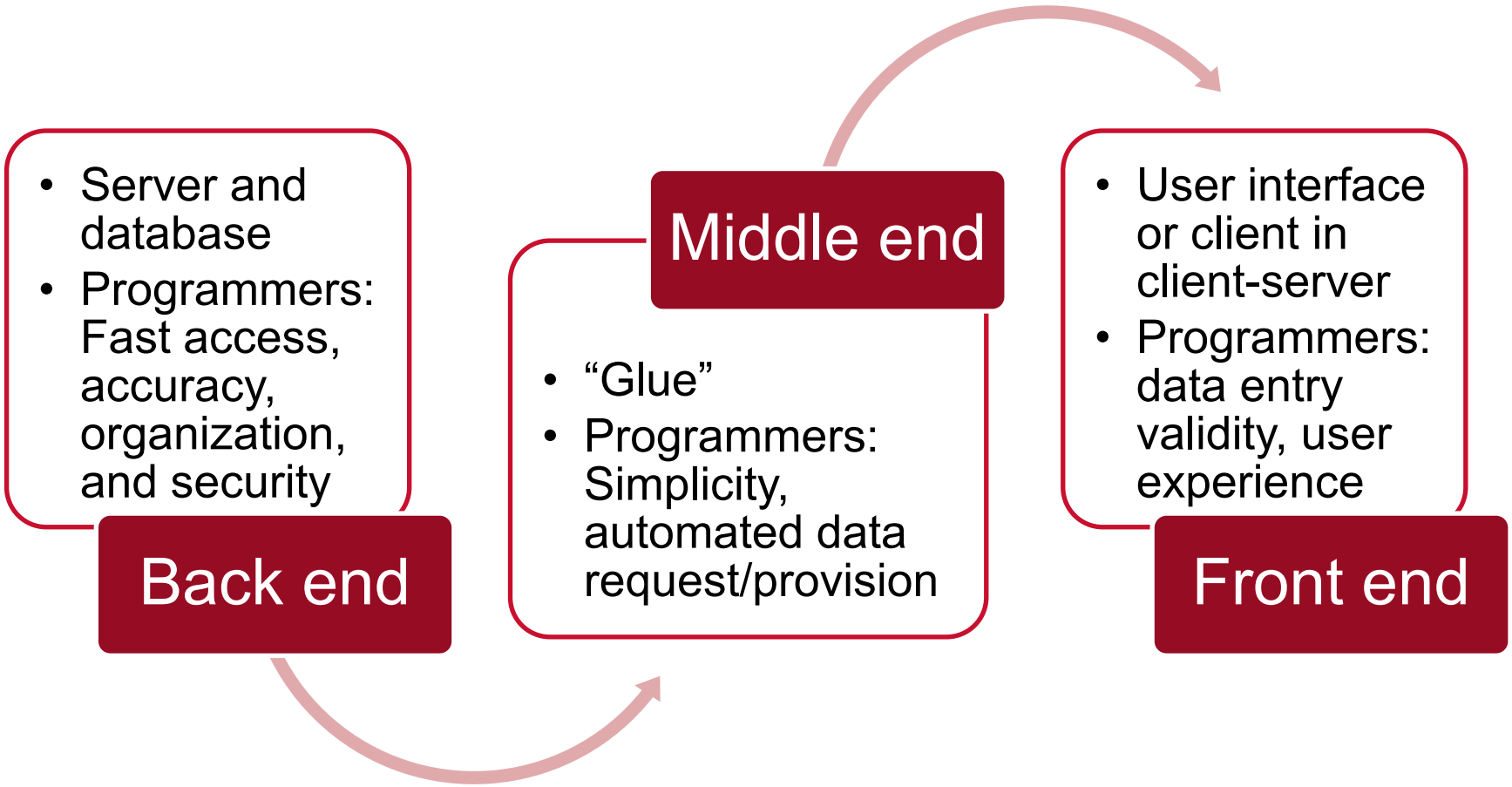
Information Infrastructure Change

- Continual system change and improvement

Action Plan, Schedule, and Prioritization

- Regular strategy, tactical update, and operational gap analyses → IT action plans

Front End, Middle End, and Back End



Middleware

- Sits in the “middle” between two applications (internal or external)
- Why care about middleware?
  - Helps integrate SC
  - Enables partners to share information
  - Avoids duplicate or inconsistent data
  - Breaks down organizational silos
  - Secure transactions
    - Authentication
    - Authorization

Content-level middleware: EDT and EDI

Data-oriented: custom linkages

Process-oriented (business process management [BPM])

Content-Level Middleware: EDT and EDI

- Electronic data transfer (EDT) is synonym; electronic data interchange (EDI) is standardized version.
- Electronic version of document, e.g., purchase order, ASN, or invoice.
- Batch-processed.
- Parties must agree on EDI data format.

Application Programming Interfaces (APIs)

- Middle end code residing nearer to front end than middleware
- Simple one-to-one interactions (not multiple systems at once)
- Other devices can query the database automatically and frequently.
- Lightweight, developer friendly, platform independent, scalable code.
- Software architecture: Web services
  - Interchangeable “building blocks.”
  - Open standards.
  - For example, airline flight check-in:
    - Get best available database search engine and best seat assignment applications from different vendors.
    - Develop own pricing application but all works together.

Application Programming Interface Types

Service-Oriented Architecture (SOA)

Modular design (a service)

Loose coupling between applications (easy re-configure)

Universal functionality (has all data for processing)

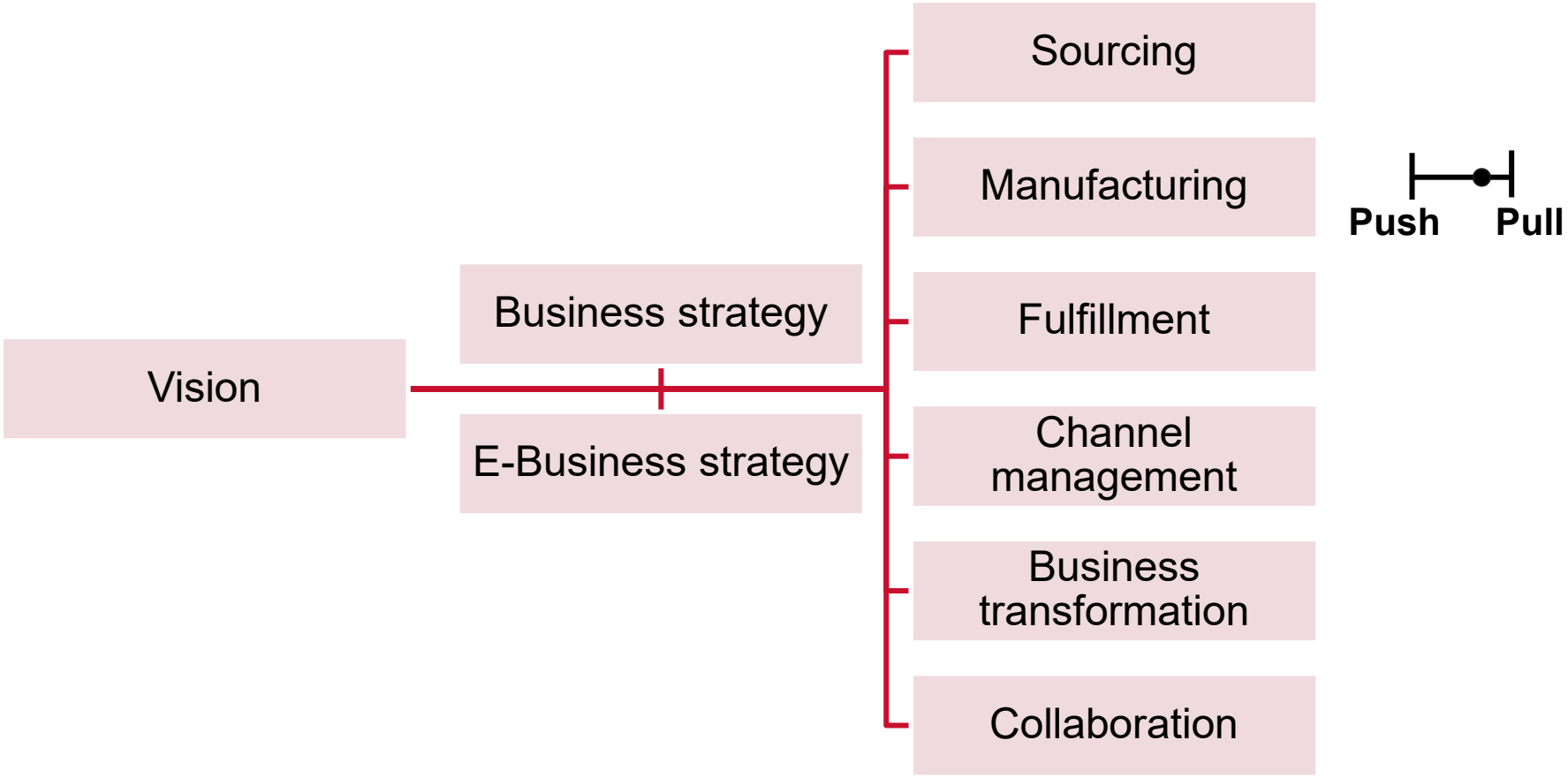
Microservices

- Cloud native
- Loose coupling within an application
- Publish/subscribe messaging

Traditional vs. Electronic Business Supply Chain

Characteristic	Traditional Supply Chain	Electronic Business Supply Chain
Ownership	Own vertical SC through mergers	Own core capabilities in virtual SC
Competitive advantage	High market share/assets dominate	Agile firms with few assets dominate
Nucleus firm	Retailer/manufacturing (industrial)	Brand equity or greatest efficiency
Trading	Best deal at expense of other	Share risks and rewards
Competitors	No competitor interaction	Interact if mutual gain can be found
Production	Economies of scale and scope	Engineering competitive SC
Collaboration	Internal silos/costly networking	Partner silos/open networking
Suppliers	Limited by buyer relations (phone)	Marketplaces and partner integration
Customer service	Reactive, with little feedback used	Proactive with better use of feedback
Intermediaries	Fixed, vertically integrated	Avoid some unless they add value

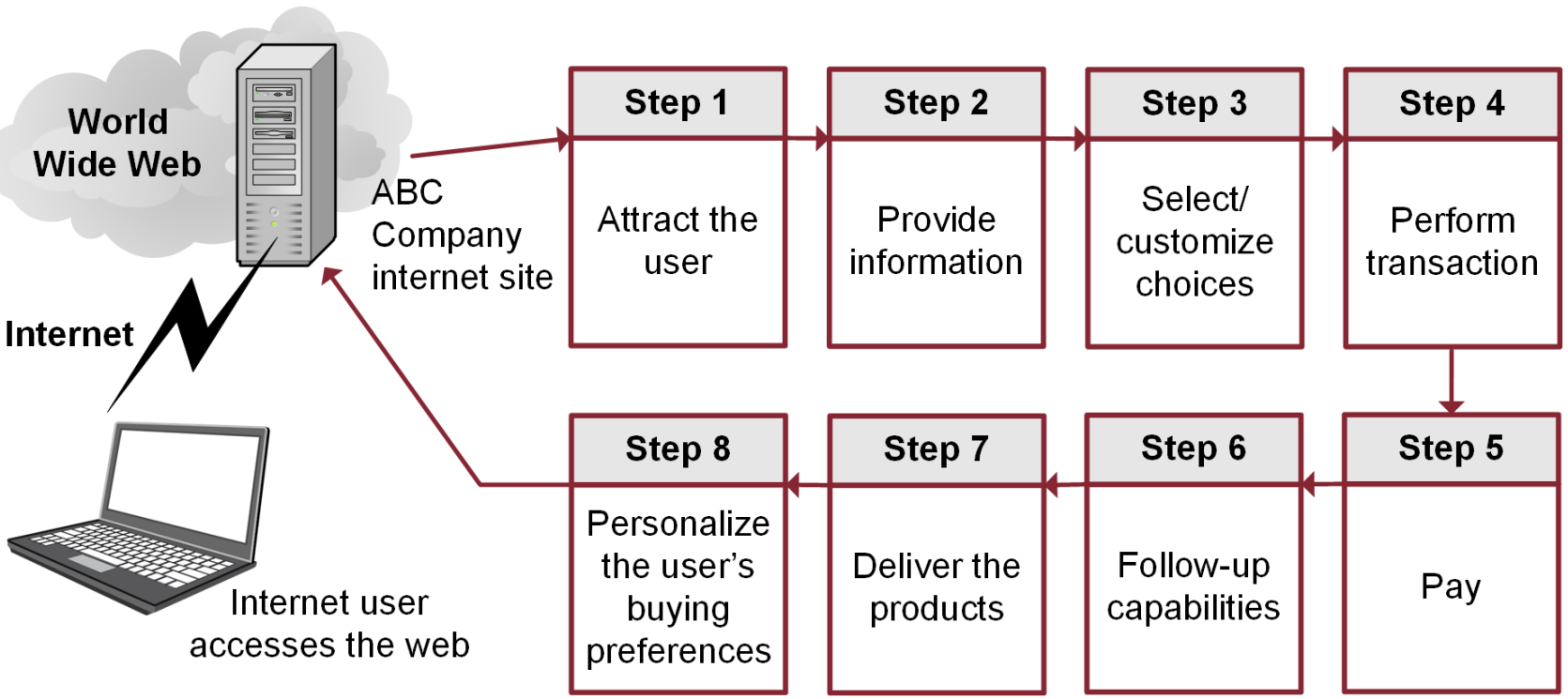
E-Business Considerations



Potential Costs and Challenges with e-Business

- Regular reinvestment
- Hardware/software
- Implementation and change management
- System security
- Increased outbound transportation costs
- Increased materials handling costs
- Reliance on outside suppliers
- Global localization
- Accessibility, ease of use

Sell-Side E-Commerce Website



Sharing Data Among Trading Partners

	Distributor Integration	Quick Response Program	Continuous Replenishment	Vendor-Managed Inventory
Customer Role	• N/A	• Provide POS data to supplier. • Submit individual orders.	• Notify suppliers of actual daily sales or ware-house shipments.	• Sell. • Do joint forecast. • Manage relationship. • Help logistics.
Supplier Role	Integrate IS to share: • Inventory data • Expertise • Inventory-related DI • Service-related DI.	• Synchronize supply with demand. • Forecast.	• Replenish without receiving orders. • Prevent stockouts. • Reduce inventory. • Improve turnover.	• Display, store, deliver, receive, stock, and count. • Schedule replenishment. • Keep inventory records. • Represent supplier at plant.

VMI and Consignment Combinations

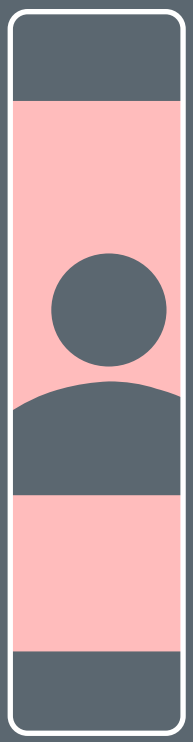
Consignment?	VMI? Yes.	VMI? No.
No.	Supplier decides on replenishment. Replenishment goods are immediately invoiced. Buyer owns inventory.	Traditional: Organization owns and manages inventory or sells it to independent distributors who order and manage their own inventory.
Yes.	Supplier decides on replenishment, but only sold inventory is invoiced. Supplier employs restockers, e.g., Frito Lay pays restockers per bag of chips sold to promote proactive restocking.	Seller wants/needs items on site but may not be fast-selling, e.g., hospital controls stock of pacemakers owned by supplier. When one is used, one is sent to replenish inventory and invoice is sent for the used one.

Collaborative Planning, Forecasting, and Replenishment (CPFR®)

Manufacturer Tasks	Collaboration Tasks	Retailer Tasks
Strategy & Planning		
Account planning Market planning	Collaboration arrangement Joint business plan	Vendor management Category management
Demand & Supply Management		
Market data analysis Demand planning	Sales forecasting Order planning/forecasting	POS forecasting Replenishment planning
Execution		
Production & supply planning Logistics/distribution	Order generation Order fulfillment	Buying/re-buying Logistics/distribution
Analysis		
Execution monitoring Customer scorecard	Exception management Performance assessment	Store execution Supplier scorecard

Legal and Privacy Requirements

Trade disruptions	Disruption insurance
Political risk: IP expropriation	Disruption insurance
Data privacy risk	PII policies, controls
Cybersecurity	Cyber insurance

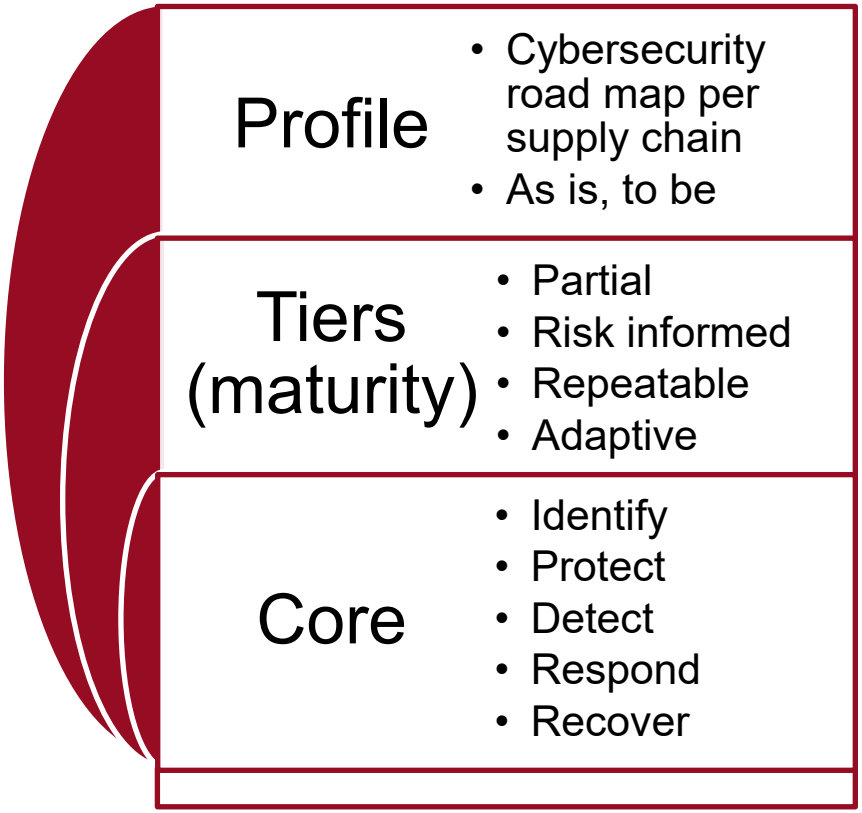


EU's GDPR Rights

- Informed how used
- Access personal data
- Correct errors
- Be forgotten
- Get copy
- Opt out

Cybersecurity Risks

NIST Cybersecurity Framework



MITRE ATT&CK Framework

- Reconnaissance
- Resource development
- Initial access
- Execution
- Persistence
- Privilege escalation
- Defense evasion
- Credential access
- Discovery
- Lateral movement
- Collection
- Command and control
- Exfiltration
- Impact

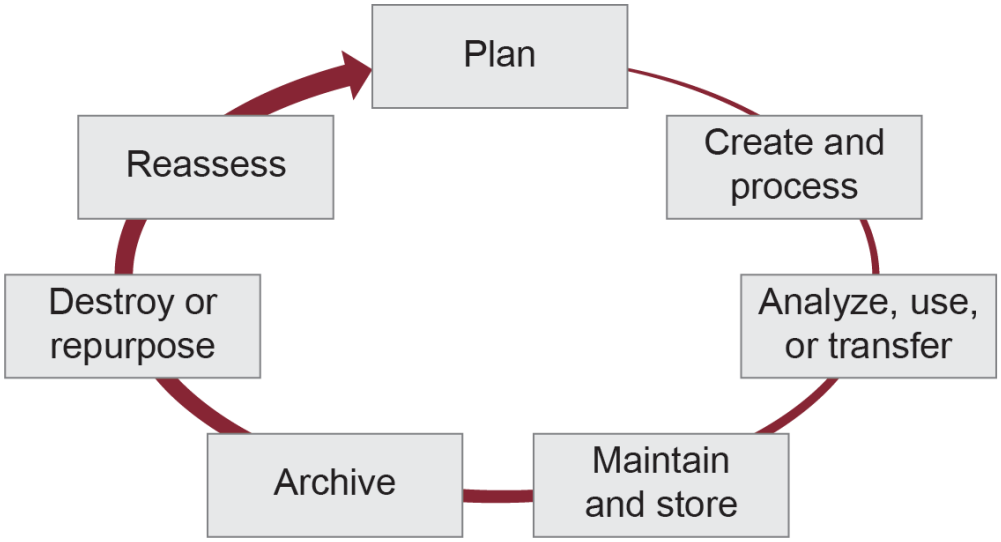
Master Data Management and Life Cycle

Master Data Management

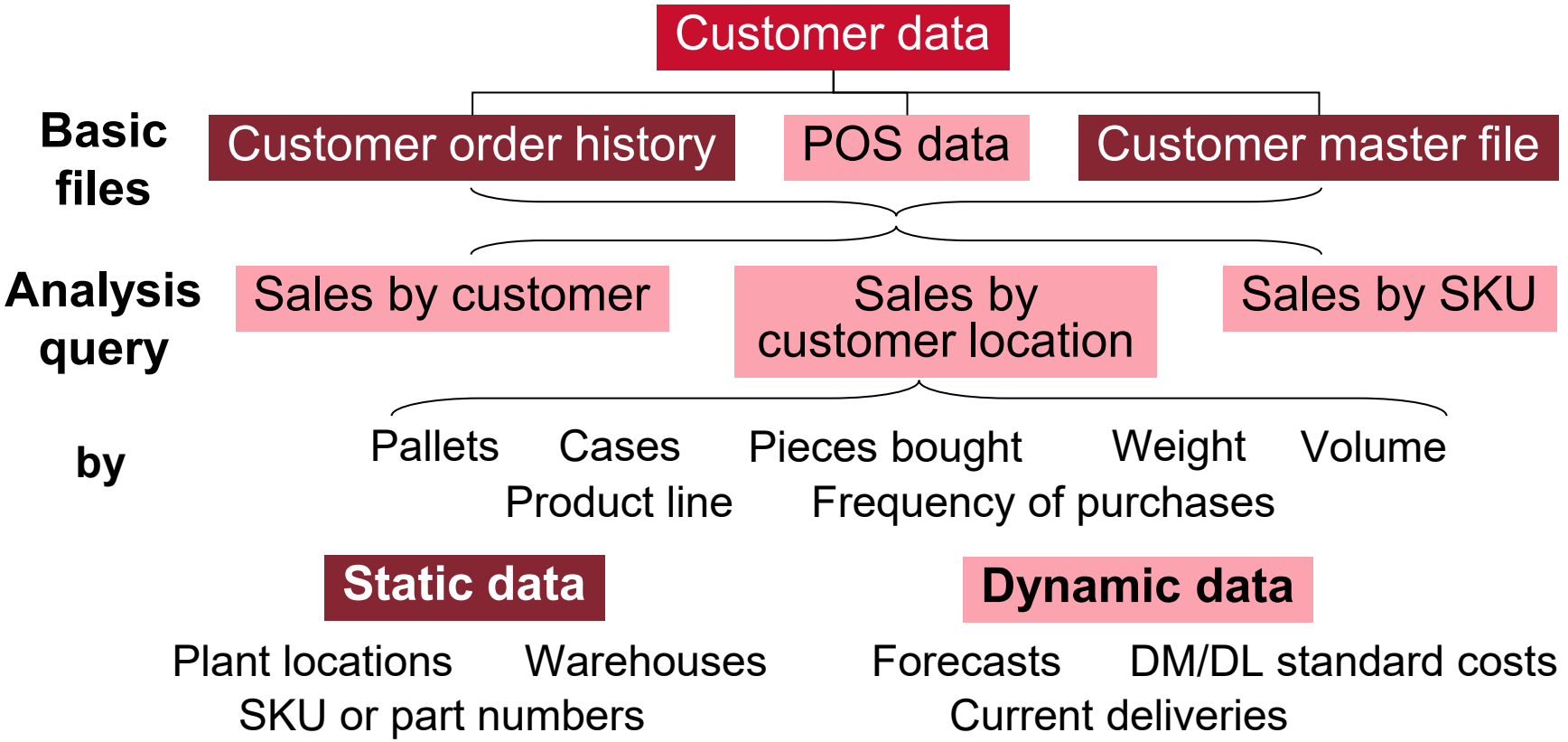
Governance, methodologies, policies, procedures, and technologies

- Coordinates life cycle
- Stewardship
- Accuracy
- Consistency
- Completeness
- Timeliness

Master Data Life Cycle



Types of Master Data Used



Creating Data: Data Capture

- Incremental data volume improvement.
- Partial data better than no data.
- Capture data at the source.
- Passive better than manual capture.
- Overcome fast-paced, hostile, or language barrier areas.
- Capture ancillary data when possible.
- Real-time is best, but batch may suffice.

Automatic Identification Technologies

Automatic Identification System (AIS)

- Automatic classification
  - Optimize for storage/transport
- Automatic identification
  - Devices communicate presence

Types of AIS

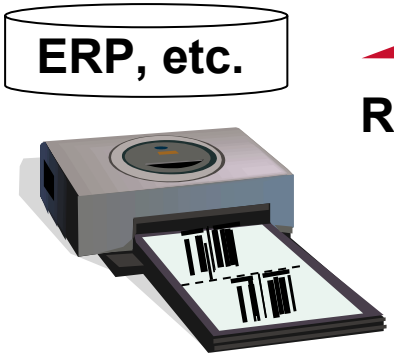
- Warehouse automation, bar codes, RF devices, RFID, smart cards, magnetic stripes, vision systems

Impact of AIS on SC

- Paper-free, fewer errors
- Wireless and real-time inputs and payments
- Reduces stockouts
- Enriches customer information/service
- Automated replenishment, inventory visibility
- Track savings to offset huge investment

Bar Codes and Bar Code Scanners

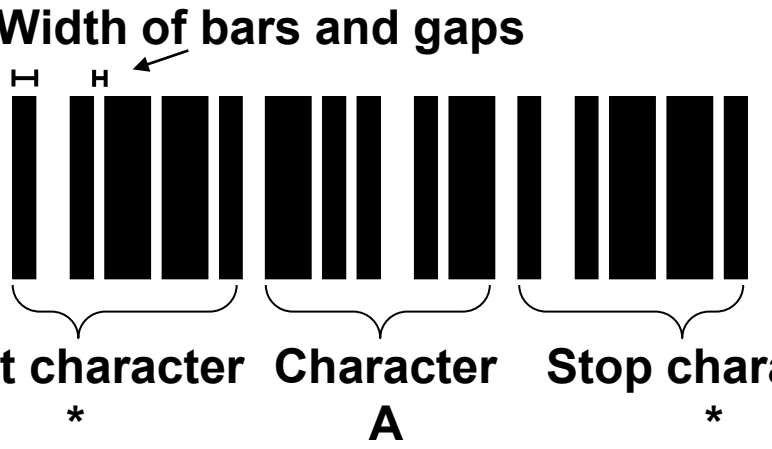
Direct link



RF link

UPC

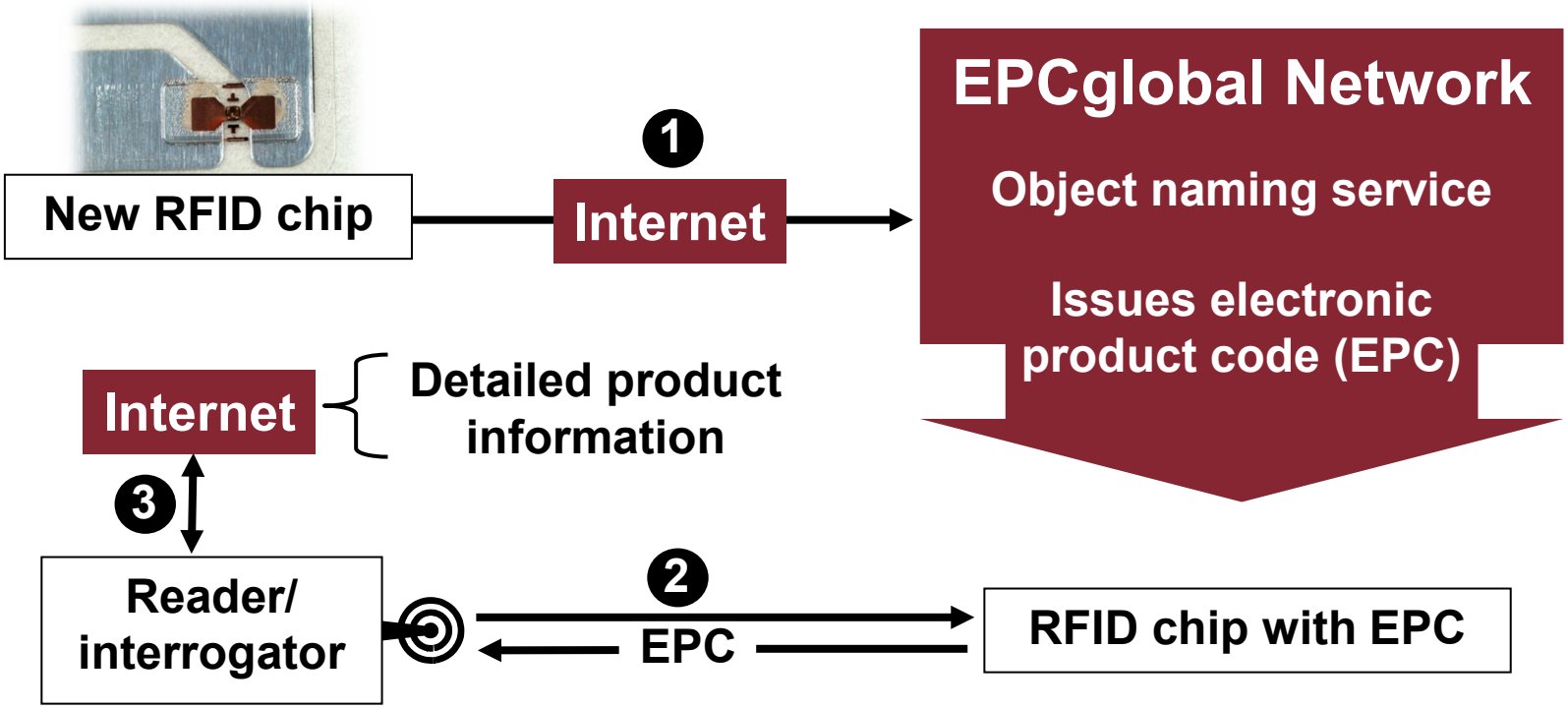
Identifies product SKU and manufacturer



2D: QR code

More information, e.g., serial number

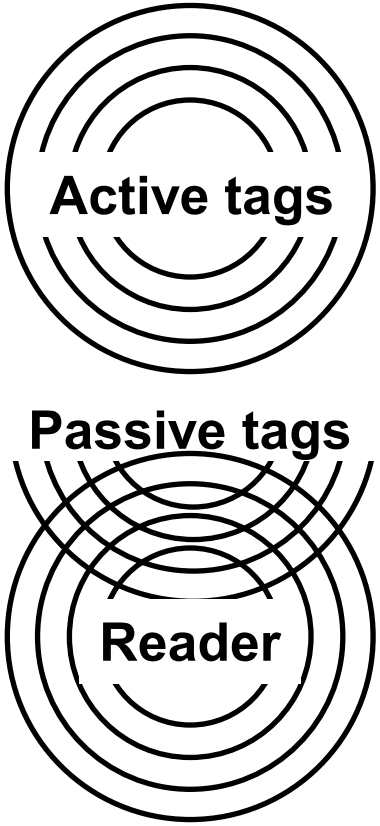
Radio Frequency Identification (RFID)



Internet verification prevents counterfeiting and stores extra product information.

RFID Tags, Errors, and Adjustments

Tag types



Causes of read errors

Antenna size **Reader power** **Frequency used**

Liquids absorb ⟷ **Signals** ⟷ **Metals reflect**

Reading cases on conveyor more reliable than whole pallet.

Adjustments

- **Readers located for low interference**
- **Buffers or shields**
- **Adjusting angle of antennae**
- **Changing reader/tag to suit facility**

Capturing and Communicating POS Data

Point-of-sale

- Inventory and sales data adjusted at time and place of sale (bar codes, etc.).
- Information collected about customers at time of sale.
- Mobile devices can collect POS data too.
- Needed for VMI, etc.

Benefits

- Capture data on SKU, promotions, inventory.
- Replace push with pull.
- Inventory deductions to finance.
- Collect purchasing habits.
- Reduce bullwhip effect.
- Reduce data entry errors.
- Low-cost updates.

Model and Data Validation

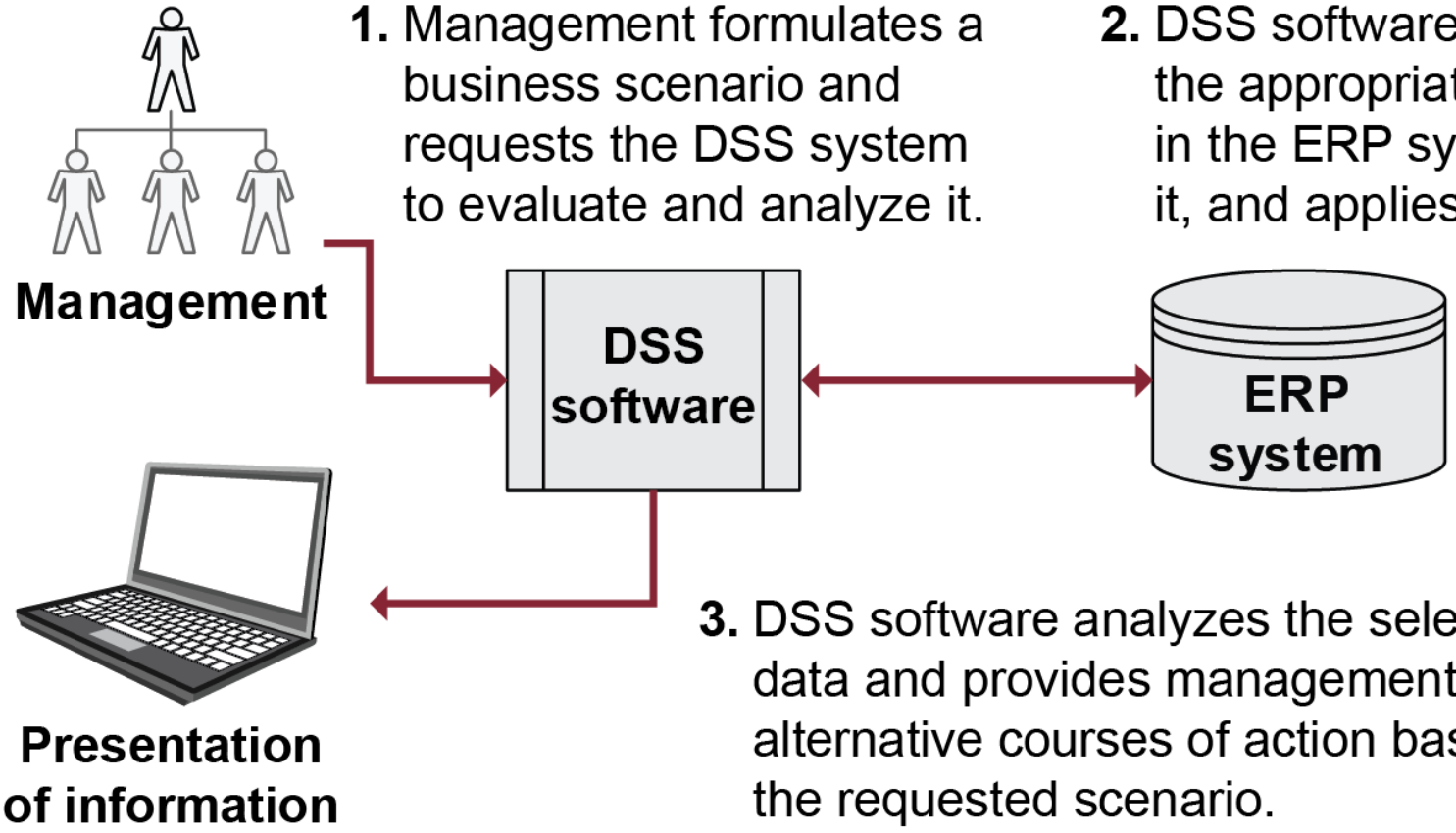
- **Test with historical data.**
- **Test with current data.**
- **Measure error related to aggregation.**

Data Aggregation

Smooths peaks and valleys: Pooling random variables reduces variance of aggregated variable.

Easier to interpret less data.

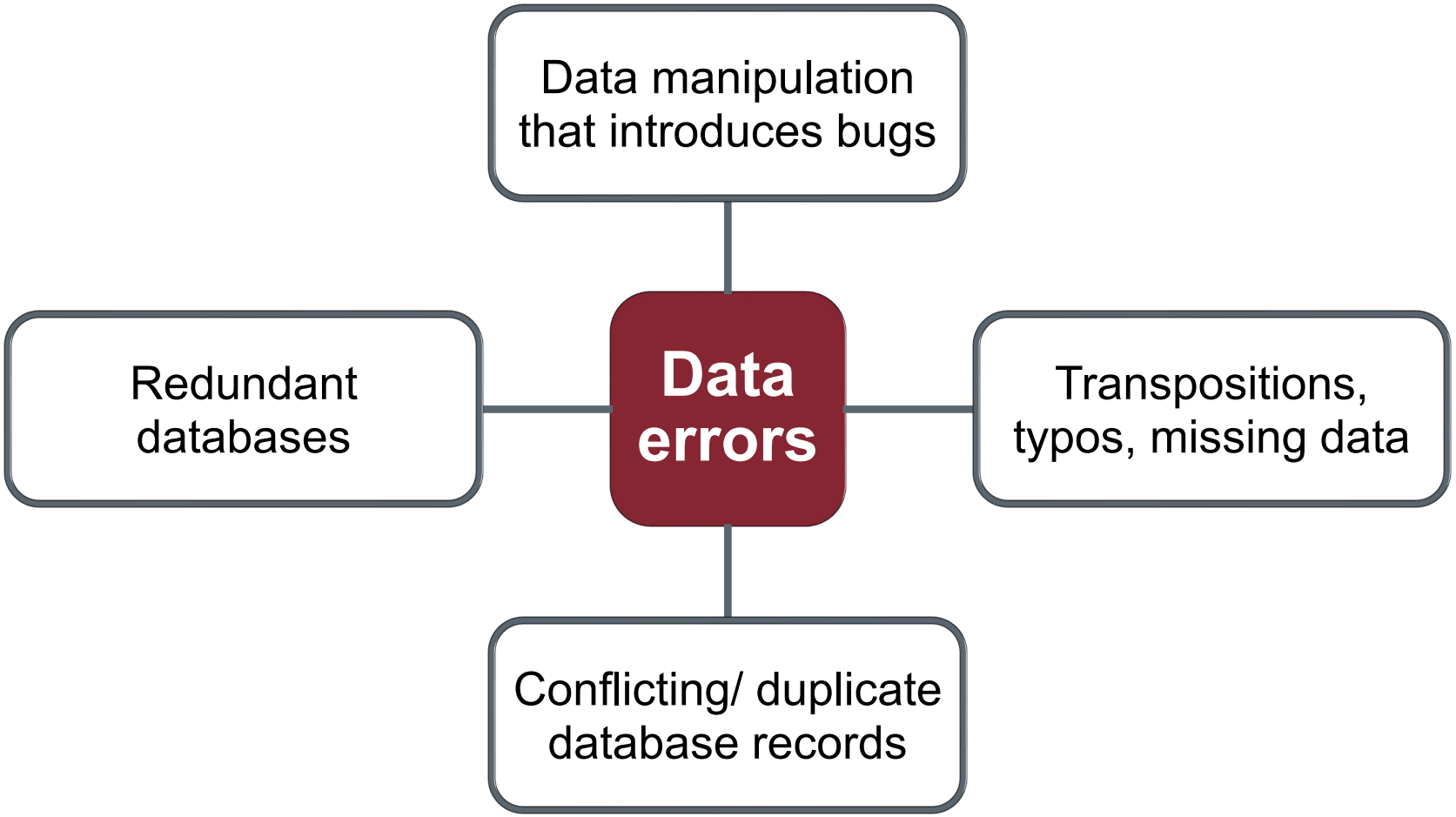
Decision Support Systems (DSS) and Big Data



Big Data and Data Analytics

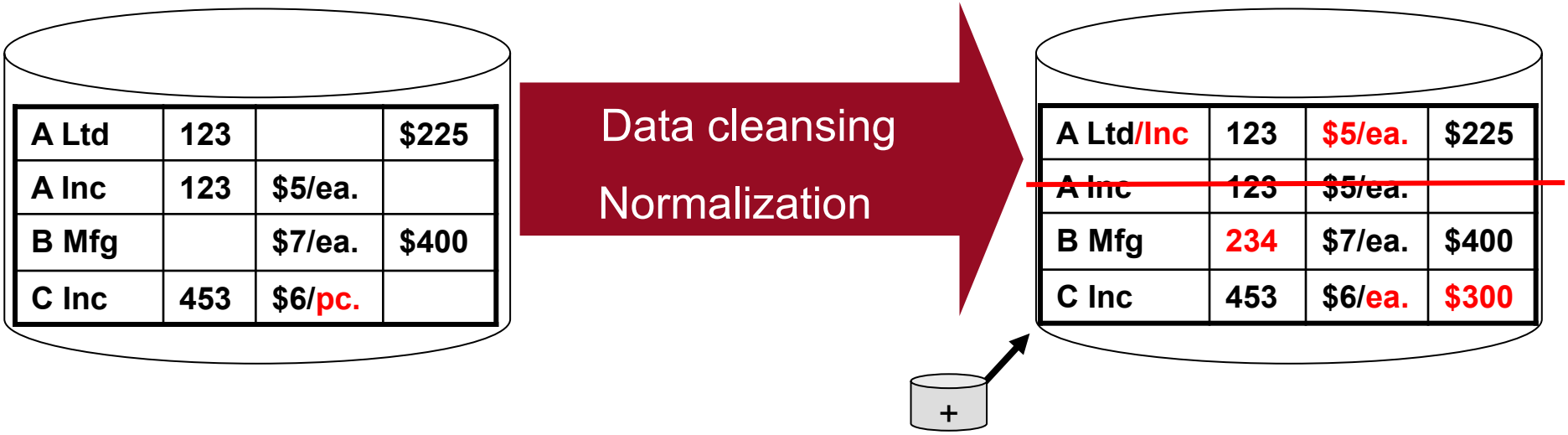
- Big data
  - Massive amount of structured and unstructured data
  - Identify problem areas in supply chain early
  - How best to collect, use, and leverage?
- Data acquisition and analytics goal: Seamless links among processes and partners
  - Collecting information
  - Timely, controlled access
  - Reducing visibility gaps
  - Improving planning effectiveness
  - Ensuring and maintaining data accuracy

Causes of Errors



Ways to Improve Data Accuracy

- Sharing POS/transaction data across SC
- Real-time transfer when feasible
- Immediate data entry/automation if feasible



Maintaining Data Accuracy

Role-based policies, procedures

Software limits for adding, deleting, modifying

Data maintenance and continuous user training

CSCP

CERTIFIED SUPPLY CHAIN PROFESSIONAL

SECTION C:
SUPPLY CHAIN METRICS AND REPORTS

APICS

ASCM

Section C Introduction

Section C Key Processes:

- Develop and maintain reports, analytics, and metrics.
  - Incorporate supply chain operations reference (SCOR) metrics.
  - Utilize dashboards and balanced scorecards.
  - Define financial metrics and reports.
  - Define operational metrics and reports.

Section C Topics:

- Topic 1: Supply Chain Metrics, Reports, and SCOR
- Topic 2: Financial and Operational Metrics and Reports

Measuring Performance

Performance Measures

- You get what you measure
- Objective, consistent, and quantified
- Measure at least 2 parameters (e.g., quality, time)
- Set targets to gauge relative success
- Customize

Internal Measurement Benefits

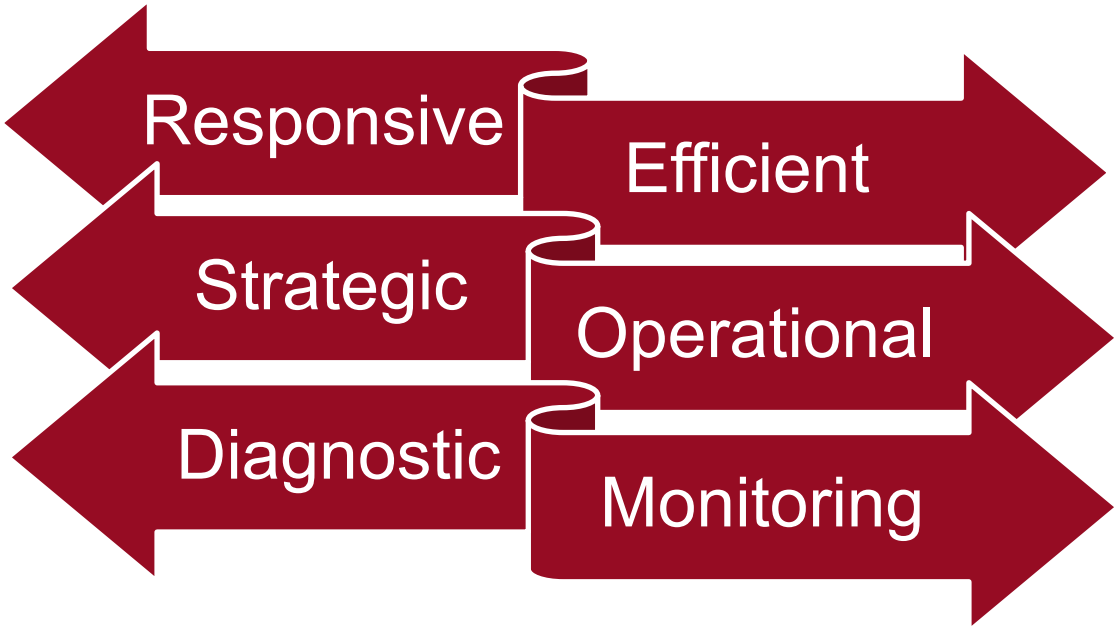
Control of processes and employees

Reporting to managers and external sources

Communication of expectations and problems

Learning and continuous improvement

Metric Selection Framework



Balanced Scorecard (BSC)

Customer Perspective

Goal	Measure	Target	Actual

Present performance, future prospects

Innovation & Learning Perspective

Goal	Measure	Target	Actual

Training and product development

Business Process Perspective

Goal	Measure	Target	Actual

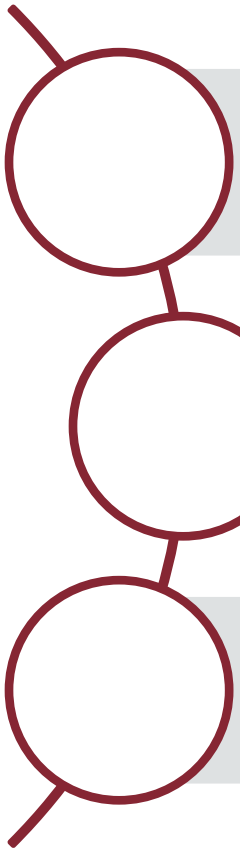
Productivity, prospecting, flexibility, etc.

Financial Perspective

Goal	Measure	Target	Actual

Traditional, historical only, necessary

Key Elements in Balanced Scorecard (BSC) Initiative



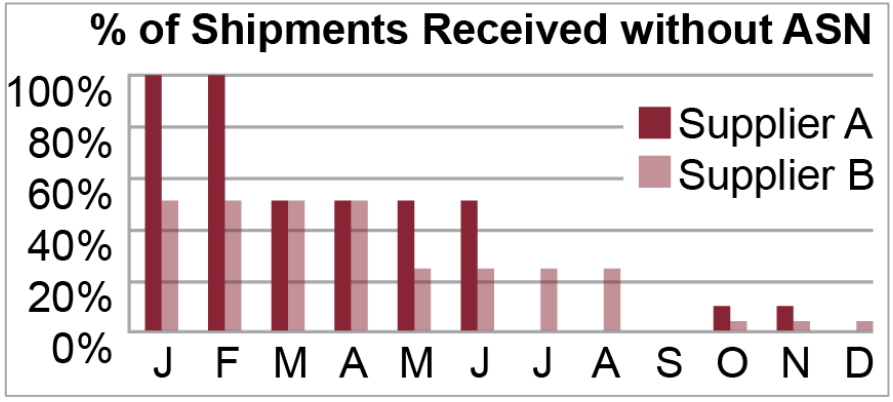
Communicate strategic purpose of scorecard to partners.

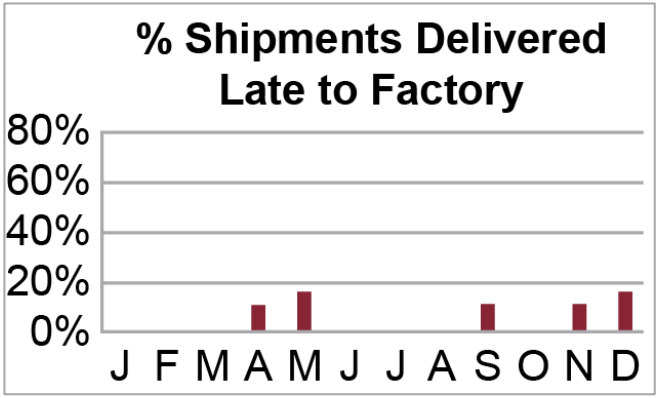
Develop goals and measures consistent with internal and SC strategies.

Create schedules and assign responsibilities.

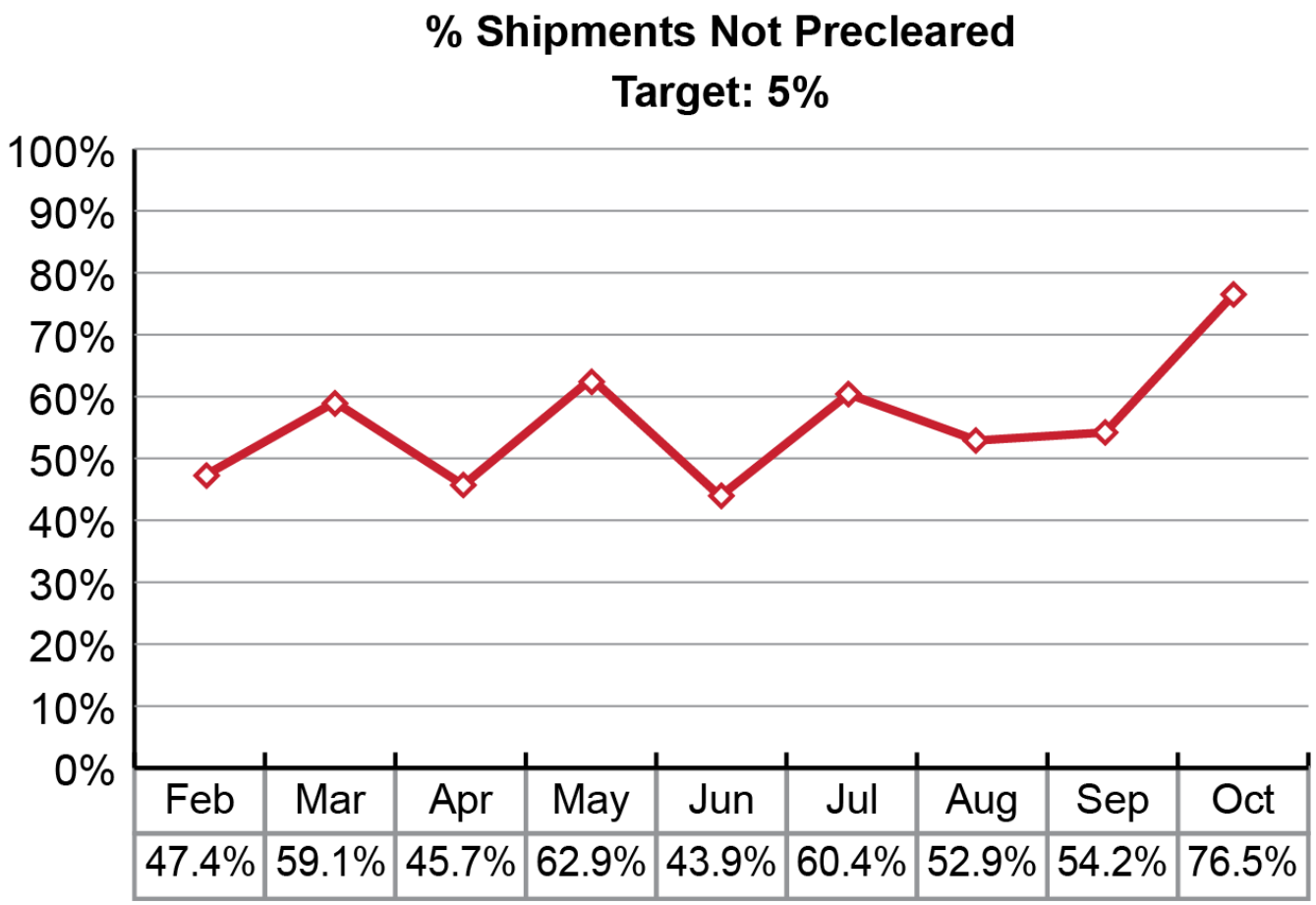
Custom Scorecard for 3PL (Service Quality)

Category	Target	Jan	Feb
ASN Compliance			
% Shipments Received Without ASN: Supplier A	0%	100%	100%
% Shipments Received Without ASN: Supplier B	0%	50%	50%
Inventory Count			
# of Parts Physically Counted	—	28	28
Inventory Accuracy Based on Physical Count	100%	80%	85%





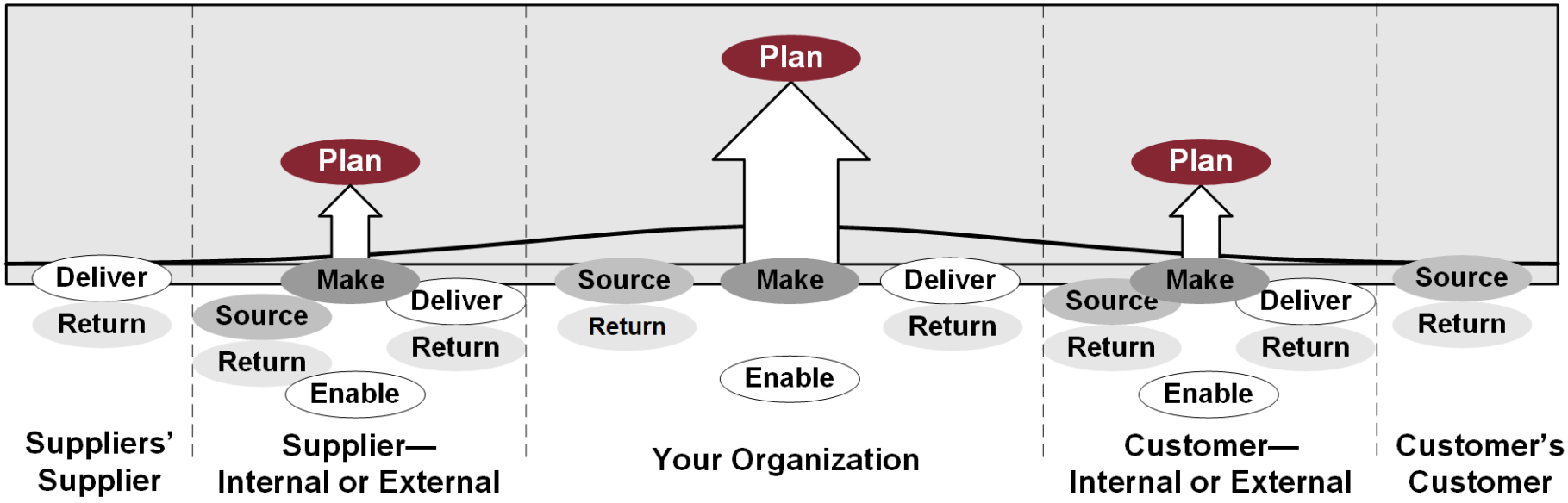
Performance Metrics



Average actual is about 50%, target is 5%, so:

- Review measurement and target to see if accurate and feasible
- Mandate supplier process correction and/or set more realistic target.

SCOR® Digital Standard's Process Model



Level 1 SCOR Management Processes

Plan	Demand/supply plans for operating SC: gather requirements, collect resource data, and balance requirements and resources to find capabilities and gaps
Source	Ordering (scheduling) and receipt of incoming goods and services: POs, schedule, receive, validate, store, and accept invoice
Make	Conversion of materials/creation of services: assembly, maintenance, repair, etc. (1+ items go in → 1+ different items come out)
Deliver	Creation, maintenance, and fulfillment of customer orders: validate receipt; create order; schedule delivery; pick, pack, ship; and invoice
Return	Reverse flow of goods: identify need, ship, and return (does not include repair, recycling, or refurbishment)
Enable	Establish, maintain/monitor information, relationships, resources, assets, business rules, compliance, and contracts

SCOR Level 2 Process Types

Process Type	Description
Planning Aligns expected resources to meet expected demand requirements	• Balance aggregated demand and supply • Occurs at regular, periodic intervals • Consider consistent planning horizon • Can contribute to SC response time
Execution Process triggered by planned or actual demand that changes state of materials	• Involves: Scheduling/ sequencing → Transforming product → Moving product to next process • Can contribute to order fulfillment cycle time

Possible Capabilities in Execution Process

Make-to-stock

Driven by inventory (plan)

- Standard material orders
- High fill rate, short turn-around

Make-to-order

Driven by customer orders

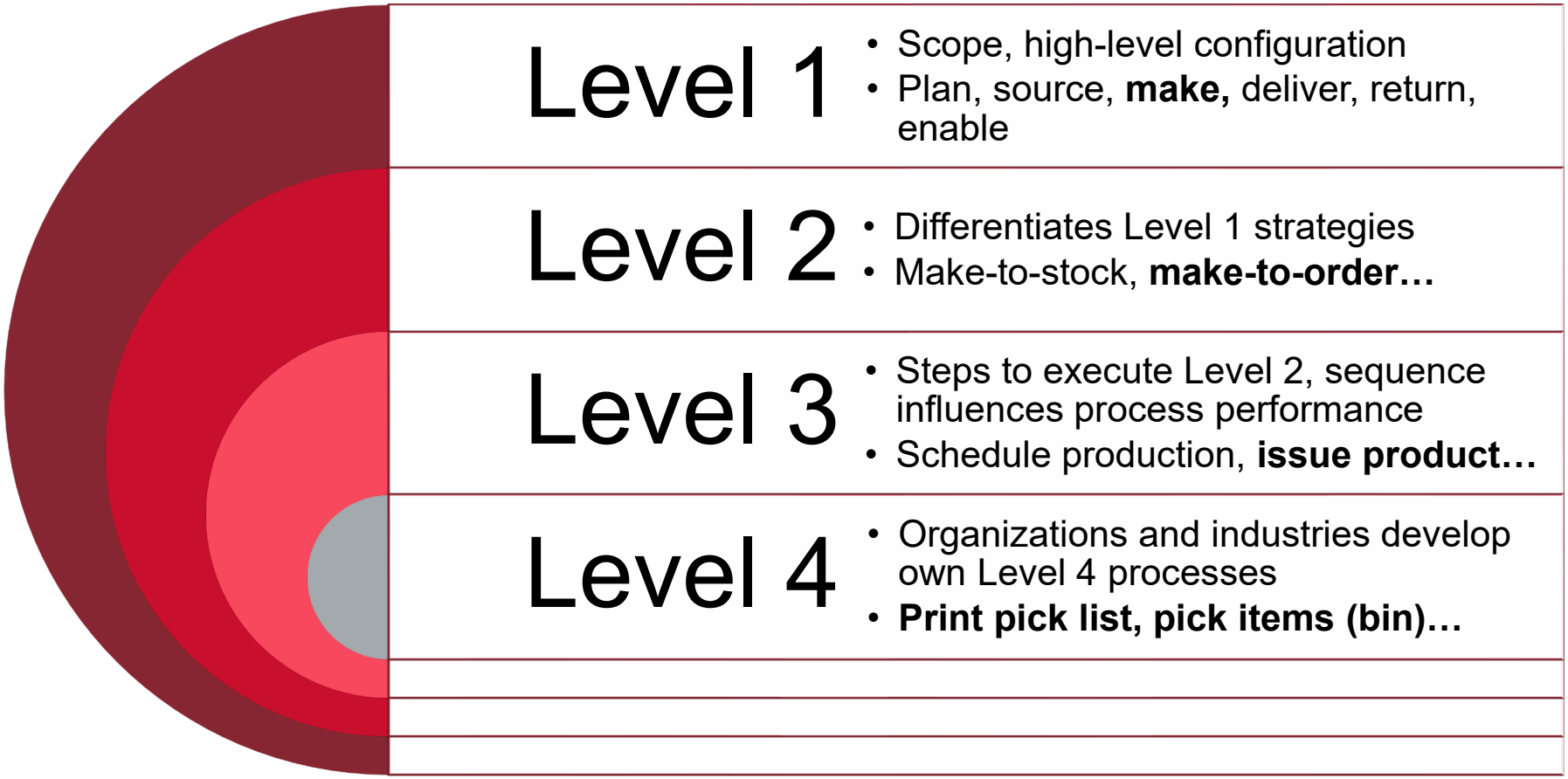
- Configurable materials
- Longer turn-around times

Engineer-to-order

Driven by customer requirements

- Sourcing new materials
- Longest lead times, low fill rates

Levels of Process Details in SCOR



***Use of bold text indicates a running example per level.**

SCOR Performance Attributes and Metrics

Performance Attribute	Performance Attribute Definition	Level 1 Metric
Supply chain reliability	Correct product, place, time, condition, packaging, quantity, documentation, and customer	Perfect order fulfillment
Supply chain responsiveness	Speed at which SC provides products to customer	Order fulfillment cycle time
Supply chain agility	Ability of SC to respond to marketplace changes to gain or maintain competitive advantage	Upside SC adaptability Downside SC adaptability Overall value at risk
Supply chain costs	Costs associated with operating supply chain	Total supply chain management cost Cost of goods sold
Supply chain asset management	Effectiveness in managing assets to support demand satisfaction; includes fixed assets and working capital	Cash-to-cash cycle time Return on SC fixed assets Return on working capital

Supply Chain Reliability and Responsiveness

Area	SCOR Level 1 Metric	Definition	Calculation
Reliability	Perfect order fulfillment	Percentage of orders with complete and accurate items and documentation and no delivery damage.	$\frac{\text{Total Perfect Orders}}{\text{Total Number of Orders}}$
Responsiveness	Order fulfillment cycle time	Average speed of delivery.	Order Fulfillment Process Time + Order Fulfillment Dwell Time

Supply Chain Agility

SCOR Level 1 Metric	Definition	Calculation
Upside SC adaptability	Amount of increased production an organization can achieve and sustain in 30 days	Largest sustainable quantity increase considering source, make, and deliver components
Downside SC adaptability	Amount of decreased production an organization can achieve and sustain in 30 days	Least reduction sustainable when considering source, make, deliver, and return components
Overall value at risk (VaR)	Evaluation of SC agility based on selected performance measures	Sum of the SC's values at risk

Supply Chain Costs (Financial Metrics)

SCOR Level 1 Metric	Definition	Calculation
Total supply chain management cost (TSCMC)	Costs to plan, source, make, deliver, return, and mitigate.	TSCMC = Sales − Profits − Cost to Serve
Cost of goods sold (COGS)	Costs associated with buying raw materials and producing finished goods.	Direct Materials + Direct Labor + Overhead

Supply Chain Asset Management

SCOR Level 1 Metric	Definition	Calculation
Cash-to-cash cycle time	Time for inventory investment to flow back as cash receipts.	Days of Sales Outstanding + Inventory Days of Supply − Days of Payables Outstanding
Return on SC fixed assets	Return on capital invested in fixed assets for plan, source…	$\frac{\text{(SC Revenue − COGS − SC Management Costs)}}{\text{SC Fixed Assets}}$
Return on working capital	An organization's working capital position versus SC revenue.	$\frac{\text{(SC Revenue − COGS − SC Management Costs)}}{\text{(Inventory + A/R − A/P)}}$

Digital Capabilities Model for Supply Networks

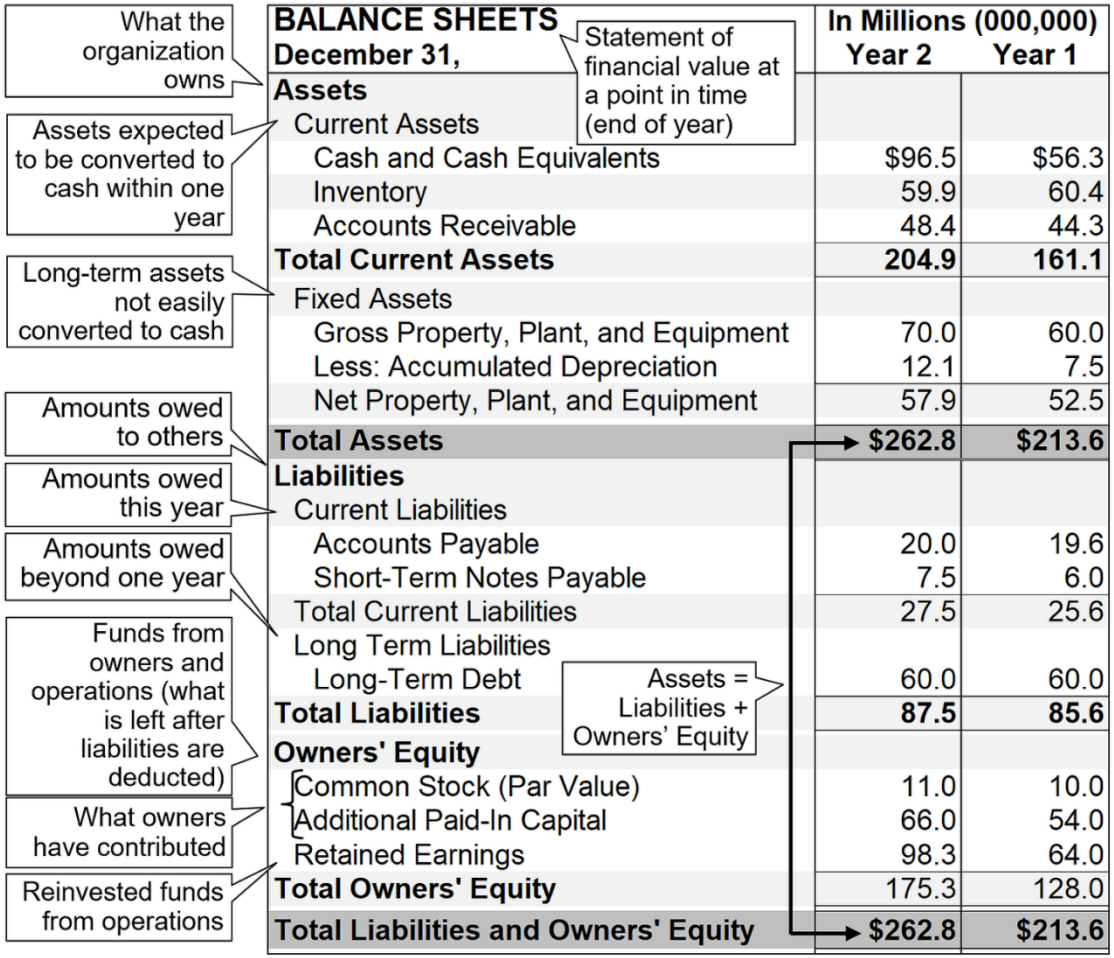
Capability	Description	SCOR Linkages
Connected customer	Inspire at start of customer life cycle; service at the end.	Enable
Product development	Do proactive product life-cycle management.	Enable
Synchronized planning	Leverage human and process capabilities for planning efficiency.	Plan, enable
Intelligent supply	Leverage technologies to reduce costs.	Source, enable
Smart operations	Digital transformation for connectivity, agility, and proactivity.	Make, enable
Dynamic fulfillment	Add order fulfillment speed and agility.	Deliver, return, enable

Standard Costing

A cost accounting system that uses cost units determined before production for estimating the cost of an order or product

COST = VOLUME x RATE

Balance Sheet for Two Years



BALANCE SHEETS December 31,	In Millions (000,000) Year 2	 Year 1
Assets		
Current Assets		
Cash and Cash Equivalents	$96.5	$56.3
Inventory	59.9	60.4
Accounts Receivable	48.4	44.3
Total Current Assets	**204.9**	**161.1**
Fixed Assets		
Gross Property, Plant, and Equipment	70.0	60.0
Less: Accumulated Depreciation	12.1	7.5
Net Property, Plant, and Equipment	57.9	52.5
Total Assets	**$262.8**	**$213.6**
Liabilities		
Current Liabilities		
Accounts Payable	20.0	19.6
Short-Term Notes Payable	7.5	6.0
Total Current Liabilities	27.5	25.6
Long Term Liabilities		
Long-Term Debt	60.0	60.0
Total Liabilities	**87.5**	**85.6**
Owners' Equity		
Common Stock (Par Value)	11.0	10.0
Additional Paid-In Capital	66.0	54.0
Retained Earnings	98.3	64.0
Total Owners' Equity	175.3	128.0
Total Liabilities and Owners' Equity	**$262.8**	**$213.6**

Income Statement for Two Years

Expenses from providing goods/services that generate revenue

Revenue – COGS = Gross Profit

General expenses from running business that cannot be directly linked to specific units of goods/ services sold

Lowers fixed asset value for taxes

Payments on debt

Shows effect of taxes on profits

Gross Profit – Operating Expenses – Depreciation – Interest Exp. – Income Taxes = Net Income

INCOME STATEMENTS For the Years Ending (Profit or loss over a period of time)	(000,000s) except per share amts. Year 2	Year 1
Revenue (Sales)	**$302.6**	**$276.9**
Direct Labor	38.3	37.6
Direct Materials	101.5	99.7
Factory Overhead	26.6	26.1
Less: Cost of Goods Sold (COGS)	166.4	163.4
Gross Profit	**136.2**	**113.5**
Less: Operating Expenses		
Selling Expenses	30.3	24.9
General and Administrative	27.2	22.2
Lease Expense	12.1	8.3
Less: Total Operating Expenses	69.6	55.4
Less: Depreciation	4.6	4.0
Less: Interest Expense	3.9	3.9
Net Income (Profit) Before Taxes	**58.1**	**50.3**
Less: Income Taxes	16.3	14.1
Net Income (Profit) (The "bottom line")	**$41.8**	**$36.2**
Net Income (as a Pct. of Revenue)	14%	13%
Net Income Per Share-Basic	**$3.95**	**$3.78**

Statement of Cash Flows for Two Years

A viable firm needs positive cash flow from operations in most years.

Depreciation is deducted on the income statement but doesn't reduce cash (added back).

Increase in inventory or accounts receivable reduces cash.

Increase in accounts payable increases cash.

Increase in business investments decreases cash.

Increase in new debt or equity provides cash.

Net Income
+/– Change in (Δ) Operating
+/– Δ Investing
+/– Δ Financing
+ Beginning Cash
= Ending Cash

CASH FLOW STATEMENTS	In Millions (000,000)	
Year (Change in cash balance over a period of time)	Year 2	Year 1
Operating Section		
After-Tax Net Income	$41.8	$36.2
Depreciation Add-Back	4.6	4.0
(Increase)/Decrease in Inventory	0.5	(8.6)
(Increase)/Decrease in Accounts Receivable	(4.1)	(4.1)
Increase/(Decrease) in Accounts Payable	0.4	1.8
Cash Flow from Operations	**43.2**	**29.3**
Investing Section		
Capex Spend (Capital Expenditures)	(10.0)	(10.0)
Cash Flow from Operations and Investment	**33.2**	**19.3**
Financing Section		
Additional Equity Capital	13.0	7.0
Less Dividends Paid	(7.5)	(5.0)
Increase/(Decrease) in Long-Term Debt	-	-
Increase/(Decrease) in Short-Term Notes	1.5	(1.5)
Cash Flow from Operations, Investments, and Financing	**40.2**	**19.8**
Beginning Cash Balance	56.3	36.5
Ending Cash Balance	**$96.5**	**$56.3**

Supply Chain Financial Metrics

Supply chain profit	Supply chain management cost reduction and efficiency efforts impact profit, e.g., Contribution Margin = Sales − Variable Costs.
Supply chain cost	Cost areas include order processing, inventory, transportation, warehousing and materials handling, and network integration.
Supply chain total cost	An aggregation of the costs of all organizations that participate in a given supply chain.
Altman Z-score	A combination of four or five weighted ratios to measure bankruptcy risk.
Customer creditworthiness	The goal of monitoring customer creditworthiness is to ensure that invoices are paid on time.

Operational Metrics