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RISK ANALYSIS AND FORECASTING IN UPSTREAM OIL AND GAS INDUSTRY"

BY

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Declaration by the Guide

This is to certify that the Mr Dinank Joshi, a student of MBA-Oil & Gas, SAP ID 500065630 of UPES has successfully completed this dissertation report on "Risk Analysis and Forecasting in Upstream Oil and Gas Industry" under my supervision.

Further, I certify that the work is based on the investigation made, data collected and analysed by him and it has not been submitted in any other University or Institution for award of any Degree. In my opinion, it is fully adequate, in scope and utility, as a dissertation towards partial fulfilment for the award of degree of MBA.

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Chapter 01: Introduction

Assessment and period of hydrocarbons is a high-chance endeavor. Geologic musings are unsure concerning structure, supply seal, and hydrocarbon charge. Then again, monetary assessments contain vulnerabilities identified with costs, likelihood of finding and making financially sensible stores, and oil cost. As a general rule, even at the improvement and age engineer the arranging parameters typify a sporadic state of vulnerabilities in relationship with their fundamental components (foundation, creation plan, nature of oil, operational costs, storage facility qualities, and so forth.). These vulnerabilities began from land models and united with monetary and building models fuse high-chance choice conditions, with no accreditation of effectively finding and making hydrocarbons.

Corporate officials dependably face colossal choices with respect to the assignment of extraordinary assets among undertakings that are portrayed by liberal land and budgetary hazard and helplessness. For example, in the oil business, administrators are powerfully utilizing choice interpretive procedures to help in picking these choices. In this sense, the oil business is a model event of fundamental expert under weakness; it gives a perfect setting to the evaluation of threat corporate lead and its consequences for the association's showcase. The wildcat debilitating choice has for quite a while been a conventional model for the utilization of choice appraisal in old style course readings.

The future models in oil assets transparency will depend, everything considered, on the agreeableness between the outcome of the cost developing impacts of exhaustion and the cost-decreasing impacts of the new improvement. In light of that condition new sorts of stores misuse and managing will show up where the duties of danger and choices models are one of essential fixings. This model can be found over the most recent two decades. The new comprehensive associated with assessment and age systems were made a beeline for a confined degree by quickly advancing new improvements. Innovative advances permitted the assessment in delved in dishes correspondingly as in new edges zones, for example, ultra-huge waters. Those advancement driven by and large assessment and age ways of thinking joined with new and stand-out key parts where hazard evaluation and choice models address tremendous segments of a development of hypothesis choices.

In this sense, this presentation covers a smaller survey of past applications incorporating the going with subjects: (1) Risk and Decision Analysis in Petroleum Exploration; (2) Field Appraisal and Development, and Production Forecast under Uncertainty, (3) Decision Making Process and Value of Information and (4) Portfolio Management and Valuations Options Approach. This presentation delineates a piece of the standard models and difficulties and demonstrates a trade of systems that effect the present degree of hazard applications in the oil business made courses of action for improving the fundamental activity methodology.

'Oil and gas assessment is a muddled open framework that requirements high undertaking and long running term. There are numerous peril factors that could affect the framework, and the relationship among these portions are muddled, so oil and gas assessment is a dubious approach that recommends:

(1)Geologist and geophysicist need to look into the likelihood of oil and gas hold in a specific region.

(2)The believability of finding the oil and gas aggregating must be settled. (3)Whether the found oil and gas could be mishandled monetarily is dull.

Along these lines, by applying the learning of hazard the executives, experience manager could keep up a key decent ways from, include and decrease the dangers, or offer them with different people. Before long the certifiable peril assessment methodologies for oil and gas assessment are merge applied likelihood philosophy, three-organize chance appraisal and Monte Carlo procedure, and so on., yet they have following deformations:

(1)These approachs can't fabricate the entire bundling of the curious about issues. They couldn't cement the information of pioneers, assessment boss and experts with assessment framework appraisal learning; they couldn't uncover topographical, experience and cash related sections as to the entire assessment process which unites oil and gas storing up assessment, misuse examination, experience assessment and economy assessment; they couldn't show the relations among stochastic factors in the assessment procedure. So it isn't great for framework analyzers to chat with supervisor and masters, and change the models as shown by new issues making during the structure assessment process.

(2)There will be incredible bothers for settling affiliation issues between risk factors. Two or three strategies could improve relationship issues to single issues, in any case this is genuinely settled on presumptions: simply included substance development or multiplicative endeavor will happen between fragments with respect to mean dangers, the multiplicative parts are free, and the extra substance elements are autonomous or straight affiliation. Subsequently, the outcomes dependent on these presumptions will have some redirection.

(3)These techniques couldn't exhibit the enormous impacts of idle components which are stayed away from in the model considered or don't have a true sensible clarification. In addition, when utilizing standard hazard assessment frameworks, chance experts are required to check chance factors of the undertaking and the relationship between them. In any case, a mass of critical masterminded flighty parts which will affect dangers are disallowed in the numerical models, and they are basically tentatively solidified into hazard assessment.

Chapter 02: Literature Review

Hazard assessment is a bewildering asset organizing frameworks where choice under vulnerability is fused. Explicitly for oil well endeavors, various articles have been indicated drawing out how danger appraisal frameworks can be utilized to develop the likelihood of tolerating, for a specific development, the right choice. For depleting works out, paying little heed to the way that not broadly utilized, a gathering of employments have been made. In this part, an audit of those tremendous applications is exhibited.

Newendorp and Root2 facilitated a pioneer study on the likelihood of utilizing danger appraisal frameworks while picking entering experiences, which fuses a commitment of massive extent of capital under very questionable conditions. Producers suggested that, rather than getting in contact at choices dynamically impacted by energetic perceptions in an individual and regular framework, a choice hypothesis system could be utilized making conceivable to asses and measure the dangers related with entering speculations, quantitatively.

Since dangers related in entering experiences contain vulnerabilities in perspective ashore and organizing factors that effect favorable position of hypothesis, it rushes to check range and spread of potential delayed consequences of a debilitating set out to examine the advantage of a prospect.

Producers imparted that the methodology would confine hypothetical choices and decisions for a debilitating undertaking. With the utilization of the technique, impacts of boundless number of components on invading prospects can be broke down, affectability appraisal can be driven and factors remarkably affecting the bit of leeway could be secluded and better isolated. The proposed strategy is on a very basic level logically present day, objective and distinct for appraisal of depleting prospects than the kind of passionate evaluation typically utilized when of scattering of the article.

Regardless of the manner in which that the article did not manage a specific debilitating procedure or errand, it demonstrated a framework to oversee vulnerabilities that plainly could be extrapolated for conditions went facing normally on essential well activities.

Hazard appraisal can clearly analyze various potential results and separation various alternatives for theory and various degrees of peril and vulnerabilities.

Cowan conveyed that the two explicit qualities of oil and gas assessment are high vulnerabilities included and critical extent of capital uses. Along these lines, potential results from stores ought to be poor down vigilantly and chance appraisal ought to be finished on assessment prospects to check the impacts of vulnerabilities on the money related result. Cowan proposed a hazard assessment model that could be utilized to measure the sections of dangers related with looking into and stirring up a hydrocarbon prospect. Once more, this article was not explicitly gone for

debilitating activities, yet certainly brought up explicit headings that would be utilized later on depleting organizing issues.

The proposed model joined probabilistic land, building and cash related information to pass on conceivable arrangement limits identified with potential results of mauling new holds. The model can oversee five specific occasions of prospect task. First of these stages is the "assessment period" which circuits the expense of the assessment contemplates in a given field. Following, comes the second stage which joins the appraisal of wildcat depleting and breaks down the opportunity of discovering hydrocarbon assets in a given zone. On the off chance that the probability of achievement in "entering the wildcat" is high, by then the model records for the third stage, which is "depicting the field". Target rate and starter cash related assessment on advancement program are done in this time of the model. By at that point, if the field has some potential worth, stages 4 and 5 are related. These stages are "building up the field" and "passing on the field", solely. These last two stages are investigated subject to broadening age, stable creation and declining age cases.

Cowan raised the transcendence of utilizing probabilistic strategies looked single worth evaluations. Probabilistic arrangement framework empowers to exhibit potential results interminable supply of different data parts and vulnerabilities and permits continuously sensible evaluation.

Newendorp raised that the consciousness of industry on hazard assessment increments with the expanding case of the assessment rehearses towards progressively humble, more enthusiastically to discover traps, testing conditions and improved new advancements. There are a wide extent of ways for finishing hazard assessment system for an entering prospect and the paper needed to bundle them in five requests, Level 1 being the most key one with two potential results and Level 5 being the most intensive Monte Carlo beguilement appraisal. In light of the open information, he proposed utilizing one of the five peril assessment models to separate invading prospects.

He thought about the basic three models (Level 1, Level 2 and Level 3) as "discrete-result models" while the last two models (Level 4 and Level 5) are "enduring result models." Initially, because of nonattendance of data, Level 1 can be utilized and one of two potential results (hydrocarbons or no hydrocarbons) can be poverty stricken down. As more information ends up accessible, Level 2 which records for four potential results (three conceivable hold respects and no hydrocarbons) can be utilized. Level 3 give six conceivable discrete results; five being conceivable extra respects and one being no hydrocarbons. Newendorp conveyed that to go past five conceivable extra results, the model ought to be changed over to a consistent result model with the target that the whole extra spread could be portrayed. Level 4 takes after Level 3 with the exception of by the way where that topography related likelihood dispersing cutoff points are settled utilizing reenactment and budgetary sections are gotten utilizing deterministic techniques. At long last, Level 5 is the most present day model addressing vulnerabilities in both geologic information and cash related vulnerabilities.

The creator conveyed that, subordinate upon the risks accounted and vulnerabilities open, each degree of peril assessment model gives imperative data in various times of an entering prospect appraisal. He recommended utilizing a greater proportion of hazard assessment model as more information is picked up from the exercises being finished.

Another spellbinding application, this one created to a much basic tie present in certain penetrating activities. The producer proposed a system to pick if the base expense while entering is cultivated by (1) depleting the gap further with the penetrating liquid right now in the opening, (2)with weighted debilitating liquid, (3) stopping depleting and setting the packaging to that noteworthiness or (4) even by giving up the well if this is the most shown because of thriving and borehole constancy contemplations. He brought up that, during authentic depleting development these four decisions are persistently accessible. For the condition that it is picked to enter further, by then it is ceaselessly conceivable to encounter a kick or loss of spread contingent on progress loads. This risk assessment model imparted that, since the majority of the choices are identified with the improvement weight and other depleting parameters, expected costs will also be at last identified with a practically identical factor (the strategy weight.)

Utilizing a Monte Carlo multiplication system, the creator built up an approach to manage assess the dangers related with the given strategy of debilitating parameters. Utilizing the method, it is conceivable to survey quantitatively the expense of penetrating further with existing mud, weighted mud, setting a packaging, surrendering the well and possessing. It ought to be seen that, the threat assessment model made is delicate to cost stream of the tenacious kick and level of shortcoming being created weight. Hence, these two parts ought to be accounted unquestionably so as to gauge absolutely the conventional mean worth, or mishap, (EMV) of various depleting conditions.

Ostebo et al.6 displayed an evaluation on a zone where enthusiastic and quantitative peril appraisal can be executed to a remarkable broaden. After the Piper Alpha catastrophe, Norway and UK issued new principles in which danger assessment has astonishing monstrosity. Understanding that toward the sea activities have potential security and operational issues and coming about to encountering the Piper Alpha mishap, neither the nations nor the affiliations would peril having another for all intents and purposes indistinguishable experience. Along these lines, chance assessment changed into an exceptionally pleasing gadget during the time spent basic expert to overhaul stage structure, operational strategies and viability together with thriving and cost. Producers isolated the principles issued by the Norwegian Petroleum Directorate (NPD), to drive utilization of risk evaluation frameworks in toward the sea assignments.

They have depicted and clarified the Concept Safety Evaluation (CSE), which is a philosophy for assessed chance assessment. CSE is being related with all creation stage structure in Norway and its basic targets are to pick zones where issues may happen and assess those areas to lessen the likelihood of occurrences. In like manner, the creators showed various systems for applying risk assessment during the zones of unwavering quality and transparency evaluation, thriving the managers approachs and human and authoritative elements during toward the sea assignments.

Ottesen et al.7 built up another wellbore enduring quality evaluation framework, which sets an old style mechanical wellbore obvious quality model with fittingness operational cutoff centers, for instance, water control basic to permit critical cuttings transport in exceedingly veered wells. Those motivations driving imprisonment are obliged by quantitative danger assessment (QRA) measures. The producers have outlined the motivations behind control for disappointment and achievement and made a cutoff state capacity to make an association between standard wellbore plentifulness model and operational frustration. The proposed wellbore quality examination system isn't set in the state of mind for evaluating the risks related with the operational dissatisfaction yet also pulls in the coordinator to pick the fitting mud thickness to keep up a key not all that terrible ways from wellbore dubiousness issues.

Liang8 agreeable a system with pick pore weight and break inclination utilizing quantitative peril examination (QRA). It was passed on this appraisal that it is conceivable to appalling the probabilistic scattering of pore weight, relative mud weight and break assessment utilizing Gaussian spreading, which would be conceivable in perspective on the declaration of the exact degrees of those parameters at some sporadic centrality. By utilizing probabilistic game-plan purposes of repression concerning pore weight, break inclination and proportionate mud weight, perils related with expecting a kick or disaster return can be examined quantitatively.

QRA procedures showed up in the paper makes conceivable to see dangers related to having a kick or stream hardship. Such dangers can be kept or constrained by changing a touch of the crippling parameters, for example, mud weight, mud rheological properties, stream rate, bungling rate, entrance rate, and so forth. Furthermore, reliably sensible data for packaging structure and legitimately particular choice of packaging shoe massiveness is made utilizing pore loads and split edges picked with QRA approach.

McIntosh9 underlined the prerequisite for utilization of probabilistic frameworks to supervise well improvement demonstrates successfully under testing conditions where vulnerabilities exist dependably. As more noteworthy evaluation exercises are going on in continually undermining zones, for example, reasonably colossal waters and remote spaces, dangers and vulnerabilities related with the assignments are moreover raising and boss should check for perpetually trustworthy and utilitarian models for oil well debilitating exercises.

Showed up contrastingly in relationship with deterministic models, probabilistic appearing/preparing does not just consider the dealt with offers of occasions, yet contiguous locations with no status/undesired occasions. Along these lines, administrators can regulate most central and disturbing occasions, and "inadequate time" diminishes sensibly. It is in like way conceivable to demonstrate the goodness of new improvement and think about the conceivable aftereffect of new degrees of progression with the regular frameworks for a given undertaking. It is gotten a handle on to aggregate a probabilistic model around the beginning events of the improvement and advance the model reliably as more information is gained from dynamic assignments. Starting now and into the foreseeable future, authentic occasions in well-development activities are delineated generally more undeniably, extents of astonishing occasions are lessened and as such better improvement/execution can be made.

With the stretching out utilization of hazard evaluation to separate issues steadfastly identified with debilitating activities, competently express applications began to be made. Thorogood et al.10 demonstrated a peril assessment based reaction for the subsurface well impacts issue. The framework combined a numerical appraisal of the likelihood of impact joined with a choice tree to portray the results.

The delayed consequences of the mishap chance evaluation can be secluded and past what many would think about conceivable on the probabilities of the different results, which rely upon the examination of the all around dazzling shot. For all around mentioned use, the crippling organizers can structure their well activities with a stream plan of the directional-depleting systems. Unmistakably depicted degrees of peril can be fittingly settled.

Virine and Rapley11 showed a critical method to oversee use risk evaluation toolsets in real money related appraisal applications for the oil and gas industry. They depicted the mix of choice and hazard examination contraptions with money related structure application.

This area underscored the centrality of information commitment correspondingly as evaluation result. A model case was appeared.

Alexander and Lohr12 set seven focal parts for a profitable danger evaluation experience. They concentrated on that the responsibility and supporting from both connection and unequivocal get-togethers are fundamental to the hazard evaluation advance. A not all that loathsome danger assessment technique is dependably kept up by solid and consistent norms, flexible evaluation programming, astounding valuation for reliance among parts and the best outcome translation. Despite the manner by which that hazard assessment can not abrogate talented judgment, it can improve the evaluation and help to relate at the right choice.

Coopersmith et al.13 plot organizations of choice tree assessment in the oil and gas industry through a genuine examination where a deepwater creation structure was poor down. In the wake of depicting a few parameters of the undertaking, for example, supply size, age rates, number of wells and entering plan, the uncommon state choice trees were worked for two stand-out plans. Through the assessment of last NPV figurings of the two structures under thought the one with relatively as could be normal be picked.

For the case displayed the key nonattendance of confirmation was the supply size and the most gigantic factor affecting the hypothesis pay was the improvement timing steps. Utilizing choice tree assessment, the oil association could evaluate the degree of potential results.

Chapter 03:A new Era in Petroleum and Production Management

Exploration and Production (E&P) is the business of finding petroleum and getting it out of the ground. It is a risky business in that most exploration projects are total failures while a few are tremendously successful. Thus the best possible management of risk is crucial.

In the 1930's and 1940', the development of seismic data collection and analysis substantially reduced the risk in finding petroleum. The resulting geology and geophysics (G&G) revolutionized petroleum exploration. Decision analysis has traditionally been applied to the information derived from G&G to rank projects hole by hole, determining on an individual basis whether or not they should be explored and developed.

Today this "ole-istic"approach is being challenged by a holistic one that takes into account the entire portfolio of potential projects as well as current holdings. This portfolio analysis starts with representations of the local uncertainties of the individual projects provided by the science and technology of G&G. It then takes into account global uncertainties by adding two additional G' : geo-economics and geo-politics. It thereby reduces risks associated with price fluctuations and political events in addition to the physical risks addressed by traditional G&G analysis. The holistic approach is based on but not identical to the Nobel-prize winning portfolio theory that has shaped the financial markets over the past four decades.

Portfolio thinking in petroleum E&P is based on understanding and exploiting the interplay among both existing and potential projects. It does not provide all the answers, but encourages E&P decision-makers to ask the right questions, such as:

- If we want a long-term expected return of, say, 15% on our investment, how can we insure against a cash flow shortfall over the first three years while minimizing our long-term risk?
- What should we pay for a new project, given the projects already in our portfolio?
- How would oil projects, as contrasted from gas projects, affect the impact of price uncertainty on my portfolio?
- What projects should we be seeking to reduce the effects of political instability in a given

part of the world?

- What are the effects on financial risk and return if we insist on a minimum of, say, 40% ownership of any project?

As we shall see, analytical models can help in directly addressing these and similar questions once decision-makers in the petroleum industry become comfortable with the holistic perspective.

Chapter 04: Risk and Uncertainty

"Any uncertain event that could significantly enhance *or* impede a Company's ability to achieve it's current or future objectives, including failure to capitalize on opportunities" The possibility of good things not happening

(risk as opportunity)

The potential that actual events will not equal anticipated outcomes

(risk as uncertainty)

The threat of bad things

(risk as hazard)

Table 4.1 shows the definitions of risk and uncertainty as given by different authors

AUTHORS	TERM	CONCEPTUALISATION
1. Anderson *et al.* (1981)	Uncertainty	A situation in which one has no knowledge about which of several states of nature has occurred or will occur
2. Anderson *et al.* (1981)	Uncertainty	A situation in which one knows only the probability of which several possible states of nature has occurred or will occur
3. Anderson *et al.* (1981)	Risk	Same as (1)
4. Anderson *et al.* (1981)	Risk	Same as (2)
5. Humphreys and Berkley (1985)	Uncertainty	The inability to assert with certainty one or more of the following: (a) act-event sequences; (b) event-event sequences; (c) value of consequences: (d) appropriate decision process: (e) future preferences and actions; (f) one's ability to affect future events
6. Lathrop and Watson (1982)	Risk	Potential for deleterious consequences
7. Lathrop and Watson (1982)	Uncertainty	Lack of information available concerning what the impact of an event might be
8. MacCrimmon and Wehrung (1986)	Uncertainty	Exposure to the chance of loss in a choice situation
9. Harrison (1995)	Risk	A common state or condition in decision-making characterised by the possession of incomplete information regarding a probabilistic outcome.
10. Harrison (1995)	Uncertainty	An uncommon state of nature characterised by the absence of any information related to a desired outcome.
11. Spradlin (1997)	Risk	The possibility of an undesirable result
12. Holmes (1998)	Risk	A situation which refers to a state where the decision-maker has sufficient information to determine the probability of each outcome occurring.
13. Holmes (1998)	Uncertainty	A situation where the decision-maker can identify each possible outcome. but does not have the information necessary to determine the probabilities of each of the possibilities.

Table 4.1: Risk and uncertainity Defined

4.1 Type of Risks:

In general there are TWO broad categories of risk

Systematic Risk - Systematic risk influences a large number of assets. A significant political event, for example, could affect several of the assets in your portfolio. It is virtually impossible to protect yourself against this type of risk.

Unsystematic Risk - Unsystematic risk is sometimes referred to as "specific risk". This kind of risk affects a very small number of assets. An example is news that affects a specific stock such as a sudden strike by employees. Diversification is the only way to protect yourself from unsystematic risk. (We will discuss diversification later in this tutorial).

specific types of risk that are faced by all businesses.....

1. **Credit risk**
2. **Liquidity risk**
3. **Operational risk**
4. **Market risk**
5. **Political risk**
6. **Foreign exchange risk**

Credit risk
Credit Risk is the risk that a loss will be incurred if counterparty does not fulfil its financial obligations in a timely manner. This is one of the most critical aspects of business.

Liquid Risk

It is the risk that the Bank may not be able to meet cash flow obligations within a stipulated timeframe. The purpose of the Bank's liquidity risk management is to maintain suitable and sufficient funds to meet present and future liquidity obligations whilst utilizing the funds appropriately to take advantage of market opportunities as they arise.

Liquidity Risk - Factors.

Liquidity risk factors include competition among commercial banks for larger market share in deposits, an unstable or potentially violent domestic political situation, the fluctuation of the Rupee-Dollar, and implementation of government policies which may affect capital movements in and out of India.

Operational Risk

Operational Risk is the risk of potential losses from a breakdown in internal processes and systems, human error, or management or operational failure arising from external causes. The objective of the operational risk management framework is to ensure that the Bank has in place appropriate policies, processes and procedures, and gathers relevant information relating to operational risks so as to avoid operational failures and minimize relevant losses; while enabling the Bank to quickly respond to and pursue new business opportunities under appropriate risk controls and monitoring.

Operational Risk - Factors. Significant operational risk factors include:

- Operational processes which may have flaws or weak control systems.
- Inadequate staffing which may make it difficult for staff to perform their work effectively and efficiently.
- Technological developments which may affect the security of Bank data or information held on behalf of customers.
- Malfunctions in information processing systems.
- Potential fraud by outsiders in terms of robbery, cheating, computer hacking, document falsification, credit and debit cards fraud, etc.
- Catastrophic events.

Political Risk

The likelihood that political forces will cause drastic changes in a country's business environment that will adversely affect the profit and other goals of a particular business enterprise.

In general, there are two types of political risk, **macro risk and micro risk.**

Macro risk refers to adverse actions that will affect all foreign firms, such as expropriation or insurrection, whereas micro risk refers to adverse actions that will only affect a certain industrial sector or business, such as corruption and prejudicial actions against companies from foreign countries. All in all, regardless of the type of political risk that a multinational corporation faces, companies usually will end up losing a lot of money if they are unprepared for these adverse situations.

MARKET RISK

Market Risk is the potential loss in value in a security from changes in market factors such as interest rates, foreign currency value, and/or prices of commodities and equities.

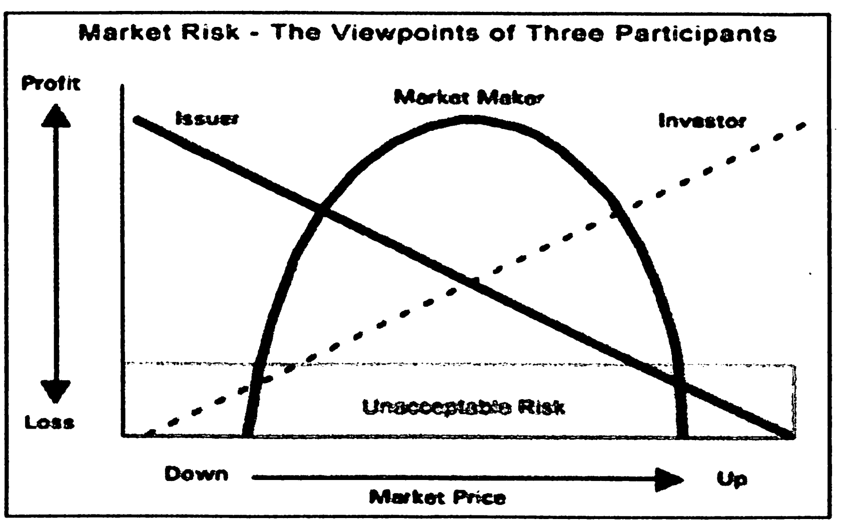

Fig. 4.1. market risk

Foreign Exchange Risk & Risk Management

Crude oil prices are generally set in US dollars, while sales of refined products may be in a variety of currencies. Fluctuations in exchange rates can therefore give rise to foreign exchange exposures, with a consequent impact on underlying costs.

Currency Risk Management

Currency risk arises because the value of the Indian Rupee or any domestic currency fluctuates due to the market forces of supply and demand.

4.2 Top ten risks in Oil and Gas Industry

Risks are inherent in every forward-looking business decision. As a result, there has been a great deal of work done and resources invested in risk management in the oil and gas industry in recent years. Financial and regulatory risks have been the focus of much of this effort. But more recently, companies have started including operational risks, prioritizing them and thinking about how they can manage and monitor all risks in a coordinated way. In collaboration with Oxford Analytical, Ernst & Young examined the strategic risks facing oil and gas companies. This study was not a random selection exercise but rather a structured consultation with industry leaders and subject matter professionals from around the world. What follows are the top 10 identified strategic risks for oil and gas companies.

Human Capital Deficit

The growing human capital deficit in the sector has become a significant strategic threat to the industry. One study participant set out the issue: "The ability of the oil and gas services sector to expand sufficiently to meet future demand growth is questionable, not least in terms of staff. Project delays and abandonment are as much a result of capacity constraints as financial calculations, although the two are intimately linked."

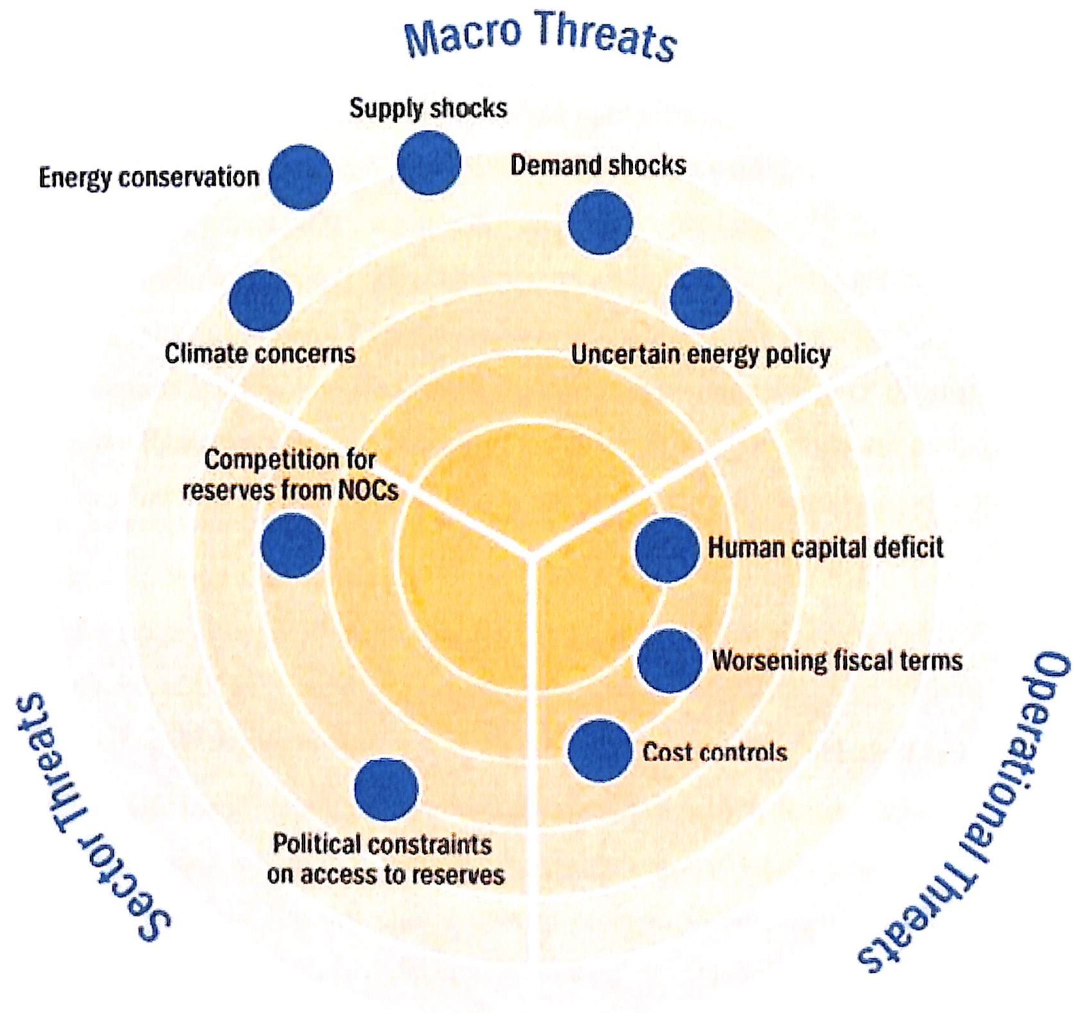

Fig 4.2 threats: oil and gas industry

Worsening Fiscal Terms

Worsening fiscal terms are seen as a high risk. In some cases, this is due to energy nationalism, although in others it is purely the result of political opportunism and high prices. Tax regime changes can spur additional oil and gas industry restructuring in countries such as Canada, Venezuela, Russia, and Algeria. The impact of political opportunism and high prices is a device that has been seen in both the developing and non developing world.

Cost Controls

The third operational threat is the inability to control costs. This threat was considered great enough to have a strategic impact, and a failure to manage the threat could undermine the competitiveness of oil and gas companies. Participants agreed that the problem extends from exploration all the way through the value chain, impacting everything from refinery build costs to pipeline construction. The Upstream Capital Costs Index, which measures cost inflation in oil and gas projects, has gone up by 79% since 2000, with most of that increase coming since May 2005.

Competition for Reserves

Competition for reserves by national oil companies (NOCs) is a major threat to international oil companies (IOCs). Again, the problem is one of strategy: "Western IOCs will find it hard to compete as deals are struck not through bidding or tenders but at a state-to-state level, bundled with development aid, for example," wrote one study participant. This observation follows evidence of such deals in the market.

Political Constraints

on Access to Reserves Recent estimates suggest that NOCs control 75% of proven global reserves, making these companies the gatekeepers of the world's oil and gas supplies. Unlike unexpected shocks, this has been well publicized in recent years. For the major IOCs, this could pose a greater strategic and competitive threat than that resulting from supply disruptions.

Uncertain Energy Policy

An increasing risk for the oil and gas industry is the uncertainty of energy policy. This was defined by one participant: "Energy policy goals include security of supply and climate change considerations, as well as more commercial goals such as affordability and meeting demand growth. The noncommercial goals will shape policy and result in increasing intervention in the market in areas such as carbon pricing, strategic reserve requirements, and subsidization of favored sources of energy." Another participant, a Harvard University-based economist, contended, "Social value regulation in the form of measures designed to reduce risk and achieve health, safety, and environmental goals can lead to a regulatory regime that ignores cost/benefit analysis to the detriment of business."

Demand Shocks

Demand shocks could be triggered by a number of global economic crises. A global financial meltdown emerging from derivatives and hedge funds was the threat rated highest by the economists who participated in the study. One comment, that echoed a frequently made observation, was that "credit disintermediation has replaced international banking as a finance source with a range of specialized credit instruments held widely with risk exposures that regulators find it difficult to assess." Several economists believed systemic risks in finance have increased dramatically and, consequently, it would be prudent to expect greater international economic volatility. A global recession could also be triggered by an energy supply disruption. "A [price] spike, especially if it lasted for a few months, could plunge the global economy into severe recession," wrote one analyst. Another participant highlighted how further social or political threats could contribute to a demand shock. "China's sustained expansion in recent years has underpinned robust world growth but is producing tensions both internally and externally. An event that throws the country off track would have a big impact on expectations of future oil and gas demand growth."

Climate Concerns

Our oil and gas panel may have been encouraged to rank the rise of climate change concern as a significant risk by the sobering comments of one of our subject matter experts, a specialist in science and international affairs: "[Current] climate predictions are based on models and, naturally, the scenarios communicated to the policy world are the scientifically conservative scenarios [i.e., the ones that most scientists agree are likely]. Yet, scientifically conservative scenarios are not necessarily what will happen; it is possible that the hazard is actually more imminent than is commonly understood. In this case, we may see physical climate surprises, as well as an increased policy response that is more abrupt than most firms are currently planning for."

Supply Shocks

Another risk for the industry is that of sudden and unexpected disruptions to global energy supplies. While our participants did not agree on what the most likely cause of such a shock would be, they did agree that unexpected shocks could pose a severe challenge. Possible consequences include extreme price volatility, global recession, and ill-considered regulatory responses, as well as potential competitive impacts on affected firms.

Energy Conservation

Not unexpectedly, the group voted for the possible success of energy conservation as the number 10 risk. Perhaps this ranking was swayed by the opinions of one of the subject matter experts, an energy economist, who wrote, "The energy intensities of developing countries are very much higher than in most of the Organization for Economic Cooperation and Development (OECD) countries. Thus the scope for improved energy efficiency and indeed switching away from oil is potentially very large." An oil and gas analyst appeared to agree, noting that, "The most powerful tool available to policymakers is energy conservation and it is the most under exploited. While there are no 'silver bullets,' energy conservation comes close. The uncertainty is not so much one of policy failure but of policy success."

It is important to note that this is only a snapshot and risks are subject to change at any time. These are not predictions, but considering them can help companies to prepare. Working through scenarios and impact studies can result in opportunities to tighten processes and controls, leading to dialogue and action plans that deliver value.

Chapter 05: Risk in Exploration & Production

5.1 Risk Analysis: Exploration

The historical origins of decision analysis can be partially traced to mathematical studies of probabilities in the 17th and 18th centuries by Pascal, Laplace, and Bernoulli. However, the applications of these concepts in business and general management appeared only after the Second World War (Covello and Mumpower, 1985; Bernstein, 1996). The problem involving decision-making under conditions of risk and uncertainty has been notorious from the beginnings of the oil industry. Early attempts to define risk were informal.

The study by Allais (1956) on the economic feasibility of exploring the Algerian Sahara is a classic example because it is the first study in which the economics and risk of exploration were formally analyzed through the use of the probability theory and an the explicit modeling of the sequential stages of exploration. Allais was a French economist who was awarded the Nobel Prize in Economics in 1988 for his development of principles to guide efficient pricing and resource allocation in large monopolistic enterprises. Allais's work was a useful mean to demonstrate Monte Carlo methods of computer simulation and how they might have been used to perform complex probability analysis had they been available at that time instead of the simplifications for risk estimation of large areas.

During this period, there were several attempts to define resource level probabilities at various stages of exploration in a basin using resources distribution and risk analysis (Kaufman, 1963; Krumbein and Graybill, 1965; Drew, 1967; Harbaugh et al., 1977; Harris, 1984, Harbaugh, 1984; Harris 1990). At that time governmental agencies were also beginning to employ risk analysis in periodic appraisals of the oil and gas resources.

During the 1980's and 1990's, new statistical methods were applied using several risk estimation techniques such as: (1) lognormal risk resources distribution (Attanasi and Drew, 1985), (2) Pareto distribution applied to petroleum field-size data in a play (Crovelli, 1995) and (3) fractal normal percentage (Crovelli et al., 1997).

During the 1960's, the concepts of risk analysis methods were more restricted to the academia and were quite new to the petroleum industry when appear the contributions of Grayson (1960), Arps and Arps (1974), Newendorp (1975, edited as Newendorp and Schuyler, 2000) and Megill (1977). During this period Newendorp emphasized that decision analysis does not eliminate or reduce risk and will not replace professional judgment of geoscientists, engineers, and managers. Thus, one objective of the decision analysis methods, as it will be discussed later in this paper, is to provide a strategy to minimize the exposure of petroleum projects to risk and uncertainty in petroleum exploration ventures.

The Utility Theory provides a basis for constructing a utility function that can be employed to model risk preferences of the decision maker. If companies make their decisions rationally and consistently, then their implied risk behaviors can be described by the parameters of a utility function. Despite Bernoulli's attempt in the 18th century to quantify an individual's financial preferences, the parameters of the utility function were formalized only 300 hundred years later by von Neumann and Morgenstern (1953) in modern utility theory. This seminal work resulted in a theory specifying how rational individuals should make decisions under uncertainty. The theory includes a set of axioms of rationality that form the theoretical basis of decision analysis and descriptions of this full set of axioms and detailed explications of decision theory are found in Savage (1954), Pratt (1964); and Schailfer (1969). Cozzolino (1977) used an exponential utility function in petroleum exploration to express the certainty equivalent that is equal to the expected value less a risk discount, known as the risk premium. Acceptance of the exponential form of risk aversion leads to the characterization of risk preference (risk aversion coefficient), which measures the curvature of the utility function. Lerche and MacKay (1999) showed a more comprehensible form of risk tolerance that could intuitively be seen as the threshold value whose anticipated loss is unacceptable to the decision maker or to the corporation.

An important contribution that provides rich insight into the effects of integrating corporate objectives and risk policy into the investment choices was made by Walls (1995) for large oil and gas companies using the multi-attribute utility methodology (MAUT). Walls and Dyer (1996) employed the MAUT approach to investigate changes in corporate risk propensity with respect to changes in firm size in the petroleum industry. Nepomuceno et al. (1999) and Suslick and Furtado (2001) applied the MAUT models to measure technological progress, environmental constraints as well as the financial performance associated with exploration and production projects located in deep waters.

More recently, several contributions devise petroleum explorations consisting of a series of investment decisions on whether to acquire additional technical data or additional petroleum assets (Rose, 1987). Based upon these premises the exploration could be seen as a series of investment decisions made under decreasing uncertainty where every exploration decision involves considerations of both risk and uncertainty (Rose, 1992). These aspects lead to a substantial variation in what is meant by risk and uncertainty. For example, Megil (1977) considered risk an opportunity for loss. Risk considerations involve size of investment with regard to budget, potential gain or loss, and probability of outcome. Uncertainty refers to the range of probabilities that some conditions may exist or occur.

Rose pointed out that each decision should allow a progressively clearer perception of project risk and exploration performance that can be improved through a constructive analysis of geotechnical predictions, review of exploration tactics versus declared strategy, and year-year comparison of exploration performance parameters. These findings showed the importance of assessing the risk behavior among firms and managerial risk attitudes. Continued monitoring of the firm's level of risk aversion is necessary due to a changing corporate and industry environment as well as the enormous contribution generated by the technological development in E&P. Over any given budgetary period, utilization of an established risk aversion level will result in consistent and improved decision making with respect to risk.

5.2 Risk Analysis: Field Appraisal and Development

During the exploration phase, major uncertainties are related to volumes in place and economics. As the level of information increases, these uncertainties are mitigated and consequently the importance of the uncertainties related to the recovery factor increases. The situation is more critical in offshore fields and for heavy-oil reservoirs.

In the preparation of development plans, field management decisions are complex issues because of (1) number and type of decisions, (2) great effort required to predict production with the necessary accuracy and (3) dependency of the production strategy definition with the several types of uncertainty with significant impact on risk quantification.

In order to avoid excessive computation effort, some simplifications are always necessary. The key point is to define the simplifications and assumptions that can be made to improve performance without significant precision loss. Simplifications are possible, for instance, in the modeling tool, treatment of attributes and in the way several types of uncertainties are integrated.

One of the simplest approaches is to work with the recovery factor (RF) that can be obtained from analytical procedures, empirical correlations or previous simulation runs, as presented by Salomão (2001). When higher precision is necessary, or when the rate of recovery affects the economic evaluation of the field, using just the recovery factor may not be sufficient.

Techniques such as experimental design, response surface methods and proxy models were used by several authors (Dejean, 1999) in order to accelerate the process. Another possible approach is to use faster models such as streamline simulation as proposed by Hastings et al. (2001), Ballin et al. (1993), Subbey and Christie (2003).

The integration of risk analysis with production strategy definition is one of the most time consuming tasks because several alternatives are possible and restrictions have to be considered. Alternatives may vary significantly according to the possible scenarios. Schiozer et al. (2003†) proposed an approach to integrate geological and economic uncertainties with production strategy using geologic representative models to avoid large computational effort.

The integration is necessary in order to (1) quantify the impact of decisions on the risk of the projects, (2) calculate the value of information, as proposed by Demirmen (2001) and (3) quantify the value of flexibility (Begg and Bratvold, 2002). The understanding of these concepts is important to correctly investigate the best way to perform risk mitigation and to add value to E&P projects.

Therefore, risk analysis applied to the appraisal and development phase is a complex issue and it is no longer sufficient to quantify risk. Techniques today are pointing to (1) to quantification of value of information and flexibility, (2) optimization of production under uncertainty, (3) mitigation of risk and (4) treatment of risk as opportunity. All these issues are becoming possible due to hardware and software advances, allowing an increasing number of simulation runs of reservoir models with higher complexity (Gorell and Basset 2001).

5.3 Decision Making Process, Value of Information and Flexibility

Making important decisions in the petroleum industry requires incorporation of major uncertainties, long time horizons, multiple alternatives, and complex value issues into the decision model. Decision analysis can be defined on different and embedded levels in petroleum exploration and production stages. Decision analysis is a philosophy, articulated by a set of logical axioms, and a methodology and collection of systematic procedures, based upon those axioms, for responsibly analyzing the complexities inherent in decision problems (Keenney, 1982, Keenney and Raifa, 1976; Howard, 1988, Kirkwood, 1996). In the last two decades, the theoretical and methodological literature on various aspects of decision analysis has grown substantially in many areas in the petroleum sector, especially in applications involving health, safety, and environmental risk.

Many complex decision problems in petroleum exploration and production involve multiple conflicting objectives. Under these circumstances, managers have a growing need to employ improved and systematic decision processes that explicitly embody the firm's objectives, desired goals, and resource constraints. Over the last two decades, the advances in computer-aided decision making processes have provided a mechanism to improve the quality of decision making in modern petroleum industry. Walls (1996) developed a decision support model that combines the toolbox systems components to provide a comprehensive approach to exploration petroleum planning from geological development through the capital allocation process.

An effective way to express uncertainty is to formulate a range of values, with confidence levels assigned to numbers comprising the range. Although geoscientists and engineers may be willing to make predictions about unknown situations in petroleum exploration and production, there is a need to assess the level of uncertainty of the projects. So, it's necessary to define the value of information associated with important decisions such as deferring drilling of a geologic prospect or seismic survey. Information only has value in a decision problem if it results in a change in some action to be taken by a decision maker. The information is seldom perfectly reliable and generally it does not eliminate uncertainty, so the value of information depends on both the amount of uncertainty (orthe prior knowledge available) and payoffs involved in the petroleum exploration and production projects. The value of information can be determined and compared to its actual cost and the natural path to evaluate the incorporation of this new data is by Bayesian analysis.

As the level of information increases, the decision making process becomes more complex because of the necessity of (1) more accurate prediction of field performance and (2) integration with production strategy. At this point, the concept of Value of Information (VoI) must be integrated with the Value of Flexibility (VoF). Therefore, risk may be mitigated by more information or flexibility in the production strategy definition. Reservoir development in stages and smart wells are good examples of investments in flexibility. The decision to invest in information or flexibility is becoming easier as more robust methodologies to quantify VoI and VoF are developed.

5.4 Portfolio Management and the Real Options Valuations

Asset managers in the oil and gas industry are looking to new techniques such as portfolio management to determine the optimum diversified portfolio that will increase company value and reduce risk. Under this approach employed extensively in financial markets, projects are selected based upon quantitative information on their contribution to the company long-term strategy and how they interact with the other projects in the portfolio. This theory of financial market and efficient portfolio was proposed by Markowitz (1952), winner of the 1990 Nobel Prize in Economics. This work has been adapted for the petroleum industry. A portfolio is said to be efficient if no other portfolio has more value while having less or equal risk, and if no other portfolio has less risk while having equal or greater value. The most important principle in portfolio analysis theory is that the emphasis must be placed on the interplay among the projects (Ball and Savage, 1999). The original idea states that a portfolio can be worth more or less than the sum of its component projects and there is not one best portfolio, but a family of optimal portfolios that achieve a balance between risk and value.

As the number of project opportunities grows, the petroleum industry is faced with an increasingly difficult task in selecting an ideal set of portfolios. Mathematical search and optimization algorithms can greatly simplify the planning process and a particularly well suited class of algorithms has been developed recently for the oil and gas applications in portfolio management (Davidson and Davies, 1995; Chorn and Croft, 1998, Orman and Duggan, 1998; Fichter, 2000; Back, 2001; Erdogan and Mudford, 2001). Garcia and Holtz (2003) combined optimal portfolio management with probabilistic risk-analysis methodology, thus helping to guide managers in evaluating a portfolio of exploration prospects, not just according to their value, but also by their inherent risk.

For several decades in the petroleum industry, the most common form of asset valuation has been the standard discounted cash-flow (DCF) analysis. However, over the past few years, an increasing number of institutions and organizations have been experimenting with the use of other valuations approaches to overcome some limitations imposed by the DCF approach. The real options approach is appealing because exploration and production of hydrocarbons typically involve following several decision stages, each one with an investment schedule and with associated success and failure probabilities. For example, in exploration phase the project can be viewed as an infinitely compounded option that may be continuously exercised as the exploration investment is undertaken. Traditional methods based upon discounted cash flow (DCF) reported in the finance literature are always based upon static assumptions - no mention about the value of embodied managerial options. Kester (1984) was the first to recognize the value of this flexibility and Mason and Merton (1985), and Myers (1987), among others, suggested the use of option-based techniques to value implicit managerial flexibility in investment opportunities, such as those of abandonment reactivation, mothballing and timing.

Some important earlier real options models in natural resources include Tourinho (1979), first to evaluate oil reserves using option-pricing techniques. Brennan and Schwartz (1985) applied option techniques to evaluate irreversible natural resources assets and McDonald and Siegel (1985) developed similar concepts for managerial flexibility. After the real options theory became widely accepted in financial markets, applications in the oil industry followed rapidly. Paddock et al. (1988) evaluated offshore oil leases. By the mid 1990's, several textbooks had been published (Dixit and Pindyck, 1994, Trigeorgis, 1996, and Luenberger, 1998) and the range of applications had widened to include applications in several economic sectors. Bjerksund and Ekern (1990) showed that it is possible to ignore both temporary stopping and abandonment options in the presence of the option to delay the investment for initial oilfield development purposes. Galli et al. (1999) discussed real options, decision-tree and Monte Carlo simulation in petroleum applications. Laughton (1998) found that although oil prospect value increases with both oil price and reserve size uncertainties, oil price uncertainty delays all option exercises (from exploration to abandonment), whereas exploration and delineation occur sooner with reserve size uncertainty. Chorn and Croft (2000) studied the value of reservoir information.

Chapter 06: Risk Management

Risk management is

"A systematic way of protecting the concern's resources and income against losses so that the aims of the business can be achieved without interruption"

- Risk Management is the process of defining all the risks that an organization faces
- Building a framework to not only monitor and mitigate those risks but to use risk management to increase shareholder value
- The point of risk management is not to eliminate it; that would eliminate reward

Need for Risk Management

- Uncertainty in Enterprise
- Growing Complexity in Business Environment
- Statutory Obligations
- Contractual Obligations
- Social Obligations
- High Profile Corporate Failures

6.1 The risk Management Process

The risk management process consists of a series of steps that, when undertaken in sequence, enable continual improvement in decision-making.

The elements of the risk management process are summarized in Figure 6.1 .

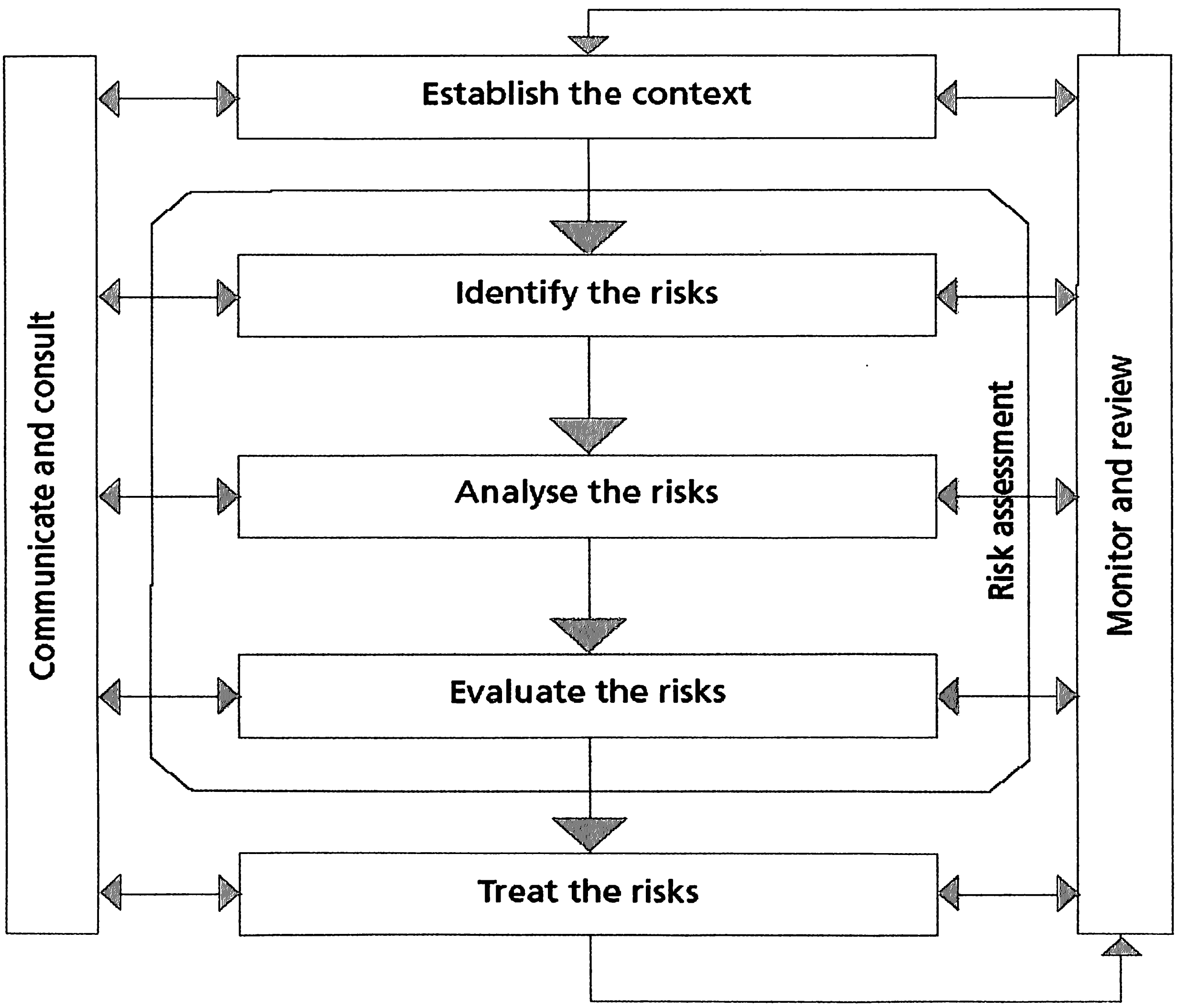

Fig. 6.1 risk management process

Step 1. Communicate and consult

This is shown in Figure 6.1 by the arrows against each step. Communication and consultation aims to identify who should be involved in assessment of risk (including identification, analysis and evaluation) and it should engage those who will be involved in the treatment, monitoring and review of risk. As such, communication and consultation will be reflected in each step of the process described in this guide.

As an initial step, there are two main aspects that should be identified in order to establish the requirements for the remainder of the process. These are communication and consultation aimed at:

- eliciting risk information
- Managing stakeholder perceptions for management of risk.

Eliciting risk information

Communication and consultation may occur within the organization or between the organization and its stakeholders. It is very rare that only one person will hold all the information needed to identify the risks to a business or even to an activity or project. It is therefore important to identify the range of stakeholders who will assist in making this information complete. To ensure effective communication, a business owner may decide to develop and implement a communication strategy and/or plan as early as possible in the process. This should identify internal and external stakeholders and communicate their roles and responsibilities, as well as address issues relating to risk management. Consultation is a two-way process that typically involves talking to a range of relevant groups and exchanging information and views. It can provide access to information that would not be available otherwise.

Managing stakeholder perceptions for management of risk

There will be numerous stakeholders within a small business and these will vary depending upon the type and size of the business (Figure 6.2).

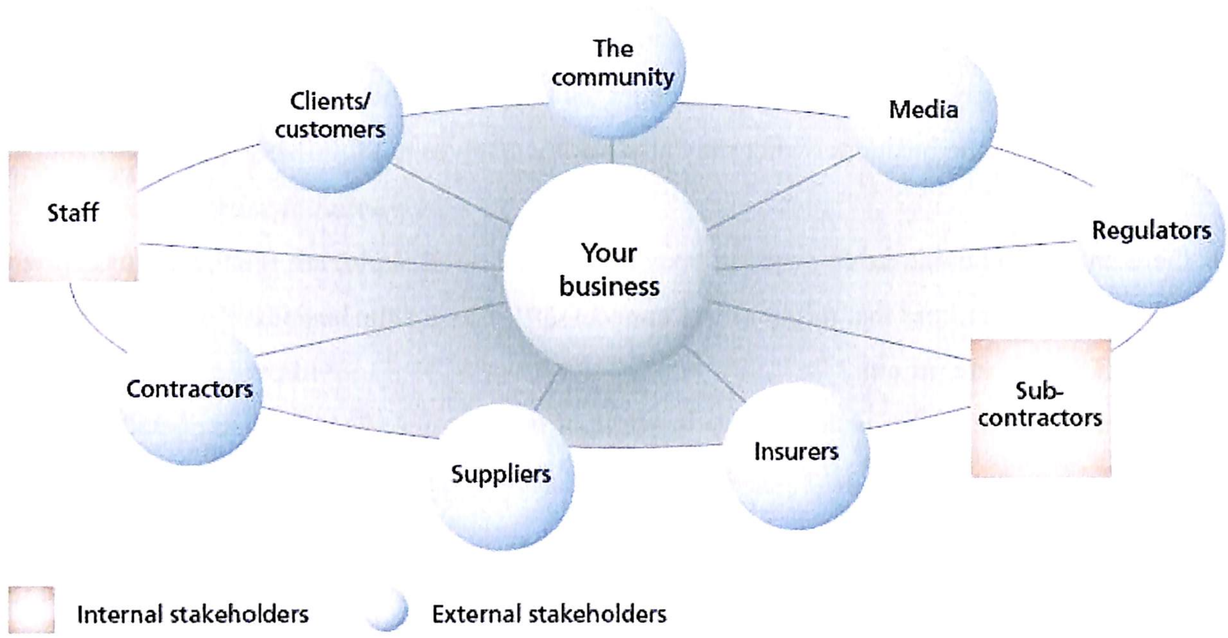

fig. 6.2 stakeholders in small business

Stakeholder management can often be one of the most difficult tasks in business management. It is important that stakeholders are clearly identified and communicated with throughout the risk management process. They can have a significant role in the decision-making process, so their perceptions of risks, as well as their perceptions of benefits, should be identified, understood, recorded and addressed. Stakeholder communication should incorporate regular progress reports on the development and implementation of the risk management plan and in particular provide relevant information on the proposed treatment strategies, their benefits and planned effectiveness.

Step 2. Establish the context

When considering risk management within a small business, it is important to first establish some boundaries within which the risk management process will apply. For example, the business owner may be only interested in identifying financial risks; as such the information collected will pertain only to that area of risk.

A five-step process to assist with establishing the context within which risk will be identified.

Establish the internal context

As previously discussed, risk is the chance of something happening that will impact on objectives. As such, the objectives and goals of a business, project or activity must first be identified to ensure that all significant risks are understood. This ensures that risk decisions always support the broader goals and objectives of the business. This approach encourages long- term and strategic thinking. In establishing the internal context, the business owner may also ask themselves the following questions:

- Is there an internal culture that needs to be considered? For example, are staff resistant to change? Is there a professional culture that might create unnecessary risks for the business?
- What staff groups are present?
- What capabilities does the business have in terms of people, systems, processes, equipment and other resources?

Establish the external context

This step defines the overall environment in which a business operates and includes an understanding of the clients' or customers' perceptions of the business. An analysis of these factors will identify the strengths, weaknesses, opportunities and threats to the business in the external environment. A business owner may ask the following questions when determining the external context:

- What regulations and legislation must the business comply with?
- Are there any other requirements the business needs to comply with? What is the market within which the business operates? Who are the competitors?
- Are there any social, cultural or political issues that need to be considered? Establishing the external context should also involve examining relationships the business has with external stakeholders for risk and opportunity.

Establish the risk management context

Before beginning a risk identification exercise, it is important to define the limits, objectives and scope of the activity or issue under examination. For example, in conducting a risk analysis for a new project, such as the introduction of a new piece of equipment or a new product line, it is

important to clearly identify the parameters for this activity to ensure that all significant risks are identified.

Establishing the parameters and boundaries of the activity or issue also involves the determination of:

• Timeframe (e.g. how long will it take to integrate a new piece of equipment?)
• Resources required
• Roles and responsibilities
• Additional expertise required
• Internal and external relationships (e.g. other projects, external stakeholders)
• Record-keeping requirements
• Depth of analysis required.

The amount of analysis required for this step will depend on the type of risk, the information that needs to be communicated and the best way of doing this.

To determine the amount of analysis required consider the:
• Complexity of the activity or issue
• Potential consequence of an adverse outcome
• Importance of capturing lessons learned so that corporate knowledge of risk associated with the activity can be developed
• Importance of the activity and the achievement of the objectives
• Information that needs to be communicated to stakeholders
• Types of risks and hazards associated with the activity.

Develop risk criteria

Risk criteria allow a business to clearly define unacceptable levels of risk. Conversely, risk criteria may include the acceptable level of risk for a specific activity or event. In this step the risk criteria may be broadly defined and then further refined later in the risk management process. It is against these criteria that the business owner will evaluate an identified risk to determine if it requires treatment or control. Where a risk exists that may cause any of the objectives not to be met, it is deemed unacceptable and a treatment strategy must be identified.

The table below (Table 6.1) provides a number of examples of risk criteria for a project.

Risk criterion	Objective
Safety	Safety must be upheld at all times. No injuries or fatalities will be accepted
Financial impact	Project costs should remain within allocated budget
Media exposure	The project must ensure that the reputation of the business is protected from negative media exposure
Timing	The project must be completed within the contractual timeframe
Staff management	The project must utilise existing staff skills. Where a particular skill set is not available, sub-contracting may be considered
Environment	The project must operate within requirements of environmental legislation and be consistent with the business's environmental commitment

Table 6.1. Examples of risk criteria for a project in small business

Define the structure for risk analysis

Isolate the categories of risk that you want to manage. This will provide greater depth and accuracy in identifying significant risks. The chosen structure for risk analysis will depend upon the type of activity or issue, its complexity and the context of the risks. Examples of risk categories for a particular risk analysis are provided in the following case study.

Step 3. Identify the risks

Risk cannot be managed unless it is first identified. Once the context of the business has been defined, the next step is to utilize the information to identify as many risks as possible. The aim of risk identification is to identify possible risks that may affect, either negatively or positively, the objectives of the business and the activity under analysis. Answering the following questions identifies the risk: There are two main ways to identify risk:

- Retrospectively
- Prospectively.

Identifying retrospective risks

Retrospective risks are those that have previously occurred, such as incidents or accidents. Retrospective risk identification is often the most common way to identify risk, and the easiest. It's easier to believe something if it has happened before. It is also easier to quantify its impact and to see the damage it has caused.

There are many sources of information about retrospective risk. These include:

- Hazard or incident logs or registers
- audit reports
- Customer complaints
- Accreditation documents and reports
- Past staff or client surveys
- Newspapers or professional media, such as journals or websites.

Identifying prospective risks

Prospective risks are often harder to identify. These are things that have not yet happened, but might happen some time in the future. Identification should include all risks, whether or not they are currently being managed.

The rationale here is to record all significant risks and monitor or review the effectiveness of their control.

Methods for identifying prospective risks include:

- Brainstorming with staff or external stakeholders
- researching the economic, political, legislative and operating environment
- conducting interviews with relevant people and/or organizations
- undertaking surveys of staff or clients to identify anticipated issues or problems
- flow charting a process
- reviewing system design or preparing system analysis techniques.

Risk categories will help break down the process for prospective risk identification. It is important to remember that risk identification will be limited by the experiences and perspectives of the person(s) conducting the risk analysis. Problem areas and risks can be identified with the help of reliable sources.

SWOT analysis

An effective method for prospective risk identification is to undertake a strengths, weaknesses, opportunities and threats (SWOT) analysis. A SWOT analysis is a tool commonly used in planning and is an excellent method for identifying areas of negative and positive risk at a business level.

Step 4. Analyze the risks

During the risk identification step, a business owner may have identified many risks and it is often not possible to try to address all those identified. The risk analysis step will assist in determining which risks have a greater consequence or impact than others. This will assist in providing a better understanding of the possible impact of a risk, or the likelihood of it occurring, in order to make a decision about committing resources to control the risk.

What is risk analysis?

Risk analysis involves combining the possible consequences, or impact, of an event, with the likelihood of that event occurring. The result is a 'level of risk'. That is:

Risk = consequence x likelihood

This is discussed further later in this section. So how is the level of risk determined?

Elements of risk analysis

The elements of risk analysis are as follows:

- Identify existing strategies and controls that act to minimize negative risk and enhance opportunities.
- Determine the consequences of a negative impact or an opportunity (these may be positive or negative).
- Determine the likelihood of a negative consequence or an opportunity.
- Estimate the level of risk by combining consequence and likelihood.
- Consider and identify any uncertainties in the estimates.

1. Identify existing strategies and controls that act to minimize negative risk and enhance opportunities

To provide a clear understanding of the possible impact of a risk, existing control measures should first be identified and then the risk analyzed to determine the amount of 'residual risk'.
For example, the risk of theft from a business is reduced by the employment of a security camera. However, this has not eliminated the risk – a residual risk remains.

2. Determine the consequences of a negative impact or an opportunity (these may be positive or negative)

Consequences are the possible outcomes or impacts of an event. They can be positive or negative, and can be expressed in quantitative or qualitative terms and are considered in relation to the achievement of objectives.
It is necessary to estimate the impact of a risk or opportunity on the identified objectives. For example, the consequence of failing to maintain a major piece of machinery may be major injury requiring hospitalization, or possible death, of an employee.

3. Determine the likelihood of a negative consequence or an opportunity

Likelihood relates to how likely an event is to occur and its frequency. An example is the likelihood that a non-maintained piece of machinery will malfunction and result in major injury requiring hospitalization, or possible death, of an employee.

*** Likelihood = probability x exposure**

Likelihood relates to the probability of a risk occurring combined with the exposure to the risk. This means that although the probability of a risk resulting in a negative outcome may be deemed rare, a higher frequency of exposure to that risk can increase the overall likelihood of a negative outcome. For example, based upon experience, the probability that an experienced courier company will encounter an increased accident rate is low when delivering within regional areas. However, this probability increases considerably when exposed to heavier traffic, e.g. if the business decides to relocate to a larger city. *Estimate the level of risk by combining consequence and likelihood* As previously introduced, to determine the level of risk, risk analysis involves combining the consequence of a risk with the likelihood of the risk occurring:

Risk = consequence x likelihood*

This is known as the 'risk analysis equation'. Techniques for determining the value of consequence and likelihood include descriptors, word pictures, or mathematically determined values. These are further described later in this section. Most commonly, the overall level of risk is determined by combining the identified consequence level with the likelihood level in a matrix (Figure 3.4). *Consider and identify any uncertainties in the estimates* In all estimates of likelihood and consequence, uncertainties will exist. This is a common limitation of the risk management process. It is important therefore to consider and identify any uncertainty. It may not be necessary to act on that uncertainty, but be aware and monitor any increases in the risk level.

Analysis techniques

The purpose of risk analysis is to provide information to business owners to make decisions regarding priorities, treatment options, or balancing costs and benefits. Just as decisions differ, the information needed to make these decisions will also differ. Not all businesses or even areas within a business will use the same risk analysis method. For example, a doctor's clinic will have very different types of risk from a software developer.

As such, the risk analysis tools need to reflect these risk types to ensure that the risk levels estimated are appropriate to the context of the business.

Types of analysis

Three categories or types of analysis can be used to determine level of risk:

- Qualitative
- Semi-quantitative
- Quantitative.

The most common type of risk analysis is the qualitative method. The type of analysis chosen will be based upon the area of risk being analyzed. More information regarding the semi-quantitative and quantitative techniques can be found within the Australian and New Zealand Standard *Risk Management Guidelines* (HB 436:2004).

Qualitative risk analysis

This form of risk analysis relies on subjective judgement of consequence and likelihood (i.e. what might happen in a worst case scenario). It produces a word picture of the size of the risk and is a viable option where there is no data available. Qualitative risk analysis is simple and easy to understand. Disadvantages include the fact that it is subjective and are based on intuition, which can lead to the forming of bias and can degrade the validity of the results. Methods for qualitative risk analysis include:

- brainstorming
- Evaluation using multi-disciplinary groups
- Specialist and expert judgement
- structured interviews and/or questionnaires
- Word picture descriptors and risk categories.

Step 5. Evaluate the risk

Risk acceptance

Low or tolerable risks may be accepted. 'Acceptable' means the business chooses to 'accept' that the risk exists, either because the risk is at a low level and the cost of treating the risk will outweigh the benefit, or there is no reasonable treatment that can be implemented. This is also known as ALARP (as low as reasonably practicable). A risk may be accepted for the following reasons:

- The cost of treatment far exceeds the benefit, so that acceptance is the only option (applies particularly to lower ranked risks)
- The level of the risk is so low that specific treatment is not appropriate with available resources
- The opportunities presented outweigh the threats to such a degree that the risk is justified
- The risk is such that there is no treatment available, for example the risk that the business may suffer storm damage.

Step 6. Treat the risks

Risk treatment is about considering options for treating risks that were not considered acceptable or tolerable at Step 5. Risk treatment involves identifying options for treating or controlling risk, in order to either reduce or eliminate negative consequences, or to reduce the likelihood of an adverse occurrence. Risk treatment should also aim to enhance positive outcomes. It is often either not possible or cost-effective to implement all treatment strategies. A business owner should aim to choose, prioritize and implement the most appropriate combination of risk treatments. Figure 3.5 overviews the risk treatment process, including what needs to be considered in choosing a risk treatment.

Treating the root cause

Before a risk can be effectively treated, it is necessary to understand the 'root cause' of a risk, or how risks arise.

Options for risk treatment

The following options may assist in the minimization of negative risk or an increase in the impact of positive risk.

Avoid the risk

One method of dealing with risk is to avoid the risk by not proceeding with the activity likely to generate the risk. Risk avoidance should only occur when control measures do not exist or do not reduce the risk to an acceptable level. Uncontrolled or inappropriate risk avoidance may lead to organizational risk avoidance, resulting in missed opportunities and an increase in the significance of other risks.

Change the consequences

This will increase the size of gains and reduce the size of losses. This may include business continuity plans, and emergency and contingency plans.

Share the risk

Part or most of a risk may be transferred to another party so that they share responsibility. Mechanisms for risk transfer include contracts, insurance, partnerships and business alliances. It is important to note that risks can never be completely transferred, because there is always the possibility of failures that may impact on the business. Transfer of risk may reduce the risk to the original business without changing the overall level of risk.

Retain the risk

After risks have been reduced or transferred, residual risk may be retained if it is at an acceptable level.

Identifying appropriate treatments

Once a treatment option has been identified, it is then necessary to determine the residual risk;

that is, *has the risk been eliminated?* Residual risk must be evaluated for acceptability before treatment options are implemented.

Conducting a cost–benefit analysis

Business owners need to know whether the cost of any particular method of correcting or treating a potential risk is justified. Considerations include:

- Number of treatments required
- Benefit to be gained from treatment
- Other treatment options available, and why the chosen one has been recommended
- Effectiveness of the treatment timeframe
- Total cost of treatment option
- Total reduction in residual risk
- Legislative requirements.

Business owners are required by law to provide a safe workplace. If existing work environments need to be upgraded to fully meet codes of practice and standards, a risk management approach should be adopted to demonstrate due diligence. A staged action or risk treatment plan can be used to document the risks and to outline a remedy. Appropriate consultation with stakeholders should also occur.

Risk treatment plan

A risk treatment plan indicates the chosen strategy for treatment of an identified risk. It provides valuable information about the risk identified, the level of risk, the planned strategy, the timeframe for implementing the strategy, resources required and individuals responsible for ensuring the strategy is implemented. The final documentation should include a budget, appropriate objectives and milestones on the way to achieving those objectives.

Risk recovery

Although uncertainty-based risks are difficult, if not impossible, to predict, there are ways in which businesses can prepare for a significant adverse outcome. This is known as risk recovery. Businesses should consider adopting a structured approach to planning for recovery. This planning may take many forms, including the following:

Crisis or emergency management planning
The business anticipates what might occur in a crisis or emergency, such as a fire or another physical threat, and then plans to manage this in the short term. This will include listing emergency contact details and training staff in evacuation and emergency response procedures.

Business continuity planning
The business moves beyond the initial response of a crisis or emergency and plans for recovery of business processes with minimal disruption. This might, for example, include ensuring that there is sufficient documentation of processes if a key staff member is unavailable to return to work and another staff member is required to fulfill that role, identifying options for alternative premises if the existing premises are damaged, or documenting alternate suppliers for key supply material if a key supplier does not fulfill their contract.

Contingency planning
Contingency planning can be a combination of the above. A contingency planning tool can help to identify what should be done to minimize the impact of a negative consequence on key business processes arising from an uncertainty-based risk. This would include the initial response (crisis management) and the delayed response (business continuity).

Step 7. Monitor and review

Monitor and review is an essential and integral step in the risk management process. A business owner must monitor risks and review the effectiveness of the treatment plan, strategies and management system that have been set up to effectively manage risk. Risks need to be monitored periodically to ensure changing circumstances do not alter the risk priorities. Very few risks will remain static, therefore the risk management process needs to be regularly repeated, so that new risks are captured in the process and effectively managed.

A risk management plan at a business level should be reviewed at least on an annual basis. An effective way to ensure that this occurs is to combine risk planning or risk review with annual business planning.

Types of Risk Management

Operational risk management: Operational risk management deals with technical failures and human errors

Financial risk management: Financial risk management handles non-payment of clients and increased rate of interest

Market risk management: Deals with different types of market risk, such as interest rate risk, equity risk, commodity risk, and currency risk

Credit risk management: Deals with the risk related to the probability of nonpayment from the debtors

Quantitative risk management: In quantitative risk management, an effort is carried out to numerically ascertain the possibilities of the different adverse financial circumstances to handle the degree of loss that might occur from those circumstances

Commodity risk management: Handles different types of commodity risks, such as price risk, political risk, quantity risk and cost risk

Bank risk management: Deals with the handling of different types of risks faced by the banks, for example, market risk, credit risk, liquidity risk, legal risk, operational risk and reputational risk

Nonprofit risk management: This is a process where risk management companies offer risk management services on a non-profit seeking basis

Currency risk management: Deals with changes in currency prices

Enterprise risk management: Handles the risks faced by enterprises in accomplishing their goals

Project risk management: Deals with particular risks associated with the undertaking of a project

Integrated risk management: Integrated risk management refers to integrating risk data into the strategic decision making of a company and taking decisions, which take into account the set risk tolerance degrees of a department. In other words, it is the supervision of market, credit, and liquidity risk at the same time or on a simultaneous basis.

Technology risk management: It is the process of managing the risks associated with implementation of new technology

Software risk management: Deals with different types of risks associated with implementation of new softwares

Use and Implementation of Risk Analysis

Implementation of risk analysis involves three basic steps: "identifying an opportunity" (or event) where the tool can be applied, "quantifying the consequences of various possible decisions" and "assessing, within the possible outcomes, the estimated best economic or operational result." The first step was considered the simplest part of the process since it is recognized that many are the decisions under uncertainty occurring during well drilling operations. The second and third steps are more complex and involve issues related to data availability and reliability, cost analysis, probability determination and economic assessment. In the next section an example of application is presented

Example of Application - Well Cost Estimation

Engineers involved in well planning and budgeting know how sensitive this subject is. A poorly prepared well budget or AFE (Authorization for Expenditure) will have effect on the company's internal functioning as well as in its relation with possible partners. Internally, the accounting department will rely on the recommendation from engineers to prepare the company's budget. Externally, partners will do the same and, only to a certain extent, will allow deviation from the proposed AFE.

Normally, in certain high-risk exploration ventures, it is very common for oil companies to look for partners to share the risks involved, potential losses and, of course, the possible gains. In this case, following clauses established in a Joint Operating Agreement (JOA), an AFE will have to be approved by all partners before drilling operation takes place. It is regular in these cases to allow a 10% over spending on the planned costs. Any amount above this limit will require mandatory approval from the partners, which may cause operational delays and doubts about the operating partner's technical proficiency.

Since cost estimation for drilling operations naturally carries a great deal of uncertainty, this area appears to be suitable for risk analysis application.

Table 6.2 presents an actual AFE for a vertical offshore well. The total estimated cost is $6,456,000. Let us assume now that the engineer in charge of well planning has uncertainties related to 16 items (see Table 6.3) on the proposed AFE. The normal approach, of considering a "best case" with all the lower costs occurring at the same time and a worst scenario with all the higher costs happening simultaneously cannot be applied here. There is no guarantee that, let us say, rig costs, will be in the lower side at the same time that supervision and P&A costs reach a minimum.

Assuming that all cost variations are independent, which may not be the case with certain related item like casings with different diameters, we can further assume that the costs will vary according to a triangular distribution where the minimum, maximum and mode value are known (as given in Table 6.3).

From that premise, a Monte Carlo simulation can be performed, with all uncertain costs being randomly varied combined with the other costs. The simulation is run consecutively, every time taking one possible cost from the distribution of each of the 16 uncertain variables. Those values are added with the fixed costs, variables where no uncertainty exist, resulting in a total.cost for the well. In this case the simulation was repeated 500 times and the results used to form a cumulative distribution function (CDF) for the well.

The resulting CDF is presented in Fig. 6.3.

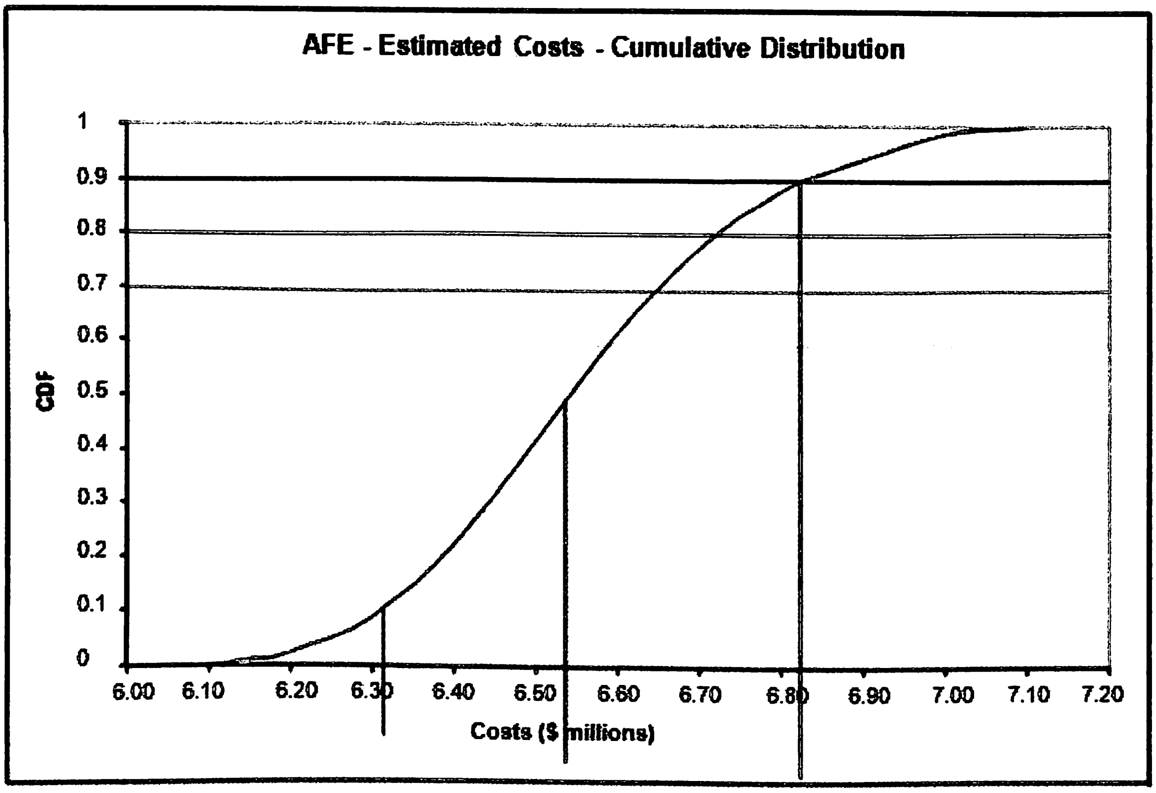

Figure 6.3 - Cumulative Distribution for AFE

Analysis of Results

After establishing the distribution of possible costs for the well, the engineer now has a much more reliable tool to be used on the AFE's preparation. Notice that the analysis itself does not substitute the engineer's evaluation or company's policy. On the other hand it provides the professional with means to best estimate contingency costs and determine P(10), P(50) and P(90) costs, in our case, \$6.32, \$6.54 and \$6.83 millions.

Conclusions

An overview on most important works relating use of risk analysis applications for drilling operations was presented.

Use of risk analysis on oil and gas investment decision is a common procedure in all major oil companies; however, use of QRA methods as an auxiliary tool for decisions under uncertainty in well engineering process is not as prevalent as it should be.

A simple example for application in well cost estimation was presented. Monte Carlo simulation was used to determine a cumulative distribution function for the expected well costs.

Use of decision methods with risk analysis required reliable database and careful analysis of possible outcomes. However, once the method is implemented, its use is simple and will provide great benefit for the company.

TABLE 6.2 - Authorization for Expenditure (AFE)

Preliminary Estimate for a 9000 ft Straight Hole, Precompletion Estimate Included						
ESTIMATED INTANGIBLE COSTS				DRILLING COST	PRECOMPL. Cost	TOTAL AFE
Surveys and Permits/Environmental				\$20,000	\$5,000	\$25,000
Location Cleanup	Rate	Days	Days			
Rig Move (Mob. & Demob.)	\$75,000	7		\$525,000	\$0	\$525,000
Drilling – Daywork	\$75,000	31	6	\$2,325,000	\$450,000	\$2,775,000
Fuel, Lubes and Water	\$2,000	31	6	\$62,000	\$12,000	\$74,000
Rental Equipment	\$3,000	31	6	\$93,000	\$18,000	\$111,000
Drill Bits				\$50,000	\$5,000	\$55,000

Drilling Mud & Chemicals		31	6	$400,000	$0	$400,000
Mud Logging	$800	5		$4,000	$0	$4,000
Cement & Squeeze Services				$130,000	$50,000	$180,000
Casing Crews & Tools				$40,000	$25,000	$65,000
OH Logging+MWD/LWD				$350,000	$0	$350,000
Cores & Analysis				$15,000	$0	$15,000
Transportation	$13,100	31	6	$406,100	$78,600	$484,700
Labor + Dock Charges	$2,000	31	6	$62,000	$12,000	$74,000
Supervision	$850	31	6	$26,350	$5,100	$31,450
P&A Costs	$120,000	5	0	$600,000	$0	$600,000
Pipe Inspection				$25,000	$10,000	$35,000
Overhead	$750	31	6	$23,250	$4,500	$27,750
Insurance	$570	31	6	$17,670	$3,420	$21,090
Communications	$300	31	6	$9,300	$1,800	$11,100
				$5,183,700	$680,500	$5,864,100

TANGIBLE COSTS

		$/FT.				
Drive Pipe	800	30"	220	$72,600	$0	$72,600
Conductor	1,600	20"	60	$96,000	$0	$96,000
Surface Casing	3,500	16"	16	$56,000	$0	$56,000
Intermediate Casing	6,000	9-5/8"	30	$180,000	$0	$180,000
Production Liner	3500	7-5/8"	13.5	$0	$47,250	$47,250
Wellhead Equipment				$120,000	$20,000	$140,000
TOTAL TANGIBLES				$524,600	$67,300	$591,900
TOTAL AFE COSTS				$5,708,300	$747,800	$6,456,000

TABLE 6.3 - Range of Costs

	Total Cost Base Case	Total Cost Lower Limit	Total Cost Higher Limit
Total Rig Cost	$3,300,000	$3,080,000	$3,960,000
Fuel, Lubes and Water	$74,000	$64,750	$77,700
Rental Equipment	$111,000	$92,500	$122,100
Drilling Mud & Chemicals	$400,000	$350,000	$500,000
Mud Logging	$4,000	$3,250	$4,500
Transportation	$484,700	$299,700	$499,500
Labor + Dock Charges	$74,000	$55,500	$81,400
Supervision	$31,450	$27,750	$33,300
P&A Costs	$600,000	$550,000	$675,000
Insurance	$21,090	$18,500	$22,570
Communications	$11,100	$9,250	$12,210
Drive Pipe	$72,600	$69,300	$75,900
Conductor	$96,000	$80,000	$104,000
Surface Casing	$56,000	$49,000	$59,500
Intermediate Casing	$180,000	$168,000	$198,000
Production Liner	$47,250	$40,250	$52,500

Chapter 07:Risk assessment and Management –To thrive amidst uncertainty (Upstream Focus)

Assessing and managing risks are essential functions for any organization, but they are particularly vital concerns for companies operating within the upstream sector of the oil and gas industry.

Even with the best seismic technology and geological expertise, exploration presents considerable uncertainty. Actuarial analysis is needed to project the life spans of discovered reserves and their market value over several decades. Extracting that oil or gas demands greater investment, additional expertise, and greater exposure to possible liabilities and compliance requirements. While international economic and political events increasingly affect all businesses, such issues have long been concerns for oil and gas companies.

Due to such factors, the upstream sector of the oil and gas industry presents a higher degree of inherent risk than most industries, and companies operating in that sector generally maintain higher risk profiles than most corporations. Maintaining a higher risk profile, however, also heightens the importance of assessing and managing risks to ensure that any potential internal or external threats an entity faces do not exceed its risk appetite.

The upstream oil and gas industry shares with some other businesses, such as the pharmaceutical industry and aerospace engineering, typically long payback periods. Payback is defined as the length of time between the initial investment in a project by the company and the generation of accumulated net revenues equal to the initial investment In the oil industry, this period is typically between ten to fifteen years

Shortages compel Asian upstream sector to focus on risk management

The Asian oil and gas industry is facing difficult times, particularly in resource availability. The main problems are the steel shortage, experienced labor shortage (all levels), and even space in fabrication yards across the region.

These problems, coupled with reserves becoming more difficult to locate and more expensive to develop, have caused the industry to begin implementing detailed planning and risk management.

Today, Asian oil and gas companies are placing more emphasis on managing assets and streamlining business processes to maximize profitability. Although the price per barrel has increased dramatically in recent months, the industry remembers the downtimes in the '90s and is wary of the current high prices. Because of this, reserves in oil and money are being shored up. Getting oil fields and equipment (onshore and offshore installations) working as fast as possible is important. With this in mind - and a strong risk management knowledge base - most Asian oil and gas companies are now practicing risk management at the highest professional levels. The main problem with risk management in the industry is the lack of tool usage to help in the automation of the risk processes being used.

This article will explore the current problems the Asian oil and gas industry are facing and how risk management is helping to solve those problems. It will also touch on the technology that can help managers automate the process of identifying and mitigating risk.

7.1 Asia Pacific oil and gas markets

The Asia Pacific region is now recognized as the major growth area for energy demand. Oil, gas, and electric power take center stage for investment in this growing and emerging market. This region has vastly inadequate local crude oil production relative to its expanding needs and will need increased imports from outside the region.

Coupled with governmental policy changes encouraging deregulation, privatization, and foreign investment, the future appears bright. Yet risk prevails. Deregulated markets bring competitive risks not previously experienced and energy risk management rises in importance dramatically changing market environments such as these.

Oil is still the key fuel of the industrial world. In the Asia Pacific region, the overriding concern has always been security of supply rather than price risk. In this environment, the use of energy risk management tools, particularly on futures exchanges, has repeatedly failed.

Risk avoidance - rather than risk management - has long been the operative word in Asian oil markets. That is about to change due to the twin engines of deregulation and privatization driving competition. Oil exhibits annualized price volatility of 40% to 50% per year, making it among the highest of any commodity.

Deregulation and globalization of energy markets are bringing the need for active management of risks. The markets are becoming more price sensitive with the rapid dissemination of price and market information. The need to automate risk management now exists out of competitive necessity. Fortunately, the effectiveness of available risk management tools is more established and the knowledge base wider.

7.2 Oil markets

The importance of the Asia Pacific region in terms of world oil demand and refining cannot be understated. Since 1985, Asia has accounted for more than 70% of total world oil demand growth. This area has surpassed Europe and will soon eclipse North America as the primary region of world oil demand.

The Asia Pacific region continues to be the most dynamic oil market in the world with demand at 25.4 million b/d in 2005, with projections of 29.4 million b/d in 2010. Most of this increased consumption will be sourced from the Middle East from where over 70% of the supply currently originates.

It is estimated that 80% of Persian Gulf oil production will be exported to China, India, Japan, South Korea, Taiwan, and the Association of Southeast Asian Nations (ASEAN) countries by the year 2010. Growing commercial ties between Persian Gulf producers and Asian consumers seem inevitable, especially as the giant US market shifts away from the Middle East to a greater dependence on Latin American producers.

By 2006, Japan, South Korea, China, India, Taiwan, Thailand, and Singapore are expected to be importing oil at over one million b/d each. While some Atlantic Basin crude oil from West Africa and the North Sea may supply some of the older, less flexible Asian refineries that have an appetite for those sweet crudes, the key issue is the growing Asia Pacific dependency on Middle Eastern sources of crude.

This increased dependency on oil presages an era of continued price volatility and the growing need for additional risk management instruments to be developed and utilized in the Asian markets. China became a net oil importer during 1993 and its needs will continue to grow. Indonesia, an OPEC member and current oil exporter, seems to be slipping from being a global supplier to being a net user of petroleum.

With about half of world oil growth projected to continue to be in the Asia Pacific region, rising product demand and tightening fuel quality standards driven by rising environmental awareness, the need for managing energy price risk seems poised for explosive growth over the next several years. However, it has taken an inordinately long time to get started in the region compared to the North American and European experiences, particularly because of the more protectionist Asian economies.

Asia will need more imported crude oil in the coming years as output declines in Indonesia and only some oil production increases in China, despite the expected short-term increases in output from Australia, Malaysia, Papua New Guinea, and Vietnam. Sour crude barrels will come from Mexico and the United States. Moreover, product import dependency is also rising at an astounding rate. Changing markets and oil trade patterns presage rising price volatility.

7.3 Deregulation as a market driver

The most significant political driver of the market in Asia is the deregulation effort underway in the energy sector in most countries. This movement to freer competitive markets will mean that risk will increasingly be shifted to energy companies and away from government protection.

7.4 Fundamental changes in Asian oil markets

For refiners and traders, petroleum storage requirements are another area affected by deregulation and are a growing area for risk management. Many storage expansions have been announced throughout the region.

Singapore, as an active regional transshipment center, has already undergone more storage capacity increases. Subic Bay in the Philippines is another strategic location. China, India, South Korea, and Thailand have all announced that large-scale storage projects are underway. These and other projects are an attempt to reduce the transshipment costs of Singapore facilities.

Another reason is the need for strategic stockpiling of oil and products for energy security reasons, which is still a dominant part of the Asian energy puzzle. In fact, regional storage seems to be taking hold as evidenced by Chinese oil stockpiling this year.

While the Asia Pacific oil trade is still centered on security of supply rather than price risk management, the Asia Pacific markets are just beginning to emerge as the next opportunity for growth for the markets in energy. Fed by growing oil demand in the region and the growing interest in making Singapore the energy derivatives center for Asia, it seems likely that this is the beginning of the change to a more financial rather than physical orientation in energy trading. As they move towards deregulation, political changes in Asian countries should bring increased trade activity in both futures and derivatives.

The highly publicized financial debacles in recent years, such as Enron, WorldCom, and others, have focused attention on risk management, creating more interest in hedging and the use of energy risk management tools.

New risks need to be intelligently managed. Consequently, risk management is now a key management tool. Once considered a peripheral concept, effective risk management can be essential to achieving industry leadership.

In the Asia Pacific markets, there is actually less uncertainty than previously on the regulatory side as countries are making their deregulation plans known. Nonetheless, market, credit, and operational risks remain pervasive in the Asian markets. Most importantly, a company's risk tolerance must be identified, particularly since oil, gas and power are the most volatile commodities traded.

The objective of using risk management tools is simply to achieve corporate goals. There is no cookie cutter approach of "one size fits all." These goals can include lower fuel costs, securing market share, reducing earnings volatility or increasing margins. The key is reduction of risk, not risk elimination (since that is impossible).

Chapter 08: Conclusion

Upstream projects today are getting larger and more complex. The attraction of upstream profits is also driving many companies to consider expanding their investments, moving from investor to operator, or entering into the space from adjacent energy sectors. At the same time, the graying of experienced project managers is reducing available capabilities. These factors combined increase the level of project-related risk within the sector.

Unless a company follows a strategy of complete risk avoidance and stays solely within its national boundaries, it will be faced with the need to consider political risk when investing outside its home country. The challenge therefore is to manage the political and other risks that are unavoidable in the industry. How well these risks are analyzed and managed will often be key to a project's success. Classic political risk in the form of expropriation and nationalization remains a threat, although it is not as prevalent as it once was. Remember, that expropriation or nationalization does not in and of itself violate international law, provided there is prompt, fair and adequate compensation to the investor. Risks of contract repudiation such as was experienced by Enron in India, and so-called "creeping nationalization" as evidenced by punitive taxation, burdensome labor and environmental regulations, price and monetary controls, pose a greater and probably more likely risk today.

While political risk can be *managed* through insurance, strategic alliances and partnering, it can also be minimized, by taking some actions, which may seem obvious, but are too often ignored. Effective techniques include keeping a low profile, maintaining close relationships with the host government, anticipating change and working with it, avoiding geographical concentration, being a good corporate citizen and utilizing local suppliers and personnel to the greatest extent possible so as to create an economic link with the host country that establishes a national constituency with a stake in your continued political survival.

However, no form of political risk insurance can protect a company if it engages in bribery or corruption, or pollutes the environment. Such actions would probably void any political risk insurance that was obtained.

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