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## Where We Are Now

Chapter	Relationships	Sustainability	Globalization	Organizational Culture/Ethics Change	Management	Measurement
<b>Part 1 Supply Chain: A perspective for Operations Management</b>						
1. Introduction to Managing Operations Across the Supply Chain	X	X	X			
2. Operations and Supply Chain Strategy	X	X	X	X	X	X
<b>Part 2 Foundations of Operations Management</b>						
3. Managing Processes and Capabilities	X					X
4. Product/Process Innovation	X	X	X		X	
5. Manufacturing and Service Process Structures	X		X	X		X
6. Managing Quality	X	X	X	X	X	X
7. Understanding Inventory Fundamentals	X		X			X
8. Lean Systems	X		X	X	X	X
<b>Part 3 Integrating Relationships Across the Supply Chain</b>						
9. Customer Management	X					X
10. Supplier Management	X	X	X	X		X
11. Logistics Management	X	X	X			
<b>Part 4 Planning of integrated Operations Across the Supply chain</b>						
<b>12. Demand Planning: Forecasting and Demand Management</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
13. Sales and Operations Planning	X		X			X
14. Independent Demand Inventory Planning	X					X
15. Materials and Resource Requirements Planning	X		X			X
<b>Part 5 Managing Change in Supply Chain Operations</b>						
16. Project Management	X	X	X	X	X	X
17. Evolving Business Models and Change Drivers in the Supply Chain	X	X	X	X	X	X

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## Learning Objectives

1. Explain role of demand management
2. Differentiate between demand management and forecasting
3. Describe various forecasting procedures
4. Develop forecast various models
5. Describe forecast measures
6. Explain how improvements make demand planning easier

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## Demand Planning

- ***Demand Planning***: both forecasting and managing customer demand to reach operational and financial goals
- ***Demand Forecasting***: predicting future customer demand
- ***Demand Management***: influencing either pattern or consistency of demand



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# Demand Planning and OM

**FIGURE 12-1**  
Elements of Demand Planning

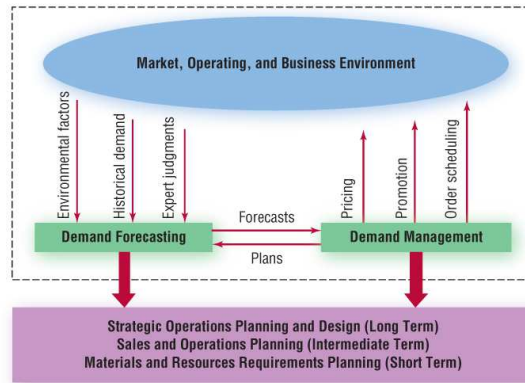


Figure 12-1

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# Planning Activities

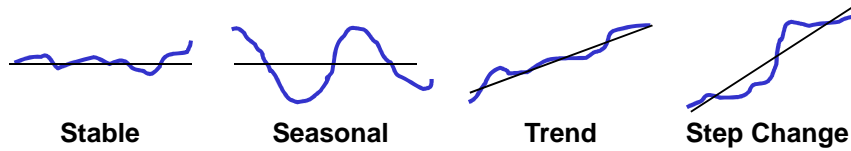
Time Horizon/ Type of Planning	Demand Planning Units	Use of Forecast and Demand Planning	Types of Decisions Involved
Long Term 1-5 years Strategic	Dollar or unit sales by business unit across sales network	<ul style="list-style-type: none"> <li>•SC network design</li> <li>•Technology investment</li> <li>•Capacity plans</li> </ul>	<ul style="list-style-type: none"> <li>•Sources of supply</li> <li>•Open/close facilities</li> <li>•Transportation</li> </ul>
Medium Term 6-18 months Tactical	Dollar or unit sales by product family in a region	<ul style="list-style-type: none"> <li>•Sales &amp; operations plan</li> <li>•Portfolio plans</li> </ul>	<ul style="list-style-type: none"> <li>•Aggregate plans</li> <li>•Workforce plans</li> <li>•New product launches</li> </ul>
Short Term 1-12 weeks Operational	Dollar or unit sales by item or service at a given location	<ul style="list-style-type: none"> <li>•Inventory plans</li> <li>•Purchasing</li> <li>•Labor scheduling</li> </ul>	<ul style="list-style-type: none"> <li>•Daily production</li> <li>•Purchase orders</li> </ul>

Table 12-1

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## Demand Forecasting

- **Components of Demand:** patterns of demand over time



- **Autocorrelation:** relationship of past and current demand
- **Forecast error:** “unexplained” component of demand

Figure 12-2

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## Forecasting Process

**FIGURE 12-3** The Forecasting Process

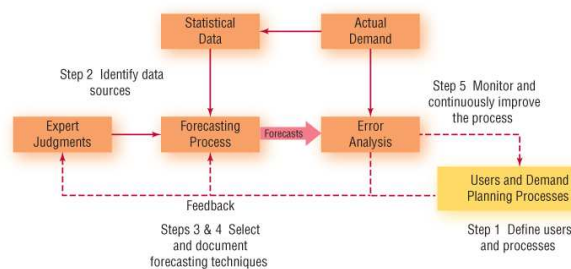


Figure 12-3

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## Judgment Based Forecasting

- **Grassroots:** input from those close to products or customers
- **Executive Judgment:** input from those with experience
- **Historical Analogy:** assume past demand is a good predictor of future demand
- **Marketing Research:** examine patterns of current customers
- **Delphi Method:** input for panel of experts

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## Statistical Based Forecasting

- **Time Series Analysis:** uses historical data arranged in order of occurrence
- **Naïve Model:** tomorrow's demand will be same as today's demand

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## Statistical Based Forecasting cont'd

- **Moving Average:** simple average of demand from some number of past periods

$$F_{t+1} = \frac{d_t + d_{t-1} + d_{t-2} + \dots + d_{t-n}}{n}$$

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## Statistical Based Forecasting cont'd

	Sales (lbs)
Sunday	137.1
Monday	123.6
Tuesday	134.9
Wednesday	160
Thursday	140.4

$$F_{Fri} = \frac{123.6 + 134.9 + 160.0 + 140.4}{4} = 139.7 \text{ lbs}$$

If actual Friday sales turn out to be 135.0

$$F_{Sat} = \frac{134.9 + 160.0 + 140.4 + 135.0}{4} = 142.5 \text{ lbs}$$

Example 12-1

12-12

## Statistical Based Forecasting cont'd

- **Weighted Moving Average:** assigns different weights to each period's demand based upon its importance

$$F_{t+1} = a_t d_t + a_{t-1} d_{t-1} + a_{t-2} d_{t-2} + \dots + a_{t-n} d_{t-n}$$

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## Weighted Moving Average

	Sales (lbs)	Day	Weight
Sunday	137.1		
Monday	123.6	4 days ago	0.1
Tuesday	134.9	3 days ago	0.2
Wednesday	160	2 days ago	0.2
Thursday	140.4	yesterday	<u>0.5</u>
		total =	1.0

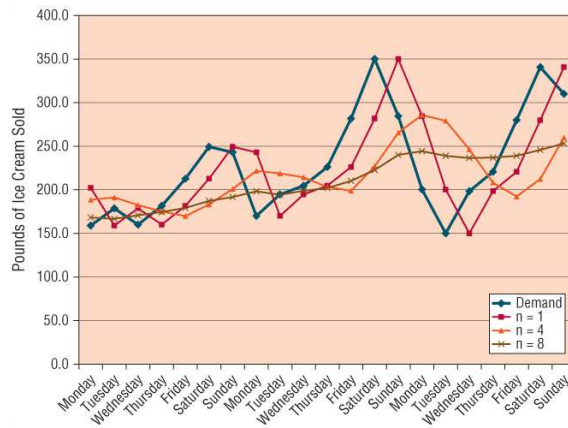
$$F_{Fri} = (.1)123.6 + (.2)134.9 + (.2)160.0 + (.5)140.4 = 141.5 \text{ lbs}$$

$$F_{Sat} = (.1)134.9 + (.2)160.0 + (.2)140.4 + (.5)135.0 = 141.1 \text{ lbs}$$

Example 12-2

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## Statistical Based Forecasting cont'd



**FIGURE 12-4**  
Comparing Moving Average Forecasting Models

Figure 12-4

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## Statistical Based Forecasting cont'd

- **Exponential Smoothing:** a moving average approach that put less weight on further back in time data
- **Smoothing Coefficient:** weight given to most recent demand

$$F_{t+1} = \alpha d_t + (1 - \alpha)F_t$$

or

$$F_{t+1} = F_t + \alpha(d_t - F_t)$$

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## Statistical Based Forecasting cont'd

The forecast of a product was 110 lbs and actual demand was 115 lbs. What is the next period forecast with a smoothing constant of 0.10?

$$F_{t+1} = 110 + (0.1)(115-110) = 110.5 \text{ lbs}$$

Example 12-3

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## Statistical Based Forecasting cont'd

- **Regression Analysis:** fits an equation to a set of data

$$\text{Sales forecast} = B + b_d(D) + b_a(A) + b_f(F) + b_s(S)$$

B = Base sales (computed y intercept)

D = Disposable personal income

A = Advertising expenditures

F = Fuel prices

S = Sales from prior year

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## Statistical Based Forecasting cont'd

- **Simulation Models:** sophisticated techniques that allow for the evaluation of multiple business scenarios
- **Focused Forecasting:** combination of computer simulation and input from knowledgeable individuals

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## Forecast Process Performance

- **Forecast Accuracy:** measure of how closely forecast aligns with demand
- **Bias:** tendency to over or under predict future demand (forecast error)

*Bias = Mean Forecast Error (MFE) =*

$$\frac{\sum_{t=1}^n (d_t - F_t)}{n}$$

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## Forecast Process Performance

- **Mean Absolute Deviation (MAD):** average of forecast errors, irrespective of direction

$$\frac{\sum_{t=1}^n |d_t - F_t|}{n}$$

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## Forecast Process Performance

1. Short term forecasts are more accurate than long term forecasts
2. Aggregate forecasts are more accurate than detailed forecasts
3. Information from more sources yields a more accurate forecast

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## Demand Planning

- Fluctuating customer demand cause operational inefficiencies, such as:
  1. Need for extra capacity resources
  2. Backlog
  3. Customer dissatisfaction
  4. System buffering (safety stock, safety lead time, capacity cushions, etc.)

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## Demand Planning

Try to manage demand by:

1. Use pricing, promotions or incentives to influence timing or quantity of demand
2. Manage timing of order fulfillment
3. Encourage shifting to alternate products

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## Improving Planning Management

- Improving information accuracy and timeliness
- Reducing lead time
- Redesigning the product
- Collaborating and sharing information

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## Improving Demand Planning

- ***Collaborative, planning, forecasting and replenishment (CPFR)***: supply chain partners share forecast, and demand and resource plans to reduce risk
  - **Market Planning**: changes to products, locations, pricing and promotions
  - **Demand and resource planning**: forecasting
  - **Execution**: order fulfillment
  - **Analysis**: data on key performance metrics

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## Improving Demand Planning

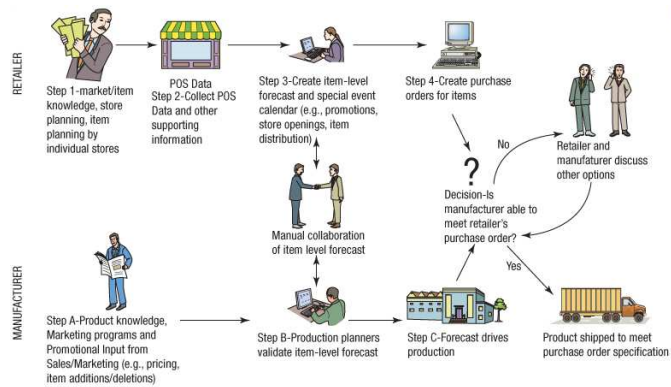


FIGURE 12-6 The CPFR Approach

Figure 12-6

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## Demand Planning Summary

1. Forecasting process choice is influenced by a variety of factors
2. Forecasts are judgment or statistical model based
3. Both accuracy and bias should be considered
4. Demand management involves influencing customer demand
5. Supply chains can be made more responsive to changes in customer demand

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