

EVALUATING THE ECONOMIC AND FINANCIAL MERITS OF CAPITAL PROJECTS: INSIGHTS INTO IMPLEMENTATION ISSUES WITHIN A FIRM

¹Ross S, Westerfield R, and Jordan, B

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Abstract

Abstract: The effective implementation of capital project approval techniques within a firm is crucial in maximizing shareholder value. This requires a disciplined and uniform approach, with established policies and procedures from corporate headquarters. The financial evaluation process should consider the merits of the project, incremental cash flow analysis, and various project evaluations. The article focuses on the guidelines for project evaluation and authorization, the models for economic and financial valuation, the data requirements and collection process, and standardized documentation for corporate approval. The author illustrates the approach used with a detailed numerical example, emphasizing the importance of a well-functioning and efficient capital investment process. Finally, the article suggests that further research in financial analysis is necessary to aid students and practitioners in their understanding and appreciation of the evaluation process.

INTRODUCTION:

The implementation of capital project approval techniques within a firm requires a disciplined approach with uniform and comprehensive evaluation standards and guidelines throughout the organization. Such an approach is necessary to ensure timely consolidation of hundreds of projects within each business unit, submission for approval, and ultimately consolidation of these business unit capital projects at the corporate level for senior management review and final approval. This article provides insights into implementing capital project evaluations within a firm. The article discusses project evaluation and authorization guidelines, economic and financial valuation models, data requirements, and standardized documentation for submission to obtain corporate approval. The article also presents a detailed numerical example to illustrate the approach used in evaluating capital projects. It is hoped that future research in financial analysis will further enhance the capital budgeting evaluation process.

LITERATURE REVIEW

The finance literature is abundant on the discussion of issues related to capital project evaluations (see Baker and English, 2011; Brealey et al., 2019; Brigham and Daves, 2015; Brigham and Houston, 2019; Ross et al., 2016; Brigham and Ehrhardt, 2019; Ehrhardt and Brigham, 2016; Gitman and Zutter, 2019; Shapiro, 2005.

¹ University of Houston-Downtown

Quirin and Wiginton (1981) focus on evaluations of capital expenditures while Scott and Petty (1984) analyze and synthesize the capital budgeting practices in large corporations. Brealey and Myers (2019) discuss issues related to estimation of the asset beta for calculation of the cost of capital to discount the expected cash flow in calculating the net present value of a capital project. Borgonovo and Peccati (2004) discuss sensitivity analysis in investment project evaluations. Finally, Dillion and Caldwell (1981) discuss a system for post-auditing capital projects.

We will identify relevant economic and financial models, and discuss the types of project evaluations and related data requirements as well as the data collection process to accomplish evaluation and implementation of capital projects within a firm.

METHODOLOGY

Financial analysts may conduct a project evaluation by several methods, deploying both diverse financial models and uniform evaluation practices. We discuss the free cash flow-based financial model to evaluate a project based on its own merits and its value creation for all investors, i.e., both equity and debt holders.

Economic and Financial Analysis Model

The cash flow associated with a project is related to its operations, which may include the purchase of property, plant, and equipment (PP&E), marketing programs, supply chains, and other projects. Because the financial evaluation is based on a project's cash flow, we exclude any effects of financing decisions such as use of debt and related interest expenses. The cash flow associated with the project should be incremental or forward looking and should not include any past expenditure or sunk costs, i.e., costs already incurred on this project in prior years. These cash flows, or discounted value benefits, are derived from the perspective of the entire entity or the firm and not from a specific business unit or division, and should be consistent with the firm's goal of maximizing shareholder value.

The financial analyst develops an incremental cash flow for a project via comparison with alternatives that provide comparable products or services over a defined time horizon in order to identify differences in the development of the cash flows. The base case of a status quo alternative is an integral part of the analysis. Unless clearly identified, the cash inflows and outflows should utilize the mid-year convention. That is, in general, revenues, expenses, and investments are assumed to occur at the end of June in a calendar year while the tax payments occur quarterly. The analysis should include a time-period that accounts for the economic life of PP&E, product life cycle, and strategies. This time-period should be supported by assumptions, forecasts of revenue, expenses, and capital investment to achieve stated objectives. The economic analysis includes a discounted cash flow analysis that utilizes the cash flow and appropriate riskadjusted discount rate. The financial analysis helps study the impact on financial performance measures for internal reporting and management actions, and utilizes GAAP to help gauge the impact on the external reporting of financials.

Types of Project Evaluation

Project evaluations may include: (1) the modernization of property, plant, and equipment; (2) new products and services; (3) replacement of property, plant, and equipment; (4) own versus lease options; (5) sale and leaseback arrangements; and (6) other criteria such as regulatory requirements. Modernization projects support growth, technology improvements, or provide back-up to current plant and equipment. Such projects when undertaken provide additional revenues and/or lower costs. Project evaluation for the replacement of property, plant, and equipment includes a base case or current status quo of "do nothing" and several alternatives to introduce new products or services. The evaluation of improvements of existing products or services includes decision analysis related to new features or modifications. Once again, the incremental analysis compares alternatives with a base case of no change. In the evaluation of buy versus lease, a financial analyst needs to evaluate the lease terms to ensure compliance with IRS guidelines. If it is a true lease, then the financial analyst treats the lease as a source of external financing and, based on the finance literature, recommends the equivalent loan methodology (ELM). Upper-level finance textbooks include a discussion on the ELM method. This method helps determine whether leasing is the better method of financing an asset after the firm has made the decision to invest in the asset using

the discounted cash flow techniques. When a lessee owns an asset but wishes to sell it and immediately leaseback, it is commonly known as sale-leaseback and this type of evaluation also utilizes the ELM methodology.

Study Data, Information, and Documents

Procuring data is a tedious and time-consuming process as it requires various sources and interaction with subject market experts in other departments; hence, by definition, it is not a well-designed process. However, it is a crucial process as it serves as a basis for analysis and recommendations.

Data Collection and Development

The financial analyst performs four tasks: (1) works in partnership with the forecasting group or department to develop a demand model for the product, which is then used to develop the dollar sales forecast and justify the associated capital investment in PP&E to meet those sales; (2) works with the engineering department to develop the PP&E-related capital expenditure costs including for manufacturing or purchasing, material, labor, engineering, and installation costs. PP&E construction-related capital expenditures are developed by engineers who work with the manufacturers and construction companies; (3) works in partnership with subject market experts to develop any third-party contractual agreements and associated payments. These identification and separation stages of data collection are important to assess sales tax net of any revenue sharing agreements; (4) works with the accounts receivable, inventory and accounts payable departments to develop net working capital forecasts. The cycle of manufacturing to sales requires an annual investment in cash, inventory, accounts receivable net of any accounts payable, accrued salaries and taxes, and any short-term bank debt; together, these comprise “net working capital.” The need for working capital is not an issue in a replacement project but is important in the modernization of PP&E and new products and services. While PP&E, which includes delivery and installation costs is subject to book and tax depreciation, the working capital and marketing expenses are not. Finally, the financial analyst also works with the marketing department to develop advertising, marketing, and other related expense forecasts. The data necessary for the analysis are sourced through subject market experts (SMEs) in each of their areas of specialization. Hence, data gathering requires time, effort, accuracy, and managerial skills, and is time-consuming. For instance, the sales forecasts come from the marketing department, which may utilize their studies of customer needs, R&D department, supplier, and employee input. Operating expense forecasts are generated using input from several groups, including the labor contract department, the maintenance contract from the supplier of services, and corporate compensation experts who collaborate with the local administrators. Each department publishes a manual that includes project guidelines for the appropriate sources of data. This reference is used by the project manager who collaborates with a team of SMEs including product or service managers, engineers, financial analysts, and human resource, legal, and marketing managers. It must be noted that there are several types of costs: (1) directly attributable costs, which are unambiguously related to the implementation of the project and should be included in the analysis; (2) common costs, which are the same under all alternatives and cannot be directly attributed to a specific project and, hence, excluded from the analysis; (3) allocated costs of shared resources, which although not directly attributed to a project, are assigned using a well-defined allocation methodology and should be included in the analysis; (4) effects of the project on other products and services of the firm, known as “externalities” or in economic terms, “cross-elastic impacts,” which can be positive or negative. The financial analyst needs to quantify these impacts in the form of potential loss of revenues or additional expenditures and vice versa. He/she needs to incorporate any impacts of a proposed project on other projects of the firm in the analysis; (5) opportunity costs are related to assets a firm already owns. For instance, if a firm owns a building or a piece of land that is not currently used and the firm plans to use it in the proposed project, then the opportunity cost of not being able to sell or rent the building or land at the current market price should be included in the analysis; (6) costs that were incurred in the past and cannot be recovered in the future regardless of acceptance or rejection of a proposed project, also known as “sunk costs,” should not be included in the analysis such as marketing expenses already incurred for the proposed project.

As data become available, the analyst needs to conduct an in-depth review and incorporate all the relevant data and issues, and evaluate for accuracy, feasibility, and consistency. All project alternatives involving replacement or modernization need to incorporate continuing operational maintenance, income taxes, and property taxes of existing or embedded plant.

Recycled Fixed Assets

A finance analyst needs to carefully evaluate the cash flow implications when a project under consideration involves using secondhand plant and equipment. If the transfer is within the firm to separate locations, then the purchase price is not treated as a cash flow; however, it may qualify for investment tax credit and the tax depreciation depends on the original date of purchase or deployment in the service. If the transfer is within the firm between two business units, then the purchase price is treated as a cash flow; however, it may not qualify for an investment tax credit and the tax depreciation depends on the original date of purchase or deployment. Finally, if the purchase or service is from another firm, then the financial analyst treats the purchase price as a cash flow; however, it may not qualify for an investment tax credit and the tax depreciation depends on the new date of purchase or deployment in service.

Impact of Inflation

Because capital projects are long-term projects, forecasted revenues and expenses should include any impact of inflation. In addition, the financial analyst needs to reflect any productivity improvements over time in the deployment of future assets in the long-term forecasts. The productivity improvements and positive impacts of inflation on revenues may or may not be offset by the negative effects resulting from higher costs and expenses due to inflation. The calculation of a risk-adjusted discount rate incorporates effects of inflation primarily via the higher risk-free rate and sometimes via the use of higher risk premium. A financial analyst needs to include any modulation in the discount rate due to differences in impacts of inflation on costs and expenses versus revenues in the discount rate and explain it in the analysis.

Taxes

There are several categories of taxes. The cash income taxes paid affect the economic analysis of cash flow and the book income taxes impact the financial records for reporting of the financial statements. The free cash flow in a project analysis is available to all investors, i.e., both debt and equity holders. Because the analyst is concerned about the cash flow from the merits of the project from operations, he/she excludes the financing-related tax benefits such as tax savings associated with interest payments on debt financing in the analysis. These tax savings, however, are included in the calculation of book taxes for inclusion in the financial statements. Most states require a firm to pay state income taxes and the state income tax rates vary by state. A firm may be operating in a regulatory industry where it pays gross receipt taxes based on its revenues. Firms pay property taxes on the gross investment in property, plant, and equipment, and any labor-related salary expenses should include social security taxes and federal and state unemployment taxes. Analysts utilize statutory or negotiated tax rates. To facilitate the data collection, a group within the corporate headquarters, which includes the subject market experts in the economics, tax, treasury, and operational departments, support the analysts in business units to gather data for the standard parameters to ensure uniform applications throughout the corporation.

Risk Analysis

The risks associated with the cash flows for a project stem from the uncertainties or variation in sales, cost, and expenses. Porter (1988) attributes these variations to a firm's product market environment and the industry growth rate, a firm's competitive position in terms of its cost position, its market share and projected revenue growth rates, life cycle of a firm's products, technology, and external economic and legal environment. The treasury department in a firm provides the project discount rates and may categorize them as low, medium, or high discount rates, corresponding to the risks of the project. The analyst then performs a risk analysis of the project and justifies the selection of an appropriate discount rate. Most firms also require a sensitivity analysis, which involves identification of critical variables and estimation of their impact on the project's financial performance due to changes in the critical variables, one at a time. In addition, a scenario analysis involves assessing the impact of

changes in overall economic, product market, or regulatory conditions, and the impact of changes in values of a set of two or more variables at a time; for instance, a potential looming recession and/or a breakthrough in technology.

EVALUATION MODEL

Analysts may use several economic models for valuation of cash flows. In a capital project analysis, the cash flows are based on the merits of a project and the net present value (NPV) of a project provides benefits to the firm, i.e., to all investors of the firm. Therefore, the appropriate cash flow to all investors is the free cash flow (FCF) and the corresponding cost of capital is the weighted average cost of capital. The valuation of the free cash flow model should be used for a capital project analysis, where the value of the project is the sum of the present value of future FCF discounted using the discount rate appropriate to the risk of the project:

$$FCF = EBIT (1 - \text{Tax rate}) + \text{Depreciation} - \text{Capital spending} - \text{Change in net operating working capital},$$
Where EBIT is earnings before interest and taxes.

The analyst may interpret the above derivation of FCF as follows: multiply the earnings before interest and taxes (EBIT) by $(1 - T)$ to derive the after-tax operating income and then add back the depreciation expense to derive the cash portion of this after-tax income. Note that the depreciation is a noncash expense. Because the analyst deducts depreciation expense in calculating EBIT, adding it back eliminates the noncash expense. Note that in calculating after-tax earnings, the analyst does not deduct the interest expense from EBIT as he/she is concerned about income only from operations and excludes any items or benefits related to financing of the firm. The last two terms in the above equation help derive the free cash flow net of investments, which includes upfront capital expenditures for the long-term, that is, over the economic life of the project, and changes in net operating working capital, which vary throughout the economic life of the project. The role of the net operating working capital varies from investment in the project in the earlier period of the project to disinvestment at the end of the project life. This change occurs as the start of the project requires a build-up of inventory and accounts payables, which is followed by an increase in accounts receivables during the intermediate stage, and then selling of inventory, paying of accounts payables, and the collections of accounts receivables at the end of the economic life of the project. The above cash flow equation ensures that the analyst evaluates each project based on its own merits and on a standalone basis. Because this free cash flow is available for both the debt holders and shareholders, the subsequent calculated value of this project is for all investors. The firm is free to utilize this FCF to make interest payments to the debt holders and or use it for retirement of debt and pay dividends to shareholders and/or buy back the shares. This valuation model helps us calculate the total value of the project for the entire firm.

As discussed earlier, the analyst focuses her/his efforts on collaborating and gathering data from subject matter experts from several departments to derive the values of the financial variables and parameters outlined in the above equation. Deriving the above equation in this manner allows the separation of operating, investment, and financing decisions.

As stated earlier, the treasury department in a firm provides a detailed explanation of the use of appropriate discount rates. For instance, a replacement project is assigned a lower discount rate while a new product/service project may require use of a higher discount rate. A replacement project does not involve any major risks as it is internal to the firm and may lead to cost savings and a better-quality product. An international project may require even a higher discount rate due to political and exchange rate risks. To develop discount rates and the associated narratives, the treasury department works on an on-going basis with subject market experts in capital management groups located within all business units and the corporate headquarters. It is the analyst's responsibility to justify her/his selection of a specific discount rate for the project. The treasury department may utilize several methods to calculate the discount rates as are discussed in most finance textbooks. Because the assets of the firm are financed by all investors, i.e., equity and debt holders, Brealey and Myers (2003) argue that the firm's cost of capital is the opportunity cost for the firm's portfolio of assets. For the sake of simplicity, one may assume the risk associated with the assets from new capital investments is the same as the existing portfolio of assets. The weighted average cost of capital is derived from the cost of equity and cost of debt. The cost of equity capital is

the sum of the risk-free rate and the risk premium, where the risk-free rate includes the inflation premium. The cost of debt capital also includes the inflation premium. The capital asset pricing model is one such method to calculate the cost of capital and it uses the beta of the asset. The beta of the asset measures the risk of an industry and firms in an industry have the same asset betas. Because individual firms may utilize various levels of debt, the equity beta is adjusted for leverage to derive the asset beta using the following equation:

$$\text{Beta}_{\text{equity}} = \text{Beta}_{\text{asset}} \times [1 + (\text{Debt/Equity}) \times (1 - T)]$$

The accounting beta may be used as a proxy for the cash flow asset beta (Beaver and Manegold, 1979).

Upon estimation of the FCF for a project, the next steps involve the calculation of economic, financial, and accounting performance measures. The main measures include the net present value (NPV), which is the sum of the present value of the free cash flow using the appropriate risk-adjusted discount rate; a project is accepted if the NPV is greater than zero. This is a primary indicator that directly measures the contribution of a project to the firm's shareholder value. While NPV incorporates in dollar terms the long-term, i.e., time value of money, the FCF, and risk, it does not calculate a rate of return. The analyst also needs to estimate the length of time of the study period of a project. The benefit-to-cost ratio or profitability index measures the sum of the present values of FCF inflows over the study period divided by the sum of the present values of investments or outflows in the project. It is a measure of efficiency of value creation per dollar of investment among projects and, therefore, is a useful measure for comparing projects rather than evaluating an individual project. For a project to be accepted, this ratio needs to be greater than one. The internal rate of return (IRR) or the modified rate of return (MIRR) measures the percentage rate of return on a project over a defined study period. To be accepted, the project IRR or MIRR should be greater than the cost of capital. While the IRR assumes each year's FCF inflows are reinvested at the internal rate of return, the MIRR assumes these FCF inflows are reinvested at the cost of capital. The latter is a more realistic measure as in the competitive market a project may not be able to sustain its competitive advantage for a long time and earn the higher IRR than what it costs the firm to source the capital funds, i.e., the cost of capital. In addition, the decision maker is interested in deriving the return from the project while in operations and not from financing or from assuming a continuation of higher reinvestment rate, which is implicit in the use of compounding/discounting techniques. The discounted payback period (DPP) measures the number of years it takes for a project to recover its investment, which for most projects is the initial investment. To be accepted, a project's DPP should be greater than the payback period set by the CFO team and based on their firm's experience and needs. Finally, the accounting measures used include return on equity (ROE), operating return on assets (ORA), and return on investment (ROI), which is discussed in finance and accounting textbooks.

ANALYSIS AND DECISION MAKING

While a financial analyst may conduct a project analysis to achieve certain department, division, or business unit objectives, he/she should always perform the economic, financial, and accounting analysis from the perspective of the total entity or firm. While the net present value is the main criterion for the selection of an alternative, other considerations may override this criterion, including regulatory requirements, implementation of strategic technology, or to satisfy certain customer requirements.

Documentation for Project Approval, Tracking, and Consolidation of Projects

The project selection and approval process goes through hierarchical stages of management review by both the finance and operations departments. It is the financial analyst's responsibility to develop the analysis in the required format and in different presentation modes for each level of review. Deo (2022) discusses in detail the documentation aspect of the capital project analysis. The project documentation package includes the project description, strategic objectives and market assessment, study assumptions, data, financial models and tools, economic analysis of alternatives, expense and capital resources, financial performance measures including free cash flow and other financial criteria, risk analysis, implementation plan and project tracking and, finally, the project executive summary as shown in the Appendix. The tracking of a project assists in evaluating its progress in comparison with the plan. Hence, a firm may establish post-audit policies that include reconciliation of the

accounting books, which track revenues, costs, whereas project approval is based on cash flows and the time value of money using risk-adjusted discount rates. The post-audit process may not be able to capture all cash flows produced by a project as it may be difficult to isolate cash flows associated with a specific project from other projects of the firm.

NUMERICAL EXAMPLE

Consider the example of a hypothetical firm (“ABC Company”) that proposes investment in machinery equipment for the manufacture and sale of a new product. The financial analyst develops this proposal by working with subject market experts in other departments, including marketing, engineering, operations, economics accounting and finance. The analytical model is developed such that any changes in assumptions allow the necessary sensitivity or scenario analysis as changes take place numerous times during the proposal development stage as market conditions and management plans change. In this example, we construct the analysis in several steps; at each step, we discuss the assumptions and summarize the underlying analysis. In accordance with the firm’s guidelines, a risk-adjusted weighted average cost of capital of 10% is provided by the firm’s treasury department commensurate with the risk of the project. The firm requires a discounted payback period of four years or less.

Sales Forecast

The firm plans to invest in 2023 so that it can produce the final product for sale starting in year 2024. ABC’s marketing department hired an external market research firm to develop projections for the unit demand for the firm’s product and paid fees of \$500,000 in the year 2022. Table 1 summarizes the sales forecast.

TABLE 1

SALES FORECAST

(Thousands of units and dollars)	<u>2023</u>	<u>2024</u>	<u>2025</u>	<u>2026</u>	<u>2027</u>	<u>2028</u>
Sales in units		4,500				
Sales growth rate: year-over-year			10	5	-4	-6
Sales in units: sales in prior year times (1+ sales growth rate): Q		4,500	4,950	5,198	4,990	4,690
Sale price per unit (\$)		2.45				
Change in sale price: Year-over-year (%)			4.0	3.5	1.5	-2.0
Sale price per unit (\$): sale price per unit in prior year times (1+ change in sale price): P		2.45	2.55	2.64	2.68	2.62
Total sales: P times Q		11,025	12,613	13,707	13,350	12,303

According to Table 1, in the first year, unit sales are remarkably high. The growth rate in unit sales is 15% in the second year, which slows in the third year due to new entrants and competitors. Thereafter, the growth rate declines due to competitive products with new features and potentially superior technology. The change in sale price after the first year reflects the competitive nature of the industry and the firm’s attempts to keep up with the inflation rate though the actual inflation rate may be higher than the forecast.

Variable and Fixed Costs

Table 2 summarizes the variable and fixed costs associated with the production and sale of the product.

TABLE 2

VARIABLE AND FIXED COSTS

(Thousands of dollars)	<u>2023</u>	<u>2024</u>	<u>2025</u>	<u>2026</u>	<u>2027</u>	<u>2028</u>
Variable Costs						
Variable cost per unit (\$)	1.95					
Year-over-year change in variable cost per unit (%)		4.5	4.50	6.00	8.00	10.00
Variable cost per unit (\$)		1.65	1.72	1.83	1.97	2.17

Sales in units		4,500	4,950	5,198	4,990	4,690
Total variable costs		7,425	8,535	9,499	9,849	10,184
Fixed cost		1,050	1,050	1,050	1,050	1,050

The variable costs of production include direct labor and material, energy costs associated with production, freight costs for moving the product from the plant, packaging, and sales commission. The variable costs per unit already reflect the inflated costs of raw materials and supply chain issues due to COVID-19, and political situations in the world. The variable cost per unit in subsequent years are higher than the inflation rate in 2024 and increase at a faster rate in the latter years due to increase in demand for labor and raw materials related to intense competition. Fixed costs include administrative salaries, insurance, property taxes, rent, utility bills, and other fixed expenses. It does not include the depreciation expense.

Initial Capital Investment and Depreciation Expense

Table 3 summarizes the initial investment in the equipment and machinery, and the associated depreciation expenses and tax benefits

TABLE 3

INITIAL CAPITAL COSTS AND DEPRECIATION EXPENSE

(Thousands of dollars)	<u>2023</u>	<u>2024</u>	<u>2025</u>	<u>2026</u>	<u>2027</u>	<u>2028</u>	<u>2029</u>
<u>Initial Investment Cost</u>							
Equipment and machinery	-5,200						
Bonus depreciation (80%)	4,160						
Tax benefits of bonus depreciation (tax rate times bonus depreciation)	1,040						
Initial net investment	-4,160						
<u>Depreciation expense</u>							
Undepreciated property (Initial equipment cost less bonus depreciation)	1,040						
MACRS rates for depreciation expense for a 5-year property		0.2	0.32	0.192	0.1152	0.1152	0.056
Depreciation expense for the undepreciated property		208.00	332.80	199.68	119.81	119.81	60.0

The 1986 Tax Reform Act created the Modified Accelerated Cost Recovery System (MACRS), which includes guidelines that have six classes of assets, each with an assumed prescribed or “class” life and depreciation percentages or rates for each year of class life, and readily available on the IRS website. The depreciation percentage for each year in the MACRS system is applied to the original cost and increase in cost due to inflation is not allowed by the IRS. Note that this system uses a half-year convention; that is, the depreciation for each year is calculated based on an assumption that the asset is placed into production/service on July 1st. As a result, the depreciation expense spills over into the sixth year for a class of property with a 5-year life. This mid-year convention assumes that the cash outflows associated with the initial investment are distributed equally throughout the year, which works fine for this project and the industry in which it operates.

A firm maintains two sets of books. The first, tax books, are to comply with and derive benefits related to the IRS tax regulations. The second set is used for stockholder reporting, including quarterly and annual reports as per FASB accounting guidelines. A firm utilizes the MACRS table published by the IRS to calculate the accelerated tax depreciation expense but uses the straight line or other methods for calculating the book depreciation for

stockholder reports. The total depreciation of an asset is the same in both cases; however, by using the MACRS, the firm derives tax savings much earlier and, hence, the net benefit to the firm is the time value of money.

The U.S. Congress passed the Tax Cuts and Jobs Act (TCJA) of 2017 to spur new investment in plant, property, and equipment where part of the provisions will sunset over time. Specifically, regarding depreciation expense, the TCJA allows immediate 100% expensing of qualified assets placed into service after Sept. 27, 2017 and before Jan. 1, 2023. This “bonus” percentage declines to 80% after Jan. 1, 2023, and before Jan. 1, 2027. TCJA temporarily allows 100% expensing for business property acquired and placed in service after Sept. 27, 2017 and before Jan. 1, 2023. The 100% allowance decreases by 20% per year in taxable years beginning after 2022 and expires Jan. 1, 2027. After accounting for the 80% bonus depreciation for the undepreciated part of the PP&E, firms use the depreciation schedule prescribed by the IRS MACRS.

Net Operating Working Capital

Table 4 summarizes the investment in net operating working capital.

TABLE 4

INVESTMENT IN NET OPERATING WORKING CAPITAL

(Thousands of dollars)	<u>2023</u>	<u>2024</u>	<u>2025</u>	<u>2026</u>	<u>2027</u>	<u>2028</u>
Inventories	891	1,024	1,140	1,182	1,222	0
Accounts receivable		1,359	1,555	1,690	1,647	0
Net operating working capital	891	2,383	2,695	2,872	2,869	0
Change or additional/recovery of investment in net operating working capital	891	1,492	311	177	-3	-2,869

The net operating working capital is the difference between the current assets and the non-interest bearing current liabilities (NBCLs). The NBCLs include all current liabilities except interest-bearing debt, such as short-term bank loans, as it is a component of cash flow from investments and not from operations. The firm will acquire an inventory of raw materials prior to the production as its warehouse informed the project manager that though it has a stockpile of raw materials for other products, it does not have the necessary raw materials of this new product. Of course, the size of inventory prior to its sale will be based on the forecasted demand and, over time, the actual inventory will vary based on the actual sales of the product. The firm plans to sell its manufactured products on credit, which will lead to accounts receivable. The firm also plans to maintain a minimum cash balance for this project for any unforeseen cash investment in any other current assets.

The project team estimated that 12% of the variable expenses are related to building an inventory of the raw material to manufacture the products in the year prior to sales. Thus, 12% of the cash expense remains within the firm tied up in the inventory. Recall that firms record inventories at cost, therefore, the percentage is applied to variable expense also known as cost of goods sold. A part of the sales are credit sales; based on the firm's experience for other products, the analyst assumes that on average customers pay their bills by 45 days after they receive the invoice. Hence, these 45 days of sales amount $(45/365)$ times sales are treated as accounts receivable. All other working capital components remain the same. For instance, this firm always takes advantage of the discount offered by its suppliers to pay bills early. Most of its suppliers offer 2/10 net 30; that is, the payment is due within 30 days of the voucher but if the payment is made within 10 days, then the supplier provides a 2% discount. Therefore, the firm pays the bills within 10 days to qualify for the 2% discount. The cash conserved via delaying the bill payments for the 10 days is offset by cash bill payment following the 10 days so there is no change in accounts payable for the month or for the year. In the last year of the project, specifically the latter part of the last year, the firm does not plan to sell on credit and/or offer discounts for cash sales so that there are no accounts receivable at the end of the last year.

Note that the firm recovers the investment in inventories in 2023 from its 2024 sales. However, in 2024, once again the firm needs to invest in inventories for sales in year 2025. Similarly, the accounts receivable generated in the year of the sale are collected in the following year. For instance, the account receivables from the sale of products in 2026 are collected in the year 2027. Therefore, the year-over-year differences or changes in inventories and accounts receivables, i.e., any additions less any recovery, are the net additional investment in or recovery of net operating working capital. The change is positive during the initial few years of the project as the firm invests in inventories and accounts receivable, and the change is negative during the latter years as it recovers this investment leading to the disinvestment. Note the sum of these changes in net operating working capital is zero.

Terminal Cash Flow

When a firm sells PP&E, it must pay taxes on any gain. This gain is the difference between the salvage value or sale price less accumulated tax depreciation, also known as tax basis or tax-adjusted cost basis. Table 5 shows that this firm estimates the salvage value of \$535,000 after the end of the fifth year. The initial cost is \$5,200,000. The total accumulated depreciation of \$5,140,000 by the end of the fifth year is the sum of the bonus depreciation in year 2022 and the depreciation amounts during the period 2023 through 2027. Because the machinery is 94.4% depreciated by the end of the fifth year, the tax-adjusted basis is \$60,000, which results in a gain of \$475,000 and an after-tax salvage value of \$356,320.

TABLE 5

TERMINAL CASH FLOW

(Thousands of dollars)	<u>2023</u>	<u>2024</u>	<u>2025</u>	<u>2026</u>	<u>2027</u>	
Sale Price of Equipment						<u>2028</u> 535
Calculation of tax-adjusted basis:						
Initial investment in equipment						<u>5,200</u>
Accumulated tax depreciation						
(Bonus tax depreciation in year 2023 + sum of the tax						<u>5.14060</u>
depreciations for the years 2024–2028)						475
Tax-adjusted cost basis						<u>118.77</u>
Gain: Sale price less tax-adjusted basis						356.32
Taxes on gain (tax rate, 25% times gain)						
After-tax salvage value						

Opportunity Cost

Because the acceptance of a project may lead to opportunity costs, analysts treat these costs as cash flow in capital budgeting decisions. The firm was already negotiating an opportunity to rent its current vacant warehouse for \$100,000 a year to another firm located in the same manufacturing zone with an agreement to raise the rent 5% per year and the tenant will assume the responsibility for its maintenance. Note that the firm will continue to pay the property taxes with or without the renting the warehouse. But the use of the warehouse for this project will result in a potential loss of rental income and is an opportunity cost to the firm.

In addition, the firm plans to utilize existing equipment, which is fully depreciated and currently not in use. However, its deployment in this project will preclude the firm from selling this equipment net of taxes for \$250,000 in the marketplace and, therefore, is treated as an opportunity cost in this capital budgeting decision. This is summarized in Table 6.

TABLE 6

OPPORTUNITY COSTS

(Thousands of dollars)	<u>2023</u>	<u>2024</u>	<u>2025</u>	<u>2026</u>	<u>2027</u>	<u>2028</u>
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Opportunity cost due to loss of rental income		-100	-105	-110	-116	-122
Opportunity cost of using existing equipment	-250					

Sunk Cost

In the year 2022, prior to this capital budgeting analysis, the firm had hired a market research firm to study and estimate the size of the market by region and estimate the market size, potential demand, and market share for this product. The market research firm was paid \$200,000. In addition, an external consulting engineering firm was retained at a cost of \$100,000 to study recent developments in manufacturing processes within the industry and to make specific engineering design recommendations for the manufacturing equipment for this product.

Because these expenses were incurred prior to the capital budgeting analysis, these expenses are treated as sunk costs and are not included in this forward-looking incremental cash flow project analysis. If the project is accepted, then the firm will incur cash outflows for initial investment during 2023 and benefit from the cash inflows starting in 2024 and onwards.

Cannibalization or Externality

The product manager of the proposed new product estimates that acceptance of this project will lead to lower sales of an existing product in another business unit as customers will switch to the new product. In marketing, this is known as “cannibalization”; in economics, it is known as an “externality.” The product manager of that business unit estimates that it will lead to a reduction of \$200,000 per year in after-tax free cash flow as shown in Table 7. The analysis includes this potential loss of free cash flow in the project evaluation process.

TABLE 7**CANNIBALIZATION OR EXTERNALITY**

(Thousands of dollars)	<u>2023</u>	<u>2024</u>	<u>2025</u>	<u>2026</u>	<u>2027</u>	<u>2028</u>
After-tax reduction in cash flow due loss of sales in other product of the firm		-200	-200	-200	-200	-200

We now proceed to combine all financials components shown in Tables 1–7 in order to develop the free cash flow for the project and then calculate the financial performance measures as shown in Table 8.

TABLE 8**FREE CASH FLOW AND FINANCIAL PERFORMANCE MEASURES**

(Thousands of dollars)	<u>2023</u>	<u>2024</u>	<u>2025</u>	<u>2026</u>	<u>2027</u>	<u>2028</u>	<u>2029</u>
<u>Investments</u>							
Purchase of equipment	-4,160						
Opportunity cost of using existing equipment	-250						
Additional investments in or recovery of net operating working capital	<u>-891</u> <u>-5,301</u>	<u>-1,492</u> <u>-1,492</u>	<u>-311</u> <u>-311</u>	<u>-177</u> <u>-177</u>	<u>3</u> <u>3</u>	<u>2,869</u> <u>2,869</u>	
Total cash flow related to investments							

<u>Operating Income</u>							
Sales		11,025	12,61	13,70	13,35	12,30	
Variable costs		<u>7,425</u>	3	7	6	3	
Gross profit		3,600	<u>8,535</u>	<u>9,499</u>	<u>9,849</u>	<u>10,18</u>	
Fixed cost (without depreciation)		1,050	4,078	4,207	3,507	4	
Depreciation		<u>208</u>	1,050	1,050	1,050	2,119	<u>60</u>
Operating income or earnings before interest and taxes		2,342	<u>332.8</u>	<u>199.6</u>	<u>119.8</u>	1,050	-60
Income taxes @ 25% tax rate		<u>586</u>	2,695	8	1	<u>119.8</u>	<u>1-5</u>
Net operating income after taxes		1,757	<u>674</u>	2,958	2,337	1	-45
			2,021	<u>739</u>	<u>585</u>	950	
				2,218	1,753	<u>237</u>	
						712	

<u>Free cash flow</u>							
Net operating income after taxes		1,757	2,021	2,218	1,753	712	-45
Plus depreciation		<u>208</u>	<u>333</u>	<u>200</u>	<u>120</u>	<u>120</u>	<u>60</u>
Cash flow from operations		1,965	2,354	2,418	1,873	832	15
Purchase of equipment	-4,160						
After-tax salvage value						356	
Additional investments in or recovery of net operating working capital Cash flow from investments	-891 -5,051	<u>-1,492</u> -1,492	<u>-311</u> -311	<u>-177</u> -177	<u>3</u> 3	<u>2,869</u> 3,225	
After-tax opportunity cost due to loss of rental income from the warehouse		-100	-105	-110	-116	-122	
After-tax opportunity cost of using existing equipment	-250						
After-tax reduction in cash flow due to externality via loss of sales in other product of the firm		<u>-200</u>	<u>-200</u>	<u>-200</u>	<u>-200</u>	<u>-200</u>	
Cash flow related to opportunity costs and externalities	-250	-300	-305	-310	-316	-322	
Cash flow of the project	-5,301	172	1,737	1,931	1,560	3,736	15
Project performance measures							
NPV (\$)	1,032						
IRR (%)	16.1						
Profitability index	1.21						
Payback period (years)	2.84						
Discounted payback period (years)	3.10						
MIRR (%)	13.6						

The free cash flow (FCF) is the sum of the cash inflow from operations, which, in turn, is the sum of the net operating profit after taxes and the depreciation for the years 2024 onwards. Note that to calculate the net operating profit after taxes, we subtract the depreciation expense. However, depreciation is a noncash expense, so we add

back the depreciation expense to derive the after-tax “cash” portion of the operating income. Next, we add the cash outflow related to the initial investment, which occurs in the year 2023. Finally, we incorporate cash flow impact related to opportunity costs and externalities. This results in a free cash flow stream of cash with cash outflow in the year 2023 followed by cash inflow during the life of the project. Using the risk-adjusted weighted average cost of capital of 10% for this project, we calculate the net present value (NPV) of \$1.032 million. We also calculate the internal rate of return for the project (16.1%), the profitability index or the benefit to cost ratio (1.21), the simple payback period (2.8 years), and the discounted payback period (3.1 years). We also calculate the modified internal rate of return (MIRR) (13.6%) for the project. We observe that NPV is positive and both the IRR and MIRR exceed the cost of capital of 10%. Finally, the discounted payback period for the project is less than the firm’s required fouryear discounted payback period. Therefore, we recommend the acceptance of the project. Upon completion of this analysis, the financial analyst will a prepare project executive summary as shown in the Appendix and, as discussed earlier, the necessary documentation for approval and consolidation process.

CONCLUSION

Financial academic literature and textbooks discuss evaluations of capital projects and identify and discuss issues in estimating project cash flows and provide examples. However, implementation of these techniques within a firm requires a disciplined approach with uniform and comprehensive evaluation standards and guidelines throughout the organization to ensure timely consolidation across hundreds of projects within each of the business units for submission and approval. Then, the process is repeated at the corporate headquarters for consolidation of these business units’ capital projects at the corporate level for submission to the senior management, which includes a series of reviews, revisions, and reconsolidations conducted prior to submission to the board of directors for their final approval of the capital budget. The team needs to execute all above activities at the business unit and corporate levels within the deadlines prescribed in the planning calendar.

In this article, we provide insights into implementation issues in capital project evaluations within a firm. To that end, first we discuss the project evaluation and authorization guidelines, including the data collection and evaluation processes, and their consistency with the firm’s strategic objectives. We then discuss the economic and financial valuation model, which includes the financial benefits of the project, incremental cash flow analysis, and types of project evaluations. The critical factors include variable costs and the fixed costs, depreciation, opportunity cost, sunk costs, and costs related to cannibalization. Furthermore, our discussion includes insights into the recycled fixed assets and recent tax laws, specifically how tax changes affect the computation of tax-depreciation. Next, we discuss the data requirements and collection process within a firm, and the standardized documentation for submission to obtain the necessary approval. We illustrate our approach with a detailed numerical example via a stepped financial analysis model. At each step, we identify a component of the cash flow, discuss the assumptions, and calculate its value. This approach simplifies the evaluation process, enhances the ease of its development, and facilitates sensitivity analyses. Finally, this modular approach enables consolidation of projects both at the business unit and corporate levels.

We hope that future research in financial analysis will further enhance this capital budgeting evaluation process, and lead both students and practitioners to better understanding and appreciation of the evaluation process.

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