Chapter 4
Research and Development Risk in Projects Selection

ABSTRACT

Elaborated method is applied to R&D for project portfolio selection to achieve investment objectives controlling risk. DMAIC framework applies stochastic techniques to risk management. Optimisation resolves Efficient Frontier of portfolios for desired range of expected return with initially defined increment. Simulation measures Efficient Frontier portfolios calculating mean return, variance, standard deviation, Sharpe Ratio, and Six Sigma metrics versus pre-specified target limits. Analysis considers mean return, Six Sigma metrics and Sharpe Ratio and selects the portfolio with maximal Sharpe Ratio as initially the best portfolio. Optimisation resolves Efficient Frontier in a narrow interval with smaller increments. Simulation measures Efficient Frontier performance including mean return, variance, standard deviation, Sharpe Ratio, and Six Sigma metrics versus pre-specified target. Analysis identifies the maximal Sharpe Ratio portfolio, i.e. the best portfolio for implementation. Selected projects in the portfolio are individual projects. So, Project Management approach is used for control.

INTRODUCTION

This chapter presents the third Portfolio Management application class of the method. It is applied in R&D to manage the risk in project portfolio selection.

Research and Development (R&D) is a very important activity of corporate business today. It creates opportunities for profit and increases the

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corporations' competitiveness, which is their ultimate objective. To achieve this objective, selecting an optimal portfolio of R&D projects is a crucial factor. The investment portfolio approach (Markowitz 1952; 1987) is mostly used for R&D projects selection.

Meade and Presle (2002) presented an analytic network process (ANP) as a potentially valuable method to support the selection of projects in a R&D environment. Also, Archer and Ghasemzadeh (1999) simplified the project portfolio selection process by developing a framework which separates the work into distinct stages. The fuzzy approach to statistical analysis of portfolio selection was applied by Carlssona, Fullérb, Heikkiläc and Majlendera (2007). They developed a methodology for valuing options on R&D projects, when future cash flows are estimated by trapezoidal fuzzy numbers. They presented a fuzzy mixed integer programming model for the R&D optimal portfolio selection problem.

During the 1990s, major international corporations significantly improved their R&D performance by introducing risk analysis and portfolio management methodologies, in addition to the new business specific techniques. As superior techniques were introduced, the industries realised that systematic procedures are crucial for better management of the R&D functions. This involves structured methodologies of: i) Risk and decision analysis to reduce R&D risk; and ii) Portfolio management to optimise the allocation of R&D capital to specific research projects in order to increase return on investment. Contemporarily, significant work was published relating to applications of risk and decision analysis and implementation of portfolio management to R&D.

Risk and decision analysis generically applies to any type of business investment decision (Bernstein 1996). Contemporary risk models are stochastic and use Monte Carlo simulation. A comprehensive elaboration on investment risk applications of Monte Carlo simulation was published by Glasserman (2004).

Portfolio analysis applies to any type of business investment decision as well. The problem of portfolio optimisation was solved in the 1950's by Markowitz (1952; 1987). Markowitz applied his award-wining Mean-Variance method. Nowadays, stochastic optimisation is used to resolve the optimal portfolio. Stochastic optimisation models are elaborated in a book edited by Ziemba and Vickson (2006).

Six Sigma is a recognised process improvement methodology across industries, which has been generally used by R&D as well. For example,