Practical 1: Implementation of Cost-Benefit Analysis using programming language and using project management tool.

THEORETICAL DISCUSSION:

Cost-Benefit Analysis (CBA) is a systematic approach used to evaluate the economic feasibility of projects, policies, or investments by comparing the costs and benefits associated with them. It helps decision-makers assess whether the benefits of a particular project or action outweigh its costs. The central idea behind CBA is to convert all costs and benefits into a common unit (usually monetary) and then compare them over a specified time period, typically using the Net Present Value (NPV) formula.

1. Cost-Benefit Analysis (CBA): CBA involves the following steps:
   a. *Identification of Costs and Benefits*: List and quantify all relevant costs and benefits associated with the project or decision.
   b. *Monetization*: Convert all costs and benefits into a common unit, typically monetary value.
   c. *Time Adjustment*: Adjust cash flows for the timing of costs and benefits, considering their occurrence over time.
   d. *Discounting*: Apply a discount rate to convert future monetary values into present values to account for the time value of money.
   e. *Net Present Value (NPV)*: Calculate the NPV by subtracting the total discounted costs from the total discounted benefits. If NPV is positive, the project is considered economically viable; if it's negative, it may not be economically justified.

2. Mathematical Formula for NPV:

$$NPV = \sum \left[\frac{(Benefit_t - Cost_t)}{(1 + r)^t} \right]$$

   - NPV = Net Present Value
   - Σ = Summation notation, indicating that you should sum up the following expression for each time period (t).
   - Benefits = Total discounted benefits over the time horizon.
   - Costs = Total discounted costs over the time horizon.
   - r = Discount rate, representing the rate at which future cash flows are discounted. It reflects the opportunity cost of capital.
   - t = Time period, which can vary from the present (t=0) to the end of the project's life.

In this formula, we calculate the present value of each cost and benefit by dividing it by $(1 + r)^t$, where "r" is the discount rate and "t" represents the time period. Then, you subtract the total discounted costs from the total discounted benefits to obtain the NPV.

A positive NPV suggests that the project is expected to generate more value than it costs, making it a financially sound investment. Conversely, a negative NPV indicates that the project may not be economically justified.

IMPLEMENTATION DETAILS:

(a) Using programming language (Java):

```cpp
#include <bits/stdc++.h>
using namespace std;

float NPVCalculator(int years, int costs[], int benefits[], int discountRate[])
{
    float npv = 0.0;

    for (int i = 0; i < years; i++)
    {
        float rateFactor = pow(1 + (float(discountRate[i]) / 100.0), (i));
        float rate = 1.0 / (rateFactor);
        cout << "Rate Factor: " << rateFactor << "\t";
        cout << "Rate: " << rate << "\t";

        npv += (benefits[i] - costs[i]) * rate;
        cout << "NPV: " << npv << endl;
    }
    return npv;
}

int main()
{
    cout << "Enter Years\n";
    int years;
    cin >> years;



    cout << "Enter cost for " << years << " years\n";
    int costs[years + 1];
    for (int i = 0; i < =years; i++)
    {
        cin >> costs[i];
    }

    cout << "Enter benefits for " << years << " years\n";
    int benefits[years + 1];
    for (int i = 0; i < =years; i++)
    {
        cin >> benefits[i];
    }
    cout << "Enter discount rates " << years << " years\n";
    int discountRate[years + 1];
    for (int i = 0; i < =years; i++)
    {
        cin >> discountRate[i];
    }
```

```
float npv = NPVCalculator(years, costs, benefits, discountRate);

    cout << "Net Profit Value = " << npv << endl;

    return 0;
}
```

OUTPUT:

```
Enter Years
5
Enter cost for 5 years
3800 3720 5040 6360 5180 4600
Enter benefits for 5 years
0 310000 43000 48000 57000 60000
Enter discount rates 5 years
0.06
Rate Factor: 1    Rate: 1 NPV: 800
Rate Factor: 1    Rate: 1 NPV: -2920
Rate Factor: 1    Rate: 1 NPV: 302040
Rate Factor: 7.41126e+013      Rate: 1.3493e-014       NPV: 302040
Rate Factor: 1.24391e+029      Rate: 8.03918e-030      NPV: 302040
Net Profit Value = 302040
```

(b) Using project management tool ():
Project Manager

Cost Benefit Analysis

Project		0	1	2	3	4	5	Total
Project	REAL ESTATE		Project Manager — Shiva Goel					
Discount Rate 0.06								
		0	1	2	3	4	5	Total
	Quantitative Costs							
Indirect Costs	Rent	$1,000	$1,100	$1,200	$1,300	$1,400	$1,500	$7,500
	Utilities	$300	$220	$240	$260	$280	$300	$1,600
Intangible Costs	Production levels	$500	$400	$600	$800	$500	$300	$3,100
	Customer satisfaction	$1,000	$1,000	$2,000	$3,000	$2,000	$1,500	$10,500
Opportunity Costs	Neglecting one project for another	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$6,000
Overall Costs		$3,800	$3,720	$5,040	$6,360	$5,180	$4,600	$28,700
	Quantitative Benefits							
Direct Benefits	Increased revenue	$0	$10,000	$15,000	$15,000	$20,000	$20,000	$80,000
	New sales	$0	$6,000	$7,000	$8,000	$9,000	$10,000	$40,000
Indirect Benefits	Increased customer interest	$0	$4,000	$5,000	$6,000	$7,000	$8,000	$30,000
Intangible Benefits	Improved team morale	$0	$0	$3,000	$4,000	$5,000	$6,000	$18,000
Competitive Benefits	First product to market	$0	$11,000	$13,000	$15,000	$16,000	$16,000	$71,000
Overall Benefits		$0	$31,000	$43,000	$48,000	$57,000	$60,000	$239,000
NPV		($3,800)	$25,736	$33,784	$34,962	$41,046	$41,398	**$173,126**