BADM 567: Process Management

Module 3: Inventory Management

Gopesh Anand

Today's Session

- Inventory in the News
- Introduction to Inventory Management
- Case Analysis: Three Jays
- Bonus Material: Inventory Planning for Supply Chain and Operations Disruptions

For Welch's, Zero-Based Budgeting Helps Zero In on Costs

The maker of jams and juices says it has reduced costs since implementing the cost-management method

By Nina Trentmann, Dec. 6, 2019

THE WALL STREET JOURNAL. WSJ

https://www.wsj.com/articles/for-welchs-zero-based-budgeting-helps-zero-in-on-costs-11575671707

Are There Enough Strawberries in a Kellogg's Strawberry Pop-Tart?

Lawsuit asks for $5 million …toaster pastries actually contain more pears and apples…

THE WALL STREET JOURNAL.
WSJ

Lawsuit claiming Kellogg's Strawberry Pop-Tarts have too few strawberries is dismissed

REUTERS

https://www.wsj.com/articles/are-there-enough-strawberries-in-a-strawberry-pop-tart-a-court-might-decide-11635207549

https://www.reuters.com/business/lawsuit-claiming-kelloggs-strawberry-pop-tarts-have-too-few-strawberries-is-2022-03-02/#:~:text=March%202%20(Reuters)%20%2D%20Kellogg,do%20not%20contain%20enough%20strawberries.

Breakout Session Scenario

Let's say you and your family eat one type of breakfast cereal every day… and you purchase it online…

…delivered at your doorstep.

You are responsible for purchasing and maintaining stock (inventory) of cereal…

…trying to avoid too much and too little.

https://images.app.goo.gl/MbBeUFxyombxog826

https://images.app.goo.gl/zfU3uGcoqfXuZidG8

Breakout Session Questions

- How do you decide…
  - How much to purchase?
  - When to purchase?
- What are the implications of…
  - Having too much?
  - Having too little?

How You Decide?

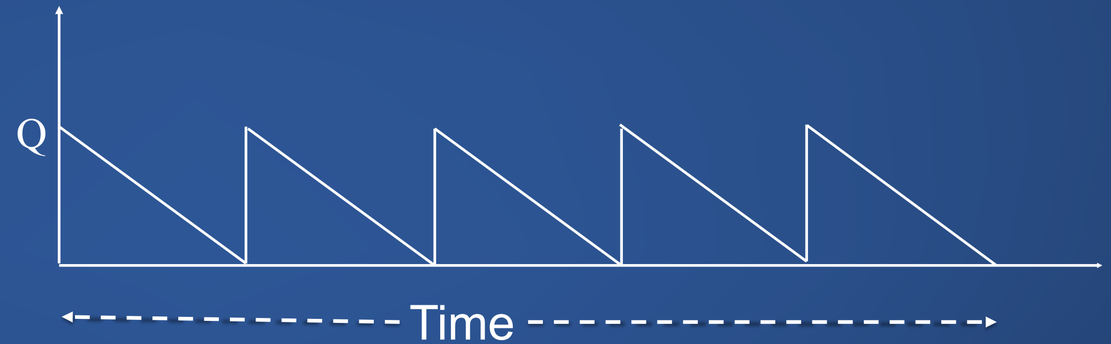
- How much and when?
  - Consumption
  - Delivery charge
  - Afford to spend
  - Time to receive
- Too much or too little
  - Spoilage
  - Running out

How Companies Decide?

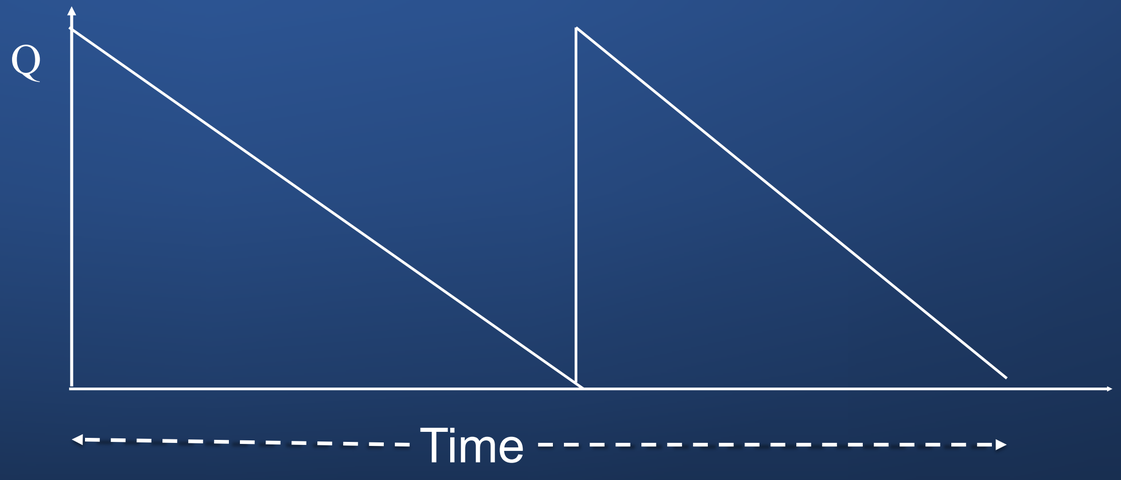
- Ordering costs and setup costs
- Transportation costs and time
- Opportunity cost of investment
- Labor and equipment utilization
- Volume discounts
- Forecasts

Ordering Cost (or Setup Cost) vs. Carrying (or Holding) Cost

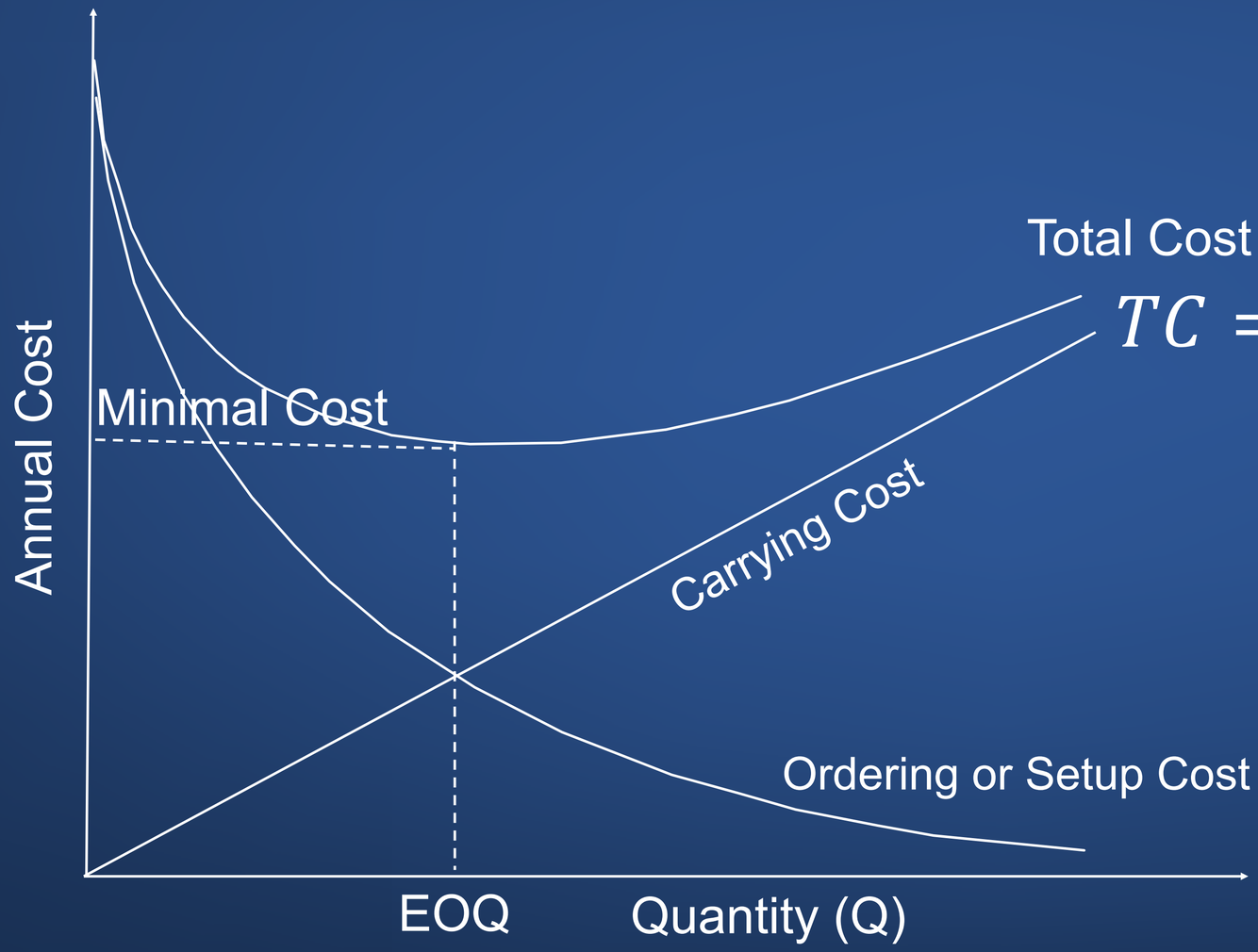
Smaller order quantity
- Incur setup or place order more frequently
- Lower average inventory



Larger order quantity
- Incur setup or place order less frequently
- Higher average inventory



Economic Order Quantity



Total Cost

$$TC = \boxed{S * \frac{D}{Q}} + \boxed{i * C * \frac{Q}{2}}$$

Solved Example: Economic Order Quantity and Total Cost

Annual Demand = 78 boxes

Cost to place an order = $2.10

Carrying cost per unit per year = 12% per year

Cost per unit = $11

$$Q^* = \sqrt{\frac{2\ S\ D}{iC}} = \sqrt{\frac{(2 * 2.10\ * 78)}{(0.12 * 11)}}$$ = 15.75 (rounded up = 16) boxes

$$TC = S * \frac{D}{Q} + i * C * \frac{Q}{2} = 2.10 * \frac{78}{16} + 0.12 * 11 * \frac{16}{2}$$

= 10.24 + 10.56 = $20.80

Solved Example: Reorder Point including Safety Stock

Annual Demand = 78 boxes Lead Time = 0.5 week

Standard deviation of weekly demand = 0.75 boxes

Service Level = 99% (z = NORMSINV(.99) = 2.33)

Reorder Point = (d X LT) + (z*σ per period * $\sqrt{LT}$)

= (1.5 * 0.5) + (2.33 * 0.75 * $\sqrt{0.5}$)

= 0.75 + 1.24 = 1.99 boxes

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Three Jays Corporation

Components of Setup and Holding Costs

Issues at Three Jays Corporation

- Too much inventory
- Inventory management system and production planning system may need update

Product Line

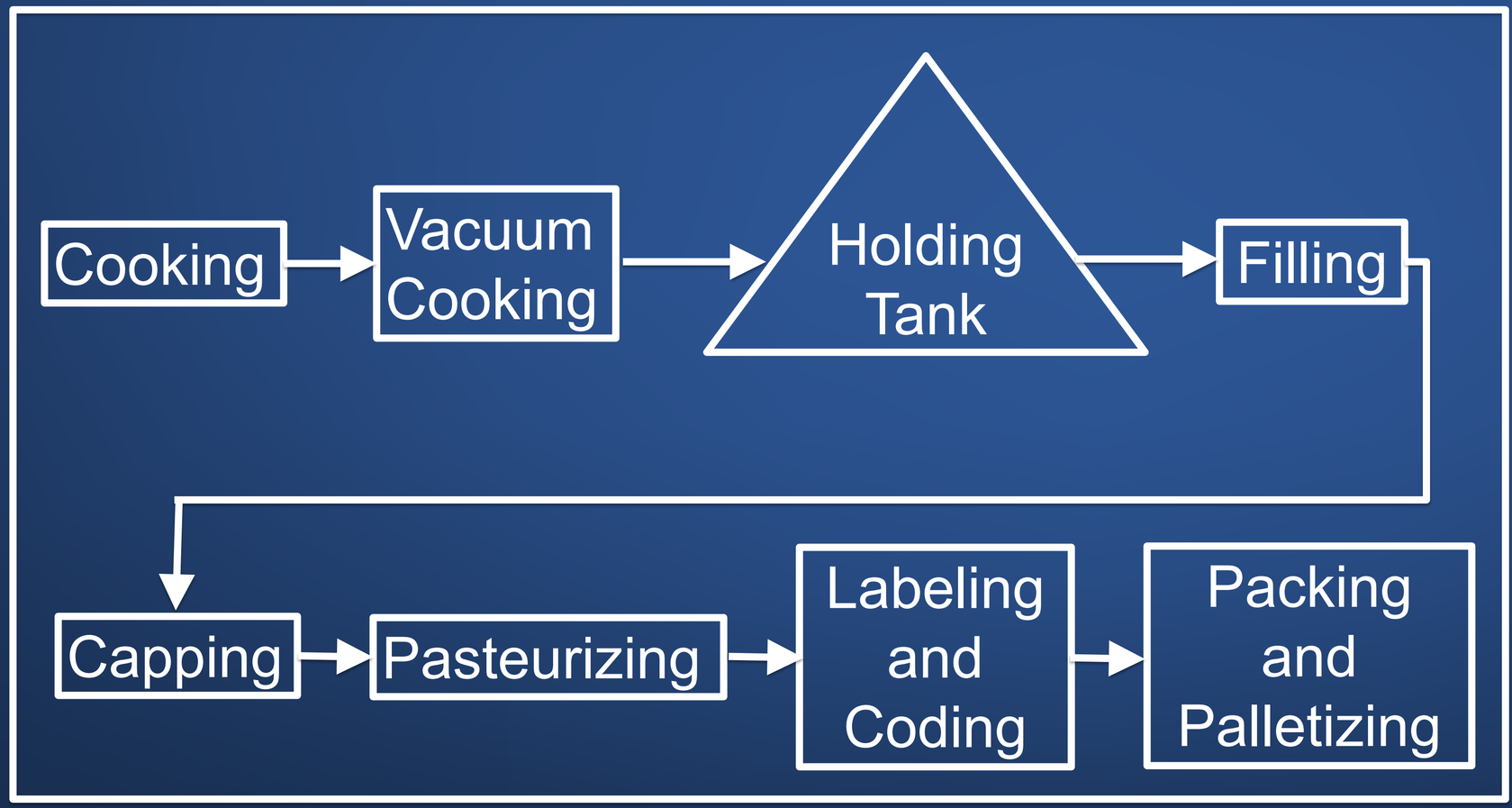
6 types of jams and jellies

4 sizes of jars

Several labels

Total: 141 Stock Keeping Units (SKUs)

Process


Cooking
Vacuum Cooking
Holding Tank
Filling
Capping
Pasteurizing
Labeling and Coding
Packing and Palletizing

How Much to Order?

EOQ = sqrt((2SD)/(iC))

Same as

=sqrt ((2* Setup Cost Per Setup * Annual Demand) / Holding Cost Per Unit Per Year)

When to Order?

ROP = 3/52 * D

= 3 * weekly demand

Like:

LT in weeks * weekly demand

Adjustment to Demand

Products	Demand (Sales)		Percent Change	EOQ		Percent Change
	2010	2012		2010	2012	
Strawberry	2,993	3,869	**29.27**	387	440	**13.70**
Raspberry	2,335	3,006	**28.74**	330	374	**13.33**
Peach	1,492	1,970	**32.04**	281	323	**14.95**
Blueberry	886	1,211	**36.68**	208	244	**17.31**
Apple/Mint	625	832	**33.12**	184	212	**15.22**

Setup Costs Currently Used by Three Jays

Admin costs = $42,000 ÷ (50 weeks * 40 hours) * 0.25 hrs. = $5.25 allocated to each order

Production Prep., Cooking and Cleaning = $30.25

Size Changeover = $4.70

Production-line cleaning = $4.70

Total: $63.70 per setup

Fixed or Variable Costs?

All components of setup costs are fixed cost allocations

Real Setup Costs are variable costs of:

Idle time of hourly line workers

3 workers * 12.50 per hour * 1 hour

= $37.50 per setup

Poll Question #1- True/False, and Why?

Using the lower setup costs will reduce the order quantity calculated based on the EOQ.

$$Q^* = \sqrt{\frac{2\ S\ D}{iC}}$$

Carrying Costs Currently Used by Three Jays

Cost of capital = 6%

Storage costs = 0

Cost of expired products, shrinkage, inventory, and taxes = 3%

Total: 9%

What to Include in Carrying Costs

Opportunity Cost: the investment possibilities a company must decline because its resources are tied up in inventory.

OR

Cost of capital: interest rate on borrowed funds (if the company needs to borrow)

True Carrying Costs for Three Jays

Opportunity cost of investing in marketing campaign = 20%

Other expenses = 3%

Total: **23% per unit per year**

Poll Question #2 - True/False, and Why?

Using the higher carrying (or holding) costs will reduce the order quantity calculated based on the EOQ.

$$Q^* = \sqrt{\frac{2\ S\ D}{iC}}$$

Adjustments to Costs

Setup cost = 37.50, Carrying Cost = 23%

Products	2012 Demand	Variable Costs	New EOQ	Old EOQ	Percent Reduction
Strawberry	3,869	25.79	222	440	49.55
Raspberry	3,006	27.97	188	374	49.73
Peach	1,970	24.31	163	323	49.54
Blueberry	1,211	26.46	123	244	49.59
Apple/Mint	832	23.77	107	212	49.53

Features of Production System

Flexibility?

Demand variation?

Poll Question #3 - True/False

The system followed by Three Jays Corporation is a Continuous Review System.

Current System

Hybrid:

- Fixed interval of 4 weeks
- Trigger point for reorder

Recommendations

Economic Order Quantity with Reorder Point

Periodic Review System

Reduce setup costs

Use better forecasting

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Inventory
Some Big Picture Implications

Pizza Finished on Delivery Truck

zume

https://www.youtube.com/watch?v=PY2bIJ9PPA8

Our Robot Overlords Are Now Delivering Pizza, And Cooking It On The Go

By Aarti Shahani, All Things Considered, September 29, 2016

npr ALL THINGS CONSIDERED from NPR NEWS

https://www.npr.org/sections/thesalt/2016/09/29/495925058/our-robot-overlords-are-now-delivering-pizza-and-cooking-it-on-the-go

Where do Losing Baseball Teams' Postseason T-shirts End Up?

After the final at-bat of the 2016 World Series, as T-shirts commemorating the winning team hit retailers' shelves almost as soon as they're on players' backs, versions celebrating the losers start a journey to the shredder.

By Lauren Zumbach Chicago Tribune October 18, 2016

https://www.chicagotribune.com/business/ct-mlb-postseason-merchandise-losing-team-1019-biz-20161018-story.html

Reduce Throughput Time

Remember Little's Law?

I = T * R

Mass customization

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Bonus Materials:
Planning for Disruptions

High Impact Low Probability Events

Average flu-related hospitalizations in the US, pre-COVID-19: 440,000

2020: 4,100,000

Sodhi, M. and Tang, C. (2021). Rethinking Industry's Role in a National Emergency. MIT Sloan Management Review.

Demand Challenge for Strategic National Stockpile

1. Every 2-3 years: One instance of doubling
2. Every 5-10 years: One instance of 3-4 times
3. Every 20-40 years: One instance of 10 times

https://www.phe.gov/about/sns/Pages/default.aspx

Solution Strategy: Combined Approach

Inventory

Capacity

Capability

Sodhi, ManMohan S. and Tang, Christopher S., Preparing for Future Pandemics with a Reserve of Inventory, Capacity, and Capability (Feb 16, 2021). Available at SSRN: https://ssrn.com/abstract=3816606 or http://dx.doi.org/10.2139/ssrn.3816606

Advanced Manufacturing

https://makerlab.illinois.edu/summer-2020-response
https://www.americamakes.us/amcpr/

Why There are Now So Many Shortages?

Video on Wendover
YouTube Channel

https://youtu.be/b1JIYZQG3II

Looking Forward

Inventory Management

- Module assignment
- Definitions and formulae, and
- solved practice examples on Canvas

Team assignment – Bergerac case

Supply Chain Management on Coursera

Thank you!