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INVESTMENT PLANNING

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## INVESTMENT PLANNING

### A. INTRODUCTION

The primary objective of oil and gas investments by the western petroleum industry is not merely to produce oil and gas, but normally to do so at optimal profit consistent with the risks, its financial restraints, and the forecast political, social, and economic scenarios. Individual corporations may have other prime objectives such as growth, or corporate survival in times of economic turndown or specific circumstances. Optimizing profit over a short/medium or longer term, though, is normally the prime objective.

The industry therefore carefully plans for its capital investments, since such investments:

- require substantial financial resources and specialized human resources;
- are inherently risky and uncertain reflecting, for example, political, economic, and geological factors;
- affect the corporation's financial performance over a long period of time; and
- are generally irreversible once commitments are made to joint-venture partners, governments, customers, etcetera.

Investment planning in exploration and development is complicated by the fact that the primary determinants of a project's profitability are uncontrollable, notably, the world price of oil, royalties/taxes, and other external economic factors. In addition, the investments themselves are inherently risky but controllable to greater or lesser degrees. Before an investment decision is made, explorationists, engineers, economists, and planners conduct thorough integrative analyses of the key factors that impact on the economic attractiveness and therefore on the profitability of a project.

These assessments deal with questions such as:

- Will geophysical/geological activities locate prospective anomalies on the acreage and how many? What will be the costs and timing of exploration expenditures to success or completion of the program?
- If there are anomalies, what are the chances of finding hydrocarbons and what type and quality (sweet or sour gas, light or heavy oil, etcetera)?
- Given a successful wildcat, what is the probability as to areal extent of accumulation, reservoir and production characteristics, development and production costs and timing of these expenditures?
- If developed, what are the market opportunities, what will be the transportation costs to market or the capital costs for transportation if undertaken by the company? What will be the selling prices of the product and the taxes, royalties and other economic factors?
- If the delineation phase is successful, will full exploitation of the discovery generate enough financial return consistent with the profitability objectives of the corporation and with due regard to the risks and financial capability of the company?
- At the level of the producing field, what production method, number of wells, spacing of wells, type of equipment, etcetera will achieve optimal unit production costs relative to optimal recovery?

These analyses, which are mainly conducted at the operational or subsidiary level of companies, involve geophysical, geological, reservoir and production engineering, economic and financial considerations. For decision making purposes, however, these analyses are factored into broader, more strategic considerations developed by the company's corporate or headquarters level management. These strategic considerations deal with issues such as the company's longer term goals and direction, its relationship with the specific country, its overall financial health, the riskiness and return of this investment relative to others, etcetera. The level at which the decisions are made (i.e., headquarters or subsidiary level) will depend on the scale of the investment, its strategic importance, and how closely it fits the corporate objectives and strategies.

Because of the magnitude of and the risks associated with major capital investments in oil and gas (such investments can range in the billions

of dollars), the complexity of the investment analyses, the size of many companies, and their specialization of functions at the corporate and subsidiary levels, companies have developed systematic processes and procedures to evaluate investments and to integrate these evaluations within a broader strategic planning framework for management decision making.

#### 1. Management's Perspective on Investment Planning

From the corporate or headquarters perspective of the typical company in the western oil and gas industry, one of management's principal goals is to optimize the company's present worth over a period of time. Investments are therefore directed to that portfolio of activities where the overall balance of risks and returns appears to be optimum by reference to this goal. The goal of investment planning is to provide a company's shareholders with a financial return which, over the long run, is no less than that which they could have obtained from similar investments in a business of comparable risk.

A company may have other important objectives, such as growth, in which case it may be prepared to invest if the return is slightly greater than its cost of money; or it may have a risk aversion strategy for financial or philosophical reasons and concentrate on low risk investments such as the acquisition of reserves at a return only slightly above its cost of money; or it may wish to diversify and be prepared for entry and experience reasons to accept an initial lower return. There is no single criteria as they will depend on the company's strategy and objectives. The important element is that the corporation's strategies and objectives are well defined and utilized by the investment decision makers.

Both the process and content of investment planning emphasize the achievement of its financial goal. The investment criteria, which are developed at the corporate level, are sufficiently flexible to deal with the diversity of the subsidiaries' business activities and of the returns and risks they produce. In addition, the economic forecasts for prices, inflation rates, currency exchange rates, etcetera to be used in the analyses are developed at the corporate level and adjusted by the operating unit for local

conditions. In line with the emphasis on economically attractive opportunities, certain general investment criteria might be identified:

- Investments should demonstrate a return that at least covers the company's incremental cost of capital.
- Where an investment proposal has a significant risk of failing to cover the cost of capital, it will be acceptable only if the expected return is correspondingly higher.
- No investments are made where there is any likelihood of losses in single projects or in combinations of projects, that could jeopardize the viability of the company as a whole.
- Payout of capital may be required more quickly at a time of uncertainty or if the company has a high debt/equity ratio.

## 2. Investment Planning Within a Broader Planning and Control Process

The application of the investment criteria and the procedures developed by the petroleum industry to screen capital investments are usually embodied in a broader, management planning and control process within each company. This process includes the evaluation of strategic, economic and financial factors. Although the nature of the process is specific to each company's needs, management philosophy, organizational structure, areas and types of operations, etcetera, certain generalizations can be made. Most of these planning processes are aimed at generating information useful for decision making in five principal areas, as shown in Figure 1. These areas are:

### Step

- 1 Identifying and quantifying major objectives and strategic direction at the corporate and business (or subsidiary) levels;
- 2 Assessing the company's internal and external situations, through the development and analyses of relevant data (for example, technical, financial, economic) in order to provide inputs for the development of strategies and investment plans;
- 3 Developing and evaluating alternative strategies or courses of action, to meet the company's desired goals or objectives;
- 4 Identifying criteria for and selecting the "best" means or plans for the company to achieve its objectives (this plan includes both medium and shorter term investments); and
- 5 Implementing the plan, monitoring, and evaluating the results relative to the expected outcomes. An important element is to react and adjust the operations if required; that is, it is not just monitoring but utilizing the information to make adjustments.

As illustrated in Figure 1, Step 4, and also in Figure 2, major investments within a company's operational plans are justified against a broader background of company goals, objectives, and strategies. In other words, before a major investment decision is made, management must understand the organization's targets and how to achieve these targets with full consideration of alternative opportunities and strategies.

### 3. Organization of this Paper

This paper is organized as follows:

- The conceptual framework for investment planning in the oil and gas industry is outlined in the next Section B. This section illustrates how investments are viewed within the broader framework of goals and strategies. It explains the underlying principles, key results expected, and responsibilities at each of the principal steps of the typical company's planning activities, as shown in Figure 1.

- Following the conceptual framework, Section C then illustrates its application, by noting some of the more specific planning considerations that are involved in selecting investments. It demonstrates the linkages between the investments included within a company's shorter term operational plans and its longer term investment and strategic plans -- as outlined in Figure 2.
- Finally, Section D outlines the underlying principles of the procedures used in the quantitative and qualitative evaluations of capital investments -- as illustrated in Figures 4 and 5.

## B. CONCEPTUAL FRAMEWORK FOR INVESTMENT PLANNING

### Requirement for an Effective Process

For the diversified oil and gas company with operating subsidiaries in several geographic regions or separate businesses, the requirement for an effective management process within which to integrate investment evaluations by its subsidiaries is as important as the evaluations themselves. Companies spend considerable effort in streamlining processes which effectively meet their unique needs, without involving an excessive amount of bureaucracy. In establishing such a process, it is vital to have clear lines and levels of responsibility and effective communications upwards, downwards, and laterally -- since several levels of corporate and subsidiary management and personnel are involved in the investment evaluations.

As outlined earlier, the management process is basically a planning and control process which is developed and managed by a central planning group at the headquarters level supported by planners in the subsidiaries. The process is a reiterative one between management at the corporate and subsidiary levels, where corporate objectives and business opportunities are continuously evaluated and mutually modified in the ongoing effort to balance the risks and returns of alternative investment opportunities. The end objective is normally to seek those opportunities that increase the economic value of the company.

The process is facilitated not only through the identification of clear roles and responsibilities, but also through the communication of

planning guidelines and suitable timetables. It includes a hierarchy of planning activities as shown in Figure 1 -- commencing with broad corporate objectives and business environmental surveys and following through to corporate and business strategies and down to the operating or shorter term plans against which business activity is controlled and monitored. It is within these operational plans that specific investments are decided.

Each of the five key elements of the investment planning process as outlined in Figure 1 will now be elaborated on, emphasizing the major results that are generated at each step, the rationale for the activities, and the key responsibilities for action.

### 1. Identifying Goals and Objectives

Major investment opportunities are assessed by a company's executive management within a broader framework of that company's strategic direction -- and its mission, goals, and objectives. This direction is established and/or re-examined at the corporate or headquarters level by executive management at the initial phases of the process. It serves to provide guidelines to management at the subsidiary levels on the corporate priorities and therefore on corresponding objectives of the investment programs of the subsidiaries.

The mission of the company defines the company's basic business and overall purpose. It is a long-term vision of what the company seeks to do and the company's purpose to its shareholders, employees, customers, and society. The mission states in what businesses it intends to engage and sometimes the type of organization it is and will be. This mission, developed at the senior level of the company, sets out the overall direction for the company.

The next level of direction is that provided by the corporate objectives, which state specific targets within the framework of the corporate mission. In the oil and gas industry, these frequently include objectives for specific functional areas such as finance, human resources, marketing, and technology, in addition to economic/financial objectives such as growth rate, profitability, return on investment, cash flow, and interest coverage.

The corporate objectives, as well as those that cut across several businesses, are established at the corporate level. For example, a corporate financial goal might be to achieve the highest quality debt rating over a five-year period or attain a certain debt/equity ratio within a defined period of time. Objectives that are specific to a particular business, such as exploration or a geographic area, are usually established at the subsidiary or business unit level, but subject to corporate approval. These objectives are usually established through a top-down, bottom-up process of discussions.

The identification of objectives is central to an effective strategic and investment plan. Objectives should be specific, measurable, concise, understandable, achievable, clearly prioritized, internally consistent, and communicated to all those at the corporate and subsidiary levels who will have a part in achieving them. They are the corporate standards against which the company and responsible parts of the company are measured.

Although the corporate objectives are normally established before strategic assessment and plans, the process is reiterative and may lead to changed corporate objectives and particularly to changes in functional or geographic objectives. In some instances, subsidiary objectives may not be established until corporate strategic plans are established.

The strategic planning horizon is usually a five to ten-year time frame, with the long-term plan more likely for a five-year period. There will frequently be generalized financial data prepared for the ten-year period.

## 2. Assessing the Company's Current Position and the External Environment

Within the broader framework of investment planning, once the company's objectives are established, the next step in the process is to determine the company's position relative to its objectives -- in other words, where the company is relative to where it wants to go (see Figure 1, Step 2). This is a critical step in investment planning, since it is this gap that the proposed investment should fill.

Key members of both corporate or headquarters management and operating or subsidiary management are involved in obtaining certain key results at this step:

- A sound competitive and strategic understanding of the company's businesses, or of a specific business in which an investment is contemplated, such as heavy oil.
- A sound understanding of the key factors in the external business environment that impact on the economic viability of the company, on a specific business activity and on attaining its corporate objectives; together with a good grasp of alternative scenarios for the future course of events (these factors are quantifiable, such as world oil prices, but also include political, technical, social factors, etcetera).
- A sound understanding of the most important issues, risks, and opportunities facing the company, and which might impact on its longer term or strategic direction (for example, internally a declining reserve base of conventional oil or externally a declining supply of condensate for heavy oil pipelining or declining energy prices).

The company's internal assessment is aimed at defining its principal strengths and weaknesses, and what could be done to ameliorate weaknesses, and its current operational and financial performance relative to its planned targets. For example, the company may have a strong technical capability on heavy oil, but has marketing problems; or it may have a low financial capacity to undertake major capital investments in heavy oil.

Information for the internal assessment is collected, and the assessments themselves are usually conducted at the business or subsidiary levels for issues peculiar to a particular business activity (for example, advanced technology experience for heavy oil). The corporate level usually is responsible for identifying issues that impact across the company, such as a deteriorating financial capacity to support major new investments.

The external assessment is aimed at monitoring and evaluating trends, events, and the demands of the company's various constituencies which impact on the company's operations and profitability. Some key factors include macro-economic variables such as world oil prices, inflation rates, exchange

rates, and interest rates; together with relevant government activity in a subsidiary's particular geographical region such as legislative or regulatory initiatives; relevant public opinion and life style factors such as an increasing concern for environmental pollution and decreasing energy intensity of industrial production processes. In addition, assessments are made of the position of the industry within the economy and the competitive position of the company within the industry.

The results of the external environmental assessment are usually embodied within alternative business environment scenarios which are used for planning purposes throughout the company. The judicious use of scenarios is an effective tool for stimulating strategic thinking and also at the operational level on different ways of running the business or on different businesses to be involved in, depending on internal capabilities and goals of the company. The scenarios are developed at the corporate or headquarters level with substantial inputs from the subsidiaries, who are much closer and more aware of problems or opportunities in their markets.

Central to the activities at this stage of the process is the availability of a timely and reliable information base, which relates to both internal factors within the company and external factors that impact on the company. The collection, organization, and communication of information which is relevant to the issues facing the company, are major tasks by themselves.

It is important to maintain effective communications between the corporate and subsidiary levels and within each subsidiary, and this is facilitated through various mechanisms such as the establishment of appropriate planning co-ordination committees; the circulation of key planning assumptions (for example, guidelines on the opportunity cost of capital, guidelines on alternative methods for assessing risks in different business, exchange rate assumptions, etcetera); and the identification of a key central group to manage the planning process.

By the completion of this stage of the process, management at both the corporate and subsidiary levels would have developed a good understanding

of the company's strategic direction and its current situation relative to its objectives.

### 3. Developing Alternative Strategies and Investment Plans

Once corporate management has agreed on the company's longer term direction and current position, and has identified the key issues, risks, and opportunities faced in its various businesses, the next step is to clarify the alternative means or strategies by which the company could achieve its objectives. It is important to understand clearly management's alternative strategies since one of the most important criteria in the selection of an investment is its "strategic fit" with the strategy of that particular subsidiary and with the overall corporate strategy of the company.

The key results expected at this stage of the process for developing alternative strategies are:

- A good understanding of the company's corporate strategies and the strategic direction they imply.
- The development, by operational managers at the business or subsidiary level, of a small number of significantly different alternative strategies -- aimed at dealing with the most significant issues identified earlier in the process.
- The integration of the various business or subsidiaries' strategies (for example, one for gas, one for conventional oil, one for heavy oil, etcetera) into alternative corporate-wide strategies and their associated financial impacts.

It is important to understand the current strategic direction implied not only by the existing operations but also by the committed investments. If the current direction differs significantly from the planned direction, changes to existing strategies or operations are required. Each of the company's subsidiaries will have its business strategy and associated investment plan based on its component investments. The integration of these strategies and investments aggregates to an overall corporate strategy with its associated financial impacts.

## Strategy Development

The development of alternative strategies is an art rather than a science, and requires a balance of creativity and objective analyses. At least three guidelines can be suggested. First, corporate or company-wide strategies must build upon the strengths of the individual subsidiaries or businesses. Second, formulating business strategies is most effectively done by people who know the business best, at the subsidiary level, with proper guidance from the corporate level and within an organizational structure that promotes a certain degree of risk-taking. Third, it should be a reiterative process between subsidiaries and corporate headquarters. An important result of strategy development is the developing of strategic thinking, the consideration of alternatives, and the consideration of "what if this happens, what if that happens."

At this stage of developing alternative strategies, the role of corporate management is to provide the overall corporate-wide direction, to establish guidelines and assumptions for developing strategies, to review and integrate the strategies developed by the businesses, and to assist in selecting the "best" strategy and investment plan for the company as a whole.

The intensity of guidance from the corporate level on strategy development depends on the culture and business diversity of the particular company. It is important that both the corporate and business or subsidiary perspectives be brought to the investment planning process and reconciled during the subsequent stage of selecting the "best" strategy and investment plan. The business perspective ensures that the expertise is utilized in developing alternative strategies and that a high level of commitment and understanding will be generated in implementing the "best" strategy. Active corporate level direction ensures the use of consistent planning assumptions and macro-environmental scenarios, helps to clarify individual roles and responsibilities, and assures integration of the various business strategies. Nevertheless, for a company with diversified businesses (such as conventional oil, heavy oil and gas, and in various geographic areas), the integration of the various business strategies into "corporate" strategies is a complex task.

The alternative strategies and investment plans for a particular business, represent selected sets of functional strategies. Each of these strategies (for example, a strategy to maximize joint-venture participation in selected heavy oil areas) seeks to take advantage of the company's internal strengths (such as technological expertise) and the external opportunities (such as the acreage owned by other companies) and to minimize threats and weaknesses in the most likely future scenario. The emphasis at the subsidiary level is on optimally positioning each major investment within its current and projected investment areas, considering corporate-directed resource allocation constraints.

At the corporate or headquarters level, the planning is more portfolio than functional in nature. It involves the evaluation of the best overall positioning of the company in terms of key strategic factors (for example, growth and positioning for potential gas markets) and of key financial factors (for example, level of capital expenditures, cash flow, debt capacity, etcetera). The strategic positions considered for the company include alternatives beyond the scope of current operations in the businesses or subsidiaries. These include alternatives for growth in new geographic or business areas. At the same time growth in new areas are being examined, broad alternative approaches to current business operations are usually addressed. This may include liquidation of selected marginal, low growth or non-core businesses, running lower cost operations through reductions in administrative expenses, and examining the relative advantages of concentrating on fewer investment areas.

#### 4. Selecting the Best Strategy and Plan

It is the responsibility of corporate or headquarters management to choose the "best" of the alternative strategies and plans in order to optimize overall corporate objectives (see Figure 1, Step 4). This selection process includes the allocation of financial, human, and technical resources to the various subsidiaries or businesses taking account of their expected contributions to existing operations or to new opportunity areas.

The process of selecting an overall "best" strategy and investment plan usually involves intensive negotiations between operating and corporate executives. The aggregation of the individual business plans is assessed relative to key company performance criteria in terms, say, of strategic and financial factors -- for example, finding and development costs, risks, return on capital employed, or longer term impact. It is this performance gap which corporate management seeks to fill by means of the best possible strategic and investment plan.

In the negotiating process, there is essentially a dialogue between operating management, equipped with highly-detailed knowledge of respective areas of their businesses, from which their plans are generated, and corporate management equipped with their broader understanding of the portfolio of strategies for the current businesses and potential investment opportunities. The dialogue attempts to generate the most creative approaches to corporate issues, and might involve application of the following criteria for the "best" strategy and plan:

- Is it consistent with overall corporate mission, goals, and objectives and the long-term positioning strategy of the company?
- Does the strategy and associated investment plan reflect appropriate considerations of broader business environmental scenarios? Which strategies and associated investments are compatible with the corporate objectives under the various business scenarios?
- Does it adequately recognize threats and opportunities and make the greatest improvement to the company's positioning in current and future markets?
- Does it capitalize to the greatest extent on corporate and business-level strengths including technology, human resource skills, and financial resources?
- Does it reduce corporate-wide weaknesses by allocating effort and/or resources to correct problems identified in the internal assessment?
- What are the major risks associated with the strategy and plan, both quantitatively and qualitatively (for example, political risks, price risks, financial risks)?

- Are the risk levels acceptable given the expected returns and financial condition of the company?
- Is there internal consistency among the functional strategies that constitute the best corporate strategy?
- Does the company have now or will have in the future, adequate resources, knowledge, and other requirements to implement the strategy?
- Are there adequate controls and procedures in place or which can be effectively developed in order to ensure proper implementation of the strategy?

As an outcome of the dialogue during this step of the planning process, a management decision is made as to the strategic direction that the company will take in the planning period. The comprehensive set of strategies and investment plans which emerges serves to link the corporate and subsidiary levels into an agreed-upon long-term direction.

In some companies, strategic planning has fallen into disrepute. In part, this is because its purpose, to set out how the company is to achieve its objectives under various possible environments, is neglected. Secondly, the equally important implementation of strategy is difficult.

##### 5. Plan Implementation and Monitoring

The final step of the investment planning process is that of implementing the selected strategy and investment plan and monitoring actual performance relative to planned targets (see Figure 1, Step 5). The challenge here is to properly integrate the longer term or strategic planning with the shorter-term operational plans.

The key results expected at this step are:

- the development of integrated short-term plans, including specific objectives;
- clear organizational authorities and responsibilities for results expected from the shorter term plans; and

- the development of a process for monitoring and assessing actual performance and modifying the shorter-term plans where appropriate (this usually includes developing contingency plans to account for unforeseen events).

The shorter term operational plan is essentially a further specification of the initial phase of the longer term strategy and investment plan, and usually extends for one year. The corporation will also have a three and/or a five-year plan developed in less detail which will include capital expenditures, expenses, revenues, etcetera. The business level management quantifies measurable short-term objectives not only for financial performance but also for exploration, production, marketing, human resources, and other functional areas. Objectives and operational tactics are translated into specific programs and action plans. Projects are identified with programs for each of the company's businesses for the following year(s) and the action plans are the step-by-step means for achieving the desired results from each program.

For the successful implementation of a plan, adequate delegation of authority and responsibility to the subsidiaries is essential but, at the same time, ensuring that each subsidiary operates according to strategy and to the investment plans approved by corporate or headquarters management.

The delegation of authority and responsibility is generally an evolutionary process that is not changed radically as part of the planning process unless there are significant changes in the company's strategy or in the business environment. For instance, if a company's financial position has deteriorated, or if energy prices have declined significantly, subsidiary or business authorities may be lowered to give more centralized control. Under the same circumstances, other companies will not decrease authorities, but impose more stringent guidelines on investment criteria, on reduction of operating and administrative expenses, and on human resource numbers and expenses.

Through the years, the company will have developed detailed corporate policies and procedures to guide and control the company and its businesses as to how it will carry out and administer its strategy and plans (i.e., the

rules, procedures and practices). The plan lays out what is to be done while the policies and procedures lay out how they are to be done within the company's organizational framework. These policies and procedures will range from broad statements at the corporate level, such as the company will optimize the use of local goods and services, to detailed policies and procedures at and within the subsidiary and business level, as for instance, hours of work.

Effective control of performance at the corporate level is maintained through the implementation of a company-wide performance monitoring system, as shown in Figure 2. It is this linkage between the planning and control system that permits managers at the subsidiary level to enjoy the necessary operating freedom within the framework of the agreed strategy and plan.

This monitoring and control occurs not only from the corporate level, but is mirrored also in each of the subsidiaries. It is essentially an extension of the planning process into the current year and immediate short-term, and has five key elements:

- an operational plan with associated targets;
- a system for monitoring performance against this plan;
- a forum where performance is critically examined;
- an independent group that services this forum; and
- unambiguous lines of authority that enable action to be taken but with the monitoring process.

The development of this monitoring system is well established in the western oil and gas companies, and is the subject of another paper at this Conference.

## 6. Summary of Conceptual Framework

As outlined above, in the western oil and gas industry, the typical company assesses a major capital investment, first, by reference to its broader corporate strategy. The corporate strategy sets out how the company

is to achieve its objectives in broad terms. The individual strategies adopted by each of the subsidiaries are developed in the light of the broader agreed-on business environment scenarios and the more specific conditions peculiar to each subsidiary (such as political conditions, availability of technical expertise, etcetera). These are the strategies that are judged by corporate management to be the most robust with respect to their risk/return profile and other key factors, when tested against the alternative scenarios.

In addition to strategic fit, the proposed investment must satisfy management's investment criteria in order to qualify for inclusion in the investment program associated with the selected "best" corporate strategy. Because of the specialization of functions at the corporate and subsidiary levels of the typical diversified oil and gas company, and the breadth of the issues to be considered in evaluating capital investments, companies have developed systematic processes and procedures to facilitate the selection of investments. Central to the effectiveness of such processes (illustrated in the five steps in Figure 1) is adequate communications between corporate and subsidiary levels, the clear identification of responsibilities for results within the selected shorter term operational plan, and a workable performance monitoring and control process.

#### C. APPLICATION OF THE CONCEPTUAL FRAMEWORK -- SOME SPECIFIC CONSIDERATIONS IN EVALUATING INVESTMENTS

Following the conceptual framework for investment planning in the previous section, this section illustrates the application of the final three steps to this framework -- the development of the strategic plan, the investment plan, and the operational plan (i.e., Steps 3, 4, and 5 respectively of Figure 1). The application is demonstrated by pointing out some of the more important planning considerations that are involved in each of these steps. In other words, the emphasis in the previous Section B was on "what was expected" or the key results at each of the major steps of the investment planning process; the emphasis in this section is on "how to achieve these results" at each of the steps.

The practical application of these steps in the typical company is reflected in the linkage between its longer term strategic plan (five to ten years), its medium-term investment plan (three to five years), and its shorter term operational plan (one and sometimes three years) -- as illustrated in Figure 2. Because of the importance of a company's strategy as the initial basis for evaluating investment proposals, relatively more attention is given to the considerations surrounding strategic development (i.e., Step 3 of the conceptual framework in Figure 1).

1. Major Considerations in Formulating Strategies --  
Application of Step 3 of the Conceptual Framework

Since investments in major projects are not approved unless there is an agreed strategy against which they may be assessed, it is important to understand the primary factors which the oil and gas companies consider in formulating their strategies. Given the lead times on planning, between exploration and production, and on the environmental changes typical of the oil and gas industry, the time horizon for strategies is normally of the range between five to ten or more years. Strategies therefore represent qualitative and directional rather than quantitative and precise thinking.

Key factors considered by companies in developing their strategies include:

- relevant corporate strategy guidelines -- as well as its mission and objectives in strategic and financial terms, as appropriate;
- principal characteristics of the business sector (for example, heavy oil, conventional oil, gas, etcetera) that shape the risks and returns attached to projects in that sector;
- assessment of risks and returns in the sector;
- critical success factors for profitable operations in the sector;
- company's position in the sector (technical, human resources, land holdings, etcetera);
- competitors' positions in the sector and their strengths and weaknesses;

- company's sector-specific strategic and longer term objectives;
- strategic program and set of projects designed to achieve the objectives; and
- results expected from the strategic program, in terms of indicators that can be monitored.

Each of these factors will now be briefly elaborated.

(a) Corporate Strategy Guidelines

As outlined in the previous section (Section B.1), the corporate strategy guidelines (in terms of variables such as objectives, strategic positioning, product/market mix, competitive mix, overall financial targets, etcetera) are generated at the corporate or headquarters level and provide direction to the subsidiaries. These guidelines recognize that:

- the company is made up of several businesses;
- the businesses often operate across national boundaries;
- certain supporting services (such as financing) are provided internationally; and
- the activities of the subsidiaries must be adjusted, in line with corporate guidelines, to the particular economic conditions under which they operate.

(b) Principal Characteristics of the Sector

The assessment of the principal characteristics of the sector is an important starting point for the development of strategy at the subsidiary level. The objective here is to identify those aspects of the technological, economic, competitive, political, and social environment which are likely to be most important in determining the nature and extent of the risks and returns associated with business activity in the sector.

The nature of these factors and their relative importance vary greatly from sector to sector and from one geographic region to another. No

simple guides to their selection can be provided. Their determination is essentially an act of business analysis and judgement, but the key factors can usually be identified by considerations in the context of supply and demand, and the extent to which they are impacted by forces such as:

- technological factors;
- economic and financial factors;
- competitive forces;
- political forces; and
- social/environmental forces.

These forces impact on the supply and demand for the particular hydrocarbon in various ways, and this differential impact provides a basis for the assessment of risks and returns on specific project activities in that sector.

Some of the elements of demand and supply which are investigated include:

#### Demand

- The volume and structure of demand by type and location of consumer under a set of alternative scenarios. For example, in the industrial market in the western economy, efficiency considerations have largely dictated the selection of less energy-intensive production processes, leading to reduced rates of demand growth for oil and gas in this sector.
- The elasticity of demand for that hydrocarbon. This requires consideration of factors such as price elasticities (i.e., the sensitivity of changes in demand to changes in price); patterns of consumer demand; and the possibilities and probabilities of substitution (for example, gas for oil).
- Political forces that affect demand, such as government regulations on conservation.

## Supply

- The volume and structure of supply by supplier and location, and the relative competitive position of suppliers. For example, since oil and gas are commodities, the natural resource markets are dependent on supply and demand, and since the products of one company are virtually identical to another, companies have pursued different strategies to assure stable supply. Some companies have pursued strategies of geographic diversification, to utilize government incentives or to minimize political risk. Other companies have attempted to mitigate the impact of cyclical price fluctuations by securing long-term contracts or a mix of long to spot supply.
- The nature of technology impacts on both supply and demand for a particular hydrocarbon, and also on the company's ability to produce the hydrocarbon. For example, the development of alternative fuels and sources of supply impacts the economic potential of petroleum, both as a local and world commodity. Alternatively, the technological demands imposed by some operations under certain circumstances (such as offshore and Arctic activities or oil sands development) are more strenuous than the demands imposed by conventional oil and gas activities -- both directly in terms of technology and indirectly, for example, in terms of their financial and human resource requirements. The viability of a company's exploration and production strategies and also its research and development initiatives are influenced by the technologies it employs.
- The elasticity of supply for that hydrocarbon. This includes factors such as the price elasticity (i.e., sensitivity of changes in supply to changes in price); the costs of entry into the sector (e.g., the resources in cash, technology or management required to enter into thermal in situ oil projects; the costs of exit from the sector (e.g., the ability to sell fixed assets and recover original costs, the political and social costs of reducing employment, etcetera).
- Institutional characteristics of the industry in that sector. This includes factors such as organization, ownership, control, etcetera.
- Political considerations. This includes factors such as strategic interest on the part of the government, fiscal concessions or penalties by the government, environmental control regulations, etcetera.
- Social considerations that might impact on supply. This includes factors such as nationalization sentiments, emphasis on renewable sources, etcetera.

The assessment of the factors identified under the demand and supply characteristics usually includes the manner in which they are likely to change over the time period covered by the strategy, and how they are influenced by the behaviour of competitors. The ultimate objective is not only volumetric estimates of supply and demand for the specific commodity, but also costs of supply and market price.

(c) Assessment of Risks and Returns in the Sector

The characteristics of supply and demand in the sector, when matched against each other, provide the base for assessing the expected returns in the sector and for relating these to the risks involved. The primary concern for most companies, in dealing with risk, is to identify and quantify those factors which have a significant positive or negative impact on the expected financial returns.

Although many of the supply and demand factors can be described in detail, the assessment of risks and returns, like the choice of the factors themselves, is a matter of business judgement. The risks can be categorized and many can be quantitatively described.

Some major categories of risks include:

- Price risks -- the financial impact to the company and project due to price changes.
- Cost risks -- the financial impact due to changes in capital, operating and administrative cost.
- Technological risks -- these can range from the strategic and financial exposure of the company to technological changes that reduce the demand for a commodity, to the technical assessment of the reserves, to technology failure of a process (enhanced oil recovery, production platforms, etcetera).
- Political risks -- such as the risks associated with government changes in fiscal policies or in product pricing policies.

- Socio-environmental risks -- such as those associated with shifts in patterns of consumption or requirements to decrease H<sub>2</sub>S emissions.
- Financial risks -- such as those related to foreign currency changes, interest rates, or impact of the project financing on the company's financial health.

Risks are not easily quantified, but must be assessed and estimated in a rational manner.

The returns likely to be achieved in any sector are also not easy to quantify. Reference to past experience or to results achieved by competitors (that is, the use of analogies) are used, but the financial aspects will also be built up primarily by building blocks, particularly for large investments. These appraisals are primarily in financial terms, such as finding and development costs or return on capital employed.

As outlined previously, the identification of an appropriate risk/return profile for a particular sector is largely a matter of business judgement and will depend on individual companies' financial position and strategy. Market forces will usually ensure that high prospective rewards are associated with high risks of failure and relatively low risks with low prospective rewards. Where returns are high, political forces tend to depress returns in relation to risk. For example, the combination with low prospective return might be associated with:

Demand Factors

- demand stagnant,
- demand elastic,
- technological factors acting to depress demand.

Supply Factors

- existing capacity above potential demand,
- large number of competitors, widely distributed,
- low costs of entry,

- high costs of exit,
- no major supply constraints.

Several combinations of risks and returns are possible and must be carefully assessed -- generalizations are misleading. For example, economies of scale may raise the cost of entry but encourage the generation of surplus capacity by firms who enter the sector. Also, government project subsidies may encourage overcapacity but may still make the business profitable for those who receive the government benefits.

In the final analysis, although it is largely a business judgement based on an assessment of both quantitative and qualitative factors, the determination of the risks relative to the returns from activities in a particular sector is most critical to strategy development and to the selection of the most economically attractive project investments.

(d) Critical Success Factors

After the principal characteristics of the sector have been identified, including the risk/return potential, the next phase is to clarify the most important factors or criteria for investment and operations which determine the successful implementation of a strategy. Essentially, the effort is directed at locating those factors, largely derived from the risk/return assessment, which are necessary to secure full realization of the sector's potential and to help ensure the viability of the proposed activities.

In oil and gas exploration and production, these key success factors are usually in the following areas:

- land position,
- risk sharing or risk reduction,
- technical information, knowledge, and skills,
- financing,

- finding, development and operating costs,
- political (concession terms, royalties and taxes, etcetera).

The description of these factors might be in terms of:

- Market (pricing, demand/supply, transportation)
- Investment
  - o timing,
  - o location,
  - o size,
  - o need to distribute risk by farm-outs, joint ventures, government participation, etcetera.
- Management and Organization
  - o data and information systems,
  - o technical capability and support (research and development requirements),
  - o skilled personnel and availability.
- Political Factors
  - o government regulations, concession terms, taxes and royalties,
  - o specific project support or hostility,
  - o consistency with national policies, etcetera.

(e) Company's Current Strategy and Position in the Sector

Once the sector's characteristics and the criteria for successful exploitation have been assessed, as described above, it is then important to review the company's current strategy and its position in the sector. This review process, which was outlined in the previous Sections B.2 and B.3, is aimed at clarifying the nature of the risks and opportunities peculiar to the company's strategy and position in the sector, and what is required and can be done to improve the viability analyzing its competitive position.

A thorough understanding of the company's and competitors' strengths and weaknesses is an important part of the assessment of the company's relative position in a business sector. An objective analysis of competitors can give useful insights into the criteria for success in the business. It also enables the competitiveness of the company to be judged in as realistic a manner as possible. This information is valuable in that it suggests activities that should be included in the company's strategic program in order to improve its competitive position.

Assessment of a company's position in the exploration and production business will include particular attention to:

- the current and projected production base of the company,
- the quality and potential of its land holdings,
- factors affecting the marketability of its current or projected reserves,
- the financial resources of the firm relative to its project commitments,
- the quality of its technical expertise and data base,
- special relationships that might promote or impede strategic flexibility, such as long-term delivery contracts, joint venture arrangements, etcetera,
- organizational structure of the company and the extent to which this promotes or impedes effective and efficient operations. The focus here is on identifying the manner in which tasks are grouped into special sub-units, the level of authority delegated to these sub-units, and the formal or informal provisions or systems for integrating the work of the sub-units. Generally, the larger the organization, the greater the tendency for the specialization of tasks and therefore the greater the need for systems of integration.

(f) Strategic Objectives

The analyses carried out to this stage (sub-sections (a) to (e) above) provide a thorough appraisal of the sector's strategic and financial potential for the company. The extent to which this potential might be

exploited is determined mainly by reference to the company's strategic goals and objectives for this sector -- as outlined earlier in Section B.1.

These objectives usually include the priority, nature and scale of the activities to be pursued, the relative strategic position in the sector which is desired, appropriate financial targets, and the internal organizational requirements to attain these objectives. The objectives are stated in terms that are robust to business environment changes of the order that can be expected over the period covered by the strategy unless the company has specific strategic positioning objectives.

(g) Strategic Program

In addition to an elaboration of its qualitative strategies based on the factors described above, the two principal outputs of the company's strategic plan include:

- the strategic options and program, and
- expected results of this program.

The strategic program is based on the assessments completed and is essentially a set of projects, satisfying the criteria for successful operations in the sector, designed to achieve the strategic objectives. The program includes:

- the set of projects or investments for that sector with some prioritizing and possible alternatives,
- timing of the program and sequential relationship of the projects,
- any required changes in policies with respect to management and organization to attain the expected results,
- the requirements for technology, personnel, information systems, research and development, etcetera, and
- quantitative estimates of the resources required, for example in terms of financial and human resources.

It is important that the program include an account of the relative importance of the various projects to the success of the strategy and the key elements that could impact on its attaining its goal. This indicates to senior management at staff and line levels the flexibility in the strategic program, or how it can be adjusted to deal with unforeseen events -- such as emerging expansion opportunities faster than anticipated, or financing capability problems, change in government terms, and new technologies.

(h) Expected Results of the Program

The final element of the strategic plan is the identification of the expected results of the proposed program in the planned period. These results are described in both financial and non-financial terms which can be monitored within the company's control procedures. Since the timeframe of the strategic plan is between five and ten years, the quantitative estimates are sometimes directional rather than precise.

Financial results could be prioritized and specified in terms of:

- capital expenditures,
- operating and administrative expenses,
- asset values,
- cash flows,
- operating revenues,
- net income,
- profitability measurements such as return on investments or on capital employed,
- debt to equity level, and
- cash flow or net income to interest coverage.

Non-financial results could be prioritized and specified in terms  
of:

- projects completed on schedule,
- production rates,
- finding and development costs,
- market shares,
- proven, probable, and potential reserves found or estimated yet to be found,
- manpower indicators,
- safety targets, and
- state of technology development.

2. Major Considerations in Formulating Business Plans  
-- Application of Step 4 of the Conceptual Framework

The company's strategies provide the framework against which specific projects and activities contained in the short-term operational plan or budget (timeframe usually one year) are developed -- in other words, the operational plan provides the means of short-term control of the strategic progress. The linkage between the longer strategic plan term (five to ten years) and the specific operating activities of the one-year budget is usually provided by an intermediate plan of three to five years -- described as the company's business plan in Figure 2.

This business investment plan is developed against the longest time horizon for which plans can usefully be formulated in quantitative terms. In the oil and gas industry, this period is usually three to five years, depending on the scale and timing of the projects involved. The investment plan therefore indicates how, in the light of the medium-term business environment scenarios, the company will progress towards its strategic goals in the subsequent three to five years.

The base for the plan will be a three or five-year financial forecast of revenues, expenses, capital expenditures, royalties, taxes, cash flow, and net income as well as debt, etcetera. More than one forecast, based on different defined assumptions may be made.

The business plan provides an investment program, and identifies the activities and targets that are important to achieving the desired goals. For example, for mature businesses (such as exploration and development of conventional oil in established geological areas), this program might include alternative means of managing the assets for maximum financial return or for sale of a mature asset with low growth; for a company expanding into a new sector, the program might specify how and when additional assets are to be obtained.

In addition to these qualitative elements, the plan will outline the broad financial and economic information which will enable assessments to be made of the impacts of changes in the economic environment. It will also identify suitable areas for modifying project magnitudes or timing or participation, etcetera in the event of major changes such as cash flow declines.

The business plan can therefore be viewed as a test of the strategy in terms of investment/divestment requirements, management, organization, and supporting services. It is this medium-term plan which forms the narrower background against which the operating plans are developed and assessed.

Further detail on the contents of the company's business plans will now be illustrated.

#### Contents of Business Plans

Business plans for a particular sector usually contain a summary of the relevant parts of the agreed strategy and an outline of the program for the next three to five-year period. It also includes an analysis of the company's performance in the prior year compared with the operating plan and the previous investment plan. It also includes the principal elements of the financing plan for the period, on an annual basis. The business plans should present information in a manner which permits ready calculation of the financial effects of changes in some key assumptions such as economic variables. The exact means of presentation is matched with the requirements of the more detailed operating plan.

Some additional components of business investment plans are identified below.

#### Business Environment Guidelines

The plans usually include a description of the key assumptions (e.g., economic, financial, strategic, etcetera) that underlie its development. Most major companies identify at least one or two alternative macro-environmental scenarios, whose key assumptions will also be specified. The chosen business plan is the one that is as robust as possible to all likely scenarios, but with due regard to priority strategic thrusts. It therefore represents the best available course of action given the medium-term scenarios.

#### Capital Investments/Divestments

The magnitude and timing of the strategic program identified in the company's strategic plan (described earlier in this Section C.1) depends in part on the company's financing capacity. The business plan therefore describes the proposed capital investment and divestment programs in order of priority, thereby permitting identification of the means and ability to accelerate or slow down the spending. The plan also highlights the elements of the capital expenditure/reduction program that are vital to the thrust of the strategy.

Projects included in the proposed program are divided into categories of expenditures, such as:

- projects already committed, stating the degree of completion and outstanding expenditures, commitments, etcetera,
- maintenance and operating expenditures,
- proposed new expenditures/divestments, indicating the strategy to which they are related (for example, market share expansion strategy), and
- potential new expenditures for which approval is not now being requested, indicating the linkage to the supporting strategies and when approval may be requested.

The business plan should also include the likely impacts of slippages in spending or acceleration in spending, in quantitative terms. Wherever possible, the description of the exploration and development program is linked with the strategic objectives and contains relevant information to support financial estimates. For example, program description might detail the mechanisms by which the commodity, such as oil, is priced in that particular sector. In addition to expenditures,

production, operating and administration expenses, prices etcetera, the business plan outlines key targets such as market shares, reserves-to-production ratios, etcetera.

#### Supporting Services

The implications of the five-year program of investments for supporting services (such as research and development, specialized skills) are usually described and a program outlined.

#### Financial Statements

The business plan contains both key assumptions and underlying data for financial analysis, as well as the principal financial statements such as income statement, balance sheet, and sources and uses of funds statement. Because of the scale and timing of investments in exploration and development, it is important to thoroughly understand the cash flow and net income effects of different investment plans. The assumptions on major variables such as price, volume, inflation rate must be specified as also the relationship between commodity price, production volume, operating costs, and government tax and royalty.

The information in the business plan therefore is at a level of detail that permits ready evaluation of financial impacts (such as cash flow and net income) that result from different assumptions. The evaluation also includes implications of production-volume response to changes in the market supply and price situation. The financial results are developed for each of the scenarios used. This information, when aggregated across all the subsidiaries, enables a corporate-level assessment of the financial impact of the proposed individual investment plans and of the sensitivity of these impacts to changed assumptions.

By linking the qualitative strategic goals and quantitative financial results over the planning period (usually three to five years), the business plan forms the background against which the more detailed operational plans are judged for strategic viability.

### 3. Major Considerations in Formulating Operational Plans -- Application of Step 5 of the Conceptual Framework

The operational plan for the forthcoming year is prepared in a bottom-up process by the subsidiaries against an agreed background of the strategic plan and investment plan, as shown in Figure 3. This plan, which is essentially an expansion of the first year of the investment plan, represents the final level of plans, and also is the basic short-term control document within the company's process. Operational plans therefore describe the expected performance for the year in terms that identify the critical success factors and provide the basis for monitoring actual performance.

Further detail on the contents of the company's operational plans will now be illustrated.

#### Contents of Operational Plans

The operational plans contain information along similar lines as the investment plans, but in considerably greater detail. In addition to a brief summary of the approved longer term strategic objectives, these plans usually include the following elements.

##### Short-Term Business Environment

This relates to the principal assumptions underlying development of the operational plan over the one-year period. It therefore includes key economic assumptions such as local crude oil and natural gas prices, quality differentials, government taxes and royalties, interest rates, inflation and exchange rates, etcetera. The expected characteristics of the market, such as projected growth or contraction, supply/demand characteristics, competitors' activities, etcetera should be considered in order to put into context the planned implementation of the strategy and expected results for the coming year.

##### Specific One-Year Objectives

Operational plans identify the critical elements in the short-term for the implementation of strategy. This includes, in the form of specific one-year objectives, management's intended actions to achieve this strategy. The operational objectives and targets for strategy implementation are described in

quantifiable terms, so as to enable subsequent performance to be monitored (e.g., production objectives, finding cost targets, etcetera). Since the implementation of strategy is often linked to specific investments, appropriate objectives for capital investments and for major projects are identified.

### Capital Investments

All the financial and non-financial detail of the proposed capital investment program for which approval will be sought, are included in the operational plan. Capital expenditures are often categorized by major project (for example, by criteria such as project expenditure and sector) and by order of priority, such as those that require immediate commitment. Operational data and targets associated with the capital investments are also used to describe expected performance for the project (for example, return on capital, reserves and production to be added, etcetera)

### Financial Statements

The financial statements are similar in principle to those of the business plan but at a much greater level of detail since the estimates are for management control purposes for one year only. Basically, the statements reflect an analysis of the expected performance of a subsidiary or business unit by the key elements of cost revenue and profitability in such a way that actual performance can be compared with the expected or planned results.

In addition to the standard financial statements (i.e., income statement, balance sheet, funds flow), the operational plan might include more detailed financial information, such as:

- statement of capital employment and sources and cost of capital if external funds are required,
- an analysis of operating income and funds flow by sector,
- detailed operating statements, with suitable identification of fixed and variable costs,
- analyses of general and administrative expenses and of productivity,
- analysis of capital investments, including justification of projects, and
- sensitivity and probability analyses of the proposed investment program to key assumptions (such as changes in operating costs, crude oil prices, differentials, etcetera).

Since the operational plan is used as the key short-term control document, other detail is often required. For example, it is required to include a quarterly and monthly financial and operating statements. Also, whenever a meaningful functional division can be made (e.g., between exploration and production), this is identified in order to understand the value being added at the various stages relative to the assets being employed. Finally, the planned results are usually compared with the expected actuals for the previous year, in both financial and non-financial terms.

#### D. PRINCIPLES UNDERLYING THE ASSESSMENTS OF SPECIFIC INVESTMENTS

Strategies are implemented primarily by means of capital investments in specific projects -- following the linkages shown in Figure 2, and as described in the previous section. The existence of an agreed strategy and investment program, however, does not guarantee approval of all the projects in that program. Each project capital investment requires its own justification that will demonstrate its economic viability and its strategic fit with the overall company strategy. The justification proceeds as follows.

The strategic plan and business plan will have identified the broad areas in which investments might be profitable, given conditions in the external business and internal company environment. Investments in specific projects must at least meet the following conditions:

- demonstrate how this investment fits in with the strategic program;
- demonstrate that the investment satisfies the relevant criteria for successful operations in that sector, taking into account technical, risk, market conditions, expected performance of competitors, and political and social considerations;
- demonstrate that this investment represents the best of the feasible alternatives for fulfilling the objectives assigned by management and reflected in the strategy and medium-term investment plan; and
- demonstrate that this investment has taken into account the lessons learned from the past project evaluations of similar investments.

The assessments of capital investments include both qualitative and quantitative components. It is important to understand that the quantitative analyses by themselves, do not prove that the investments are viable, since they are a function of the underlying assumptions. In oil and gas exploration and production, these assumptions might relate to several variables -- illustrated in Figure 3. The use of sensitivity and probability analyses as an integral part of the quantitative analysis helps to illustrate the robustness or sensitivity of the project to changes in key assumptions in the technical, economic or political environment.

## 1. Quantitative Assessments

### (a) Project Evaluation and Discounted Cash Flow Principles

The quantitative assessment of specific projects focusses on their economic evaluations. Some of the more important factors that relate to the economic evaluations of projects are illustrated in Figure 3. These evaluations provide management with the economic basis of a decision, usually on a particular investment or between two or more mutually exclusive investments, each of which could be individually acceptable.

A number of criteria can be used in the evaluation of capital investments, but for a number of years it has been recognized that the most useful indices of investment quality must take into account the time value of money. The "discounted cash flow (DCF) technique", which results in a present worth or net present value (NPV), recognizes the fact that a dollar today is worth to a company more than a dollar in the future.

Evaluations of capital investments in the oil and gas industry are normally based on this technique. In this method, future inflows and outflows are discounted to take account of the time at which it will be received and the sum of these discounted revenues less expenditures yields a "present worth value".

Present worth values are used for many purposes in the industry, including:

- to indicate the economic value of a project and the desirability of proceeding with that investment;
- to measure the relative desirability, in economic terms, of a number of investment alternatives; and
- to help determine the value of assets for purchase or sale.

Although the concept of present worth is simple and the discounting calculations are not difficult, the results of an evaluation are only as good as the underlying physical and economic assumptions. In order to develop a cash flow estimate which will reasonably model future performance for an oil or gas well, lease, pool or property, the following steps are required, as illustrated in Figure 5.

- Key economic assumptions over the forecast period must be specified. These include oil prices, inflation rates, the opportunity cost of capital or discount rate, government/tax royalty/fiscal regime, exchange rates, etcetera. The decision must be made as to whether the investments are evaluated in real terms (i.e., money of constant purchasing power) or in nominal or current terms (i.e., money spent or received in any particular year during the life of a project).
- An estimate is made of the project's economic life. Beyond 20 years, cash flows are so heavily discounted that they have little material impact on economic evaluations. There may be exceptions, such as when benefits are expected to increase significantly in later years, or when there may be significant abandonment costs. In these cases, the analyses are performed over the project life.
- The relevant technical information must be identified. For example, probability estimates are made of the total remaining reserves to be recovered. Then annual forecasts of production are required, as these are the sources of future cash flow and income. Then net annual production must be calculated, taking into account the royalties and interests owed to others.
- Revenues are calculated through the production estimates and the forecast(s) of prices. The key assumptions must be shown explicitly and major divergence with historic values must be explained.

- Costs must be estimated over the life of the project since they are charges against income. These financial estimates are usually made in the currency in which the costs are incurred (or revenue generated). The following costs are normally estimated:
  - capital costs, usually categorized according to their degree of accuracy for large projects;
  - maintenance costs;
  - operating costs, separating the fixed and variable components. Projects with a high level of fixed costs are likely to require commensurately higher returns to compensate for the additional risks;
  - working capital;
  - abandonment costs and site restoration, which may be offset to some extent by the scrap value of the assets in question; and
  - an administrative cost may also be included.
- Any relevant fiscal regime including royalties must be determined in order to identify the level of taxes. Large projects can be evaluated on a "raw economic" basis, without the impact of taxes, royalties, and other government impacts. In these cases, the impacts of alternative governments terms are treated as sensitivities.
- Cash flows are calculated essentially by deducting costs, royalties and taxes from revenues. Where the evaluations are performed in "real" terms, and the objective is to measure the increase in real wealth of the company's shareholder that will result from the project's acceptance, the cash flows are converted to real values usually using the country's Consumer Price Index (CPI).

Once the cash flow estimates are made, the following calculations are often performed for oil and gas projects:

- Present worth or net present values are determined, once a discount rate is estimated. The discount rate or the opportunity cost of capital represents an average cost of new capital for the project of average risk in the portfolio and the use of this average by the subsidiaries permits projects to be compared on a common basis, often for sensitivity purposes. In addition to net present values, other measures are usually supportive.

- The internal rate of return (IRR) is also frequently computed for projects. This is the discount rate which brings the projects net present value to zero. Projects which are riskier than the average of the company's investments will be expected to show a commensurately higher internal rate of return if risk adjusted or probability analyses are not used.
- The payback period is normally also calculated. It is the number of years between the initial outlay of capital and the time when the project is in cumulative cash flow balance. It is calculated on the basis of real discounted and real undiscounted cash flows and basically provides a rough measure of financial risk exposure and will be important if the corporation is short of capital.
- Other financial indicators such as discounted and undiscounted profit to investment ratio.

Although all these tools (NPV, IRR, pay backs and financial ratios) permit ranking, they are not the only tools necessary. Depending on the magnitude and riskiness of the investment, other factors might be important such as: What is the cash flow profile in relationship to cash needs? What is the total project net income or cash flow (to indicate ones of major impact, since small projects may have higher IRR)? What are the risks relative to the scale of investment?

(b) Dealing With Risk and Uncertainty

The importance of thoroughly understanding the risks and returns associated with various options, in the development of the company's strategies, has been discussed in the previous section (Section C.1). In this section on the quantitative assessment of specific exploration and production investments, the discussion has assumed that the key variables required for evaluation purposes (illustrated in Figure 3) are known with certainty. In fact, risk and uncertainty are inherent aspects of investing in petroleum exploration and production and have significant influence on the evaluations of these investments. We shall now outline the manner in which the western petroleum industry deals with risk and uncertainty at the level of specific projects.

(i) Definitions and Need for a Consistent Approach

Petroleum exploration and development can be viewed as a series of investment decisions, whether to acquire additional technical data (geological, geophysical, engineering or drilling), whether to drill an exploratory well or wells, whether to drill definition wells or a discovery, etcetera. Each decision should produce a progressively clearer understanding of risks versus returns, and support timely management action concerning the inferred hydrocarbon deposit.

Every exploration and development decision involves considerations of both risk and uncertainty. In the western petroleum industry, uncertainty refers to the range of probabilities that some condition may exist or occur. Uncertainty is intrinsic in all geotechnical predictions and the search for hydrocarbons is by its very nature a function of complex probabilities. Some of the most important uncertainties associated with evaluating an exploration venture are:

- Do hydrocarbons exist in a specific geographic area and how much recoverable oil and/or gas is present -- what are the probabilities that hydrocarbons are present and what are the probable producible volumes of oil and/or gas in the prospect?
- The discovery probability -- what are the chances that the inferred accumulation will be discovered by the proposed activities? The predictions involve understanding more than geotechnical issues. Land ownership, degree of competition, available capital, timing of lease sales, and many other factors affect what a company can accomplish in a certain timeframe.
- The finding costs -- what are the probable total costs to discover the accumulation, including lease costs; geological, geophysical and engineering costs; and drilling, completion and testing costs?

In exploration and production ventures, risk refers to an opportunity for loss. Risk considerations frequently involve the magnitude of the investment, say with respect to the budget, potential gain or loss, and the probabilities of the gains or losses. The analysis of risks is an

essential component of making decisions under the uncertainties faced in oil and gas investments. For example, in a simple case, in the appraisal of a drilling venture, a geologist might estimate a "most likely" reserve volume and combine it with geological judgement (often an intuitive one but still on the basis of past experience, knowledge, and analogies of the area) as to the probability of success. For areas where good analogies to the reservoir of interest exist, the "most likely" estimate might be determined by examining the size, distribution of similar accumulations and their relationship to exploration history. By matching with exploratory success, and by incorporating specific elements of the prospect under consideration, an estimate of likely success is determined.

An example of this simple approach to risk appraisal might be:

100,000 barrels of oil x 20 percent = 20,000 barrels of oil  
"most likely" reserves x "success" probability = risk-adjusted reserve volume

This risk-adjusted reserve volume might then be translated into dollars by applying a market-based oil price, and it might then be compared with dollars at risk (for example, acreage costs, geological and geophysical costs, dry hole drilling costs) to derive a profit/risk ratio. Nevertheless, such simple quantification relates to one person's experience. This "most likely" estimate may be another person's "fair chance" or another person's "long shot." The explorationist who has initially generated the estimate may be biased positively towards the prospect, perhaps having spent considerable time generating the concept and with a tendency for an optimistic bias in order to see the concept tested by drilling.

Many such biases exist in the mental processes by which most people make risk analysis. As illustrated above, one person's "most likely" estimate might just as readily be another person's "fair chance" estimate. The biases that often underly "intuitive guesses" tend to produce significant inconsistencies. We therefore need some standard method to reflect comparable definitions of risk and/or uncertainty for the same prospect. The principal challenges in making sound operational decisions that reflect realistic assessments of risk and uncertainty are:

- to be consistent and explicit in the way risk and uncertainty are determined and analyzed;
- to perceive uncertainty as accurately as possible and to reduce it wherever it makes economic sense (for instance, by undertaking further geophysical work).

(ii) Dealing with Risk -- Expected Values

The western petroleum industry has gone through an evolutionary phase in dealing with the risks and uncertainties of petroleum exploration -- first by arbitrarily or subjectively accounting for risk and subsequently developing more systematic procedures to identify explicitly the risk factors, as well as the financial conditions. The key has been to understand the major areas of uncertainty; to quantify them in terms of their probabilities and confidence levels; to develop a decision criterion (expected value) that takes explicit account of risk factors; and to conduct structured post-drilling evaluations on the actual performance records of explorationists and other predictions in order to improve the accuracy of the geological, geophysical, and engineering estimates. Quantification, including explicit identification of the risk factors, has provided the basis for dealing with risks and uncertainties in a consistent manner.

As outlined earlier (Section D.1), the first steps in the quantitative evaluation of a prospect were: to estimate the producible oil and/or gas reserves in a well or field, to apportion these into annual production rate schedules, to convert these into a series of annual cash flows (after accounting for crude and/or gas prices, royalties, taxes, operating expenses, etcetera), and then to use these cash flows together with the initial front-end costs to compute measures of profitability, such as a discounted net present worth value. Such parameters reflect "no risk" measures of value. They are the economic worth of the prospect if it is productive and yields the estimated amount of reserves. But they do not account for any of the geotechnical uncertainties that surround the estimates -- such as the possibility of a dry hole, lower productivity than anticipated, lesser or larger amounts of recoverable reserves, etcetera.

Realizing the inadequacies of no-risk profitability criteria, management accounted for risk and uncertainty in several arbitrary ways, such as:

- Requiring a higher minimum acceptable no-risk rate of return so that the prospects selected would have a return commensurate with the degree of risk (or using a higher discount rate in the net present worth calculations as a hedge against risk).
- Using profit/risk ratios, which express likely returns from a successful discovery as a multiple of the amount of capital exposed in drilling a well.
- Applying arbitrary or subjective weighting factors to downgrade the no-risk profitability estimates.

With the move into more expensive and higher-risk exploration areas, the industry began applying more systematic procedures about 15 years ago to account for risk and uncertainties -- based upon the concept of expected value. The basic procedure is to specify the possible outcomes of the (exploration) decision strategy, the probability of occurrence of each of the outcomes, and the economic worth of each outcome if it occurs (such as a net present value). From this information, a "risk-adjusted" measure of value can be determined for the particular decision strategy. This measure can then be used to help make the accept/reject decision or to compare the relative value of the strategy with other decision options.

Figure 6 illustrates the principles that are involved in the expected value computation. First, the feasible decision alternatives and the outcomes which could occur for each alternative must be defined. In the example shown for Prospect A (the first decision option), the outcomes are defined in terms of recoverable reserves ranging from 0 to 1 million barrels of oil. These outcomes for each prospect are obtained from the geologic and engineering appraisals of the possible levels of recoverable reserves.

The probabilities of occurrence of each outcome, shown in Column 2, are determined by assessing the degree of risk and uncertainty associated with each outcome. Obtaining these probabilities, or risk factors,

is a critical and usually the most difficult step in the analysis of decisions under uncertainty -- and is discussed further in the next subsection dealing with uncertainty. The sum of the probabilities must add to 1.

The values in Column 3 are those which would be realized for each specific outcome if that outcome, in fact, did occur. The values can be expressed in a number of ways, such as the after-tax net present values shown or opportunity losses or costs, etcetera -- and the values can be positive or negative depending on whether they represent gains or losses.

The first three columns of Figure 6 represent the risk and profitability dimensions of the decision alternative. The final step in the expected value computation is to multiply the probability of occurrence of each outcome (Column 2) by the value received if the outcome occurs (Column 3). These product terms are then summed algebraically to arrive at the expected value of that particular decision option (shown as \$240,000). If the measure of value is that of monetary profits and losses, this sum is often termed the expected monetary value (EMV) of the decision alternative. Note that this does not give the actual economic value if the well were drilled (assuming the technical factors remained the same) but it gives a risk-adjusted value assuming the possible outcomes in Figure 6. Depending on the specific outcome, the actual net present value would be as shown in Column 3 (for example, if the well found 400,000 barrels of oil, the discounted present value would be \$700,000).

In considering various decision alternatives (such as Prospects A, B, and C of Figure 6), the decision rule for the case where values are expressed as monetary profits and losses is to select the alternative having the highest positive expected value. That is, the decision rule is to maximize EMV profit. Maximizing EMV is a strategy for consistent decision making under conditions of uncertainty. As long as the decision maker consistently seeks to maximize expected value, and participates in many decisions, the results will be better by maximizing expected value than any other strategy for selecting decisions under uncertainty. It must be again emphasized that this decision criterion is only one of the factors considered in an investment decision.

In the western petroleum industry, therefore, risk is incorporated into the decision making process by explicitly estimating the probabilities of the outcomes associated with a particular alternative -- and multiplying these probabilities by the various values (for example, profits) associated with each outcome to arrive at an expected (monetary) value. The use of probabilities and expected values provides a consistent analytical method for comparing decision alternatives with different levels of risk and uncertainty.

The method, however, is not foolproof. The principal challenge is to achieve consistency in the risk attitudes of the decision makers -- in order to deal with their natural aversion to risk. Considerable research has been performed in identifying the key psychological forces that influence risk aversion -- primarily the size of the budget, the magnitude of the potential gain or loss, and the chance of success or failure. Various approaches have been developed to reduce the bias in the way people structure risky decisions (examples of bias include: decision makers are more inclined to take a risk at the beginning rather than later in the project's life; or decision makers prefer to take a risk by not making a decision, rather than taking action that could result in the same loss; or decision makers are more likely to invest during a "run of good fortune," and less likely to invest during a "run of bad fortune"). These approaches do not negate the validity of the expected-value concept as the decision criterion with which to judge investments, but they emphasize understanding the terms in which the decision is presented (to minimize bias) and periodically reviewing past decisions to learn from past mistakes.

If the major decisions on exploration and production are centralized at headquarters, the challenges in dealing with the risk aversion of decision makers are simpler than if the organization were decentralized. The alternative is for prospect generators and investment screeners in exploration and production to be thoroughly familiar with the organization's risk philosophy. This philosophy is not fixed but will vary, for example, with the overall economic climate, changing budgets, company fortunes and particular individuals. One of the most negative impacts of the risk aversion

phenomenon occurs when a prospect screener's risk aversion is much higher than that of the company's corporate management. The result is that the screener tends not to show managers high risk/high return possibilities that they may well be seeking. Conversely, if the corporate management risk aversion level is low, the explorationists may be directing their effort to unacceptably high risk effort. The important element is not centralization or decentralization but, rather, the communication of the corporation's view on the level of risk aversion.

### Characteristic Industry Practices with Risk

In addition to the specific procedures used by companies in dealing with risk, it is useful to outline, at a broader level, the common practices used by the western industry in mitigating risk. In situations where the risk/return characteristics of a potentially attractive prospect are seen as unfavourable in monetary terms, the common approach is to reduce the magnitude of the front-end risk, usually by reducing the working interest. Although the returns are also reduced, at least partial participation is made possible by spreading the risk. Alternatively, the probability of success may be improved by acquiring new data. Or the company may try to obtain a disproportionately larger share of the venture in relation to its share of the cost.

Some common industry practices involved in mitigating risk include:

- farming out leased acreage in exchange for a drilling commitment,
- paying substantially less than the going price for an opportunity,
- joint venturing from commencement.

### (iii) Dealing with Uncertainty -- Probabilities

As outlined in the preceding subsection, uncertainties in the outcomes or in the parameters associated with a prospect are expressed in

terms of a range of values, with confidence levels assigned to numbers comprising the range. For example, a geologist might be 50 percent confident that the reserve volume in a prospect is greater than 100,000 barrels of oil and also that there is a 10 percent chance that the volume could be as high as 1 million barrels.

Since exploration prospects are evaluated as economic ventures, the economic assessments can be viewed as initial screening devices for accepting or rejecting projects, as well as for ranking projects according to economic attractiveness (as illustrated in Figure 6). Although there are many uncertainties that influence the value of a play, the most important geotechnical uncertainties that impact on the value of an exploration venture are:

- the amount of recoverable oil and/or gas contained in the prospect;
- the discovery probability, or the perceived chance that the inferred accumulation will be discovered by the proposed test drilling; and
- the finding costs, or the estimated total costs to discover the accumulation, including lease costs, geological, geophysical, and engineering costs; and drilling, completion and testing costs.

The greatest uncertainties are likely to be in the forecasts of prospect size and the smallest uncertainties are in the forecasts of finding costs. Predictions on prospect size and discovery probability are based on geotechnical considerations, while cost estimates require inputs from other disciplines. The third element is the net price to the investor (i.e., selling price less royalties and, indirectly, taxes). All three types of predictions are made routinely by geologists/geophysicists, engineers and planners/economists and have enormous financial consequences since they directly influence all the key elements of risk: the probabilities of success, front-end costs, and the financial returns.

The industry's experience with respect to predictions under uncertainty has been that predictions can be improved by:

- separating the geologic risk factors into their components;
- conducting structured post-drilling evaluations as part of an ongoing process; and
- understanding the biases associated with predictions and adopting procedures to mitigate them.

For example, since the amount of recoverable oil and/or gas in a field is controlled by three geologic factors (i.e., area of accumulation, average net pay, and the average hydrocarbon recovery factor), predictions on the size of the field can be improved by reviewing and learning from the company's record in estimating these factors and by disciplined analyses of the basins or analogies to the basin's history. Again, predictions on discovery probability might be improved through separately assessing the probabilities of four geologic risk factors (i.e., structure, reservoir, hydrocarbon generation, and entrapment) and multiplying these factors to estimate composite geologic risk.

The use of structured post-drilling evaluations as part of a continuous self-improvement process, has been found to considerably improve the confidence with which predictions are made. The original prospect concept and geologic estimates are compared with the post-drilling interpretations and the key areas that need improvement are identified. When this process is carried out in a constructive manner (rather than as an attempt to "pin the blame" for poor performance), their positive financial impact can be significant; that is, the process is forward rather than backward looking.

Such structured programs, based upon careful reviews of standard exploration parameters and annual performances, also reduce the biases that are involved in making predictions under uncertainty (examples of such biases are: overconfidence in the estimates; geologic analogies that may not be truly analogous, say because of small sample size; and disregarding non-geologic factors in forecasting future discoveries). Although companies use various methods to improve the reliability of their risk analyses (such as the use of Monte Carlo simulation where geologic data and time are available), the key is that frequent feedback in a constructive sense is, perhaps, the most important factor in improving predictive performance.

Once the sources of uncertainty are perceived realistically, then the exploration efforts can be focussed on the components of greatest uncertainty. For example, for a prospect in which structure is the largest unknown, an additional seismic line might reduce this uncertainty. The systematic reduction of uncertainty, combined with consistency in dealing with risk (such as via the use of risk-adjusted values and techniques such as decision-analysis) has considerably improved the confidence associated with the economic evaluations of specific prospects.

(c) Sensitivity Analysis

The sensitivities are the last and very important part of the quantitative assessment. The purpose of sensitivity analysis is to explicitly illustrate the impacts of the inevitable uncertainties that surround investments. Such analyses are therefore used to show the effect on the project economics of plausible changes in the principal underlying assumptions, such as the changes in net present value with changes in oil prices. They are also used to illustrate by how much a key assumption has to change before the investment produces no benefit (i.e., zero net present value). Finally, they can be used to show the project's net present value if a reasonably pessimistic combination of assumptions does materialize.

Important variables that affect project economics will vary from case to case, but might include:

- crude oil prices;
- changes in costs such as capital and operating costs;
- project delays;
- inflation and exchange rate variations;
- royalty changes; and
- well productivity.

It is important to understand the benefits and limitations of sensitivity analyses. They are most useful in illustrating the importance of

particular assumptions on project economics. If a change occurs only in a single variable, sensitivity analysis provides a useful test.

However, changes in a single factor are often accompanied by consequential changes. If these changes are understood and can then be quantified, sensitivity analyses are useful. If, on the other hand, the changes are part of a larger structural change, such sensitivity analyses are of limited value -- since the principle underlying such analyses is that other variables are constant except the variable being changed. For example, a change in costs might be due, in part, to a change in the structure of commodity markets (for example, higher prices) -- which requires testing the project economics against an alternative scenario and not simply against changes in a few assumptions.

Identification of the most appropriate application of sensitivity analyses is essentially an act of business judgement and no ready guidelines are available. If such analyses are used, they should be accompanied by an indication of the probabilities of changes in the variable under consideration, together with the probabilities of interaction with other variables where these are relevant.

## 2. The Role of Prices

In the western petroleum industry, the level (and expectation of future levels) of oil prices exerts the most significant impact on a company's decision on whether or not to invest in exploration and production activities. This is so because wellhead prices are translated into producer netbacks (i.e., the return to the producer after deducting operating, processing, gathering and/or transportation costs, and royalties and other taxes) and thereby into the cash flow and profitability of an investment (as outlined in the preceding Section D.1 on quantitative assessments of specific prospects).

From the producer's perspective, the level of oil prices is either determined by the market or controlled in some manner by the government of that jurisdiction. If the wellhead prices are market-determined, as they

currently are in the United States and Canada, they are established by the world price of oil, after adjustments for transportation costs and quality differentials with the marker crude. The traditional factors affecting the world price include: the current and projected condition of balance or imbalance of world supply and demand, the geopolitical and economic interests and strategies of the entities in control of excess producing capacity, and the effect of business cycles and inflation (for example, a healthy economy and growing industrial activity are the key factors influencing increased demand). During the upheavals in the world oil industry over the last 15 years, several new price-influencing factors have appeared, notably: the increased importance of the spot crude oil market; the advent of petroleum futures markets; the divergent social and political goals of the Organization of Petroleum Exporting Countries (OPEC) and non-OPEC nations; and the increasing importance of non-OPEC production.

When evaluating an exploration prospect or planning a development program as part of its strategy, a company will select a finite number for crude prices now and in the future. These prices are adjusted over time as the company's perceptions of the factors that influence prices change. With the increased price volatility experienced since 1986 and expected to continue, companies are increasingly turning to the use of alternative price scenarios for longer term planning -- a tactic that does not obviate the need for a specific crude oil price forecast or a few price forecasts (low, most likely and high, for instance) for the upcoming year, required for purposes of the operational plan (as outlined in the preceding Section C.3). In the western exploration and production companies, for analysis of investments and the measurement of profitability and results, the transfer price from exploration and production is the market or regulated wellhead price of the crude oil or natural gas and by-products.

If the wellhead prices are government-controlled, as they were in the 1970s in the United States and in the early 1980s in Canada, the producing company uses these controlled prices in its economic evaluations of exploration and production investments. Although controlled prices might somewhat ease the producer's dilemma in forecasting prices (since these tend to be set

by government regulations), they introduce enormous distortions in investment decisions. The fundamental reason is that the entire structure of the western economy is largely based on the assumption that the market-determined price of an asset reflects its value -- hence the use of market-based prices in economic evaluations of investments do reflect the value of those resources. Replacing these market-driven prices with government-controlled prices in effect insulates that geographical jurisdiction from the forces operating in the rest of the world and establishes an artificial basis for valuing resources -- a basis that varies with the arbitrary objectives of the government of the day and distorts the economic basis of investment decisions (i.e., the economic basis which assumes that prices reflect values).

Regardless of the mechanism by which world oil prices are translated into wellhead prices, lower wellhead prices at the level of the individual company means that:

- In order to make a reasonable return on their investment, the threshold of the company's finding and development costs must decrease. This requires increased efficiencies to drive down the cost to find and develop a net equivalent barrel of oil.
- The company's reinvestment ratio may decrease, i.e., the share of wellhead net revenues reinvested in drilling. For example, as a result of the dramatic declines in world oil prices in 1986, the United States industry's reinvestment ratio fell from a high of 30 percent in 1981 to around 16 percent in 1986. As a minimum, because of lower cash flow, the absolute amount of capital available for an investment by a company will have decreased. This decline in drilling spending translated into reduced rig activity and production levels, with daily production in the United States dropping by about 10 percent in 1986.
- In addition to the drilling downturn, lower prices caused a significant reduction in recompletions and workovers, which will have a particular impact in reducing deliverability.
- The company places increased emphasis on early recovery of the investments that it does make. Given the volatility of today's oil and gas markets, prospects must have outstanding potential and an early payback in order to justify the risk involved. Lower risk ventures may have priority.
- Since reducing geologic risk improves a project's economics, the company spends considerably more effort in acquiring a better

understanding of an area before committing a wildcat drilling project or development program.

- Many companies have restructured, for a variety of reasons, such as: to reduce debt and maximize cash flow; to acquire rather than explore for reserves; and to focus on the core businesses of exploration and production rather than on adjuncts to these operations.

## E. SUMMARY ON INVESTMENT PLANNING

### 1. Making Investment Decisions

There is no standard formula by which companies make investment decisions in the western petroleum industry. The preceding section outlined the key elements of the economic evaluations used by the industry in the quantitative analyses of specific exploration and production opportunities. These analyses, which are mainly conducted at the operational or subsidiary level of companies, require the effective integration of geological, geophysical, reservoir and production engineering, economic and financial considerations.

The primary results of these project analyses are usually presented to senior management in terms of a ranking of the opportunities in terms of various investment criteria, such as their net economic value to the company, say with respect to the risk-adjusted net present worth of each option. Other criteria might be used, depending on the magnitude and riskiness of the investment and the strategies and financial condition of the company. For example, the dramatic decline of oil prices in 1986 forced companies to re-evaluate their strategies and capital structure and to emphasize cash flow generation, efficiencies in operational and administrative performance, rapid payback of capital investments, and minimal risk activities. The particular investment criteria used by a particular company are a function of that company's specific needs and objectives.

For corporation decision making purposes and the selection of a particular investment option, however, these quantitative analyses, say reflected in the ranking of several exploration options by expected net

present worth, must be factored into broader, more strategic considerations developed by the company's corporate or headquarters level management. These strategic considerations deal primarily with corporate management's perspectives on the overall positioning of the company -- for example, the company's longer term objectives and direction; the fit between this investment and the company's strategies; the riskiness and returns of this investment relative to others in the company's portfolio of opportunities (for example, investing in an oil exploration prospect versus investing in heavy oil in situ); the impact of this investment on the company's overall financial health; the impact on the company's growth and positioning in that particular market (for example, oil, gas, etcetera) relative to its competitors; the company's technical and managerial abilities to follow through and capture the benefits of this opportunity; and any political or social considerations that might influence the company's position with respect to the particular investment opportunity.

In addition to the quantitative factors relating to geology, engineering, economics, etcetera, the qualitative aspects of an investment are carefully assessed by both corporate and subsidiary management in helping to make an investment decision. Political and social factors, such as the justification of the company's action to the government of that jurisdiction, the greater degree of social accountability to which companies are now subjected, and the company's increasing responsibilities towards its employees, and shareholders can all affect the economics of the company's investments -- and should be evaluated where possible. If some of the risks and uncertainties associated with these factors can be quantified, the sensitivity of the project's economics to them are incorporated in the analysis.

For decision-making purposes, therefore, corporate or headquarters management makes a business judgement on the choice of an investment option based on considerations such as:

- The strategic "fit" between this (and alternative investment options) and the company's objectives and direction.
- The operational "fit" between this (and alternative options) and the particular subsidiary's strengths, weaknesses, and tactics in the particular sector.

- The economic attractiveness of this opportunity relative to others in the company's portfolio, taking account of the risks and returns relative to the scale of the investment and the current and projected business environment.
- The financial impacts of the investment, first at the level of the subsidiary and then the impact on the company's overall financial position.
- The qualitative aspects of the investment, including:
  - o the competitive position of the company (such as the company's strengths and weaknesses relative to the technology and human resources associated with project implementation; competitors' likely strategic responses to the project);
  - o regulatory aspects of the activity (for example, regulatory requirements such as safety regulations, pollution control);
  - o socio-economic impacts of the investment (for example, regional employment impacts, use of local labour and materials versus imported materials, etcetera);
  - o government philosophy (for example, attitudes of the government or of key politicians to similar investments or to the profits generated by such investments -- the project must be sufficiently attractive in economic and financial terms, after the government's fiscal and tax regime).

No easy guidelines are available in the choice of a particular investment by corporate management -- it is a business judgement which requires sound understanding of the fundamentals of the industry and of the particular business; a balancing of quantitative and qualitative factors relating to this and other competing investments; and an integration of the perspectives at least at the corporate, subsidiary and government levels. The business judgement is based on careful analytical assessments and is facilitated by an effective management process.

## 2. Requirement for Both Process and Analysis

The combined effect of three factors -- the complexities of the diversified oil and gas company with operating subsidiaries in several geographic regions; the unpredictabilities in the business environment,

particularly with respect to world oil prices which exert the most significant impact on the economics of exploration and production; and the long-term nature and inherent riskiness of oil and gas investments -- have influenced companies to develop structured management processes within which to integrate the various corporate and operational factors that bear on investment decisions. Effective decisions require both a systematic process and careful evaluations.

The management process is essentially a planning and control process which is developed and managed by a central planning group at headquarters and supported by operational staff at the subsidiary levels. The process is an iterative one between management at the corporate and subsidiary levels, where corporate objectives and business opportunities are continuously evaluated and mutually modified in an ongoing effort to balance the risks and returns of alternative investment opportunities. The end objective is usually to seek those opportunities that increase the economic value of the company to its shareholders.

It has been the experience of the western petroleum industry that a proper planning system, designed to meet the needs of the specific company and its management, can establish an overall organizational framework to structure decision making responsibility, identify planning and operational roles, and provide a basis for control. The development of structured plans within a broader organizational process (illustrated in Figures 1 and 2) has been found to be instrumental as a basis for setting strategic direction, clarifying objectives, and facilitating changes within a company.

The process itself should be designed to facilitate communication, provide an increased awareness of corporate priorities and integration requirements, and help to motivate people. The motivational aspects of the process cannot be overemphasized. The opportunity for employees to participate in the establishment of objectives, strategies, and operational plans helps not only in the effective implementation of plans but also in the coordination between subsidiaries and between the corporate and subsidiary levels.

The process is aimed at delivering results in the areas identified by management as critical to the success of the company. The quantitative assessment of specific prospects focusses on their economic evaluations, taking into account the risks and uncertainties inherent in the business. The investment decision is the result of a complex balancing between quantitative and qualitative factors within the context of the company's strategies.

Figure 1

GENERAL FRAMEWORK OF INVESTMENT PLANNING

<u>Step</u>	<u>Key Elements</u>	<u>Outputs</u>
1	Identifying Corporate Direction and Objectives	<ul style="list-style-type: none"><li>. Corporate Long-Term Mission</li><li>. Corporate Strategic Direction</li><li>. Corporate Objectives</li></ul>
2	Assessing Corporation's Internal Position and the External Situation	<ul style="list-style-type: none"><li>. Comparison of Current Short-Term Plan to Actual Performance</li><li>. Alternative Financial, Business, Economic, Political and Technical Scenarios</li><li>. External Opportunities and Threats</li><li>. Internal Strengths and Weaknesses of Company</li><li>. Major Issues Facing Company</li></ul>
3	Developing Alternative Strategies, Investment Plans and Subsidiaries' Objectives	<ul style="list-style-type: none"><li>. Alternative Strategic Plans</li><li>. Subsidiaries' Objectives</li><li>. Integration of Investment Plans at Subsidiary Level</li></ul>
4	Selecting the "Best" Plan That Meets Company's Objectives	<ul style="list-style-type: none"><li>. Final Strategic and Business Plan</li></ul>
5	Implementing Plan and Monitoring Performance	<ul style="list-style-type: none"><li>. Short-Term Operational Plans at Subsidiary Level</li><li>. Monitor Performance and Modify Activities to Achieve Objectives</li></ul>

Figure 2

LINKAGES BETWEEN COMPANY'S LONGER TERM STRATEGIC DIRECTION AND OPERATIONAL PLANS

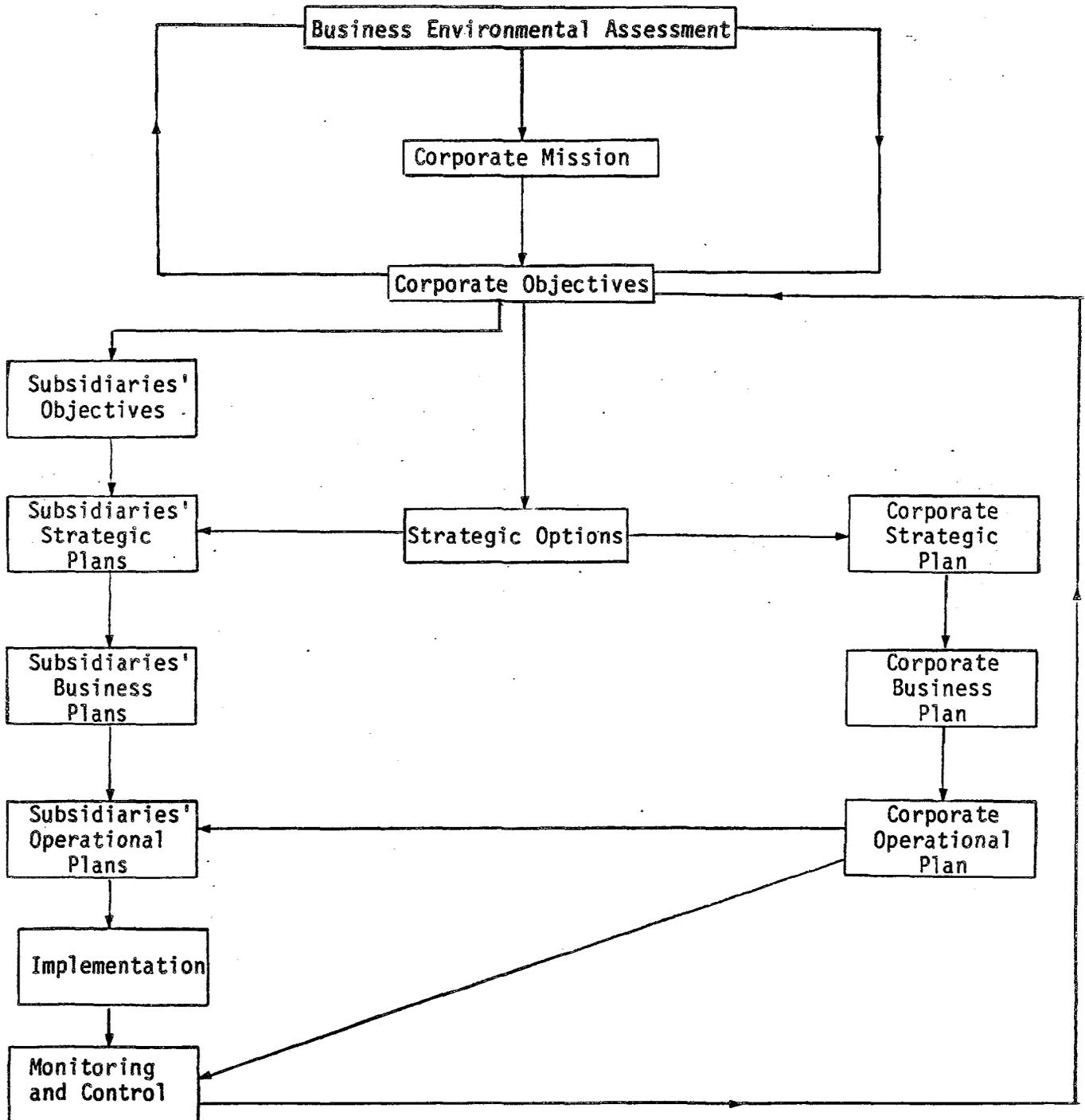


Figure 3

TYPICAL VARIABLES IN  
EVALUATIONS OF CAPITAL PROJECTS

Land, Reserves, Production

Pricing

Investment Capital

OUTPUTS

- |  |   |  |
|--|---|--|
| <ul style="list-style-type: none"><li>. Estimate recoverable reserves</li><li>. Forecast annual production</li><li>. Estimate net annual production (after royalties and interests owed to others)</li></ul> | <ul style="list-style-type: none"><li>. Forecast prices</li></ul> | <ul style="list-style-type: none"><li>. Capital costs</li><li>. Operating costs</li><li>. Revenues</li><li>. Cash flow</li></ul> |
|--|---|--|

VARIABLES

- |  |   |   |
|--|---|---|
| <ul style="list-style-type: none"><li>. Net pay</li><li>. Porosity</li><li>. Permeability</li><li>. Areal extent</li><li>. Probability of success</li><li>. Type of hydrocarbons</li><li>. Land interests</li><li>. Participation arrangements</li><li>. Royalties</li><li>. Contract factors</li><li>. Timing</li></ul> | <ul style="list-style-type: none"><li>. World oil price forecasts</li><li>. Domestic oil price forecasts</li><li>. Quality differentials</li><li>. Gas price forecasts</li><li>. NGL price forecasts</li><li>. Exchange rates</li></ul> | <ul style="list-style-type: none"><li>. Discount rates and type (real or current)</li><li>. Income taxes</li><li>. Other taxes</li><li>. Inflation rates</li><li>. Interest rates</li></ul> |
|--|---|---|

Figure 4

OVERVIEW OF KEY ELEMENTS IN PETROLEUM ECONOMICS

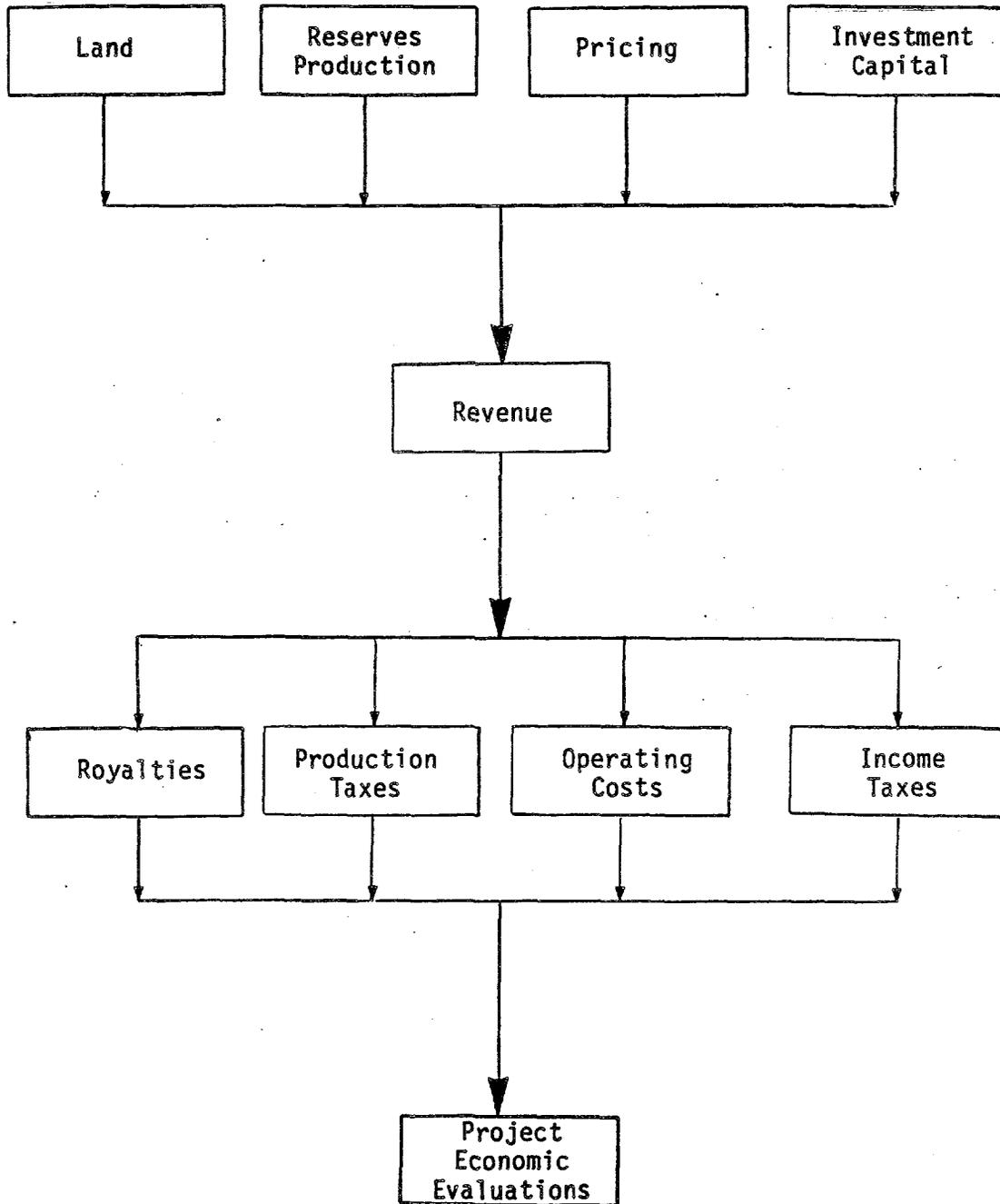


Figure 5

STEPS IN THE ECONOMIC EVALUATION OF A CAPITAL INVESTMENT IN EXPLORATION AND PRODUCTION

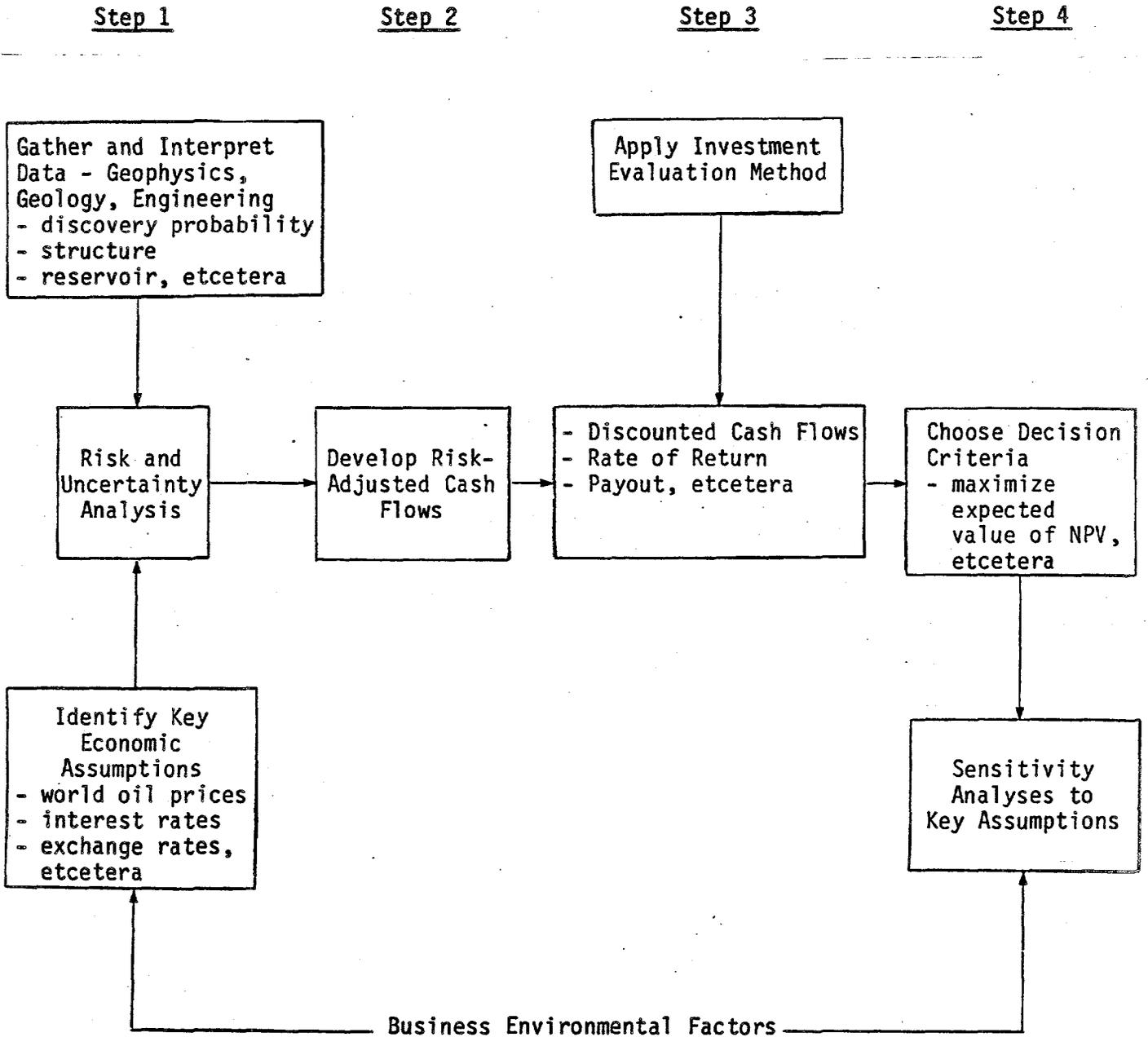


Figure 6

PRINCIPLES OF EXPECTED VALUE COMPUTATIONS

<u>Possible Outcomes</u>	<u>Probability Outcome Will Occur</u>	<u>Conditional Value (eg. Profitability) If Outcome Occurs -- Discounted Present Value</u>	<u>Expected Value of Each Outcome</u>
(1)	(2)	(3)	(4)
$O_1$	$P_1$	$V_1$	$P_1V_1$
$O_2$	$P_2$	$V_2$	$P_2V_2$
$O_3$	$P_3$	$V_3$	$P_3V_3$
⋮	⋮	⋮	⋮
$O_n$	$P_n$	$V_n$	$P_nV_n$

$P_i = 1.00$

Expected Value =  $P_iV_i$

Note:  $P_1 + P_2 + P_3 + \dots + P_n = P_i$

Example

(a) Prospect A

Dry Hole	0.50	-400,000	-200,000
100,000 Bbl	0.10	-200,000	-20,000
400,000 Bbl	0.20	+700,000	+140,000
700,000 Bbl	0.10	+1,200,000	+120,000
1,000,000 Bbl	0.10	+2,000,000	+200,000

Expected Value A = +\$240,000

(b) Prospect B

⋮

Expected Value B = ?

(c) Prospect C

⋮

Expected Value C = ?