PORTFOLIO RISK ANALYSIS BY USING MULTI CRITERIA DECISION MAKING METHOD

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DEDICATION

This project is dedicated to:

My beloved and kind wife, Elham Mehdizadeh, who always supported me to develop myself and fill my heart with nothing but love. who gives me ambition and determination to achieve any goal in my life.

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ABSTRACT

Portfolio risk management is ever growing and needs to be understood to assist modern project management. A systematic decision making approach is required for helping decision makers to choose wisely under conditions of uncertainty in complex situations where there are several projects running at the same time. This approach should include all the thresholds and criteria which are important for the managers when they want to discriminate between their projects. The aim of this study is to develop a new framework for portfolio management of oil and gas organization which is handling several projects at the same time. The adopted methodology was combination of literature reviews, conducting nominal process and questionnaire survey to highlight the critical criteria from top management point of view when they want to discriminate between the projects. This method resulted in refined framework for structuring the hierarchy of decision making model. A multi-criteria approach has been used to determine the importance and severity of each project with respect to all managerial criteria for decision making. In the end, the severity and importance of the projects have been determined, overall risk severity factor is developed to rank the identified risk within portfolio. The study identified the managerial criteria to cope with portfolio risk management. Moreover, this study established the systematic methodology for using Multi Criteria Decision Making (MCDM) model to determine the severity of the risks in portfolio level. It is hope that this method will form the basis for portfolio risk assessment in oil and gas industry.

ABSTRAK

Sistem pengurusan risiko potfolio adalah satu bidang yang sedang berkembang pesat dan perlu difahami untuk meningkatkan lagi keupayaan dalam pengurusan projek masa kini.Satu kaedah yang sistematik dalam membuat keputusan adalah sangat diperlukan untuk membantu pihak yang bertanggung jawab membuat keputusan agar dalam menentukan sebarang pemilihan secara tepat dalam suasana yang kompleks serta sukar membuat ramalan terutamanya apabila sesuatu organisasi menjalankan beberapa projek secara bertindih dalam satu masa yang sama. Pendekatan ini mesti merangkumi semua aspek dan kriteria yang penting bagi membolehkan pihak pengurusan membuat keputusan dalam memberi keutamaan apabila mengendalikan beberapa projek secara selari pada masa yang sama. Tujuan kajian ini adalah untuk mengujudkan satu rangka kerja untuk pengurusan potfolio untuk membuat keputusan bagi industri minyak dan gas asli. Metodologi yang digunakan bagi projek ini adalah kajian literatur, menjalankan proses nominal dan pengedaran borang soal selidik. Kajian ini telah menghasilkan satu proses rangka kerja yang telah dimurnikan untuk menstruktur model hiraki dalam membuat keputusan. Pendekatan berdasarkan pelbagai kriteria telah digunakan untuk rangka kerja ini bagi membolehkan pihak pengurusan mengenalpasti keutamaan dan kekangan pada setiap projek yang dijalankan dalam proses membuat keputusan. Dengan melaui proses ini pihak pengurusan dapat mengenalpasti dan menentukan tahap risiko yang berbeza untuk setiap projek dibawah sistem pengurusan potfolio. Kaedah ini adalah satu pendekatan yang sistematik dalam menggunakan model membuat keputusan multi kriteria dalam pengurusan risiko ditahap pengurusan potfolio. Adalah diharap rangka kerja ini akan menjadi asas yang boleh digunakan dalam pengurusan risiko bagi industri minyak dan gas.

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LIST OF ABBREVIATIONS

AHP	-	Analytical Hierarchy Process
FL	-	Fuzzy Logic
MCDM	-	Multi Criteria Decision Making
CR	-	Consistency Ratio
CI	-	Consistency Index
RI	-	Consistency Ratio

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Traditional project management is, by and large, a process whereby each project is approved and managed independently. In this arena, the focus is on a single project and the triple constraint-Scope, time and cost-of that project separate from other projects. Typically, the project manager is responsible for evaluating the performance of the project. At times, given the importance of the project, the project might be evaluated or reviewed at the executive level, but this review is still conducted in isolation of other projects.

By contrast, in the portfolio management environment, there is pre-defined process for selecting projects and uniform process for evaluating their success. The selection decisions, and the periodic evaluations, are made in light of the enterprise's business goals and strategies. Evaluations are conducted regularly and are based on standardized procedures. The emphasis is on ensuring that each project contributes to the overall organizational success. The project must continue to support business goals even if there are major changes in the project requirements.

On the other hand, Portfolio management can be conducted in a number of ways, but the dominant approaches involve the application of some form of rational model(s) to evaluate and rank projects and monitor their progress. These functions are often assembled in an information system that makes it possible to automate the collection, calculation, and presentation of data. The information system or portfolio system is then expected to aid rational decision-making. Decision makers can be located at various levels and units in companies and the decision process can be organized in numerous ways, but in this project the research writer focused on AHP method in order to develop a process for rank the project risks when they are brought to the portfolio level. The output of this method brings the clear cut picture of the project issues prioritization for the management level in order to make crucial decision in the portfolio level.

1.2 Problem Statement

Even though there are numerous studies have been undertaken towards portfolio risk management, only few concepts are available in order to measure project risk ranking. This may due to the complexity and fragmentation of portfolio management in comparison with project management.

On one hand, risks should be identified and managed in the projects, however when it comes to the portfolio, interactions between different projects signify on the importance of integrating the identified risks as a unique package to be analyzed rather than considering projects individually. On the other hand, identified risks in the individual projects required systematic methodology for ranking and prioritizing the projects with their relative risks.

With the aid of Analytic Hierarchy Process which is one of the most practical method in Multi Criteria Decision Making methods, the complexity of this issue will be handled and there will be a clear cut picture of the portfolios' risk and prioritization of them in front of management which will make the risks respond planning much more easier and practical. The principal research contributions of the proposed research are summarized as follows:

- Improvement of using AHP method in Portfolio Risk Analysis.
- Evaluating and prioritizing the identified risks within portfolios where there are several projects under-going at the same time.

1.3 Objectives of the Study

The main aim of the study is to using the Multi Criteria Decision making method in order to portfolios' risk ranking and the objectives of study are as following:

1) To refine the portfolio's risks framework with consideration of AHP decision making method.

2) To develop systematic approach in using AHP method for portfolio risk analysis.

3) To apply the refined decision making framework for a selected organization for portfolio risk management.

1.4 Scope of the Study

The scope of this study is targeting the portfolios which are dealing with several projects at the same time to handle the identified risks in oil and gas industry. The reason for selection the oil and gas industry as a platform industry for this study is the pioneer role of such industry in project management issues as they are dealing with mega projects concurrently. The selected method to dealing with the decision making process of the study is selected among the practical Multi Criteria Decision Making (MCDM) models

1.5 Brief Research Methodology

This project is composed of five main stages; Literature review on portfolio risk analysis, eliciting the original framework of portfolio decision making ,refinement of the elicited framework thanks to nominal process, prioritizing the projects within portfolio , incorporating the project ranking into risk management process to come up with the overall risk severity factor.

The aforesaid steps are elaborated in more details schematically hereinafter as shown in Figure 1.1. It is worth to mention that the more detail of each step and the methodology inside each stage have been discussed and mentioned in chapter three. Moreover, in the end, it is hoped that the implemented methodology in this study will be used as a basis for organizations in oil and gas field as the practicability of the method has been proved through case study in the second large company in the world in terms of capital investment which is running many mega projects all around the world.

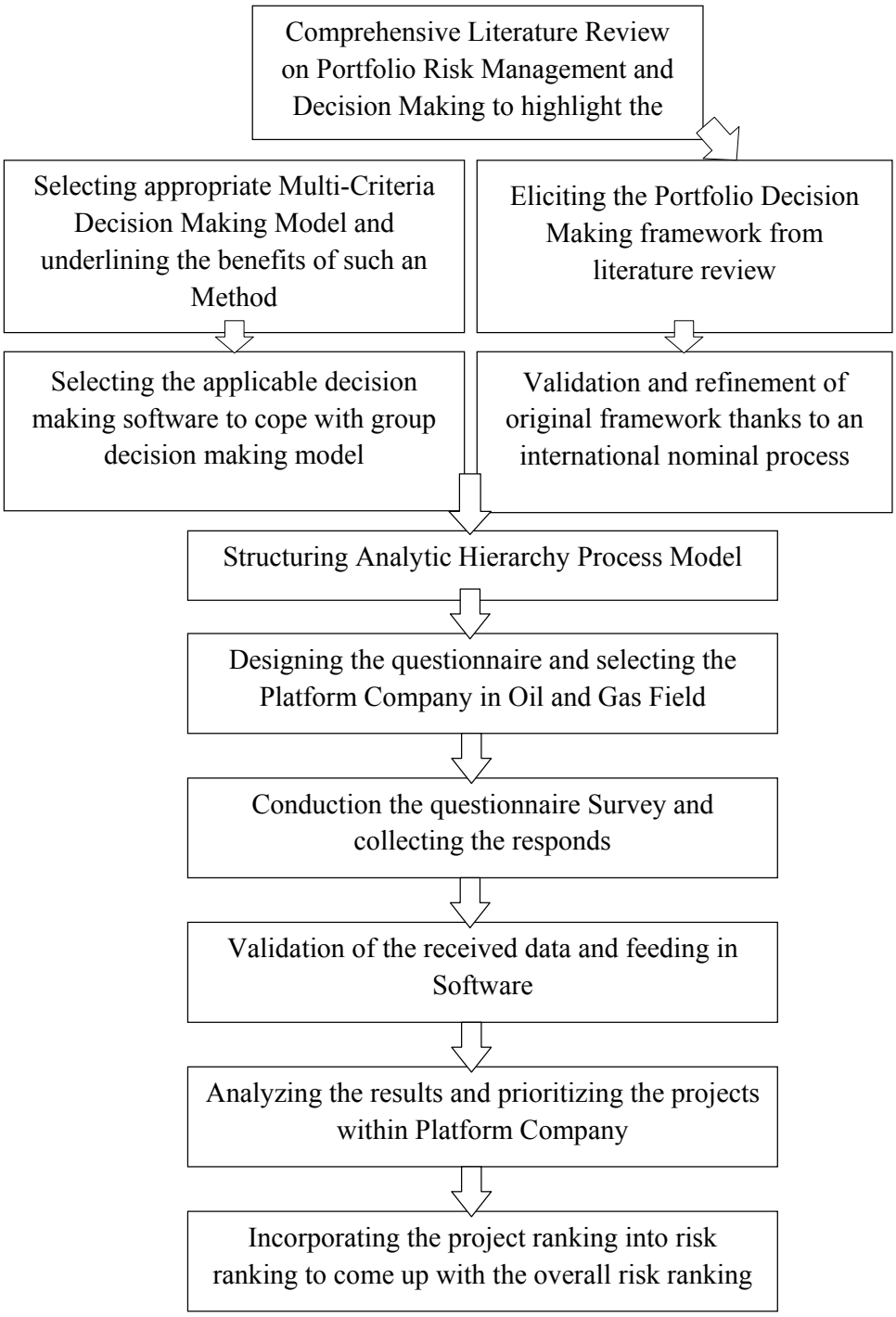

Figure 1.1: Methodology for implementing the study

1.6 Organization of Thesis

This thesis consists of five chapters. In Chapter 1, general introduction of the project, research background, contributions, objectives, scopes and methodology is described to explain the purposed implementation of this project.

Chapter 2 represents the principal concepts, basic theories and reviews of the previous proposed researches through literature reviews. The reviews consist of decision making, AHP modeling, group decision making process, portfolio management and risk management. The methodology of doing the study and the overall concepts of the methods used in this study are described in Chapter 3. AHP is used to base the concept of the study; hierarchy of the model is refined based on nominal process.

The questionnaire survey is discussed in Chapter 4, the respondents to the questionnaire have been selected and after conducting the survey the result is collected and validated. In chapter 5, the collected data have been feed in established model and the weights of all criteria in the hierarchy have been calculated.

Eventually in Chapter 6 the outcomes of the project come to conclusion and future works are outlined.

REFERENCES

1. Acerbi, C., Simonetti, P., 2002. *Portfolio optimization with spectral measures of risk.* Working paper, Abaxbank, Italy.

2. Acerbi, C., Simonetti, P., 2002. *Portfolio optimization with spectral measures of risk.* Working paper, Abaxbank, Italy.

3. Al-Bahar JF, Crandall KC. *Risk management in construction projects*: a systematic approach for contractors. In: Counseil International du Batiment W55/W65 Joint Symposium. Sydney, 14±21 March, 1990

4. Artzner, P., Delbaen, F., Eber, J.-M., Heath, D., 1999. *Coherent risk measures*. Mathematical Finance 9 (3), 203–228.

5. Belton V. *Multiple criteria decision analysis Ð practically the only way to choose.* In: Hendry LC, Eglese RW, editors. Operational research tutorial papers. 1990, pp. 53±102

6. Belton V, Gear T. *On a shortcoming of Saaty's method of analytical hierarchy*. Omega 1983;11(3):228±30.

7. Belton V, Gear T. *The legitimacy of rank reversal Ð a comment.* Omega 1985;13(3):143±4.

8. Bassett, G.W., Koenker, R., Kordas, G., 2004. *Pessimistic portfolio allocation and Choquet expected utility*. Journal of Financial Econo-metrics 2 (4), 477–492.

9. Brooks, C., Kat, H.M., 2002. *The statistical properties of hedge fund index returns and their implications for investors.* Journal of Alterna-tive Investments 5, 26–44.

10. Cooper, R.G., Edgett, S.J. and Kleinschmidt, E.J. (2004), *"Benchmarking best NPD practices – II"*,Research Technology Management, Vol. 47 No. 3, pp. 50-9.

11. Cooper, R.G. and Edgett, S.J. (1997), *"Portfolio management in new product development: lessons from the leaders – I",* Research Technology Management, Vol. 40 No. 5, pp. 16-29.

12. Cheklov, A., Uryasev, S., Zabarankin, M., 2005. *Drawdown measure in*

portfolio optimization. International Journal of Theoretical and Applied Finance 8 (1), 13–58.

13. Chabaane, A., Laurent, J.-P., Malevergne, Y., Turpin, F., 2006. *Alternative risk measures for alternative investments.* Journal of Risk 8 (4), 1– 32.

14. De Giorgi, E., 2005. *Reward risk portfolio selection and stochastic dominance.* Journal of Banking and Finance 29 (4), 895–926.

15. Denuit, M., Dhaene, J., Goovaerts, M.J., 2006. *Actuarial theory for dependent risks.* Wiley.

16. Dyer JS *Remarks on the analytical hierarchy process*. Management Science1990;3:249±58

17. Embrechts, P., Frey, R., McNeil, A., 2005. *Quantitative risk management: Concepts, techniques and tools.* Princeton University Press.

18. Giamouridis, D., Vrontos, I.D., 2007. *Hedge fund portfolio construction: A comparison of static and dynamic approaches.* Journal of Banking and Finance 31, 199–217.

19. Heyde, C.C., Kou, S.G., Peng, X.H., 2006. *What is a good risk measure: Bridging the gaps between data, coherent risk measures and insurance risk measures.* Working paper, Columbia University.

20. Krishnan, V. and Ulrich, K.T. (2001), *"Product development decisions: a review of the literature",* Management Science, Vol. 47 No. 1, pp. 1-21.

21. Kahneman, D., Tversky, A., 1979. *Prospect theory: An analysis of decision under risk.* Econometrica 47 (2), 263–291.

22. Krokhmal, P., Uryasev, S., Zrazhevsky, G., 2002. *Risk management for hedge fund portfolios.* Journal of Alternative Investments 5 (1), 10– 29.

23. Lifson MW, Shaifer EF. *Decision and risk analysis for construction management.* New York: Wiley, 1982.

24. Morton, D.P., Popova, E., Popova, I., 2006. *Efficient fund of hedge funds construction under downside risk measures.* Journal of Banking and Finance 30, 503–518.

25. Markowitz, H.M., 1952. *Portfolio selection.* Journal of Finance 7 (1), 77– 91.

26. Pearson D. *Managing public sector risk.* In: ARIMA Conference, Perth, Western Australia, 17th October, 1994, p. 84±90.

27. Pearson, A.W., Stratford, M.J.W., Wadee, A. and Wilkinson, A. (1996), *"Decision support systems in R&D project management"*,in Gaynor, G.H.

(Ed.), Handbook of Technology Management, McGraw-Hill, New York, NY, pp. 15.1-15.23.

28. Rockafellar, R.T., Uryasev, S., Zabarankin, M., 2006. *Master funds in portfolio analysis with general deviation measures.* Journal of Banking and Finance 30, 743–778.

29. Saaty TL. *The analytic hierarchy process*. New York: McGraw Hill, 1980.

30. Souder, W.E. and Mandakovic, T. (1986), *"R&D project selection models",* Research Management, Vol. 29 No. 4, pp. 36-42.

31. Scaillet, O., 2004. *Nonparametric estimation and sensitivity analysis of expected shortfall.* Mathematical Finance 14 (1), 115–129.

32. Schuyler JR. *Decision analysis in projects*. Upper Darby, PA, USA: Project Management Institute, 1996

33. Treasurer's Instruction 109 Ð Risk Management. *Western Australian Government*, July 1997.

34. Tasche, D., 2002. *Expected shortfall and beyond.* Journal of Banking and Finance 26 (7), 1519–1533.

35. Watson SR, Freeling ANS. *Assessing attribute weights.* Omega 1982;10(6):582±3.

36. Wang, S.S., Young, V.R., Panjer, H.H., 1997. *Axiomatic characterization of insurance prices.* Insurance: Mathematics and Economics 21 (2), 173–183.

37. Yaari, M.-E., 1987. *The dual theory of choice under risk.* Econometrica 55 (1), 95–115