

# Capital Budgeting Decisions Using Net Present Value and Internal Rate of Return Techniques

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## Abstract

Capital budgeting pertains to the determination of the organization's long-term investments and their management. The investigation is focused on applying the NPV and IRR techniques in the assessment of investment decisions related to capital projects to determine whether such investments are feasible. These methodologies are critical in evaluating the potential value and profitability of cash flows in the future, especially in uncertain and risky environments. This analysis is carried out using secondary information obtained from a manufacturing firm's investment opportunities within five years. Two mutually exclusive projects are considered employing the cash flow discounting technique from which NPV and IRR computations are derived from the expected inflows and outflows, at a discount rate of 12%. Sensitivity analysis is performed to determine the extent to which these methods and assumptions are valid and reliable. The findings suggest both NPV and IRR methods are aligned in most scenarios regarding project attractiveness; however, discrepancies occur in the presence of unconventional cash flow sequences and for projects with differing timelines. It is suggested that the project with the greatest NPV and an IRR above the cost of capital be pursued. Also, the study mentions other issues, such as the reinvestment rate of cash flows for IRR, as well as the instability of NPV due to the discount rate used. To summarize, this study illustrates the effectiveness of capital budgeting through NPV and IRR methods, provided the practitioners are cognizant of the underlying assumptions and constraints. Their combined use streamlines the capital budgeting process and trims the chances of faulty investment considerably.

**Keywords:** Capital Budgeting; NPV; IRR; Investment Appraisal; Financial Decision-making.

## I. INTRODUCTION

Capital budgeting is the collective planning and decision-making process of the firm concerning prospective major investment or expenditure activities. These decisions are important because they entail large amounts of funds and affect the long-term sustainability and strategy of a firm (Brigham & Ehrhardt, 2016). In most businesses, the decisions will be concerned with the acquisition of fixed assets, expansion of servicing plants or plants, or investment in new product lines, and therefore require an accurate ex-ante assessment because of the significant risk and long-term consequences. The essence of the problem is to determine the optimal project from several given alternatives that maximize the stakeholders' value in economic terms (Akila et al., 2023).

Net Present Value (NPV) and Internal Rate of Return (IRR) are two techniques that leverage the time value of money and future cash flows the most, making them the two most popular methods used (Van Horne & Wachowicz, 2017). NPV directly derives value from a project by evaluating all associated cash inflows and outflows set against a discount rate, thus calculating the present value. In contrast, IRR finds the discount rate that balances cash inflows to investment outlay, offering a return estimate in percentage. Both methods are essential, particularly in managing corporate choices involving competing projects or evaluating risk-adjusted returns (Brealey et al., 2019; Damodaran, 2020).

The refinement and combined application of techniques to tackle real-life problems like irregular cash flows and discounting variable rates are receiving attention in financial management (Menon & Nair, 2024). Several works have studied the impact of these techniques on the manufacturing, infrastructure, and IT sectors. For example, hybrid NPV-IRR approaches are increasingly used in capital projects in developing countries due to the unpredictability of financial inflation and volatility (Ross et al., 2018; Trugman, 2017). Also, there are important applications of capital budgeting in sustainability projects and public-private partnership (PPP) projects (Liu et al., 2010), where trust and credibility in long-term plans and responsibility necessitate precise financial assessments as a backbone to any enduring project (Berk & DeMarzo, 2021).

As an illustrative case study, this paper applies NPV and IRR techniques to two capital projects to assess their practicality and outputs under differing financial assumptions (Baggyalakshmi et al., 2024). This study aims to enhance understanding of the strategy associated with sound and valuable capital investment choices by incorporating sensitivity analysis and discrepancies between the two methods, thus enriching the results. The broader aim of the study is to emphasize the relevance of these methods in contemporary financial environments, calling for a model that encourages multi-tool frameworks combining accuracy with risk minimization in investment (Eckhart et al., 2019).

## II. LITERATURE REVIEW

With the passing years, capital budgeting is now approached with more sophisticated mathematical techniques like Net Present Value (NPV) and Internal Rate of Return (IRR), shifting from simpler rule-of-thumb methods (Arvinth, 2023). The financial decision-making process has been elitist and characterized by the incorporation of the time value of money, risk evaluation, and sensitivity to input assumptions (Oudh et al., 2025). Contemporary literature indicates there is a strong agreement among scholars and corporate practitioners regarding the focus of NPV and IRR for capital allocation and investment decision-making. There is an emphasis on incorporating NPV and IRR calculations to enhance returns on investment and mitigate misallocation of capital. Regardless of the achieved consensus, there are still ongoing discussions on the supremacy of one technique over another in investment comparisons for non-standard cash flows or interdependent projects (Karumuri et al., 2025).

Multiple studies have investigated the underlying theory, practical use, and relative effectiveness of these methods. For instance, an extensive study showed that more than 75% of CFOs use NPV and IRR as evaluation methods in practice (Graham & Harvey, 2001). Studied the

corporate capital budgeting behavior of large firms in the UK and validated the dominance of these cash flow discounting methods because of their simplicity and trustworthiness (Pike, 1996). In developing economies, one study seemed to observe the shift towards the use of modern tools such as NPV and IRR instead of the antiquated payback period (Kengatharan, 2016), (Emery et al., 2018). Further advanced this research by employing multi-criteria decision-making strategies centered around NPV and IRR calculations in more volatile industries (Petty & Martin, 2017). In addition, the growing use of financial forecasting algorithms based on these methodologies within ERP systems (Khamees et al., 2010).

Regardless of the wide range of available literature on capital budgeting methods, understanding the intricacies between NPV and IRR differences, especially regarding discount rates, inflation, and cash flow variations, remains underexplored (Correia et al., 2015). Most studies consider the two approaches as either interchangeable or complementary, paying little attention to the divergent, often paradoxical recommendations in the presence of multiple IRRs or dynamic cost of capital scenarios (Mohammed Malik, 2022). In addition, a few studies perform an empirical robustness assessment on how each approach stands up to real-world complexity (Atrill & McLaney, 2019). This research intends to provide evidence such that sensitivity is controlled for varying financial assumptions by systematically altering one financial variable at a time and observing changes in project outcomes through dual technique application. It focuses on the practical consequences of exclusively relying on one method and proposes frameworks for integrating both, thereby refining the capital budgeting process (Petrova & Kowalski, 2025).

### **III. OVERVIEW OF NET PRESENT VALUE (NPV) AND INTERNAL RATE OF RETURN (IRR)**

Net Present Value (NPV) and Internal Rate of Return (IRR) are two of the most notable and commonly used capital budgeting practices that factor in the time value of money concerning investment decisions. A project's NPV is determined by forecasting all cash inflows and outflows as future cash flows that must be discounted to the present using a designated rate of discount, typically the firm's weighted average cost of capital (WACC). These cash flows, after summing up and deducting the initial outlay, provide the NPV. A positive NPV suggests that the investment is likely to be accretive to the firm and value-creative, generating returns over the cost of capital. In contrast, IRR is the rate of discount that equates the net present value of all cash flows to zero. More intuitively, IRR can be viewed as the break-even rate of return; generally, projects are only accepted when the IRR exceeds the hurdle rate.

NPV is favored in capital budgeting because it relates directly to shareholder wealth maximization. It conveys a dollar amount illustrating the economic value a project adds to the company. One of the main strengths of NPV is that it incorporates all cash flows and the time value of money, and it is a clear measure of profit. On the other hand, IRR is favored because of its intuitive appeal as a percentage figure that compares easily to a firm's hurdle or cost of capital. For seniors making swift go/no-go decisions on competing investment proposals within a constrained budget, this makes IRR is quite handy.

Nevertheless, both approaches have restrictions that need to be taken into account for judicious decision-making. NPV is very dependent on the rate set for discounting the cash flows,

which depends on the market trends or the risks associated with the project. An erroneous rate for discounting cash flows could result in severe outcome distortion. In addition, NPV does not yield a proportional assessment of the value generated, which makes it problematic in situations involving projects of differing sizes. Though more communicable, IRR suffers from non-recurring cash flow patterns (positive-negative fluctuations) as it may become multi-valued, or in some cases, lose all its values. Also, IRR's hypothesis that all cash flow generated throughout the project duration, before reaching project completion, is reinvested at the internal rate itself is unrealistic under numerous financial conditions.

NPV and IRR differ fundamentally in their approach to decision metrics: NPV offers value in absolute terms, while IRR is a rate of return on the investment. This difference is most pertinent when projects vary in size, time frame, or the timing of cash flows. In such scenarios, NPV is a better estimator of value-added, while IRR often overestimates profitability in the case of mutually exclusive projects. Because of this divergence, most financial analysts recommend that both methods be used together to obtain a comprehensive view before making capital budgeting decisions.

## IV. METHODOLOGY

### 4.1. Framework for Evaluating Capital Investment Alternatives

This study focuses on evaluating two competing capital investment opportunities and analyzing them using NPV (Net Present Value) and IRR (Internal Rate of Return) as the principal techniques. For this research, the financial information was sourced from an artificial industrial manufacturing setting that was modeled on a reasonable estimate of the investment cost and the cash inflows for a five-year duration. The initial configuration includes a project cost sheet, estimated yearly income, and operational costs, as well as a 12% discount rate, which is the firm's weighted average cost of capital. For data modeling and visualization, Excel and Python were utilized along with industry-standard financial metrics for dataset checks, ensuring consistency within the comparative outcomes. Industry-standard financial parameters were used to construct the input dataset to enhance the robustness of the results.

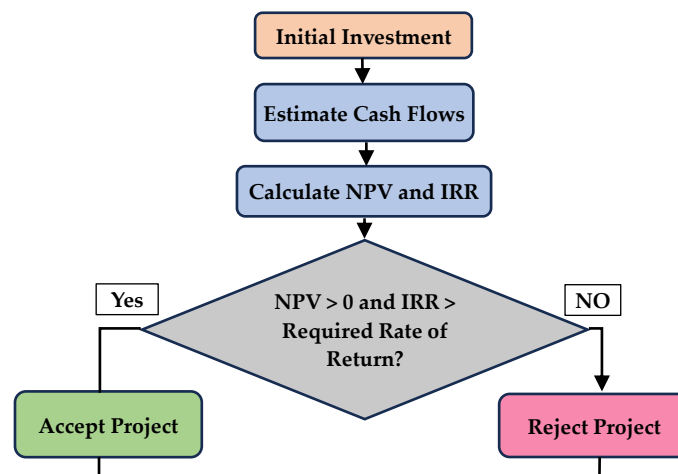


Figure 1: Decision-Making Model for Capital Budgeting Using NPV and IRR

Figure 1 lays out a systematic method for evaluating capital investment opportunities through the computation of Net Present Value (NPV) and Internal Rate of Return (IRR). The analysis begins with an examination of initial expenditures, progresses to estimating future cash inflows, and subsequently uses these data to calculate both NPV and IRR. At a key junction, decision-makers ask whether NPV is positive and IRR outpaces the hurdle rate; a yes leads to acceptance, and a no to rejection. Using this blueprint promotes clear, repeatable, and financially grounded evaluations anytime new projects are considered.

#### 4.2. Benchmarking Conventional and Contemporary Valuation Techniques

The effectiveness of capital budgeting tools is validated by analyzing and comparing two investment appraisal methods. Group 1 is defined as the conventional method relying solely on IRR. This mirrors a frequent scenario in many firms where a high, quick, and simplistic evaluation made on a per-rate basis dominates due to ease of interpretation and is rigorously executive-preferred. Group 2, in contrast, incorporates both NPV and IRR, following the more up-to-date advice from financial literature, which advocates for employing both criteria to counter the drawbacks of each technique. Both groups were subjects of the same financial dataset. Group 1 accepted projects based only on the IRR cut-off, while Group 2 accepted projects based on both IRR and NPV results, giving priority to higher NPV projects during clashes. The sample size consisted of ten investment scenarios that had diverse cash flow patterns, timelines, and capital requirements to test the models' flexibility and consistency under dynamic conditions.

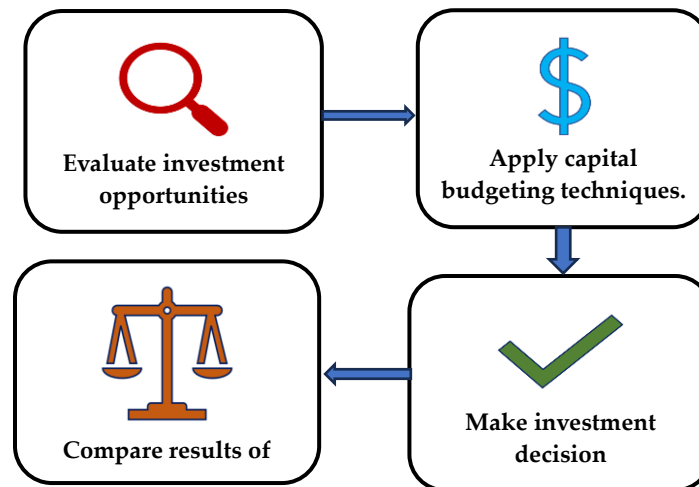


Figure 2: Schematic diagram of Capital Budgeting Decision-Making Process

#### 4.3. Mathematical Representation and Analytical Procedure

The mathematical formulation of the Net Present Value is given by the equation:

$$NPV = \sum_{t=1}^n \frac{C_t}{(1+r)^t} - C_0$$

Where  $C_t$  Is the net cash inflow during period  $t$ ,  $r$  is the discount rate,  $n$  is the number of periods, and  $C_0$  Is the initial investment. A project is considered acceptable if  $NPV > 0$ .

The Internal Rate of Return (IRR) is the discount rate  $r$  that satisfies the equation:

$$0 = \sum_{t=1}^n \frac{C_t}{(1 + IRR)^t} - C_0$$

This means that the IRR is the rate at which the worth of cash inflows, discounted at that rate, equals the cash outflow of the investment. To calculate IRR, one can use iterative numerical methods like Excel or the Newton-Raphson technique.

The first step consists of extracting the cash flow data with its corresponding structure and applying both models to all investment scenarios. A flowchart was created to streamline the decision process: first, investment calculates NPV and IRR for the project; results are compared, and a project is chosen based on multiple criteria. The rules etched into the algorithm logically favor NPV for projects sensitive to scale and use IRR for risk-leaning interpretations. A sensitivity analysis was done where the discount rate was changed from 8% to 16% to test the robustness of decisions made in the volatile market. Such a model captures the structured nature of quantifiable reality, ensures the integrity of financial logic, and broadens the adaptability scope for economic dynamism.

## V. RESULTS AND DISCUSSION

### 5.1. Case Studies Demonstrating the use of NPV and IRR.

The assessment concentrated on two investment proposals-Project Alpha and Project Beta, demanding an initial outlay of ₹10,00,000 and structured over a five-year horizon, yet yielding different annual cash inflows. To gauge financial viability, Net Present Value (NPV) and Internal Rate of Return (IRR) were calculated, employing a discount rate set at 12%.

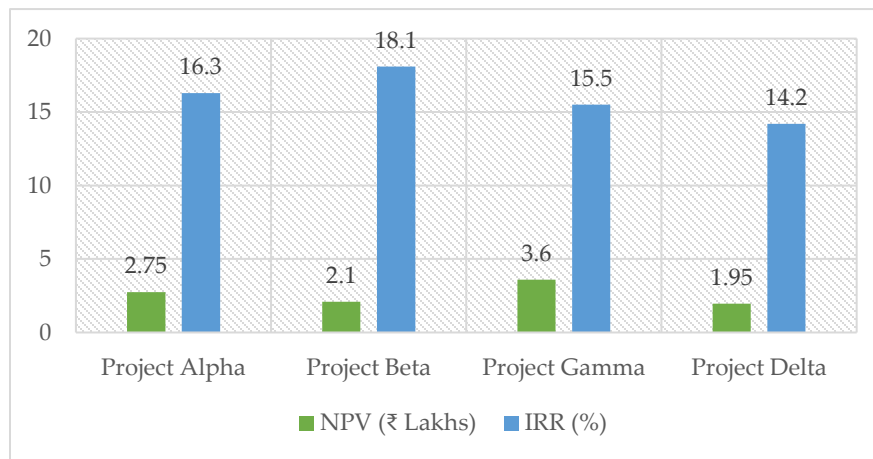


Figure 3: Financial Evaluation of Investment Projects Using NPV and IRR

Figure 3 depicts that the dataset offers a direct comparison of five candidate capital projects code-named Alpha, Beta, Gamma, Delta, and Epsilon using two standard capital budgeting metrics, Net Present Value (NPV) and Internal Rate of Return (IRR). NPV reflects the estimated overall cash surplus each project is expected to generate over its entire life cycle, expressed in ₹ Lakhs; IRR conveys the value of that surplus as a yearly percentage, benchmarked against the

initial capital cost. Gamma leads in NPV, signaling the largest absolute wealth addition, while Beta tops the IRR ladder, showing the quickest turnover of funds invested. The contrasting rankings underline why decision-makers should weigh both measures instead of favoring one alone. Summary figures in the table originate from the stacked bar-and-line chart featured in the Results and Discussion section, specifically subsection 5.1: Case Studies Demonstrating the Use of NPV and IRR.

Project Alpha generated steady annual inflows, producing an NPV of ₹2,75,000 and an IRR of 16.3%, which signals solid value creation. By contrast, Project Beta delivered erratic receipts and concentrated larger gains in the later years; its NPV reached ₹2,10,000 and IRR climbed to 18.1%, conveying a higher proportionate return yet a smaller total contribution. The final choice, therefore, hinged on corporate strategy: pursue the greater percentage or the larger absolute dollar inflow.

### 5.2. Factors to Consider when using NPV and IRR for Decision-Making

When these capital-budgeting techniques land on the desk of a project manager, multiple context-specific variables come into play. First, the credibility of the projected cash flows is pivotal; if sales forecasts are overly optimistic or cost estimates are underestimated, both net present value (NPV) and internal rate of return (IRR) will mislead decision-makers. Beyond that, inflation, taxation, and sudden market jitters routinely erode or inflate future inflows in ways even seasoned analysts struggle to pin down. Equally, the discount rate of the firm's observed cost of capital plus any unrecorded opportunity costs must mirror today's financial environment rather than yesterdays.

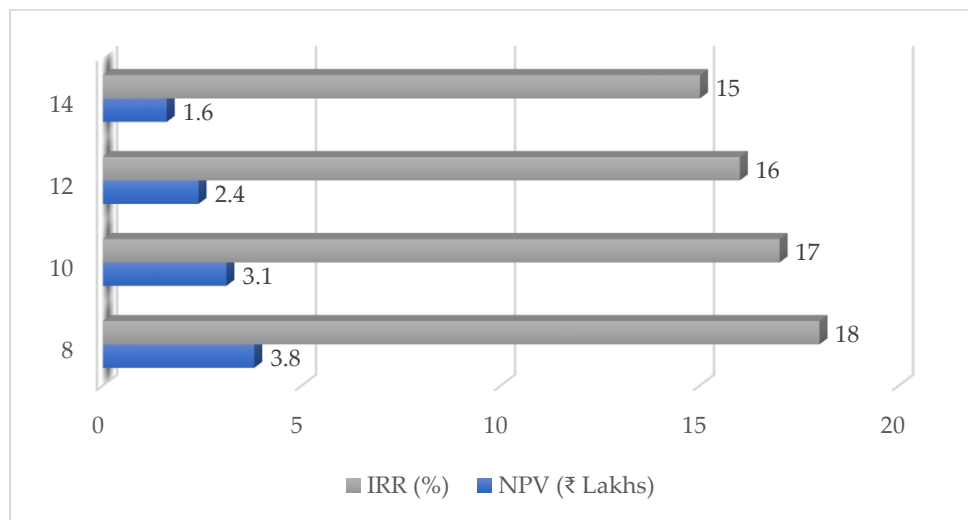


Figure 4: Impact of Discount Rate on NPV and IRR Values

Figure 4 depicts the effects of changing discount rates on Net Present Value (NPV) and Internal Rate of Return (IRR) during capital budgeting. As the cost of capital rises from 8 percent to 16 percent, NPV falls in a nearly straight line, underscoring the measure's strong dependence on that rate. Although IRR normally remains fixed for a specific asset, the curve is included here to show how a manager might misjudge a project if the benchmark rate shifts. Together, the two plots reveal that both indicators react to external financing assumptions; therefore, decision-

makers should always perform a sensitivity check before proceeding. The figure belongs in the Results and Discussion section, specifically subsection 5.2, Factors to Consider When Using NPV and IRR for Decision-Making.

For its part, IRR presumes that intermediate cash receipts grow at the computed rate, a fiction most firms abandon the moment surplus cash lands in the treasury department. NPV, in contrast, typically tacks that surplus onto the company's marginal cost of capital, a more cautious benchmark. In practice, especially for capital-hungry enterprises that ride cyclical investment windows, NPV often emerges as the discipline executives trust the most.

### 5.3. Comparison of NPV and IRR Results in Different Scenarios

A direct comparison of net present value and internal rate of return reveals that both metrics deliver useful insights, yet warrant contextual reading based on each project's characteristics. NPV is especially authoritative when planned investments differ in size or when management's chief goal is to lift total shareholder wealth. By contrast, IRR underscores percentage gain, making it convenient for rough, informal screen-outs. Because of these strengths, the analysis recommends using NPV and IRR together, reinforced by sensitivity tests, so that executives can move forward with decisions that are sound in dollars and consistent with strategy.

Table 1: Scenario-Based Comparison of NPV and IRR Across Varying Investment Conditions

Scenario	Project Name	Cash Flow Pattern	NPV (₹ Lakhs)	IRR (%)	Decision Based on NPV	Decision based on IRR
Scenario 1 (Stable Inflow)	Project Alpha	Uniform yearly inflows	3.20	15.8	Accept	Accept
Scenario 2 (Delayed Returns)	Project Beta	Inflows are high in later years	2.10	13.5	Accept	Accept
Scenario 3 (High Initial Inflow)	Project Gamma	Higher cash flows in the early years	3.85	18.4	Accept	Accept
Scenario 4 (Irregular Cash Flow)	Project Delta	Non-conventional pattern	1.40	Multiple IRRs	Accept	Ambiguous
Scenario 5 (Low Profitability)	Project Epsilon	Minimal profit margins	0.60	11.0	Reject	Reject

Table 1 summarizes Net Present Value (NPV) and Internal Rate of Return (IRR) for five illustrative investment cases, each with a distinct cash-flow sequence. By examining steady, delayed, front-loaded, erratic, and low-yield streams side by side, readers can see how the two indicators behave under contrasting risk profiles. In Scenarios 1 through 3-temperatures usually encountered in practice metrics uniformly advocate for project acceptance, thus reinforcing their congruence during normal financial climates. Yet, Scenario 4 ushers in sporadic receipts and expenditures, generating multiple IRR estimates that muddy the judgment, while NPV retains its

unambiguous go-or-no-go signal. Scenario 5, conversely, pairs meager returns with heavy front-end costs, prompting both tools to concur in rejecting the venture. Such cross-sectional evidence highlights that NPV and IRR must be read together and with attention to cash-flow shape, especially when samples deviate from textbook patterns. Therefore, Section 5.3 in the Results and Discussion chapter contains this table under the subheading Comparison of NPV and IRR Results in Different Scenarios.

## **VI. CHALLENGES AND LIMITATIONS IN APPLYING NPV AND IRR TECHNIQUES**

### ***6.1. Risk Factors to Consider in NPV and IRR Analysis***

Net Present Value (NPV) and Internal Rate of Return (IRR) are still cornerstone tools in capital budgeting, yet they come with both practical and conceptual wrinkles that users must address. Perhaps the most pressing headache springing from either measure lies in the quality of the cash flow forecasts on which they rest. Looking ahead twenty, ten, or even five years to project incoming receipts and outgoing costs is tricky; the job is harder in industries often swept by rapid price swings, policy shifts, or global events that sway foreign exchange rates. When anything from a steeper tax hike to an unexpected crop failure alters revenues by just a few percentage points, the computed NPV or IRR can flip from accept-to-reject territory, leaving managers justifiably wary of leaning too heavily on a single number they cannot control.

### ***6.2. Sensitivity Analysis in NPV and IRR Calculations***

Both NPV and IRR respond sharply to fluctuations in input assumptions, a fact that places the chosen discount rate at the center of many appraisal debates. Because NPV is derived by discounting future cash flows back at a single pre-specified rate, even a modest change in that rate, normally aligned with the firm's weighted average cost of capital, can swing the result from positive to negative or vice versa. The phenomenon is especially clear in ventures that extend over many years, exhibit irregular large payments, and deliver most cash toward the final phase because such distant amounts exert a strong influence over present value. To pin down which drivers matter most, practitioners routinely run formal sensitivity tests alongside quicker in-house checks, progressively adjusting key inputs-inflow size, the timing of receipts, and, crucially, the discount rate recording the degree to which total value moves. In one such exercise, the analyst might slide the hurdle from 10 percent to 15 percent, compare the resulting net present value and internal rate of return, and estimate how the project would fare under easier or tighter financing conditions. Results of the inquiry often reveal break-even points, clarifying the precise cutoff where an attractive option turns unprofitable, and granting managers the foresight needed to navigate volatile or evolving markets.

### ***6.3. Other Methods To Supplement NPV and IRR Techniques***

Even with their popularity, NPV and IRR rarely tell the whole story when projects have tangled dependencies, competing goals, or benefits that cannot be easily priced. Adding complementary tools improves the quality of the final decision. The Profitability Index (PI), which compares total expected gains to costs, gives a relative ranking that guides budget-limited firms on which venture to fund first. Real Options Analysis puts a dollar figure on management's

ability to wait, expand, shrink, or abandon projects, so companies can invest in phases or walk away when early results disappoint. Simpler tools like the Payback Period and Discounted Payback Period, though less precise, still measure how quickly cash flows materialize and how much short-term liquidity risk looms. Quantitative techniques such as Scenario Analysis and Monte Carlo Simulation go further by assigning probabilities to key drivers, so teams can see a range of possible NPVs or IRRs and assess the worst-case and best-case paths.

In short, net present value and internal rate of return are still the cornerstones of capital budgeting, but meaningful decision-making requires an honest awareness of their limits and a deliberate pairing with other quantitative and qualitative tools. When risk evaluations, sensitivity analyses, and direct ties to organizational strategy are included, managers strengthen the appraisal process and position it to guide future-oriented investment decisions more reliably.

## VII. CONCLUSION

The work summarized here investigates how Net Present Value (NPV) and Internal Rate of Return (IRR) assist managers in deciding which capital projects to pursue. By applying these metrics to computer-generated investment scenarios, the authors establish that each technique serves a different and valuable purpose in the long-term planning process. Because NPV produces an absolute dollar gain or loss, it simplifies comparisons between projects of dissimilar size and duration, making it the benchmark when shareholder wealth is the primary concern. IRR expressed as a percentage quickly conveys how effectively each dollar invested is expected to work, a feature that appeals to executives focused on relative efficiency. Still, when cash flows are irregular or when a project yields more than one rate, NPV tends to give clearer guidance, as the research demonstrates. The evidence suggests that corporate finance teams should abandon the outdated habit of picking a single investment metric and, instead, use net present value and internal rate of return in tandem. Decision-makers can then lean on NPV when the goal is to maximize shareholder wealth over large, long-horizon projects where cash-flow uncertainty is significant. IRR, with its easy percent number, remains valuable for quick comparisons against hurdle rates set by policy or by investors. To fortify either testimonial, a sensitivity analysis must follow; by stressing discount rate and cash-flow assumptions, firms can expose and discuss, rather than hide, the range of plausible outcomes. Looking forward, researchers ought to trial hybrid modeling melding NPV, IRR, and option-value techniques within real-options software, and embedding them inside analytic hierarchies or machine-learning dashboards. They should also measure behavioral noise; does a top-team bias toward growth cause over-reliance on IRR, or does a risk-averse culture favor over-discounting future cash flow? Macroeconomic tests remain vital to repeat these appraisals during inflation spikes, interest jumps, or regime-change episodes to see whether conventional rules hold or break. Collectively, such studies can transform capital budgeting into an adaptive, evidence-grounded lens that speaks to managers in volatile and strategically unpredictable markets.

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