Lecture #30

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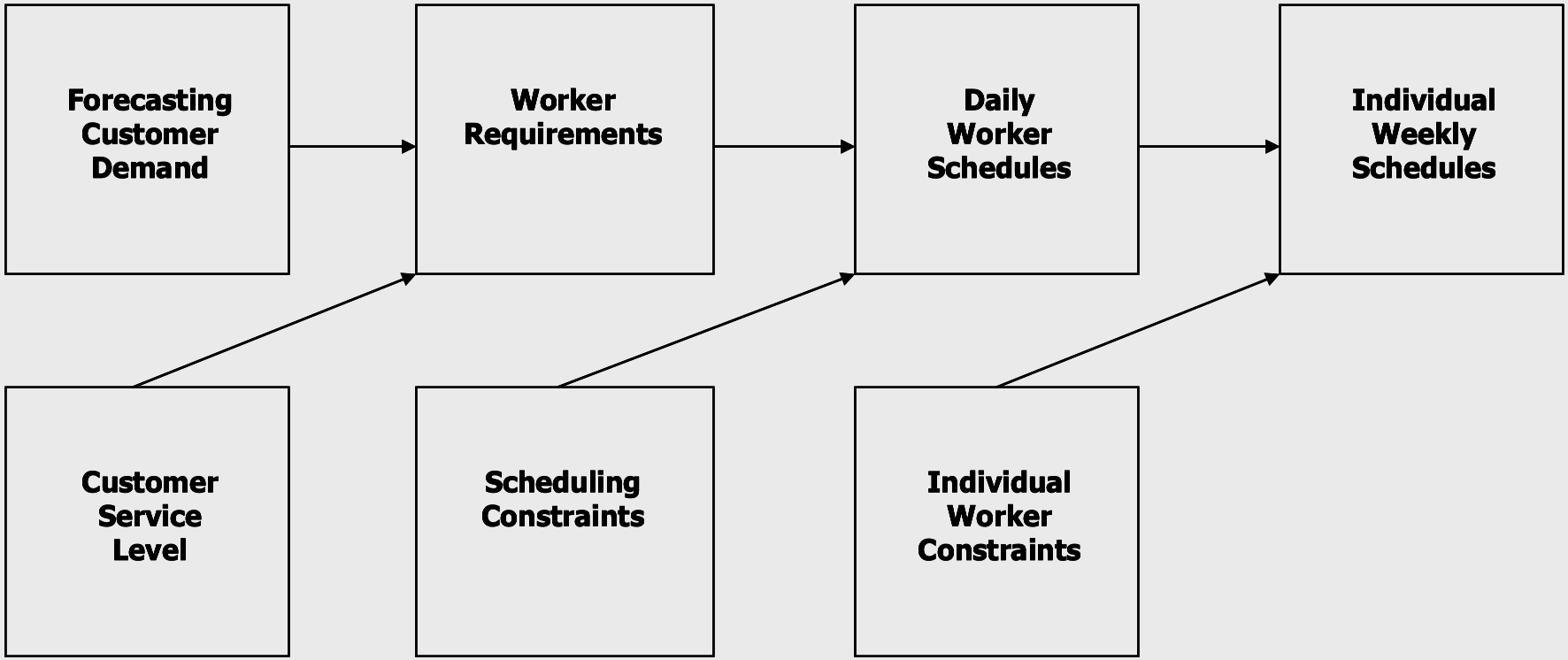
Last class…

- Last class we took a look at the different priority rules regarding scheduling work in a way that is called: Back-of-the-House-Operations, since they are based on the operations requirements or workloads.
- Today we will analyze the second type of scheduling which is called: Front-of-the-House-Workers, and this one is focused on the employees and their schedules.

Scheduling Front-of-the-House Workers

- Procedure divided into four major elements:
  - Forecasting customer demand
  - Converting customer demand into worker requirements
  - Converting working requirements into daily work schedules
  - Converting daily work schedules into weekly work schedules.

Scheduling Front-of-the-House Workers



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Forecasting Demand

- **Patterns of demand to be considered:**
  - **Variation in demand within days (or hours)**
  - **Variation across days of the week**
  - **Variations within a month**
  - **Seasonal variations**
- **Historical data collection about customer demand is needed. The actual number of customers expecting service in a given time interval is the preferred data.**

Converting Customer Demand into Worker Requirements

- Establishment of a customer-service level is a necessary element.
  - Many restaurants offer express lunches within a specified time period
  - "93% of calls should be answered in 20 seconds or less"

Converting Customer Demand into Worker Requirements

- Knowing the avg. number of customers who require service in a given time period and the avg. length of time it takes to provide service to each customer, a manager can determine how many workers to schedule for that time period to provide the desired level of service.
  - Labor requirements table

Labor Requirements for a Fast-Food Operation

Volume Guidelines (Sales($)/Hour)	Total Number of Workers	Grill	Windows	Drive-Through	Bin	Fry	Floaters
$140 (Minimum)	4	1	1	1	0	0	1
150	5	1	1	1	0	0	2
180	6	2	1	1	0	0	2
210	7	2	2	1	0	0	2
240	8	2	2	2	1	0	1
275	9	2	2	2	1	0	2
310	10	3	3	2	1	0	1
345	11	3	3	2	1	1	1
385	14	3	3	3	1	1	1
425	13	4	3	3	1	1	1
475	14	4	3	3	1	1	2
525	15	4	4	3	1	1	2
585	16	5	4	3	1	1	2
645 (Full Staff)	17	5	4	3	1	1	2

- **e.g., 8 workers in total are required when the forecasted hourly demand is $240 in sales**

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Converting Worker Requirements into Daily Work Schedules

- The basic goal is to schedule a sufficient number of workers in a given time period to meet the expected demand at the target service level. Some other factors are:
  - Minimum length of a shift that might be prescribed either by law or by a union contract
  - Maximum shift length permitted by state or local labor laws
  - Company's policies about rest and meal breaks

Converting Worker Requirements into Daily Work Schedules

Converting Daily Work Schedules into Weekly Work Schedules

- In developing weekly schedules, managers need to consider workers' days off for illness, holidays, and vacations.
- They also need to factor in the additional cost of paying workers to work on holidays if services are offered on those days, etc.
- Scheduling vacations is normally challenging.

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Forecasting

- As stated earlier, forecasting customer's demand is a very important issue when optimizing scheduling activities in terms of workers or machines (labor and resources).
- We will analyze some of the most common forecasting methods.

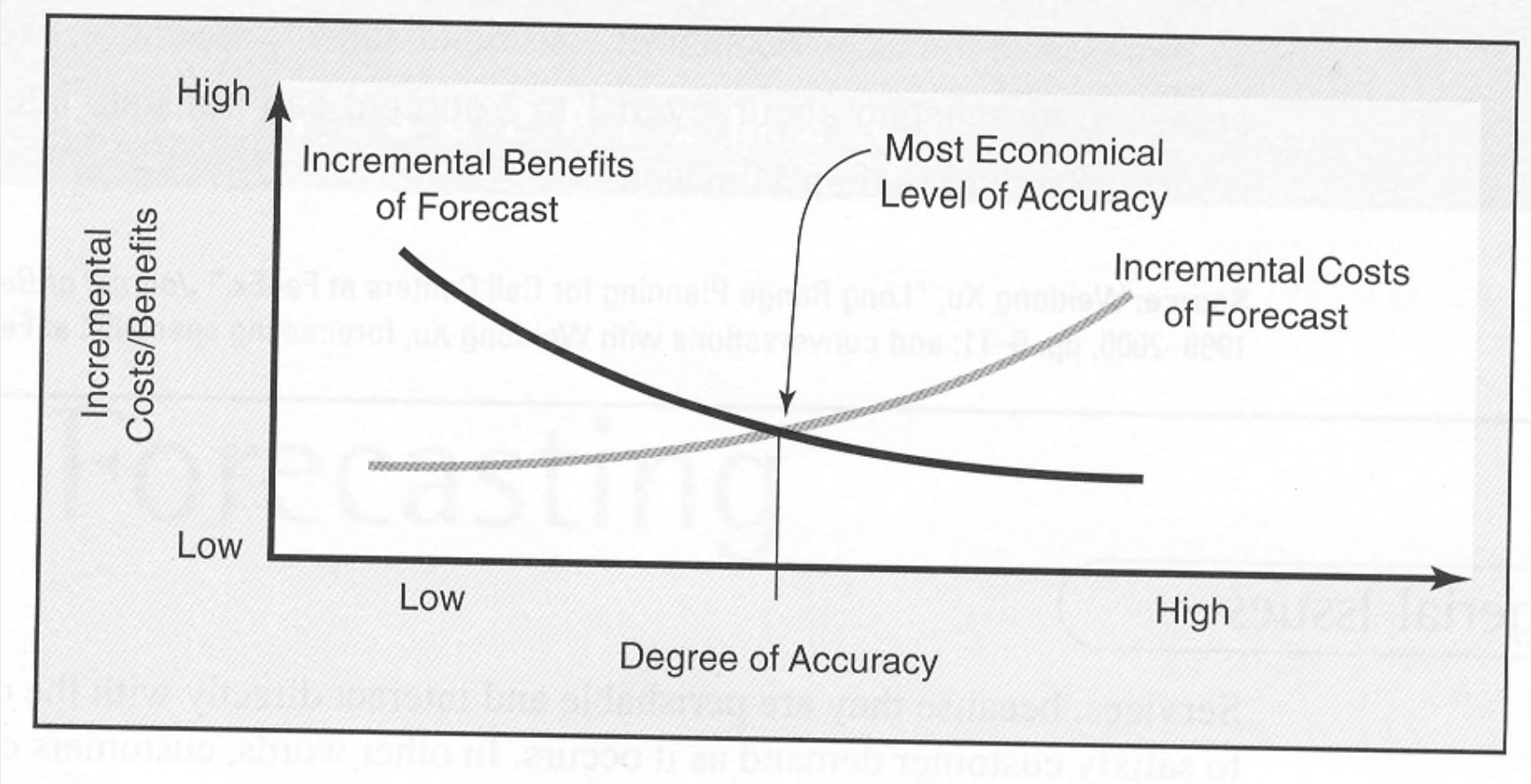
Managerial Issues

- Services, because they are perishable and interact direct with the customer, must be able to satisfy customer demand as it occurs.
- Customers cannot be “inventoried” to some future time or to another location when or where sufficient capacity is available.
- As a result, services must have adequate capacity to meet peak periods of customer demand. However, capacity costs money, and unused capacity become a waste.

Forecasting for Service Operations

- **Long range**
  - Estimate annual sales for potential location and size.
- **Intermediate range**
  - Manage existing capacity. Hotels and airlines, when to offer lower rates.
- **Short range**
  - Estimate customer demand for each day of the week in small time periods such as hour or half-hour (Scheduling).

Comparison



Characteristics of Forecasting Methods

TABLE 11.1 Characteristics of Forecasting Methods

Method	Data Required	Relative Cost	Forecast Horizon	Application
Subjective models:				
Delphi method	Survey results	High	Long term	Technological forecasting
Cross-impact analysis	Correlations between events	High	Long term	Technological forecasting
Historical analogy	Several years of data for a similar situation	High	Medium to long term	Life cycle demand projection
Causal models:				
Regression	All past data for all variables	Moderate	Medium term	Demand forecasting
Econometric	All past data for all variables	Moderate to high	Medium to long term	Economic conditions
Time series models:				
Moving average	*N* most recent observations	Very low	Short term	Demand forecasting
Exponential smoothing	Previous smoothed value and most recent observation	Very low	Short term	Demand forecasting

Characteristics of Forecasting Methods

I.	**Qualitative**	*Subjective, judgmental. Based on intuition, estimates, and opinions.*
	Delphi method	An interactive consensus-building process involving a group of experts who respond to a questionnaire. A moderator compiles results and formulates a new questionnaire, which is again submitted to the same group of experts.
	Market research	Collects customer data in a variety of ways (surveys, interviews, etc.) to test hypotheses about the market. This information is typically used for long-range forecasts including changing consumer preferences.
	Historical analogy	Relates what is being forecast to a similar service. Important in planning new services where a forecast may be derived by using the history of a similar existing service.
II.	**Time Series Analysis**	*Based upon the idea that the history of occurrences over time can be used to predict the future.*
	Simple moving average	The data points from several time periods are averaged by dividing the sum of the point values by the number of data points. Each, therefore, has equal influence. These data points may be weighted equally or unequally, based on experience.
	Exponential smoothing	Recent data points are weighted more, with weighting declining exponentially as data become older.
	Regression analysis	Fits a straight line to past data generally relating the data values to time. Most common fitting technique is least squares.
	Trend projections	Fits a mathematical trend line to the data points and projects it into the future.
III.	**Causal**	*Tries to understand the system underlying and surrounding the item being forecast. For example, sales may be affected by advertising, quality, and competitors.*
	Regression analysis	Similar to least squares method in time series but may contain multiple variables. Basis is that the forecasted variable is caused by the occurrence of other events or factors.
	Input/output models	Focuses on sales of each industry to other firms and governments. Indicates the changes in sales that a producer industry might expect because of purchasing changes by another industry.
	Leading indicators	Statistics that move in the same direction as the series being forecast but move before the series, such as an increase in the price of gasoline indicating a future drop in the sale of large cars.

Subjective Models

- Delphi Method
- Cross-Impact Analysis
- Historical Analogy

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Delphi Method

- Developed at the Rand Corporation, it is based on expert opinion. In its simplest form, persons with expertise in a given area are asked questions, and are asked to make numerical estimates.
- The test administrator tabulates the results into quartiles and supplies these findings to the experts, who then are asked to reconsider their answers in light of the new information.
- The process may continue through several more iterations, with the intent of eventually having the experts arrive at a consensus that can be used for future planning.

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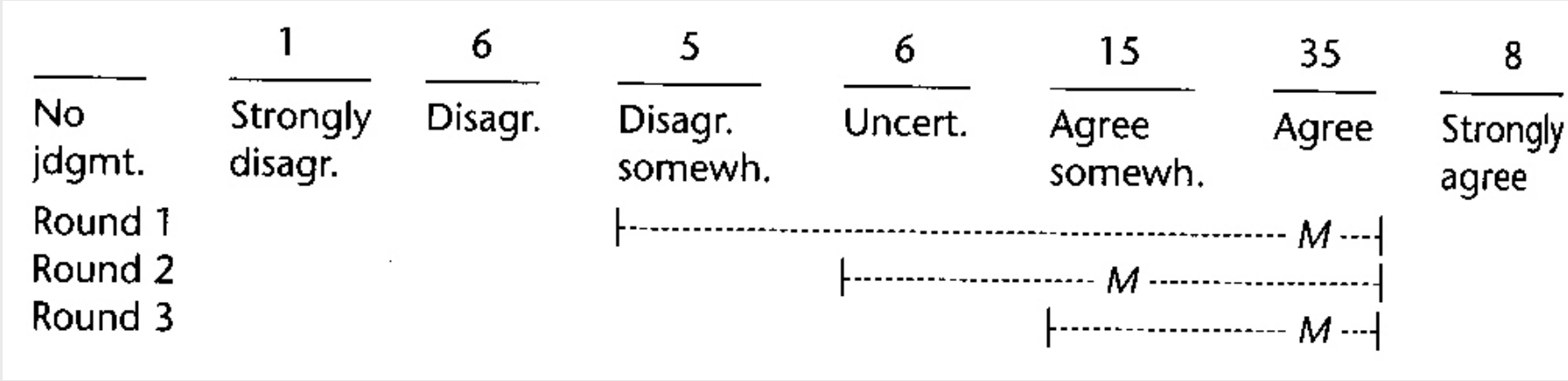
Delphi Method



- M = Median
- 98 people
- Round 1: 37 questions, 11, concerning the past evolution of the nuclear industry and 26 the future
- "It is desirable that utilities be permitted to integrate capital investment costs more aggressively into rate structures".
- Good when addressing situations for which quantifiable data are not available.

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Cross-Impact Analysis

- It assumes that some future event is related to the occurrence of an earlier event.
- A panel of experts studies a set of correlations between events presented in a matrix.
- These correlations form the basis for estimating the likelihood of a future event occurring.

Cross-Impact Analysis

- **Forecast conducted in 2003, it assumes $3-per gallon gasoline prices by 2010 (event A) and the corresponding doubling of ridership on mass transit by 2020 (event B).**

	Probability of Event	
Given event	A	B
A	-	0.7
B	0.6	-

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Cross-Impact Analysis

- Assume that the forecasted unconditional probability for doubling mass transit ridership by 2020 is 1.0 and the forecasted unconditional probability of $3 per gallon for gasoline by 2010 is 0.8. These values are statistically inconsistent with the values in the matrix, and will be pointed out to the experts, who then would revise their estimates in a series of iterations

Historical Analogy

- It assumes that the introduction and growth pattern of a new service will mimic the pattern of a similar concept for which data are available.
- It is used to forecast market penetration or life cycle of a new service.
- Color T.V. based on black and white T.V.