# TIME EFFECT IN COST / BENEFIT ANALYSES OF IM (MURAT) INTRODUCTION IN FORCES.

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## **ABSTRACT :**

Muratization requires an initial investment. Benefits appear throughout the whole weapon system life. At the end of life, demilitarization of remaining items introduces cost differences. In Cost/Benefit analyses (CBA), the time pattern of annual cash flow is usually taken into account by conducting analyses in "Present value" (PV) (called also discounted cash flow).

As the life of weapon systems may be as long as 20 or 25 years, effect of time is quite important, and PV techniques must be used in CBA – ACB software of Club MURAT effectively incorporates such a function.

The user of software introduces values in price of year. Then present values are automatically computed by the software according rules which are explicated hereafter.

Results obtained with discounted cash flow, and given in PV, are less favourable to IM introduction; however they are financially orthodox

#### **INTRODUCTION**

Club MURAT has developed the ACB software. ACB stands in French for "Analyse Coût – Bénéfice" – in English "Cost Benefit Analysis" or CBA. This CBA tool enables the impact of muratization on the life cycle cost of a munition to be assessed. In this paper, our purpose is to present a specific feature of ACB, which consists in taking into account the time effect in CBA.

We first will explain why the temporal dimension of cash flow must be taken into account ; secondly, we will explain how the software processes the data ; thirdly, we will illustrate the effect of such a processing on the results of analyses.

Nota : ACB main feature can be consulted on our website : www.clubmurat.com.

# 1 WHY THE TIME EFFECT MUST BE TAKEN INTO ACCOUNT IN CBA OF MURATIZATION

# 1.1 GENERAL ANALYSIS

Temporal dimension of cost is emphasized in Life Cycle Cost Manuals. Manual of US NAVY (Ref. 1) explains that the shape of cost pattern in the time may be crucial.

"It is reasonable to discount where alternatives have differing expenditures patterns."

Nota : "Discount" is the technique name to take into account the time effect.

Cost benefit analyses are precisely analyses comparing two patterns : one which is called the "base-case" (or the do-nothing option), and the other, in which a particular project's option is considered.

So cost / benefit manuals recommend strongly to take into account the time effect.

Manual of Cost / benefit of EUROCONTROL says (Ref. 2 - page 2) :

"CBA is an objective study in which the costs and the benefits of a particular project's option are fully quantified in economic terms, taking full account of the times at which costs are paid and at which benefit accrue."

# 1.2 AN ILLUSTRATION OF TIME EFFECT ON CASH FLOW

Let us assume a benefit appears at the end of a life cycle at year 20.

Let us assume, that in constant price, its value is 1,000 Euros.

Let us assume a yearly inflation rate of 2 %, and a long-range interest rate of 6%.

The current value of this benefit, in year 20 is :

$$1,000 \ge (1.02)^{20} = 1,490$$
 Euros.

According to the financial rules such a benefit has a present value. This present value will be all the less valuable because the benefit appears in distant years.

The present value (PV) is :

 $1,000 \ge (1/1.04)^{20} = 460$  Euros (1.04 = 1.06 - 0.02)

For this benefit of 1 000 Euros in year 20 :

- the constant value is 1,000 Euros ;
- the current value in year 20 is 1,490 Euros ;
- the present value is 460 Euros.

"4 %" is named the yearly discount rate. A benefit of 1,000 Euros (in constant value) in year 20 is balanced by an extra cost of only 460 Euros in Year 0.

1.3 Time pattern in IM introduction in Forces

Muratization requires an initial investment. Benefits appear through the whole weapon system life. Some benefits may appear at the beginning of the cycle (for example : reduction of magazines building cost), the majority of them appear throughout the whole life, such as reduction of loss severity.

At the end of the life cycle, demilitarization of remaining items introduces cost differences.

The specificity of the life of a munition or a missile is its great duration of life ; 25 years is a usual time life for a warhead, for example.

With such an extended duration, the correction factor is of

 $(1/1.04)^{20} = 0.456$  (example of §1.2)

If the yearly discount rate is chosen higher - for example 1.06 - and life time of 25 years, the correction factor becomes as low as **0.23**.

## **1.4 TAKING INTO ACCOUNT THE TIME EFFECT**

Those preliminary analyses led Club MURAT to introduce a time pattern in ACB, as early as ACB 2.1 was created.

Expected results (benefits minus costs) will be less favorable, since muratization benefits appear generally after extra-costs. However computations are so, financially orthodox at an era when majority of governments balance their budget by getting money on financial market.

# 2 RULES RETAINED IN ACB SOFTWARE

Following rules are retained in ACB Software (V 2.7).

#### 2.1 YEARLY RATES

User of ACB can choose :

- a yearly inflation rate expressed in percentage;
- a yearly long range interest rate expressed in percentage.

These two rates are supposed to be constant through the whole life of the munition.

ACB computes the "discount rate" which is the difference.

If no data is introduced, values of 2 % for the first one, and 6 % for the second one are introduced by the software.

#### 2.2 CONSTANT VALUES

To avoid any confusion, all values of price (acquisition, losses, ...) must be introduced by the ACB user in constant values of year 0.

# 2.3 CORRECTION FACTORS

ACB computes automatically a discounted cash flow according the following rules.

a) All acquisition costs are introduced as they are, without correction. They are supposed to intervene on year 0.

Logistic benefits except withdrawal are obtained year after year. They are discounted on a mean value according the formula :

# <u>Y1 correction + Y2 correction + ..... + Yn correction</u> n

b) The withdrawal cost reduction is supposed to intervene at the end of the munition life. It is discounted on the basis of the last year of the munition (Yn).

c) Potential benefits are aleatory observed, once : ACB applies a yearly equal distribution (coefficient of correction is the same as for logistic benefits).

Then ACB applies these correction factors on the different elements of the balance.

## CONCLUSIONS

Club MURAT clearly realizes that economical elements alone are not probably decisive to choose a MURAT option, when developing a new munition or replenishing existing one. However positive results of muratization operation may stop negative a priori appraisals. So, it is necessary to use correct tools to exchange data with deciders. Postponing IM introduction is probably attractive for financial managers inside procurement agencies and time effect is important in CBA analyses. With ACB 2.7, it is possible to present a financially correct analysis, using own tools of financial people.

#### REFERENCES

1 Life Cycle Cost in Navy Acquisition. Military Hand Book – MIL – HDBK – 259 (NAVY) 01 APRIL 1983.

2 Guideline for the economic appraisal of EATCHIP projects. The effective use of cost – Benefit studies – EUROCONTROL – JUNE 1996.

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Co	st Benefit Calculation
Munition name :	Example
Simulation reference :	NIMIC WORKSHOP JUNE 2001
Muratisation cost :	48 500 000
Logistic profits :	-375 117
Potential benefits wher losses :	143 319 817
Result	
Benefit - Cost balance :	94 444 700
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Cost Benefit Calculation	
Cost	Benefit Calculation
Munition name :	Example
Simulation reference :	NIMIC WORKSHOP JUNE 2001
Muratisation cost :	48 500 000
Logistic profits :	-1 000 000
Potential benefits when losses :	229 354 570
Result	
Benefit - Lost Dalance :	1 179 854 570
Help	Quit