Production Planning

Course: Production Management and Logistic Systems [10592713]

Economia e management (Latina Campus)

AA 2024-2025 | Prof. Alessandro Pietrogiacomi

SAPIENZA
UNIVERSITÀ DI ROMA

Latina 12 March, 2025

Lesson Plan for Tuesday, March 12

Overview of the lesson, and educational objectives,

Topic: Production Planning

Time: 14:00–17:00

Duration: 3 hours

Learning Objectives

By the end of this lesson, students will be able to:

- Understand the importance of production planning in managing operations.
- Apply demand forecasting techniques to predict future production needs.
- Develop capacity planning strategies to optimize resource utilization.
- Understand scheduling techniques to organize production activities efficiently.

Lesson Outline

1. Introduction (15 minutes)
2. Demand Forecasting (45 minutes)
3. Capacity Planning (45 minutes)
4. Scheduling Techniques (45 minutes)
5. Recap, Q&A and Homework Assignment (15 minutes)

Introduction

- Welcome back, let’s recap the previous session
- Welcome students and recap the previous session (Product Design).

Demand Forecasting

1. Definition and Importance
2. Techniques for Demand Forecasting
3. Activity

Definition and Importance

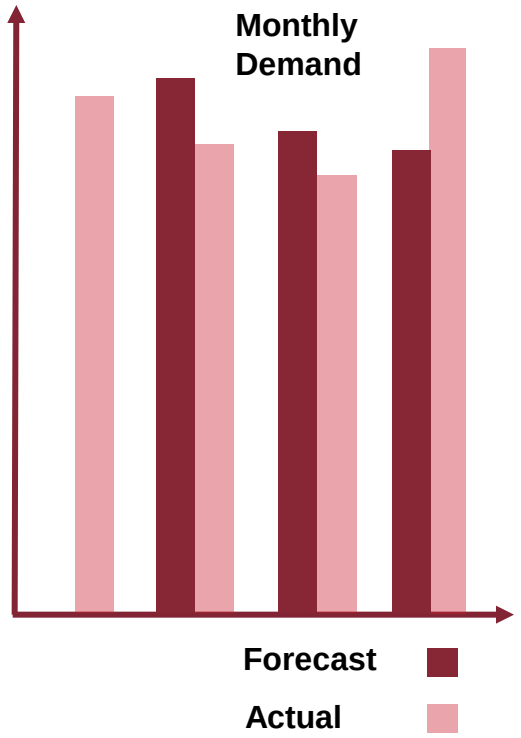
1. **Demand Forecasting**: The process of estimating future customer demand for products or services.

2. **Importance:** Helps businesses plan production, manage inventory, and allocate resources effectively.

Principles of Forecasting

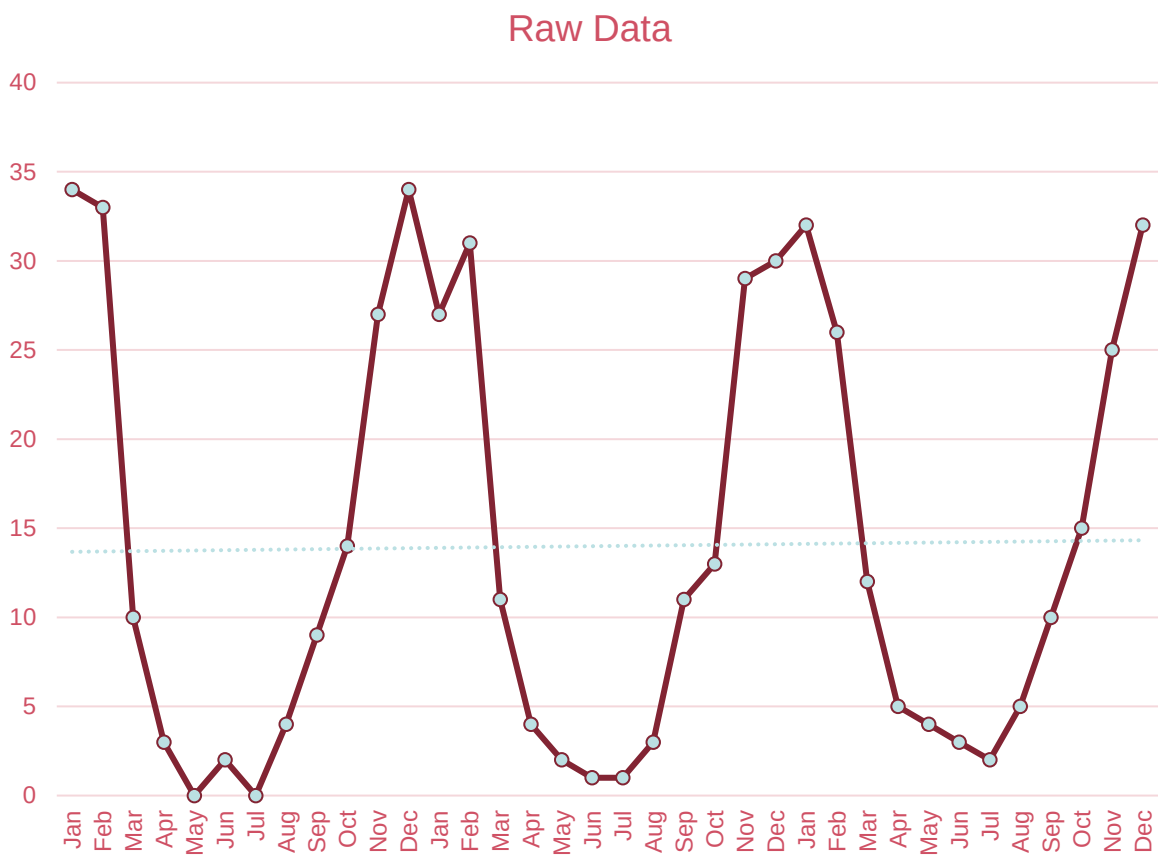
Forecasts are:

- 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.



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. Review and improve.



Techniques for Demand Forecasting

Qualitative Methods:

1. Industry experts for insights.
2. Market Research: Conducting surveys and focus groups to gather customer feedback.
3. Delphi Method: Collecting and aggregating opinions from a panel of experts.

Quantitative Methods

1. Time Series Analysis: Using historical data to identify trends, seasonality, and patterns.
2. Moving Averages: Calculating average demand over a specific period to smooth out fluctuations.
3. Exponential Smoothing: Giving more weight to recent data to predict future demand.
4. Regression Analysis: Identifying relationships between demand and external factors (e.g., price, advertising).

Qualitative and Combination Methods

- Estimates
  - $\bar{} \quad \frac{\text{Optimistic} + (4 \times \text{Most Likely}) + \text{Pessimis}}{6}$
- Judgmental/expert judgment
- Delphi method
  - Anonymous to avoid:
    - "Groupthink"
    - "Stake in the ground"

- Combine with quantitative to add expertise, assumptions
- When to use qualitative forecasting methods:
  - For new products
  - When hard data are lacking

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				

- Calculate month average for each month: e.g., (Jan-Y1 + Jan-Y2 + Jan-Y3)/3
- Calculate year average: Sum month averages and divide by 12.
- Calculate seasonal index:
  - Divide each month average by the year average.
  - $$\text{Seasonal Index} = \frac{\text{Average Demand for Period (e.g., Month)}}{\text{Average Demand for all Periods (e.g., Year)}}$$

Simple or Weighted Moving Average

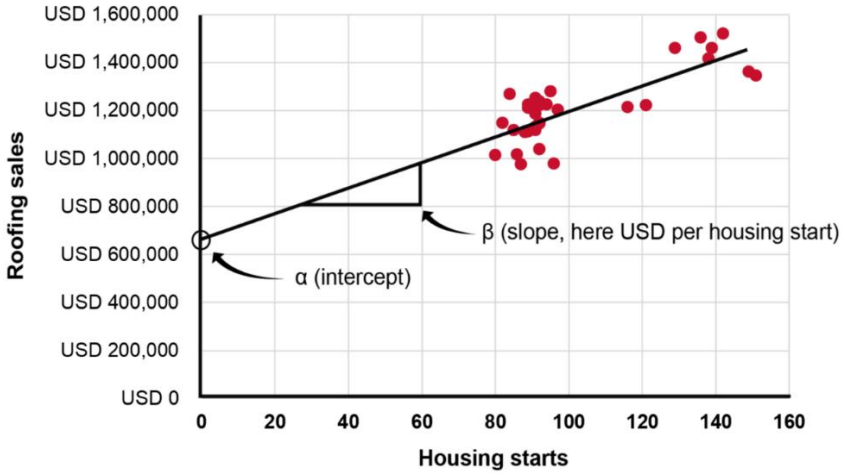
- Simple moving average:
  - 3-Month Moving Average = $\frac{(M1 + M2 + M3)}{3} = \frac{14.00 + 15.87 + 14.64}{3} = 14.84$
  - Smooths out irregular demand, but lags trend
- Weighted moving average:
  - 3-Month Weighted Moving Average = $\frac{(1 \times M1) + (2 \times M2) + (3 \times M3)}{6} = \frac{(15.51) + (2 \times 19.73) + (3 \times 18.61)}{6} = 18.47$
  - Also smooths, but lags trend less

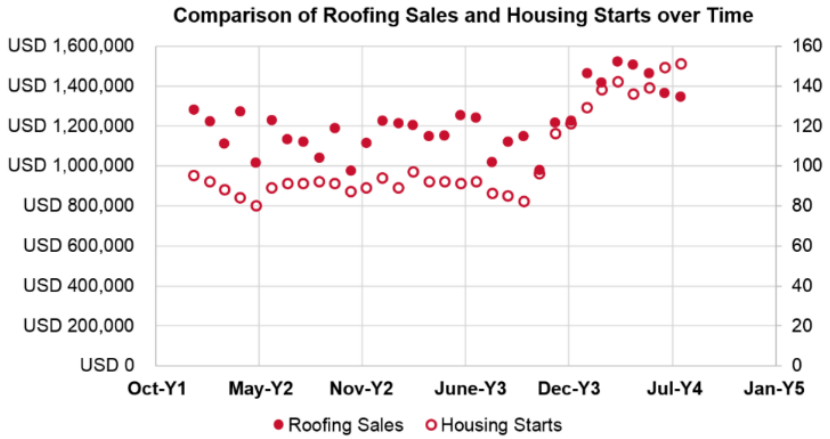
Exponential Smoothing

- Inputs: last period's forecast, last period's demand, and alpha
  - New Forecast =
    (α × Last Period's Demand) + [(1 − α) × 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 × 14.92) + [(0.7) × 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

Regression Analysis:

- $y = \alpha + \beta x$
- *Roofing Sales = α + (β ×Prior Month's Housing Starts)*





Activity

1. **Case Study Analysis:** Review file with historical sales data for a product.

2. **Task:** Use moving averages and exponential smoothing to forecast demand for the next quarter.

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3. **Capacity Planning (45 minutes)**
4. Scheduling Techniques (45 minutes)
5. Recap, Q&A and Homework Assignment (15 minutes)

Capacity Planning

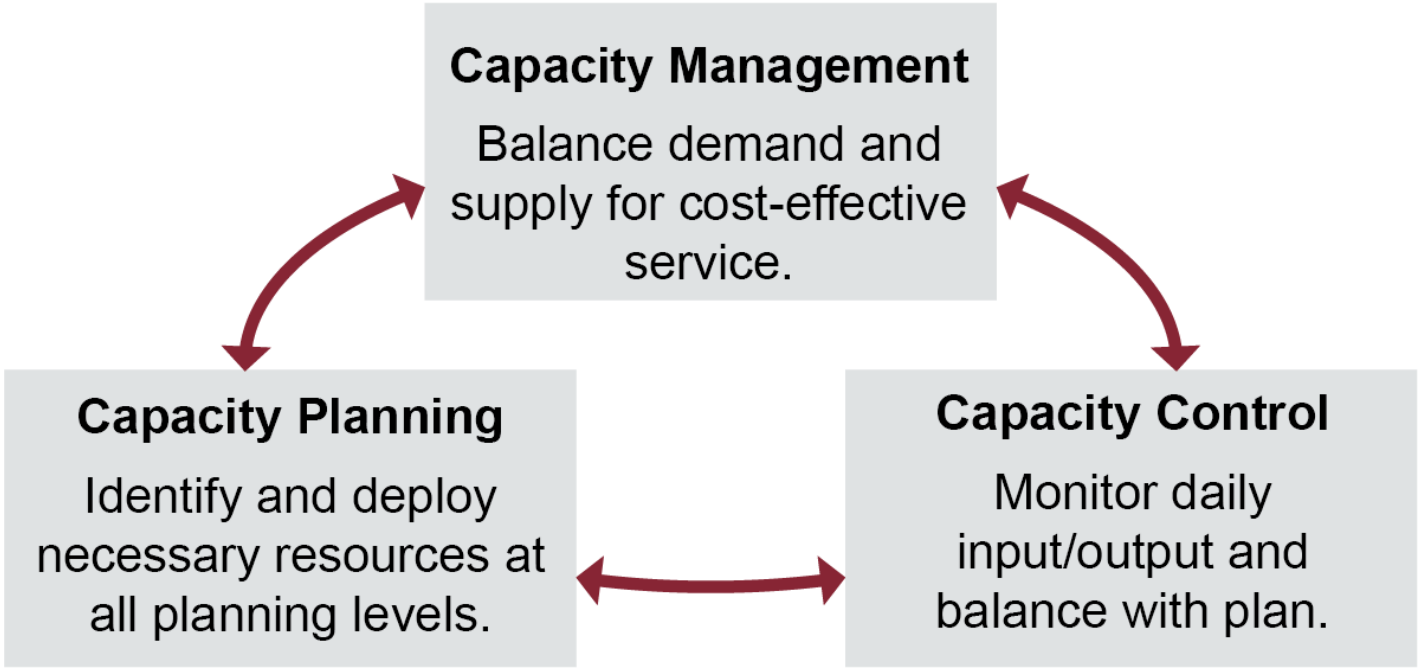
1. Definition and Importance
2. Strategies for Capacity Planning
3. Tools for Capacity Planning

Definition and Importance

1. Capacity Planning: The process of determining the production capacity needed to meet demand.

2. Importance: Ensures that resources (e.g., labor, machinery, materials) are available to meet production goals.

Capacity Management, Planning, and Control



Capacity Objectives

- Supply > demand
- Layoffs, idle machines, unused storage
- Excess inventory

- On-time fulfillment
- Quality items
- Optimal use of resources

- Demand > supply
- Stockouts, broken orders, overtime, temps, work shifts, etc.

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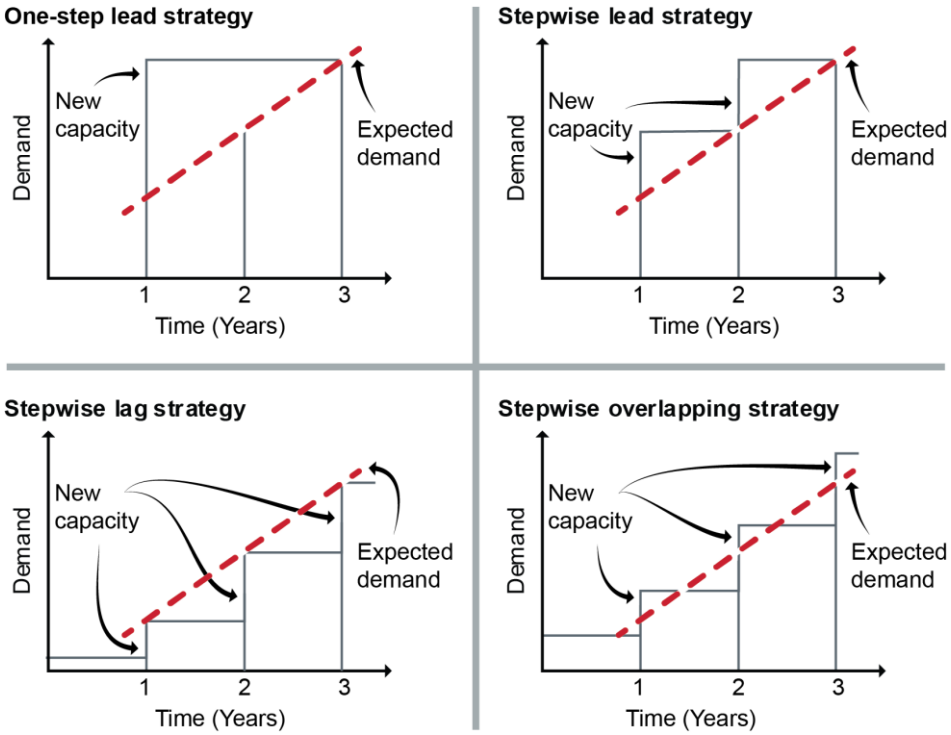
Strategies for Capacity Planning



1. One-step lead strategy: expanding all at once ahead of demand
2. Stepwise lead strategy: expanding in steps ahead of demand
3. Stepwise lag strategy: expanding in steps behind demand (to catch up, in other words)
4. Stepwise overlapping strategy: expanding in steps that are sometimes ahead of and sometimes behind forecast demand

Tools for Capacity Planning

Rough-Cut Capacity Planning (RCCP)

- Process of converting MPS into key resource requirements
- Comparison of load vs. available or demonstrated capacity for each key resource
- Medium-term
- Bottlenecks, gateway work centers, critical suppliers only

Capacity Requirements Planning (CRP)

- CRP takes place at level of MRP.
- Assigns each facility, work center, and operation a load and does load leveling.
- Steps to determine site capacity:
  - Check open order file.
  - Check planned order releases.
  - Check routing file.
  - Check work center file.
  - Output: adjustment of load or capacity (or both) to meet plan, as required.

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Scheduling Techniques

1. Definition and Importance
2. Techniques for Scheduling

Definition and Importance

1. **Scheduling**: The process of organizing production activities to meet deadlines and optimize resource utilization.

2. **Importance:** Ensures timely delivery of products and efficient use of resources.

Techniques for Scheduling

1. **Gantt Charts:** Visual tools for planning and tracking production schedules.

2. **Critical Path Method (CPM):** Identifying the longest sequence of tasks to determine the minimum project duration.

3. **Program Evaluation and Review Technique (PERT):** Estimating task durations and identifying critical paths in complex projects.

4. **Just-in-Time (JIT):** Scheduling production to minimize inventory and reduce waste.

Recap and Homework Assignment

1. Recap of Key Points

1. Importance of demand forecasting, capacity planning, and scheduling in production planning.
2. Techniques and tools for each aspect of production planning.

2. Homework Assignment

1. **Task:** Research a company known for its effective production planning (e.g., Toyota, Amazon).

2. **Deliverable:** Write a 1-page report describing the company's production planning strategies and their impact on its success.