The Modelling of the Large Investment Projects – Problems, Limits and Solutions.

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1. Introduction

The results achieved during simulation of the cash flows of a concrete investment (which is intended to be carried out in central Asia) has been presented. Virtually the same model has been used in a decision-making process on credits for much smaller investments in Czech banks. The long-term strategic plan of the author is – in collaboration with some Czech companies – creation of a centre of export support which would evaluate various investment plans of companies and in which would simulated the cash flow within the framework of the future investment realisation. Czech companies are currently interested in the investment activities carried out in the way of the BOT project which is convenient for the investors as well as for the future provider. A typical form of the BOT project requires a strong investor or (more often) a group of investors who arrange for the construction (realisation) of the investment and carry it out for a fixed period. During this period (contracted beforehand) the technical personnel and the personnel of the investment operation will be gradually worked in and the investor will collect the earnings income. After the fixed period of operation the investor passes the investment over to a domestic provider. Typical provider of investments constructed by means of BOT is usually the government of the country on whose territory this investment will be made – e.g. power station, water treatment station, water supply station, etc.

2. Cash flow model of the project

As mentioned in the introduction some Czech companies focus in the long-run their attention on the area of investment in the world's financially risky areas (such as e.g. countries of south-east Asia, Africa etc.). These companies have to face two important decisions – an investment decision and consequently a financial decision. Both decisions are in a close relation. The necessity of the project cash flow simulation throughout its whole lifetime, including the preparation time and the operating time are the common features of both decisions. The project cash flow comprises all the earnings and all the expenses generated during the project's lifetime – which means in the course of its construction, during its own functioning (which its operating time) and during its liquidation. The theoretic aspects of the projects cash flow monitoring are incorporated in a number of publications, here it is referring to work [2] and [3].

In practice the model can support the investor's effort to acquire financial means for realisation of a project. In our case we described an example of a project which required **an investment of 260 millions of USD**. The objective of our simulation is particularly monitoring sensitivity of its individual parameters and stability of the suggested solution. The conclusion of our advisory activity using a model of a concrete investment project should direct the investors attention to the critical points which might result in unstability during the long-term realisation of the project, or contrary-wise should draw his attention to the unnecessarily great robustness (stability) of the project in practice (which is, unfortunately, less common).

The basic entries of our model are

- the project's lifetime
- the height of the credit charges and its interest rate,

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- the credit interests,
- the rate of taxation, the costs growth,
- the project's earnings and costs (e.g. generation of electricity and its agreed cost during the lifetime of the project, costs of the project's realisation, depreciation, rough profit, rate of taxation, netto profit),
- the discount rate (as the expected gross margin).

The following **outgoing characteristics of the model** facilitate evaluation of the economic effectiveness of the monitored project:

- **Net present value, NPV** – so called netto current value and
- **Internal rate of return, IRR** – so called internal profit percentage.

Above mentioned entries are inserted in a model (made in Microsoft Excel) whose outputs are (apart from the detail outputs, formed in a table) graphs of the relation of the quantity NPV to time (the project life time) and in particular, to the change of particular parameters in the model (e.g. change of the product cost, change of the tax or the credit burden of the investor, etc.) The model facilitates detail analyses of stability of the NPV quality progress in relation to the change of particular parameters, such as e.g. change of the interest rate, change of the price of product (e.g. electric power), change of the tax burden, etc. The results of modelling will be given during presentation. Further, the model facilitates demonstration of the investor's credit situation related to the individual years of the investment.

3. Role of expert system in investment decision process

During the work on the deterministic model it was obvious that a number of factors that have a significant effect on the course of the real economic results are indefinite, hard to quantify and that it is desirable to make use of basic features of expert systems. The usual criteria of decision making can be applied successfully to simple – scholar – cases. These criteria are based on quantification of a particular objective function simulating profits (or loses) of the decision-making process. The following criteria are the best known: Hurwitz's criterion, Laplace's criterion, Wald's criterion. However, their basic drawback is their inability to cover the evaluation of quality factors which have an effect on the decision-making.

At present we have an expert system with a few individual basis of knowledge at our disposal. (Numerical) results obtained by deterministic simulation are the main input to all the bases.

4. The relationship between operations research and expert system tools in the investment decision process.

In the process of modelling the investment problems we can find a lot differences between tools of operation research (OR) or expert systems (ES). The basic differences consist of :

a) characteristics of the input data:

- the ES are able to work not only with quantitative input data but also with qualitative input data (the OR models require only quantitative input data),
- the ES do not require a complete set of input data (the OR models, to the contrary, strictly and unambiguously require all the input data).

b) architecture of the decision-making supporting tool:

- the prerequisites of the model must be met with OR models (with the ES, this requirement does not need to be strictly met),
- the decision-making problem (for the OR models) must be capable of being reduced to an algorithm (this requirement for the ES is not unambiguous),
- the decision-making problem may not be easy to structure (typical for the strategic management of an enterprise), OR models are not able to solve such problems,

- the objectives of a decision-making problem for ES applications may be unclear and hazily defined (the OR models require unambiguous definition of the set of objectives),
- in dealing with decision-making problems where the heuristic parameters are known, the ES may be used (heuristics will significantly affect the quality of the solution); the OR models cannot use heuristics,
- the role of criterion function in the ES application is unclear, while the OR models require one or more unambiguously defined criterion functions,
- ES make backward monitoring of the calculation possible (with possible analysis of the causes of the development of a specific consultation); when OR models are applied in practice, backward monitoring of calculations is not done.

c) characteristics of the output:

- when the prerequisites are met, the OR models provide the best possible (optimal) solution for the given situation; the ES solution provides also the likelihood of the practical implementation of the solution,
- the ES output is, as a standard, completed with a large amount of additional information; such a possibility is not available with the OR models.

d) the investment decision process may be described by the following characteristics:

- problems are usually solved at the higher levels of the enterprise (they are non-repeatable and unique),
- there is a larger number of factors that affect the solution (that cannot be expressed in numbers); some factors are not known at all, there are complex relations between the factors,
- the fortuity of changes of some elements of the enterprise environment, where the problem is solved (for example changes in technology, or in the social environment of the enterprise),
- the existence of a larger number of evaluation criteria of alternative solutions, some of which may be qualitative,
- difficult interpretation of information necessary for decision-making and of variables that describe the environment.

Obviously, the problems the management of the investment decision process must deal with (with the possible aid of a consultant firm) are poorly structured. It is evident that the role of expert systems in the investment decision process will further increase. This, however, does not mean an absolute rejection of the OR models.

In the process of decision-making support, both groups of tools for modelling may work symbiotically; it is the manager's job or assistant manager's job to decide which tool to use in a specific situation. The wrong choice of tool to support of decision-making in the specific conditions of an enterprise leads to the wrong results. This, however, is not the problem of bad tools but of mistaken management of the firm (or mistaken consultancy to the firm).

5. Summary

In practice the model can support the investor's effort to acquire financial means for realisation of a project (we described an example of a project which required an investment of 260 millions of USD). Presentation of the results of the model can help the project investor to win credibility with bank institutions which is one of the conditions in order to acquire financial support of the project.

Considering the long-term life time (20 years) of such projects, one of the main problems that has to be solved by the project authors is the risk evaluation of the practical realisation of the project (e.g. change of the finance rate in volatile economic of Africa, Asia; change of

the costs of the project product (energy, water); change of the cost of labour force in course of the project life time; change of interests from debts; change of the government policy in the country where the project is realised, etc. We have to make a model which will be able to take into account (at least some) before stated aspects of indefiniteness.

Methods of operation research and expert systems are and will be important support tools for decision-making in the process of management of Czech enterprises. The application of OR models can be expected especially in the area of operating management of an enterprise, where the problems are well structured, reducible to algorithms and we work (often as a routine) especially with quantitative data. Especially in the area of **investment decision process** strategic management we encounter higher utilisation of expert systems, (the possibility of working with qualitative and vague data). A symbiosis of OR and ES models may certainly be profitable for any manager of an enterprise.

In our conditions of applied research of artificial intelligence tools it may be expected that expert system applications will be further developed, in particular in the area of financial consultancy to enterprises (taxes, accountancy, loans, etc.).

6. Literature

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