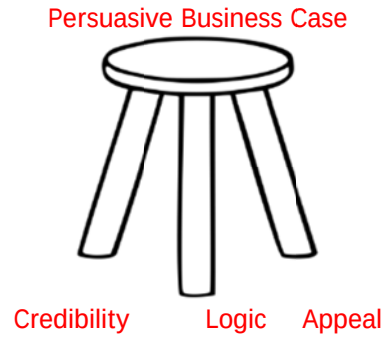
Building a Business Case for Material Handling System Investment

Introduction

Investments in new or updated material handling equipment and control systems offer an outstanding opportunity for Supply Chain leaders to contribute bottom line benefit to the financial performance of their organizations. The first and perhaps most important step in realizing this benefit is communicating the value of these investments in terms that are important to executive stakeholders and decision makers. This paper will define the primary financial terms and basic building blocks to consider when developing an executive level business case for an investment in material handling systems or any other capital intensive supply chain initiative. Particular emphasis will be placed on the accounting of depreciation due to the vital role it plays when calculating the return on investment.

The Purpose of a Business Case

It's important to realize that a business case is much more than presenting a return on investment (ROI) analysis. Rarely will an executive make a decision purely based upon the numbers presented in the financial justification. Instead, a myriad of other factors must be considered. For example, does the investment address a key business priority? What are the risks of moving forward with this investment? What other alternatives were considered? What is the cost of doing nothing? How credible is the analysis? Etc. The business case needs to anticipate and address concerns and questions through the eyes of the decision maker. More importantly, the business case needs to persuade the decision maker to take action.



The fundamental means of building a persuasive argument are logic, credibility, and appeal. Like three legs on a stool, if any are missing the argument will collapse. Therefore, a business case must be logical, credible, and appealing to the decision maker. In other words, the analysis must be logically constructed and key assumptions regarding timing, cash flow estimates, and organizational capabilities to implement and realize benefits must make sense. The analysis must also be credible. Conservative estimates from unbiased, knowledgeable sources add to the credibility of the argument. In addition, the analysis must be correctly constructed in the financial accounting terms used by the business. Finally, the business case must appeal to the key priorities of executive decision makers. A high investment proposal for a high return project in an area of low priority to the decision maker isn't likely to be persuasive.

The purpose of the business case is to persuade the decision maker to take your recommended path forward. Understanding this fundamental requirement will create a solid foundation for building your business case.

Defining Value

The emphasis on material handling solution decisions is often too heavily focused on the investment to be made rather than the value to be created. One reason is because we too narrowly scope the benefits generated from the investment and therefore undervalue the business case. The value of a material handling solution should be viewed more broadly than the impact on space and labor. Value can come in many forms. Conceptually, the goal of any supply chain investment (including MHS) is to increase revenue, growth, quality, service, and flexibility while also reducing time, risks, costs, working capital, and taxes. This can be viewed as a simple value equation to reference when identifying the benefits of your recommended investment.

$$\text{Value} = \frac{\text{• Revenue • Growth • Quality • Service • Flexibility}}{\text{• Risks • Time • Costs • Working Capital • Taxes}}$$

Increase These ↑

Decrease These ↓

Here are a few potential ways in which material handling solutions can increase the "numerator" in the value equation:

Revenue & Growth	Quality	Service	Flexibility
• Increase throughput/ storage capacity • Enable new or value added service (VAS) • Enable higher fill rate • Enable faster order turnaround time • Provide higher picking/ shipping/ invoicing accuracy	• Increase receiving/ putaway accuracy • Provide higher picking/shipping/ invoicing accuracy • Increase inventory accuracy • Increase reporting accuracy	• Support new customer requirements • Increase fill rate • Reduce order fulfillment time • Increase shipment compliance	• Employ low risk/proven technologies • Support non-compliant vendor receipts • Support new customer requirements • Support variable demand levels

The potential means of decreasing the "denominator" in the value equation go beyond the impact on labor and space.

Risks	Time	Costs	Working Capital
• Employ low risk/proven technologies • Employ proven tools & methodologies during implementation • Leverage highly skilled design and implementation resources	• Reduce dock to stock time • Reduce replenishment time • Reduce order to shipment time • Reduce shipment to invoice time	• Reduce labor costs • Reduce supervision costs • Reduce facility space costs • Reduce overhead costs • Reduce freight costs • Reduce IT costs • Reduce inventory carrying costs	• Reduce inventory • Reduce cash to cash cycle

Building the Business Case

The remainder of this paper will focus primarily on the terms used and mechanics of generating the financial justification within a business case. Although all business cases are unique, there are a number of common terms to know, rules to follow, and steps to consider. The following table outlines a suggested 10 step process to follow when developing a detailed business case. Each of these steps will be discussed in greater detail throughout the remainder of this document.

Basic Steps to Business Case Development	Considerations
1. Specify the feasible alternatives	• What are we comparing against? • What is the cost of doing nothing?
2. Determine the financial metrics to assess	• What financial metrics will be compared (e.g. Payback, NPV, IRR, MIRR, etc.)?
3. Establish pre-tax cash flow estimates	• What are the positive and negative cash flows for each alternative? • What is the timing of these cash flows? • What is the cash flow horizon?
4. Use accounting view of cash flow and ROI (return on investment)	• How do we impact the income statement? • How do we impact the balance sheet?
5. Determine depreciation expense	• What will be capitalized vs. expensed? • What depreciation method will be used? • What is the depreciation time period for each asset?
6. Calculate after-tax cash flow	• What is the client income tax rate?
7. Calculate discounted cash flow	• What rate will be used to determine the NPV of cash flows?
8. Assess alternatives based on financial metrics	• How do the numbers stack up and compare? • Does the answer change if different assumptions are used?
9. Complete quantitative and qualitative analysis	• What other decision factors need to be considered beyond the ROI?
10. Package and present the business case	• What is the level of detail needed to present your recommendation? • What questions must be answered to drive a decision? • Are you fully prepared to present your recommendation?

1. Define the Feasible Alternatives

The first step in justifying an investment is to define the feasible alternatives, including the possibility of doing nothing. The path of least resistance is often doing nothing. It's also usually the least risky proposition. But, doing nothing always comes at some cost. Often, it means the cost of maintaining or developing new capabilities within older equipment and systems. There is also the opportunity cost of not taking advantage of newer technologies.

$$\text{“Business Case”} = \frac{\text{Value to be Created (relative to doing nothing)}}{\text{Investment Required (relative to doing nothing)}}$$

Be cognizant of the need to define and develop a list of feasible alternatives. An executive decision maker will always want to know if other options were considered and how they compare on a relative basis. Therefore, an ideal approach is to gain insight into alternatives they deem important for consideration during the very early stages of the financial analysis.

2. Determine the Financial Metrics to Assess

The term Return on Investment (ROI) is often used synonymously with a business case, but there are many financial terms and metrics to consider.

Financial Term	Definition	Consideration
Net Cash Flow	Sum of negative and positive cash flows	• Simple, but does not consider time value of money • Overstates the relative value of longer term cash flow
Simple ROI	Ratio of net cash flow divided by the initial investment	• Simple, but does not consider time value of money • Difficult to compare alternative investments without also knowing the size of cash flow
Simple Payback	The period of time, usually measured in years, required to recover the original project investment without applying a discount rate	• Conceptually easy to understand • Measures relative risk of projects (i.e. short payback = lower risk) • Simple, but does not consider time value of money • Does not consider positive cash flow after breakeven
Discount Rate	The interest rate (or opportunity cost of capital rate) used in determining the present value of future cash flows. The opportunity cost of capital can either be how much you would have earned investing the money someplace else, or how much interest you would have had to pay if you borrowed money	• Generally difficult to determine what rate to use • Perform sensitivity analysis using different discount rates
Discounted Payback	The period of time, usually measured in years, required to recover the original project investment considering the time value of money	• More acceptable version of payback • But, does not consider positive cash flow after breakeven
Discounted Cash Flow (DCF)	Common method of estimating an investment's present value based on the discounting of projected cash inflows and outflows	• Most acceptable method of evaluating cash flows • Perform sensitivity analysis of different discount rates and time horizons
Net Present Value (NPV)	The net present value of expected future cash flows of a project minus the initial project investment	• Result of discount cash flow analysis • Positive NPV represents a favorable project • Pursue the project alternative with the highest NPV

Internal Rate of Return (IRR)	The internal return rate which equates the present value of a project's expected cash inflows to the present value on its expected outflows – can also be viewed as the expected rate of return on a project	• Often compared against desired "hurdle rates", which are generally higher than the cost of capital • Pursue project alternative that exceed internal hurdle rate • Incorrectly assumes positive cash flow can be reinvested at IRR
Modified IRR (MIRR)	The internal rate of return using a reinvestment rate for positive cash flows equivalent to the company's cost of capital or average rates of return	• Assumes positive cash flows are reinvested at average company rate of return • Generates more conservative and realistic expected rate of return

Each of these financial terms will be illustrated in examples as the business case development process is further defined in this document.

3. Establish Pre-Tax Cash Flow Estimates

The core component of a financial justification is the anticipated positive and negative cash flow associated with an investment. Net Cash Flow is the cumulative sum of positive and negative cash flows over the life span of the investment. A favorable investment must obviously have positive net cash flow. So, a pre-tax net cash flow analysis allows for "quick and dirty" analysis of an investment to determine Net Cash Flow, Simple ROI and Simple Payback. Simple Payback is perhaps the most popular "quick and dirty" method of evaluating a potential investment. Simple payback is the period of time, usually measured in years, required to recover the original project investment.

The following is a simple example that illustrates these calculations.

	Financial Analysis						
Investment Life Span (Years)	0	1	2	3	4	5	Total
Cash Inflow	$0	$0	$150	$150	$150	$150	$600
Cash Outflows	($200)	($100)	$0	$0	$0	$0	($300)
Net Cash Flow (Pre-Tax)	($200)	($100)	$150	$150	$150	$150	$300
Cumulative Cash Flow	($200)	($300)	($150)	$0	$150	$300	$600

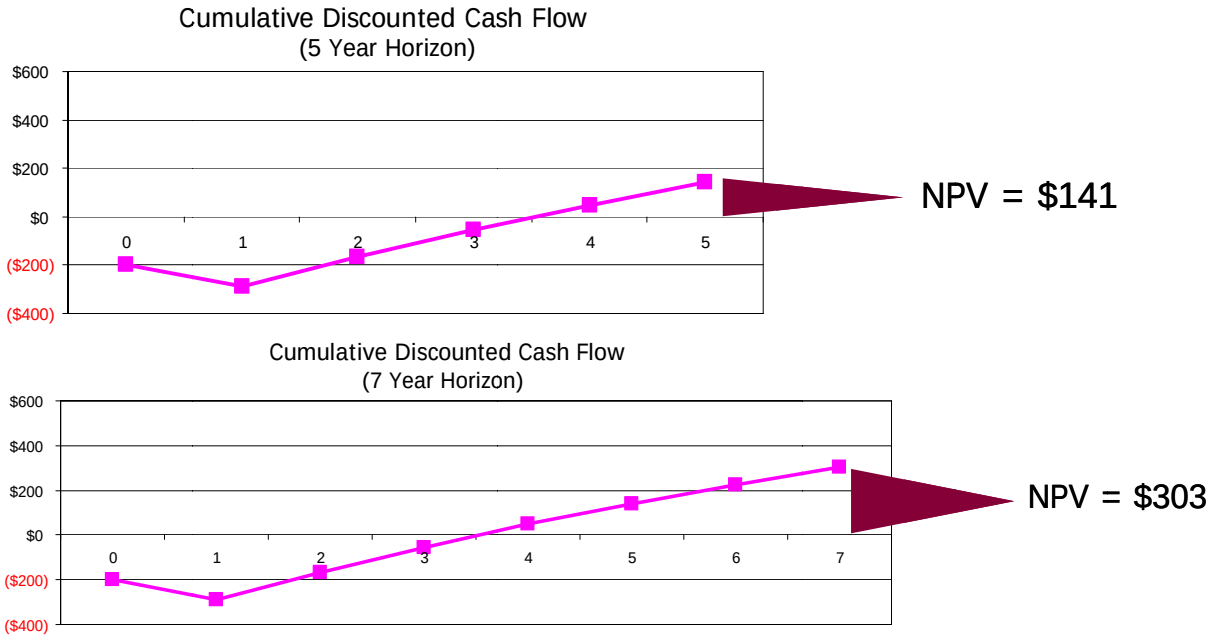
Net Cash Flow	$300
Total Investment	($300)
Simple ROI (Pre-Tax Cash Flow)	100%
Simple Payback Years	3

Time Horizon Considerations

Another important consideration when developing a business case is the time horizon of the cash flow analysis. Generally, the longer the cash flow horizon the higher the return. This is especially important when evaluating material handling solutions. Material handling equipment and control systems have long useful lives that continue to enable benefits for years after their installation. Therefore, the financial evaluation of these solutions should fairly consider their useful life.

As an example for comparison, the following illustrations depict the same investment evaluated over a 5 year vs. a 7 year horizon. One can clearly see that the net present value (NPV) is significantly higher when viewed over the longer horizon because positive cash flow continues to accrue.

Example of 5 vs. 7 Year Horizon:

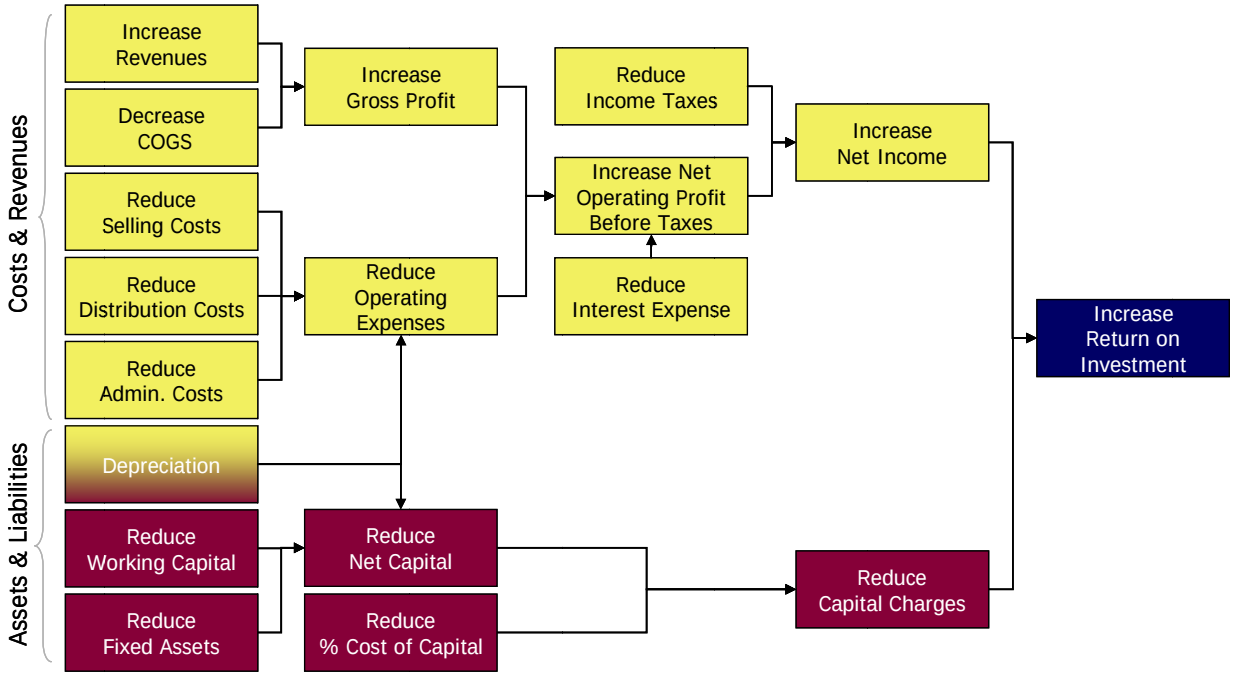


Although a longer term horizon generally implies a higher return, there are also practical and conservative considerations to apply. From an accounting standpoint, material handling equipment is usually depreciated over a 7 year period, and software solutions are usually depreciated over 5 years. So, a solid rule of thumb is to align the time horizon for positive cash flows with the time horizon over which the investment is being depreciated.

4. Use Accounting View of Cash Flow & ROI

The next important step in the process is to put the cash flow analysis into accounting terms so that the investment can be evaluated on an after tax basis. To do so requires a basic understanding of the income statement, the balance sheet, and how depreciation impacts both.

The premise behind a return on investment analysis is to determine the net income generated by virtue of the net capital employed. The following illustration depicts the relationship between the income statement (costs and revenues) and balance sheet (assets and liabilities) when determining a return on investment.



Depreciation impacts net income because it is a pre-tax expense that reduces taxable income. Depreciation impacts the balance sheet by reducing the book value of the investment. Appropriately accounting for depreciation is vital for the financial analysis to be credible. In doing so, a point to remember is that depreciation is a non-cash expense. Therefore, the depreciation expense must be "added back" to the after tax value in order to determine the actual after tax cash flow. The following example illustrates how this is done.

Net Cash Flow (example)	
Revenue	$2,040
- COGS	($1,000)
- Expenses (excl. depreciation)	($470)
- Depreciation	($200)
Net Profit Before Taxes	$370
- Taxes	($148)
Net Profit After Taxes	$222
+ Depreciation (add back)	$200
= Net After-Tax Cash Flow	$422

5. Determine Depreciation Expense

Given the importance of depreciation in developing a business case for material handling solutions or any capital intensive project, it is worth reviewing a number of accounting rules and guidelines regarding depreciation.

General Rules and Guidelines when Accounting for Depreciation:

- Capital expenditures (CAPEX) form the basis of the assets being depreciated
- Capital expenditures are expenditures creating future benefits
- CAPEX is incurred when a business spends money either to buy fixed assets or improve the value of an existing fixed asset with a useful life that extends beyond the taxable year

- The general rule is that if the property acquired has a useful life longer than the taxable year, the cost must be capitalized
- The CAPEX costs are then amortized or depreciated over the life of the asset
- For accounting purposes, a CAPEX is added to an asset account (e.g. Property, Plant, and Equipment), and the asset's book value is decreased annually by the amount of accumulated depreciation
- For tax purposes, CAPEX are costs that cannot be deducted in the year in which they are paid or incurred, and must be capitalized
- If the expense is one that simply maintains the asset at its current condition, the cost must be deducted fully in the year of the expense
- Tangible operational assets, except land, are subject to depreciation because they have limited economic lives
- Depreciation begins the period when the asset is placed into service for it's intended use
- Depreciation is a non-cash expense that reduces the asset's book value and a company's tax liability
- Depreciation for each asset is usually calculated separately and is based on four factors:
  - Acquisition cost
  - Estimated life
  - Residual (or salvage) value (book value after being fully depreciated)
  - Method of depreciation selected
- Acquisition cost is all cost incurred to acquire, transport and prepare the asset for its intended use, such as sales tax, commissions, transportation, and installation
- Estimated life is the number of years a company expects the asset to last or the amount of measurable production it expects from the asset
- Residual value is an estimate of the dollar amount that can be recovered for the asset at the end of its useful life when it is disposed of (sold or traded in). This remaining amount cannot be depreciated for financial reporting purposes. Acquisition Cost – Residual Value = Depreciable Base
- Several potential depreciation methods may be used (to be further discussed)

Determining Acquisition Cost

As noted, the capital amount to be depreciated is the acquisition cost less the anticipated residual value. The acquisition cost is all cost incurred to acquire, transport and prepare the asset for its intended use, such as sales tax, commissions, transportation, and installation as illustrated in the following example.

Acquisition Cost (example)		
Invoice price, gross	$	150,000
Less: 20% discount for payment	$	(30,000)
Invoice price, net	$	120,000
State sales tax @ 5%	$	6,000
Transportation costs	$	4,000
Installation costs	$	10,000
Total Acquisition Cost	$	140,000

Installation costs may include the cost of internal and external resources deployed. Typically, resource costs may be capitalized if these resources are engaged in the detail design, the development, or the actual installation of the asset whereas resource costs are expensed if they are engaged in other activities such as process design, selection, training, and operations transition.

Depreciation Methods

There are several methods that may be used when calculating deprecation. It's interesting to note, however, that the method required for tax reporting is different than the methods most often used for financial reporting.

Financial Reporting Methods

- Generally Accepted Accounting Principles (GAAP) is the standard framework of guidelines for financial reporting
- GAAP Methods for Depreciation
  - Straight Line
  - Productive Output
  - Declining Balance
  - Sum of the Years Digits
- The depreciation period is based on it's estimated useful life or units

Tax Reporting Methods

- Modified Accelerated Cost Recovery System (MACRS) is the required method of depreciation required by IRS
- Specific types of assets are assigned to X-year property classes with distinct accelerated depreciation schedules.
- MACRS is required by the IRS for tax reporting but is not aligned with GAAP for external financial reporting.

Straight Line Depreciation

Straight line depreciation is the easiest to determine. The following example illustrates how it is calculated.

- Depreciation = (Cost - Salvage value) / Useful life
- Example:
  - Acquisition Cost $140,000
  - Salvage Value $20,000
  - Depreciable Value $120,000
  - Useful Life 5 Years
  - Depreciation/Year $120,000/5 = $24,000

- The MS Excel Function is SLN(cost,salvage,life), where
  - Cost is the initial cost of the asset.
  - Salvage is the value at the end of the depreciation (sometimes called the residual value of the asset).
  - Life is the number of periods over which the asset is depreciated (sometimes called the useful life of the asset).

Year	0	1	2	3	4	5
Depreciation Percentage		20%	20%	20%	20%	20%
Depreciable Base for Calculation	$120,000	$120,000	$120,000	$120,000	$120,000	$120,000
Depreciation Expense	$ -	$ 24,000	$ 24,000	$ 24,000	$ 24,000	$ 24,000
Cumulative Depreciation	$ -	$ 24,000	$ 48,000	$ 72,000	$ 96,000	$120,000
Beginning Book Value	$140,000	$140,000	$116,000	$ 92,000	$ 68,000	$ 44,000
Ending Book Value	$140,000	$116,000	$ 92,000	$ 68,000	$ 44,000	$ 20,000

Accelerated Depreciation

Accelerated depreciation methods are commonly used because they reduce a company's tax burden during the initial years following installation more so than the straight line method. Common accelerated depreciation methods include:

- Sum of Years Digits;

- Declining Balance;
- Productive Output.

Sum of Years Digits Depreciation

Sum of the Years Digits is an accelerated depreciation method with a decreasing percentage of depreciation applied each year.

- Depreciation = [Useful Life – (Current Period– 1)]/SYD * Depreciable Value, Where SYD = Useful Life*[(Useful Life+1)/2]
- Example
  - Acquisition Cost $140,000
  - Salvage Value $20,000
  - Depreciable Value $120,000
  - Useful Life 5 Years
  - Current Period 3rd Year

  SYD = 5*[(5+1)/2] = 15, or 1+2+3+4+5 = 15
  Depreciation = [5-(3-1)]/15*$120,000 = $24,000

- The MS Excel Function is SYD(cost,salvage,life,per), where Per is the period being depreciated

Year	0	1	2	3	4	5
Depreciation Percentage		33%	27%	20%	13%	7%
Depreciable Base for Calculation	$120,000	$120,000	$120,000	$120,000	$120,000	$120,000
Depreciation Expense	$ -	$ 40,000	$ 32,000	$ 24,000	$ 16,000	$ 8,000
Cumulative Depreciation	$ -	$ 40,000	$ 72,000	$ 96,000	$112,000	$120,000
Beginning Book Value	$140,000	$140,000	$100,000	$ 68,000	$ 44,000	$ 28,000
Ending Book Value	$140,000	$100,000	$ 68,000	$ 44,000	$ 28,000	$ 20,000

Depreciation – Declining Balance

Double declining balance is a common method of accelerated depreciation, where the straight line percentage is doubled and applied to the remaining book value of the asset.

- Depreciation =(1/Life*2)*Book Value,
  Where Book Value = Acquisition Cost – Accumulated Depreciation
- Example:
  - Acquisition Cost $140,000 (equals initial book value)
  - Salvage Value $20,000
  - Useful Life 5 Years
  - Current Period 3rd Year

  Depreciation Factor = (1/5*2) = 40%
  Depreciation 1st Year = 40% * $140,000 = $56,000
  Depreciation 2nd Year = 40% * ($140,000 - $56,000) = $33,600
  Depreciation 3rd Year = 40% * ($140,000 - $89,600) = $20,160

- The switch to the straight-line method is necessary in the year that the straight-line method, using the remaining depreciable balance, yields a higher depreciation expense than the double-declining method.
- The MS Excel "VDB" function will correctly calculate the depreciation for each year
- VDB(cost,salvage,life,start_period,end_period,factor,no_switch), where:
  - Start_period is the starting period for which you want to calculate the depreciation.
  - End_period is the ending period for which you want to calculate the depreciation.
  - Factor is the rate at which the balance declines. If factor is omitted, it is assumed to be 2 (the double-declining balance method).
  - No_switch is a logical value specifying whether to switch to straight-line depreciation when depreciation is greater than the declining balance calculation. If no_switch is FALSE or omitted, Excel switches to straight-line depreciation when depreciation is greater than the declining balance calculation.

Year	0	1	2	3	4	5
Depreciation Percentage		40%	40%	40%	34%	0%
Depreciable Base for Calculation	$140,000	$140,000	$ 84,000	$ 50,400	$ 30,240	$ 20,000
Depreciation Expense	$ -	$ 56,000	$ 33,600	$ 20,160	$ 10,240	$ -
Cumulative Depreciation	$ -	$ 56,000	$ 89,600	$109,760	$120,000	$120,000
Beginning Book Value	$140,000	$140,000	$ 84,000	$ 50,400	$ 30,240	$ 20,000
Ending Book Value	$140,000	$ 84,000	$ 50,400	$ 30,240	$ 20,000	$ 20,000

Variations of declining balance may be used. The following is an example of 150% Declining Balance Depreciation.

- VDB(cost,salvage,life,start_period,end_period,1.5,False),
- Example:
  - Acquisition Cost $140,000 (equals initial book value)
  - Salvage Value $20,000
  - Useful Life 5 Years

Year	0	1	2	3	4	5
Depreciation Percentage		30%	30%	30%	30%	41%
Depreciable Base for Calculation	$140,000	$140,000	$ 98,000	$ 68,600	$ 48,020	$ 33,614
Depreciation Expense	$ -	$ 42,000	$ 29,400	$ 20,580	$ 14,406	$ 13,614
Cumulative Depreciation	$ -	$ 42,000	$ 71,400	$ 91,980	$106,386	$120,000
Beginning Book Value	$140,000	$140,000	$ 98,000	$ 68,600	$ 48,020	$ 33,614
Ending Book Value	$140,000	$ 98,000	$ 68,600	$ 48,020	$ 33,614	$ 20,000

Depreciation – Productive Output

Productive output is a method of depreciation where the useful life of the asset is based on the expected number of lifetime units to be produced, hours to be consumed, etc.

- Depreciation = (Cost - Salvage value) * (Actual Units Produced/Lifetime Units Expected)
- Example:
  - Acquisition Cost $140,000
  - Salvage Value $20,000
  - Depreciable Value $120,000
  - Lifetime Units 100,000
  - Depreciable $/Unit $1.20

Year	0	1	2	3	4	5
Productive Output		15,000	25,000	25,000	20,000	15,000
Depreciation Percentage		15%	25%	25%	20%	15%
Depreciable Base for Calculation	$120,000	$120,000	$120,000	$120,000	$120,000	$120,000
Depreciation Expense	$ -	$ 18,000	$ 30,000	$ 30,000	$ 24,000	$ 18,000
Cumulative Depreciation	$ -	$ 18,000	$ 48,000	$ 78,000	$102,000	$120,000
Beginning Book Value	$140,000	$140,000	$122,000	$ 92,000	$ 62,000	$ 38,000
Ending Book Value	$140,000	$122,000	$ 92,000	$ 62,000	$ 38,000	$ 20,000

Depreciation – MACRS

Modified Accelerated Cost Recovery System (MACRS) is a depreciation method required by the IRS for assets placed into service after 1986. Because the depreciation expense calculated by MACRS may vary significantly from other depreciation methods used for financial reporting purposes, most organizations only use the MACRS for tax reporting. Here is a basic overview of the MACRS depreciation method.

- Assets are grouped into property classes
- The depreciation is predetermined by a MACRS table for each property class
  - Nonresidential real property (real estate) is depreciated over a useful life of 39 years using straight line depreciation
  - Other asset classes utilize accelerated depreciation methods
  - The residual value of the asset is ignored
- The two most common asset classes other than real estate are the five-year and the seven-year asset classes.
  - The five-year asset class includes information systems, computers, and vehicles
  - The seven-year class includes most machinery and equipment
- All fixed assets are assumed to be put in and taken out of service in the middle of the year. Therefore:
  - For the five-year class assets, depreciation is spread over six years.
  - For seven-year class assets, depreciation is spread over eight years.

The table below represents the depreciation percentages applied for taxes purposes based on asset property class and assuming a mid-year convention. The highlighted cells are the years in which depreciation is converted to the straight line method.

Recovery Year	3-Year	5-Year	7-Year	10-Year	15-Year	20-Year
1	33.33%	20.00%	14.29%	10.00%	5.00%	3.75%
2	44.45%	32.00%	24.49%	18.00%	9.50%	7.22%
3	14.81%	19.20%	17.49%	14.40%	8.55%	6.68%
4	7.41%	11.52%	12.49%	11.52%	7.70%	6.18%
5		11.52%	8.93%	9.22%	6.93%	5.71%
6		5.76%	8.92%	7.37%	6.23%	5.29%
7			8.93%	6.55%	5.90%	4.89%
8			4.46%	6.55%	5.90%	4.52%
9				6.56%	5.91%	4.46%
10				6.55%	5.90%	4.46%
11				3.28%	5.91%	4.46%
12					5.90%	4.46%
13					5.91%	4.46%
14					5.90%	4.46%
15					5.91%	4.46%
16					2.95%	4.46%
17						4.46%
18						4.46%
19						4.46%
20						4.46%
21						2.23%
	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

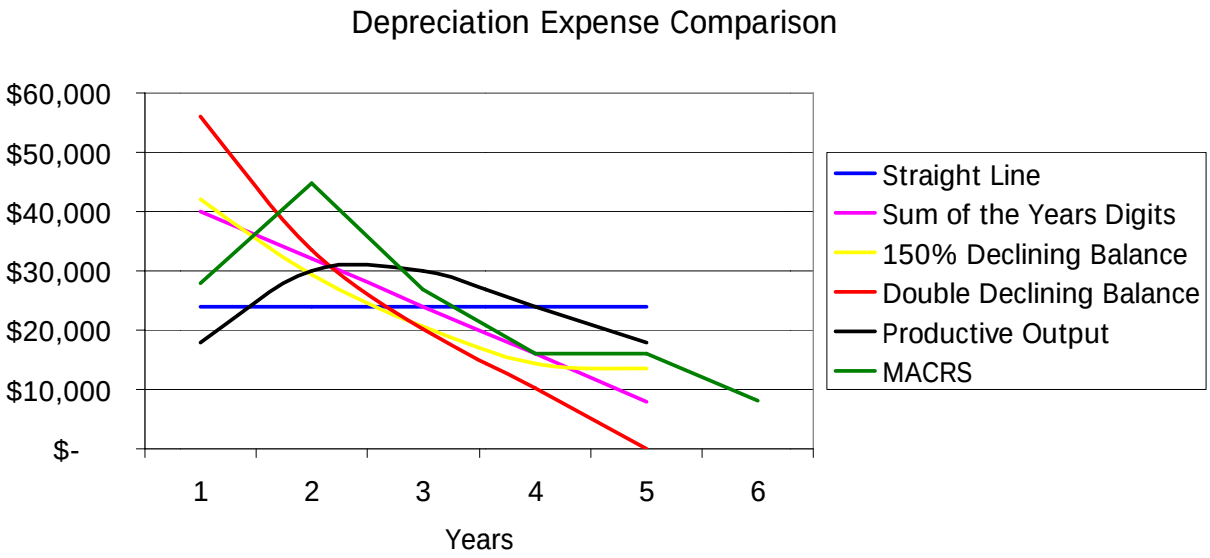
The following is an example of how the MACRS deprecation method may be applied.

- Example:
  - Acquisition Cost $140,000 (equals initial book value)
  - Salvage Value $20,000 (not used in MACRS calculation)
  - Property Class 5 Years

Year	1	2	3	4	5	6
Depreciation Percentage	20.00%	32.00%	19.20%	11.52%	11.52%	5.76%
Depreciable Base for Calculation	$140,000	$140,000	$140,000	$140,000	$140,000	$140,000
Depreciation Expense	$ 28,000	$ 44,800	$ 26,880	$ 16,128	$ 16,128	$ 8,064
Cumulative Depreciation	$ 28,000	$ 72,800	$ 99,680	$115,808	$131,936	$140,000
Beginning Book Value	$140,000	$112,000	$ 67,200	$ 40,320	$ 24,192	$ 8,064
Ending Book Value	$112,000	$ 67,200	$ 40,320	$ 24,192	$ 8,064	$ -

Depreciation – Methods Comparison

The straight line method is the easiest to compute whereas accelerated methods accelerate the tax benefit by expensing depreciation earlier over an asset's useful life. The following chart illustrates the comparison of annual depreciation expense for each of the previous examples of depreciation methods.



6. Calculate After Tax Cash Flow

Once a well grounded understanding of depreciation is established, it is now possible to begin calculating the after tax cash flow. The basic steps to determine after tax cash flow are as follows:

- First, estimate pre-tax cash flows for each year of the investment life span
  - Outflows (e.g. one time capital and expenses)
  - Inflow (e.g. net annual savings)
- Determine the annual depreciation on the capital investment
- Subtract the annual depreciation from the pre-tax cash flow to determine the taxable net income (Net Operating Profit before Taxes)
- Calculate the tax expense (for non-capital spending). The result is the Net Operating Profit after Taxes (NOPAT)
- Subtract the tax expense from the pre-tax cash flows to arrive at the after tax cash flow.

The following example illustrates the calculation of after tax cash flow.

- Example:
  - Acquisition Cost $200K (depreciable)
  - Project Expense $100K (not depreciable)
  - Salvage Value $0
  - Useful Life 5 Years
  - Depreciation Method Straight Line
  - Income Tax Rate 40%

	Financial Analysis						
Investment Life Span (Years)	0	1	2	3	4	5	Total
Cash Inflow	$0	$0	$150	$150	$150	$150	$600
Cash Outflows (Assumes Capital in Y0; Expense Y1)	($200)	($100)	$0	$0	$0	$0	($300)
Net Cash Flow (Pre-Tax)	($200)	($100)	$150	$150	$150	$150	$300
Depreciation (5 Years)	$0	($40)	($40)	($40)	($40)	($40)	($200)
Net Operating Profit (Before Tax)	$0	($140)	$110	$110	$110	$110	$100
Taxes (40%)	$0	$56	($44)	($44)	($44)	($44)	($120)
Net Cash Flow (After Tax)	($200)	($44)	$106	$106	$106	$106	$180
Net Cash Flow	$180						
Total Investment	($300)						
Simple ROI (After-Tax Cash Flow)	60%						

7. Calculate Discounted Cash Flow

The next step in the process is to determine the discounted cash flow. A discount rate must be applied to cash flow due to the time value of money which assumes that a dollar in hand today is worth more than dollar to be received in the future. The sum of the discounted cash flow is the present value of the investment.

Preset Value of an Investment

=

Future Cash Flows (Factored by Discount Rate)

Discounted Cash Flow

Present Value simply discounts future cash flow based upon an assumed rate (i.e. discount rate, interest rate, hurdle rate, or opportunity cost of capital).

- Net Present Value = $C0 + \frac{C1}{1+r1} + \frac{C2}{1+r2} + \frac{C3}{1+r3} \ldots \frac{CN}{1+rN}$
- The higher the discount rate the lower the present value of future cash flow as illustrated in the following example.

10% Discount Rate	Financial Analysis						
Time Period (Years)	0	1	2	3	4	5	Total
Future Cash Flow	$100	$100	$100	$100	$100	$100	$600
Present Value (@10% discount rate)	$100	$91	$83	$75	$68	$62	$479
Net Present Value	$479						

20% Discount Rate	Financial Analysis						
Time Period (Years)	0	1	2	3	4	5	Total
Future Cash Flow	$100	$100	$100	$100	$100	$100	$600
Present Value (@20% discount rate)	$100	$83	$69	$58	$48	$40	$399
Net Present Value	$399						

8. Assess Alternatives Based on Financial Metrics

The next step is to calculate, assess, and compare the financial results of each feasible alternative. The basic process is as follows:

- Confirm cash flow assumptions
- Confirm correctness of worksheet calculations
- Conduct sensitivity analysis on key parameters. Examples:
  - Discount rate
  - Time horizon
  - Magnitude of investment
  - Probabilities of annual savings realized
  - Probabilities of operating costs required

Net Present Value and Internal Rate of Return

As referenced earlier, the Net Present Value (NPV) is determined by simply discounting annual net cash flows by the assumed discount rate. The higher the net present value the more favorable the investment.

Internal Rate of Return (IRR) is often used in conjunction with or in lieu of an NPV analysis because it is not dependent on an assumed discount rate. IRR is the rate at which the investment has a Net Present Value of $0. The lower the internal rate of return the less favorable the investment. IRR is often compared against a company's threshold "hurdle rate" to determine whether the investment is worth pursuing.

- Example:
  - Acquisition Cost $200K (depreciable)
  - Project Expense $100K (not depreciable)
  - Salvage Value $0
  - Useful Life 5 Years
  - Depreciation Method Straight Line
  - Income Tax Rate 40%
  - Discount Rate 10%
  - Reinvestment Rate 10%

	Financial Analysis						
Investment Life Span (Years)	0	1	2	3	4	5	Total
Cash Inflow	$0	$0	$150	$150	$150	$150	$600
Cash Outflows (Assumes Capital in Y0; Expense Y1)	($200)	($100)	$0	$0	$0	$0	($300)
Net Cash Flow (Pre-Tax)	($200)	($100)	$150	$150	$150	$150	$300
Depreciation (5 Years)	$0	($40)	($40)	($40)	($40)	($40)	($200)
Net Operating Profit (Before Tax)	$0	($140)	$110	$110	$110	$110	$100
Taxes (40%)	$0	$56	($44)	($44)	($44)	($44)	($120)
Net Cash Flow (After Tax)	($200)	($44)	$106	$106	$106	$106	$180
Discounted Cash Flow (using 10%)	($200)	($40)	$88	$80	$72	$66	$65
Net Present Value	$65						
Internal Rate of Return (IRR)	18.7%						
Modified IRR (w/10% reinvestment rate)	15.1%						

The Modified Internal Rate of Return (MIRR) is often used rather than the IRR due to the conceptual inaccuracies in the IRR calculation. IRR assumes all positive cash flows can be reinvested at the IRR rate, which generally is a flawed assumption. Instead, a more appropriate approach is to assume positive cash flows can be reinvested at either the average rate of return of all company investments or the company cost of capital rate. The MIRR allows the use of a more conservative reinvestment rate in the calculation and therefore results in a more conservative and realistic expected rate of return.

9. Complete Quantitative and Qualitative Analysis

As noted earlier, a business case is more than presenting a return on investment (ROI) analysis. It must also address other factors that executive decision makers will weigh in the final decision. Generally, decision making requires a connection between the left brain (logical side) and the right brain (intuitive, creative, and holistic side). Therefore, for a business case to be persuasive to decision makers, it must encompass both quantitative and qualitative criteria.

The ROI analysis is an obvious quantitative criterion. If the ROI analysis doesn't identify positive cash flow with a sufficient rate of return to the business, then there is little need to address other decision criteria unless the investment is an imperative to sustaining the business. But, even if the ROI analysis reveals a very high rate of potential return, it doesn't necessarily mean the investment is the correct one to make. Large organizations almost always have a basket of alternative investments they can make, but they are limited by a finite set of funds in which to invest. So, the decision on where to invest is often determined by the more personal, motivational criteria of the decision maker.

Supply chain executives are often evaluated by performance against of number of key performance indicators (KPIs). Opportunities to improve KPI performance can be a highly motivating decision factor. Common KPIs in distribution include:

- Distribution Costs as a % of Sales
- Distribution Cost per Unit
- Units per Total Labor Hours
- % Fill Rate
- Inventory Turn Rate
- Order Fulfillment Lead Time

Material handling equipment and control system solutions can have a dramatic, positive impact on many of these KPIs. Therefore, the business case presentation should specifically identify how the distribution KPIs tracked by executive decision makers will be impacted by the investment.

In addition to quantitative criteria, a number of qualitative considerations should be addressed within the business case. As a rule of thumb, the business case should answer the questions we would ask ourselves if we had to put on own money on the line. Below is a listing of a few of the more prevalent questions to address:

- What is the priority of investment?
  - Within the distribution organization
  - Across the executive team
- What are the risks and how will they be mitigated?
- What are the critical success factors?
- Are the assumptions feasible?
- Do we have the resources to successfully implement?
- What are the intangible benefits?

10. Package and Present the Business Case

The final step in the process is to package and present the Business Case for executive decision makers in a manner that will allow them to quickly understand the scope of the recommend investment and the impact on relevant decision criteria.

Suggested components of an executive business case include:

- Statement defining purpose of meeting… convey your expected outcomes from the meeting
- Overview of project scope and objectives…put the discussion in context
- Key business assumptions…summarize major assumptions that lead to your recommendation
- Alternatives considered…summarize the primary alternatives evaluated
- Overview of project analysis & results…briefly describe how you got to this point
- Recommendation…clearly state what you recommend and why
- Anticipated benefits…put in terms important to the audience
  - Financial return
  - Key performance indicators (KPIs)
  - Qualitative factors
- Required investment…define how much, when, and who
  - Financial commitment necessary
  - Organizational resources required
  - Timing of investment
- Critical success factors…address risks and mitigating actions that will be taken
- Project roadmap…create a summary gantt chart of major work streams
- Supporting analysis and assumptions (appendices)…organize in a separate file or document for easy access.

Of course, the business case documentation itself will rarely sell the recommendation. Instead, the documentation is simply the ammunition needed during the presentation. Selling the recommendation will require a lead presenter fully knowledgeable and rehearsed in describing the recommended solution and the business case supporting the investment. Ideally, utilizing the terms and methods prescribed within this document will adequately arm the presenter to successfully gain approval and eventually reap the bottom line benefits enabled by the material handling system investment.

Summary

As a Supply Chain leader, your responsibility is to continually seek to maximize the long term profitability of the business. Often, this is possible through a rational investment in a new or updated material handling system solution. Such investments offer great opportunity to reduce costs, increase capacity, improve service, and positively impact the key performance indicators (KPIs) by which Supply Chain executives are evaluated. When confronted with an opportunity for such an investment, it is imperative to put together a business case that fairly and conservatively evaluates the value of the investment and its potential bottom-line contribution to the profitability of business. This paper has provided a detailed overview of the fundamental financial terms and methods to use when conducting this evaluation.

This paper has also described other decision impacting factors that must be considered when developing and presenting your business case. Your business case must be logical, credible, and presented in terms that are important and appealing to executive stakeholders. Decision makers are motivated to contribute to bottom line performance. But, they are also motivated by more personal criteria. Understanding and addressing the personal decision criteria of the decision maker will be as much or more important as the return on investment analysis in building a persuasive business case for your material handling system investment.

About Fortna

Fortna helps companies with complex distribution operations meet customer promises and competitive challenges profitably. We're a professional services firm built on a singular promise – we develop a solid business case for change and hold ourselves accountable to those results. Our expertise spans supply chain strategy, distribution center operations, material handling, supply chain systems and organizational excellence. For over 60 years, we've partnered with the world's top brands – companies like ASICS, O'Reilly Auto Parts and MSC – helping them improve their distribution operations and transform their businesses.

How Can We Help?

Fortna helps companies develop business cases for supply chain investment, including Material Handling systems. To learn more, ask to speak with one of our consultants.

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