Chapter 5 Risk Analysis Techniques used by AHL in Comparison to Other Oil Companies.

Thus far, this thesis has studied risk management from a theoretical perspective by extracting all the relevant information from extensive literature consisting of the most up to date publications. It was this literature review that formed the basis for the RMQ. The replies to the questionnaire have been evaluated in Chapter 4. It is now necessary to single out one company, who have sponsored this Doctoral Thesis, from the total replies to examine more issues on risk management in greater detail to endeavour to improve or modify the methodology of certain aspects of their risk management process. This is accomplished by understanding the current methods, by reading the many documents that are required for a major project, and altering these processes in the attempt to attain better results. From the five components that comprise the risk management process, Figure 2.1, only one is able to be changed from an external position. This component is risk analysis, or more specifically risk estimation. The other constituents, namely identification, evaluation, response and monitoring, are all very dependent on the attitudes and perceptions of the company under scrutiny and to suggest alterations to any of these would require the author to be in permanent employment, which was not possible. Therefore, for that reason alone the methodologies of the risk analysis techniques were investigated and attempts were made to improve these methods. Hence, the first aspect of this case study is to ascertain which risk analysis methods AHL use, by extracting the relevant information to the pertinent questions from the total replies to the questionnaire.

5.1 Risk Analysis Techniques used by AHL

5.1.1 Introduction

As already discussed in section 4.7.3, questions 43 to 45 from the questionnaire deal directly with the techniques that analyse risks. These three questions were, in Chapter 4, very important in determining the frequency and success of the present day techniques used in construction and the oil industries. However, for the purpose of this case study the emphasis now concentrates on the oil replies alone. The relevant information from the replies to these questions has been elicited to identify the more prominent methods used by the oil industry, with the expectation of recognising the most successful ones for the companies to either continue using or to experiment with. It is also the aim of this case study to ascertain which techniques are used by AHL. Distinguishing the contrariety in the techniques applied by AHL against the oil industry as a whole is not entirely satisfactory, so the author has also taken the replies from another of the world's leading oil companies, who will remain anonymous to protect its confidential replies to the questionnaire, in order to enable direct comparisons between two individual companies as well as from the industry at large. This company is referred to as company 'Y'. The principal objective is to propose new or refined methods to improve or modify AHL risk analysis methodology, which will ultimately improve their overall risk management life-cycle.

Obviously, the same qualitative and quantitative techniques as those used in section 4.7.3 are the focus of this case study. The ranking system and the methods of evaluating the replies are identical to those explained in section 4.7.3. As expected, the rank 5 phenomenon is again appropriate for obtaining the values present in Table 5.1 and Table 5.2. The first aim, however, is to ascertain whether the oil industry or the 2 companies use these two types of methods singularly or in combination.

5.1.2 The type of techniques used. (Qualitative, Quantitative, or a combination of the two)

Questions 43 determines whether the companies use one or other of qualitative or quantitative methods, or both as a combination. As mentioned in section 4.7.3, 42 replies were obtained for this question from the oil industry with the results illustrated in Figure 5.1. Of these 42 replies, 5 were from AHL and 11 were from company Y. An additional 5 from AHL were canvassed for this section alone, increasing the replies from AHL to 10. It is well understood, by the author, that drawing any conclusions from sample sizes of 10 and 11 could be biased. This problem cannot, unfortunately, be remedied, although the author did approach more personnel from both companies to increase the sample, but due to a lack of company time, the sample sizes of 10 and 11 remained. However, it is the purpose of this chapter to highlight which techniques are used and most successful for risk analysis within the three sets of data and these limited sample sizes achieved this objective.

Studying Figure 5.1, one can clearly notice that the uses of just qualitative methods are extremely rare. A similar picture can be portrayed for the quantitative techniques. Approximately 98% use a combination of both techniques. Further, the candidates from the two companies in question were all in this bracket, leaving the singular reply being answered by an employee from a different oil company. Now, an examination of the two types of methods, qualitative and quantitative, follows to see which exact combination seems to be most successful.

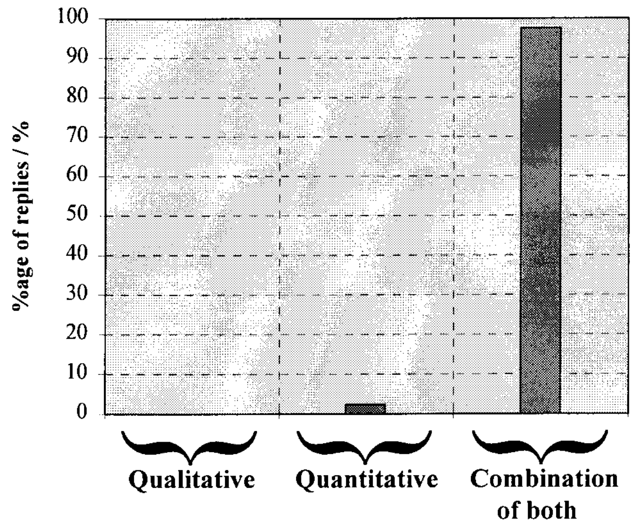

Figure 5.1 *A summary of the replies for the type of techniques used for risk analysis*

5.1.3 An analysis of the risk analysis techniques used by the oil industry, AHL and company Y (Questions 44 and 45)

For the three categories, namely the oil industry as a whole, AHL and company Y, the method, see section 4.7.3, of reviewing the percentages of respondents answering specific ranks is taken further. This section analyses the responses from the three categories, by examining the proportions of respondents answering ranks 1 and 2. This section further extracts the proportions of replies to ranks 1, 2 and 3. Table 5.1 represents the frequency and success of the qualitative techniques and Table 5.2, the quantitative. The two tables are in order of the most frequently used or most successful to the least, from an oil industry perspective to answering ranks 1 and 2.

Table 5.1 and Table 5.2, illustrate three different samples, although two of them have been extracted from the larger one. Nevertheless, one can clearly observe the types of techniques that are currently being utilised by two large companies and by the oil industry as a whole. From this information, it is possible to ascertain which techniques produce successful analysis of risks. These two questions themselves only identify the technique names. The specific processes, which can and do vary from one company to the next, need to be procured from the companies very own documents. The objective here is to distinguish the techniques that need pursuing, for the benefit of AHL.

The system for evaluating the data presented in Table 5.1 and Table 5.2 could potentially be quite confusing. Therefore, to ease this problem some fundamental directives, or guidelines are implemented. These directives have been revised and are more focused than those used in section 4.7.3. They are:

1. Any technique that has 40%, or more, respondents replying to ranks 1 and 2 is regarded, to be frequently, or successfully, utilised as an integral part of risk analysis. Obviously the higher the mean rank the more frequently, or successful, it is put to use. These values are highlighted by a light shading. Their respective values when including rank 3 are then introduced and discussed if necessary
2. Any technique that has less than 40% respondents replying to ranks 1 and 2 is regarded to be sparsely used, or not successful, as the percentage suggests. The reality is that these methods are probably used in specific situations. However, the objective of this exercise is to ascertain the methods pertaining to the norm, hence these guidelines, and not individual occurrences.

3. Any technique with a success percentage significantly higher (i.e. by 20%) than its respective frequency figure is highlighted in a darker shade and duly discussed.

Forty percent was used as a threshold value because it falls slightly below the majority figure of 50%, which would be optimal, but in order to take account for the 'rank 5 phenomenon', 40% became the assumed value.

These guidelines also have another advantage. They avoid comparisons made between the three sectors as to the physical positions of the techniques. This comparison, without looking more carefully at the actual proportions could be misleading.

Evaluating the qualitative methods first, Table 5.1 and using guideline 1, one can see, from an oil industry perspective, that the six techniques are divided into two equal classes when evaluating the frequency of their use. The three most regularly applied are engineering judgement, personal and corporate experience and brainstorming. It has always been known that experience and engineering judgement have been qualities that are crucial in everyday work and not just in risk analysis. Brainstorming is clearly a preferred technique over interviewing. However, upon examination of how successful these methods are, interviewing is regarded to be as successful as brainstorming. This is to be expected as both are fundamentally identical in that they use direct subjective interaction to achieve results. Brainstorming probably takes less time to organise and to achieve results and is thus practised more frequently. There is a major difference between the two companies regarding interviewing as a qualitative technique. AHL use this technique as often as brainstorming and find it to be as successful. Company Y, on the other hand, use it rarely, but when employed find it relatively successful.

The one other method, percentage contingency from historical data, is not used very often, but conforms to the first guideline, 1 above, and is generally successfully employed. This method is still utilised by many companies with varied success. One only has to compare the results of the two chosen companies. AHL occasionally applies this method, with little success. Conversely, the other leading company implements it more often and finds it to be very successful, hence the darker shading. This technique relies heavily on the updating of data and the classification of that data, and one of the explanations for this discrepancy between the two companies could be that company Y produces enhanced user friendly databases which are constantly maintained, and the data updated frequently. The data which results from this method could be the input source for the more complex mathematical quantitative techniques, discussed later. The only method outside of this bracket is fuzzy set analysis, which has generally been neglected by the oil industry and the two individual companies alike. Other than the differences just outlined, the two companies' percentage figures for the remaining techniques are comparable. However, the candidates from company Y are generally more satisfied with the actual performance and success of the techniques than AHL, as confirmed by the higher percentages of respondents allocating ranks 1 and 2. Further, the percentages for the success of the qualitative techniques are all lower than their respective frequency percentages, suggesting that the techniques are not being used to their full potential. More of this later though.

By analysing the quantitative techniques, see Table 5.2, using guideline 1, one can notice that for the oil industry, as a whole, there are only four techniques used frequently by over 40%. These four are ENPV, scenario analysis, break-even analysis and decision tree. One can clearly identify that these four techniques are the top four in AHL, albeit in a different order. The other leading oil company, company 'Y', however, employs seven methods. In addition to the four mentioned above, they also use EMV, algorithms and simulation. Therefore, company Y is more diverse in its usage of quantitative techniques than either AHL or their oil company counterparts.

Qualitative Techniques	Percentages of replies with ranks 1 and 2 and 1, 2 and 3 (%)					
	Oil Industry		AHL		Another leading company: Y	
	No. of replies = 42		No. of replies = 10		No. of replies = 11	
	1 and 2	**1, 2 and 3**	**1 and 2**	**1, 2 and 3**	**1 and 2**	**1, 2 and 3**
Frequency						
P and C Experience *	75.61	90.24	66.67	100.00	77.78	100.00
Engin. Judgement *	73.17	82.93	83.33	100.00	100.00	100.00
Brainstorming	51.22	80.49	66.67	100.00	66.67	88.89
% contingency *	39.02	63.41	40.00	80.00	44.44	77.78
Interviewing	19.51	51.22	60.00	100.00	11.11	33.33
Fuzzy set analysis	0.00	14.63	0.00	0.00	0.00	11.11
Success						
Engin. Judgement *	80.00	100.00	66.67	100.00	100.00	100.00
P and C Experience *	59.46	97.30	50.00	100.00	55.56	100.00
Brainstorming	51.22	80.49	50.00	100.00	55.56	100.00
% contingency *	48.28	82.76	20.00	80.00	71.43	85.71
Interviewing	42.31	100.00	40.00	100.00	33.33	83.33
Fuzzy set analysis	14.29	57.14	0.00	0.00	0.00	50.00

Scale which was used in the questionnaire: Frequency: Used very often 1 2 3 4 5 Never used
Success Very successful 1 2 3 4 5 Not successful

* Engin. judgement = Engineering judgement; % contingency = Percentage contingency from historical data
P and C Experience = Personal and corporate experience;

Table 5.1 *A table illustrating the frequency and success differences in the qualitative risk analysis techniques used by AHL and Y and the Oil Industry as a whole.*

The methods EMV and ENPV are most commonly used when deciding on which exploratory wells to build upon, i.e. once seismic survey has taken place to show oil and gas presence in the form of fields, and exploratory wells have confirmed it is, the job of these two techniques is, as a lucrative business decision tool, to determine which well to construct a platform over. Therefore, these two methods really concentrate on financial risks, which is outwith the scope of this thesis.

Further exploring quantitative aspects, it is necessary to evaluate the techniques using the latter two directives, 2 and 3. Assembling the information currently attained, Table 5.2 has shown there to be between four and seven techniques that are frequently exercised. Looking at Table 5.2 from a different angle, it is possible to suggest which techniques are very rarely used, and moreover not successful. Since the objective of this table is to ascertain the methods which are favoured on a regular basis, it would be beneficial to strike off the techniques, obtained from the replies of the respondents, which will, in the foreseeable future, never be used as an integral part of the oil industries' strategy to analyse risk. Looking at all three categories in Table 5.2, one can conclude that there are three methods which qualify for this classification. These methods are portfolio theory, stochastic dominance and EMV incorporating the Delphi peer group.

Examining the oil industry category, one can determine that the majority of success percentages for the quantitative techniques are greater than their frequency values, with six of them coming under the first directive, i.e. above 40%. Particular attention should be made to two techniques, namely EMV and simulation, as a substantial increase in the two percentages has occurred. This means that these techniques could, and maybe should, be used more regularly. The remaining methods, although having success percentages higher than their respective frequency values are still either not successful enough, i.e. they fall into directive 2, or are not abundantly used to merit further consideration when trying to ascertain the common techniques. Comparing the two individual companies against the oil industry and themselves produces some very interesting conclusions.

Firstly, trying to avoid physical positions within the three divisions, which are quite different, one can determine that AHL have only two techniques under the first guideline, and even then the values are just 40%, which in itself is quite alarming. When comparing AHL's percentages to ranks 1 and 2 to the oil industry, one clearly discovers that all are lower. Even worse, especially with the more frequently used techniques, the percentages for the success of the methods are lower than their respective frequency values, which suggests a lack of confidence in the use of these methods. Most of the values are at 0%, which suggests no success at all. However, if one studies the next column where rank 3 is included, the values dramatically increase, implying the successful use of the quantitative techniques is very average. Therefore, it is clear that AHL must improve their use of these risk analysis techniques. The employees, albeit a small proportion, feel that these quantitative techniques, which are believed by the oil industry to be the best ones, are not properly being used and the success figures need to improve. This is coupled with heavy usage with average success of the qualitative techniques, identified earlier. All this information suggests that AHL are dependent upon the initial aspects of risk analysis, i.e. qualitative, and are slightly inadequate in the latter stages, i.e. the quantitative side. This could be disastrous and is an area which requires considerable attention. The values for the success of the quantitative component of risk analysis need bolstering and could be done by improving the reliability of the input data for such analyses. The author, in Chapter 6, proposes achieving this goal through the use of simulation.

Having said that, simulation, when used by AHL is the exception within the quantitative techniques. Its success value is higher than the associated frequency figure. It is also a technique employed successfully by company Y, as well as the industry in general. Of the many simulation packages available at present, the packages that were repeatedly declared, from the questionnaire, were @RISK and less frequently BRISK. By examining the replies to the use of simulation, and @RISK in particular as a package, it is possible to attain the mean values allocated to this package. Of the respondents that gave replies to simulation, a significant proportion (30.56%) specified the employment of @RISK, and the respective frequency and success mean values were 1.60 and 2.07. This implies that the respondents that use @RISK, for their simulation, employ it regularly and regard the package to be extremely successful.

Contrary to AHL's figures, company Y's percentages illustrate how successful these methods can be. There were over 40% of respondents from the other leading company who allocated ranks 1 and 2 to eleven of the techniques postulated for their success. These eleven can be observed in Table 5.2, with five of the percentages substantially higher. Again, like the oil industry sector, most of the success percentages were higher than their frequency counterparts. This suggests more confidence shown in their methods than AHL. The explanation for this could be that

Quantitative Techniques	Percentages of replies with ranks 1 and 2 and 1, 2 and 3 (%) Oil Industry		AHL		Another leading company: Y	
	No. of replies = 42		No. of replies = 10		No. of replies = 11	
	1 and 2	1, 2 and 3	1 and 2	1, 2 and 3	1 and 2	1, 2 and 3
Frequency						
ENPV *	54.76	73.81	80.00	80.00	77.78	77.78
Scenario Analysis	50.00	72.50	75.00	75.00	77.78	88.89
Decision tree	47.62	76.19	60.00	80.00	40.00	80.00
Break-even analysis	47.50	67.50	75.00	100.00	55.56	88.89
EMV *	38.10	57.14	20.00	40.00	77.78	88.89
Decision matrix	33.33	50.00	20.00	40.00	30.00	60.00
Algorithms	33.33	42.86	20.00	40.00	40.00	60.00
Simulation	30.00	37.50	25.00	25.00	44.44	55.56
RADR *	17.50	27.50	25.00	75.00	33.33	44.44
Stoch. dec. tree *	10.26	30.77	25.00	50.00	11.11	22.22
Bayesian theory	10.00	25.00	25.00	25.00	11.11	33.33
EMV + Delphi *	2.50	17.50	0.00	0.00	0.00	11.11
Portfolio theory	2.50	12.50	25.00	75.00	0.00	11.11
Stoch. dominance *	0.00	5.00	0.00	25.00	0.00	11.11
Success						
EMV *	64.00	96.00	0.00	75.00	100.00	100.00
ENPV *	59.38	96.88	40.00	100.00	87.50	100.00
Scenario Analysis	55.17	93.10	33.33	100.00	75.00	88.89
Simulation	52.63	73.68	33.33	67.00	66.67	66.67
Decision tree	44.12	94.12	40.00	80.00	44.44	88.89
Algorithms	43.48	73.91	0.00	66.67	50.00	62.50
Decision matrix	38.46	88.46	0.00	66.67	71.43	85.71
Break-even analysis	34.48	79.31	0.00	100.00	50.00	87.50
RADR *	33.33	55.56	0.00	66.67	50.00	66.67
Bayesian theory	26.67	60.00	0.00	33.33	60.00	60.00
Stoch. dec. tree *	18.75	62.50	0.00	66.67	40.00	40.00
EMV + Delphi *	7.69	38.46	0.00	0.00	0.00	50.00
Portfolio theory	0.00	46.15	0.00	50.00	0.00	50.00
Stoch. dominance *	0.00	33.33	0.00	33.33	0.00	66.67

Scale which was used in the questionnaire: Frequency: Used very often 1 2 3 4 5 Never used
Success Very successful 1 2 3 4 5 Not successful

* EMV = Expected monetary value; ENPV = Expected net present value;
Stoch. dominance = Stochastic dominance; EMV with Delphi = EMV using Delphi peer group;
RADR = Risk adjusted discount rate; Stoch. dec. tree = Stochastic decision tree;

Table 5.2 *A table illustrating the frequency and success differences in the quantitative risk analysis techniques used by AHL and Y and the Oil Industry as a whole.*

the other leading company could employ and exploit these techniques differently to AHL and due to these subtle differences, the results may become more successful. These differences are impossible to ascertain as the documents containing the techniques and methods used by other companies are mostly confidential, and thus unavailable. However, one of the assumed principal reasons for this extra confidence is the methods of attainment for risk levels, presented in frequencies per annum, are more advanced and incorporate some form of uncertainty quotient. This could be performed using certain simulation packages, and is discussed further in Chapter 6.

5.2 Concluding remarks

The information contained in section 5.1 is extremely valuable to any readers from the oil industry, and indeed other industries interested in improving risk analysis, as it identifies which techniques should be examined and tested first, given that the specifics of the project satisfy the requirements of the method. The author has specified and targeted simulation, purely for the purposes of this Doctoral thesis. This does not detract from the fact that any of the other identified techniques can be used for quantitative risk analysis. Further, these techniques also have the potential for improvement.

Concluding this analysis of questions 44 and 45, one can infer that the difference between the oil companies is their contrasting views on the usage of quantitative techniques, and how those techniques should be applied. The frequency and success of the qualitative methods, in comparison, are similar. This is fortunate as attempting to modify these techniques would be very difficult. The reason for this is that all six approaches are very subjective in nature and require knowledge, judgement, opinions etc. which are qualities gained only from experience. In fact, all the five stages of risk management have varying degrees of subjective inputs and thus outputs, and thus are very difficult to change as these methods are performed differently by similar companies. Some of the stages, like risk identification for example, are wholly dependent upon subjective material. Hence, one attempting to standardise or improve these stages of the risk management life-cycle is very hard, and is not possible until many years of experience have been attained.

However, one of the sub-stages can be improved. This is the quantitative slant to risk analysis. Here, the techniques used are more scientific and mathematical and as such are able for criticism or praise. Therefore, the quantitative techniques are the focus for the remainder of this Doctoral Thesis, with simulation being the crux of the investigation. Nevertheless, some of the input information into these techniques is still subjective in nature. The potential ironing out of this element is the aim of Chapter 6 of this thesis. With the proposals made by the author and by the use of simulation, this subjective constituent could be more objective.

Simulation is one of the more notable techniques utilised relatively infrequently by company Y, and the oil industry, but has displayed significant success. AHL, not only use this method less often, but also find it to be less productive. It is for this reason the investigation was undertaken. The author takes the technique of simulation and uses it to improve the quantitative analysis characteristics of the risk estimation process, essentially for AHL, but also for the oil industry in general. One is not saying that the remaining techniques cannot be refined and improved, as they can and must be, but the general feeling of future quantitative risk analysis is that simulation is beginning to develop into a critical component for analysing technical risks.