Supply Chain Analytics

Lecture 6: Supply chain measures of performance

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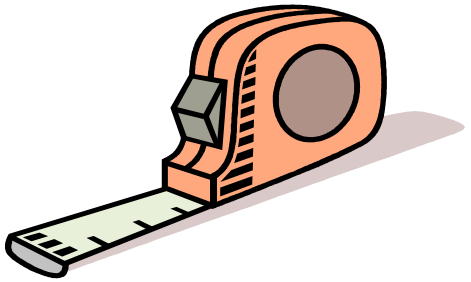
The Micros and More logistics profile points out a very important issue for all organizations: Each needs performance measurements or metrics.

Achieving efficiency and effectiveness objectives requires a set of standards to compare to actual performance.

These standards are called metrics.

DIMENSIONS OF PERFORMANCE METRICS

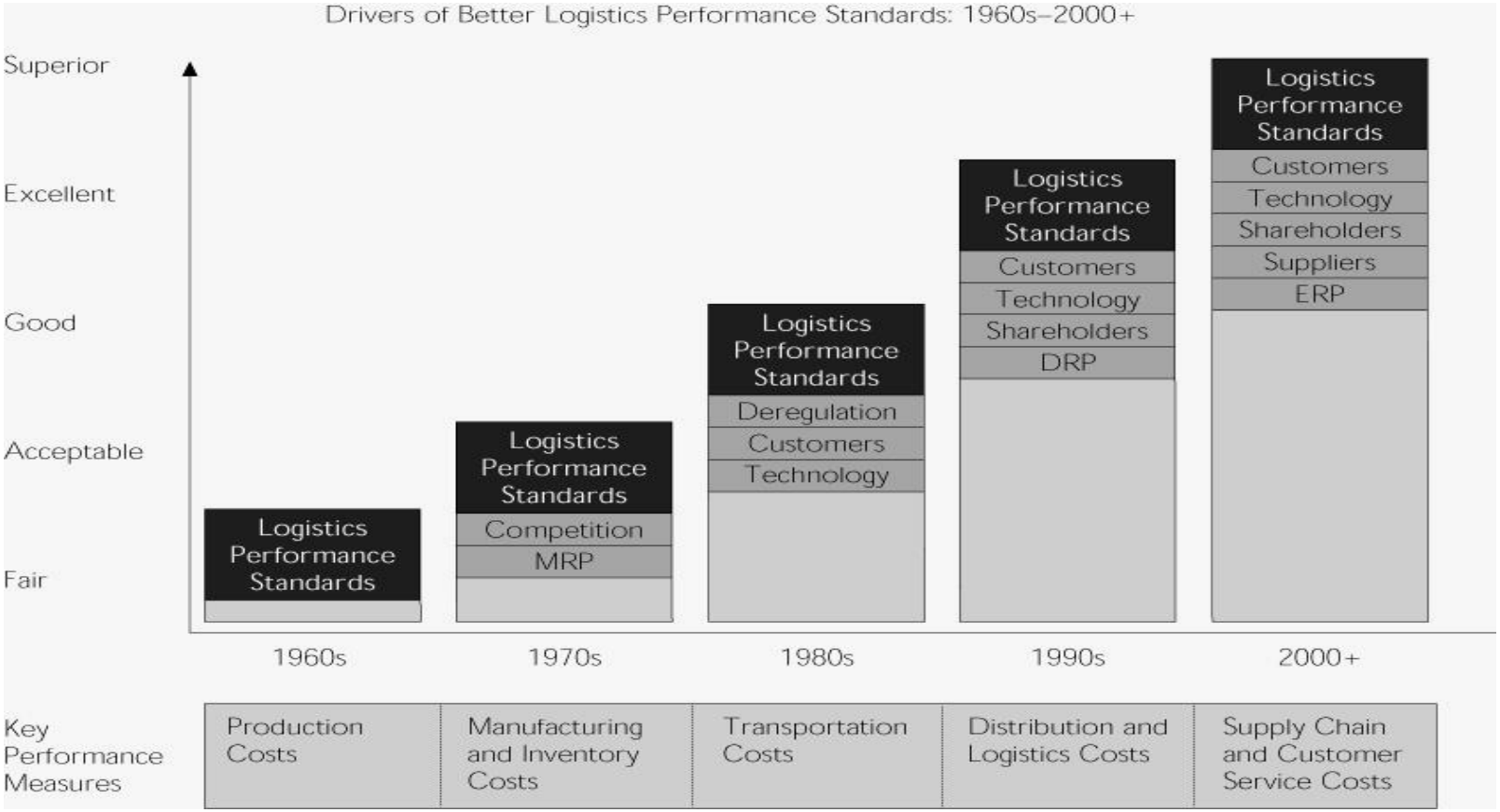


Establishing appropriate metrics is a complex problem.

- Measuring inappropriate performance can lead to a company chasing the wrong goal.
- Metrics drive behavior --- what you measure is what you get.

Logistics cost metrics should focus on the total supply chain, not on just one link.

FIGURE 1
RAISING THE PERFORMANCE BAR



OVERVIEW OF PERFORMANCE MEASUREMENT[1]

Figure 2 contains a list of performance measures captured on a regular basis within companies.

Knowing what metrics to use is a very important issue.

Figure 3 provides some insight into the characteristics of good performance measures.

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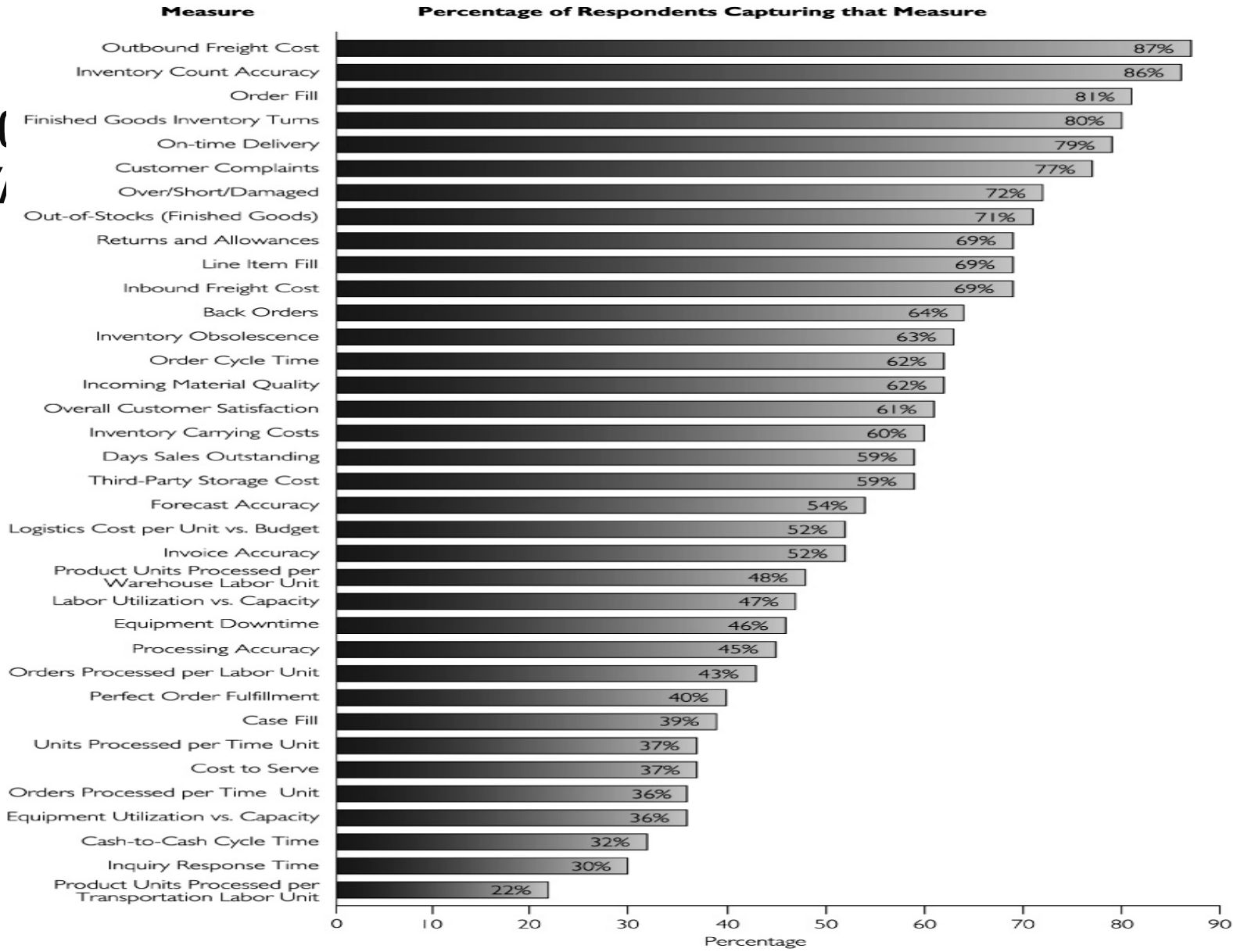
Measure
Percentage of Respondents Capturing that Measure
Outbound Freight Cost 87%
Inventory Count Accuracy 86%
Order Fill 81%
Finished Goods Inventory Turns 80%
On-time Delivery 79%
Customer Complaints 77%
Over/Short/Damaged 72%
Out-of-Stocks (Finished Goods) 71%
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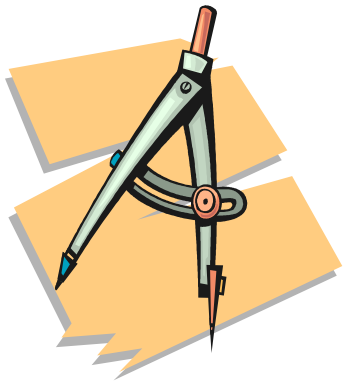
Units Processed per Time Unit 37%
Cost to Serve 37%
Orders Processed per Time Unit 36%
Equipment Utilization vs. Capacity 36%
Cash-to-Cash Cycle Time 32%
Inquiry Response Time 30%
Product Units Processed per Transportation Labor Unit 22%
0 10 20 30 40 50 60 70 80 90
Percentage

FIGURE 3 *CHARACTERISTICS OF GOOD MEASURES*

A Good Measure	Description
• is quantitative	• The measure can be expressed as an objective value.
• is easy to understand	• The measure conveys at a glance what it is measuring, and how it is derived.
• encourages appropriate behavior	• The measure is balanced to reward productive behavior and discourage "game playing."
• is visible	• The effects of the measure are readily apparent to all involved in the process being measured.
• is defined and mutually understood	• The measure has been defined by and/or agreed to by all key process participants (internally and externally).
• encompasses both outputs and inputs	• The measure integrates factors from all aspects of the process measured.
• measures only what is important	• The measure focuses on a key performance indicator that is of real value to managing the process.
• is multidimensional	• The measure is properly balanced between utilization, productivity, and performance, and shows the trade-offs.
• uses economies of effort	• The benefits of the measure outweigh the costs of collection and analysis.
• facilitates trust	• The measure validates the participation among the various parties.

Source: Keeping Score: Measuring the Business Value of Logistics in the Supply Chain, CSC, University of Tennessee, CLM, 8.

OTHER USEFUL PERFORMANCE GUIDELINES[2]



The metrics must be consistent with overall corporate strategy.

The metrics must focus on customer needs and expectations.

Prioritize your metrics.

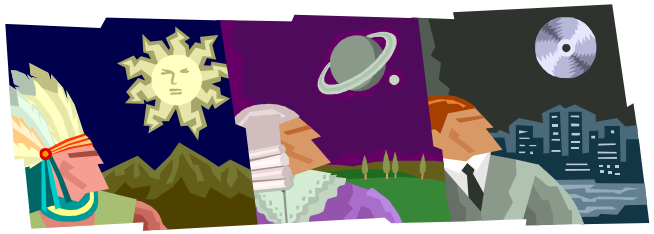
Focus upon processes not functions.

Use a balanced approach in selecting and developing metrics.

Precise cost measurement is an important aspect for gauging improvement.

Use technology to enhance efficient performance measurement.

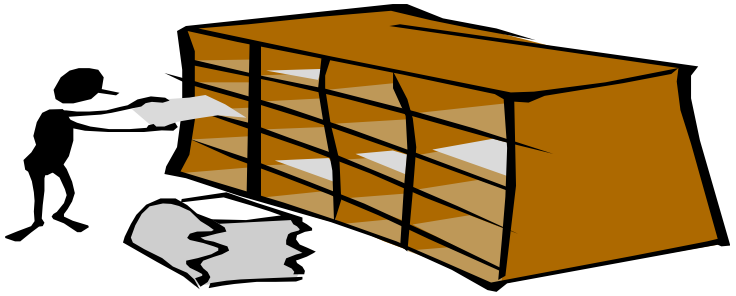
EVOLUTION OF METRICS UTILIZATION



Most organizations go through several phases in the development of meaningful metrics:

- Stage 1 – awareness of the importance of using the appropriate metric
- Stage 2 – developing the actual metric
- Stage 3 – performance improvement
- Stage 4 – integration internally and across the supply chain

PERFORMANCE CATEGORIES



There are a number of approaches that can be used to classify performance metrics.

The next two slides illustrate performance metrics:

- Figure 13-4 identifies four principle process measure categories.
- Figure 13-5 shows various customer service metrics and how important they are to customers.

FIGURE 4
PROCESS MEASURE CATEGORIES

FIGURE 13–4 Process Measure Categories

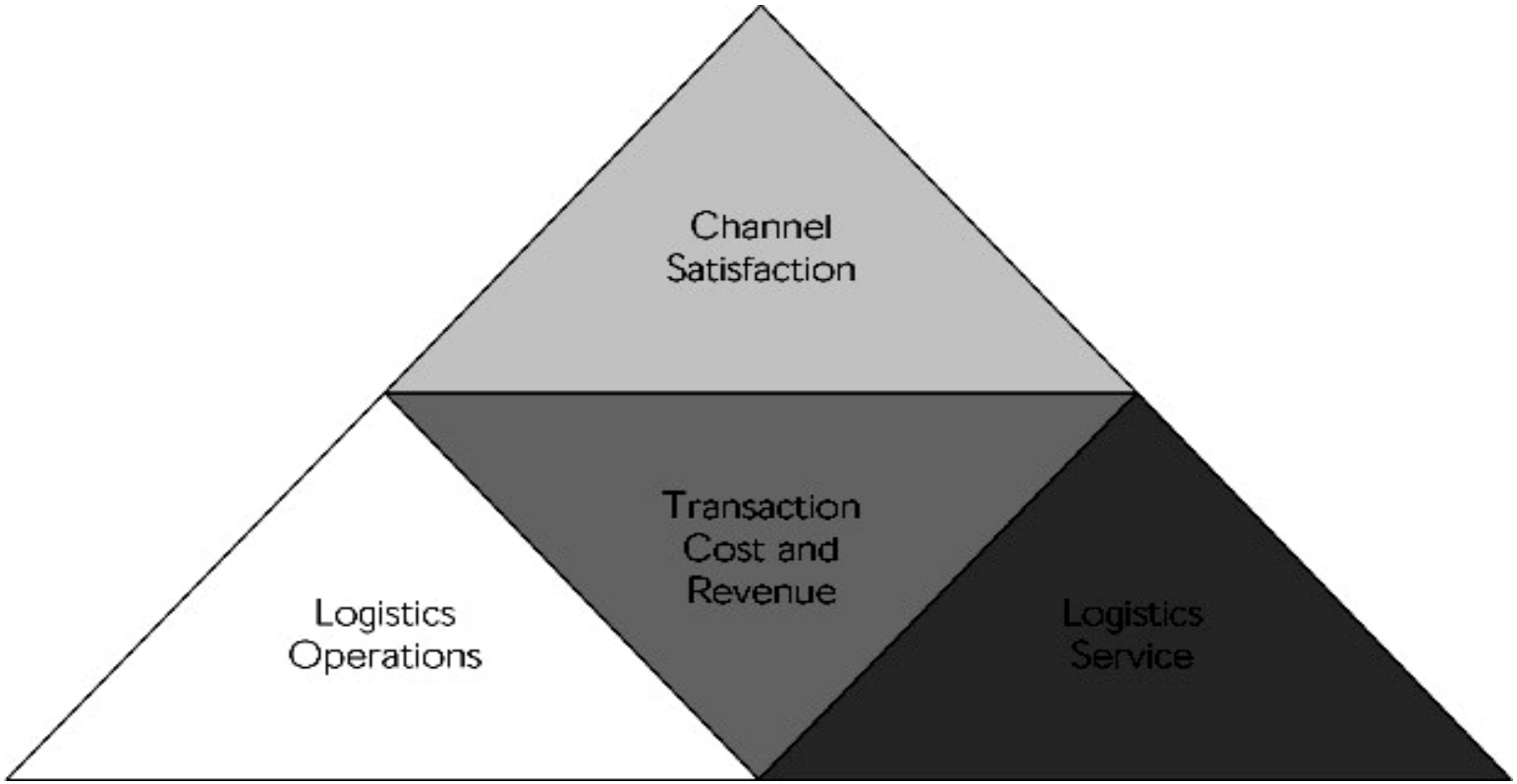
Time	**Cost**
On-time Delivery/Receipt Order Cycle Time Order Cycle Time Variability Response Time Forecasting/Planning Cycle Time	Finished Goods Inventory Turns Days Sales Outstanding Cost to Serve Cash-to-Cash Cycle Time Total Delivered Cost • *Cost of Goods* • *Transportation Costs* • *Inventory Carrying Costs* • *Material Handling Costs* All Other Costs • *Information Systems* • *Administrative* Cost of Excess Capacity Cost of Capacity Shortfall
Quality	**Other/Supporting**
Overall Customer Satisfaction Processing Accuracy Perfect Order Fulfillment** • *On-time Delivery* • *Complete Order* • *Accurate Product Selection* • *Damage-free* • *Accurate Invoice* Forecast Accuracy Planning Accuracy • *Budgets and Operating Plans* Schedule Adherence	Approval Exceptions to Standard • *Minimum Order Quantity* • *Change Order Timing* Availability of Information

** Contains a time component.
* Indicates a component of a process measure.
Source: J. S. Keebler et al., *Keeping Score,* Council of Logistics Management, 1999.

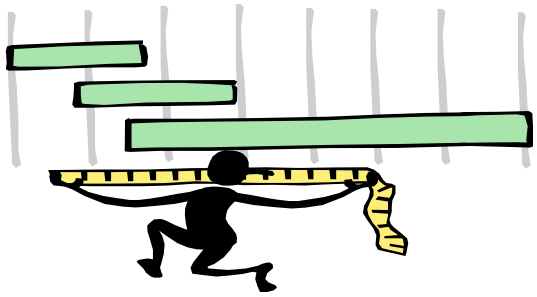
FIGURE 5 *DO CUSTOMERS USE THESE MEASURES TO EVALUATE YOUR PERFORMANCE?*

Measure	Percent of Customers Using Measure	Percent Say Important or Very Important	How are measures defined? Jointly	By Customer	Total Defined
On-time Delivery	86	91	31	29	60
Order Fill	75	88	25	33	58
Invoice Accuracy	69	77	28	30	58
Performance to Request Date	66	82	22	32	54
Order Cycle Time	63	78	25	25	50
Customer Service Performance	63	79	24	28	52
Stockouts/Back Orders	62	84	26	29	55
Over/Short/Damaged	61	73	25	32	57
Performance to Commit Date	55	84	22	30	52
Line Item Fill	55	84	29	29	58
Returns and Allowance Handling	44	63	24	26	50
Freight Cost	44	68	31	21	52
Inquiry Response Time	36	63	25	27	52
Case Fill	32	77	24	29	53
Forecast Accuracy	16	55	25	19	44

FIGURE 6
LOGISTICS QUANTIFICATION PYRAMID



ANOTHER APPROACH TO METRIC CLASSIFICATION



The next four slides demonstrate other approaches to metric classification:

- Figures 7 and 8 illustrate for ABC Power Tools, cost and management of inventory metrics.
- Figure 9 shows basic logistics service outputs or service performance for metrics development.
- Figure 10 shows the results of a 1999 survey of the percentage of companies that measure performance of each of the five service outputs as well as the percentage that measures value.

FIGURE 7
DISTRIBUTION INVENTORY COSTS

FIGURE 13–7 Distribution Inventory Costs

Case Example: ABC Power Tool
What does it cost to hold one unit of inventory?

Item 1		**Average Value Per Units = $ 647.00**	
Cost Element		*Computation*	*Annual Cost*
Interest		614.65/Unit ´ 10% interest	
Freight Inbound	+	32.35/Unit	64.70 each
		647.00 ´ 10% interest	
Labor		16.18/Unit received	16.18
		1.29/Unit/month upkeep ´ 12 months 15.48 total	31.66
Space		0.30/Sq. ft/Month ´ 8 sq. ft/Unit ´ 12 months	28.80
Insurance		3.23/Year/Unit	3.23
Taxes		10.00/100 assessment @ 25% valuation	16.18
Loss & Damage		2%/Year ´ 647.00/unit	12.94
Obsolescence		1%/Year ´ 647.00/Unit	6.47
Total Annual Carrying Cost			196.33
Inventory Carrying Cost %		196.33/647.00	30.3%

Source: R. A. Novack, Center for Supply Chain Research, Penn State University.

FIGURE 8
DISTRIBUTION INVENTORY MANAGEMENT

FIGURE 13–8 Distribution Inventory Management

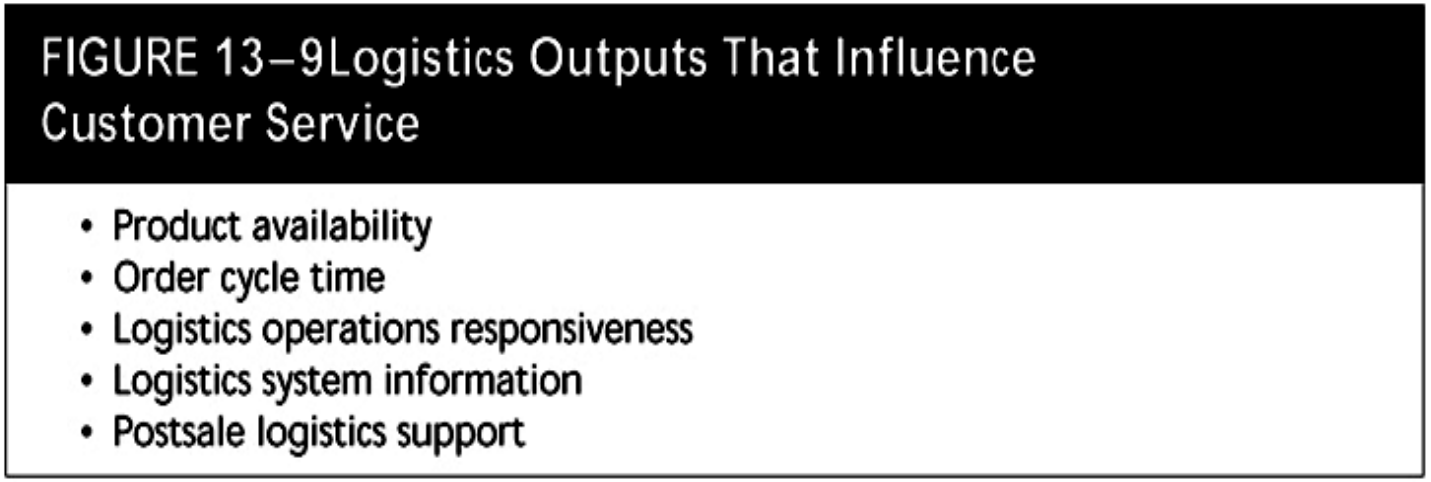
Case Example: ABC Power Tools
Increase Turns
How do inventory turns impact ABC Power Tools 'inventory investment?

Turns	Average Inventory	Inventory Carrying Cost*	Incremental Savings in Carrying Costs	Cumulative Savings in Carrying Costs
1	150,000,000	45,000,000	—	—
2	75,000,000	22,500,000	22,500,000	22,500,000
3	50,000,000	15,000,000	7,500,000	30,000,000
4	37,500,000	11,250,000	3,750,000	33,750,000
5	30,000,000	9,000,000	2,250,000	36,000,000
6	25,000,000	7,000,000	1,500,000	37,500,000
7	21,428,571	6,428,571	1,071,429	38,571,429
8	18,750,000	5,625,000	803,571	39,375,000
9	16,666,667	5,000,001	624,999	39,999,999
10	15,000,000	4,500,000	500,001	40,500,000

* Assume ICC = 30%

Source: R. A. Novack, Center for Supply Chain Research, Penn State University.

FIGURE 9 *LOGISTICS OUTPUTS THAT INFLUENCE CUSTOMER SERVICE*



Source: R. A. Novack, Center for Supply Chain Research, Penn State University.

FIGURE 10
SERVICE MEASUREMENT

FIGURE 13–10 Service Measurement		
	1994 (%)	**1999 (%)**
Product availability	89.8	94.9
Order cycle time	77.4	79.3
Logistics operations response	63.9	59.7
Logistics system information	40.8	39.0
Postsale customer support	40.9	32.3

Source: R. A. Novack, Center for Supply Chain Research, Penn State University.

SUPPLY CHAIN METRICS

Supply chain metrics are very different from traditional logistics metrics in that they measure inter-company performance rather than just internal performance.

These measures of performance must be common across the firms in the supply chain to be meaningful.

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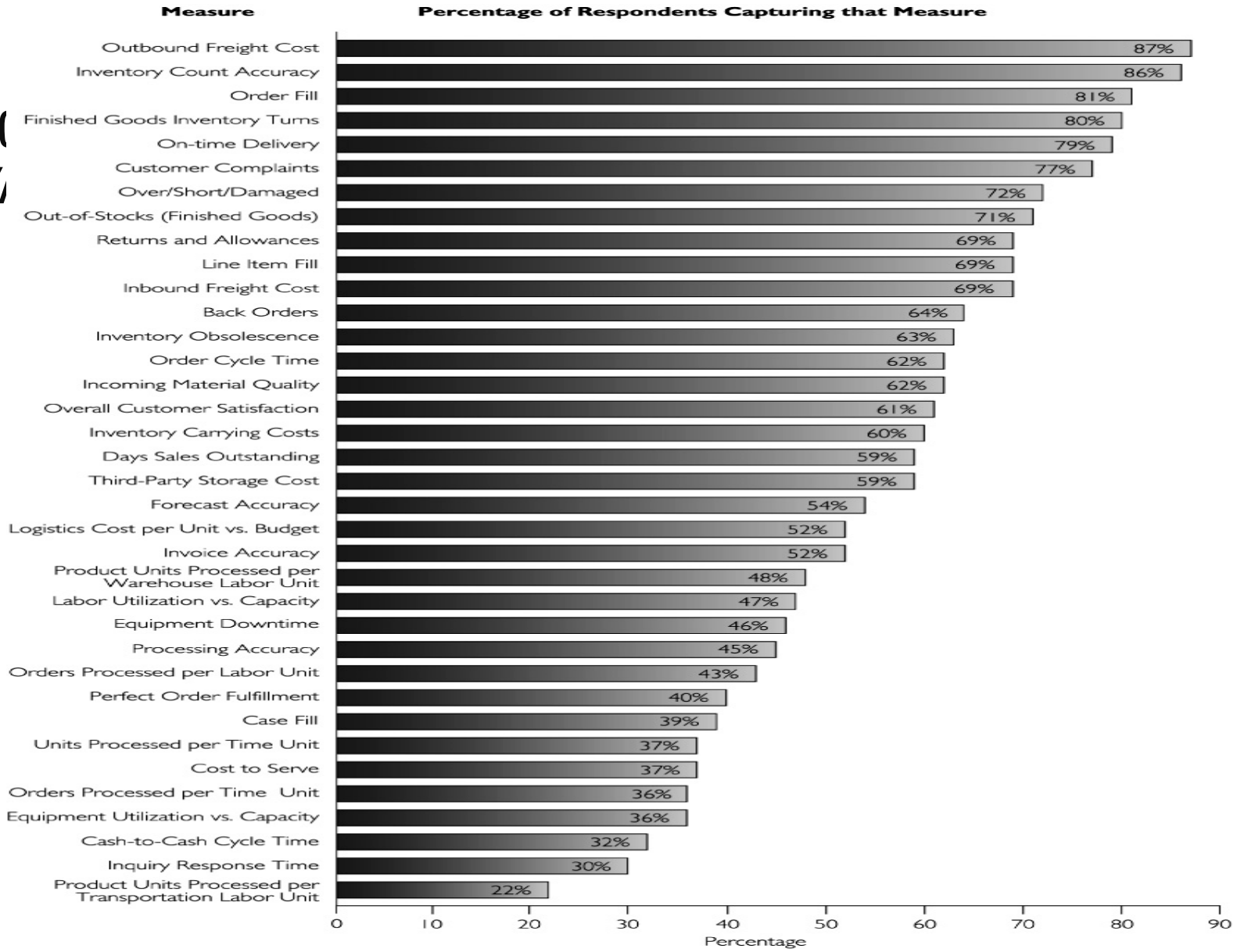
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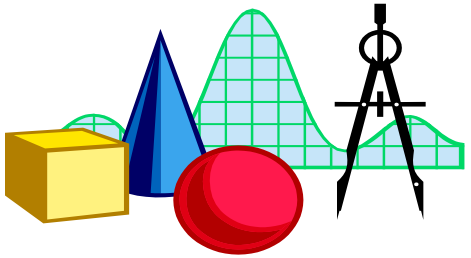
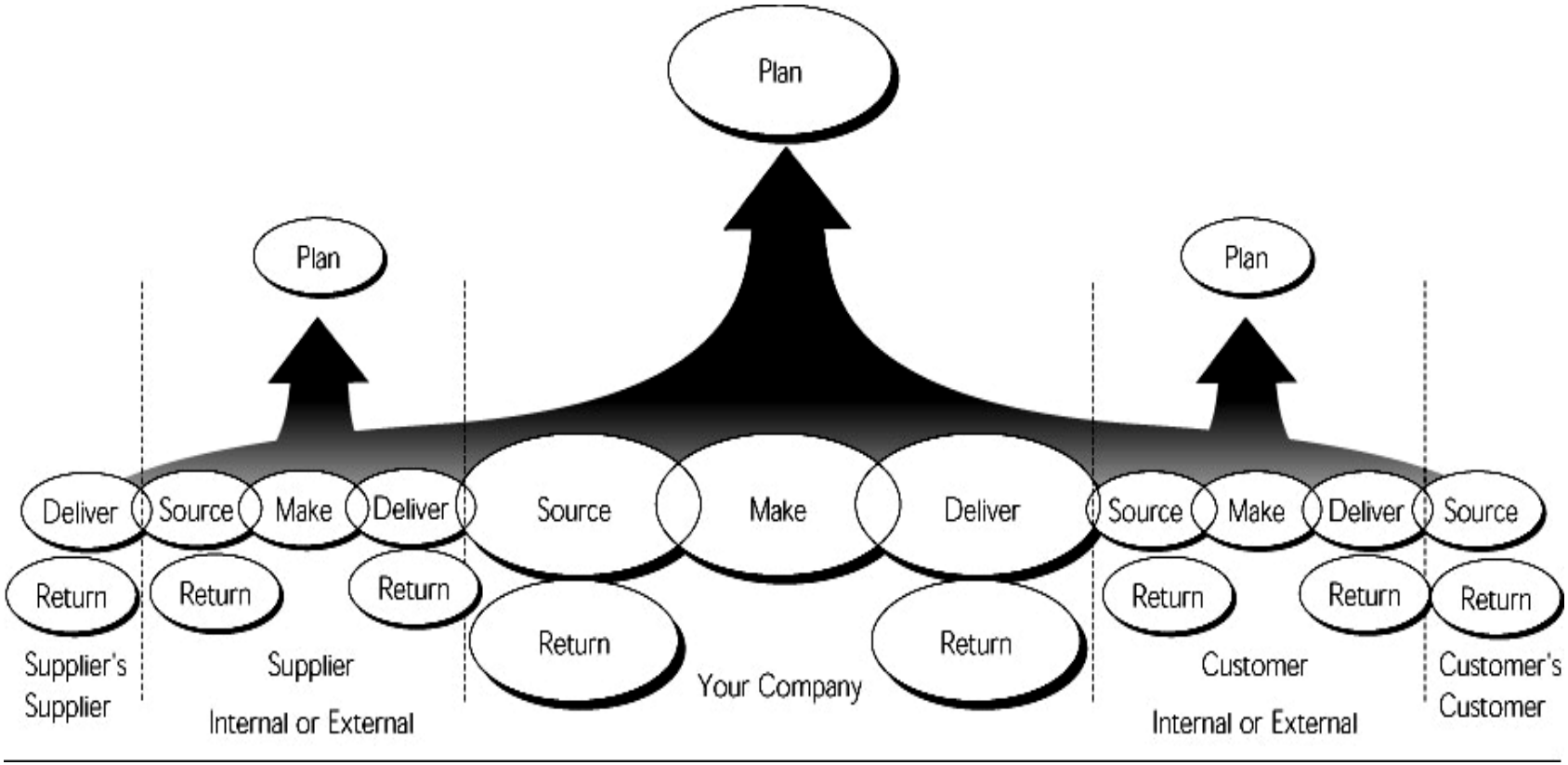
THE SUPPLY CHAIN OPERATIONS REFERENCE (SCOR) MODEL



This model was attempts to integrate well known concepts of process reengineering, benchmarking, and process measurement into a cross functional relationship by:

- Capturing the “as is” state of a process and derive the “to be” future state (reengineering);
- Quantify the operational performance of similar companies and establish “best of class” performance (benchmarking); and,
- Characterize and describe the management processes that will result in “best in class” performance (best practice analysis).

FIGURE 11
SCOR IS BASED ON FIVE DISTINCT MANAGEMENT PROCESSES



APPLICATION AREAS

Strategic planning

Supply chain management

Pricing and revenue management

Logistics and site location

Optimization

Marketing research

APPLICATIONS AREAS (CONT.)

Scheduling

Portfolio management

Inventory analysis

Forecasting

Sales analysis

Auctioning

Risk analysis

EXAMPLES

British Telecom used OR to schedule workforce for more than 40,000filed engineers. The system was saving $150 million a year from 1997~ 2000. The workforce is projected to save $250 million.

Sears Uses OR to create a Vehicle Routing and Scheduling System which to run its delivery and home service fleet more efficiently -- $42 million in annual savings

UPS use O.R. to redesign its overnight delivery network, $87 million in savings obtained from 2000 ~ 2002; Another $189 million anticipated over the following decade.

USPS uses OR to schedule the equipment and workforce in its mail processing and distribution centers. Estimated saving in $500 millions can be achieve.

A SHORT LIST OF SUCCESSFUL STORIES (1)

Air New Zealand
- Air New Zealand Masters the Art of Crew Scheduling

AT&T Network
- Delivering Rapid Restoration Capacity for the AT&T Network

Bank Hapoalim
- Bank Hapoalim Offers Investment Decision Support for Individual Customers

British Telecommunications
- Dynamic Workforce Scheduling for British Telecommunications

Canadian Pacific Railway
- Perfecting the Scheduled Railroad at Canadian Pacific Railway

Continental Airlines
- Faster Crew Recovery at Continental Airlines

FAA
- Collaborative Decision Making Improves the FAA Ground-Delay Program

A SHORT LIST OF SUCCESSFUL STORIES (2)

Ford Motor Company
- Optimizing Prototype Vehicle Testing at Ford Motor Company

General Motors
- Creating a New Business Model for OnStar at General Motors

IBM Microelectronics
- Matching Assets to Supply Chain Demand at IBM Microelectronics

IBM Personal Systems Group
- Extending Enterprise Supply Chain Management at IBM Personal Systems Group

Jan de Wit Company
- Optimizing Production Planning and Trade at Jan de Wit Company

Jeppesen Sanderson
- Improving Performance and Flexibility at Jeppesen Sanderson

A SHORT LIST OF SUCCESSFUL STORIES (3)

Mars
- Online Procurement Auctions Benefit Mars and Its Suppliers

Menlo Worldwide Forwarding
- Turning Network Routing into Advantage for Menlo Forwarding

Merrill Lynch
- Seizing Marketplace Initiative with Merrill Lynch Integrated Choice

NBC
- Increasing Advertising Revenues and Productivity at NBC

PSA Peugeot Citroen
- Speeding Car Body Production at PSA Peugeot Citroen

Rhenania
- Rhenania Optimizes Its Mail-Order Business with Dynamic Multilevel Modeling

Samsung
- Samsung Cuts Manufacturing Cycle Time and Inventory to Compete

A SHORT LIST OF SUCCESSFUL STORIES (4)

Spicer
- Spicer Improves Its Lead-Time and Scheduling Performance

Syngenta
- Managing the Seed-Corn Supply Chain at Syngenta

Towers Perrin
- Towers Perrin Improves Investment Decision Making

U.S. Army
- Reinventing U.S. Army Recruiting

U.S. Department of Energy
- Handling Nuclear Weapons for the U.S. Department of Energy

UPS
- More Efficient Planning and Delivery at UPS

Visteon
- Decision Support Wins Visteon More Production for Less

REFERENCES

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