# An Incremental IRR Approach to Project Selection

V. Scalesse

EMP-9375

# An Incremental IRR Approach to Project Selection

by

Vincent F. Scalesse

Portland State University
Engineering Management 535
Dr. Hulya Yazici
March 9, 1993

## Table of Contents

# Introduction

a. Purpose.

The purpose of this project is to develop a project selection and ranking tool which can be used by capital budget administrators to maximize the effectiveness of capital expenditures. It is intended that this tool be used as a "field guide" by engineers and managers at a manufacturing site of a larger corporation. Therefore, the input must be simple and readily available to facilitate the use of this technique.

b. Significance for Engineering Management.

This problem is significant for engineering management since the engineering manager's success relies on the proper and most effective use of available resources. This problem focuses on perhaps the most critical resource - the capital budget. By focusing resources on the most effective group of projects, the engineering manager increases his own chances of success, while increasing the company's opportunity for long-term profitability.

c. Benefits of the Project.

This project provides an easy-to-use macro driven spreadsheet program designed to rank and select projects from a given listing. It can be used as a guideline for the allocation of resources to develop and support projects. It can also be used

as an evaluation tool to track the effectiveness of the capital program, and, if necessary, redirect the allocation of resources.

d. Engineering Economic Analysis Techniques.

The internal rate of return (IRR) analysis technique is used in this project's problem formulation. IRR provides the manager with a measure of project effectiveness expressed as an equivalent percentage return on the project investment. This return is calculated based on the project's cash flow assumptions, and is independent of an external discount rate. Therefore, an IRR can be calculated with as little information about a project as the cost and expected return - two pieces of information that are required to properly evaluate a project using any technique.

IRR is an important piece of information in evaluating projects, but it can be misleading in cases where the project costs vary significantly. To account for differences in the magnitude of project costs, this project goes beyond a simple IRR ranking of projects. The project selection analysis also employs an incremental IRR approach, which is used to further maximize the project rankings. This is done by evaluating the IRR of the incremental investment, or difference in project costs, represented by selecting one project over another.

This incremental approach is similar to the Fleischer Bundling Technique which evaluates the incremental IRR of one bundle of projects over another until all possible combinations are

evaluated. The problem with the bundling technique is that the number of bundles increases exponentially with the number of projects being considered. In the case of this problem, the number of projects can easily be as high as 50 to 60, making the bundling technique, at best, very cumbersome.

Therefore, this project uses an iterative approach to the incremental IRR analysis. Incremental IRR is typically used to find the best project from a group of mutually exclusive projects. By using this technique to find the best project, then repeating the process on the "rejected" projects, a portfolio, or bundle, of projects can be constructed which maximizes the effectiveness of the entire capital budget.

## Data

a. Required Data.

The program requires the following information about each project:

- Name
- Cost
- Annual Return
- Project Life
- Salvage Value.

It also requires some general information, including total budget, minimum attractive rate of return (MARR), and tax rate, to complete the analysis. The tax rate is optional. Without it, the program performs a before tax cash flow analysis.

The output of the program is a prioritized list of projects which maximize the effectiveness of the budget.

b. Assumptions.

The following assumptions were used in developing the program:

- The program is modeled after a heavy industrial manufacturing site of a large corporation.
- Each site's capital budget is determined at the corporate level.
- Cost of capital information is not readily available and is not significant to project selection at each site.
- MARR is determined by corporate policy, since most projects must be approved for funding at the corporate level.
- The Net Present Value (NPV) Technique is not used since adequate information is not readily available at this level of the company.
- A typical project in this environment has a life of 10 to 20 years.
- Depreciation is based on the 7-year MACRS schedule.
- The level of uncertainty in the project costs and returns is constant for each group of projects input.

## Formulation

a. Problem Formulation.

An Excel macro program was developed to assist the user in selecting a portfolio of projects which best utilizes the available capital budget. The program allows the user to input or edit a list of projects, then takes the following steps in determining the group of selected projects:

1. An IRR is calculated for each project.

2. Any project with an IRR less than the MARR is eliminated.

3. Any project whose cost exceeds the capital budget is eliminated.

4. A set of "candidate projects" is identified. This set is considered acceptable based on the preliminary screening of the previous steps. This is the group of projects which would be selected if the capital budget were not constrained.

5. An incremental IRR analysis is performed to determine the best project in the candidate set. This project is then removed from the candidate set and added to the selected set of projects. This step is repeated until the capital budget is depleted.

6. The selected set of projects is presented in prioritized order.

b. Spreadsheet Program.

The following spreadsheets are used in this project:

- Project.xlm: This is the macro program which automatically executes the steps outlined in the problem formulation. A program listing of the macro is included as Appendix A.

- Project.xls: This is the worksheet that performs the IRR calculations. A printout of the formulas used in this spreadsheet is included as Appendix B.

- Project1.xls: This is the worksheet which is used to perform the incremental IRR iterations. It is a copy of the information on "Project.xls" and is used to preserve the original data input by the user.

- Project2.xls: This is the spreadsheet used to save the candidate list of projects for each iteration of incremental IRR. No calculations are performed on this spreadsheet.

- Result.xls: This is the spreadsheet which accumulates the selected projects from each iteration of the incremental IRR routine. It is used to present the problem output. The only calculation made on this sheet is the summation of selected project costs.

## Conclusion

a. Output of Formulation.

The formulation output is presented by the spreadsheet "Result.xls". It includes a listing of the selected projects, the data that was input for each project, and a summation of the project costs. It also includes the constraints (budget, MARR) that were used in determining the selected portfolio of projects.

Appendix C contains the results of several program runs. Each result sheet is accompanied by a project sheet showing the data used for that particular run.

b. Results.

Some of the program runs used project data taken from example problems in the class text. This program provided results which matched the answers provided in the text.

The output indicates that the problem formulation has achieved the desired result. The incremental IRR routine can be effectively employed to select a portfolio of projects from a large group of candidates and maximize the effectiveness of the capital program.

This project provides a macro-driven spreadsheet which is capable of selecting the most effective portfolio of projects using a minimum of user input. It can be a very effective tool for the engineering manager.

c. Future Research Opportunities.

Additional user selected options, such as depreciation type, could be programmed in to give the program more versatility in the selection of cash flow assumptions.

Many of the assumptions made in this project could be relaxed in order to give the program a wider scope of utility. For example, the cash flow analysis could be modified to accept a wider range of project lives.

Risk analysis could also be added to the program on a per project basis by including the level of uncertainty for each project cost estimate and expected return.