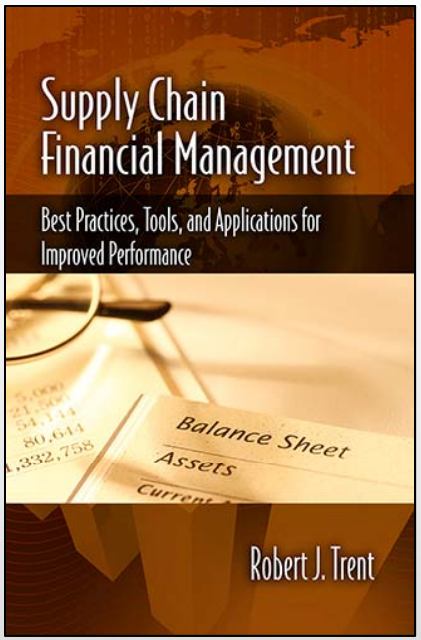
QUANTITATIVE INVENTORY TECHNIQUES



Quantitative Inventory Techniques

- Calculating…
  - Inventory carrying charges
  - Economic order quantity
  - Cash conversion cycle
  - Return on assets with the DuPont Model
  - The cost of foregoing a trade discount

Calculating Inventory Carrying Charges

- Simply put, it costs money to hold inventory
- Inventory represents a non-producing asset
- Inventory carrying charges can accrue wherever inventory resides in a supply chain:
  - In-transit from a supplier
  - During manufacturing
  - While stored in warehouses and distribution centers
  - At retail locations

Calculating Inventory Carrying Charges

- Central to carrying charges is the carrying charge percentage
  - The carrying charge percent is calculated by finance, not supply chain personnel
  - It is a percentage that represents what it would cost to hold a unit of inventory for one year
  - Always applied against an item's unit cost, not a total cost figure
  - The carrying charge represents the combined cost of capital; cost of storage; and the costs of risk, obsolescence, deterioration, and loss

Example 1: Calculating Inventory Carrying Charges—Normal Inventory Replenishment

- Use the following data to calculate (1) the total inventory carrying charge and (2) the per pound inventory carrying charge for a raw material
  - 144,000 pounds of a raw material are used each year
  - The raw material costs $1.75 per pound
  - Demand occurs at a steady rate throughout the year
  - Inventory is received at the start of each month and used throughout the month until it reaches zero at the end of the month
  - Inventory carrying charge is 24% annually
  - The average inventory method is used
    - ((Beginning Inventory + Ending Inventory)/2) = Average inventory for a period

Calculating Inventory Carrying Charges

- Using the previous data we can determine the total inventory carrying charge
  - Average inventory each month=((12,000 BI + 0 EI)/2)=6,000 lbs.
  - This is the equivalent of holding 6,000 lbs. for a year
  - 6,000 lbs. x $1.75 unit cost = $10,500 inventory value
  - $10,500 x .24 carrying charge = $2,520 total carrying charge for the year

Calculating Inventory Carrying Charges

- Using the previous data we can determine the per pound inventory carrying charge (which would be applied in a total cost model)
  - $2,520 annual inventory carrying costs/144,000 annual demand in pounds = **$.0175 per pound**

Example 2: Calculating Inventory Charges—Safety Stock

Using the following data, calculate (1) the total inventory carrying charge and (2) the *per pound* inventory carrying charge for inventory that is *used as safety stock*:

- Item: chemical raw material
- 480,000 pounds of this raw material used each year
- Cost: $11.50 per pound
- Two months' worth of annual demand to be held as safety stock
- Inventory carrying charge is 21% annually

Calculating Inventory Carrying Charges

- Using the previous data we can determine the total inventory carrying charge
  - The company plans to hold two months worth of demand as safety stock, or (480,000 annual demand/12) x 2 = 80,000 lbs.
  - 80,000 x $11.50 per pound = $920,000 total value of the safety stock inventory
  - $920,000 x .21 carrying charge percent = **$193,200 annual carrying charge cost for holding safety stock**

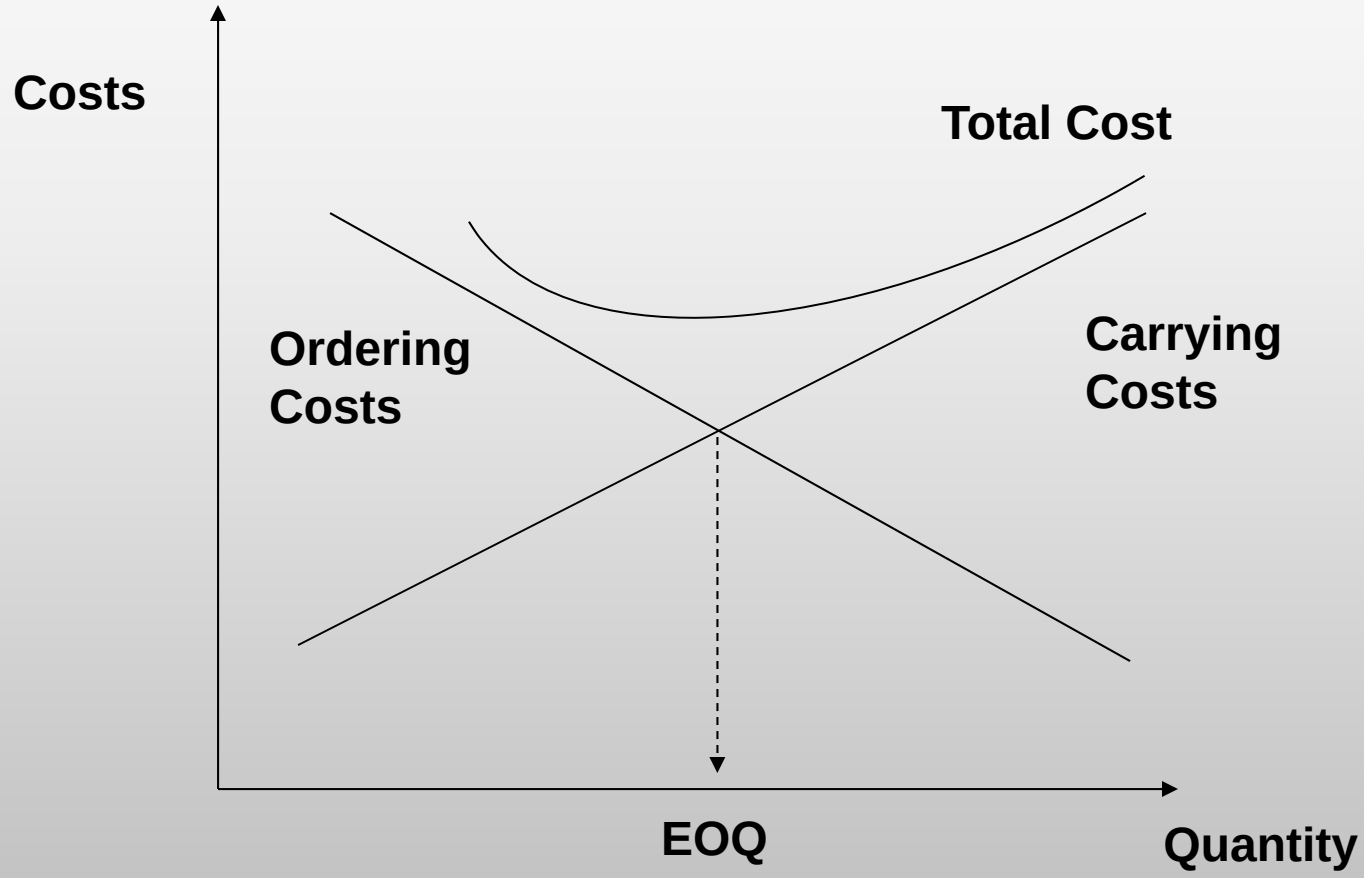
Calculating Inventory Carrying Charges

- Using the previous data we can determine the per pound inventory carrying charge (which would be applied in a total cost model) for carrying this item in safety stock
  - $193,200 annual inventory carrying costs/480,000 annual demand in pounds = $.4025 per pound

Economic Order Quantity

- A well-established approach for managing inventory is the economic order quantity (EOQ)
- The economic order quantity finds the optimal quantity that reflects the lowest total cost between ordering and inventory carrying (i.e., holding) costs for a specified annual demand.
- The EOQ approach is often used for items that are not managed on a lot-for-lot (LFL) basis. With LFL a company only orders the amount needed without consideration given to a lot size (the EOQ is essentially a lot size)
- The challenge EOQ model is usually not mathematical. The challenge involves obtaining reliable demand estimates and determining accurate ordering and carrying costs

Economic Order Quantity Model



EOQ Model

The following is the basic EOQ formula:

$$Q = \sqrt{2DS/H}$$

Q = Economic order quantity

D = Annual demand

S = Ordering costs per order in $

H = Annual inventory holding cost per year in $

Sample Problem:

A company is managing an item using an EOQ model. The item has a demand of 15,000 units annually (D) and the cost to carry one unit in inventory (H) is $7.25 per year. The ordering cost (S) for this item is $22 per order.

What is the EOQ?

Sample Problem:

What is the EOQ?

Answer:

Q = $\sqrt{2DS/H}$ = (2 x 15,000 x 22)/7.25 = 91034

The square root of 91,304 = 301.7, or 302

The EOQ is 302. Every time this company orders this item it will be for 302 units.

Cash Conversion Cycle

- The conversion cycle is a metric that calculates the number of days it takes a company to convert its resource inputs into cash
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Cash Conversion Cycle =
Days Inventory Outstanding (DIO) + Days Sales Outstanding (DSO) - Days Payable Outstanding (DPO)

Cash Conversion Cycle

Cash Conversion and Working Capital Formulas

Source: CFO Magazine

Measure	Interpretation
Days Sales Outstanding (DSO): Accounts receivable/(total revenue/365)	A decrease in DSO from one period to another represents an improvement, an increase a deterioration. When comparing companies from the same industry, a lower DSO is better
Days Inventory Outstanding (DIO): Inventory/(total revenue/365)	A decrease in DIO from one period to another represents an improvement, an increase a deterioration. When comparing companies from the same industry, a lower DSO is better
Days Payables Outstanding (DPO): Accounts payable/(total revenue/365)	An increase in DPO is an improvement, a decrease a deterioration (although keep in mind the potential negative effect of extending payment terms with suppliers). When comparing companies from the same industry, a higher DPO is better
Days Working Capital: (Accounts receivable + inventory – accounts payable)/(total revenue/365)	The lower the number of days, the better. When comparing companies from the same industry, a lower Days Working Capital is better

Cash Conversion Cycle Example

Data to Calculate the Cash Conversion Cycle—XYZ Corporation
All figures are in thousands of $

Period Ending	Dec 31 Current Year	Dec 31 Previous Year	Dec 31 Two Years Ago
Receivables	613,672	537,438	384,880
Inventory	61,675	61,251	64,335
Accounts Payable	281,631	257,113	234,379
Total Revenue	1,365,271	1,436,769	1,345,923

What is the cash conversion cycle for this company?

Is it getting better or worse?

Cash Conversion Cycle—Answer

Days Inventory Outstanding (DIO): Inventory/(total revenue/365)

Current year: ($61,675)/($1,365,271/365) = 16.5 days

Previous year: ($61,251)/($1,436,769/365) = 15.6 days

Two years ago: ($64,335)/($1,345,923/365) = 17.4 days

Days Sales Outstanding (DSO): Accounts receivable/(total revenue/365)

Current year: ($613,672)/($1,365,271/365) = 164.1 days

Previous year: ($537,438)/($1,436,769/365) = 136.5 days

Two years ago: ($384,880)/($1,345,923/365) = 104.4 days

Days Payables Outstanding (DPO): Accounts payable/(total revenue/365)

Current year: ($281,631)/($1,365,271/365) = 75.3 days

Previous year: ($257,113)/($1,436,769/365) = 65.3 days

Two years ago: ($234,379)/($1,345,923/365) = 63.6 days

Cash Conversion Cycle—Answer

Cash conversion cycle (CCC) = DIO + DSO - DPO

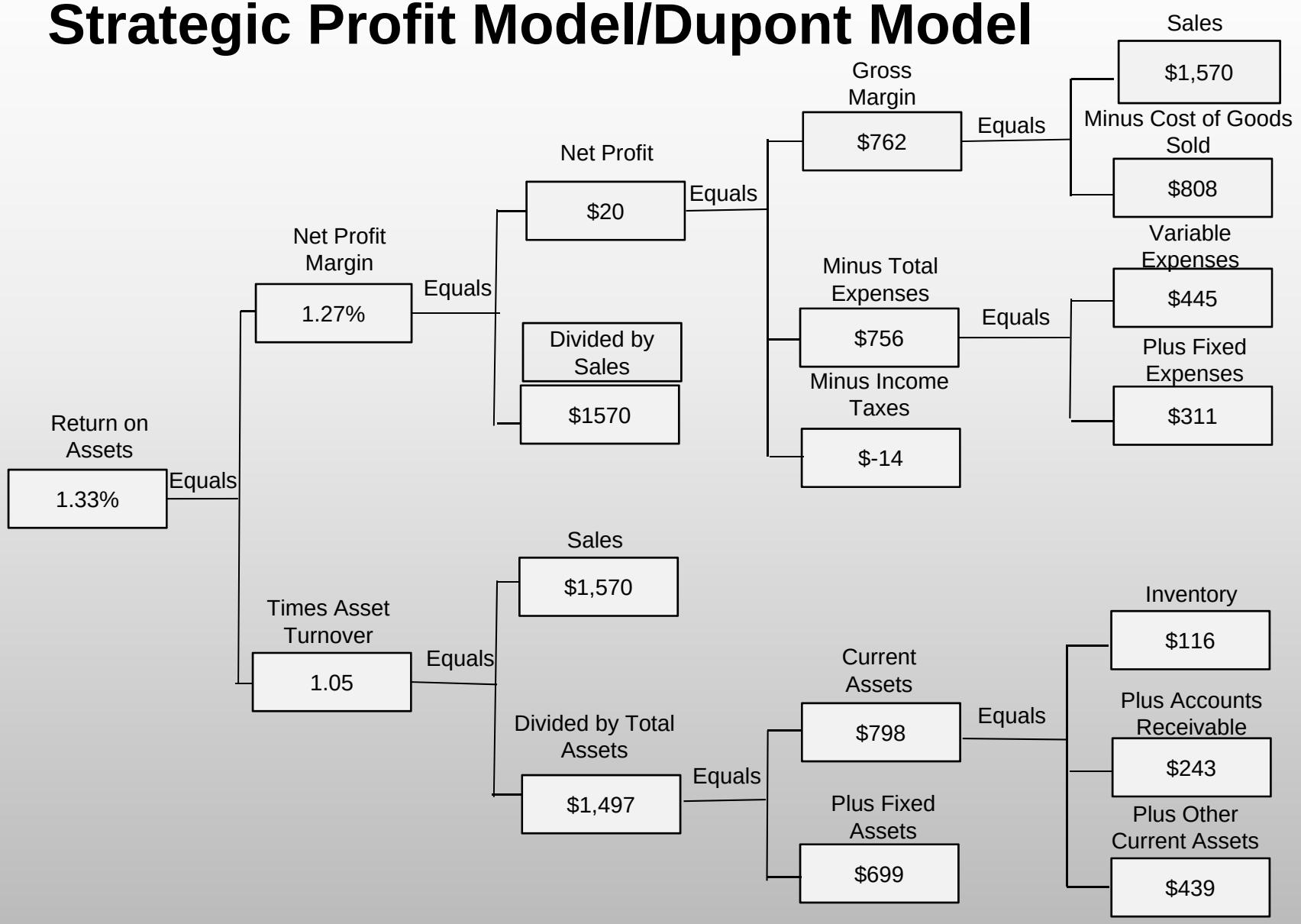
	Current year	Previous year	Two years ago
DIO	16.5	15.6	17.4
+ DSO	164.1	136.5	104.4
- DPO	75.3	65.3	63.6
= CCC	**105.3 days**	**86.8 days**	**58.2 days**

Overall, this company is currently taking longer to convert its resource inputs into cash compared with the previous two years.

DuPont Model Return on Assets

- Return on Assets (ROA), which is a ratio we usually present as a percentage, shows earnings that are generated from invested capital (assets)
- ROA provides an idea of how efficient assets are utilized to generate earnings
- The basic formula for ROA is net income/total assets
- The following illustrates the flow of financial data to arrive at the ROA

Strategic Profit Model/Dupont Model



Cost of Foregoing a Trade Discount

Most suppliers offer incentives in the form of a trade discount for early invoice payment, which most companies ignore as they stretch their payments to suppliers

It is worthwhile to analyze the benefit of paying early, which involves calculating the cost of foregoing a trade discount

Calculating the cost of foregoing a trade discount involves the following formula:

Cost of not taking a discount =
(stated rate per period) x (number of periods per year)

where:

Stated rate per period = (discount %)/(1 – discount %) and

number of periods per year = 365 days/(due date – discount period)

Cost of Foregoing a Trade Discount Example

Assume a supplier offers payment terms to customers of 2/10 net 30. This means the customer can take 2% off the invoice amount if paid within 10 days. Otherwise, full payment is expected within 30 days.

What is the cost of foregoing the trade discount?

First, calculate the stated rate per period, which is (.02)/(1 – .02) = .0204, or 2.04%.

Next, calculate the number of periods per year, which is 365/(30 – 10) = 18.25

Finally, calculate the cost of not taking a discount, which is (.0204 x 18.25) = .372, or 37.2%

Unless a customer can earn better than a 37% return on the money it is withholding from the supplier, it makes financial sense to take the 2% discount and pay on the 10th day.