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A Process Model of Decision Support System for Projects Selection

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Abstract. In project management, often times may lead to requests exceed limited resources. This paper provides a process model for projects selection that can support the enterprise to manage a portfolio of the projects with limited resources. The system performed calculation of NPV, IRR, and PI of the projects. Then ranking the projects. Finally, projects can be selected to portfolio in order until budget are exhausted. From this study, the projects selection are based on simple investment to presents the concept idea, with the selection of the projects to portfolio meet the budget constrained exactly. If the selection of the projects to portfolio, less than budget limit then knapsack solution should be used. For further study, the problems in practical situations would be solved.

Keywords: Decision support system, Project selection, Project management

1. Introduction

All organizations must select the projects they decide to pursue from among numerous. How to determine which projects should be supported? Although early project decision follow a main criteria as financial analysis, according to this criteria the enterprise is often exclude many potential projects which may be have larger benefits [1].

In project management, often times may lead to projects requests that exceed budget and resource constraints. Most of project selection approach is to calculate the ratio of benefit to cost then ranking all projects. Finally, projects can be selected in order until budget is exhausted. Within narrow functions, it may be possible to have a good single measure of benefit. Within a greater asset management context, must be considered many different performance issues [2].

There are usually more projects available for selection than can be undertaken within the physical and financial constraints of a firm; therefore, choices should be selected in constituting a suitable project portfolio [1]. The process of project selection can be illustrated with the “knapsack problem”. When the input data in the problem, such as costs or revenues, are stochastic, the problem of project selection is known as portfolio optimization. Projects are selected to maximize the overall portfolio value subjected to constraints on risk levels [3].

In order to improve the usability of decision models and methods in real application, decision support systems (DSSs) have been proposed and developed, which integrate decision models and methods with computer-based supports together [4].

This paper provides a process model for projects selection in quantitative manner, which can help the enterprises to manage the project portfolio when face with limited of resources. Optimize the value of the portfolio can be easily achieved from the proposed system.

2. Literature Review

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Stage by stage, approach would be preferable when project indicators are compared on the natural basis characteristic of the project implementation process. First the set of reviewed projects is subdivided into ordered subsets in accordance with the specifics of the customer's technological structure and (or) according to the customer's preferences with respect to the established criteria. For this purpose, the entire set of presented projects is subdivided into four groups: exploratory, innovation, innovative investment, and investment projects. Innovative projects presented to the customer also differ in the following: the state of the goal-attaining process; positioning with respect to the customer's package technology; level of competitive ability; patentability level; the project state within the project life cycle (PLC); risk level; economic outcome; information-logical model (ILM) of the decision-making process. Then for the analysis and selection of projects, well-known methods of multi-criteria optimization can be successively used in each group or methods of scalar convolution function [5].

Project portfolio management is a dynamic decision process driven by business strategy, whereby a business's list of active projects is constantly up-dated and revised. In this process, new projects are evaluated, prioritized and selected; existing projects may be accelerated, killed or de-prioritized; and resources are allocated and re-allocated to active projects. Three goals in portfolio management are: (1) maximizing the value of the portfolio; (2) linking the portfolio to the strategy; (3) balancing the portfolio.

This provides a process model for project portfolio management. It involves three phases and seven included stages: pre-process phase, process phase and post- process phase.

1. Pre-process

a) Strategic objects and focuses area Development of vision and strategy, allocation of resources on strategic goals, on project types, on geography   Competition theory, SWOT

2. Portfolio selection process

b) Pre-screening Kill the projects that don't meet the "Should Meet Criteria" Checklist

c) Individual project analysis Calculation of parameters NPV ROI decision tree risk est., etc.

d) Screening, prioritizing Kill unfeasible projects, prioritize projects according to total project score Scoring model Q-sort, AHP, etc.

e) Portfolio balance Have the appropriate breakdown in spending (or numbers of projects) across markets, technologies and project types. Bubble diagram, pie chart, etc.

f) Portfolio review Adjustment of portfolio according to the changes on goals, on resources, etc. add balance criterion

3. Post- process

g) Project implement and completion Implementation of projects, feedback PM techniques, data collection [6].

The Analytic Hierarchy Process is one of the most widely exploited decision making methods in cases when the decision (the selection of given alternatives and their prioritizing) is based on several criteria/subcriteria. The method application can be explained in four steps: 1) The hierarchy model of the decision problem is developed in such a way that the goal is positioned at the top, with criteria and subcriteria on lower levels, and finally alternatives at the bottom of the model. 2) After the hierarchy has been constructed, on each hierarchy structure level the pair-wise comparisons should be done by comparing all pairs of the elements belonging to the same node, starting with the top of the hierarchy and working this way to the lowest level. This procedure is supported by Saaty-es fundamental scale of absolute numbers by which the ratios of relative importance are represented. On the basis of the pair-wise comparisons, local importance (expressed as priorities for alternatives and weights for criteria) of elements of the hierarchy structure are calculated. 3) Finally, these results are synthesized into an overall priority list of alternatives. Decision maker is allowed to change preferences and to test the results if the inconsistency level is considered high. 4) The sensitivity analysis is also carried out. Sensitivity analysis is used to determine how the priorities of the alternatives change with respect to the importance of the criteria or sub-criteria [7].

As was indicated, both the net present value and the internal rate of return methods result in identical decisions to either accept or reject an independent project. This is true because the net present value is greater than zero if and only if the internal rate of return is greater than the required rate of return, k. In the case of mutually exclusive projects, however, the two methods may yield contradictory results; one project may have a higher internal rate of return than another, at the same time a lower net present value. The outcome depends on the assumptions the decision maker chooses to make about the implied reinvestment rate for the net cash flows generated from each project. Consequently, in the absence of capital rationing, the net present value approach is normally superior to both the profitability index and the internal rate of return when choosing among mutually exclusive investments [8].

The final potential difficulty related to implementing the alternative methods of project evaluation and selection that we will discuss concerns capital rationing. Capital rationing occurs any time there is a budget ceiling, or constraint, on the amount of funds that can be invested during a specific period, such as a year. Such constraint is prevalent in a number of firms, particularly in those that have a policy of internally financing all capital expenditures. Another example of capital rationing occurs when a division of large company is allowed to make capital expenditures only up to a specified budget ceiling, over which the division usually has no control. With a capital rationing constraint, the firm attempts to select the combination of investment proposals that will provide the greatest increase in the value of the firm subject to not exceeding the budget ceiling constraint. Because of the budget constraint, you cannot necessarily invest in all proposals that increase the net present value of the firms; you invest in an acceptable proposal only if the budget constraint allows such investment. As you can see, selecting projects by descending of profitability index allows you to select the mix of projects that adds most to firm value when operating under a single-period budget ceiling [9].

3. Methodology

In this study, Microsoft Excel under Windows environment has been used to develop a system prototype on a microcomputer. The process model of system prototype is shown in figure 1.

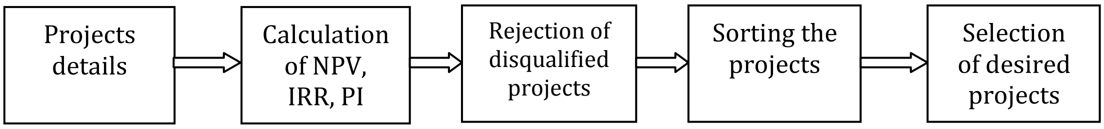

Fig. 1: The process model of system prototype.

The first step, the data such as Project name, Cash out-flow, and Cash in-flow are entered into the system as shown in table 1. In the example, the required Rate of return is 12%, when Budget constrained is $300,000.

TABLE 1: Data input (Partial display)

Project name	Cash	Y_0	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7	Y_8	Y_9	Y_{10}
P1	I.F		15000	15000	15000	15000	15000	15000				
	O.F	50000										
P2	I.F		5000	10000	15000	15000	25000	35000				
	O.F	30000	20000									
P3	I.F			20000	25000	25000	25000	25000	25000	25000	25000	25000
	O.F	80000	20000		20000							
P4	I.F			20000	25000	30000	25000		30000	25000	20000	20000
	O.F	60000	20000		10000							

From input data, the system then performed calculation of NPV, IRR, and PI with rate of return equal to 12%as shown in table 2.

when, Present Value (PV_0) $= FV_n\,[1/(1+i)^n]$ (1)

Then, Net Present Value (NPV) = Present value of net in-flow - Present value of net out-flow (2)

Internal Rate of Return (IRR) $= [NIF_1\ /(1+r)^1] + [NIF_2/(1+r)^2] + \ldots + [NIF_n/(1+r)^n] - PV_0$ of NOF (3)

Profitability Index (PI) $= \dfrac{\text{Present value of net in-flow}}{\text{Present value of net out-flow}}$ (4)

TABLE 2: Calculation of NPV, IRR, and PI from input data

Project name	Net investment ($)	NPV ($)	IRR (%)	PI
P1	50,000	11,671	20	1.23
P2	50,000	14,563	19	1.29
P3	120,000	1,374	12	1.01
P4	100,000	24,191	19	1.24
P5	60,000	-1,103	12	0.98
P6	80,000	6,809	14	1.09
P7	40,000	5,514	17	1.14
P8	60,000	6,822	17	1.11
P9	30,000	-1,412	10	0.95

Then ranking the projects by their PI in descending manner, the projects which have PI less than 1.0, with negative NPV or IRR less than cost of capital, must be rejected. In this example, project P5 has negative NPV, and project P9 also has negative NPV and IRR less than 12%, their PI equal to 0.98 and 0.96 respectively. So the project P5 and P9 then rejected, as shown in table 3.

TABLE 3: Ranking the projects by their PI

Project name	Net investment ($)	NPV	IRR	PI	Remark
P2	50,000	14,563	19	1.29	
P4	100,000	24,191	19	1.24	
P1	50,000	11,671	20	1.23	
P7	40,000	5,514	17	1.14	
P8	60,000	6,822	17	1.11	
P6	80,000	6,809	14	1.09	
P3	120,000	1,374	12	1.01	
P5	60,000	-1,103	12	0.98	Rejected
P9	30,000	-1,412	10	0.95	Rejected

Next, performed calculation of Cumulative Net investment after each project selected. The project P6 and P3 then rejected due to they were exceed the budget limited, as shown in table 4.

TABLE 4: Projects selection to their budget constrained

Project name	Net investment ($)	Cumulative Net investment($)	NPV	IRR	PI	Remark
P2	50,000	50,000	14,563	19	1.29	
P4	100,000	150,000	24,191	19	1.24	
P1	50,000	200,000	11,671	20	1.23	
P7	40,000	240,000	5,514	17	1.14	
P8	60,000	300,000	6,822	17	1.11	
P6	80,000	380,000	6,809	14	1.09	Rejected
P3	120,000	500,000	1,374	12	1.01	Rejected

Finally, Project P2, P4, P1, P7, and P8 can be selected to the portfolio in order within the budget constrained of $300,000. The cumulated NPV for the selection projects were $56,036, as shown in table 5.

TABLE 5: Projects selection to portfolio

	Net investment ($)	NPV	IRR	PI
P2	50,000	13,003	19	1.35
P4	100,000	21,599	19	1.28
P1	50,000	10,421	20	1.26
P7	40,000	4,923	17	1.14
P8	60,000	6,090	17	1.11
Cumulated	*300,000*	*62,761*		

4. Conclusions

Most of project selection approach is to calculate the ratio of benefit to cost then ranking all projects. Finally, projects can be selected in order until budget is exhausted. This paper provides a process model for project selection in quantitative manner, which can help the enterprises to manage the project portfolio when face with limited of resources. Maximize the value of the portfolio can be easily achieved from the proposed system. Microsoft Excel under Windows environment has been used to develop a system prototype on a microcomputer. The first step, the data such as Project name, Cash out-flow, Cash in-flow, Rate of return and Budget constrained are entered into the system. The system then performed calculation of NPV, IRR, and PI. Next, ranking the projects by their PI in descending manner, the projects which have PI less than 1.0 must be rejected. Then performed calculation of Cumulative Net investment after each project selected. Finally, projects can be selected to the portfolio in order within the budget constrained.

From this study, the projects selection is based on simple investment to presents the concept idea, with the selection of the projects to portfolio meet the budget constrained exactly. In the real-world projects, if the selection of the projects to portfolio, after ranking, less than budget limit then knapsack solution should be used to optimize the cumulative NPV. In addition, the criteria for projects selection in qualitative manner should be concerned. For further study, these practical situations would be solved.

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