CONSULTING GRUPPE

engineering and infrastructure

Value for Money (VfM)

Consulting Services for Project Implementation -
Institutional Support to the National Fund for Climate Change and Environment

(FONERWA)

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1 Introduction

Value for Money (VfM) has several definitions, eventually all meaning the same thing:

- The most advantageous combination of cost, quality, and sustainability.
- Not paying more for a good or service than necessary (minimizing cost to obtain a well-defined result)
- The highest value of the Benefit / Cost ratio.
- Obtaining the best balance between the "three E's"; Economy, Efficiency and Effectiveness. Equity may be added as a fourth E.
- Maximizing the benefit for the population for every RWF spent. Or as in FONERWA operational manual:

The optimal use of resources to achieve the intended outcome. It is not necessarily about doing the cheapest thing, it is about doing what produces the best outcomes by the most cost-effective means.

In the private sector, it is relatively easy to calculate Benefit / Cost ratios because investments will, in general, only be done if they result in benefits i.e. generate income and/or reduce costs, thus maximizing profit.

In the public sector, this is often more difficult because many investments may not generate income and/or the benefits are difficult to define.

VfM does not (necessarily) mean we only buy or do the cheapest thing but that we are obtaining the correct result at the lowest price or, if we pay more, the additional cost is justified by obtaining a better result.

2 The relationship between money and time.

Before we can start evaluating costs and benefits, we must acknowledge the relationship between money and time.

Most, if not all, projects involve the commitment of capital and expenditures over a period of time and income or benefits, if any, are most probably also spread in time.

A Franc spent today is worth more than the same currency spent a year later and, similarly, a Franc earned today is worth more than the same Franc earned a year later.

So, as time passes, the value of money decreases or, to buy the same thing, we will need more money than today.

The reason for that is because of the interest the money could earn and inflation.

As time passes, the value of money decreases.

which means that

In the future, we will need more money to buy the same thing as today.

In order to calculate costs and benefits correctly over time, we will have to calculate the value of the money, spent or earned, over the lifetime of the project.

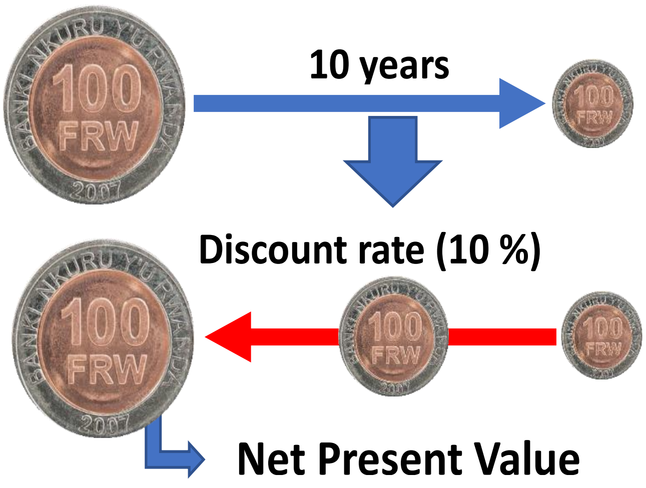
A project, whether it is private or public, should in general only be financed if the benefits are greater than the costs, otherwise the project is not viable or sustainable.[1]

There are several methods to do that, but we will discuss only the Net Present Value (NPV) and Internal Rate of Return (IRR) methods.

Other methods (Annual Worth, Future Worth, External Rate of Return, etc.) will generate the same conclusions.

The Net Present Value (NPV) method

In the NPV method, all cashflows, in and out, are discounted to the same point in time which is the present.



The first thing we need to do is to identify all these cashflows.

Costs to consider are:

- Investment costs.
- Possible replacement cost of equipment after a number of years.
- Operational costs (fuel, electricity, consumables, …).
- Preventive maintenance costs.
- Corrective maintenance cost estimation.
- Salaries.
- Disposal costs.

Possible benefits could be:

- Income from sold (produced) goods or services.
- Reduction of CO_2
- Improved quality of life.
- Improved air quality.
- Reduction of the number of vulnerable people.
- Salvage value of equipment at the end of the project.

[1] Abstract is made here, for the time being, of projects for which the costs outweigh the benefits but are essential for a community, a country or the greater benefit of all and "political" decisions ignoring (partially) the economical context.

We see immediately that the costs can be quantified relatively easy, or at least estimated quite accurately.

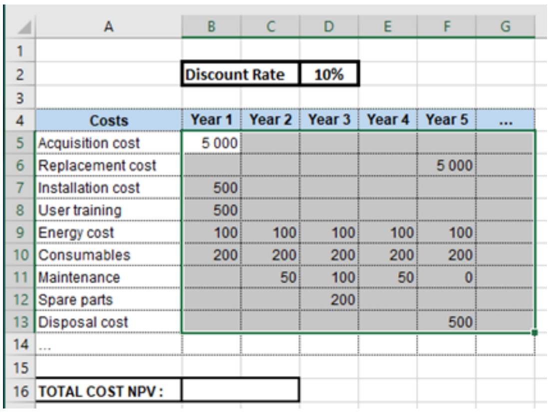
For the benefits, it is quite easy to quantify or estimate the generated income from produced goods or services in monetary terms. That is not the case for a lot of other benefits.

Once we identified all costs and benefits, we will put them in an Excel sheet as follows:

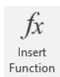
Costs	Year 1	Year 2	Year 3	Year 4	Year 5	…
Acquisition cost	5 000					
Replacement cost					5 000	
Installation cost	500					
User training	500					
Energy cost	100	100	100	100	100	
Consumables	200	200	200	200	200	
Maintenance		50	100	50	0	
Spare parts			200			
Disposal cost					500	
…						

In Excel, calculating the Net Present Value (NPV) is easy:

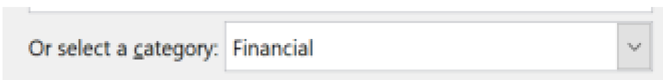
- Select a cell in which the discount rate is entered. FONERWA uses a discount rate of 10% (0,1).
- Select a cell in which the NPV formula will be entered. (In the example B16)



	A	B	C	D	E	F	G
1							
2		Discount Rate		10%			
3							
4	Costs	Year 1	Year 2	Year 3	Year 4	Year 5	...
5	Acquisition cost	5 000					
6	Replacement cost					5 000	
7	Installation cost	500					
8	User training	500					
9	Energy cost	100	100	100	100	100	
10	Consumables	200	200	200	200	200	
11	Maintenance		50	100	50	0	
12	Spare parts			200			
13	Disposal cost					500	
14	...						
15							
16	TOTAL COST NPV :						

- In the menu, select “Formulas” and then on the left side “Insert Function” 

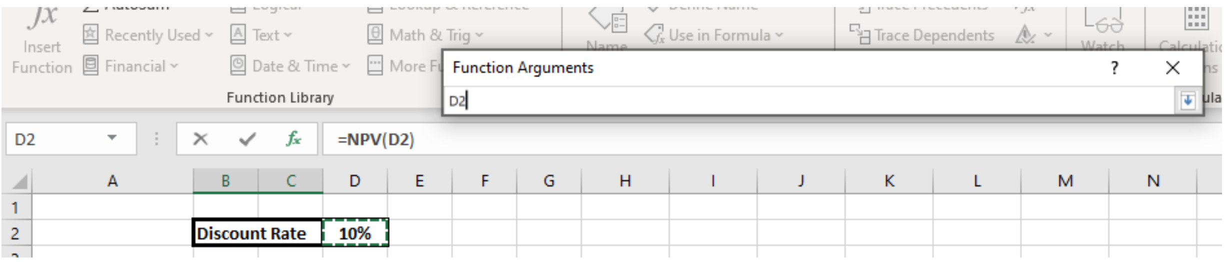
- When you do that, a pop-up window will appear. In the “select category” we put “Financial”



- In the list below, select the function “NPV”.
- Another pop-up window appears:

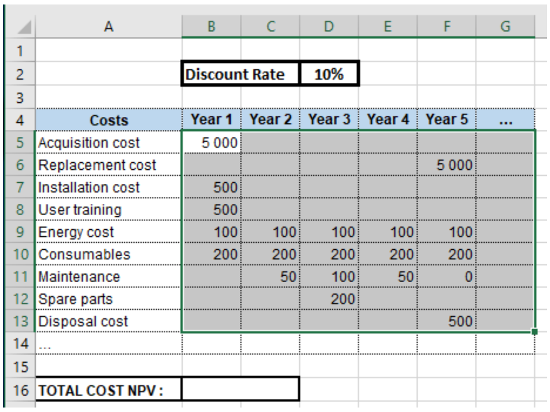
- By clicking on the first upward arrow, you can select the cell in which the discount rate is entered.[2]
- When you do that, another pop-up appears:

Simply click the cell in which the discount is stated and the click on the blue arrow down at the right of the "Function Arguments" pop-up window.



- Follow the same procedure to enter Value 1.

  Value 1 contains, in our example, all the costs over the foreseen lifetime of the project in years.



	A	B	C	D	E	F	G
1							
2		Discount Rate		10%			
3							
4	Costs	Year 1	Year 2	Year 3	Year 4	Year 5	...
5	Acquisition cost	5 000					
6	Replacement cost					5 000	
7	Installation cost	500					
8	User training	500					
9	Energy cost	100	100	100	100	100	
10	Consumables	200	200	200	200	200	
11	Maintenance		50	100	50	0	
12	Spare parts			200			
13	Disposal cost					500	
14	...						
15							
16	TOTAL COST NPV :						

[2] Alternatively, the discount rate (0,1) can be entered directly in the field rate. The advantage of entering the Cell coordinates however is that it is possible to change the value of the discount rate in the Excel sheet and the calculation will change accordingly.
Another possibility (instead of selecting the cell), is to enter the coordinates (in our example "D2" manually)

In the example, these are the cells B5 to F 13 or G 13 (blank cells are automatically ignored in the calculation)

- You do not need to fill out Value 2 unless you want to combine other sections in the Excel sheet, for instance the benefits whereby then costs should be negative and benefits positive.
- We see that Excel calculates the NPV of the costs as being 10 125.95

The whole procedure can now be repeated for the benefits.

For a project to be viable, two financial conditions are essential:

1. The NPV of all costs should be smaller than the NPV of the benefits, and
2. The cash position must be positive at any moment in time.

If NPV(Costs) > NPV(Benefits), the project will not survive without additional external support.

Even if NPV(Costs) < NPV(Benefits) over the duration of the project but the cash position becomes negative, the project will also die because of lack of cash, even before the benefits may start coming in.

An example could be that an initial investment is made for a project but, for instance, 5 years are needed before the project generates income. In the meantime, staff needs to be paid, cars need to be maintained etc.

If there isn't enough money to pay staff, vehicles, insurance, maintenance, consumables, … the project will never reach the stage of being beneficial.

In case benefits cannot be expressed in monetary terms, are unknown or very uncertain, a cost per unit may be used by dividing the NPV(Costs) by the number of units produced by the project.

The second element remains essential though: The cash position must be positive at all times.

The FONERWA support cannot be considered as a benefit (income) but is to be considered as cash available.

The Benefit / Cost ratio may also be used as an indicator[3] for the "soundness" of a project. It is simply the NPV(Benefits) divided by the NPV(Costs). The ratio should be bigger than 1. When there are no benefits, they cannot be expressed in monetary terms or are very difficult to estimate, the Benefit / Cost ratio cannot be used of course.

Another term and ratio which is sometimes used is the Internal Rate of Return (IRR). The IRR is the interest rate at which NPV(Costs) = NPV(Benefits) in other words, the total NPV = 0. Once the IRR is known, it is compared with the "Minimum Acceptable Rate of Return" (MARR) [4]. If IRR > MARR, the project is acceptable, if not, it is rejected.

[3] See chapter E though: The B/C ratio cannot be used for choosing between alternatives.
[4] The MARR is a percentage set by the investor.

For FONERWA decision making.

3 Selection among alternatives.

Since the money that FONERWA can spend to support projects is limited and there are more applications than FONERWA can support, a choice needs to be made between those projects.

The project must show a continuous positive cash position and the NPV of the project should preferably be positive, or, if benefits are unknown, the NPV (costs) should be as low as possible.

It is possible though that many applications comply with those two conditions.

In that case it is important that FONERWA selects those projects which result in a maximum benefit / or lowest cost for every RWF spent.

The method of Selection Among Alternatives can be defined as:

"The alternative that requires the minimum investment of capital and produces satisfactory functional results will always be chosen unless the incremental first cost associated with an alternative having a larger investment can be justified with respect to its incremental savings or benefits."[5] or in other words, additional investment of capital is only justified if the additional capital produces a sufficiently high rate of return.

Additional capital usually results in increased capacity and output and may decrease operational costs per unit produced. As such the total NPV of the project may be increased.

Before we decide to invest the (additional) capital though, we must investigate whether each "avoidable" increment is more interesting than another alternative or not.

The alternative requiring the lowest initial investment, is called the baseline alternative. The condition to use that alternative as baseline is that it must be acceptable and the investment is justified.

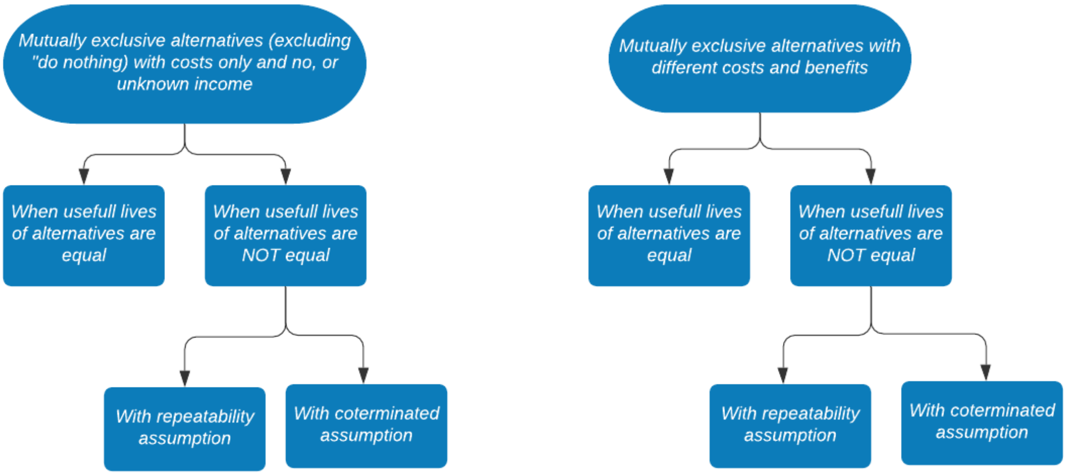
In some cases, that baseline alternative could be to do nothing, with zero investment.

The alternative with the second lowest investment is compared with the baseline alternative.

The best choice when we want to maximize results for every RWF spent is the alternative that requires the largest investment for which its increment of invested capital is justified by savings or additional income in view of the minimum attractive rate of return (10 % for FONERWA)

There are several scenarios possible though:

[5] Engineering Economy 7th. Edition – Collier McMillan



3.1 Alternatives with only costs and identical (or unknown) revenues and lives.

This is the simplest scenario.

Example:

We have 4 different applications A, B, C and D

Costs are as follows:

	A	B	C	D
Investment	5 000	6 000	10 000	12 000
Lifetime of project	5 yrs	5 yrs	5 yrs	5 yrs
Power	600	650	800	850
Labor	7 000	6 000	4 000	3 000
Maintenance	300	400	600	500
Taxes	100	150	200	250
Insurance	100	150	200	250
TOTAL ANNUAL COSTS	8 100	7 350	5 800	4 850

When we calculate the NPW of investment and annual costs, we see that the NPV for

A = 41 363 B = 38 863 C = 35 454 D = 32 954

The alternative with the lowest NPV (Costs) will be preferred, which is alternative D, despite the higher investment cost.

3.2 Alternatives with identical or unknown revenues and different lives.

To be able to compare such cases, we need to put the alternatives on a comparable basis. There are 2 methods:

- The repeatability assumptions, and
- The co-terminated assumption

In most cases the conclusion of the two methods will be the same. Only when the difference between 2 alternatives is very small, the two methods may lead to a different decision.

3.2.1 Using the repeatability assumption.

Two alternatives A and B need to be compared. There are only costs (or unknown benefits) and lifetime is different.

Alternative A has an initial investment cost of 24 000, a lifetime of 12 years and a yearly cost (operation, maintenance, …) of 3 000.

Alternative B has an initial investment cost of 50 000, a useful life of 30 years, a salvage value of 5 000 at the end of its useful life and yearly costs of 1 000.

The discounting rate is 10%.

To compare both alternatives, we will repeat the two until they end at the same point in time i.e., for the lowest common multiple of life which is 60 years.

Alternative A will need to be repeated 5 times, alternative B only twice.

The second investment for B will not be 50 000 but only 45 000 at the end because there will be a salvage value (or a negative cost) of 5 000 at the end of the first 30 years.

When calculating the NPV (Cost) of the two alternatives, for a period of 60 years, we see that:

NPV A = 61 817

NPV B = 57 750

Despite the higher investment cost, alternative B will be chosen.

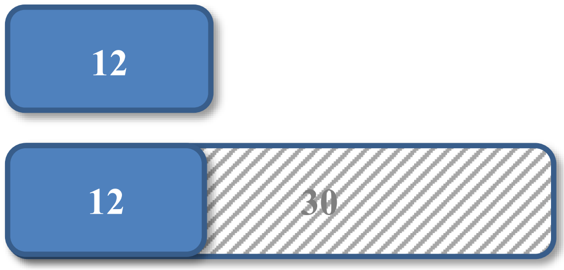
3.2.2 Using the coterminated assumption.

When the “services” of the project are not needed for a period equal to a common multiple of lives, then the comparison should be done on the basis of the required timeframe, using the coterminated assumption.

Even when the timeframe is unknown, the study can be done based on a specified period for the alternatives, for instance when it becomes very difficult to foresee the (changed) circumstances in the (far) future.

The only problem could be to determine the salvage value of the alternative which will not have reached its useful life at the end of the study period.

The timeframe used in this methodology is often the lifetime of the shortest lived alternative or a small multiple of it, depending on the foreseeable life of a continued project.



Taking the previous example and using this methodology now, we will terminate the study period after 12 years. We assume that the salvage value of the second alternative will be 20 000.

Calculating the NPV (Costs) of both alternatives, we see that:

NPV (Costs A) = 42 259

NPV (Cost B) = 45 896

Alternative A is now the best, mainly because we lose money by selling our equipment before it is at the end of its useful lifetime. If the salvage value of B would have been 31 000 instead of 20 000, alternative B would again become the most interesting.

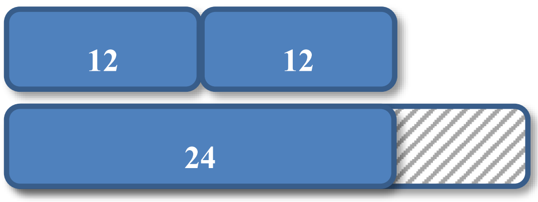
It is thus very important to estimate costs and possible benefits as correctly as possible.

It may also be worthwhile in all evaluations to do a sensitivity analysis; What if, yearly costs decrease or increase, what if salvage value is different, what if ….

That analysis will show us how fast the two alternatives become equal if data would change and in Excel, that is very easy to do.

3.2.3 Using a hybrid solution

When we repeat the first alternative once, the end date is nearer to the end date of the second alternative.



When we assume that the salvage value of alternative B is now 10 000 the results are as follows:

NPV (Costs A) = 55 724

NPV (Cost B) = 53 424

B is again the best alternative now [6].

[6] Note that the result depends quite heavily on the salvage value of B after 24 years.

3.3 Alternatives with identical lives and different revenues.

We are taking the following example of 5 alternatives, all with a lifetime of 10 years:

	A	B	C	D	E
Investment	1 000	1 500	2 000	5000	7500
Annual revenue [7]	120	250	400	700	900
Salvage value [8]	1 000	1 500	2 000	5 000	7 500

Calculating the NPV of the 5 alternatives discounted at 10 %, we obtain the following results:

A. 80

B. 511

C. 1 053

D. 958

E. 599

We see that all alternatives are acceptable (total NPV > 0) but if funding is limited, the preference goes (in descending order) to alternatives C, D, E, B and A respectively.

3.4 Alternatives with different revenues and different lives.

We can again use two different methods: Using the repeatability – or coterminated assumption.

Example:

We have two alternatives A and B. They have different costs and / or incomes as well as a different useful life.

The data are as follows:

	A	B
Investment	7 000	14 000
Annual income	5 000	6 000
Annual Costs	1 000	2 000
Useful life	5 years	10 years
Disposal cost	0	0
Salvage value	0	0

Which alternative is the most economic advantageous, using the discount rate of 10 %?

3.4.1 Using the repeatability assumption.

Since the lowest common multiple lifetime is 10 years, we will reinvest in option A in year 6.

Using the NPV method we see that:

NPV(A) = 11 284

[7] Annual revenue in this case = revenue – expenses.

[8] It is not uncommon for salvage values to be equal or even higher than the initial investment, for instance in the case of terracing or planting trees.

NPV(B) = 16 481

Even though the immediate investment for B is double that of A, the total investment for A = B and the annual net income (income – costs) being the same for the two alternatives, B is much more attractive than A.

3.4.2 Using the coterminated assumption.

What happens with the two alternatives when we decide that both options will be terminated after 5 years?

We assume the net salvage value of option B to be 7 000 at the end of year 5.

In that case:

NPV(A) = 8 727

NPV(B) = 6 124

In this scenario, option A is the most advantageous.

Once again, we see that the estimated salvage value is an important factor in the evaluation when we use the coterminated assumption!

When choosing between the repeatability assumption and the coterminated assumption, it is thus important to choose the method which corresponds the most with the reality.

4 Dealing with uncertainty

There are several methods to deal with uncertainty while executing the economic analysis of projects.

Most of them though come down to a sensitivity analysis of the available data and estimates.

What happens if the useful lifetime is increased or decreased, or the duration of the project is changed? If income or expenses are increased or decreased? If we use another discount rate?

It is of course of utmost importance to reduce the uncertainty to a minimum. This means that any data provided, whether they concern costs or benefits, must be determined as exact as possible.

If the data are wrong, everything else will be wrong.

As such, FONERWA must check data carefully. Possibly outside experts need to be consulted to verify the data. In any case, promoters of projects seeking financing must be able to clarify and justify their data. They must be based on (proven) and internationally accepted figures or assumptions.

If similar projects for instance, use different values for the cost of labour per unit, that must be clarified because, for instance the cost for unskilled labour cannot differ (much) from one project to another.

The same can be said when similar or identical goods are being procured, etc.

If the benefits of a project are intangible and it is difficult or even impossible to express the benefits in monetary form, comparable projects should be analysed based on their costs only.

5 Benefit – Cost ratio

In all methods above we have decided whether a project was worth executing, using the NPV values of the proposed projects. If the NPV > 0 (for projects with income as well as costs), the project was economically acceptable. When choosing between alternatives, the project with the highest NPV (in case there are also benefits), or the lowest NPV(Costs) is the preferred one because it maximizes the outcome for every RWF spent.

Sometimes the Benefit-Cost ratio (B-C Ratio) is used as an indicator.

This ratio is simply obtained by dividing the NPV of all benefits by the NPV of all costs.

If the ratio > 1, the project is economically acceptable.

The B/C ratio can thus only be used if there are benefits which can be (relatively accurate) expressed in monetary terms.

The B/C ratio analysis **cannot** be used for choosing between alternatives though because the B-C method only shows the ratio of benefits and costs and not the total project's potential.

In other words, it is not because the B-C Ratio of project A > the B-C Ratio of project B that A will be the preferred one.

If both have a ratio > 1, they are both acceptable but if we need to choose between the two, the B-C ratio only cannot be used as reference!

6 The four E's

It is one thing to analyse whether a project is economically acceptable, it is another thing to design it so that it becomes (more) attractable, at the start, but also over the lifetime of the project by continuous improvement.

The four E's framework is often used for this purpose.

They are:

1. Economy
2. Efficiency
3. Effectiveness, and
4. Equity

1. Economy

Economy refers to purchasing of the right inputs at the right price.

To evaluate this criterion, one must consider the Life Cycle Cost (LCC) of equipment i.e. the investment, installation, maintenance, running costs (electricity, consumables, …), salvage value if any, disposal cost, … over the lifetime of the equipment or goods.

2. Efficiency

Efficiency refers to the quantity (and quality) of outputs generated.

As such, we cannot decide on Economy without considering efficiency in the equation.

3. Effectiveness

Effectiveness refers to how well the outputs contribute to the desired outcomes.

4. Equity

Equity refers to how fairly inputs, outputs, outcomes and results are distributed.

Referring to previous chapters, we see that Economy and Efficiency can be calculated and/or estimated fairly easy. For Effectiveness, it may become more difficult, and Equity is entirely difficult to express in monetary terms.

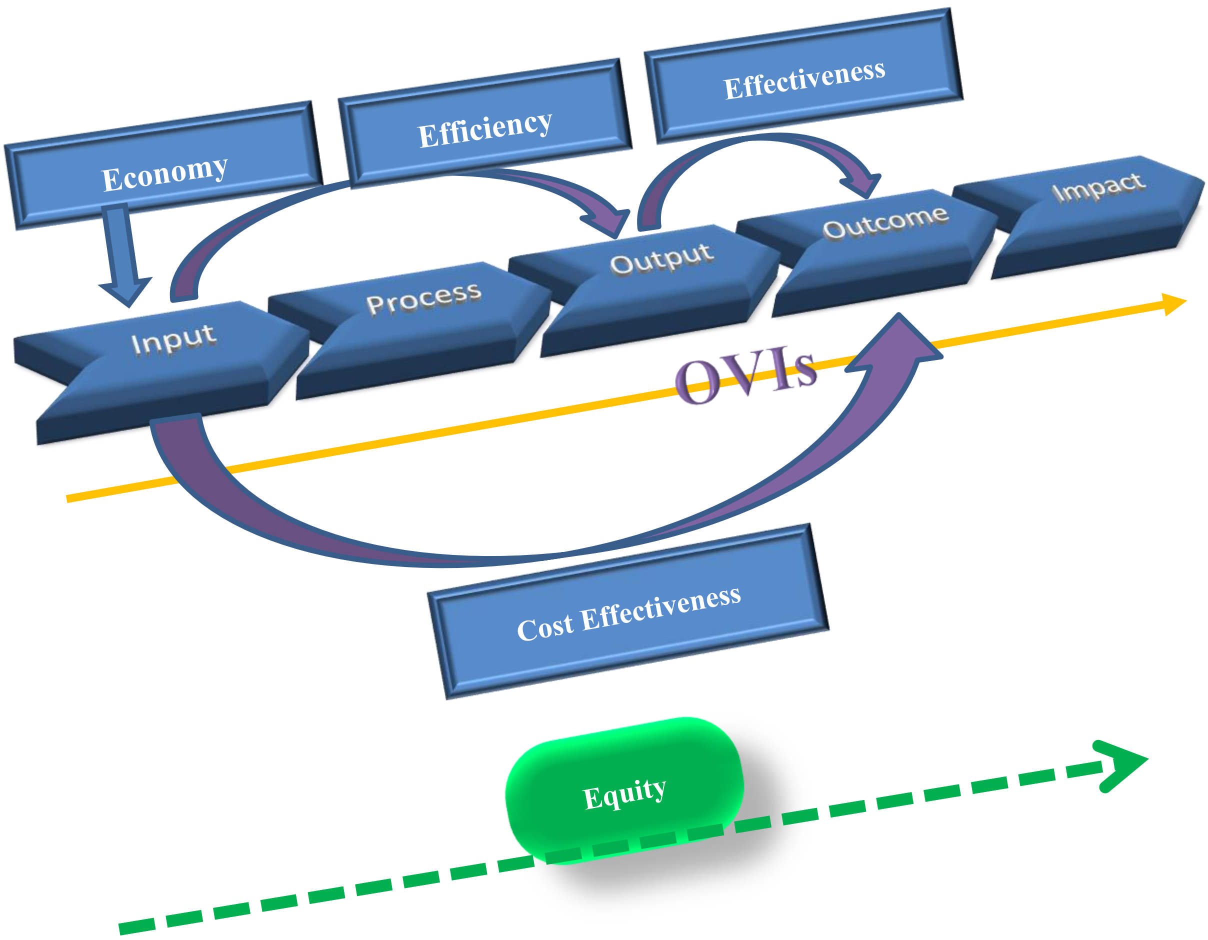
The conclusion of the analysis on Economy and Efficiency may as such be overruled because certain conditions regarding Effectiveness and/or Equity are unacceptable.

Effectiveness:

A project may have a high NPV but the outputs are listed as less important in the goals of FONERWA.

Equity:

A project may have a high NPV and contributes to the most important goals of FONERWA but does not respond to the rules of equity for instance because it discriminates women, it only benefits the upper class, etc.


Economy
Efficiency
Effectiveness
Input
Process
Output
Outcome
Impact
OVIs
Cost Effectiveness
Equity

The art of developing a project with Cost Effectiveness and to maximize Impact is to ask oneself if Economy can be improved, obtaining the same result, whether the process cannot be simplified or altered in a way so that costs are being reduced and thus efficiency increased, whether the output contributes sufficiently to the outcome and eventually the impact or if changes can be made in input or process to increase the outcome.

It is an iterative process that needs to be followed carefully when developing the project but also an exercise that needs to be repeated several times during the project to attain continuous improvement.

As indicated before, it is of utmost importance that all costs and possible benefits are listed or estimated as carefully and correctly as possible. It is equally important to have sufficient, correct and sensitive “Objectively Verifiable Indicators” (OVIs) to monitor the different stages in the process and of course the outcome.

Those OVIs must be quantifiable and measurable.

Inputs are investments, staff, raw materials, consumables, used to produce the outputs.

Outputs are the results delivered.

The **process** transfers inputs into output.

The **outcome** is the result of an effective use of outputs.

The **impact** finally is the effect that the outcome has on defined goals such as cleaner air, poverty reduction, empowerment of women, cleaner water,

Apart from all economic analysis, **equity** must also be taken into account. We already mentioned that economical viable projects may be refused for funding because some fundamental aspects and conditions are not fulfilled.

Equity may also mean that projects which are viable but economically less interesting than other projects are still accepted because those projects are for instance in regions which are difficult to reach and thus more cost. Context must thus also be considered.

7 Conclusion

Determining Value for Money, trying to improve that value in the course of a project, monitoring the indicators is not an easy but a complex task.

It doesn't mean it cannot be done and it certainly does not mean that it doesn't need to be done because it is complex.

Money for investment is scarce and it is thus of utmost importance for FONERWA but eventually for the people of Rwanda that this money is spent as good as possible.

Although the methods explained in this paper are not always perfect, not in the least because we cannot always express costs or benefits in monetary terms, but also because of uncertainty, risks etc., it is the only possible way to come to a rational and reasoned decision.

The more accurate and correct all elements and data are compiled, the more accurate and correct the decision can be made.