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CAPITAL BUDGETING APPLICATION IN ENTERPRISE MANAGEMENT

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The Given article is devoted to the application of process of capital budgeting in enterprise management. In the article the concept of capital budgeting is determined, the classification of capital projects is given, examples of calculation of a payback period, NPV, IRR are brought. At the same time there are described the advantages and disadvantages of the given methods, the problem of multiple search of IRR and an answer to to the question: why the methods NPV and IRR can lead to inconsistent ranging of analyzed capital projects.
Keywords: *capital, budgeting, investments, investment project, capital investment, cash flow, payback period, net present value, internal rate of return.*

UTILIZAREA BUGETULUI DE CAPITAL ÎN GESTIUNEA ÎNTREPRINDERII
În articol se descrie aplicarea procesului de bugetare a capitalului în managementul companiei. Se dă definiția conceptului de bugetare a capitalului, se face clasificarea proiectelor de capital, se aduc exemple de calcul al perioadei de recuperare a investiției, VNA şi RIR. Concomitent, sunt descrise avantajele şi dezavantajele acestor metode, este analizată problema căutării multiple a RIR şi se caută răspuns la întrebarea: de ce metodele NPV şi IRR pot duce la rezultate diferite în analiza proiectelor capitale.
Cuvinte-cheie: *capital, bugetare, investiții, proiect investițional, investiții de capital, flux de numerar, perioadă de recuperare a investiției, valoare actualizată netă, rată internă de rentabilitate.*

Capital budgeting is the process of determining and selecting the most profitable long-term (greater than one year) projects. Capital budgeting is the process of planning expenditures on assets whose cash flows are expected to extend beyond one year.

For a number of good reasons, capital budgeting may be the most important responsibility that a financial manager has. First, since a capital budgeting decision involves the purchase of a long-term asset with a life of many years, the firm sacrifices some degree of flexibility in terms of being *locked in* for the duration of the asset's life. Second, an acquisition of an asset to expand operations is based on its expected future revenues, so a decision to buy an asset will require forecasts of revenue over the asset's life. Finally, a firm's strategic plan is defined by its capital budgeting decisions.

Capital projects may be classified as follows:

- *Replacement* decisions to *maintain the business* are normally made without detailed analysis. The only issues here are whether the existing operations should continue and, if so, should the same procedures or processes be maintained.
- *Replacement* decisions for *cost reduction* purposes determine whether equipment that is obsolete, but still usable, should be replaced.
- *Existing product or market expansion* involves a complex decision-making process since it requires an explicit forecast of future demand. A very detailed analysis is required.
- *New products or markets* development also involves a complex decision-making process that will require a detailed analysis.
- *Mandatory investments,* such as safety-related and/or environmental projects, often accompany new revenue-producing projects.

Further distinctions among capital investment opportunities are whether the projects are mutually exclusive or independent.

- *Mutually exclusive* means that only one project in a set of possible projects can be accepted.
- *Independent projects* are projects that are unrelated to each other. If you have unlimited funds, you may accept or reject any combination of independent projects.

Calculate and interpret payback period, net present value (NPV), and internal rate of return (IRR), and evaluate capital projects using each method.

The **payback period** (PBP) is the number of years it takes to recover the initial cost of an investment.

Example: **Payback period**

Calculate the payback periods for the two projects that have the cash flows presented in Table 1. Note the year 0 cash flow represents the net cost of each of the projects.

Table 1

Expected Net After-Tax Cash Flows

Year (t)	*Project A*	*Project B*
0	-2,000	-2,000
1	1,000	200
2	800	600
3	600	800
4	200	1,200

Note that the cumulative net cash flow (NCF) is just the running total of the cash flows at the end of each time period. Payback will occur when the cumulative NCF equals zero. To find the payback periods construct a table like Table 2.

Table 2

Cumulative Net Cash Flows (in dollars)

	Year (t)	*0*	*1*	*2*	*3*	*4*
Project A	Net cash flow	-2,000	1,000	800	600	200
	Cumulative NCF	-2,000	-1,000	-200	400	600
Project B	Net cash flow	-2,000	200	600	800	1,200
	Cumulative NCF	-2,000	-1,800	-1,200	-400	800

The payback period is determined from the cumulative net cash flow table as follows:

$$\text{payback period} = \text{full years until recovery} + \frac{\text{unrecovered cost at the beginning of the last year}}{\text{cash flow during the last year}}$$

payback period A = 2 + (200/600) = 2.33 years

payback period B = 3 + (400/1200) = 3.33 years

Generally speaking, the shorter a project's payback, the better. To decide which project(s) to accept, the firm must first establish a benchmark payback period. Presume that the firm requires a payback period of three and a half years.

Decision rule: payback < the benchmark payback, accept the
project payback > the benchmark payback, reject the project

If A and B are *independent,* accept project A and project B.

If A and B are *mutually exclusive,* then A would be accepted over B.

The main drawback of the payback period is that it ignores the *time value of money.* The payback period ignores cash flows beyond the payback period. This means terminal or salvage value wouldn't be considered. Benefits: The payback period is a good measure of project liquidity and riskiness.

The net present value (NPV) method relies on *discounted cash flow* (DCF) analysis.

The first step in NPV analysis is to find the present value of each cash flow discounted at the project's cost of capital. This assumes that the cost of capital has been adjusted for risk.

Next, we must compute the NPV, which equals the sum of these discounted cash flows (note that CF_0 is a negative cash flow, the project's initial cost):

$$NPV = CF_0 + \frac{CF_1}{(1+k)^1} + \frac{CF_2}{(1+k)^2} + \cdots + \frac{CF_n}{(1+k)^n} = \sum_{t=0}^{n} \frac{CF_t}{(1+k)^t}$$

The NPV is the amount of cash flow (in present value terms) that the project generated after repaying the invested capital (project cost) and paying the required rate of return on that capital. A positive NPV project increases shareholder wealth, and a negative NPV project decreases shareholder wealth.

For *independent* projects, the *NPV decision rule* is to accept the project if NPV > 0. For *mutually exclusive* projects, choose the one with the higher NPV, as long as its NPV is greater than 0.

***Example:* NPV analysis**

Using the projects described in Figure 1, compute the NPV of each project's cash flows and determine which project should be accepted if: (1) the projects are independent, and (2) the projects are mutually exclusive.

$$NPV_A = -2000 + \frac{1000}{(1.1)^1} + \frac{800}{(1.1)^2} + \frac{600}{(1.1)^3} + \frac{2000}{(1.1)^4} = 157.64$$

$$NPV_B = -2000 + \frac{200}{(1.1)^1} + \frac{600}{(1.1)^2} + \frac{800}{(1.1)^3} + \frac{1200}{(1.1)^4} = 98.36$$

Decision rule: If projects A and B are independent, accept both. If projects A and B are mutually exclusive, A has the higher NPV and would, therefore, be accepted.

The internal rate of return (IRR) is the rate of return that equates the present value of a project's estimated cash inflows with the present value of the project's costs. That is, IRR is the discount rate that makes the following relationship hold:

PV (inflows) = project cost in present value terms

Alternatively, the IRR may also be defined as the rate of return for which the net present value of a project is zero.

$$NPV = 0 = CF_0 + \frac{CF_1}{(1+IRR)^1} + \frac{CF_2}{(1+IRR)^2} + \cdots + \frac{CF_n}{(1+IRR)^n} = \sum_{t=0}^{n} \frac{CF_t}{(1+IRR)^t}$$

To calculate the IRR you may use the trial-and-error method. That is, just keep guessing IRRs until you get the right one or you may use a financial calculator (usually a bit faster).

IRR decision rule: First, define the firm's *hurdle rate* as the minimum rate the firm will accept for a given project. This is usually the firm's cost of capital. Note that the cost of capital may be adjusted upward or downward to adjust for differences in project risk.

For independent projects:

IRR > the cost of capital (hurdle rate), accept the project.

IRR < the cost of capital (hurdle rate), reject the project.

For mutually exclusive projects, rank all projects for which **IRR** > hurdle rate.

***Example:* IRR**

Continuing with the cash flows presented in Figure 1 for projects A and B, compute the **IRR** for each project and recommend acceptance under the assumption that the projects are independent, and if they are mutually exclusive.

$$Project\ A: 0 = -2000 + \frac{1000}{(1+IRR_A)^1} + \frac{800}{(1+IRR_A)^2} + \frac{600}{(1+IRR_A)^3} + \frac{200}{(1+IRR_A)^4}$$

$$Project\ B: 0 = -2000 + \frac{200}{(1+IRR_B)^1} + \frac{600}{(1+IRR_B)^2} + \frac{800}{(1+IRR_B)^3} + \frac{1200}{(1+IRR_B)^4}$$

Trial and error gives IRR_A = **14.5%**

Trial and error gives IRR_B = **11.8%**

Decision rule: If **A** and B are independent, accept both. Both IRRs are > **10%,** which is the cost of capital. If **A** and B are mutually exclusive, project **A** would be ranked higher than project B since its IRR of A =**14.5%** > B = **11.8%** > the cost of capital **10%.** Note however that IRR ranks and NPV ranks can differ.

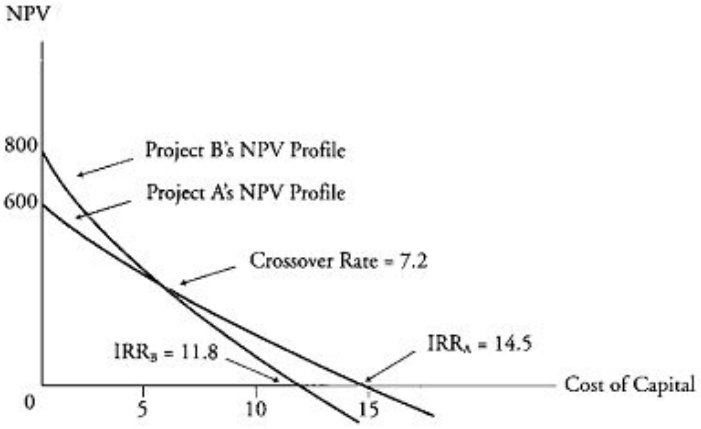
Explain the effect on shareholders of the adoption of investment opportunities with 1) zero net present values and 2) positive net present values.

The logic behind the NPV method for evaluating capital projects is based on the effect of adopting a project on shareholder wealth. When the NPV is positive, the PV of the project's expected future after-tax cash flows is greater than the cost of the project, so firm value is increased and shareholder wealth is increased. By the same reasoning, an NPV of zero means the project does not increase shareholder wealth and a negative NPV means undertaking the project is expected to decrease the value of the firm, and therefore, shareholder wealth.

Explain the NPV profile, the relative advantages and disadvantages of the NPV and IRR methods, particularly with respect to independent versus mutually exclusive projects, the "multiple IRR problem" and the cash flow pattern that causes the problem, and why NPV and IRR methods can produce conflicting rankings for capital projects.

A project's NPV profile is a graph that plots the project's NPV for different discount rates. Remember, when you change the discount rate you change the NPV. The NPV profiles for the two projects described in Figure **1** are presented in Figure **1.** The discount rates shown in the table at the bottom of Figure 1 are located along the x-axis of the NPV profile, and the corresponding NPVs are plotted on the y-axis.

Note that the projects' IRRs are located where the NPV profiles intersect the x-axis (cost of capital), where the NPV is zero. This is because, by definition, the IRR is the discount rate that makes the NPV zero.



Discount Rate	NPV_A	NPV_B
0%	600.00	800.00
5%	360.84	413.00
10%	157.64	98.36
15%	(16.66)	(160.28)

Fig.1 NPV profiles.

Also notice in Figure 1 that the NPV profiles intersect. They intersect at the discount rate that makes the NPVs of both projects equal.

The NPV profiles for projects A and B intersect because of a difference in the timing of the cash flows. From the cash flows for the projects (Figure 1) we see that the total cash inflows for project B are greater (2,800 lei) than those of project A (2,600 lei). Since they both have the same initial cost (2,000 lei), at a discount rate of zero, project B has a greater NPV (2,800 - 2,000 = 800) than project A (2,600 - 2,000 = 600).

We can also see from the cash flows in Figure 1 that the cash flows for project B come later in the project's life. That's why the NPV of project B falls faster than the NPV of project A as the discount rate increases, and the NPVs are eventually equal at a discount rate of **7**.2 percent. At discount rates above **7**.2 percent, the fact that the total cash flows of project B are greater in nominal lei is overridden by the fact that project B's cash flows come later in the project's life than those of project A.

The Relative Advantages and Disadvantages of the NPV and IRR Methods

A key advantage of NPV is that it is a direct measure of the benefit of the project to shareholders. NPV is considered the best measure. Its main weakness is that it does not measure the size of the project, just the size of the return. For example, an NPV = 100 lei is great for a project costing 100 lei but very bad for a project costing 1 million lei.

The NPV method is considered the best method since it leads to theoretically correct capital budgeting decisions.

A key advantage of IRR is that it measures profitability as a percentage, showing the return on each lei invested. The IRR provides safety margin information to management. The IRR tells to manager how much the project return could fall (in percentage terms) before the firm's capital is at risk.

The *disadvantages* of the IRR method are: (1) the potentially conflicting accept or reject decisions when compared to NPV for mutually exclusive projects and (2) the multiple IRR problem.

The "Multiple IRR Problem"

If a project has cash outflows during its life or at the end of its life (where the sign of the net cash flow goes from minus to plus back to minus) the project is said to have a *non-normal* cash-flow pattern. Projects with such cash flows may have multiple IRRs. This problem doesn't exist with the NPV method. Multiple IRRs are possible when there are negative cash flows in future periods.

Why NPV and IRR Methods Can Produce Conflicting Rankings

For *independent projects,* the IRR and NPV methods always give the same accept or reject decision. To see why, assume A and B are independent and look again at Figure 8. If the cost of capital is less than 14.5 percent, both the NPV method and the IRR method would accept project A. On the other hand, if the cost of capital is greater than 14.5 percent, both methods reject the project. Similar analysis shows that for project B, both methods give similar accept/reject decisions.

For *mutually exclusive projects,* sometimes the IRR and NPV methods give different accept or reject decisions. Referring to Figure 8, again assume A and B are mutually exclusive. As long as the cost of capital is greater than the *crossover rate* of 7.2 percent, both methods give the same decision, so accept A ($NPV_A > NPV_B > 0$ and **IRRA** $> IRR_B > 10.0\% > 7.2\%$). If the cost of capital is below the crossover rate, the NPV method ranks project B over project A, while the IRR method favors project A. When such a conflict occurs, go with the NPV method, because it selects the project that maximizes shareholders' wealth. The NPV method implicitly assumes the reinvestment rate for the cash flows is the cost of capital, while the IRR method assumes the reinvestment rate is the IRR.

The reason, described earlier, that the NPV rankings switch for projects A and B in our examples is the difference in the *timing of the cash flows* (early in the project's life versus late in the project's life). A second reason, besides timing differences, that NPV and IRR may give conflicting project rankings is that the projects *may be of different sizes.* Consider an extreme (and somewhat unrealistic) example. Consider two projects, one with an initial outlay of 100 lei and one with an initial outlay of 1 million lei. The smaller project may have higher IRR, but the increase in firm value (NPV) may be small compared to the increase in firm value (NPV) of the larger project, even though its IRR is not as high.

Summarizing all aforesaid it is necessary to draw the following conclusion. To managers of the company it is entrusted to them to be engaged in capital investment very important to follow up all capital budgeting decisions a firm makes. An analyst should compare the actual results to the projected results. The project managers should explain why their projections did or didn't match up to actual performance. The capital budgeting process is only as good as the input estimates used to calculate the cash flows. The capital budgeting process should include a post-audit to ensure that sound decisions are being made and to improve cash flow forecasting and project management in the future.

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