

CSCP

CERTIFIED SUPPLY CHAIN
PROFESSIONAL

MODULE 1: SUPPLY CHAINS, DEMAND MANAGEMENT, AND FORECASTING

Section A: Introduction to Supply Chains



Section A Introduction

Section A Key Processes:

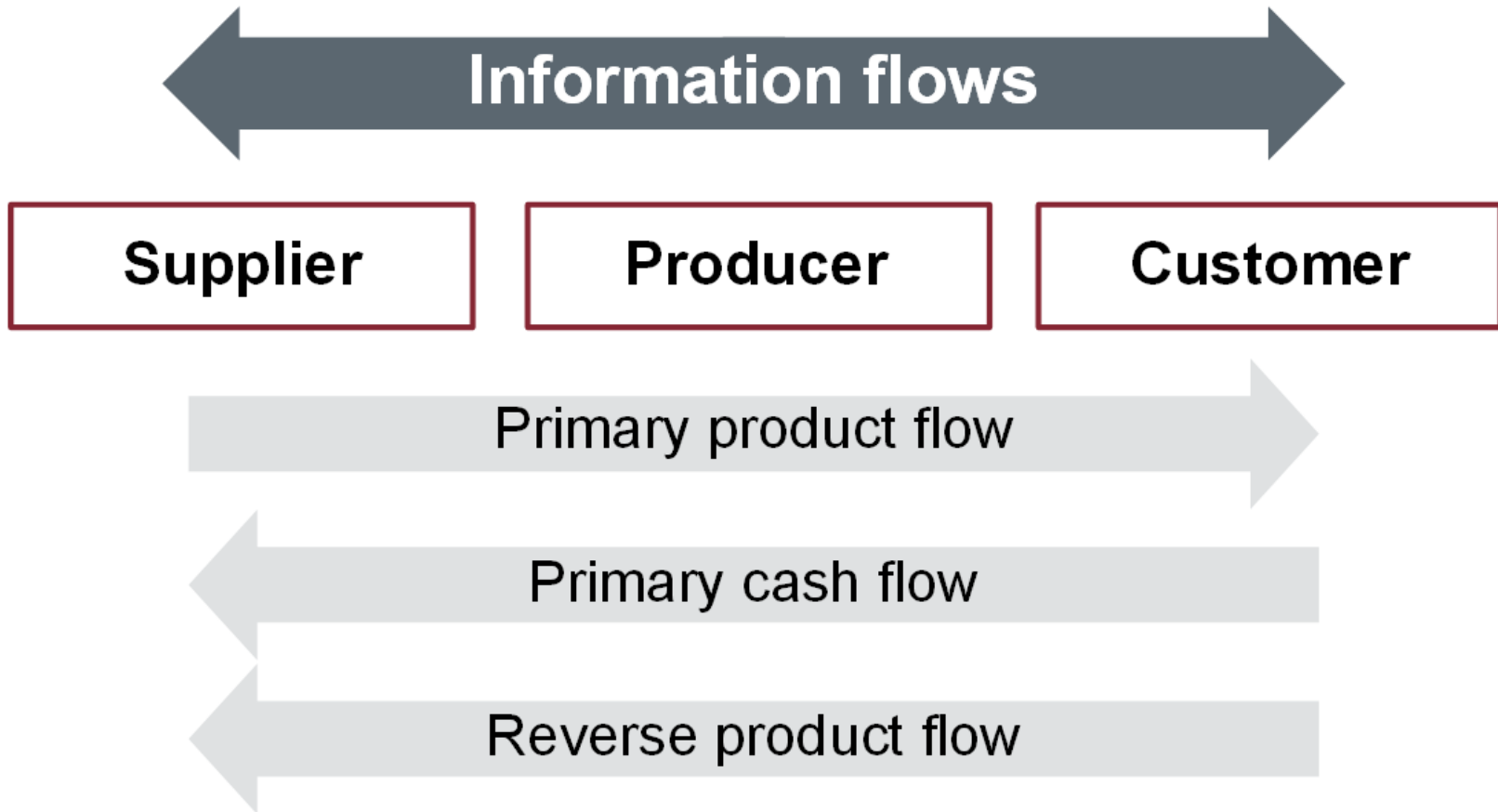
- Design the supply chain network.
 - Flow of product, information, and funds

Section A Topics:

- Topic 1: Supply Chain Models
- Topic 2: Supply Chain Maturity and Complexity

Topic 1: Supply Chain Models

Basic Supply Chain for a Product



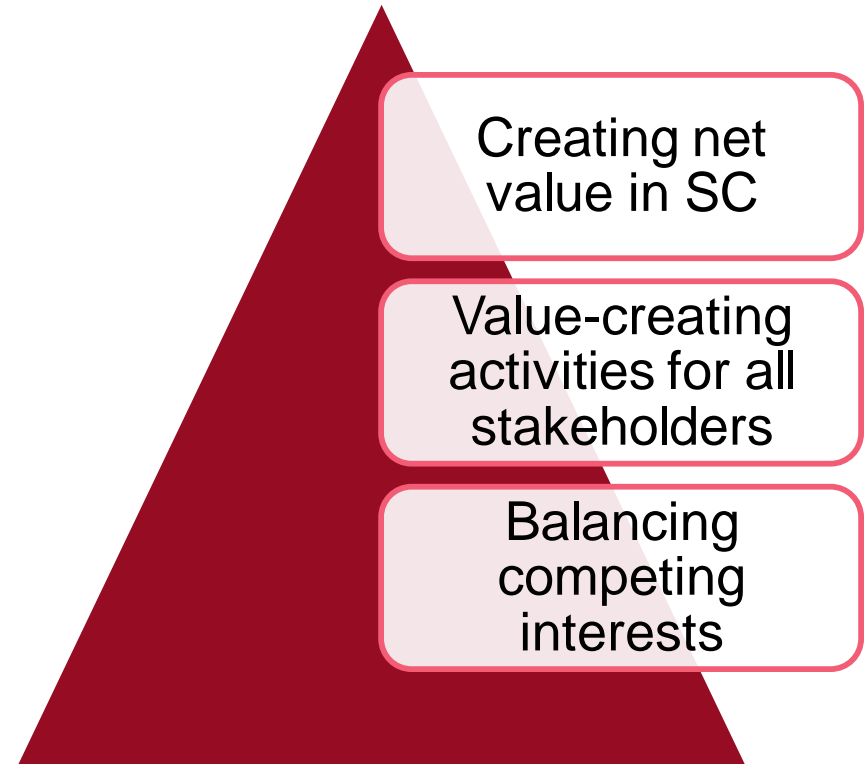
Topic 1: Supply Chain Models

Funds Flows, Value, and Balance

Funds Flows

- Goes upstream: customer > producer > supplier.
- Not linear.
- Electronic payments reduce cash-to-cash cycle time (cash to inventory to credit to cash).
- Advantages:
 - Improves customer-supplier relationships.
 - Reduces imbalances between larger and smaller players.

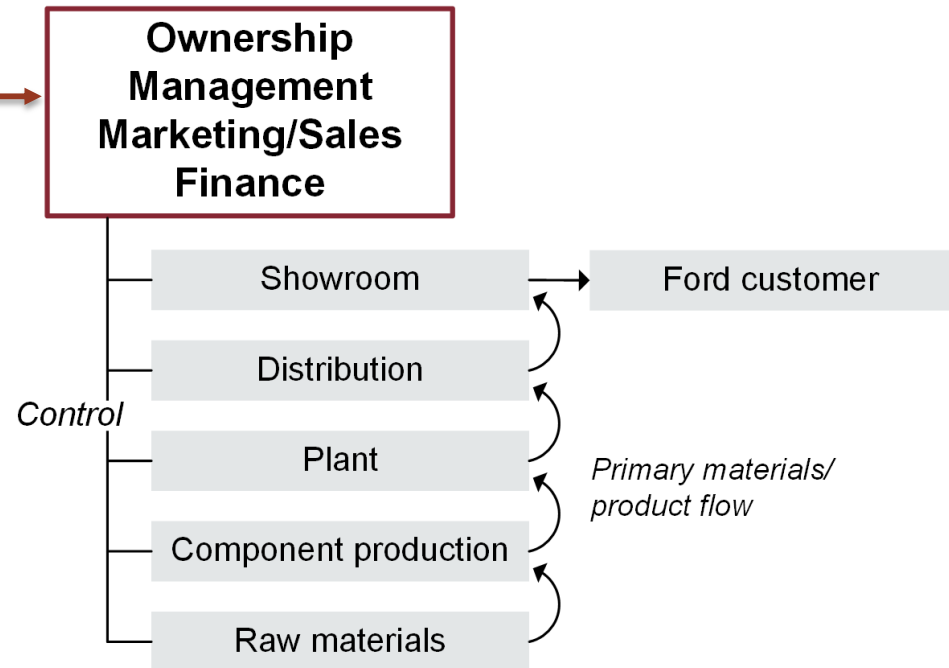
Value and Balance



Topic 1: Supply Chain Models

Vertical Integration

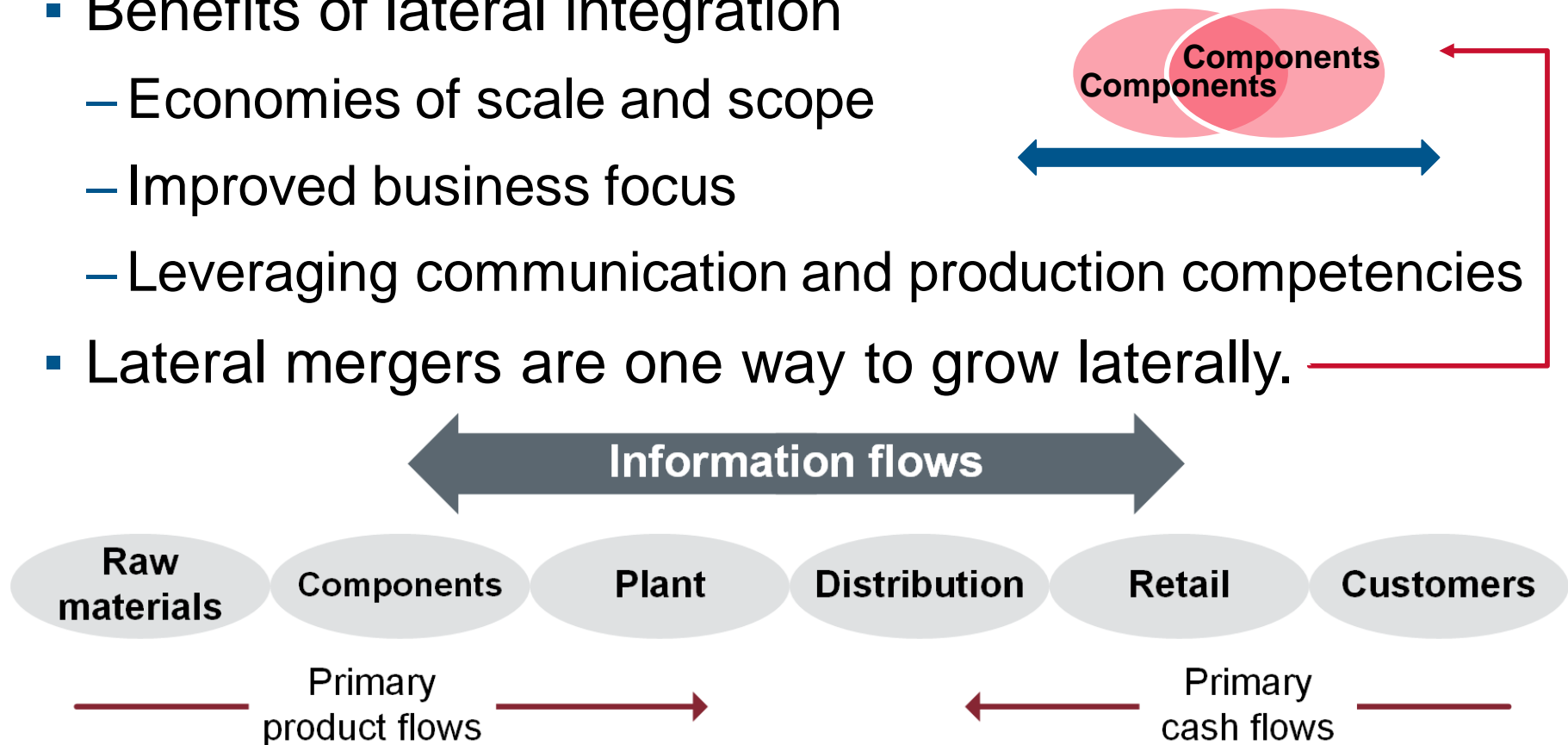
- Benefits of vertical integration
 - No dealing with competitors for supplies, etc.
 - Enhanced visibility into operations
 - Same ownership and management for all activities in supply chain
- Ford: historic example
- McDonald's doesn't directly own its supply chain, but:
 - Long-term supply contracts
 - Vested interest model
 - 100% landowner of all sites
 - Significant control



Topic 1: Supply Chain Models

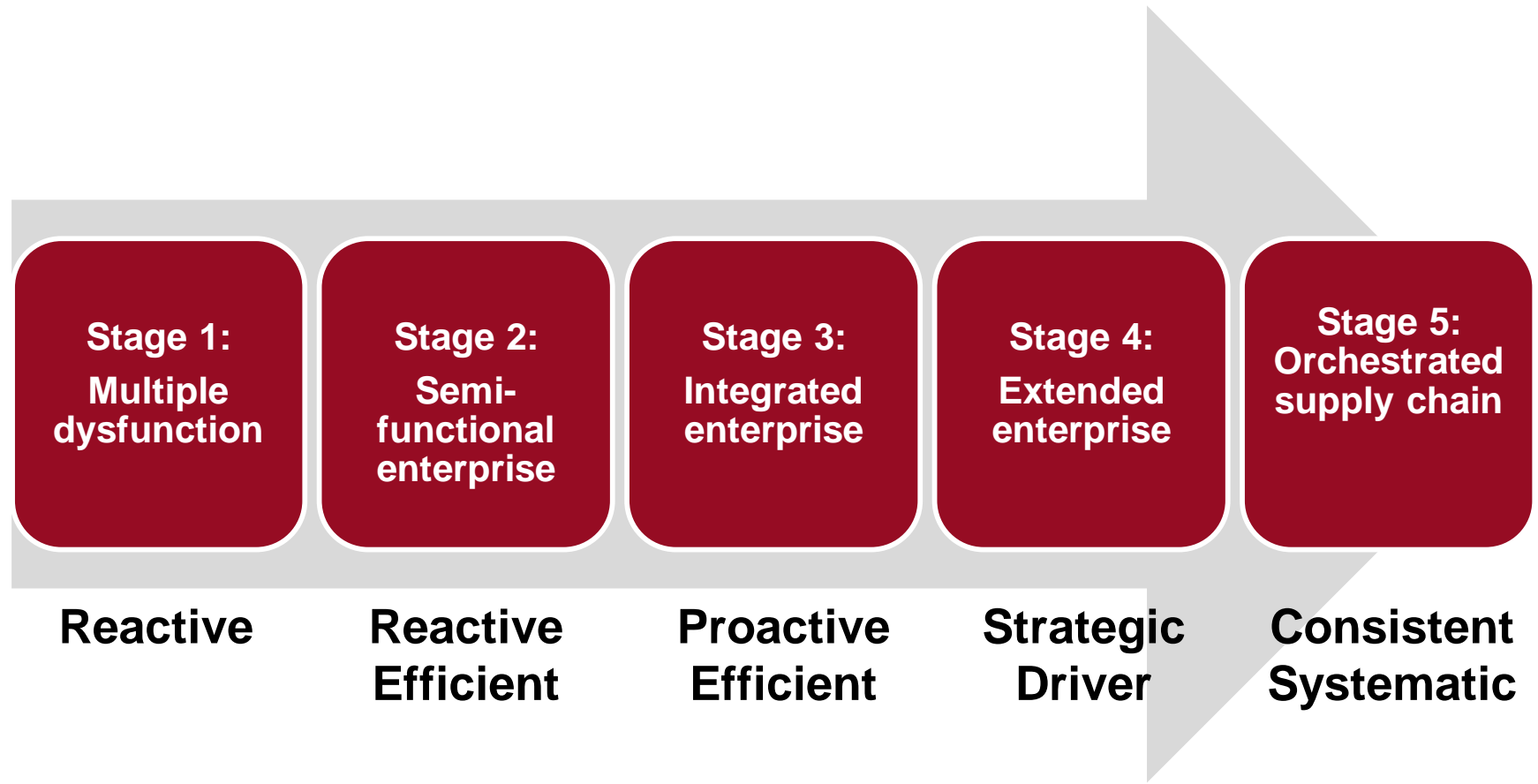
Lateral (Horizontal) Integration

- Benefits of lateral integration
 - Economies of scale and scope
 - Improved business focus
 - Leveraging communication and production competencies
- Lateral mergers are one way to grow laterally.



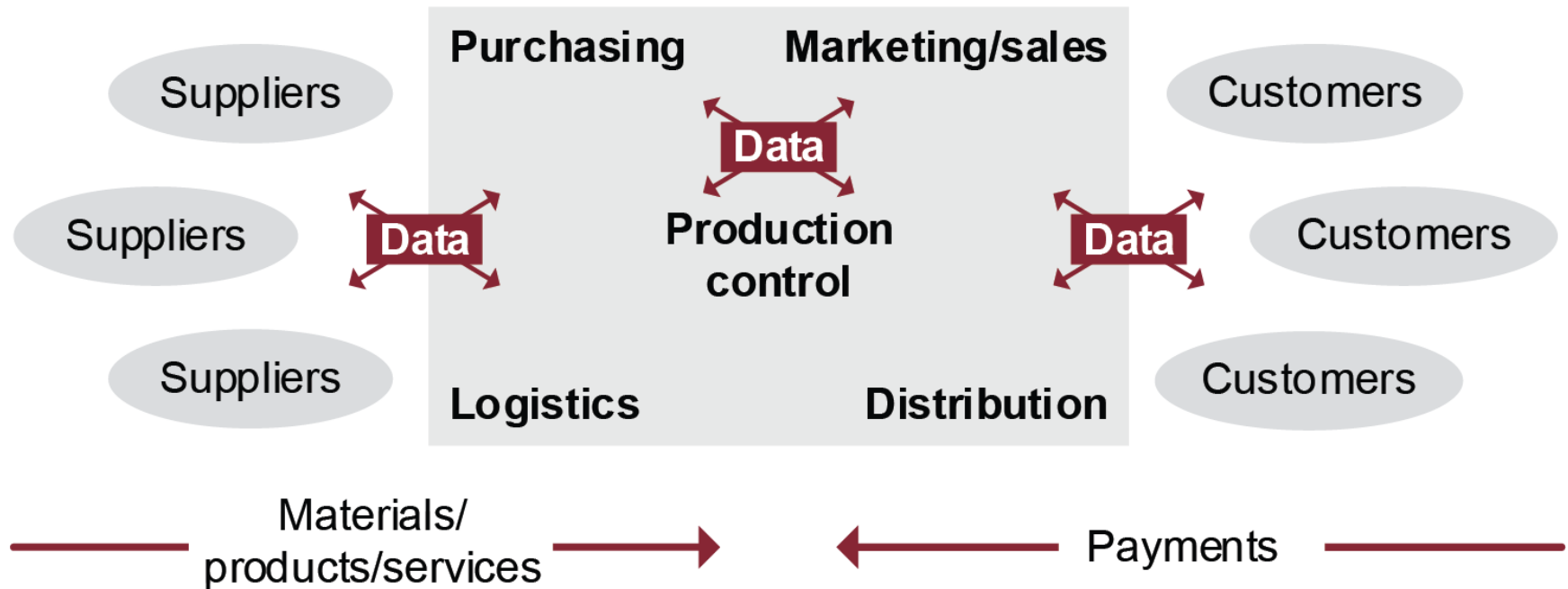
Topic 2: Supply Chain Maturity and Complexity

Supply Chain Stages



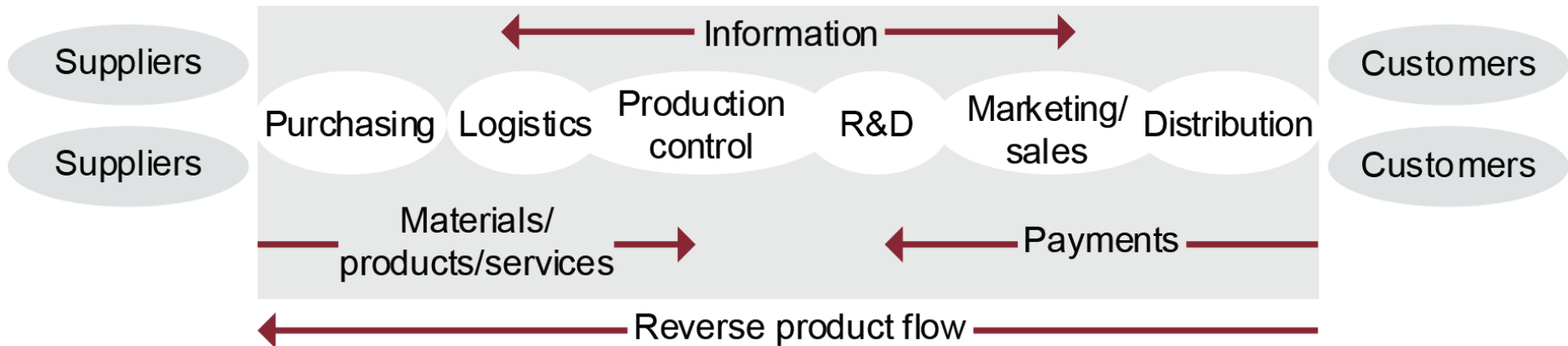
Topic 2: Supply Chain Maturity and Complexity

Stage 1: Multiple Dysfunction



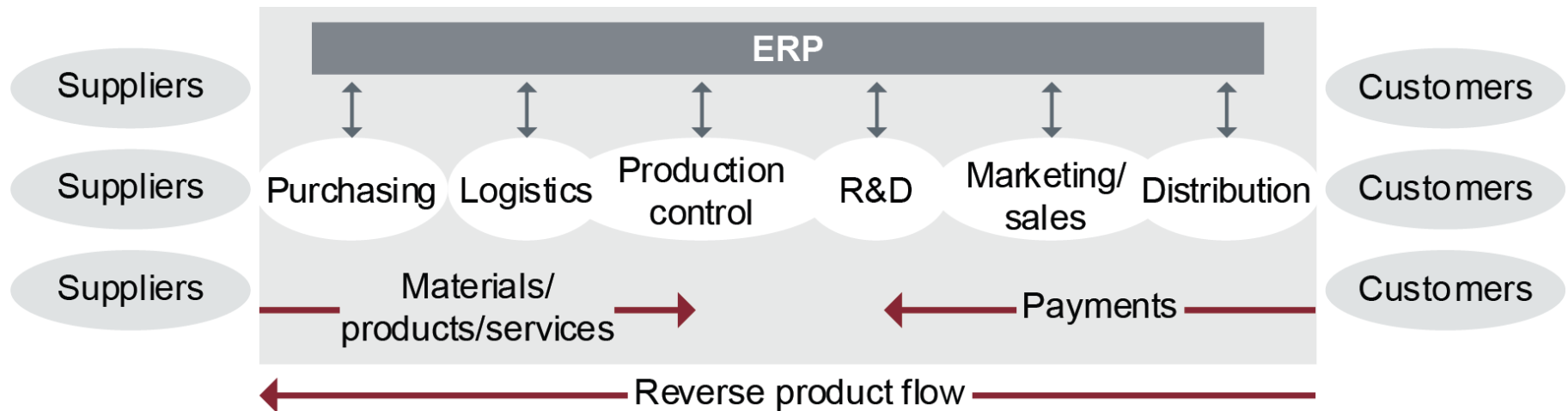
Topic 2: Supply Chain Maturity and Complexity

Stage 2: Semifunctional Enterprise



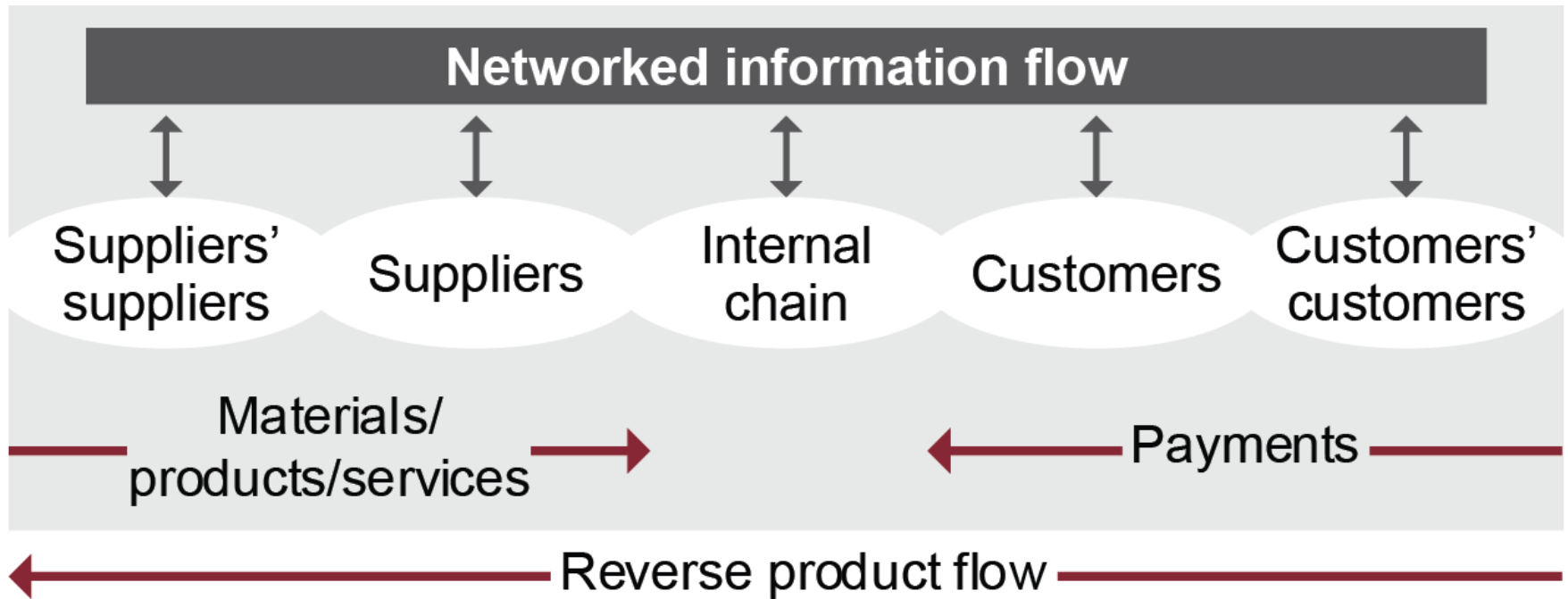
Topic 2: Supply Chain Maturity and Complexity

Stage 3: Integrated Enterprise



Topic 2: Supply Chain Maturity and Complexity

Stage 4: Extended Enterprise



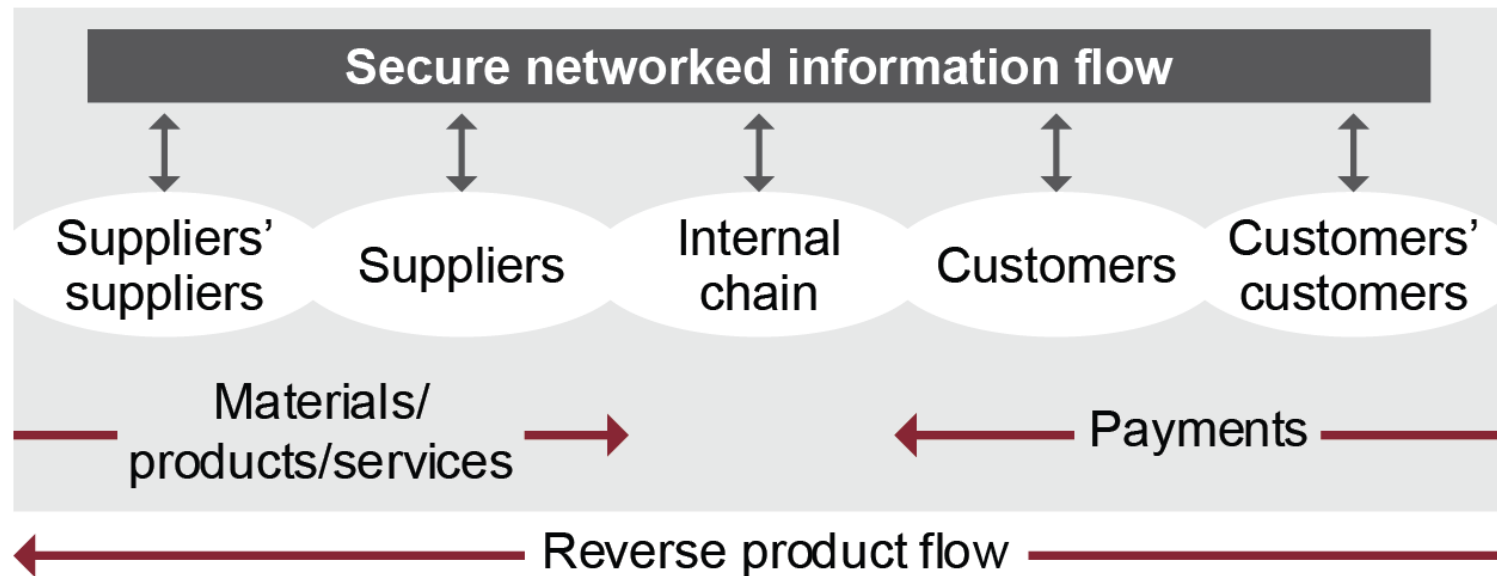
Topic 2: Supply Chain Maturity and Complexity

Stage 5: Orchestrated Supply Chain

Data-driven ♦ Team-driven

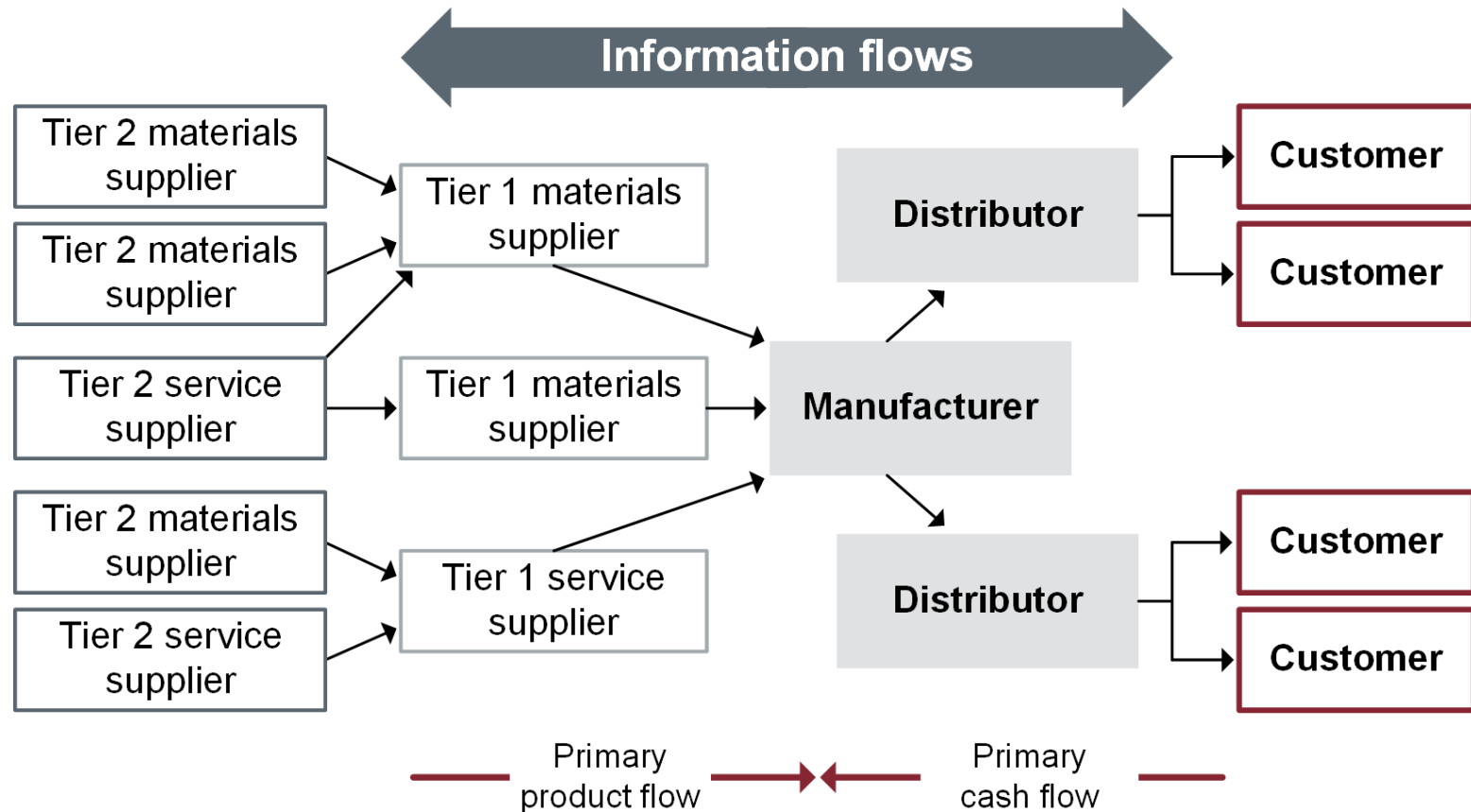
Resiliently sourced ♦ Inclusively designed ♦ Change-ready

Gaps addressed for end-to-end visibility and process automation



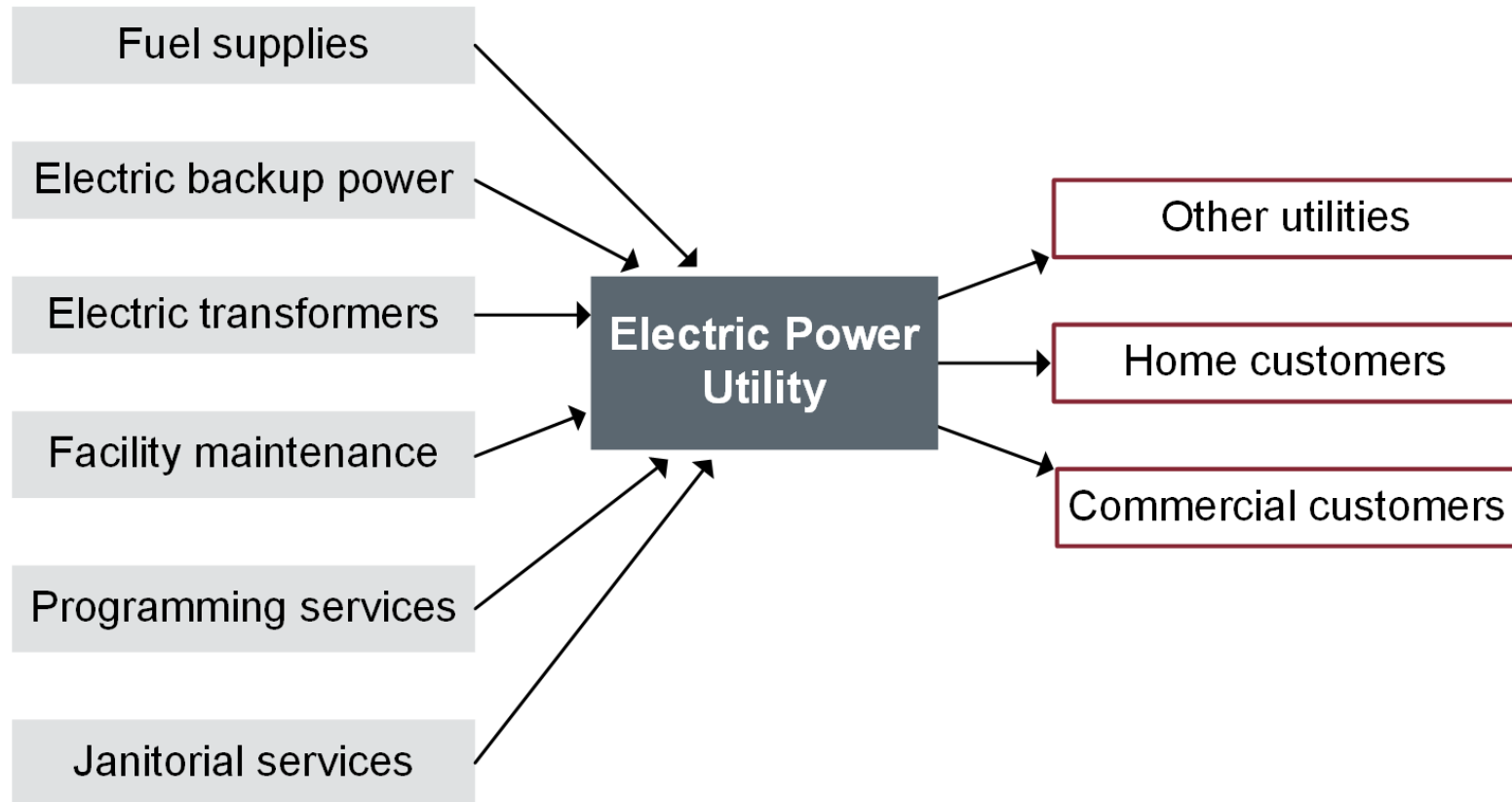
Topic 2: Supply Chain Maturity and Complexity

Manufacturing Supply Chain Model



Topic 2: Supply Chain Maturity and Complexity

Services Also Have Supply Chains



Topic 2: Supply Chain Maturity and Complexity

Specialized Supply Chains

- **Humanitarian and disaster relief:** Trusted relationships help overcome infrastructure failures.
- **Hospital:** Cost cutting (given quality), actual versus contract prices, tracking and billing accuracy, centralizing supply.
- **Retailers:** Amazon severely pressuring multichannel distribution model. Stores as DCs.



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SECTION B: DEMAND ANALYSIS AND PATTERNS



Section B Introduction

Section B Key Processes:

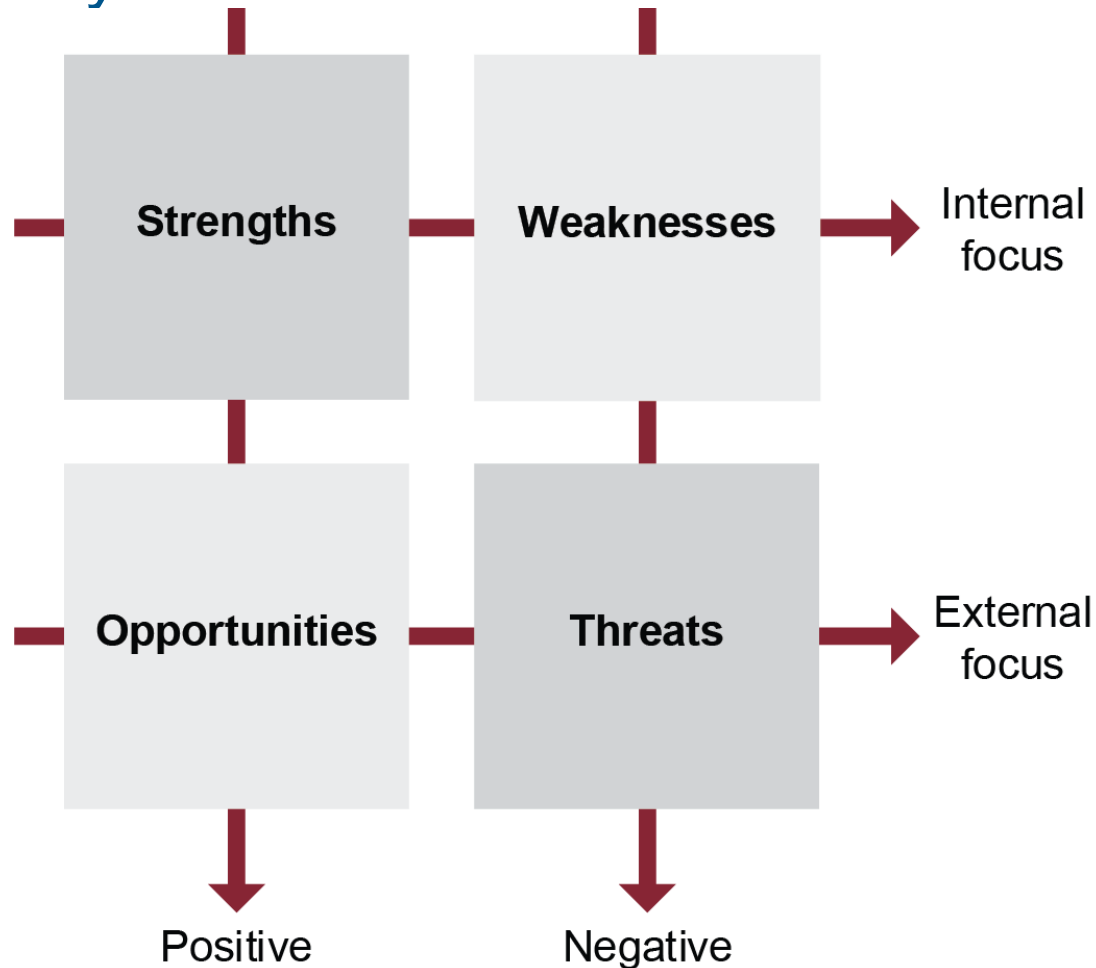
- Collect and analyze historical and environmental demand data.
 - Perform historical analysis.
 - Competitive environment
 - Perform environmental scan and market analysis.
 - Perform product assessment.
 - Demand patterns

Section B Topics:

- Topic 1: Demand Analysis
- Topic 2: Demand Patterns

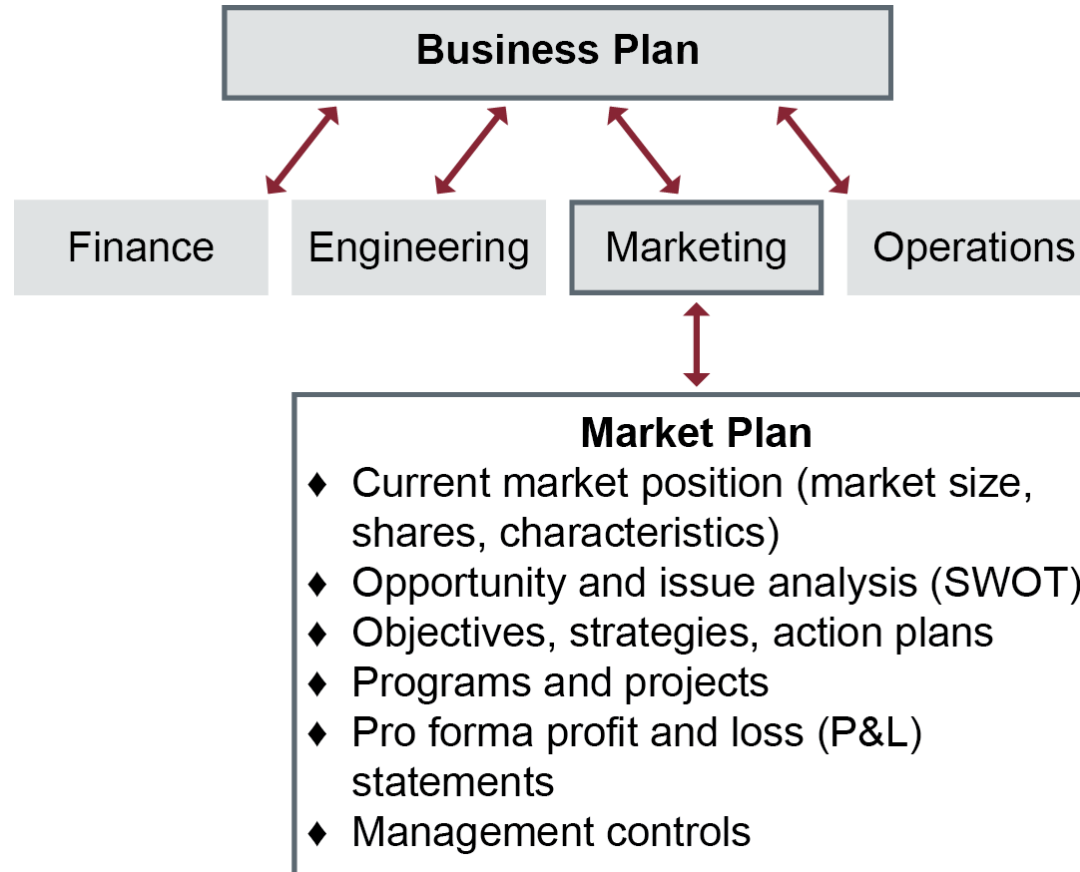
Topic 1: Demand Analysis

SWOT Analysis



Topic 1: Demand Analysis

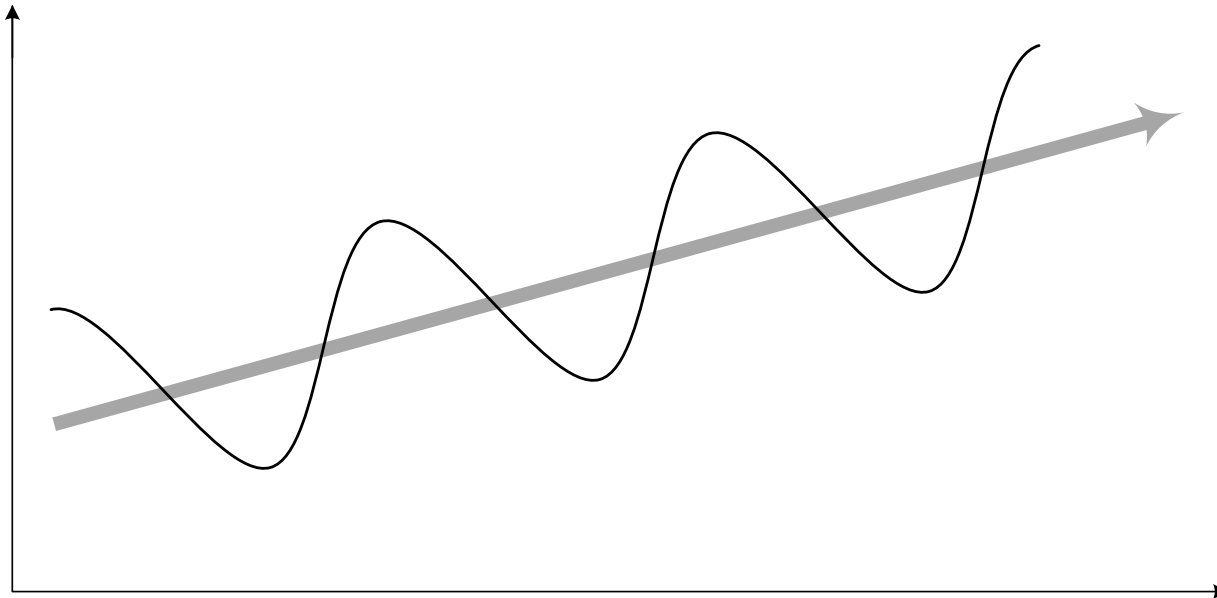
Marketing Strategy and Plan



Topic 1: Demand Analysis

Market Research: Market Analysis

- Global, local, and industry economy
- Government and third-party sources
- Value deals during recessions



Topic 1: Demand Analysis

Purposes of Market Research

- Finding potential markets
 - Does anyone care?
- Analyzing markets
 - Who, where, when, why, what, how many?
- Refining product design
 - Strategic price.
 - Include features with positive contribution margin.

Topic 1: Demand Analysis

Competition

- Scan
- Regional unsatisfied demand
- Footholds in saturated markets
- Benchmark



Topic 1: Demand Analysis

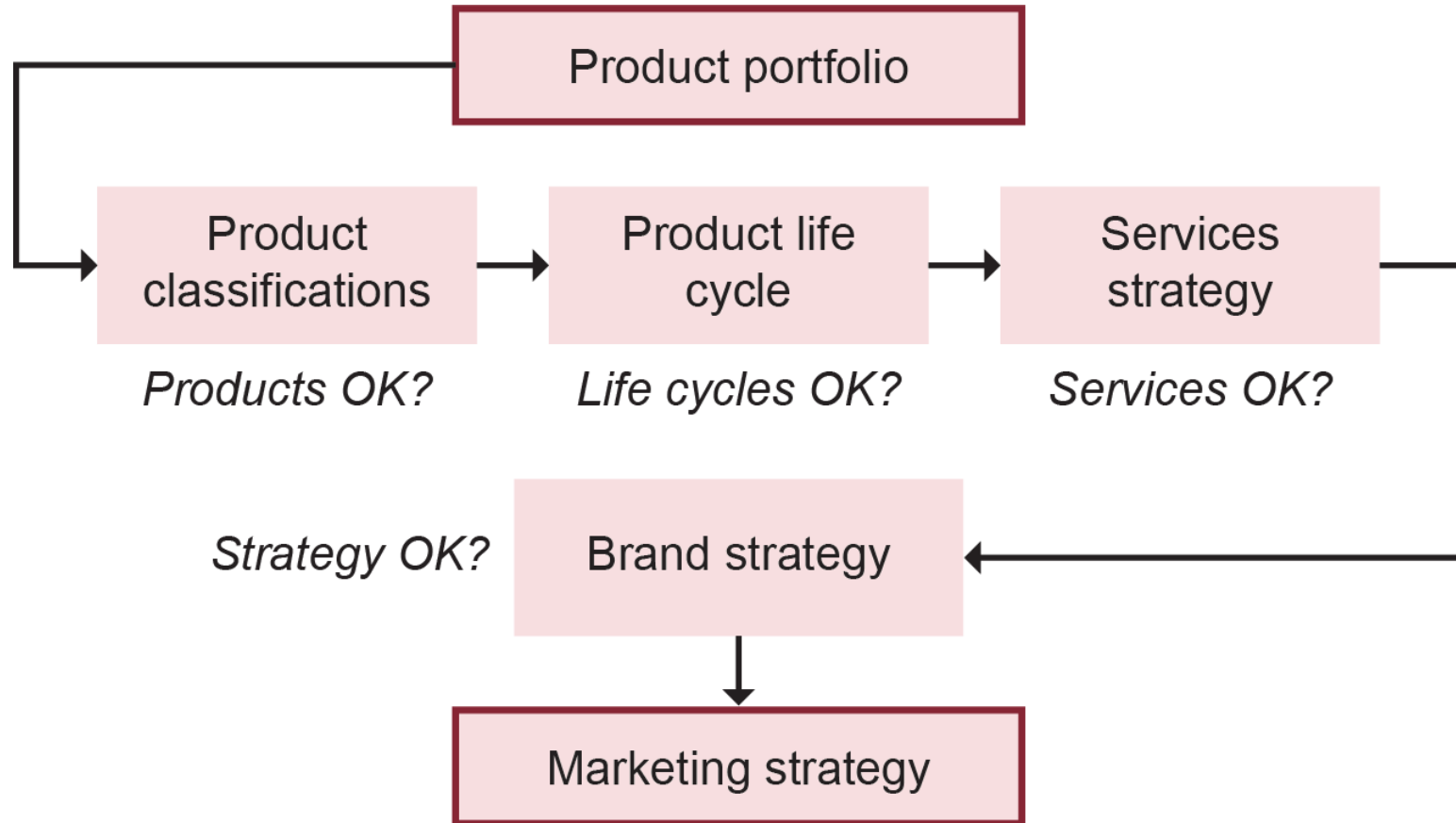
Global Perspectives

- Connected
- Complex
- Volatile



Topic 1: Demand Analysis

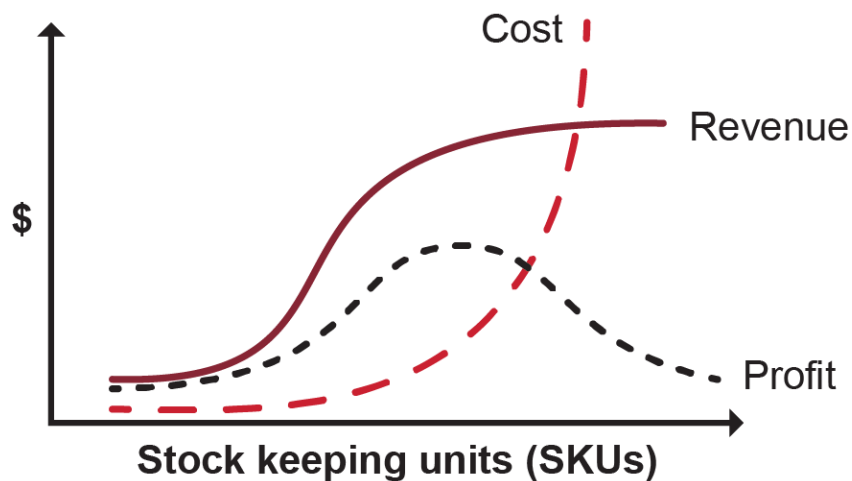
Product Portfolio Management



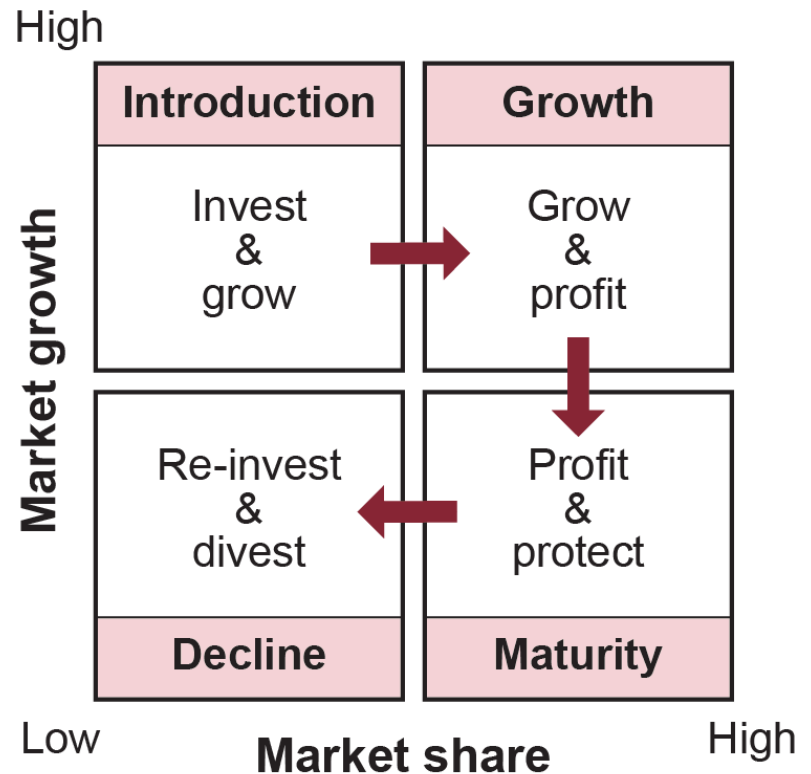
Topic 1: Demand Analysis

Portfolio Complexity and Life Cycle Reviews

Portfolio Complexity Impact

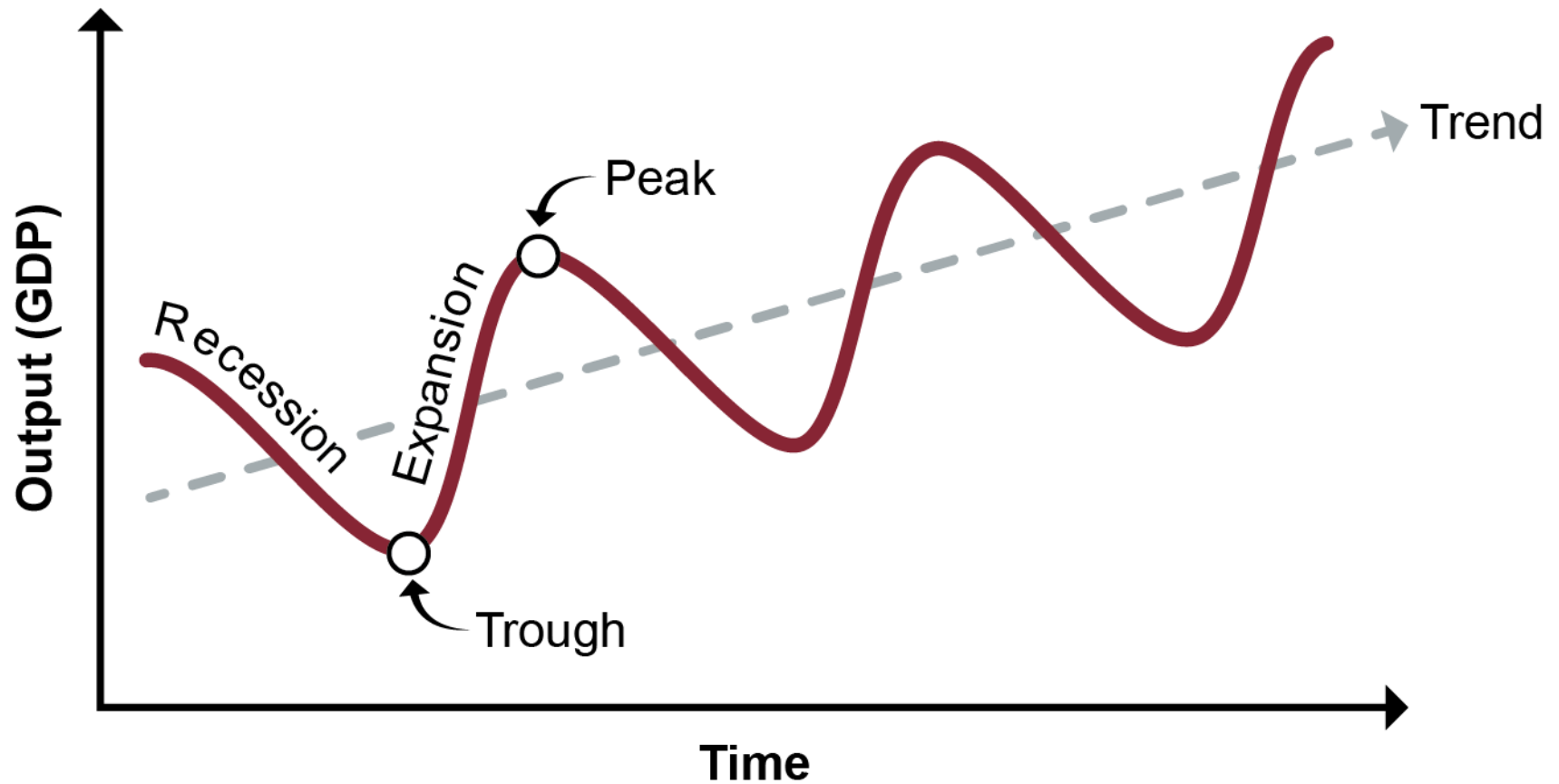


Product Life Cycle Review



Topic 2: Demand Patterns

Macroeconomic Demand Patterns



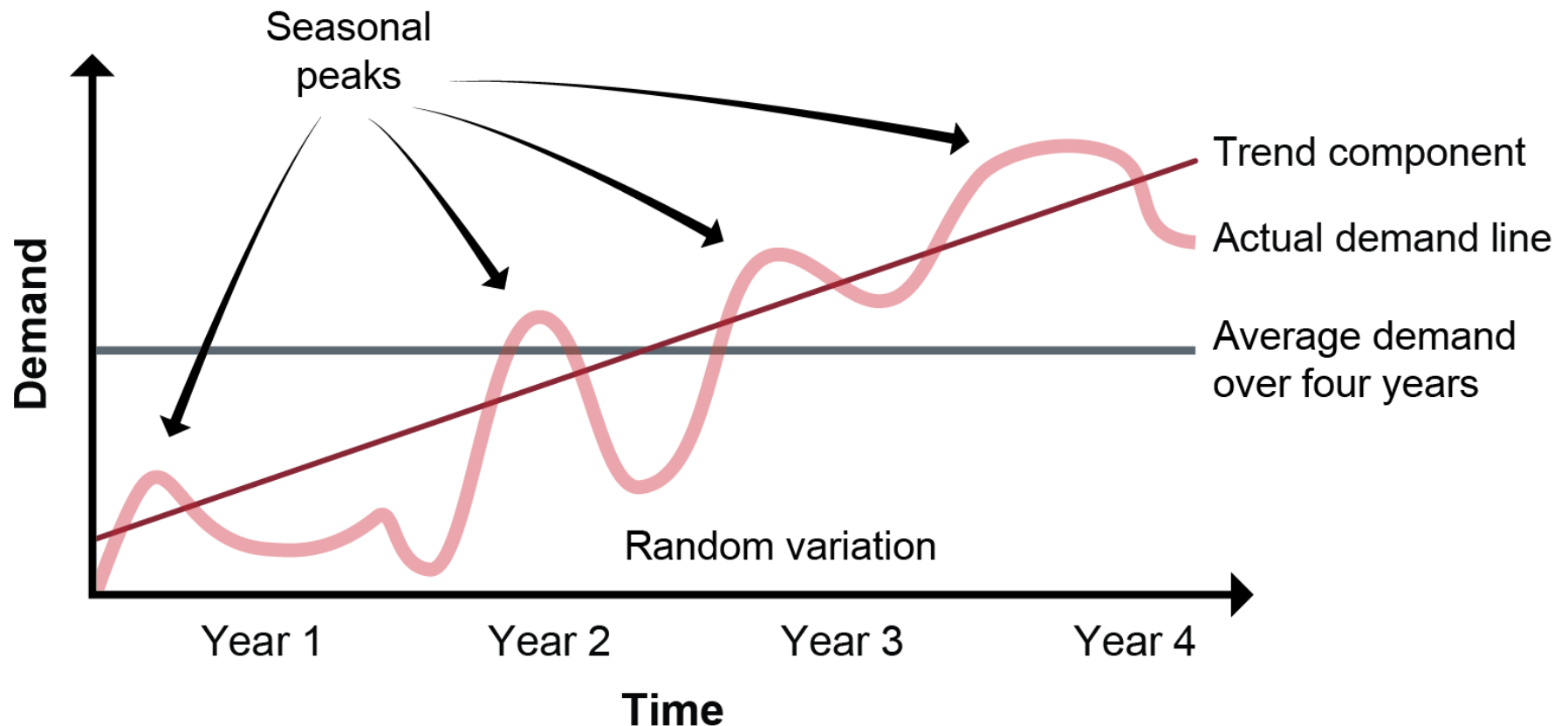
Topic 2: Demand Patterns

Microeconomics

- Price goes up, demand goes down and vice versa.
- Substitution effect: interrelated prices.
- Price adjusts until supply and demand equilibrium.
- Given small price change.
 - Elastic: large change in demand.
 - Inelastic: small change in demand.
 - Maximize profit margin with price changes.
- Marginal analysis: $\text{marginal utility} > \text{marginal cost}$.
 - Ignore costs incurred regardless of choice.

Topic 2: Demand Patterns

Short- to Medium-Term Demand Patterns



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SECTION C: DEMAND MANAGEMENT



Section C Introduction

Section C Key Processes:

- Influence demand through marketing activities.
 - Apply the four Ps.
 - Analyze product life cycles.

Section C Topics:

- Topic 1: Demand Management
- Topic 2: Influencing Demand

Topic 1: Demand Management

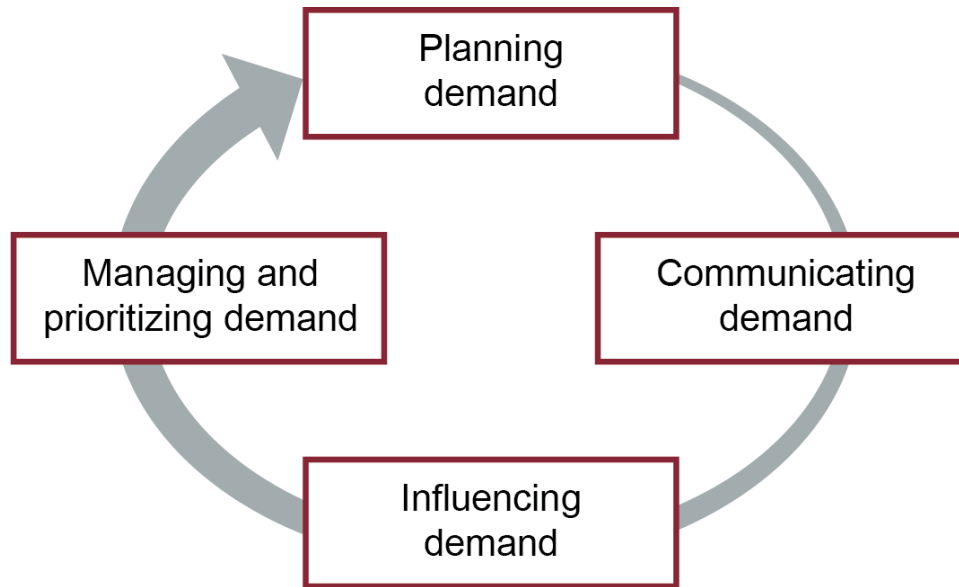
Demand Management

Demand management is the function of recognizing all demands for goods and services to support the marketplace:

- Prioritizing demand
- Planning, executing, controlling, and monitoring the design, pricing, promotion, and distribution of products and services

Topic 1: Demand Management

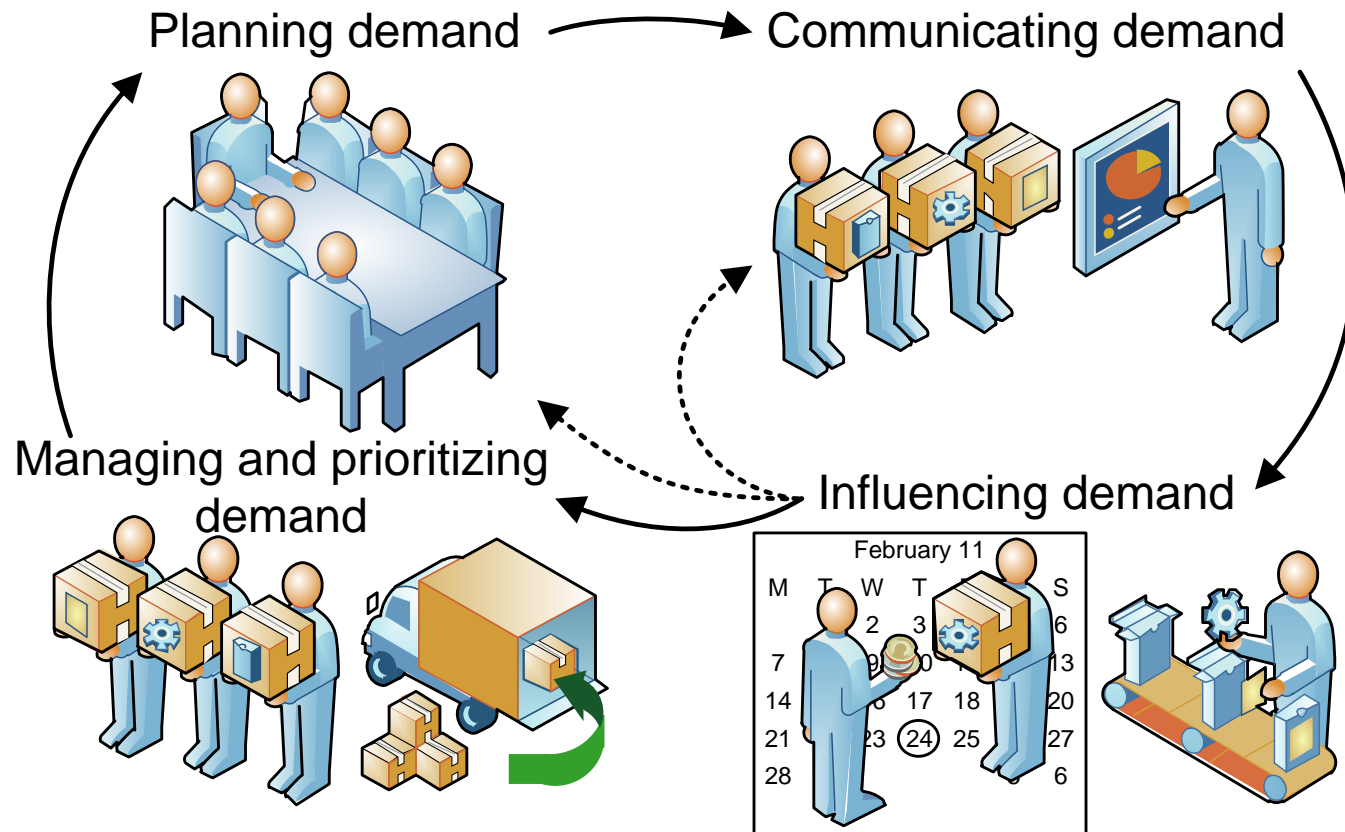
Demand Management Road Map



- Liaison between manufacturers and potential customers.
 - Influence organization to make products the market needs.
 - Convince customers to purchase in profitable manner.
- Product-service package should have capability of being order winner:
 - Order qualifiers
 - Order winners

Topic 1: Demand Management

Linkages Among Elements of Demand Management



Topic 1: Demand Management

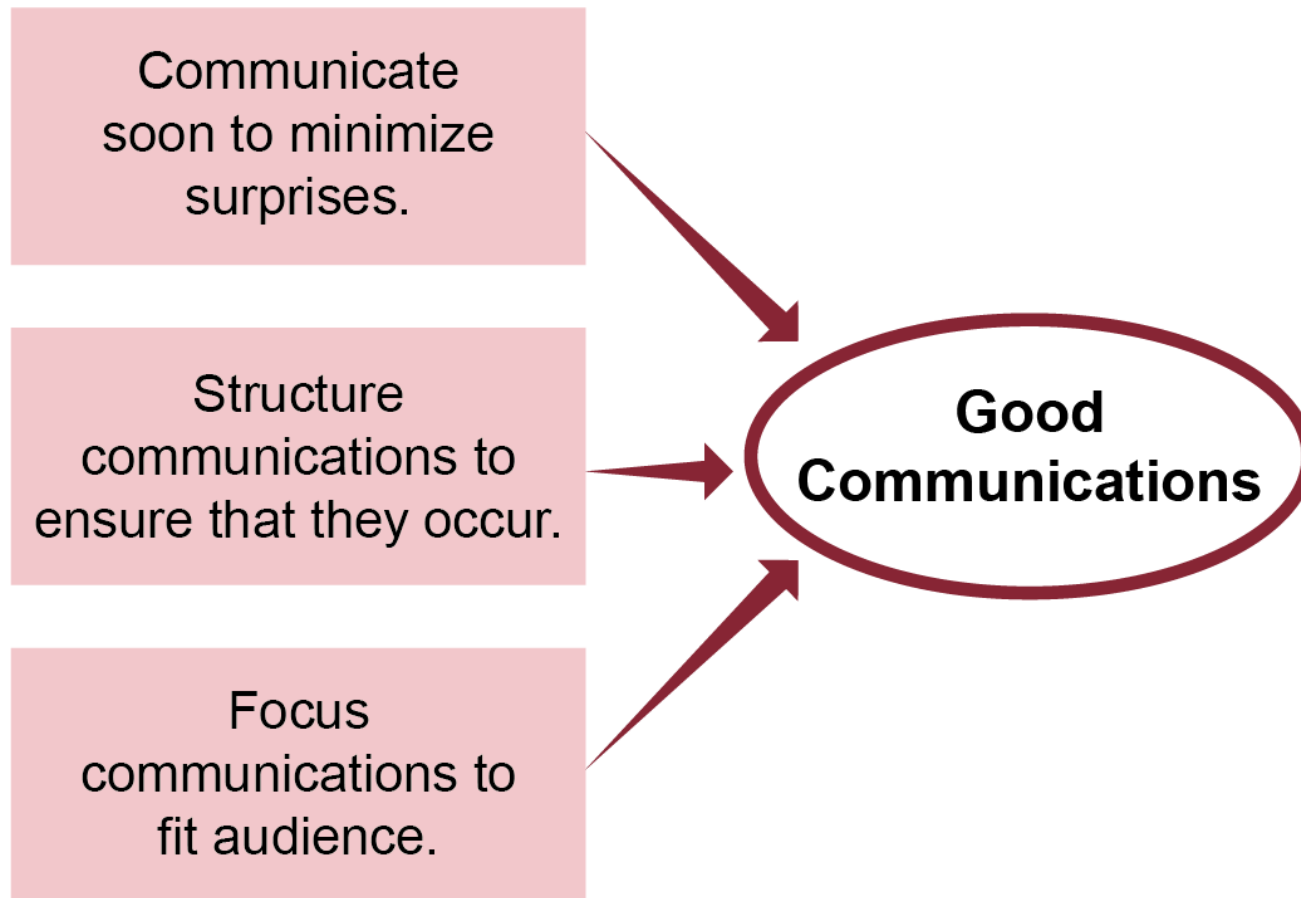
Planning Demand and Demand Plan

- Demand plan is plan for action based on
 - Forecasts
 - Planned demand generation activities.
- Planning horizon
 - Best practice: 18-month+
 - Revise on regular basis



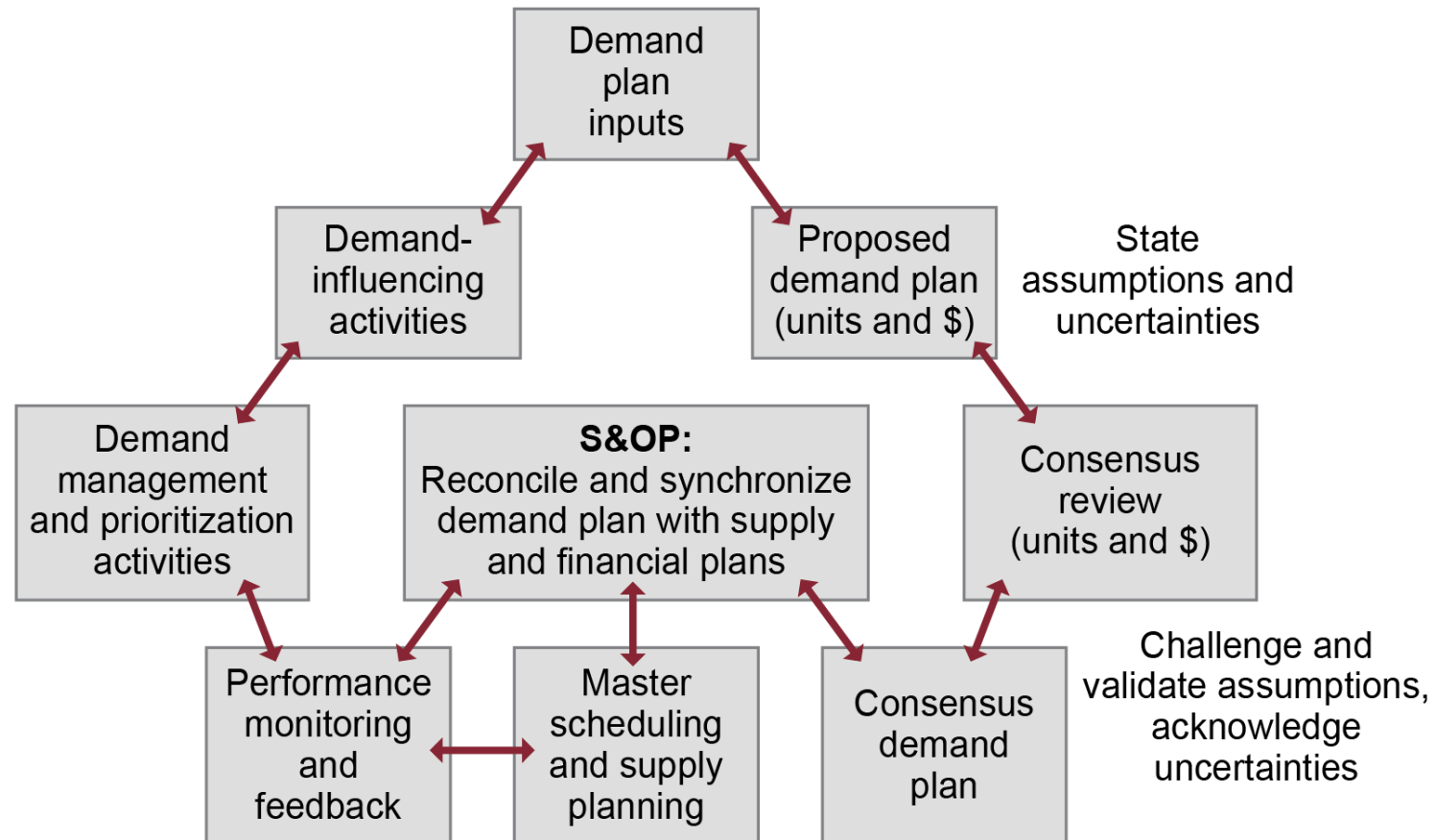
Topic 1: Demand Management

Communicating Demand



Topic 1: Demand Management

Communications Structure for Communicating Demand



Topic 1: Demand Management

Demand Manager as Focal Point

Communicate to sales organization:
what sales is expected to sell;
what is available to be sold
(consensus supply and demand).

Performance feedback:
how well it is executing
sales plans.

Salespersons

Marketing
staff

Master
scheduler
and supply
planners

*Feedback and performance
monitoring goals:*

Communicate consensus demand
plan and outcome of S&OP
processes of reconciling and
synchronizing supply and demand.

**Demand
manager**

Get/give feedback on
effectiveness of demand
management efforts.

Alert product/brand, sales,
marketing, and supply organizations
of the need for action.

Key
customers

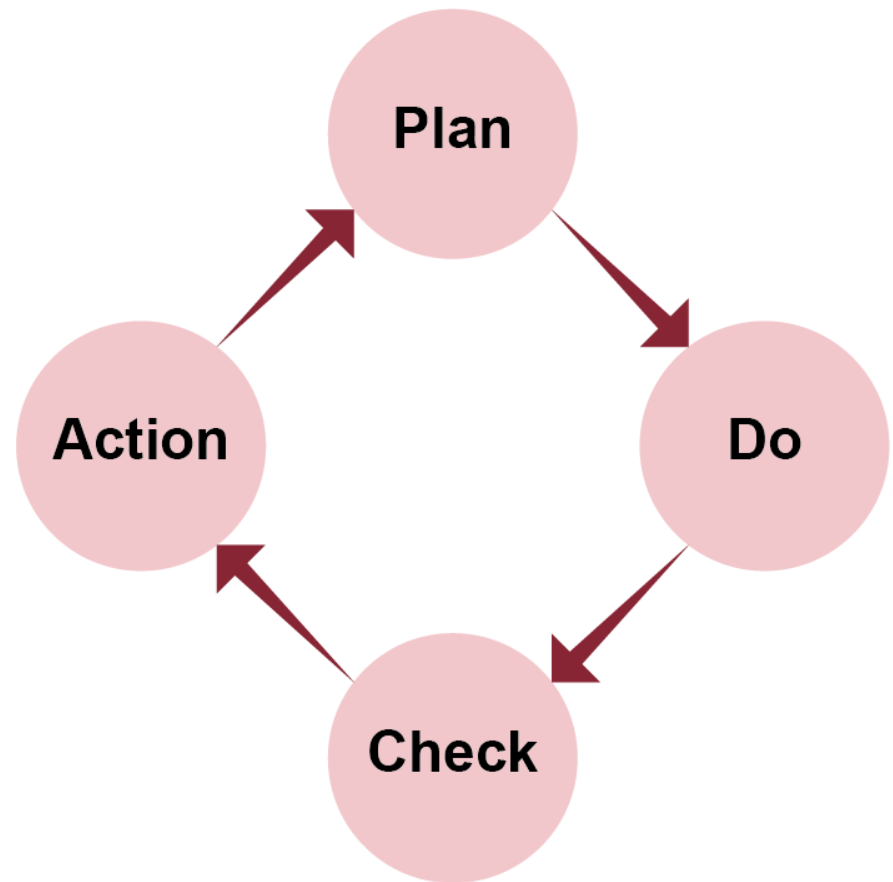
Product
and brand
managers

*Communicate to
product/brand and
marketing organizations:*
changes in tactics needed
to meet demand or
business objectives.

Topic 2: Influencing Demand

Influencing Demand Using Plan, Do, Check, Action

- Brand, marketing, and sales activities to convince customers to purchase products and services so that business objectives are met or exceeded
- Influencing product development and supply sides of organization



Topic 2: Influencing Demand

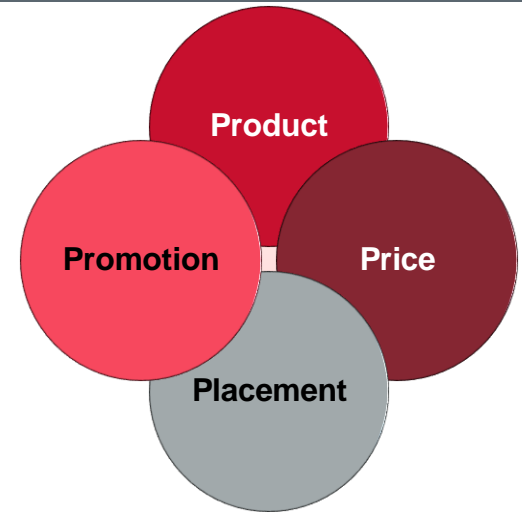
Demand Generation

- From latent to actual demand
- Educating customers
 - Product/brand awareness takes a long time.
 - Use feedback to modify approach/budget.
- Educating SC partners
 - Persons who design, build transport, or sell product.

Topic 2: Influencing Demand

4 Ps: Product (Service)

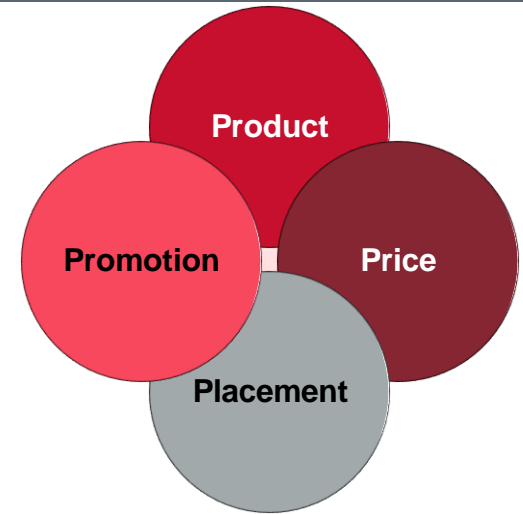
- Was: products identical to all customers; item generated need.
- Is: dynamic; customer need is basis.
- Designed to be customizable for segments.
- Customer care is an implied or explicit product.
- Customized design, manufacture, promotion, distribution, sales methods, and customer care training.



Topic 2: Influencing Demand

4 Ps: Price

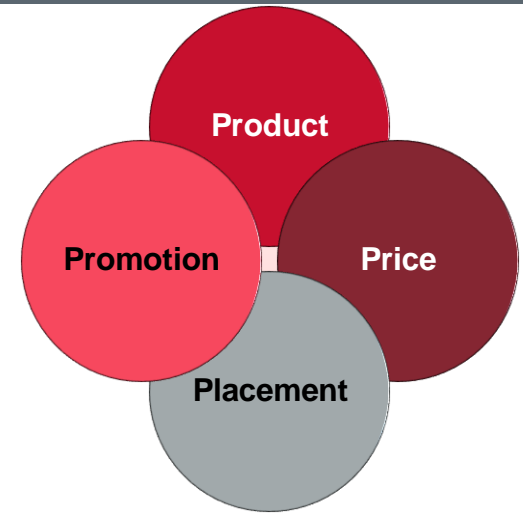
- Strategic decision based on competition, perceived value, and brand identity.
- Commodity price based on competition.
- Differentiated market can base price on R&D, marketing costs, or value to customer.
- Customer-focused differentiates products/price by segment.
- Finds optimal balance of profit vs. attractive price to customers.



Topic 2: Influencing Demand

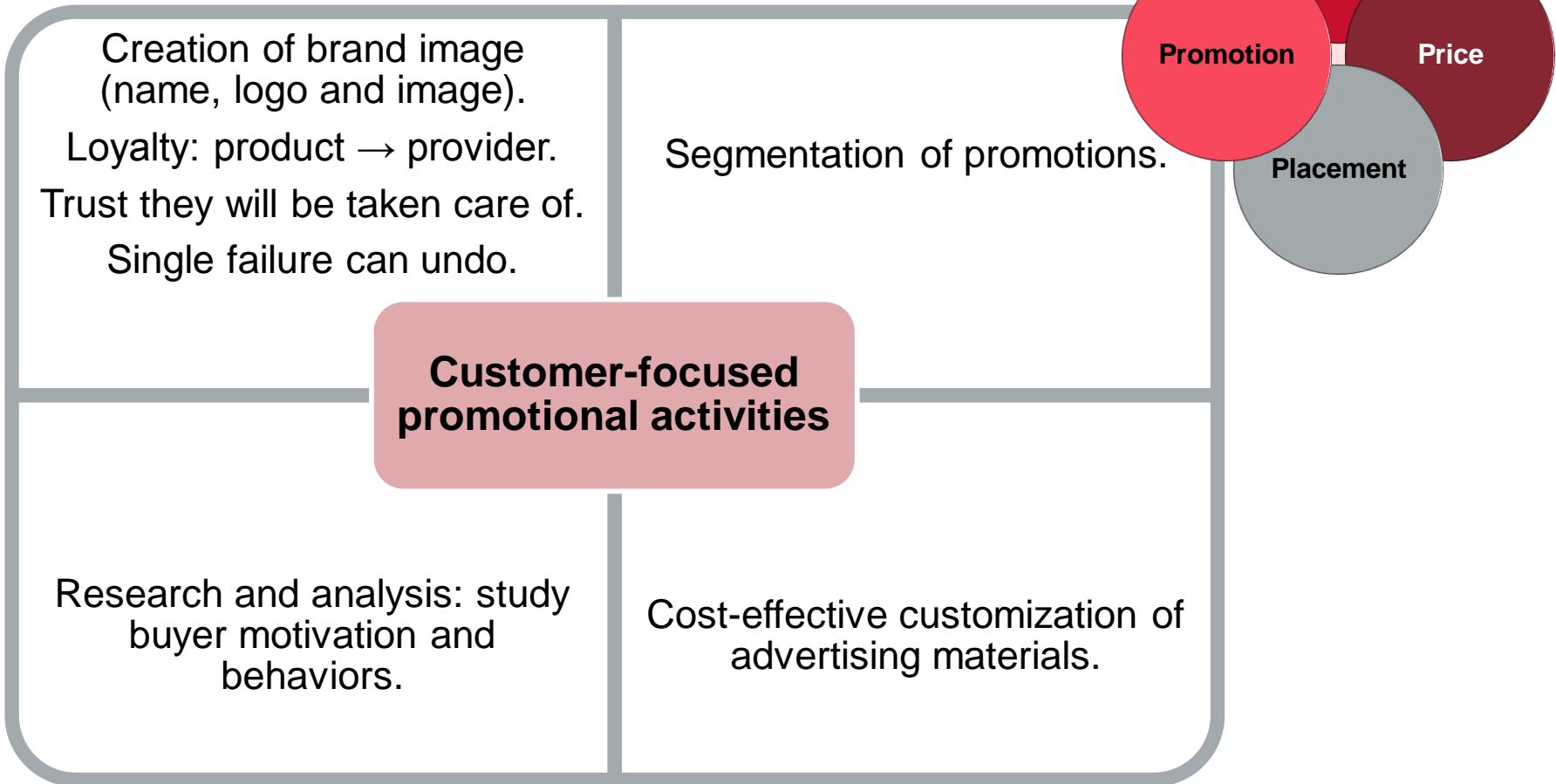
4 Ps: Placement

- How to get it to customer.
- Traditionally one-way communication; now back-forth flow.
- Contact channel strategy:
 - Means to increase profitability, control, and consistency
 - Interactive contact channels (call centers, live dialogue websites, chat rooms).
 - Is itself a product; different segments get different options.



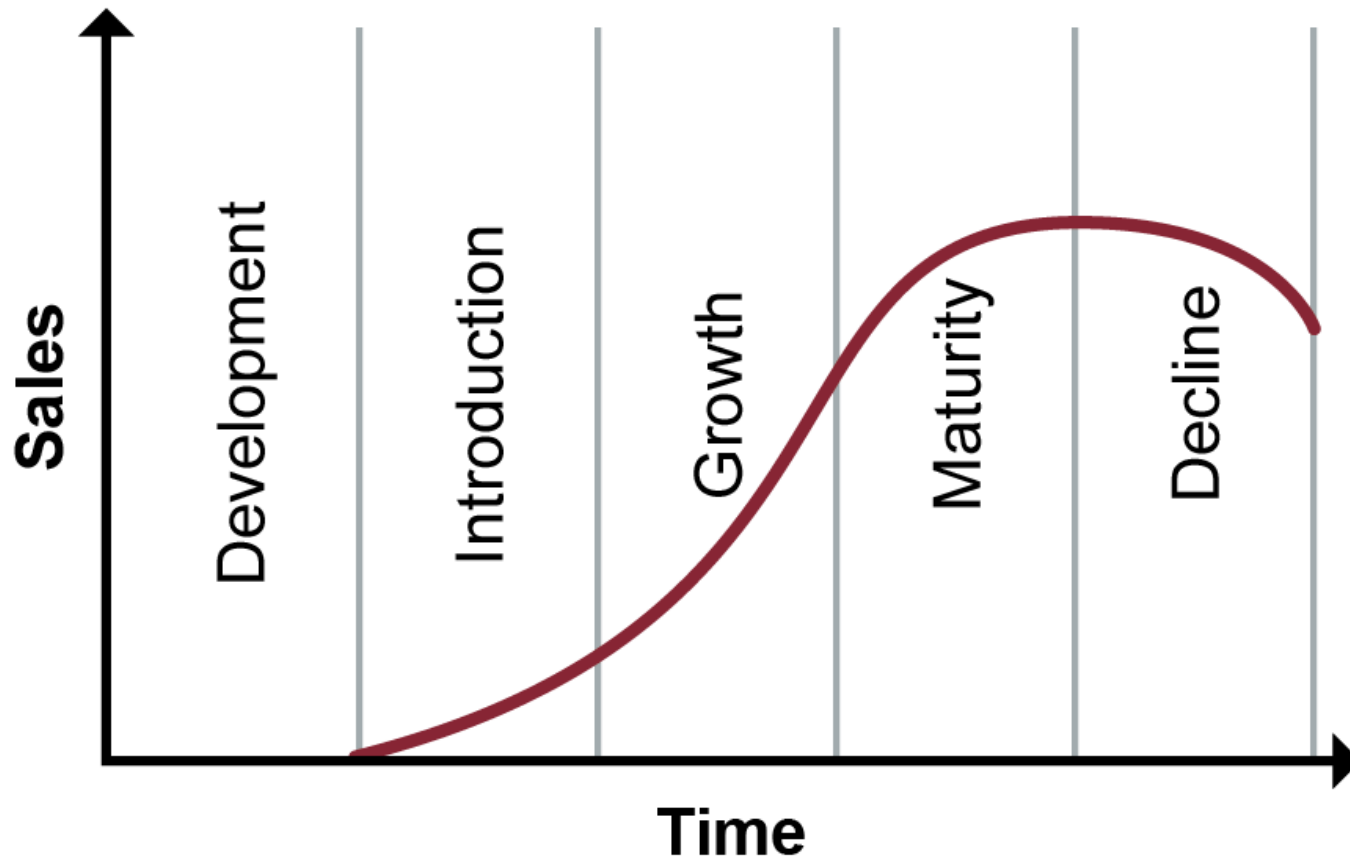
Topic 2: Influencing Demand

4 Ps: Promotion



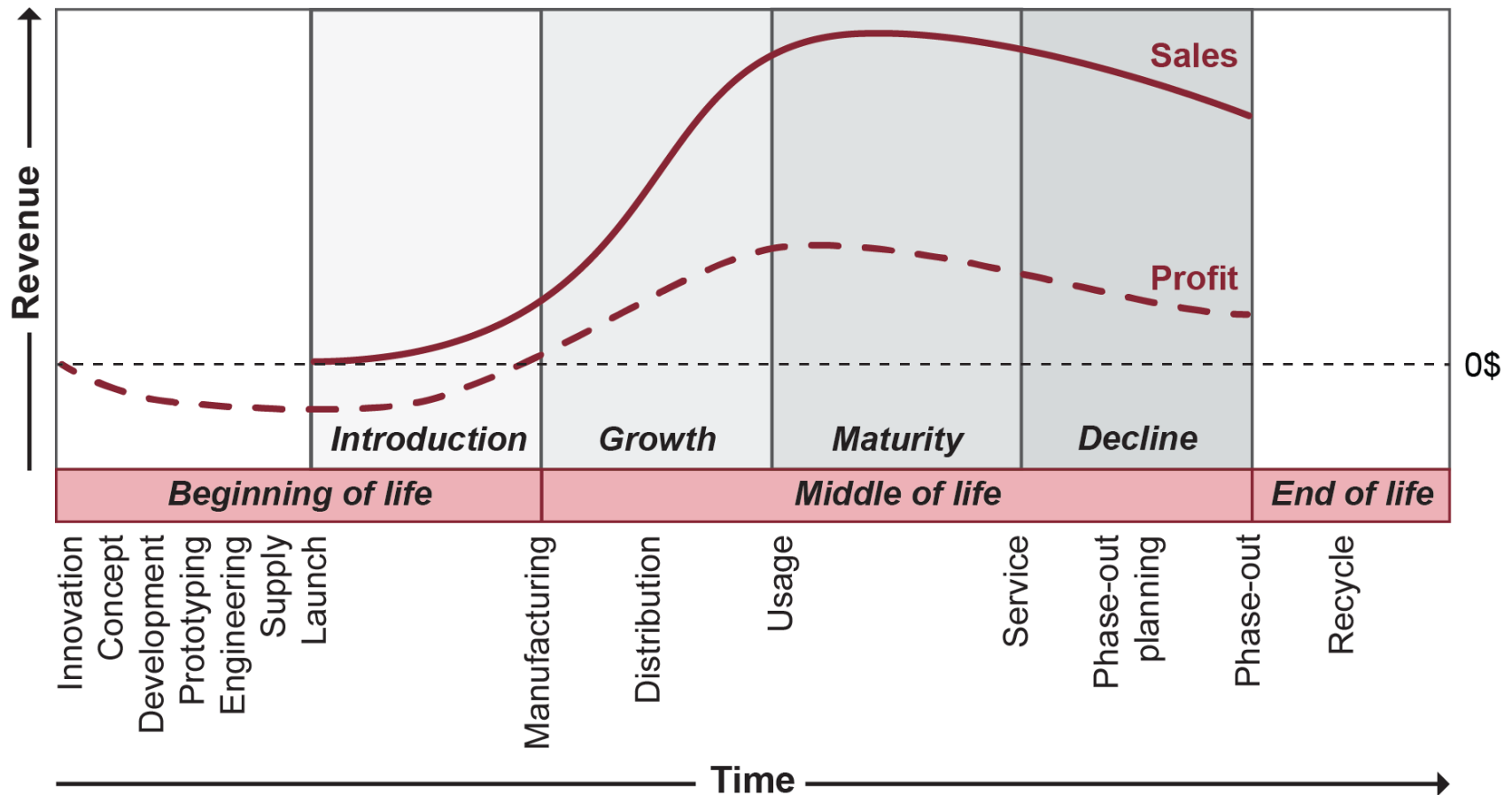
Topic 2: Influencing Demand

Product Life Cycle Stages



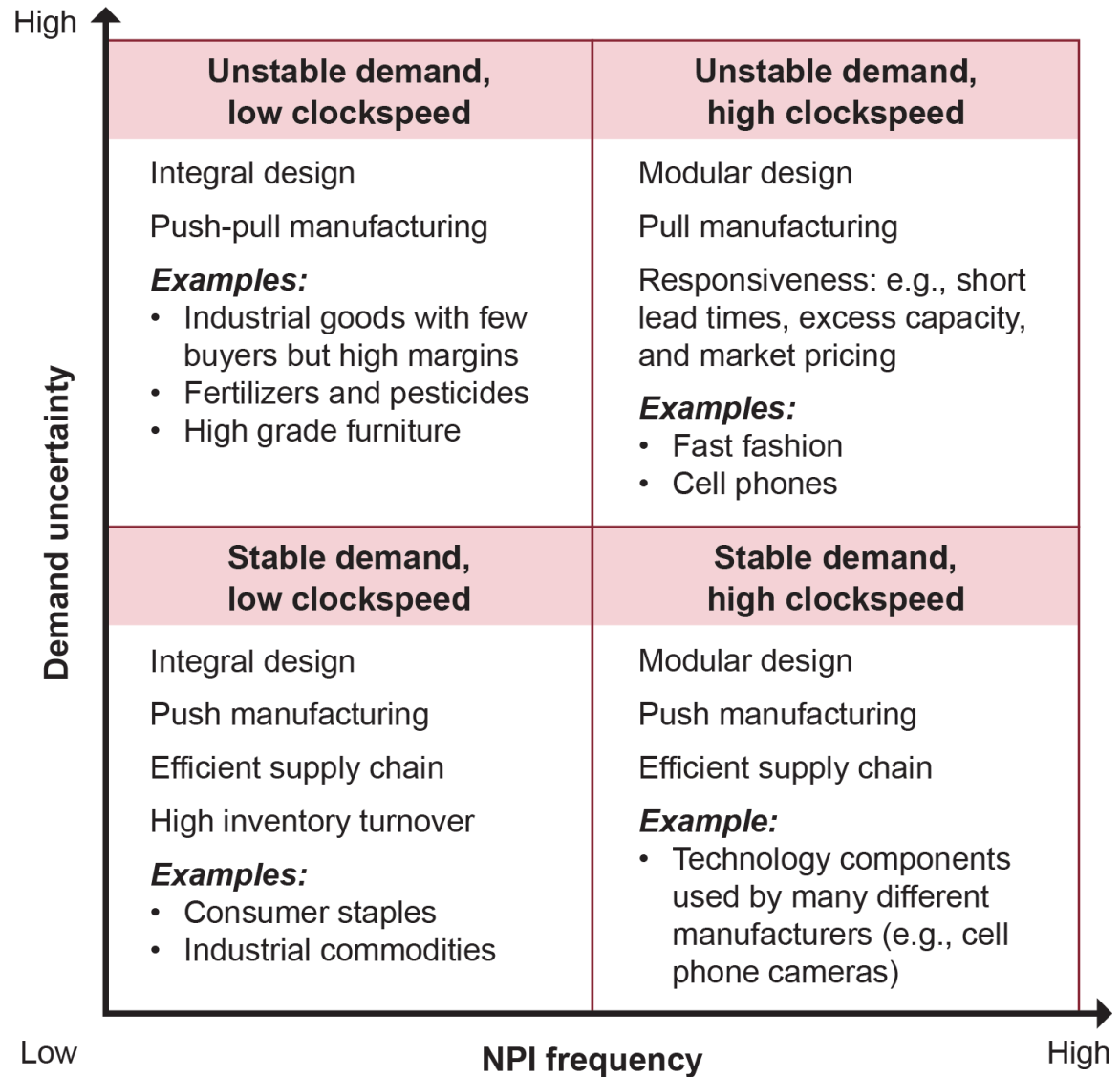
Topic 2: Influencing Demand

Product Life Cycle Management



Topic 2: Influencing Demand

NPI Frequency versus Demand Uncertainty



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SECTION D: FORECASTING



Section D Introduction

Section D Key Processes:

- Build the forecast.
 - Select appropriate forecasting methods.
 - Qualitative, quantitative
 - Intrinsic, extrinsic
 - Measure forecast accuracy.
 - Forecast error, forecast bias

Section D Topics:

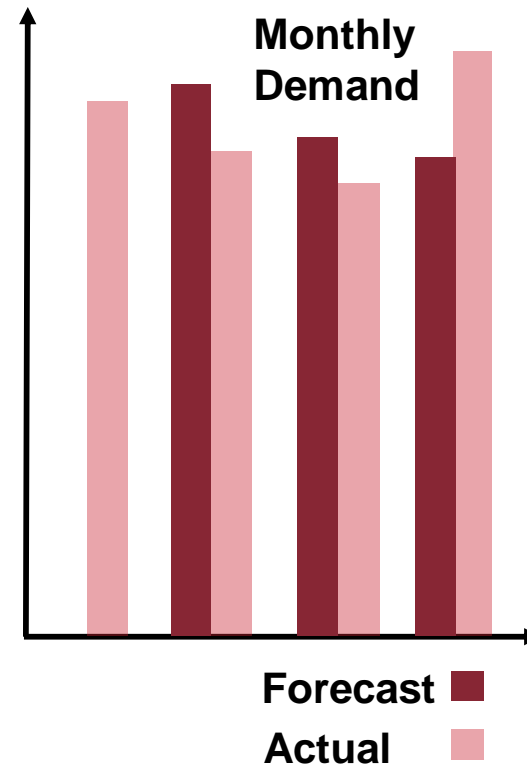
- Topic 1: Forecasting Principles and Process
- Topic 2: Forecasting Methods
- Topic 3: Measures of Forecast Error

Topic 1: Forecasting Principles and Process

Principles of Forecasting

Forecasts are:

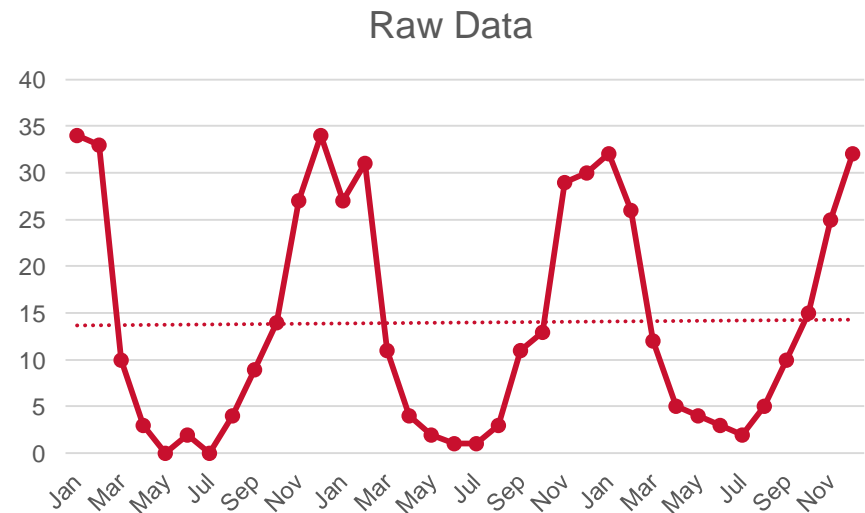
- Necessary (sometimes)
- Best based on actual demand rather than just orders
- Wrong (almost always, and they should include an estimate of error)
- More accurate for groups than for single items
- More accurate for near term than for long term.



Topic 1: Forecasting Principles and Process

Forecasting Process

1. Specify purpose,
2. Aggregation, units, and
3. Time horizon.
4. Visualize data.
5. Choose forecasting method or model.
6. Prepare data.
7. Test (historical data).
8. Forecast.
9. Perform S&OP.
10. Review and improve.



Topic 2: Forecasting Methods

Qualitative and Combination Methods

- Estimates
 - Judgmental/
expert judgment
 - Delphi method
 - Anonymous to avoid:
 - “Groupthink”
 - “Stake in the ground”
 - Combine with quantitative to add expertise, assumptions
- $$\frac{\text{Optimistic} + (4 \times \text{Most Likely}) + \text{Pessimistic}}{6}$$
- When to use qualitative forecasting methods:
 - For new products
 - When hard data are lacking

Topic 2: Forecasting Methods

Deseasonalizing

1. Calculate month average for each month: e.g.,
(Jan-Y1 + Jan-Y2 + Jan-Y3)/3
2. Calculate year average: Sum month averages and divide by 12.
3. Calculate seasonal index: Divide each month average by the year average.

$$\text{Seasonal Index} = \frac{\text{Average Demand for Period (e.g., Month)}}{\text{Average Demand for all Periods (e.g., Year)}}$$

Topic 2: Forecasting Methods

Deseasonalizing

	A	B	C	D	E	I	J	K	L
1		Raw Data					Deseasonalized Data		
2	Month	Year 1	Year 2	Year 3	Month Average	Seasonal Index	Year 1	Year 2	Year 3
3	Jan	34	27	32	31.00	2.214	15.35	12.19	14.45
4	Feb	33	31	26	30.00	2.143	15.40	14.47	12.13
5	Mar	10	11	12	11.00	0.786	12.73	14.00	15.27
6	Apr	3	4	5	4.00	0.286	10.50	14.00	17.50
7	May	0	2	4	2.00	0.143	0.00	14.00	28.00
8	Jun	2	1	3	2.00	0.143	14.00	7.00	21.00
9	Jul	0	1	2	1.00	0.071	0.00	14.00	28.00
10	Aug	4	3	5	4.00	0.286	14.00	10.50	17.50
11	Sep	9	11	10	10.00	0.714	12.60	15.40	14.00
12	Oct	14	13	15	14.00	1.000	14.00	13.00	15.00
13	Nov	27	29	25	27.00	1.929	14.00	15.04	12.96
14	Dec	34	30	32	32.00	2.286	14.88	13.13	14.00
15	SUM	170	163	171	168				
16	Year Average	14.17	13.58	14.25	14.00				

Topic 2: Forecasting Methods

Naïve; Simple or Weighted Moving Average

- Naïve: Lasts month's actual is this month's forecast
- Simple moving average:

$$\text{3-Month Moving Average} = \frac{(M1 + M2 + M3)}{3} = \frac{14.00 + 15.87 + 14.64}{3} = 14.84$$

– Smooths out irregular demand, but lags trend

- Weighted moving average:

$$\begin{aligned} \text{3-Month Weighted Moving Average} &= \frac{(1 \times M1) + (2 \times M2) + (3 \times M3)}{6} \\ &= \frac{(15.51) + (2 \times 19.73) + (3 \times 18.61)}{6} = 18.47 \end{aligned}$$

– Also smooths, but lags trend less

Topic 2: Forecasting Methods

Exponential Smoothing

- Inputs: last period's forecast, last period's demand, and alpha
 - New Forecast = $(\alpha \times \text{Last Period's Demand}) + [(1 - \alpha) \times \text{Last Period's Forecast}]$
- Alpha, α , a smoothing constant between 0 and 1
 - Example: 0.3, 30% weight on demand, 70% on forecast, $(0.3 \times 14.92) + [(0.7) \times 17.71] = 16.87$
 - Typically between 0.05 and 0.5
 - Experience, trial and error, and historical testing
- Can minimize lag even more, but not eliminate

Topic 2: Forecasting Methods

Comparison of Time-Series Forecasts

Forecasting month-to-month works well.

	A	C	D	E	I
19		Deseasonalized			
		Moving	Weighted		Actual
20		Average	Average	Exponential	Demand
45	Jan	14.45	14.45	13.43	14.45
46	Feb	12.13	12.13	13.74	12.13
47	Mar	15.27	15.27	13.26	15.27
48	Apr	17.50	17.50	13.86	17.50
49	May	28.00	28.00	14.95	28.00
50	Jun	21.00	21.00	18.87	21.00
51	Jul	28.00	28.00	19.51	28.00
52	Aug	17.50	17.50	22.05	17.50
53	Sep	14.00	14.00	20.69	14.00
54	Oct	15.00	15.00	18.68	15.00
55	Nov	12.96	12.96	17.58	12.96
56	Dec	14.00	14.00	16.19	14.00
57	Jan	13.99	13.82	15.54	15.87
58	Feb	14.28	14.76	15.64	14.64
59	Mar	14.84	14.94	15.34	15.68
60	Apr	15.40	15.36	15.44	15.51
61	May	15.27	15.42	15.46	19.73
62	Jun	16.97	17.65	16.74	18.61
63	Jul	17.95	18.47	17.30	17.37
64	Aug	18.57	18.17	17.32	18.61
65	Sep	18.19	18.19	17.71	14.92
66	Oct	16.97	16.56	16.87	15.79
67	Nov	16.44	15.97	16.55	15.51
68	Dec	15.41	15.50	16.23	15.08

	A	C	D
		Moving	Weighted
20		Average	Average
45	Jan	14.45	14.45
46	Feb	12.13	12.13
47	Mar	15.27	15.27
48	Apr	17.50	17.50
49	May	28.00	28.00
50	Jun	21.00	21.00
51	Jul	28.00	28.00
52	Aug	17.50	17.50
53	Sep	14.00	14.00
54	Oct	15.00	15.00
55	Nov	12.96	12.96
56	Dec	14.00	14.00
57	Jan	13.99	13.82
58	Feb	13.65	13.74
59	Mar	13.88	13.81
60	Apr	13.84	13.79
61	May	13.79	13.79
62	Jun	13.84	13.79
63	Jul	13.82	13.79
64	Aug	13.82	13.79
65	Sep	13.82	13.79
66	Oct	13.82	13.79
67	Nov	13.82	13.79
68	Dec	13.82	13.79

Forecasting over longer periods results in same value repeated.

Topic 2: Forecasting Methods

Reseasonalizing

	A	I	O	P	Q	R	S	T	U
1			Deseasonalized			Year 4 Reseasonalized Forecasts			
2	Month	Seasonal Index	Moving Year 4	Weighted Year 4	Expon. Year 4	Moving Average	Weighted Average	Exponential	Year 4 Raw Actuals
3	Jan	2.214	13.99	13.82	15.54	30.97	30.60	34.40	34
4	Feb	2.143	14.28	14.76	15.64	30.60	31.64	33.51	29
5	Mar	0.786	14.84	14.94	15.34	11.66	11.74	12.05	13
6	Apr	0.286	15.40	15.36	15.44	4.40	4.39	4.41	5
7	May	0.143	15.27	15.42	15.46	2.18	2.20	2.21	5
8	Jun	0.143	16.97	17.65	16.74	2.42	2.52	2.39	3
9	Jul	0.071	17.95	18.47	17.30	1.28	1.32	1.24	2
10	Aug	0.286	18.57	18.17	17.32	5.31	5.19	4.95	6
11	Sep	0.714	18.19	18.19	17.71	13.00	13.00	12.65	11
12	Oct	1.000	16.97	16.56	16.87	16.97	16.56	16.87	16
13	Nov	1.929	16.44	15.97	16.55	31.71	30.80	31.91	30
14	Dec	2.286	15.41	15.50	16.23	35.21	35.44	37.11	33

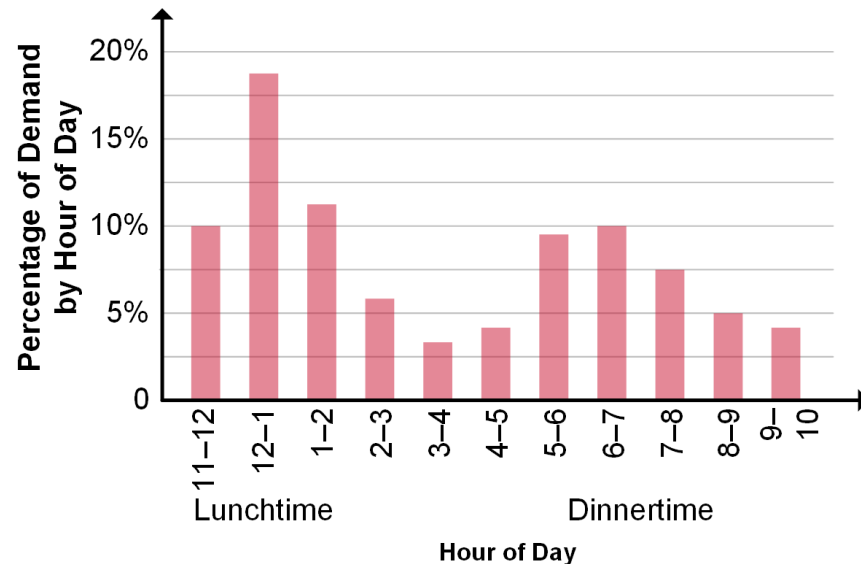
$$0.786 \times 14.84 = 11.66$$

$$0.071 \times 18.47 = 1.32$$

Topic 2: Forecasting Methods

Service-Sector Forecasting

Service businesses, such as restaurants, may track “seasonal” demand in units as short as minutes.



Some restaurant variables

- Workers per shift
- Registers in operation
- Number of available tables
- Space requirements
- Amount and types of foods

Topic 2: Forecasting Methods

Leading and Lagging Economic Indicators

Lagging Indicators

- Unemployment rate
- Outstanding business and commercial loans
- Inventory to sales
- Changes in company profits
- Spending by businesses
- Consumer price index (CPI)
- Average duration of unemployment

Past and current trends

Leading Indicators

- Building permits
- Initial unemployment claims
- Orders for plant equipment
- Manufacturers' orders for durable goods and materials
- Changes in money supply
- S&P 500
- Long- vs. short-term interest rates
- Consumer optimism

Future trends

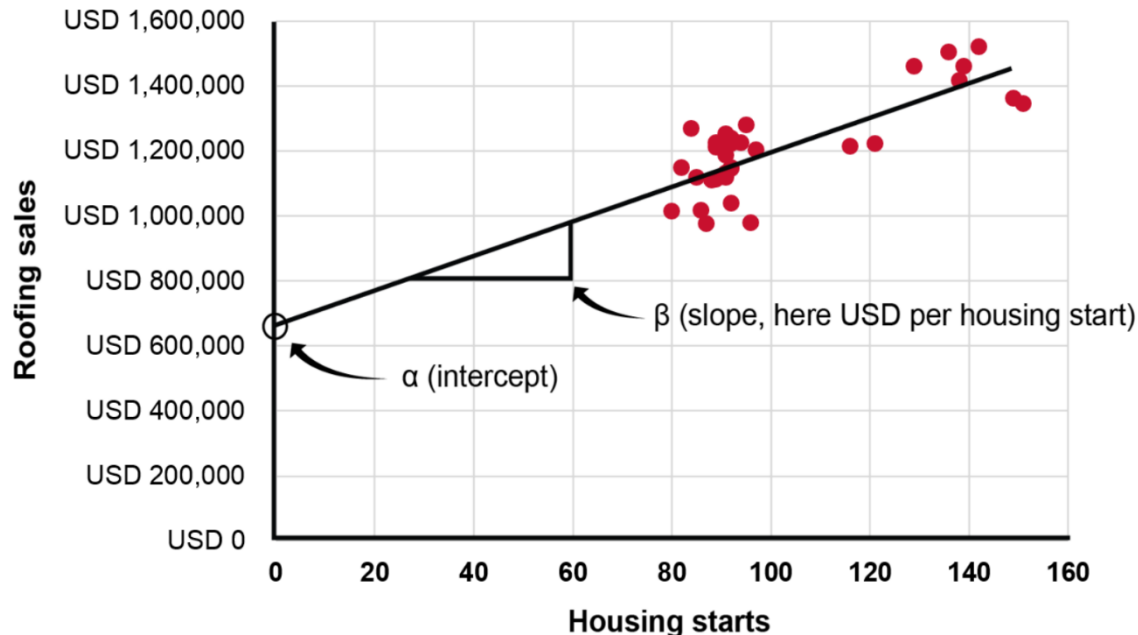
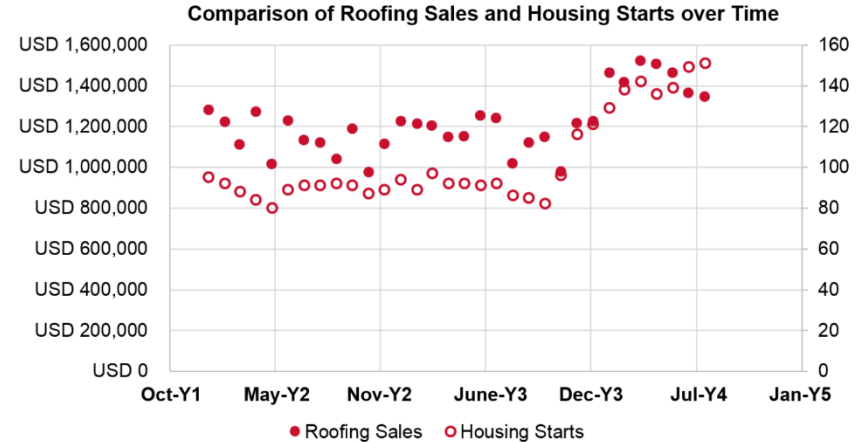


Topic 2: Forecasting Methods

Associative Forecasting

$$y = \alpha + \beta x$$

$$\text{Roofing Sales} = \alpha + (\beta \times \text{Prior Month's Housing Starts})$$



Topic 3: Measures of Forecast Error

Forecast Error

$$\begin{aligned}\text{Forecast Error} &= |A - F| \\ &= |29 \text{ units} - 33.51 \text{ units}| = |-4.51 \text{ units}| = 4.51 \text{ units}\end{aligned}$$

Where:

A = Actual demand

F = Forecast demand

NOTE:

Absolute = $| \quad |$.

An absolute value has no +/- sign, and so, in this case, it measures the size of the error, not the direction.

Topic 3: Measures of Forecast Error

Forecast Error and Accuracy

$$\begin{aligned}\text{Forecast Error as a Percentage} &= \frac{|A - F|}{A} \\ &= \frac{|29 \text{ units} - 33.51 \text{ units}|}{29 \text{ units}} = \frac{4.51 \text{ units}}{29 \text{ units}} \\ &= 0.155 = 15.5\% \text{ error}\end{aligned}$$

$$\begin{aligned}\text{Forecast Accuracy} &= 1 - \text{Forecast Error as a Percentage} \\ &= 1 - 0.155 = 0.845 = 84.5\% \text{ accuracy}\end{aligned}$$

Where:

A = Actual demand

F = Forecast demand

Topic 3: Measures of Forecast Error

Bias and Random Variation

Bias

- Consistent deviation from the mean in one direction
- Good forecast: not biased
- Cumulative Forecast Error = Cumulative Actual Demand – Cumulative Forecast Demand
- Not absolute (direction matters)

Random Variation

- If cumulative actual demand = cumulative forecast demand, then no bias.
- Wide swings in both directions can still cause issues.

Topic 3: Measures of Forecast Error

Mean Absolute Deviation (MAD) with Smoothing

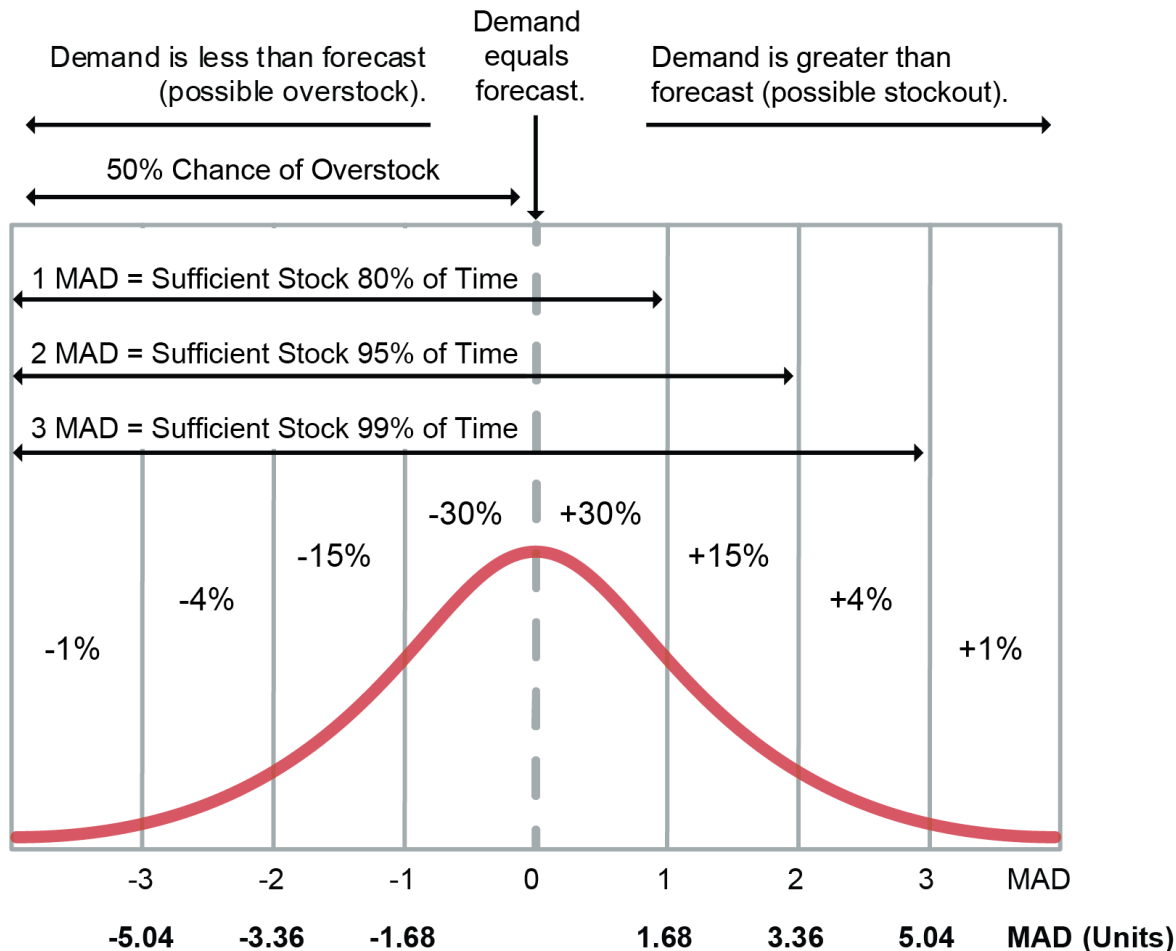
	R	S	T	U	V	W	X
1	Year 4 Reseasonalized Forecasts				Absolute Errors		
2	Moving Average	Weighted Average	Exponential	Year 4 Raw Actuals	Moving Error	Weighted Error	Expon. Error
3	30.97	30.60	34.40	34	3.03	3.40	0.40
4	30.60	31.64	33.51	29	1.60	2.64	4.51
5	11.66	11.74	12.05	13	1.34	1.26	0.95
6	4.40	4.39	4.41	5	0.60	0.61	0.59
7	2.18	2.20	2.21	5	2.82	2.80	2.79
8	2.42	2.52	2.39	3	0.58	0.48	0.61
9	1.28	1.32	1.24	2	0.72	0.68	0.76
10	5.31	5.19	4.95	6	0.69	0.81	1.05
11	13.00	13.00	12.65	11	2.00	2.00	1.65
12	16.97	16.56	16.87	16	0.97	0.56	0.87
13	31.71	30.80	31.91	30	1.71	0.80	1.91
14	35.21	35.44	37.11	33	2.21	2.44	4.11
15				SUM	18.25	18.45	20.20
16				MAD	1.52	1.54	1.68

The Greek uppercase letter Σ stands for "the sum of."

$$\begin{aligned}
 \text{MAD} &= \frac{\sum |A - F|}{n} \\
 &= \frac{20.2}{12} \\
 &= 1.68 \text{ units}
 \end{aligned}$$

Topic 3: Measures of Forecast Error

Distribution Curve for MAD of 1.68 Units



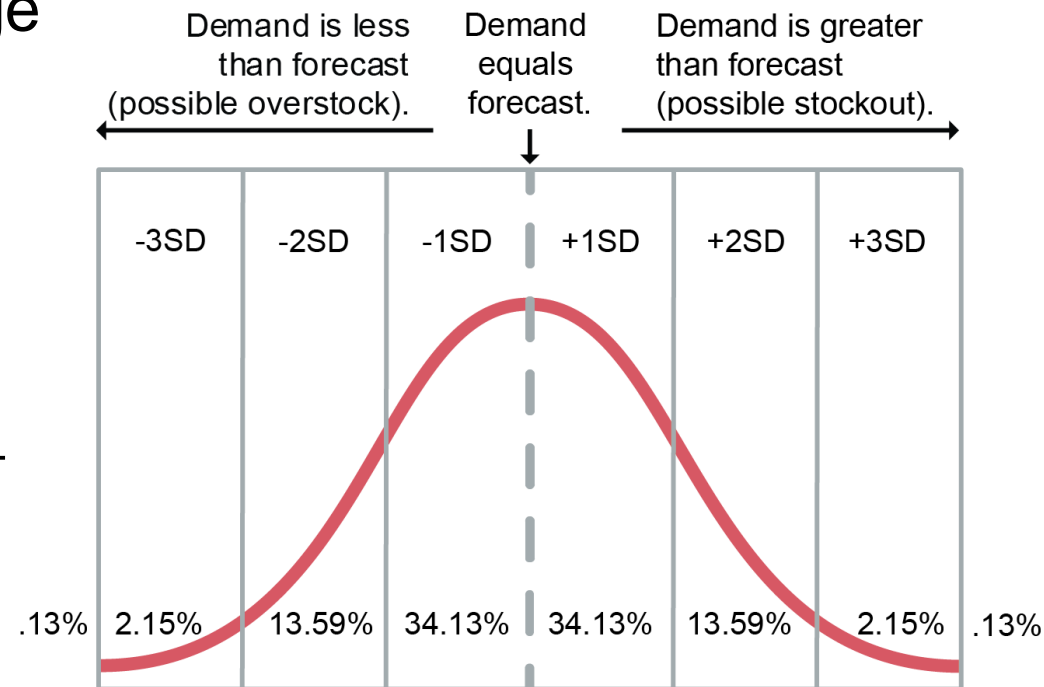
Topic 3: Measures of Forecast Error

Standard Deviation

Difference between average and actual observations, squared, divided by n (or n-1), then square root.

Standard Deviation =

$$\sqrt{\frac{\sum(\text{Sample} - \text{Sample Mean})^2}{n - 1}}$$



Topic 3: Measures of Forecast Error

Other Measures of Forecast Error

$$\text{Tracking Signal} = \frac{\text{Algebraic Sum of Forecast Errors}}{\text{Mean Absolute Deviation}} = \frac{-6.69}{1.68} = -3.98$$

$$\text{MSE} = \frac{\sum(\text{Errors for Each Period})^2}{\text{Number of Forecast Periods}} = \frac{55.57}{12} = 4.63$$

$$\text{MAPE} = \frac{\sum\left(\frac{|A - F|}{A}\right)}{n} = \frac{206.87\%}{12} = 17.24\%$$

Topic 3: Measures of Forecast Error

MAD, Tracking Signal, and MSE

	U	V	W	X	AD	AE	AF	AG	AH	AI
1		Absolute Errors								
	Year 4 Raw	Moving	Weighted	Expon.	Moving	Weighted	Expon.	Squared	Squared	Squared
2	Actuals	Error	Error	Error	Error +/-	Error +/-	Error +/-	Moving	Weighted	Expon.
3	34	3.03	3.40	0.40	3.03	3.40	-0.40	9.16	11.54	0.16
4	29	1.60	2.64	4.51	-1.60	-2.64	-4.51	2.55	6.95	20.31
5	13	1.34	1.26	0.95	1.34	1.26	0.95	1.80	1.58	0.90
6	5	0.60	0.61	0.59	0.60	0.61	0.59	0.36	0.37	0.35
7	5	2.82	2.80	2.79	2.82	2.80	2.79	7.94	7.82	7.79
8	3	0.58	0.48	0.61	0.58	0.48	0.61	0.33	0.23	0.37
9	2	0.72	0.68	0.76	0.72	0.68	0.76	0.52	0.46	0.58
10	6	0.69	0.81	1.05	0.69	0.81	1.05	0.48	0.65	1.10
11	11	2.00	2.00	1.65	-2.00	-2.00	-1.65	3.98	3.98	2.72
12	16	0.97	0.56	0.87	-0.97	-0.56	-0.87	0.93	0.31	0.76
13	30	1.71	0.80	1.91	-1.71	-0.80	-1.91	2.91	0.64	3.66
14	33	2.21	2.44	4.11	-2.21	-2.44	-4.11	4.90	5.93	16.87
15	SUM	18.25	18.45	20.20	1.30	1.60	-6.69	35.87	40.47	55.57
16	MAD	1.52	1.54	1.68						
17	MSE	2.99	3.37	4.63						
	Tracking									
19	Signal	0.85	1.04	-3.98						

Topic 3: Measures of Forecast Error

MAPE

	R	S	T	U	V	W	X	Y	Z	AA
1	Year 4 Reseasonalized Forecasts				Absolute Errors					
2	Moving Average	Weighted Average	Exponential	Year 4 Raw Actuals	Moving Error	Weighted Error	Expon. Error	Moving APE	Weighted APE	Expon. APE
3	30.97	30.60	34.40	34	3.03	3.40	0.40	8.9%	10.0%	1.2%
4	30.60	31.64	33.51	29	1.60	2.64	4.51	5.5%	9.1%	15.5%
5	11.66	11.74	12.05	13	1.34	1.26	0.95	10.3%	9.7%	7.3%
6	4.40	4.39	4.41	5	0.60	0.61	0.59	12.0%	12.2%	11.8%
7	2.18	2.20	2.21	5	2.82	2.80	2.79	56.4%	55.9%	55.8%
8	2.42	2.52	2.39	3	0.58	0.48	0.61	19.2%	16.0%	20.3%
9	1.28	1.32	1.24	2	0.72	0.68	0.76	35.9%	34.0%	38.2%
10	5.31	5.19	4.95	6	0.69	0.81	1.05	11.6%	13.5%	17.5%
11	13.00	13.00	12.65	11	2.00	2.00	1.65	18.1%	18.1%	15.0%
12	16.97	16.56	16.87	16	0.97	0.56	0.87	6.0%	3.5%	5.5%
13	31.71	30.80	31.91	30	1.71	0.80	1.91	5.7%	2.7%	6.4%
14	35.21	35.44	37.11	33	2.21	2.44	4.11	6.7%	7.4%	12.4%
15				SUM	18.25	18.45	20.20	196.3%	192.0%	206.9%
16				MAD	1.52	1.54	1.68			
18				MAPE	16.4%	16.0%	17.2%			

CSCP

CERTIFIED SUPPLY CHAIN
PROFESSIONAL

SECTION E: SUPPLY AND DEMAND ALIGNMENT



Section E Introduction

Section E Key Processes:

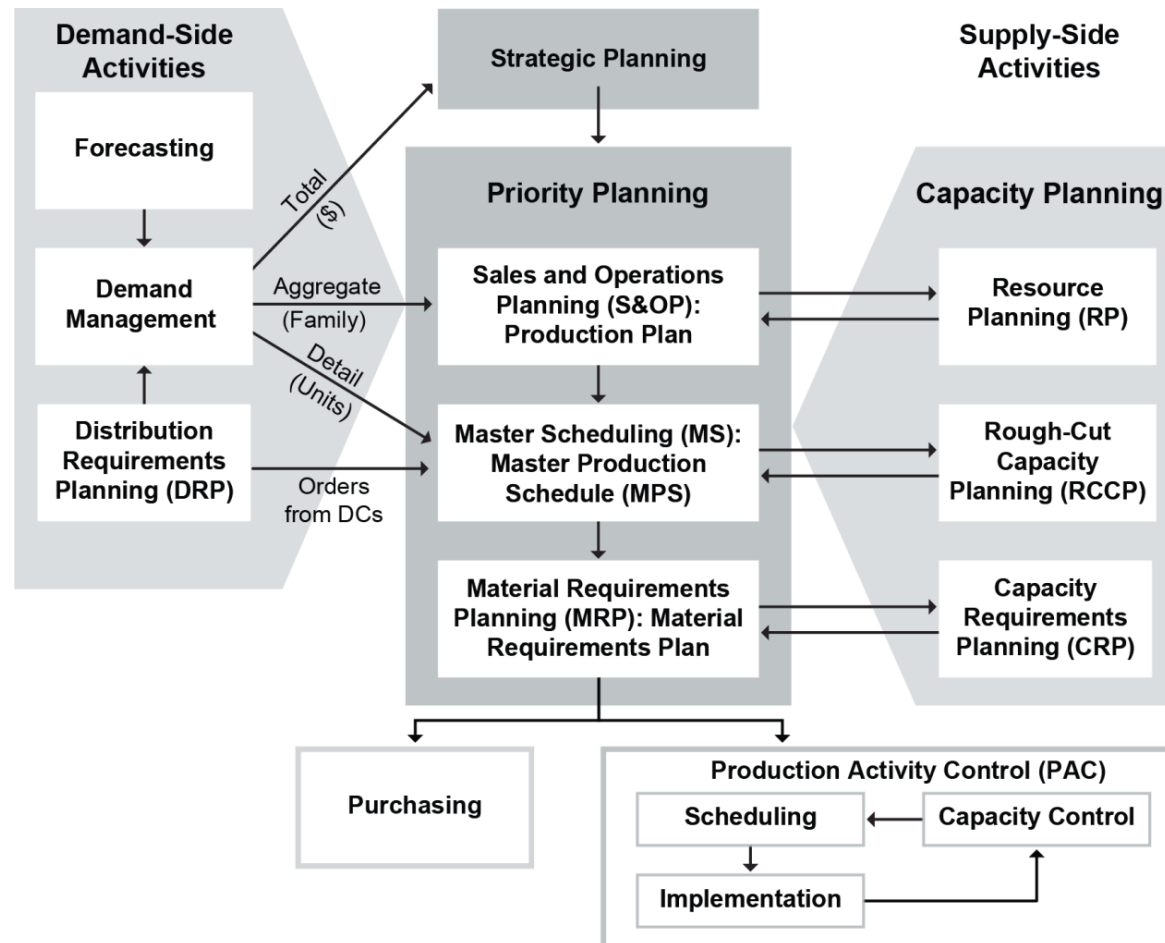
- Align supply with demand.
 - Execute sales and operations planning (S&OP) process.
 - Manage inputs and outputs.
 - Perform reconciliation and analysis.

Section E Topics:

- Topic 1: Supply and Demand Alignment
- Topic 2: Sales and Operations Planning

Topic 1: Supply and Demand Alignment

Operations Planning and Control



Topic 1: Supply and Demand Alignment

Strategic and Business Planning

- Strategic plan
 - Mission and the resources needed to get there
 - Goals: Market share, revenue, profits, and growth
 - Objectives: Value to customers, owners
- Business plan
 - Inputs: demand plan and long-term forecasts
 - Explicit vision to achieve strategy over 1-3 years
 - In dollars and grouped by product family
 - Point of reference for S&OP
 - Guidance for tactical production and sales plans

Topic 1: Supply and Demand Alignment

Master Planning and Resource Planning

Master Planning

- Long-term resource plan
- Near-medium-term sales and operations plan
- Available capacity (S&OP) plus investments in capacity (resource planning)
- Satisfy stakeholders including ROI

Resource Planning

- 15- to 18-month capacity planning
- Capacity at business and production plan level
- Resources that take long to acquire
- Lead time to get equipment, install it, and get it producing

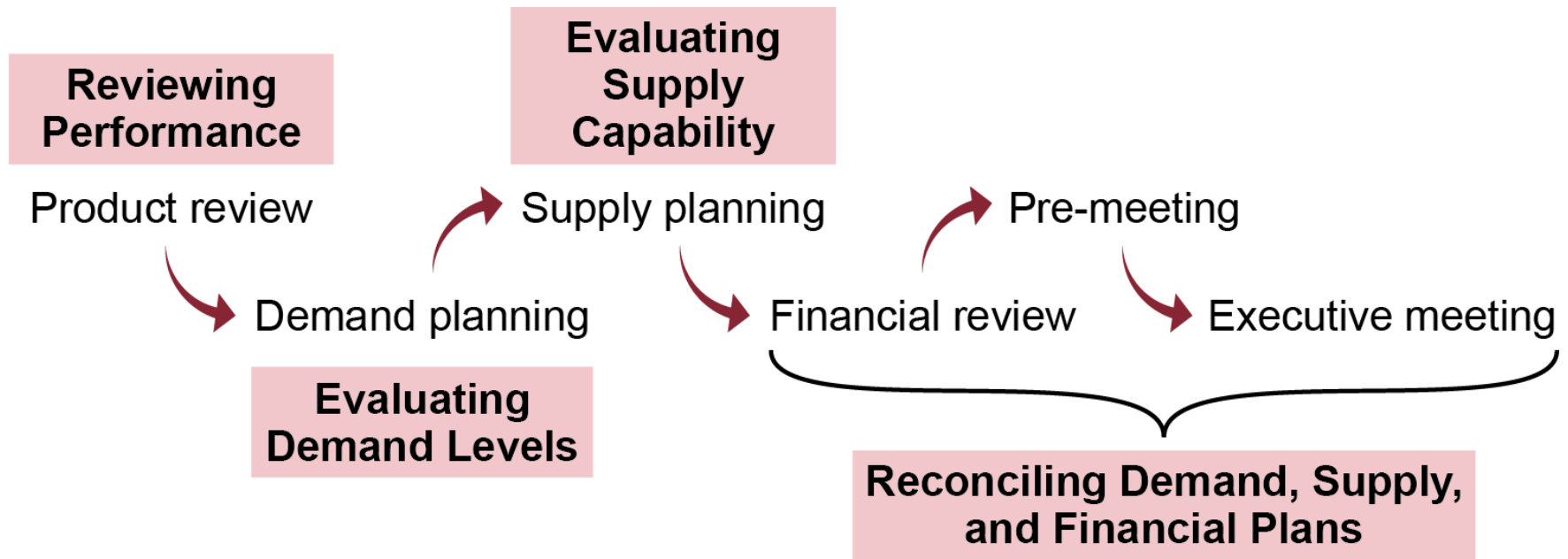
Topic 2: Sales and Operations Planning

Monthly Sales and Operations Planning Process

Step 1	Data gathering	Statistical forecast updated.
Step 2	Demand planning phase	Statistical forecast reviewed by product/brand, marketing, sales.
Step 3	Supply planning phase	Supply management team may alter operations plan if necessary.
Step 4	Pre-meeting	Key players review data, set executive meeting agenda.
Step 5	Executive meeting	VPs meet monthly to review decisions and strategy.

Topic 2: Sales and Operations Planning

Sales and Operations Planning (S&OP)



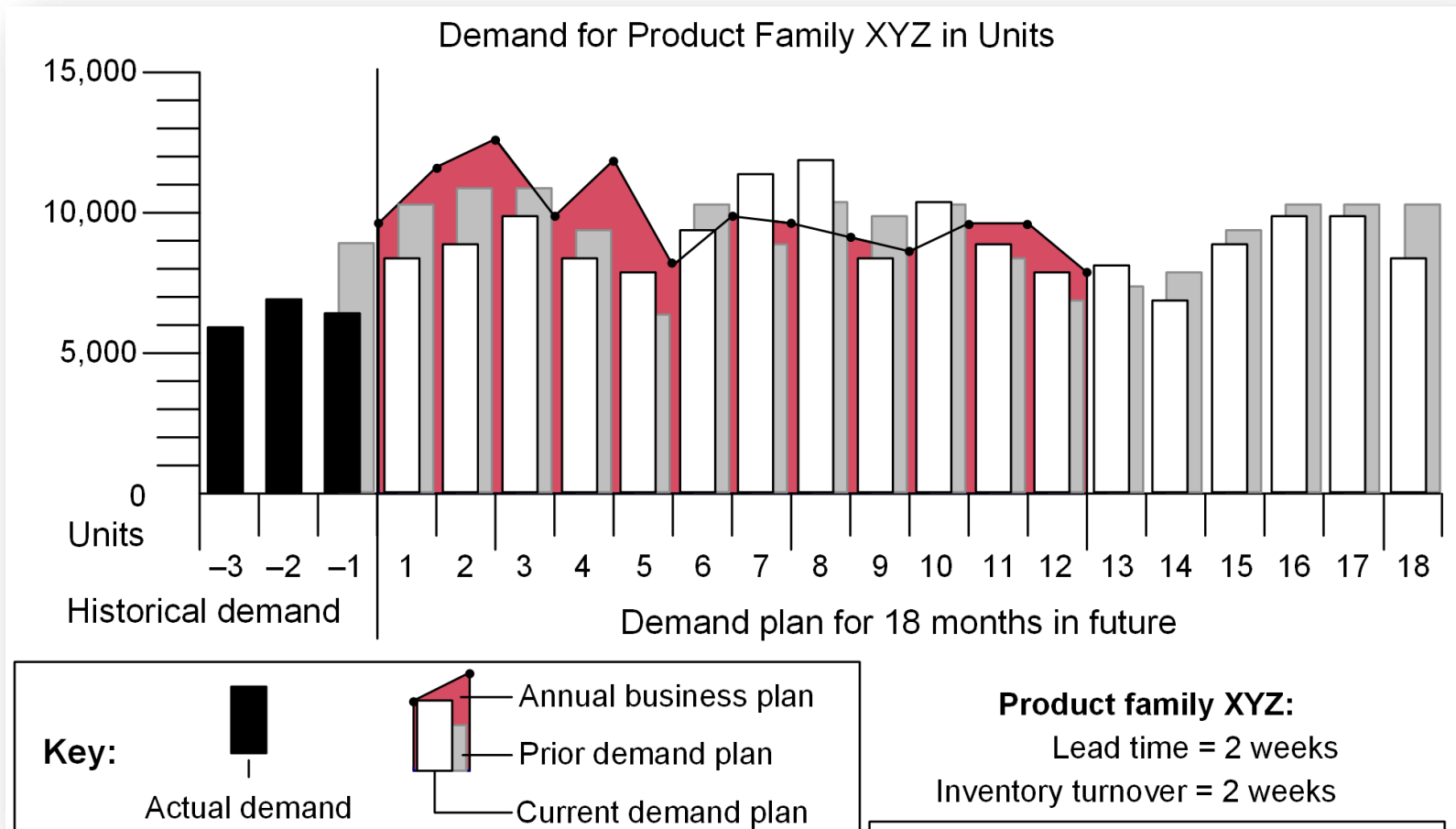
Topic 2: Sales and Operations Planning

Demand Planning Phase Meeting

- Highest-ranking demand-side professional chairs.
- Demand manager prepares dashboards.
 - Consolidates product and brand management, marketing, sales plans.
 - Demand plan in units and in dollars.
 - Metrics, assumptions, events, opportunities, risks, and decisions.
- Meeting brevity:
 - Product family level, subfamilies by exception.
 - What changed since last meeting (replanning).
 - Validating assumptions.
- Strategies to close gaps between demand plan and business plan.
- Success of demand plan depends on quality of communications.

Topic 2: Sales and Operations Planning

Demand Plan Dashboard in Units



Topic 2: Sales and Operations Planning

Evaluating Supply Capability

Supply/Demand Match

- Production plan will match demand plan.



Supply/Demand Mismatch

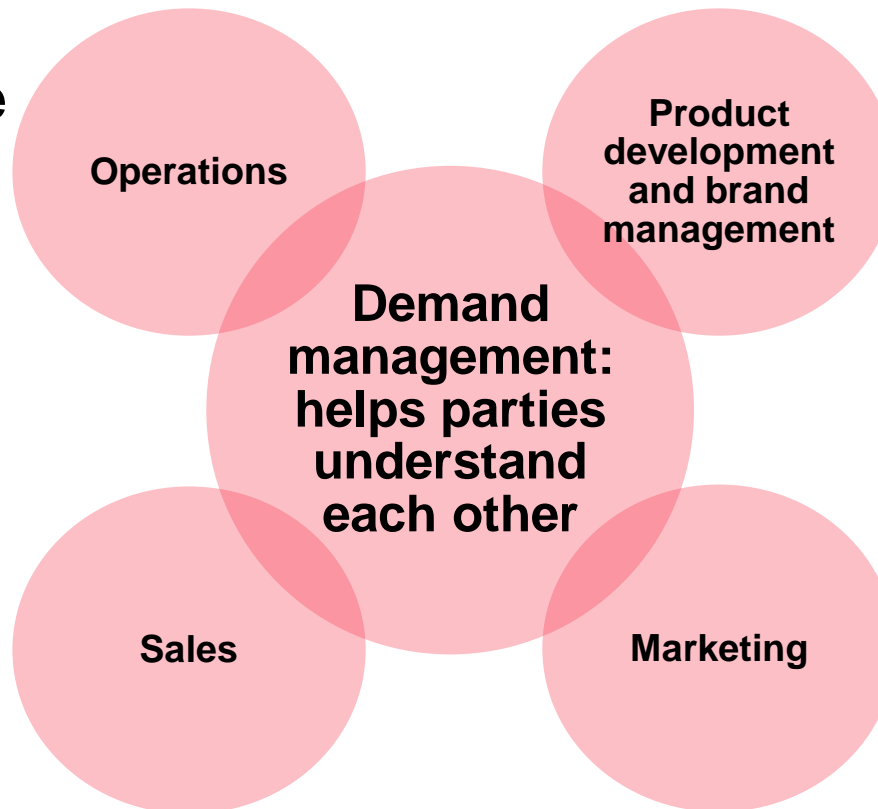
- Supply develops alternative plans:
 - Produce above demand for certain periods to meet later spikes in demand.
 - Increase capacity by hiring, adding shift, planning overtime, leasing equipment, or outsourcing (or opposite).
 - Reducing demand plan (as last resort).

Topic 2: Sales and Operations Planning

S&OP Inputs and Outputs

- Represent demand-side interests in operations terms

- Daily
- Sufficient inventory
- Time to market



- Long-term
- Seek value added

- Medium to short term
- Tailoring demand to capacity

Topic 2: Sales and Operations Planning

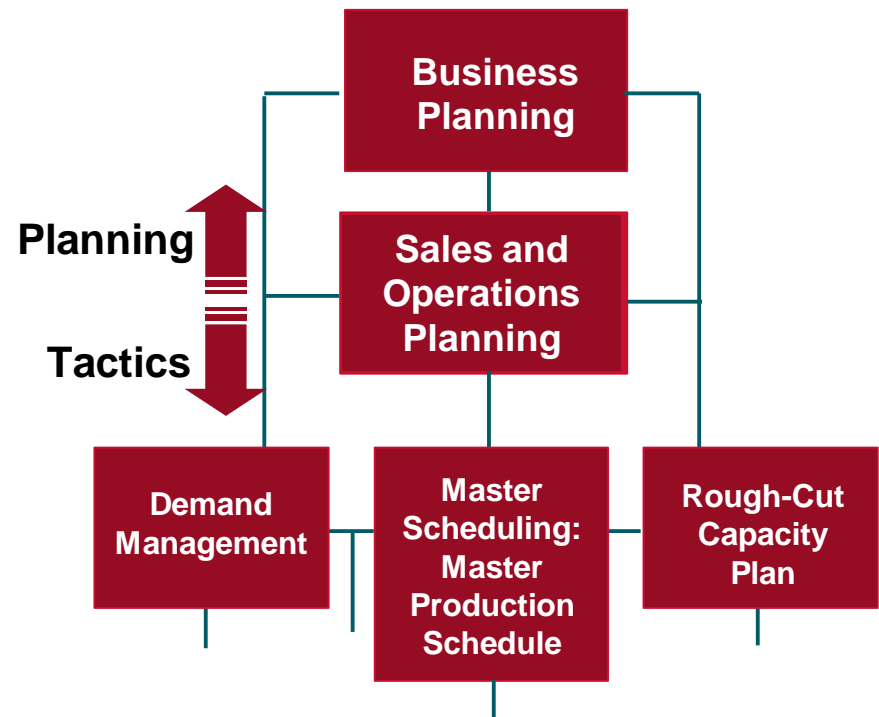
Reconciliation: Executive Meeting

- Participants: CEO and demand, supply, and financial executives and other direct reports to CEO.
- Goal: consensus demand plan.
 - Review metrics, changes, new risks and opportunities, and other events.
- Executives will want to know:
 - Are plans on budget, schedule, and scope?
 - How are product mixes performing?
 - Do strategies need modifying and when do decisions need to be made?
- Communication of agreed-upon plan to all internal participants is critical.
 - Depends on quality of internal communications process.

Topic 2: Sales and Operations Planning

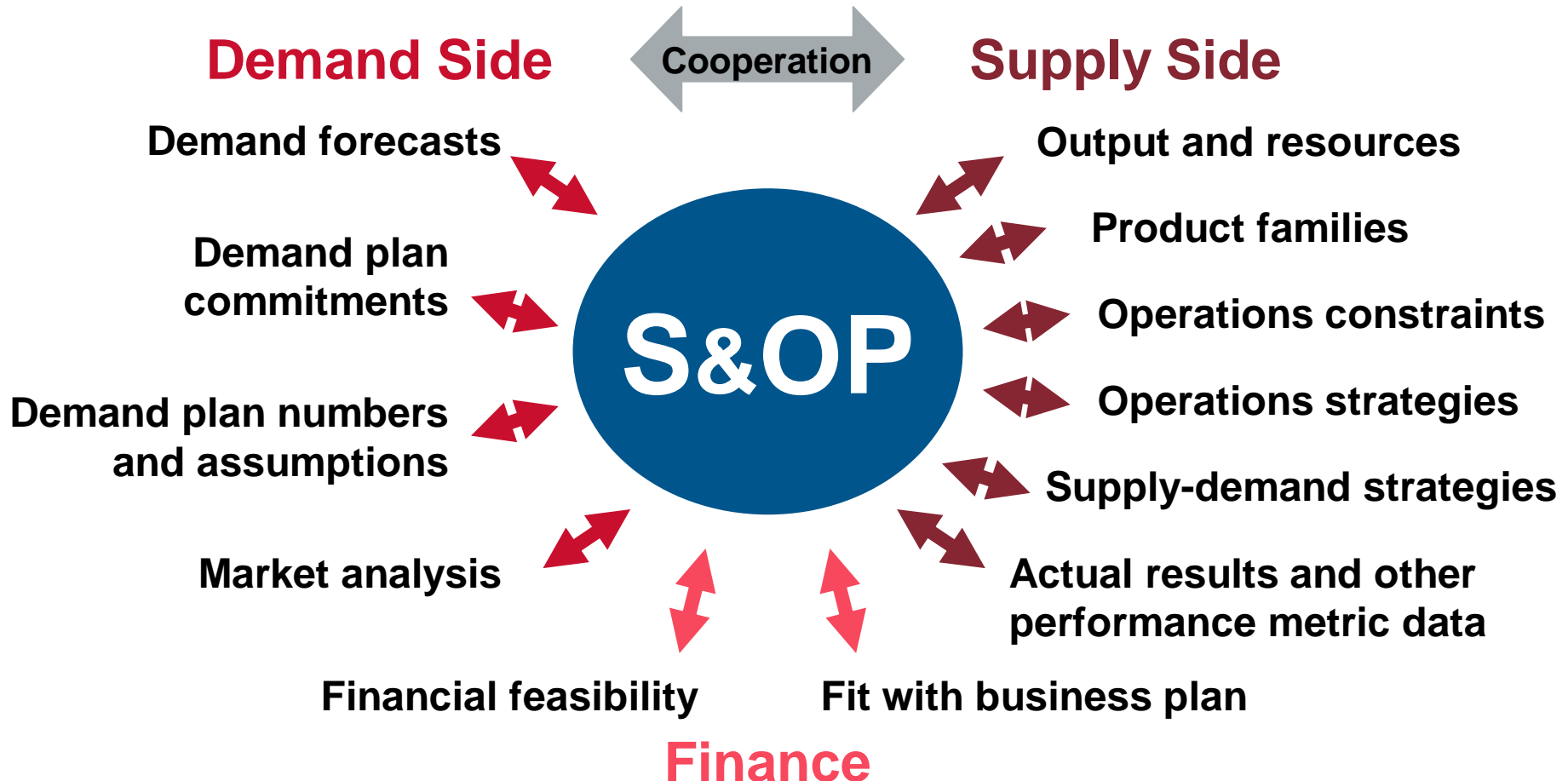
Implementing S&OP: Coordinating Function

- S&OP institutionalizes communications among functional areas by getting all facts in one place for debate.
- Links business planning and tactics.
- Opportunity to be proactive.
- Defines short to medium term.
- Reconciles functional plans.
- Builds bridge from customer value to SC efficiency.
- Replanning motivates continuous improvement.



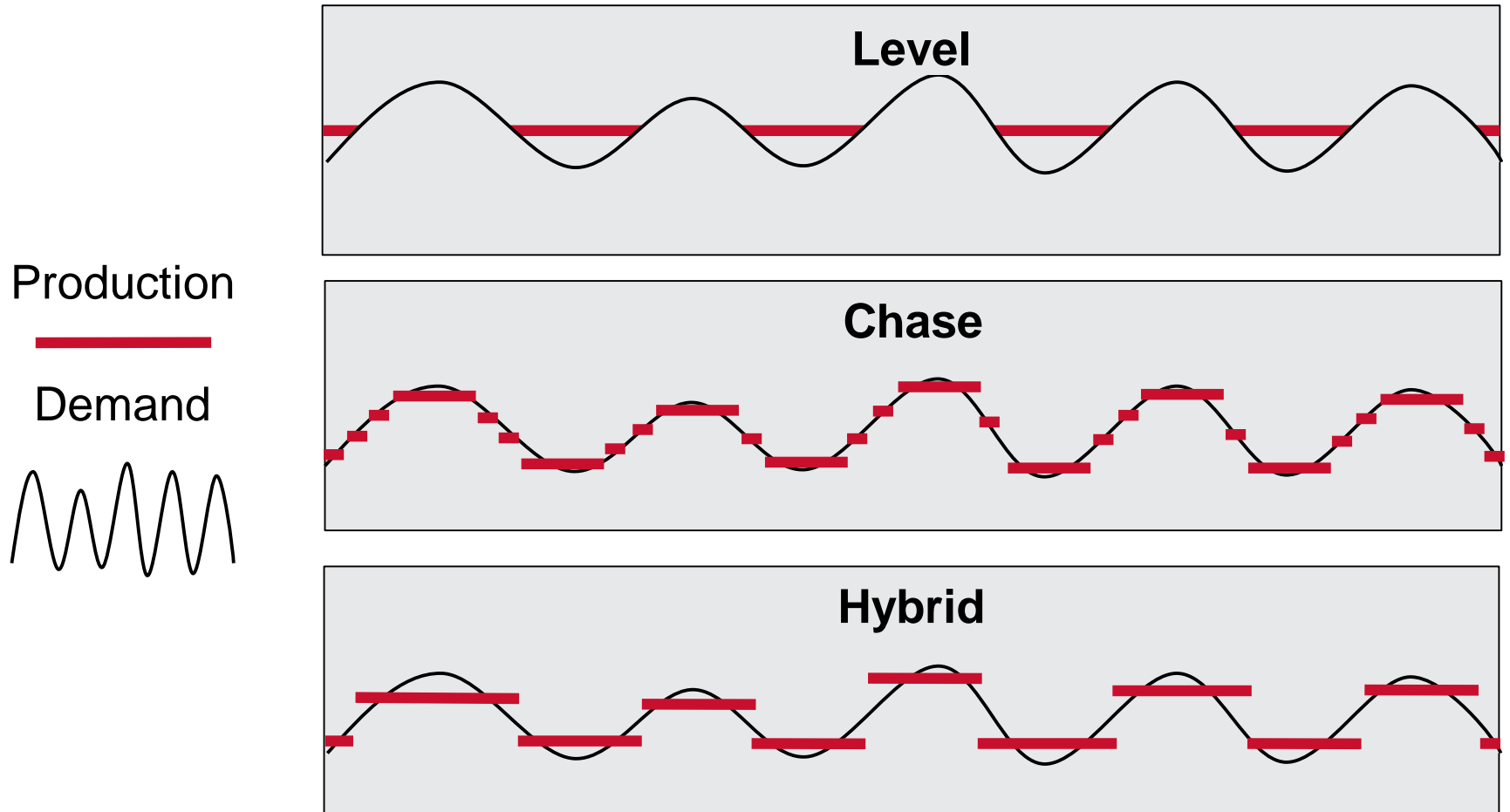
Topic 2: Sales and Operations Planning

Contributions to S&OP



Topic 2: Sales and Operations Planning

Operations Strategies



Topic 2: Sales and Operations Planning

Supply-Demand Strategies

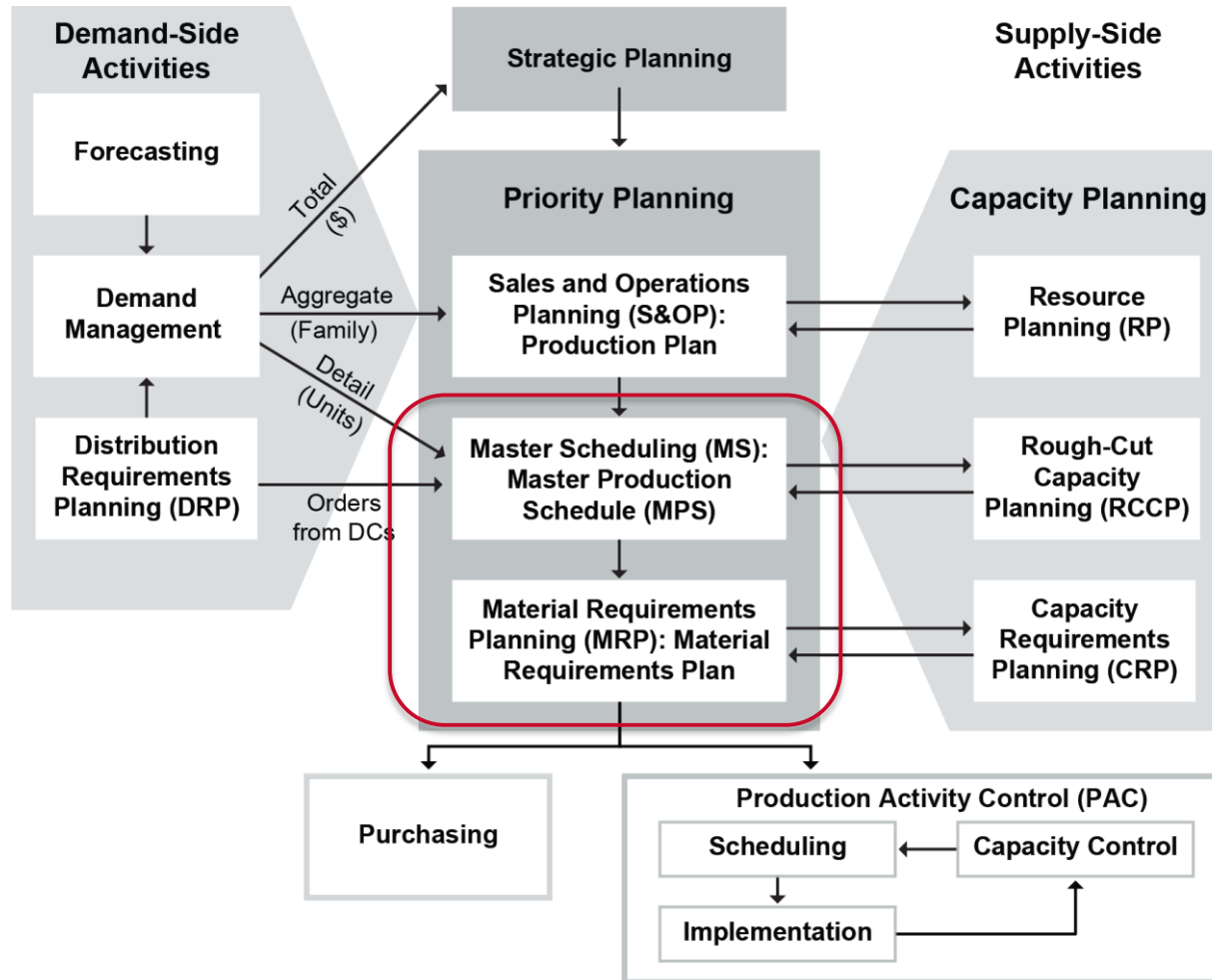
Allocation:

- Assign items to specific orders but still in inventory
- Process to distribute materials in short supply

Supply-Demand Option	MPS Focus
Make-to-stock (MTS) <ul style="list-style-type: none">• Few items made from many components• Integral design	Schedule finished goods.
Make-to-order (MTO) <ul style="list-style-type: none">• Many items made from few components• Custom	Schedule raw materials.
Assemble-to-order (ATO) <ul style="list-style-type: none">• Many end items, few components• Assemble near point-of-sale	Schedule module production.

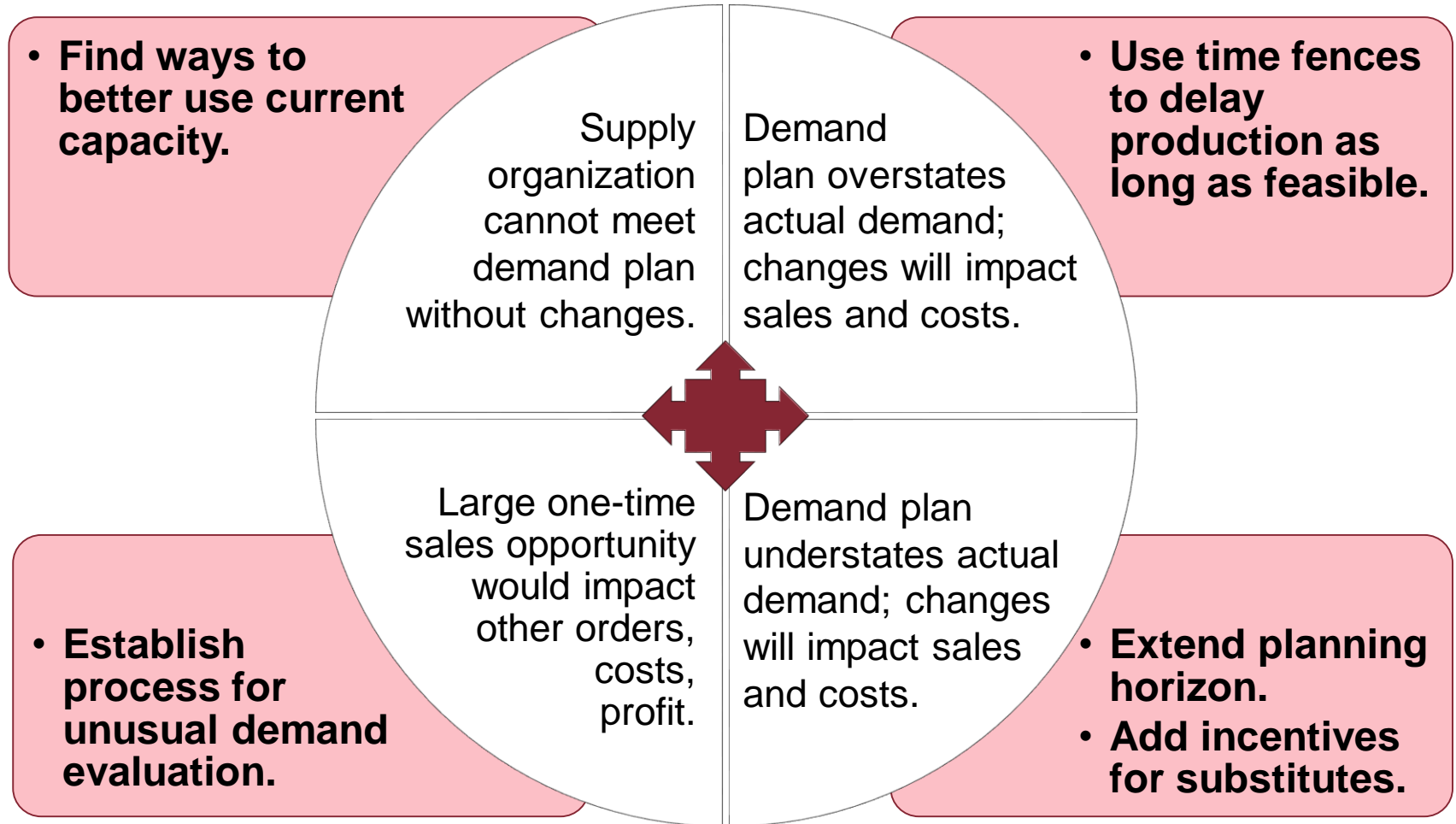
Topic 2: Sales and Operations Planning

Demand Management and Prioritization: MPS and MRP



Topic 2: Sales and Operations Planning

Situations for Managing and Prioritizing Demand



Topic 2: Sales and Operations Planning

Measures of Customer Service Levels

- Is cost of achieving a given service level a sound investment?
- Fill rates:
 - Unit fill rate
 - Line item fill rate
 - Monetary value fill rate
- Stockout frequency
- Lead time monitoring
 - Speed of performance
 - Consistency
 - Flexibility
 - Malfunction recovery
- Order status reporting
- Customer satisfaction
 - Establish, then fulfill expectations