Lecture 04: Forecasting and Demand Planning

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Outline

1. Understanding your demands
2. Forecasting SCM Demand
3. Operational Planning Concepts
4. Aggregate Planning
5. Sales and Operations Planning

General Reference: [JC10] [Bal07] [CM07] [Goe11]

Game Plan: From Conception to Shipping...

- Identifying & assessing our capability $\Longleftrightarrow$ Strategic planning & mgt
- Guessing customer's demands & requirements $\Longleftrightarrow$ Forecasting
- Smoothing & Managing resources $\Longleftrightarrow$ Aggregate planning & Demand mgt
- Sourcing R/M needed to produce $\Longleftrightarrow$ Purchasing & Material requirement
- Estimating producing time $\Longleftrightarrow$ Production planing & Manuf mgt
- Managing stocks $\Longleftrightarrow$ Warehousing mgt & Inventory control
- Maintaining availability & service levels $\Longleftrightarrow$ Channel & Distribution mgt
- Ensuring commitment & delivery products $\Longleftrightarrow$ Routing, Outsoucing, & Shipping

What are demands?

Are these terms difference?

demand $\stackrel{?}{\neq}$ sale $\stackrel{?}{\neq}$ order $\stackrel{?}{\neq}$ forecast

Nature of demands

- **Price Elasticity:** price dependence (electricity, TH cigarette)
- **Predictability:** fluctuation, seasonal, customer-driven (meme)
- **Service Lv:** expectation (iPhone), customization
- **Geographic:** regional, location

How should we manage demands?

Understanding nature of demands:

- Aggregate VS **Market**: Why do we think about demand of our brand?
- Stochastic VS **Deterministic**: Why do we think about constant demand?
- Dependent VS **Independent**: Why do we think about independent demand?

How do we manage/model inventory?

$$\text{Demand}^{dep} = f(\text{Demand}_i^{ind}, \text{Demand}_j^{ind}, \cdots)$$

$$\text{Demand}_i^{ind} = \text{demand}_{certain} + \text{demand}_{random}$$

$\Downarrow$ $\Downarrow$

- *steady*
- *trend*
- *seasonal*

- *safety stock*

Note: consolidate demands $\rightarrow$ better mgt and forecasting

Pg:HP Postponement

Postponement: delay differentiation [**IE**]

Motivation: HP Customization

- **Motivation:** inventory, nature of demand, multiple markets
- **Idea:** delay the differentiation of product/process
- **Related concept:** localization, simple and modular design
- **Trade-offs:** economy of scale, production cost **VS** inventory, transportation
- **Implementation:** cross-organization coordination (manufacturing, purchasing, R&D, market)
  - ***Product design:*** reducing inventory & leadtime by std parts & manuf.
  - ***Process design:*** delaying process differentiation by technology
  - ***Agile supply chain:*** time based competitive
- **Example:** DeskJet, Paint mixture, Benetton shirt, HP hard drive test

Prioritizing demand with parieto principle

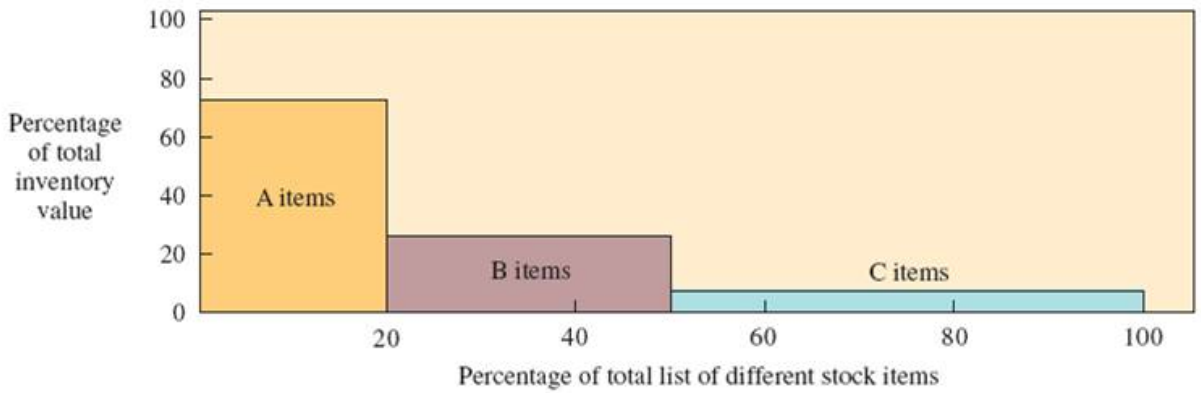
- **Idea:** few items affects majority of activity

> *You don't get what you want in life*
> *You get what you focus on and expect.*
> —Tony Rush

- **Therefore:** focus on few that are important
- **Application:** ABC analysis
  - Class A important (15-20 percentile → for 55-75% of activity)
  - Class B some-what important (20-50 percentile → 15-15% of activity)
  - Class C not important (50-100 percentile → 5-15% of activity)

Example of ABC analysis

Item No.	Annual dollar	% Total Value
22	95,000	40.69
68	75,000	32.13
27	25,000	10.71
03	15,000	6.43
82	13,000	5.57
54	7,500	3.21
36	1,500	0.64
19	800	0.34
23	425	0.18
41	225	0.10
-	$223,450	100%



What should know on forecasting

- **What:** A process to understand systematic of demands
- **Facts:** Inaccurateness, but all companies need it
  - Forecasting is, typically, incorrect
  - Forecasting is suitable for a group of products
  - Forecasting is inaccurate as time horizon increases
- **Ideal:** Valid for short time and need updated
- **Aware** Art & Science: roles of marketing & sale; common misconcept
- **Types:** Qualitative, Time Series, Regression, Simulation

Need Help!

- **Recap:** 04 time series (extra)
- **Textbook:** https://otexts.com/fpp3/

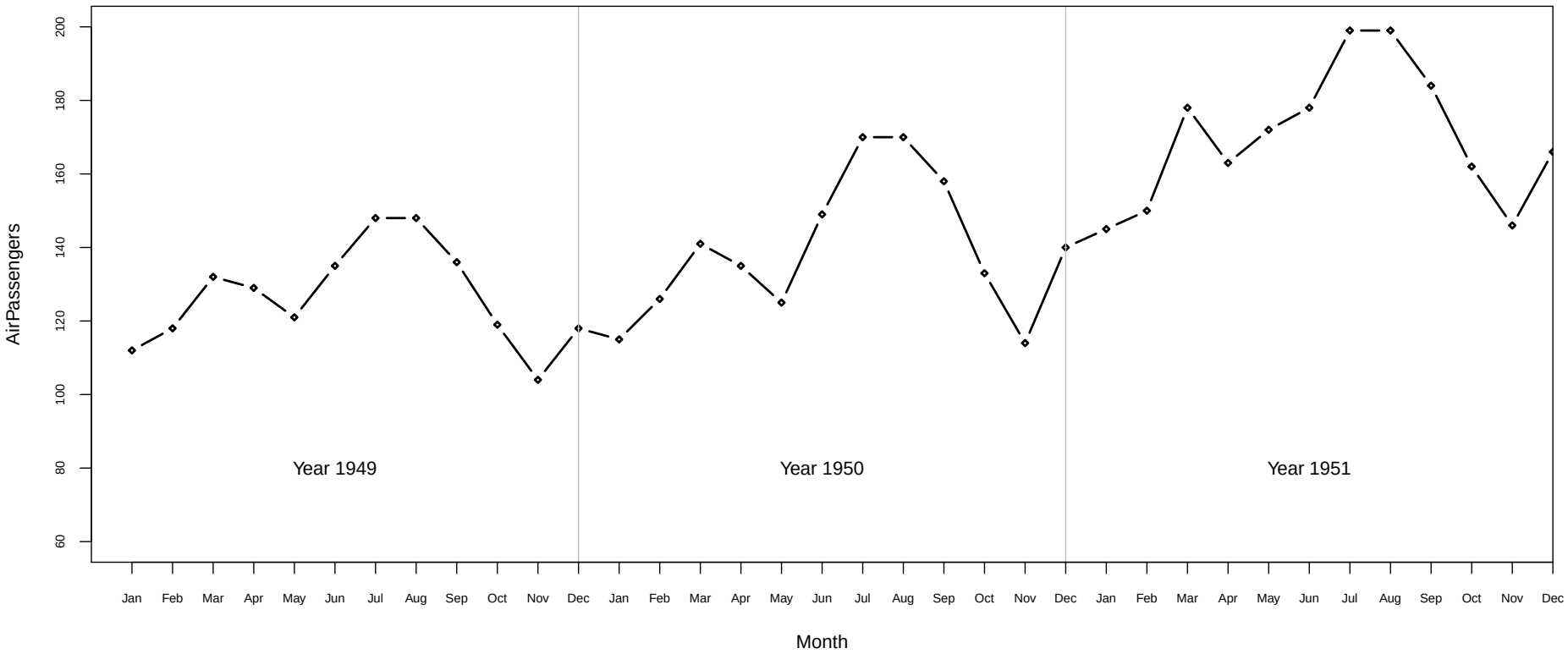
What should aware before forecast

- **Description:** story, relationship with other data
- **Time Horizon:** hour, day, week, year

$$\text{Actual} = \text{Forecast} + \text{error}$$

- **Pattern of Data:** seasonal, trend, cycle
- **Forecasting Model:** assumptions, data required, parameters (static VS dynamic)
- **Accuracy:** measuring, how to improve

Example: US Air Passengers 1949-1951



Time Series Review: Workshop

- **Forecasting Accuracy:** Actual_t - Forecast_t (i.e., MAPE, MSE)
- **Naive Method:** Forecast = actual
- **Smoothing Tech:** Forecast $\approx$ set of actual
  - **Moving Average:** Forecast = average of actual
  - **Exponential Smoothing** Forecast = combination of actual and last forecast
- **Trending:** Forecast = expo smoothing + slope $\times$ period

  Slope = gap of forecast
- **Seasonality:** $\text{Forecast}_{sea} = r_{sea} \cdot \text{Forecast}_{de-sea}$

Communicating and updating demand forecast

If you have to forecast, forecast often.

source: Edgar Fiedler

Sharing Points:

- **Know data source:** market goal $\stackrel{?}{\div}$ operation cap, reliability VS urgency
- **Keep process simple/ comm. flat:** verbal & constant, formal & informal, time frame
- **Right communication channel:** always confirm & name (scope), IT as enable (goldcity)

Believe the forecasting pattern, not absolute quantity or time

Strategies for Responding to demands

Supply always comes on the heels of demand.

source: Robert Collier

Sharing Points:

- **Agile Design:** modular product, delayed differentiation, flexible capacities
- **Responsive Sourcing:** diversification, strategic partnership
- **Adaptive Network:** omni-channel, dyn routing, collaborative network
- **Data-Driven Sensing:** adv forecasting tech, scarcity & halo technique

Influencing demand

Cutting prices or putting things on sale is not sustainable business strategy.

source: Howard Schultz

Sharing Points:

- **Other factors:** service (physician schedule), experience (food), waiting time (BTS), events (MOTOR SHOWS), quality (GRAB)
- **Marketing:** focused social media (time spent)

What is planning?

Planning: Process of determining how an organization can get destination it wants to go and what actions it will do to accomplish its objectives. Through planning, the organization identifies:

- Where it/we is going?
- How it/we will get there?

Thinking Points: Recall your last travelling experience

- What do you need (resources) ?
- How to estimate such needed resources?
- How you manage if you estimation is incorrect?

Operation Planning Concept

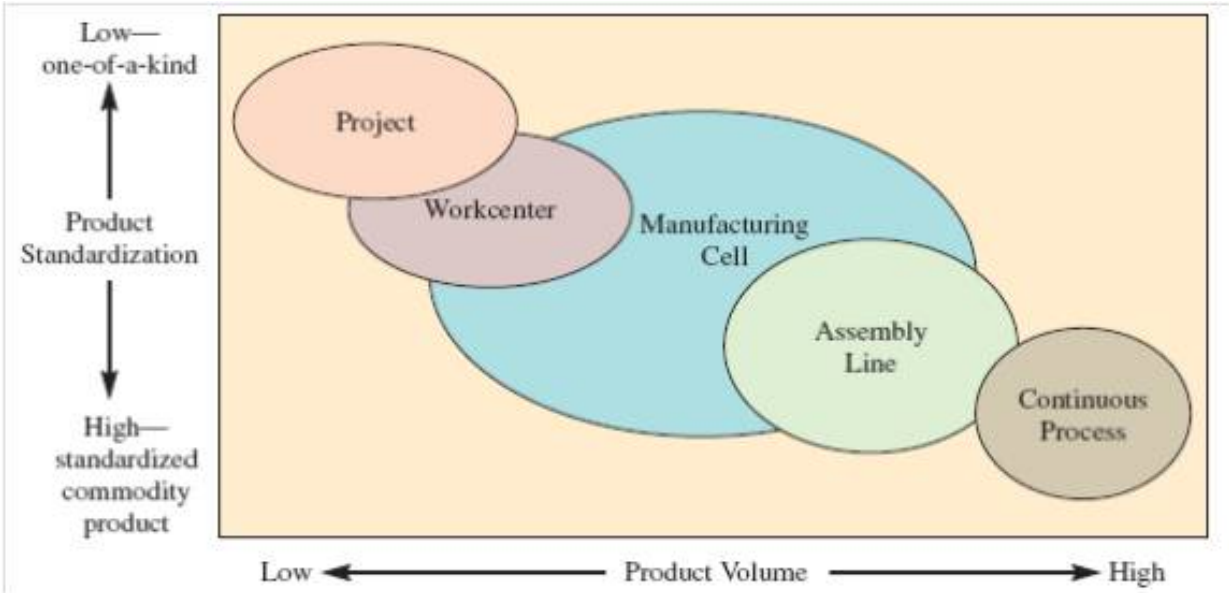
- **Hierarchy:** decision in upper-level $\rightarrow$ constraint in lower-level
- **Feedback:** systematic correction from its result
- **'Single' database & Integration:** maintaining data integrity and accuracy
- **Coverage:** cover 80% of cases or focus on bottleneck
- **Flexibility:** alternative, answering what if, provide exception
- **Transparency:** understanding logic and algorithm behind system

- **OKC's Note:** keep it simple and roll quickly

Warning!!

Be positive; Everyone makes mistake

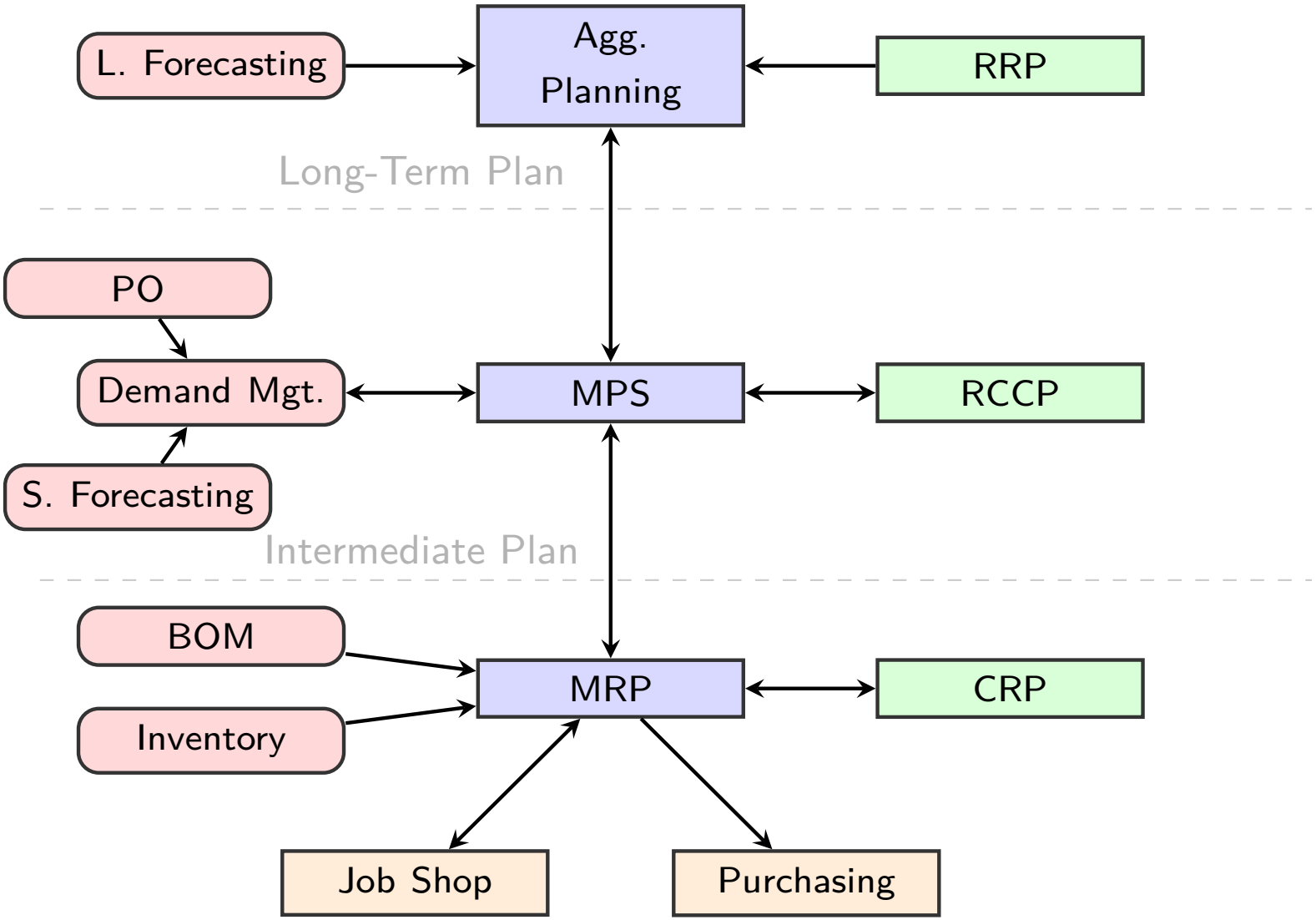
Production Process



source: Chase & Jacabs. 2010. *Operation and Supply Chain Management*.

- **Project:** product remains in a fixed location — Gantt Chart
- **Work center:** similar equipment or functions are grouped together — Machine Scheduling
- **Manufacturing cell:** dedicated area where similar products are produced
- **Assemble line:** processes are arranged according to the progressive steps
- **Continuous process:** assembly line only the flow is continuous — Model Change-Over

Closed-Looped Production Planning



adopted from: *Smith, S.* 1989.

Aggregate Planning

- **What:** planning for family of product
- **Idea:** smoothing demands & key resources (workers, # machine)
- **Occurred:** beginning of fiscal year (*unit:* month of sale)
- **Input:** long-term forecasting + key resources, policy (overtime, subcontract, backlog, machine capacity)
- **Output:** production plan, capacity, inventory at acceptable cost
- **Note:** must be flexible and share-able

Red Tomato: Aggregate planning

Red Tomato Tool, a US gardening tool manufacturer, usually faces with highly seasonal demands and considers three distinguish strategies as follow:

	Strategies
a)	adding seasonal worker
b)	using subcontractor
c)	building inventory/backlog

Month	Demand	Month	Demand
Jan.	1600	Apr.	3800
Feb.	3000	May	2200
Mar.	3200	Jun	2200

The company sells each tool for $40 that requires 4 hour and has initial inventory and workers in January of 1000 unit and 80 employees, respectively. A employee of Red Tomato typically works 8 hours a day and earns $4 per hour during regular time. Because of labor law, no worker can work more than 20 days of regular time per month and 10 hours of overtime per month.

Item	Cost
Material cost	$15/unit
Holding cost	$2/unit/month
Stockout cost	$10/unit/month

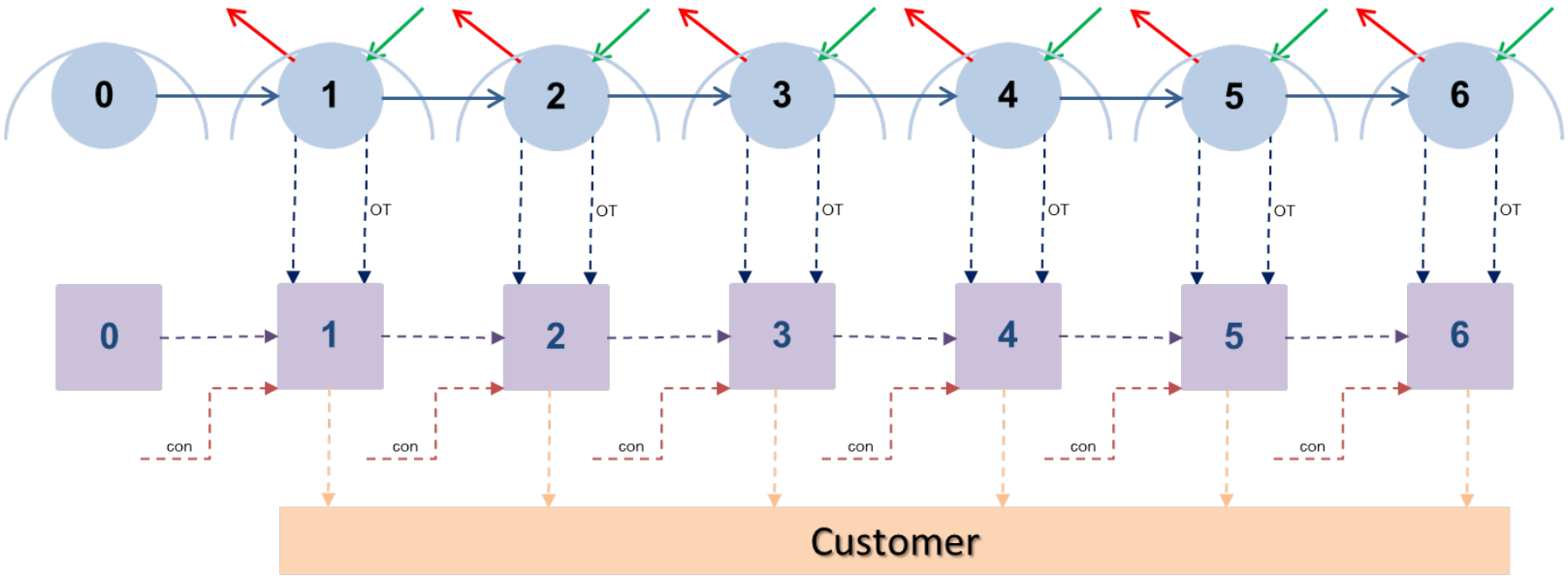
Item	Cost
Hiring costs	$300/worker
Layoff costs	$500/worker
Labor required	4/unit

Item	Cost
RT cost	$4/hour
OT cost	$6/hour
Subcontract cost	$30/unit

Determine the most suitable 'pure' strategy and the optimal 'mixed' strategy that maximizes profit if the company profile must have at least 500 units in June.

adopted from: *Chopra, S. & Meindl* 2016. pp. 227

Red Tomato: Model and Excel



Problems with aggregate planning

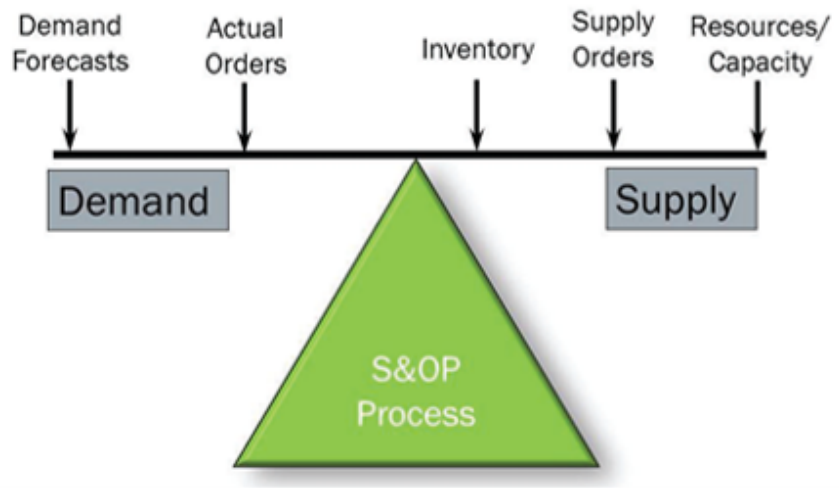
Methods

- **Price taker:** price can influence demand or negotiation (what if) → S&OP
- **Inventory of component:** lack of components → MPS & MRP
- **Capacity issues:** simplified production constraints

Application

- **Aggregate product:** no information on exact product → communication
- **Delivery plan:** frequency, product mixed, lot size → communication

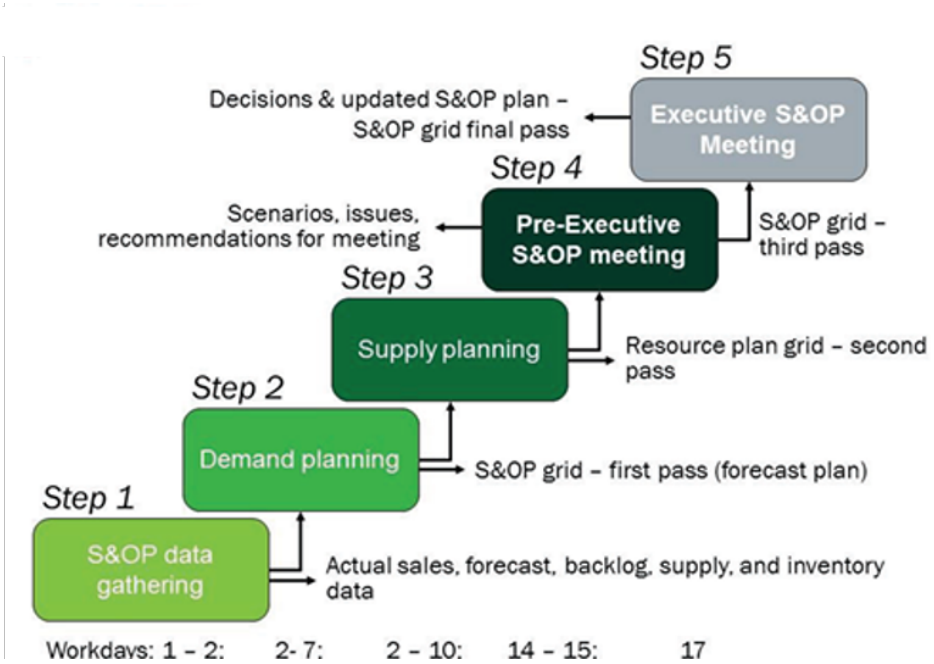
HS.0132: Sale and Operation Planning



source: ASCM 2020, Principle of S&OP Workshop

- **What:** strategic supply or demand mgt at predictable variability
- **Idea:** seasonal demand, but fixed Cap. $\rightarrow$ aligning finance & strategic goals
- **Managing supply:** capacity (flex workforce & machine, subcontracting), investment (common components)
- **Managing demand:** shift or manipulate demand (using price) or promotion

S&OP Process



source: ASCM 2020, Principle of S&OP Workshop

- **Data Gathering:** ERP, historical Cap, diff dept EXCEL → current req^m
- **Demand Planning:** review forecasting, (MTO &r MTS) → demand plan
- **Supply Planning:** last period, involve key suppliers → supply plan
- **Pre-S&OP Meeting:** discuss w/ dept on fact, conflict, and plan → agenda
- **Executive Meeting:** review finance and goals for decisions → S&OP

Reference

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