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Risk response techniques employed currently for major projects

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Risk management is fundamental to the success of a major project. However, the variations in using risk management practices are considerable and are dependent on numerous factors such as the industry sector, the size of the project, and the stage in the project life cycle. One of the major constituents of successful risk control is the use of risk response. This paper concentrates on the choice and use of the most successful risk response techniques within the oil and gas industry and compares them with the use of those chosen by the construction industry. Results were ascertained through a survey of over one hundred companies within these two sectors by use of an extensive questionnaire. The main conclusions are that risk reduction as a response to assessed risks is most commonly used by both sectors; and that the construction industry concentrates almost exclusively on reduction of financial risk. It is proposed that the construction industry can benefit greatly from the more experienced oil and gas industry in managing technical risk which, with the advent of private funding, is likely to become a more predominant part of construction procurement.

Keywords: Risk management, risk response

Introduction

Risks are ever present. Depending on the uncertainties and the consequences, they are accepted routinely, and measures are taken to minimize their consequences. Risks are anticipated when driving a car and, as a response to this, a motor insurance policy provides 'cover' in case of an accident. Extending this to the management of the risks within the construction industry and the oil and gas industry is not straightforward. Further, the consequences of an accident can be significantly greater, such as in the Piper Alpha disaster in the North Sea (Cullen, 1990). Therefore, within these industry sectors there is continual and detailed management of risks, conducted at all stages of a project life cycle, from feasibility to decommissioning (Buchan, 1994). Despite risk management being a growing element of major projects, there is no standard to which reference may be made for techniques, factors and approaches, and it was this lack

of information that led to the research described in this paper.

It has to be acknowledged that the oil and gas industry has far greater experience in risk management than does the construction industry. An extensive literature review had illustrated that within the oil and gas industry risk management is routine, but within the construction industry only some companies employ it (Lock, 1992). With this in mind, the main objectives of the work presented, which are twofold, can be stated. First, it is appropriate to determine and then compare the risk management techniques that have been adopted by the construction industry, and the oil and gas industry. In particular, the ways in which these two industries respond to identified risks is investigated and the reasons for any differences are discussed. Second, the question is raised as to whether the construction industry can benefit from the experience of the oil and gas industry, and an attempt is made to answer this. The paper concludes by summarizing the

information elicited from a questionnaire survey and placing this in the context of a changing construction industry.

Risk management in current practice

Buchan (1994) took three processes, namely risk identification, analysis and response, and implemented a 15-step sequence to account for risk management. He concluded that the process is a simple step by step procedure, but if it is followed then beneficial results and a stable risk environment should be attained.

Three steps for risk management are identified by Buchan (1994), but this had been four in Bostwick's (1987) paper, and is five in Nummedal *et al.* (1996), Eloff *et al.* (1993) and British Standards BS 8444 (BSI, 1996). It is these five steps that are most commonly used in contemporary risk management. By using the terminology from BS 8444: 1996, the systematic five steps involved for a comprehensive risk management process are

- Risk identification
- Risk estimation
- Risk evaluation
- Risk response
- Risk monitoring

These five stages fit together into a simple circular procedure which, if maintained, yields a controlled risk environment (Figure 1). The stages of risk identification and estimation also can come under the broader title of risk analysis. Risk analysis, with risk evaluation, can be grouped under risk assessment, with response and monitoring collectively entitled risk control. Of these five, the stage of risk response is the focus in this paper.

Methodology

Information on risk response techniques was gathered through the use of a questionnaire survey, targeted at

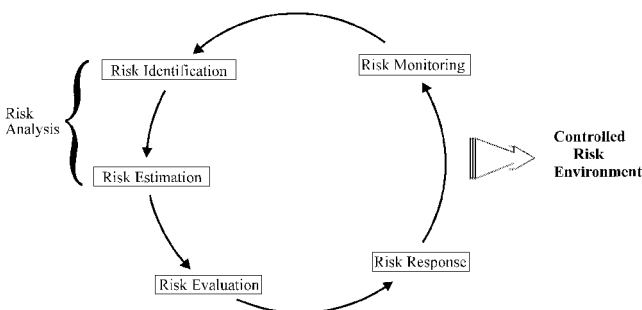


Figure 1 Risk management life-cycle

relevant companies within the construction and oil and gas industry. The investigation of risk response techniques was part of a larger study of risk management in general, which elicited information on how such companies, in the terminology of BS 8444: 1996, analysed and then evaluated and finally controlled risks. The investigation involved three stages: (a) questionnaire design; (b) selection of the sample; and (c) analysis of the responses. The questionnaire was initiated and based on extensive discussions with many risk analysts within a major construction company and a principal oil company. Many versions of the questionnaire were piloted out to a number of industrial personnel from the construction industry and experts in the field of oil exploration, before the final version was dispatched.

The questionnaire contained 56 questions split into seven separate sections: (i) background information to elicit information about the respondent and the company itself; (ii) general risk questions, determining general practices, policies and attitudes of the company; (iii) risk transfer, determining if, how and why this risk response is used; (iv) risk retention; (v) risk reduction; (vi) risk analysis, with specific questions on the identification and estimation of risk; and (vii) specific risks, seeking more information regarding the types and variation of risks experienced by the company.

The research presented is intended to be relevant to 'major' projects; therefore, only the 100 largest construction companies listed in Jordan's (1992/93) were included in the survey. The oil and gas industries constitute a relatively much smaller unit in terms of number of players, but with the majority dealing with projects that can be considered major. Therefore, all the oil companies (M-G, 1994/95) currently operating in the UK were targeted.

According to good survey practice (Tull and Hawkins, 1990), a letter was sent to the Chief Executive/Managing Director of the chosen companies, introducing the research and requesting their input. Referred to in the letter was a request for names of the staff directly associated with risk management, who would subsequently be canvassed for opinions. These members of staff could be from a variety of areas within the company, such as finance, insurance, safety, design, exploration, installation and operations.

Summary of the questionnaire replies

The survey was carried out over the period extending from March to December 1995. The questionnaires were posted to named individuals in May 1995, with a suggested date for return at the end of June 1995.

Questionnaire returns were received over the next four months, in some cases after a phone call reminder. Multiple copies of the questionnaire were distributed to the 107 companies who expressed an initial interest. Completed questionnaires were received eventually from 52 of these companies, with a total of 139 responses from individuals. The breakdown between the industries is given in Table 1. The response rate for completed questionnaires was high. Of the 55 non-completions, 33 of those companies did not respond at all. Eleven of those who did said that they were unable to participate because they were too busy or the questionnaire too lengthy, while the remaining eleven declared that it was company policy not to take part in surveys.

Primary responsibility of the respondents

The primary responsibility of the respondents to the questionnaire should indicate important information as to the policies and attitudes of the company to the type of risk that is managed. For example, a company which places little emphasis on financial risk may not employ financial people to assess and control risk of a different nature. It is for this reason that the first question asks the respondent which area is his/her primary field of responsibility.

Table 2 contains the aggregated replies of the 93 respondents from the construction industry and 46 from the oil and gas industry; also it illustrates how each of these two industries is proportioned with respect to the primary responsibility of the respondents. It can be seen that the differences between the industries are small with respect to primary responsibility, with the notable exception of two categories: safety/risk and finance. As could be perhaps anticipated, the oil and gas industry is extremely safety conscious because of their working environment. This has been enhanced by events such as Piper Alpha, and therefore accountability for safety/risk is of prime importance. Thus, as also commented by Powell (1991), there is an ever increasing abundance of risk analysts or similar within the oil business.

Table 1 Breakdown of responses

Industry	No. of companies who showed immediate interest	No. of companies who replied	Responses (%)	Actual No. of completed questionnaires
Construction	80	40	50	93
Oil	27	12	44.4	46
Total	107	52	48.6	139

Table 2 Proportions of primary responsibility for total replies and by industry

Primary responsibility	Aggregate (%)	Construction (%)	Oil and gas (%)
Safety/risk	23	14	41
Finance	15	22	2
Gen. management	27	26	28
Design	7	4	13
Construction	9	13	2
Insurance	7	6	7
Other	12	15	7

Conversely, the construction industry relies on well established technologies and operates in physical environments considerably less hostile. In terms of severity of hazard, safety/risk is of relatively lesser importance than for its oil and gas counterpart. However, the construction industry operates in a much harsher financial environment (Edwards, 1995), and this is reflected in the significantly higher percentage of financial analysts responding to the questionnaire. The construction industry seems to place more emphasis on financial risk.

Risk response methods

It is appropriate to describe briefly the methods available for responding to risk. Raftery (1994) has identified four possible techniques: risk elimination, risk transfer, risk retention and risk reduction. An analysis of the results obtained from the questionnaire will reflect these techniques.

Risk elimination

Risk elimination is sometimes referred to as risk avoidance. A contractor not placing a bid or the owner not proceeding with project funding are two examples of eliminating the risk totally. There are a number of ways through which risks can be avoided, e.g.: tendering a very high bid; placing conditions on the bid; pre-contract negotiations as to which party takes certain risks; and not bidding on the high-risk portion of the contract (Carter and Doherty, 1974).

Risk transfer

Risk transfer can take two basic forms (Thompson and Perry, 1992): (a) the property or activity responsible for the risk may be transferred, i.e. hire a sub-contractor to work on a hazardous process; or (b) the property or activity may be retained, but the financial risk transferred, i.e. methods such as insurance. There

are other ways of using insurance as a means of transferring the risk, for example, through risk sharing or establishing a captive insurance company. The four forms of risk sharing (Hertz, 1964) are co-insurance, re-insurance, excess or deductible, and first loss cover. A captive insurance company (Edwards, 1995) is a privately owned insurance company directly related to risk management. A 'captive' is created and owned by an organization; it insures all the risks encountered by its parent organization.

Table 3 (Flanagan and Norman, 1993) shows a typical breakdown for a company handling risks on a project. It is an illustration, and the methods will change from company to company, depending upon the size of the company, the attitude towards risk, the perceptions of risks, etc.

Risk retention

This is the method of handling risks by the company who controls them. The risks, foreseen or unforeseen, are controlled and financed by the company or contractor that is fulfilling the terms of the contract. There are two retention methods (Carter and Doherty, 1974), active and passive. Active retention (sometimes referred to as self-insurance) is a deliberate management strategy after a conscious evaluation of the possible losses and costs of alternative ways of handling risks. Passive retention (sometimes called non-insurance), however, occurs through neglect, ignorance or absence of decision, e.g. a risk has not been identified and handling the consequences of that risk must be borne by the contractor performing the work. As shown in Table 3, the risks suitable for retention are those that occur frequently but have small losses.

Risk reduction

It may be argued that reducing risks is a part of risk retention, because the risk has to be retained before pursuing actions to reduce the effects of a foreseen risk. Alternatively, risk reduction may be an action within the overall risk management, and it is because

of the possible wider use of risk reduction that it has been categorized separately. The actual reduction of risks within these categories is confined to the improvements of a company's physical, procedural, and educational and training devices (Flanagan and Norman, 1993). The physical devices can be improved by continually maintaining and updating the devices which help prevent loss. The effect of improving procedural devices can be significant. Simple, low cost measures like housekeeping, maintenance, first aid procedures and security can lead to better morale, improved labour relations and increased productivity, as well as their more obvious benefits. Education and training within every department of a business are important, especially in reducing the harmful effects of risks within the working environment. Loss prevention consumes capital resources, and with better education and training devices the effect may be minimized, freeing capital for more productive investments.

Analysis of the methods used to respond to risk

The questionnaire ascertained which risk response method, or methods, the respondents' company employed. The responses to the four principal methods, i.e. transfer, retention, reduction and elimination, are summarized in Figure 2. The most popular method overall is risk reduction, with only 11 respondents claiming that their company does not employ this technique. Overall, the methods available are favoured in the order of risk reduction, risk transfer, risk retention, and risk elimination.

Similar trends are observed within each industry. All four methods are used by the oil industry, but three of them are eclipsed by one prominent method, i.e. risk reduction, which obtains usage from 93% of respondents. Risk transfer is used by 40% of respondents in oil, with only 14 positive replies for risk retention and 10 for risk elimination methods. In all the 10 responses for risk elimination it was stated that the client/owner did not proceed with the project.

Table 3 A typical framework for deciding the method for handling risks, depending on likelihood and severity (after Flanagan and Norman, 1993)

Severity	Likelihood				
	Improbable	Rare	Possible	Probable	Very likely
Negligible (Up to £500)	Retain	Retain	Retain	Retain	Retain
Small (£500–2k)	Retain	Retain	Partial insure	Partial insure	Partial insure
Moderate (£2k–5k)	Retain	Partial insure	Insure	Insure	Insure
Large (£5k–50k)	Insure	Insure	Insure	Insure	Insure
Disastrous (over £50k)	Insure	Insure	Cease activity	Cease activity	Cease activity

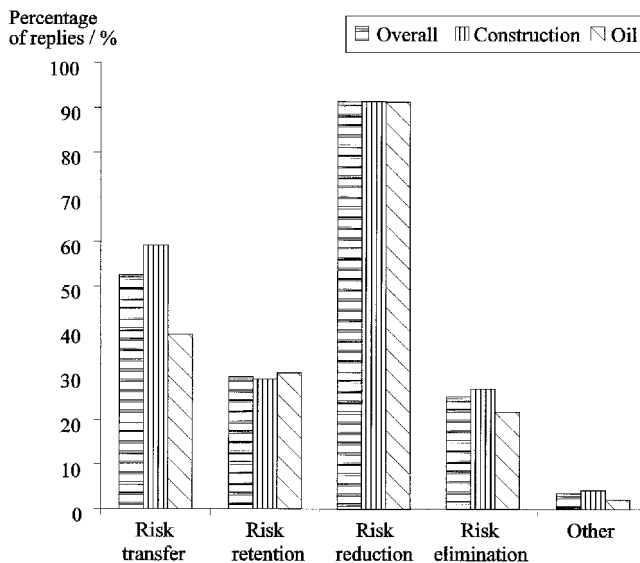


Figure 2 Methods used when responding to risk

Risk reduction and risk transfer are the methods dominating the construction industry responses, with 85 (91%) and 55 (60%) positive replies, respectively. However, this industry also has a number of replies for the other methods. Interestingly, when construction companies eliminate risks, they do so either by not placing a bid, or tendering at a very high price.

Within the response methods themselves, there are many ways of reacting to a risk. There follows a discussion of the three main techniques, starting with the most popular, risk reduction.

Risk reduction

A company that seeks actively to reduce risk can do so in many ways. The fifth section of the questionnaire attempted to elicit from the respondent information of this nature and was devised carefully, drawing on a combination of the authors' experience and texts on the matter. Carter and Doherty (1974), in particular, was referred to in the derivation of many parts of the questionnaire.

The first question investigated the competence of the company, in the eyes of the respondent, in activities for reducing risk. The four activities identified were: (a) education and training; (b) physical protection to reduce the likelihood of risk; (c) brainstorming to identify new risks; and (d) physical protection for people and property. As would have been expected the responses were all better than 'adequate', see Figure 3. The oil industry did consider itself to be nearer 'excellent' than 'adequate'. The construction industry had an identical pattern to that of oil, but ranked all four activities notably lower. Respondents from both

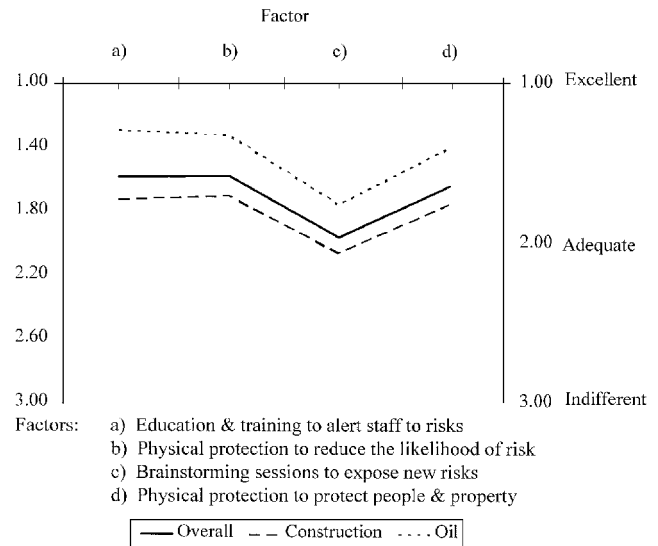


Figure 3 Industry's perceived competence in employing the four principal factors for reducing risk

industries felt that activities (a), (b) and (d) were competently handled by their companies. Similarly, all respondents felt clearly that there is room for improvement with activity (c), which involves exposing new risks. It would seem sensible that risk analyses should be reviewed and updated regularly as a project progresses, thus enabling the identification of new risks.

The respondents were then asked to rank the relative success of particular approaches to reduce the risk to/from employees. In Figure 4 the approaches or methods (a)–(e) employed are shown with the average value of rank, from 1 to 5 and corresponding to 'very successful' down to 'not successful', respectively. The distribution of ranking is similar in both the oil and construction industries. Two methods of risk reduction, namely 'prevention by educating employees' and 'improved working conditions' (i.e. methods a and e), clearly are more successful than the remaining three. Education, by experts in the field, is the key to introducing new ideas, methods, procedures, etc. to personnel who lack insight or knowledge. Therefore, it is important to train and educate the employees for the future of the companies existence, as better outcomes lead to a more enjoyable working environment, stronger employee relations, higher profit, etc. This in turn results in secure employment, loyalty and a fuller understanding of the company's procedures and policies.

Method (c), 'bonus system for improved safety standards,' is ranked at around 3.0, which would indicate that it is not always successful. Method (d), 'penalty system for decreased safety standards,' is the converse of method (c). Although (c), the bonus system, has

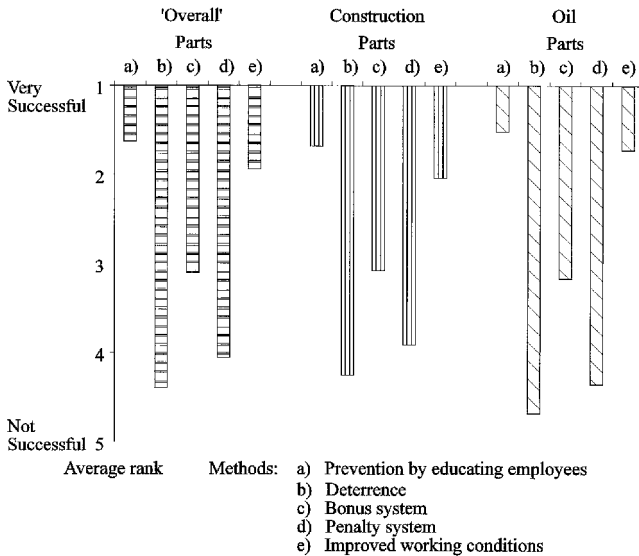


Figure 4 Industry ranking of the five principal methods for risk reduction

had some limited success, clearly punitive methods (d) and (b) are identified as unsuccessful. The punitive methods are negatively biased and tend to generate attitudes of distrust and nervousness. This can itself lead to accidents. The methods with a positive outlook are preferred, and are proving to be more successful.

Risk transfer

Risk transfer may be considered a form of risk reduction, but is being examined separately because of the numerous ways in which the risk can and is transferred. Risk transfer is used by over 52% of the respondents, and the purpose of this section of the questionnaire was to identify the techniques most commonly used. The first part investigated the frequency of risk transfer, either to a specialist subcontractor or through financial means such as insurance. Both techniques are used frequently as seen in Figure 5. The construction industry uses both methods but favours transferring the risk to a specialist. On the other hand, the oil industry, although using both techniques, prefers to transfer the risks financially. The number of different ways in which a company can transfer the risks financially was investigated further, and the results are given in Figure 6. Transferring the risk to an employee through higher remuneration (option (d)) clearly is not a method favoured in either industry. There are a few instances where, as in option (c), the risk is transferred back to the client, who either retains it or further transfers it through insurance. The most popular methods were with insurance, and by exclusion or indemnity clauses

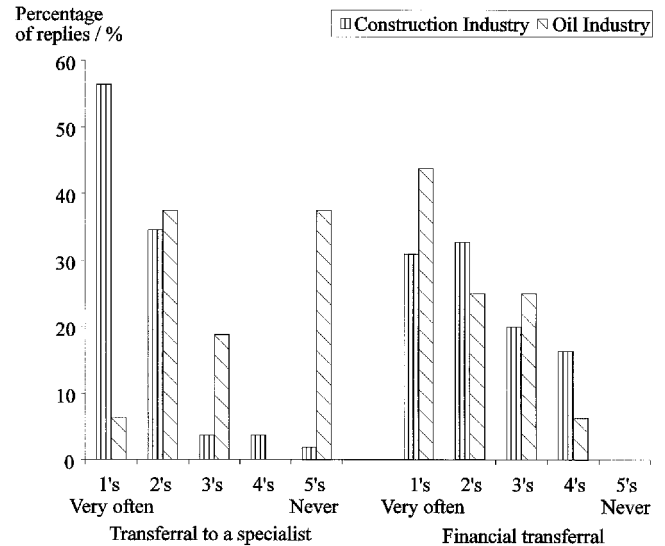


Figure 5 Amount of use of the two methods for risk transfer

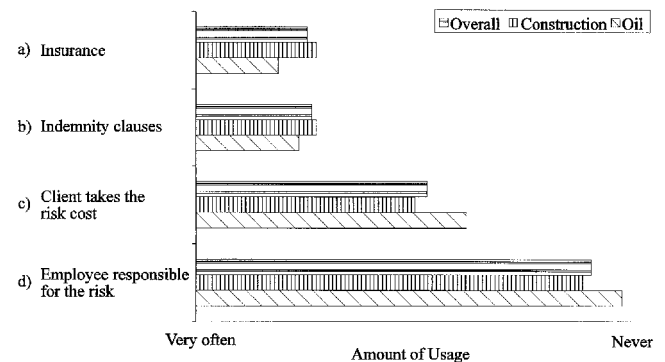


Figure 6 Amount of use of the four methods for the financial transfer of risks

in contracts. The frequency of usage of the techniques is similar in the two industries.

Rather than transfer all of the risk it is possible to transfer risk partially through sharing. This was investigated next through a question which identified the frequency with which the risk was shared, through co-insurance, excess, or first loss cover. Some 73% replied that their company has shared, or is sharing, a risk. The most frequently used method was to share the risks with an 'excess or deductible' (Figure 7). The two other methods are used, but not as often and with a much wider range of responses. Further methods used by the respondents are 'consortium agreements' and 'joint ventures'.

Captive insurance companies for the transfer of risk have been identified in the literature and were examined in the next part. It is not unusual to find a 'captive' located in a tax-free country, like Jersey or Andorra for

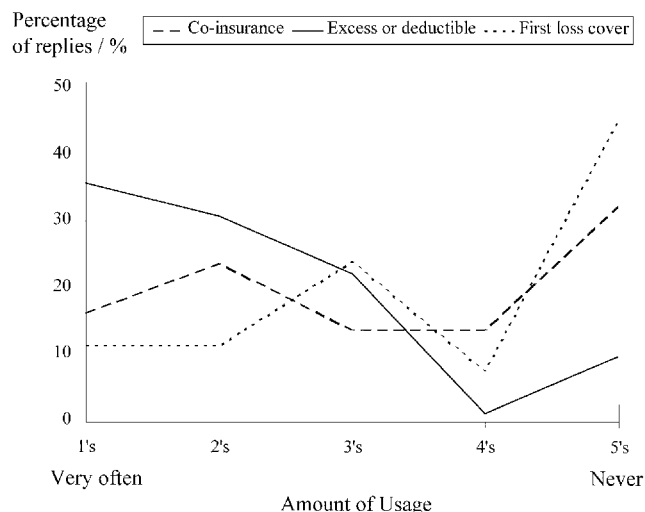


Figure 7 Amount of use of the three methods for risk sharing

example, so as to reap tax benefits. Approximately 20% of the entire sample have used or are using a captive. A subsidiary question established that all of those are still actively using one. A follow-up question indicated the success of 'captives': of the 27 respondents, 82% found that using a captive is the most manageable way of insuring risks, with all of them still continuing to do so. Although 11% answered negatively to this question, they still continued to use a captive. This suggested that captives are beneficial to the company once they are set up, and advantages identified were cost efficiency, tax savings, and facilitated central control.

Risk retention

The corollary to risk transfer is risk retention, and was investigated in the next section of the questionnaire. Almost 30% of respondents did at some stage of risk management retain some of the risks, and 85% of them did so through active risk retention. This suggests that these companies have identified the possible risks, measured their likelihoods and consequences, and have concluded that risk retention was the best response to the risk. The subsequent question investigated why this decision to retain the risk was made in preference to other response methods. The principal reason was that the required insurance premium was judged to be too high: sometimes insuring risks can result in very large premiums but have very low associated probabilities, with the result that retaining the risk is considered to be more cost effective.

If the decision is made to retain a risk, it is necessary to be able to finance that risk. The final question of this section aimed to find out how often certain

methods were used. The results, shown in Table 4, clearly identified two: 'internal funding' (or self-insurance) and 'absorbing losses as part of current operating costs'.

The methods of actively retaining risks implies identifying the risks, evaluating all outcomes, and then comparing it with other forms of risk response. As the management of risk becomes routine and an integral part of a project, and as alternative responses become more expensive, risk retention is likely to become a much more widely used form of risk response.

Discussion

Risk management is a complex means of analysing, evaluating and controlling uncertainties. One of the principal observations that can be made from the survey presented here is the difference between the perceptions of the oil and gas industry and the construction industry of what constitutes risk. If the main functions of staff engaged in risk management is an indicator as to what that company and industry considers to be risk then it is clear that the construction industry places relatively little importance on technical risk.

Possible reasons for this are discussed in the text, but it is an indicator as to how the construction industry can learn from the techniques of others. The construction industry is changing rapidly, and it is no longer concentrated solely on the provision of a service to a client. In the UK, contractors are becoming multi-disciplinary, and the nature of construction procurement is changing. Private finance, in its many forms, not only has increased the financial risk of projects but also has increased the predominance of technical risk – those projects that are effectively owned by the construction company for a concession period cannot be ignored in terms of potential failure.

As an example, the design, build, finance and operate scheme that is now used for road procurement places the responsibility for long term maintenance

Table 4 A table showing which methods are most frequently used to finance retained risks

Method of financing retained risks	Mean value	Verbal description of frequency of use
Diminution of assets	4.00	Infrequently
Absorbing losses as part of current operating costs	2.58	Frequently
Diversion of internal funds	3.73	Sometimes
<i>Ad hoc</i> loans	4.56	Almost never
Contingency loans	4.53	Almost never
Internal funding	2.70	Frequently

and, to a lesser extent, safety of users with the construction company. These companies must assess the risk of long term failure and manage it accordingly. There is also, perhaps, little flexibility in the response to such risks: they cannot be eliminated or transferred to a specialist and must be actively retained, reduced or insured. It is likely, therefore, that in the future such companies will employ increasing numbers of risk analysts at the design stage to assess the technical risks of the design.

The survey provided some further conclusions that may be summarized as follows.

Risk reduction was the most frequently utilized method. Over 90% of the replies suggested the constant use of risk reduction techniques. Risk transfer was next, with risk retention used least. In a comparison between the industries, the relative frequency of the methods was similar, indicating that the two perceptions of risk already identified, financial and technical, may be managed in an equally effective way by the same method. That risk reduction is the most favoured technique is perhaps no surprise: it is the authors' opinion that reducing a risk requires the greatest understanding of that risk. The end result would be better management of the risk produced by improved procedural (such as quality management) and training devices, aspects of a company's expertise that will produce benefits in areas other than just risk management.

Within risk reduction the respondents within the oil industry classed their companies as being very competent at education and training, to alert staff to potential risks, and used the method of improving working conditions very successfully to reduce these risks. The technique of a bonus system for improved safety standards also was favoured, but was not regarded as highly as the previous two.

When transferring risk, the construction industry prefers to use both specialists and financial transferral, unlike the oil industry which prefers to transfer the risks financially. Insurance and exclusion or indemnity clauses in contracts are the most popular way of transferring risks financially. Risk sharing is used frequently, with excess or deductibles being the preferred options. Companies who have ever used a captive are still using it, with 82% of them believing that this is the best way of insuring ones risks: a situation that may prove useful to the construction industry in the future. Effectively, the oil industry has to manage all projects until their decommissioning date. If a risk is transferred to a third party, control over that risk is to some extent lost. Construction companies that are involved in privately financed and owned projects cannot afford to lose control of such aspects and must either retain or reduce the risks, or transfer them financially. As a reflection of the 'risks' of risk transfer, it is interesting to see the

increasing use of 'partnering', whereby risks are shared by all parties but the specialist knowledge and skills of the subcontractor are retained.

Interestingly, 85% of respondents, i.e. those replying to this method, actively retain their risks, the main reason being because the required insurance premium is judged to be too high. Internal funding and absorbing losses as part of current operating currently are favoured for financing retained risks.

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