Life cycle costing : a tool for capital budgeting in a corporate environment?

Life Cycle Costing: a tool for capital budgeting in a corporate environment ?

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4.1 Introduction:

Maintenance is not the central theme in this presentation. It is merely one- be it an important one - of the cost-categories to be considered when looking at the life cycle costs of technical production systems.

Let us first define what we consider to be a technical production system (TPS). With respect to LCC we want to talk about any physical object emerged from technical design and production, repeatingly performing the functions desired by the user during its life span. The repetitive use of the TPS implies that the occurrence of a system-breakdown doesn't automatically imply the disposal of the system: a TPS is basically repairable. Examples of TPS'es are:

- machines
- means of transport
- buildings
- computers.

In practice the concept is greatly covered by the item "material fixed assets" on the balance sheet of a corporation.

A second item to define is the life cycle concept. It will be regarded from the point of view of the TPS. In that respect the life cycle comprises the time span between the decision to develop a TPS up to and including its final disposal. It is similar (though not equal) to the concept of "technical life span". It should be noted that this definition differs from the concept usually practised in decision calculations, where only the economic useful life of a TPS is relevant (see figure 4.1). In addition, the ownership of a TPS may change over the years. Each subsequent owner may have his own perception of the life-cycle costs of the TPS concerned.

Finally it should be noted that the term "life cycle" is a little bit misleading. It suggests a sort of mysterious, Phoenix-like ability of a TPS to be reborn from its own ashes after its final disposal. The finite character of the TPS'es we are usually dealing with would be better described by the term " life span ".

4.2 Background of the theme

The Life cycle costing (=LCC) concept is unbreakably connected with the name of Benjamin S. Blanchard. Thanks to his initiative in the early '60-ties an awareness grew of the trade-off between initial investment expenditure on one hand and exploitation, maintenance and disposal expenditure of a TPS on the other hand. His concern was how to get a clear view on the budgetary consequences of the decision to develop and use complex technical defence systems for the US ministry of defence. He noticed a systematic under-estimation of the exploitation, maintenance and disposal expenditure of TPS'es because of the urge to save

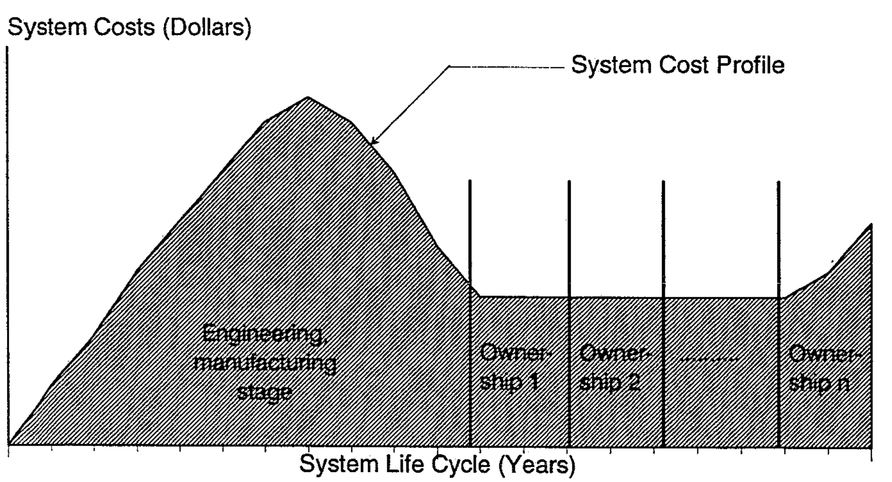

Figure 4.1 The system life cycle

funds in the developing stages of the systems concerned. The concept found its way to the non-governmental world, and became a topic in the discussions about capital budgeting for corporate use.

The principal question of this short paper is:

Can LCC serve as a tool for capital budgeting in a corporate environment?

To answer this question we first have to find out under what circumstances LCC emerged (see figure 4.2).

4.3 The limitations of the Life Cycle Costing approach

Big governmental defence projects tend to be managed strictly by budget constraints. Often new technologies were used, therefore a limited knowledge of exploitation characteristics and so little or no knowledge about possible trade-offs between initial investment expenditure and future exploitation expenditure.

In addition, usually a tendency exists amongst decision makers to over-emphasise the functional performance whilst neglecting the economic performance of a TPS.

Other factors, which may limit the usefulness of LCC are other non-quantifiable factors such as political needs and short term goals in governmental institutions.

The decisions made under these circumstances could be best characterised by the wish tot get the best functional performance for the smallest possible amount of "short term" money, i.e. the initial investment outlay.

Once in operation the systems showed very often an insatiable and growing demand for exploitation funds, and so laid heavy claims on the then available budgets. The possibilities for new projects were severely diminished by the unexpected and apparently under-estimated needs for funds from existing projects. Stretching the life time of in fact worn out systems because of insufficient funds for replacement was another consequence of the way the decisions were made.

Blanchard ([1], [2]), who was among those who signalled this undesirable situation, suggested the idea that decisions about design and purchase of technical systems shouldn't be

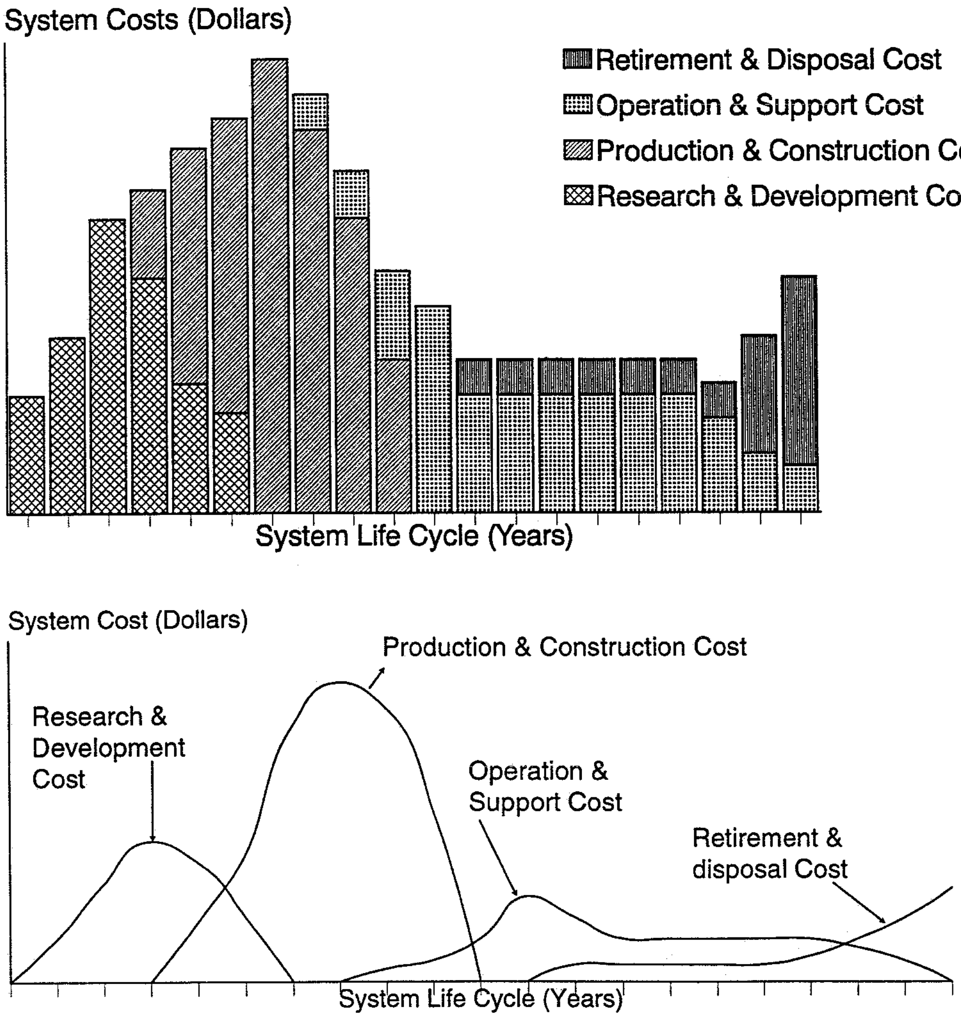

Figure 4.2 The life cycle environment (Blanchard [1])

primarily based on the funds required for the initial investment, but also on the expected exploitation and disposal expenditure. In other words: all cash outflows during the expected lifetime of the system.

Blanchard defines the framework of the way in which a LCC analysis has to be carried out in a number of steps, which have to be carried out sequentially:

1) determination of operational system requirements, maximum development period, life span activity program, expected technical life span. determination of life cycle evaluation criteria.
2) cost break down structure (allocation of expenditure (cost) over categoria and over life span, possible means for cost control)
3) estimation of life cycle expenditure: parametric and analogous cost estimations
4) Discounted expenditure profile per alternative,

Brown & Yanuck [3] experimented with the LCC approach and discovered a number conditions which have to be met to make LCC successful. These conditions can be summarised as follows:

1) *Energy-intensity:* LCC is considered to be more useful when energy expenditures connected with the use of a TPS are relatively important.
2) *Life span expectation:* Brown and Yanuck expect that the relative importance of exploitation expenditure as compared to initial investment expenditure increases with the increase of the estimated life span of a TPS. However, in economic decision making the importance of cash flows that occur in a far away future is greatly reduced because of the influence of the used discount rates.
3) *Efficiency (insight in possible savings):* Awareness of the importance of exploitation expenditure could have a positive impact on the willingness to search for the possibilities to reduce costs.
4) *Magnitude of investment expenditure:* the bigger the amount involved, the bigger the risk perceived by the investor.

In general, literature isn't very specific about any limitations of the use of LCC. One might get the impression that LCC is a normative and universal tool for capital budgeting decisions. However, as the criticism at the beginning of this section suggests, there are a few considerations though that may raise any doubt about the truth of this impression.

Firstly, there is the problem of the distinction to be made between producer and user of the system, because of differing interests. Normally, producer and consumer represent different

economic entities and therefore they will have different interests. Users may not be willing to provide complete cost/revenue information to the designers and vice versa, because of existing trade secrets.
Secondly, it seems to make sense to distinguish between standard products or engineer to order products. Users of standard products are normally not known individually beforehand. Designers have to base their design a product for a virtual user defined by marketing considerations. Engineer to order products don't have this problem, but sometimes the costs and efforts involved to make a complete LCC analysis may not be always justifiable.

To find out if and how LCC is used today in industry a survey was carried out amongst 7 producers and 11 users of "complex" technical systems, each representing companies spending over hfl 100000 on new TPS's per year (Jorissen [4], van Bel & Martin [5]),

Relatively large corporations are aware of the LCC concept and show interest in the use of it, although none of them showed any sign of trading in their currently used methods of capital budgeting for the LCC-instrument.

It then it becomes relevant to proceed to the following questions:

- *Is LCC consistent with the principles of economic decision-making?*
  The type of decision concerned is the development and/or use of complex technical systems. The implication of such a decision is the allocation of substantial amounts of money for relatively long periods, better known as capital budgeting. The basic corporate economic principle is to maximise the increase of shareholder value; the value concept used to measure this increase in the theory of corporate finance is the present value of net future cash flows. The information that is required for the calculation of capital budgeting decisions consists of all the cash flows that originate from the decision to buy and use a TPS.
  The effects of using discounted cash flows in LCC may distort decision making for TPS's with a long life cycle. High costs at the end of the life cycle are systematically underestimated. Figure 4.3 shows the strong devaluation of a cash flow with different interest rates. Especially, in high risk projects large interest rates are very common.

- *What other options are available?*

  A situation of interest are replacement problems. The user need for continuation of a technical function may not always result in a clear cut economically sound LCC calculation, since nuances in modes of operation create and the situation dependent depreciation policy effectively create more options that must be taken into consideration as well. E.g. The life cycle of a truck is difficult to define. At some point in time a truck may have a significant value to local distributors, whilst the same truck is of no value for long intercontinental transports. Thus, the decision on when to sell a truck (i.e. determining the length of a life cycle) depends on the needs of the second hand truck market.

- *What are the differences with well known principles of capital budgeting, which are much more frequently used in industry?*

1) LCC only focuses on the outgoing cash flows. Only when the TPS's under consideration do not differ in cash receipts, LCC might be useful for making a choice among alternative TPS's.
2) LCC is limited to those outgoing cash flows that are directly related to the object. Indirect cash flow effects are neglected. A typical example of these effects can be found in the governmental system of taxation.

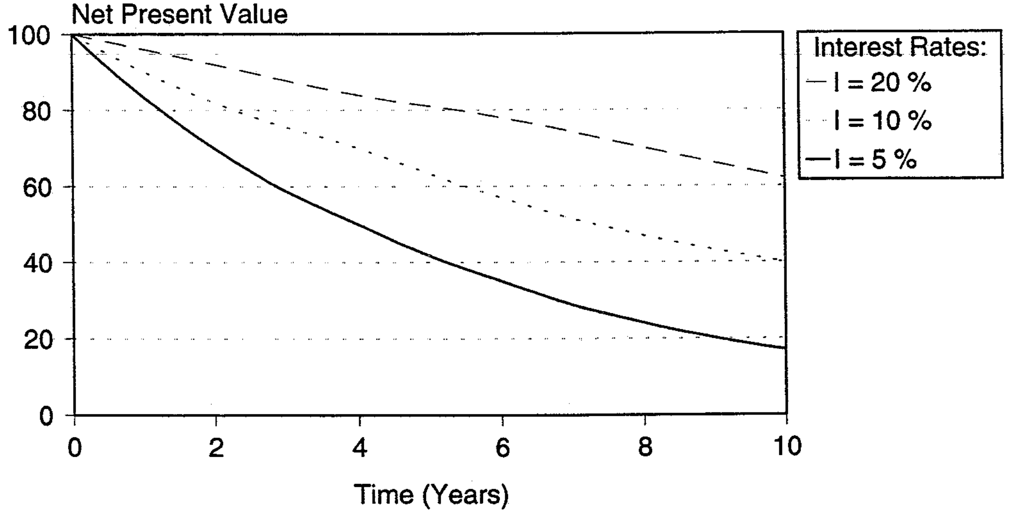

Figure 4.3. The discounted cash flow for several interest rates

3) LCC does take into account the expenditure caused by the disposal, but neglects apparently any salvage value, because of its orientation to the technical life span of the TPS. Many users though will dispose of a TPS before the end of its technical life span of the TPS. One of the motives to do so can be found in the development in time of the salvage value of the TPS. In that respect we better use the term liquidation value. Changes in the liquidation value of a TPS are an important motive to decide whether to continue the use of a TPS or to dispose of it.
4) LCC gives more information on outgoing cash flows than necessary for most of the capital budgeting decisions because of its orientation to the predicted technical life time. For a producer c.q. seller of a TPS the relevant cash flows ends (roughly stated) with the sales proceeds of the system. Any system expenditure due to exploitation by the user is only relevant as a commercial argument for supporting the sales force. But it has no relevance for the decision whether or not to develop and/or produce the TPS. A similar argumentation is valid for the user. Development and production expenditure are basically irrelevant for the cash outlay to be made because of the decision to buy the TPS. The same goes for any expenditure to be expenditure to be expected after the useful life time of the TPS (for this particular user). The economics useful lifetime of the TPS might well be a lot shorter than its estimated technical lifetime.
   Also expected expenditure after the economic lifetime is irrelevant. Because of the need to discount future cash flows, the relevance of far away future expenditures becomes very doubtful. Here do we touch a weak spot in the current practice of the discounted cash flow methods: all cash flows are treated as if they were equal in risk.
   One of the strong points of LCC is that it provides us with evidence that this is by no means always the case. Market risks are to be considered as bigger than the mere time depending risks. Cash receipts and outlays depending on market circumstances are less certain than cash outlays originating from e.g. maintenance schemes. Myers [6] and Traas [7] suggested - for different reasons - the use of more than one discount rate.

4.4 Conclusion

It is clear that the basic ideas of LCC do make sense. However, the practical application is hampered, mainly because of the lack of LCC to cope with uncertainty and the omission of

taking revenues into account. Furthermore, the limited use of LCC in industry suggests that LCC is not well known and if its known capital budgeting methods are preferred.
Future research in this field will be aimed at merging the LCC approach with capital budgeting techniques. Real life limitations listed in the previous paragraph need special attention in this research.

4.5 References

[1] Blanchard, B.S., "Design and manage to life cycle cost", M/A Press, Portland Oregon, USA, 1978, 255p.

[2] Blanchard, B.S., "Logistics Engineering and management", Prentice Hall, Englewood Cliffs, N.J. USA, 1992.

[3] Brown, R.J. & Yanuck, R.R., "Introduction to Life Cycle Costing", Prentice-Hall, Englewood Cliffs, N.J., 1982.

[4] Jorissen, W.C.L., "Life Cycle Costing: Levensduurkosten en -opbrengsten van duurzame productiemiddelen", Msc thesis TUE Eindhoven, Dept. of Operations Management, Eindhoven, December 1992. (in Dutch).

[5] Bel, F. van, Martin, H.H., "Een analyse van de toepassingsmogelijkheden van life cycle costing in een industriële omgeving" (eng: An analysis of the possibilities for application of life cycle costing in an industrial environment), Research report TUE/BDK/LBS/93-37, December 1993.

[6] Myers, S.C., "Finance theory and financial strategy", Interfaces, vol 14 pp 126 - 137, jan/feb 1984.

[7] Traas, L., "Waardebepaling van ondernemingen volgens de "Twee-staps-methode", Tijdschrift voor Financieel Management, 1989/4 (in Dutch).