

SOME COST AND MANAGEMENT ACCOUNTING PRINCIPLES APPLIED TO DIAMOND DRILLING

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The mediocre teacher tells.
The good teacher explains.
The superior teacher demonstrates.
But the great teacher inspires.

William Arthur Ward

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OPSOMMING

ENKELE BEDRYFS- EN BESTUURSREKENINGKUNDIGE BEGINSELS BY DIAMANTBOORWERK

1. INLEIDING

Die diamantboorbedryf het in die tydperk vanaf 1986 tot 1990 'n ongekende groeifase beleef wat gevolg is deur 'n afname in die vraag na diamantboorwerk in 1991 as gevolg van die inkorting van hoofsaaklik goud eksplorasiëbedrywigheide deur die groot mynhuise en eksplorasiemaatskappye. Dit het maatskappye genoop om hulle koste tot in die fynste besonderhede te ondersoek om te kon oorleef in 'n mark wat met die afswaai in vraag al hoe meer mededingend geraak het.

2. DOEL VAN DIE STUDIE

Die doel van die studie is om die toepassing en gebruik van enkele bedryfs- en bestuursrekeningkundige riglyne in die diamantboorbedryf te ondersoek om die bestuur met daaglikse bestuurstake soos organisasie, beplanning, beheer en besluitneming te help.

3. OORSIG VAN DIE STUDIE

In die studie word enkele diamantboortegnieke beskryf asook die belangrikste interne en eksterne omgewingsfaktore wat die koste van diamantboorwerk kan beïnvloed. Die beskrywing van hierdie tegnieke word gevolg deur 'n bespreking van koste-elemente en -beginsels wat deur maatskappy A gebruik word.

Min gepubliseerde inligting aangaande die koste van diamantboorwerk is beskikbaar as gevolg van die sensitiwiteit van die inligting. Dit het aanleiding gegee tot 'n literatuurstudie van toepaslike beginsels wat in die praktyk gebruik kan word. Die literatuurstudie is opgevolg deur 'n toepassing van die bedryfs- en bestuursrekeningkundige beginsels wat as prakties toepaslik geïdentifiseer is.

4. BEVINDINGS VAN DIE STUDIE

Die invordering van daaglikse bedryfsinligting en die verwerking daarvan is van die belangrikste aspekte wat nodig is om 'n sinvolle en bruikbare bestuursinligtingstelsel saam te stel. Die inligting met betrekking tot die prestasievermoë van die verskillende diamantboortegniese moet met die werklike koste verbonde aan die verskillende tegnieke gekombineer word om aanvaarbare standaarde daar te stel vir 'n doeltreffende bestuursinligtingstelsel. Die historiese prestasie-inligting is ook van waarde vir die kliënte van die diamantboormaatskappye vir hulle eiesoortige probleme ten opsigte van beplanning en begrotings.

Aangesien geen beginvoorraad of eindvoorraad van die produk, (boorkern) bestaan nie, is dit nie nodig om 'n keuse te maak tussen 'n direkte of volkoste benadering nie aangesien daar geen verskil in wins sal wees nie. Die gebruik van ekwivalente eenhede van produksie word ten sterkste aanbeveel aangesien dit die vergelyking van prestasie van die verskillende kontrakte, bore of areas sal vergemaklik. By ekwivalente eenhede van produksie word daar nie verwys na die algemene gebruik soos in die geval van voorrade en werk in prosesrekening nie. Hier word verwys na vergelykbare eenhede aangesien die produk in 'n proses vervaardig word wat langer neem soos wat die boorgat dieper word en die rotstipe wat deurboor word verander.

Ekwivalente eenhede sal van nut wees by die vasstelling van tenderpryse wanneer daar om nuwe kontrakte of kliënte beding word. Die maandelikse en jaarlikse beplanning en begrotings kan ook baat by die gebruik van ekwivalente eenhede om die realisme daarvan te toets.

5. GEVOLGTREKKING

Die studie wys op die gebruik en toepassing van sekere bedryfs- en bestuursrekeningkundige beginsels wat ingesluit behoort te word in enige koste- en prestasiemetingstelsel wat deur die onderskeie diamantboorondernemings gebruik kan word vir bestuursdoeleindes. Die gebruik en toepassing van die voorgestelde beginsels word veral in die huidige afswaafase van die diamantboorbedryf sterk aanbeveel, aangesien kostebetreë en die neem van die regte bestuursbesluite van belang is. Hierdie besluite kan slegs gereëen word indien die toepaslike bestuursinligting korrek en tydig beskikbaar is vir interpretasie en evaluasie.

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CHAPTER 1

NATURE AND EXTENT OF STUDY

1.1 INTRODUCTION

Due to South Africa's dependency on its mineral export to earn much needed currency to finance job creating projects for its ever increasing population, the quest for these minerals will not easily subside.

Gold, being the biggest earner of foreign currency from mineral export sales, some 64 percent in 1990, in the South African mineral industry (Fourie, 1991:4), will therefore stay in demand for as long as it can be mined profitably.

In order to satisfy the worldwide need for minerals, to increase these mineral resources and to extract them to earn money, there has to be a continuing search for minerals. To satisfy the above-mentioned needs, exploration must be carried out to determine the existence and extent of such mineral deposits and whether they are economically exploitable if and when found.

To obtain this data, boreholes, producing rock in the form of a round core, have to be drilled to enable the geologist to interpret the sub surface geology. This geological data is then compiled and interpreted to determine the extent and value of a deposit.

This study will focus on the costs of drilling the holes which sometimes are expected to go to great depths (up to 6 kilometres deep) and under very expensive and high financial risk conditions to both the exploration company and the drilling contractor.

A major company recently announced that they had spent R97 000 000 on the evaluation of a possible mine and planned to spend an additional R36 500 000 for the year 1990/1991 on the next phase of exploration which will include a number of boreholes (Anon., 1990a:251).

1.2 PROBLEM STATEMENT

The above figures coupled to the fact that geologists, who are earth scientists, are predominantly in charge of exploration boreholes and the decisions regarding the awarding of tenders, wedging, sizes of holes, scheduling and budgeting of exploration projects, led to this study. It is considered that the geologists are partly responsible for the high costs of drilling in as much that they sometimes make decisions which cost the drilling companies large amounts of money which will only be recouped in following contracts.

The same can be said of drilling companies who also sometimes make decisions without realising the full cost implications of such decisions due to insufficient or unavailable cost and performance information, (personal experience).

A number of problems exist in the drilling of the holes which have an influence on the planning, budgeting and control of costs as experienced by a drilling contractor. A number of problems have been identified with the intention of finding solutions to them.

- The first and foremost problem in diamond drilling is the poor decisions that are made, based on sheer “gutfeel”, and the lack of reasonably accurate, recent and relevant performance and cost data. Expensive fishing operations exceeding the cost of replacing the lost equipment and/or redrilling is known to have occurred on numerous occasions, (personal experience).
- A big problem encountered in the diamond drilling of a borehole is the fact that a borehole is a production process where the product (core) is almost infinitely variable in character and composition in the microscopic scale. This factor makes it very difficult to set performance and costing standards which are used in the planning and control processes. The generalizations in the industry as far as rock types are concerned will be accepted and some cost and management accounting principles pertaining to the diamond drilling industry will be described.
- Because the exact depths of the major different rock types and target horizons are not known beforehand, it severely influences budgeting and planning by both the geologist and the contractor. These relatively vague factors also have a large impact on the risk profile and cost profile of the hole.
- Drilling crew proficiencies cannot be measured as a function of the product due to the product's variability, e.g. different rates of production in the same depth category achieved by different drilling crews in different rock types, cannot be used as a basis for the determination of which crew is the best. The actual work

done, for example, the rod handling times achieved by the crew can be used to compare the performances of the different drilling crews and the setting of performance standards. Production bonuses are usually paid on a basis of production rates within certain depth categories and the number of metres drilled per bit. The latter is commonly referred to as bit life.

- The cost of producing the product (core) increases with the increase in depth of the borehole. The deeper the borehole, the slower the production rate and therefore the higher the cost per metre drilled due to the fact that overheads are relatively fixed over a given period and variable on a cost per metre produced.

From the problems listed above, it can be seen that the most important problem in the drilling of diamond holes, is that sound performance and financial information is required to enable the contractor and client alike, to make the best decisions possible for a given situation. The variability in composition and character of the product (core) severely influences the measurement of a number of factors. This is very important in the design of an effective costing system, which is to supply relevant and useful information to supervisors and management, that can be used in a pro active manner for budgeting, planning and control functions.

1.2.1 Hypothesis

In the formulation of a hypothesis for this study the effect of technical factors influencing performance, decision making and variable risk profiles of decision makers are somewhat discounted, as it is very difficult to test what the effect of some of the technical variables would be if otherwise decided.

As a working hypothesis it can be said that the use of a comprehensive, yet simple costing system and application of some management accounting principles will lead to more efficient decision making, reduced production losses and increased productivity due to better planning and control.

1.3 STUDY OBJECTIVES

1.3.1 Primary objective

This study is undertaken with a number of objectives in mind. The primary objective being to determine the applicability of some cost and management accounting principles

to diamond drilling. This primary objective can be subdivided into the following specific objectives.

- To acquire a quick and reasonably accurate determination of costs incurred to date.
- To determine the effect on profits of future planned expenditures.
- To supply sufficient cost and performance data that can be utilized in the setting of standards to be used for variance calculations, cost and performance control and assist in decision making based on physical and financial factors.

The cost and performance data obtained through the costing system should be used in such a way that pro active management actions and decisions can be taken in order to be cost efficient and cost effective in a highly competitive and risky market.

1.3.2 Secondary objectives

The secondary objectives of this study are aimed at slightly more subjective but important issues.

- The costing system should be able to build a better mutual understanding and relationship for each other's problems and needs between the contractor and the client.
- To assist both contractor and client in their individual planning, budgeting and control functions and needs. The client uses the contractor's planned performance figures and tender prices for his own project management purposes.
- To reduce potential production losses due to bad decisions based on incorrect or incomplete data.
- To enable contractors to tender for new contracts with professionalism and increased confidence as to the possible profitability at possibly more competitive rates than the competition.

1.4 REFERENCE FRAMEWORK

1.4.1 Introduction

Company A, which will supply most of the data used in this writing, can be regarded as a small company with six, deephole diamond drilling machines. One large competitor has up to fifty such machines (Edwards, 1988:73).

It is imperative for the company to keep its unit cost of production to a bare minimum to be competitive in a field where very large competitors also operate. The size of the company, together with the risks involved in diamond drilling, makes the company very vulnerable to any breakdowns and/or problems encountered on any of its machines or holes that it is drilling.

In the diamond drilling industry, work is obtained by means of tenders being asked for by the different exploration companies for holes they want to be drilled. The different drilling companies then tender for the work by quotation as per tender request.

The exploration company will then review all applications and decide on a contractor to be used. Price is not always considered to be the only measure on which the exploration company base its decision as to which contractor will be employed. Factors like the size of the contractor, its experience in the specific area and expected rock types to be drilled are also carefully evaluated before any final decisions are made. These factors are important as it is very difficult and expensive to find a contractor willing to complete a hole that was abandoned by another company.

Exploration companies are therefore quite wary of employing small diamond drilling contractors because of their vulnerability to problems and shortages of capital to purchase new or additional equipment, should it become necessary in the life of the borehole.

1.4.2 Extent of study

With each geological area and borehole being rather unique in character, this study will concentrate on exploration drilling done for the Witwatersrand type gold deposits in predominantly the Klerksdorp and Orange Free State Goldfields. This was chosen because most of the exploration diamond drilling is carried out in this type of geological province as 98 percent of South Africa's gold production is produced from the Witwatersrand Basin (Anon., 1990b:62), and some of the deepest holes in the world are also drilled in this geological sequence (Savage, 1986:25). Actual figures supporting the amount of diamond drilling being undertaken on the Witwatersrand Supergroup can unfortunately not be obtained as the exploration companies are very secretive about their exploration projects.

Based on the above-mentioned information it is suggested that diamond drilling done in the Witwatersrand Basin be regarded as representative for the industry for the purpose of this study.

1.5 RESEARCH METHODOLOGY

A very limited amount of literature on the subject of diamond drilling is available in South Africa, probably due to the sensitivity of the information to the drilling companies and their biggest clients, the large mining and exploration companies. A subject search of the NAVO data base at the Human Sciences Research Council did not produce any information regarding studys or any theses dealing with any cost and management accounting aspects of diamond drilling.

Most of the research into the different practical and technical aspects to be addressed, will be based on literature studies of recent publications regarding drilling in South Africa, personal experience and on personal contact with some of the drilling companies, three of which are presently drilling boreholes for the company at which the author is an employee. The national data base, Index to South African Periodicals from 1987 onwards, was also consulted for publications relevant to the content of the study.

Research into the theoretical aspects to be addressed in the course of the study will be based on studies of the literature and relevant publications regarding costing and management accounting principles and systems being available in South Africa.

A search in the two international data bases, i.e. the Business Periodicals Index, 07/1982 - 20/12/1991, and the ABI-INFORM, 10/1986 - 09/1991, for applicable published American literature regarding diamond drilling and associated cost and management accounting, did not reveal any publications applicable to the South African diamond drilling industry. Most of the American publications deal with the acquisition of ground and funding of exploration programmes in oil exploration which uses a different drilling technique to the techniques used in South Africa.

Where applicable and necessary, some relevant drilling data generously supplied by another company, will be included in the descriptive work to illustrate certain aspects where a lack of data from company A was experienced.

After numerous consultations with the directors of company A and telephonic discussions with the managements of other big diamond drilling companies the obtained information was compiled. (Some discussions on audio tapes in possession of author.)

The application of some cost and management accounting principles was evaluated after an investigation of the relevant figures and data obtained from company A,

other drilling companies and colleagues was completed. A personal computer was extensively used for data compilation and simulation to evaluate the application of the different cost and management accounting principles.

1.6 LIMITATIONS OF STUDY

As most of this study is done on a diamond drilling company by a member of an exploration company, whom it serves contractually, the situation can be regarded as quite unique. By virtue of this relationship it can be accepted that some of the sensitive data supplied by the contractor will be somewhat altered, so as not to disclose what could be regarded as the company's differential advantage in the market place.

Whenever altered information is used it will be indicated as such, and care taken that the information is still representative and relevant.

Because the contractor and the exploration company did not have a very long relationship at this point in time, only limited performance data is available on the drilling done by the contractor. Performance data of other drilling contractors, generously supplied by another exploration company will, when deemed necessary, be incorporated into this study to highlight and prove certain aspects.

Due to the limited amount of actual figures obtained, some of the calculations are based on practical experience and sometimes fictitious values. The fictitious values used are approximate figures and were discussed with some of the drilling contractors to ensure that they are representative enough for the purpose of this study.

1.7 GLOSSARY OF DIAMOND DRILLING TERMS USED

Due to the technical nature of diamond drilling, some of the more technical terms used in this study will be explained or defined in more common terms in this glossary (Heinz, 1989:425-482; Whitten & Brooks, 1988).

- Annulus - the gap that exists between the outside of the rod and the side of the hole.
- Bit - any device that may be attached to, or is, an integral part of a drill string and is used as a cutting tool to bore into or penetrate rock or other materials utilizing power applied to the bit percussively or by rotation.

- Bit life - the number of metres of borehole a bit has drilled.
- Caving - fragmented rock materials, derived from the sidewalls of a borehole, that obstruct the hole or hinder drilling progress.
- Chert - a dense and very hard, cryptocrystalline, silica rich, chemical sediment that is usually difficult to drill.
- Circulating fluid - a fluid pumped into a borehole which cools the bit, washes away the cuttings from the bit and transports the cuttings out of the borehole.
- Collar - the mouth of a borehole or the process of starting to drill a borehole.
- Conglomerate - an assemblage of predominantly rounded rock pebbles.
- Core - a cylindrical sample of rock and/or the process of cutting such a sample by use of an annular (hollow) drill bit.
- Core barrel - a length of tubing designed to carry or contain the core produced until the core can be raised to the surface or collar of the hole.
- Coring tool - see "bit".
- Cuttings - very fine chips of rock created at the bit cutting face.
- Derrick - a framed wood or steel tower placed over the borehole to support the drilling tools for hoisting and lowering drill rods, casing or pipe. It is sometimes also called a tower.
- Dip - the angle of a slope, vein, rock stratum or borehole as measured from the horizontal plane downward.
- Drill rig - a drill machine complete with all tools and accessory equipment needed to drill boreholes.
- Fish - the article recovered and/or the act or process involved in the recovery of lost drilling tools, casing, or other articles from a borehole.
- Grout - a pumpable slurry of cement or a sand/cement mixture, commonly forced into a borehole to seal crevices in a rock to prevent water from entering the hole or to cement and consolidate rock fragments or caving.
- Intrusive - a rock that was injected into the surrounding rock in a molten state and then solidified. It is sometimes very weak and altered at the contacts with the surrounding rock.
- Log - the record of, or the act of recording, events or the type and characteristics of the rock penetrated in drilling a borehole, as evidenced by the cuttings, core recovered, or electronically obtained information.
- Mud - a circulation fluid which contains either a natural mud or a synthetic material.
- Non operational time - this is the time when the machine itself is not running and doing any work.

- Polycrystalline bit - a drill bit using pieces of synthetic polycrystalline diamond crystals which are sintered on a tungsten carbide base under high pressure as the cutting material instead of diamonds only (Shafto, 1985:119).
- Rod string - a collective name for any number of rods connected end on end to form the link between the drilling machine and the coring tool. Also referred to as a drill string.
- Running dyke - an unconsolidated or extremely weathered and altered intrusive rock which is very difficult to drill because of poor core recovery, caving and poor penetration.
- Site move - a term used when a drill rig is moved from one borehole to another.
- Wedge - a metal device inserted in a borehole to deflect or change the course of the hole.

1.8 FURTHER DEPLOYMENT OF STUDY

The following aspects are to be addressed in the course of this study.

- Chapter 2: A brief description of diamond drilling techniques and the internal and external environmental factors that influence the cost of diamond drilling.
- Chapter 3: The identification of the relevant cost elements as encountered, and the present cost and management accounting principles used by company A.
- Chapter 4: A literature study of some cost and management accounting principles that is believed to be relevant and applicable to diamond drilling.
- Chapter 5: The implementation of some of the discussed cost and management accounting principles based on the supplied and gathered information. This is done with the objectives of this study in mind in order to find solutions to some of the problems identified.
- Chapter 6: In this chapter certain conclusions are drawn from the preceding chapters and the subsequent recommendations made are aimed at the objectives set out in chapter 1.

CHAPTER 2

DRILLING METHODS AND ENVIRONMENTAL FACTORS INFLUENCING THE COST OF DRILLING

2.1 INTRODUCTION

This chapter will initially deal with a description of the most commonly used drilling methods presently used in South Africa. Secondly some external and internal environmental factors influencing the cost of drilling, which is regarded as being causal to the initiation of this study, will be discussed.

2.2 DRILLING METHODS

The term, diamond drilling, will be used throughout this study in preference to the more descriptive term, core diamond drilling, which is not generally used in South Africa. Various technical refinements to the different drilling methods exist, but will for the purpose of this study not be discussed in detail.

2.2.1 Percussion drilling

This form of drilling is very common and is predominantly used for the drilling of water holes. In the case of diamond drilling it is used for the drilling of the pilot hole through the overburden and the commonly weathered, jointed and broken upper section of the lithology near the surface.

As the name of this type of drilling implies, it comprises the use of rods, driven by compressed air that is circulated through the rods, to actually “hammer” the tungsten carbide bit into the rock or material that is being drilled. The broken pieces of rock, referred to as chips, are transported to the surface by the returning compressed air. The recovered chips are collected at predetermined intervals and placed in small heaps for the geologist to record.

When the solid formation is reached, the hole is cased off with steel or plastic casing to prevent unconsolidated material and excessive groundwater, if present, from entering the borehole as this can hamper future drilling operations.

This is usually a very fast drilling method yielding high penetration rates, in comparison to diamond drilling, because no core is retrieved from the bottom of the hole.

Numerous disadvantages with regard to depth limitations and the contamination of the chip samples exist but will not be discussed in detail.

2.2.2 Tricone drilling

Tricone drilling, as used in the diamond drilling industry, is a direct derivative from the drilling methods used in the oilfields. This method has not been proved to be successful under South African conditions, but this might be due to the contractor's lack of experience.

This type of drilling can be regarded as a combination of percussion and diamond drilling as no core is produced. Rock chips, similar to percussion drilling, are produced, and the rods are rotated as in diamond drilling. The largest difference is in the type of drilling bit that is used. The bit has tungsten rollers that break the rock as it is rotated and the rock chips are transported to the surface by the circulating fluid.

This type of drilling is reportedly very successful in the oil fields due to the softer and less abrasive nature of the rocks being drilled. The most common rock types are shales, clays, sandstones, dolomites and occasional hard chert layers. Some of the large oilfield drilling machines were imported to South Africa in 1987 at a reported capital expenditure of +R10 000 000 each. These machines were adapted for South African drilling conditions to also produce core. Anon. (1990c:6) reports that after seven holes were drilled with these machines the rate of drilling was approximately three times faster and 1.55 times more expensive than for conventional diamond drilling rigs.

De Jager (1990:91) states that this drilling was technologically successful but failed financially due to the high costs involved in the running of these machines.

2.2.3 Core diamond drilling

2.2.3.1 Introduction

According to Heinz (1989:27) the ancient Egyptians understood the principles of core drilling, but whether they used diamonds is not established as yet. Drilling equipment set with diamonds was used as early as 1751 in France (Heinz, 1989:27).

The two basic different types of core diamond drilling, wireline and conventional drilling, will be discussed in more detail in paragraphs 2.2.3.3 and 2.2.3.4 on page 14 and page 15 respectively.

2.2.3.2 Equipment

A diamond drilling unit consists of a drilling machine with its derrick, rod string, coring tool and circulating fluid. All pieces of equipment are of equal importance in the drilling operation, but perhaps the coring tool could be singled out as the most important piece. The coring tool and its cutting surface has to do the cutting and recovery of the core which is the prime source of revenue for the contractor. Additional equipment like pumps, lighting plants, accommodation etc. will be regarded as peripherals to the main drilling unit.

Heinz (1989:37) states that the quality of the core recovered will be a function of the technique used, e.g. wireline drilling or conventional drilling, and the selection of the correct combination of components of the coring tool. Due to the importance of the coring tool will it be discussed in slightly more detail. This is to indicate that the large number of different components can lead to a very large variety of combinations that can be used in making up a coring tool. This number of possible combinations necessitates that comprehensive records are kept on all the components and the performances of each within the major rock types to enable the contractor to minimize errors on tool selection, and the resulting costs, when subsequent holes are drilled in the same geological province.

□ The diamond bit

The diamond bit is responsible for the cutting of the rock and its selection is therefore of critical importance to penetration rates obtained and the costs and profits of the borehole.

Diamond bits can be classified according to the following characteristics (Heinz, 1989:38-44):

- Type of Cutting Stones:
 - ❑ Surface set Diamond Bits
 - ❑ Impregnated Diamond Bits
 - ❑ Polycrystalline Diamond Bits
 - ❑ Tungsten Carbide Bits
- Crown Design:
 - ❑ Coring Diamond Bits
 - ❑ Non coring Diamond Bits
 - ❑ Face and Internal Discharge Bits
- Drilling Technique Used:
 - ❑ Conventional Drilling Diamond Bits
 - ❑ Wireline Drilling Diamond Bits
 - ❑ Air and Mud Diamond Bits

❑ The reaming shell

The minimum outside diameter (OD) of the reaming shell, which acts as a link between the core barrel and the drilling bit, must not be smaller than the maximum OD of the bit. This is to ensure that new bits can go down the hole and no time and money is wasted on the reaming of the hole to allow the new drilling bit to get to the bottom of the hole. It also provides enough clearance for the drilling fluid to circulate between the core barrel and the side of the borehole.

A new design reaming shell was released in 1988 that assisted the recovery of drill rods after burning in of the bit at a much reduced time and cost than previously used (McCuaig, 1988:48).

❑ The core barrel

The core barrel is the instrument that has to encase the core that has been drilled and keep it intact while it is transported to the surface.

Numerous different types and designs of core barrels exist. The main classification is as follows:

- Conventional drilling core barrel
- Wireline drilling core barrel
- Single tube core barrels
- Double tube core barrels
- Triple tube core barrels
- Rigid and swivel type core barrels

2.2.3.3 Wireline diamond drilling

The use of the wireline drilling techniques began in the early 1940's within the oil industry. The main features of the wireline system, as it is used today for slimhole drilling, were patented in 1953 by the Longyear Company in the U.S.A. (Heinz, 1989:187).

Wireline drilling has a rod string with larger inside diameter than the conventional drilling rods used, which allows a device to be lowered on a cable from a winch, through the inside of the rods, to the bottom of the hole to latch onto the inner tube of the core barrel. The previously core filled inner tube is then retracted, through the inside of the rods, to the surface where the core is removed. The rod string only needs to be extracted from the hole when the drilling bit or reaming shell has to be replaced or when other "down the hole" problems are encountered.

The benefits of this system can be clearly seen in the following comparison: When using standard rods and core barrels, drilling at approximately 4000m depth, core extraction and the lowering of the core barrel to the bottom will take approximately 18 hours. With the wireline system, core retrieval and inner tube lowering will take about 3 hours (Savage, 1986:25). This resulted in a reduction of 15 hours in operational time which can lead to a considerable saving in direct operational costs.

The wireline system has as yet not been standardized and all parts must be related to a particular manufacturer's design (Heinz, 1989:187). The purchasing of a wireline system must therefore be done with great care to ensure a continuous supply and compatibility of equipment when replacement is due.

The writer agrees with Heinz (1989:188) that the main advantages and disadvantages of this system compared to conventional drilling, can be summarized as follows:

□ **Advantages**

- A reduction in rod handling time.
- An increased coring bit life.
- Higher core recovery.
- Hole caving is reduced due to rods being in the hole longer and thus minimizing hole wall damage.
- The rods, being flush jointed, can be used as casing.
- Some geophysical logging can be done through the rods eliminating the need to pull the rods.
- Hole deviation surveys can be done inside aluminium rods, without having to pull the rods from the hole for every survey.

□ **Disadvantages**

- Wireline equipment is more expensive.
- Wireline systems require intensively trained and skilled personnel to operate them successfully.
- Rods are not as strong as conventional rods.
- Rods are more easily damaged when pipe wrenches are used for fastening and loosening of rods.
- A small annulus can induce larger circulation fluid losses due to the higher pressures.

2.2.3.4 Conventional diamond drilling

In conventional diamond drilling the same basic equipment is used as in wireline drilling, the main difference being that the rods have a larger wall thickness and thus a smaller inner diameter. The complete rod string has to be extracted from the hole in order to remove the drilled core from the core barrel which makes this type of drilling very time consuming.

Because the advantages and disadvantages of the wireline system, in comparison to conventional drilling, have been discussed previously, it will not be repeated for conventional drilling.

2.2.4 Circulation fluid

2.2.4.1 Introduction

The main purpose of the circulation fluid is to cool the drilling bit, transport the cuttings to the surface and lubricate the bit and drill string. The circulation fluids used are usually water and in some instances water in combination with certain chemicals, which are commonly referred to as “muds”. In extreme problem situations, oil has also been used with a variable amount of success.

2.2.4.2 Water

Depending on the water supply and the losses incurred in the hole, water is the cheapest form of circulating fluid. Water does not have the proposed lubrication properties, hole cleaning and hole stabilization abilities of the “muds” that are commonly used, the lack of which can lead to a number of, induced, “down the hole” problems.

2.2.4.3 Chemicals

The chemicals used are mainly viscosifiers, lubricants and inhibitors. Chemicals or “muds” as they are commonly called, are becoming increasingly more popular and necessary in circulating fluid systems. Anon. (1990c:5) states that during a drilling project with the new imported oilfield drilling rigs, it became apparent that mud technology became the critical limiting factor. In agreement with Heinz (1989:214-215) the following advantages and disadvantages in comparison to a clean water fluid system are:

□ Advantages

- The main benefits from the use of these chemicals are their hole cleaning and lubrication properties.
- Chemical fluid systems can also, reportedly, help in the prevention of caving in certain boreholes.
- Increased bit life and penetration rates can be expected when the correct fluid systems are chosen and used.
- Less wear and tear on the rod string due to the better lubrication.
- Control of water losses.
- To suspend cuttings and weighting material when circulation stops.
- To assist in supporting part of the rod string weight.

- To prevent damage to permeable formations.

□ **Disadvantages**

- Chemicals can be very expensive if the costs are not controlled properly. Costs exceeding R50/metre can easily be incurred (personal experience).
- Chemicals require continuous monitoring to ensure that the correct concentrations of the different constituents are maintained.
- Chemicals require sophisticated testing and analytical apparatus for proper maintenance.
- Needs experienced and qualified people to select and monitor the fluid systems.
- Some muds need specialized mixing equipment.
- Certain chemicals affect the hardening of cement grout and result in the dumping of a complete chemical fluid system (50000 - 80000 litres) at a considerable cost when cement grouting is done.
- It is believed that the biggest disadvantage of a chemical circulation system is the fact that the efficiency and effectiveness of the system cannot be accurately determined as some of the benefits of the systems are impossible to measure in any unit of measurement.

2.2.5 Fishing operations

2.2.5.1 Introduction

Retrieval operations, commonly referred to as fishing operations or fishing, are the actions carried out to retrieve anything that became stuck in the borehole for some or other reason. Fishing jobs can often be avoided by good drilling practices, but the human factor, time of equipment failure and the condition of the hole cannot always be predicted and assessed in time to avoid this costly event.

2.2.5.2 Planning of fishing action

Due to the extremely high cost of fishing, it is essential to plan the fishing job at hand very carefully and comprehensively, before any fishing attempt is conducted. The following suggestions, some viewed by Heinz (1989:247) should be considered in any fishing operation.

- Appoint a fishing committee with each person's responsibility clearly delineated and ensuring that they have the ability to carry out their respective tasks.
- Determine the exact shape, size and attitude of the fish.
- Check all available data and information.
- Consider the various alternatives. A critical path type analysis is suggested.
- Check that all equipment is in good condition.
- Inform the client that a fishing job is to be undertaken and supply him with all the relevant information on what happened, which technique is to be used and why.
- Contact the client as to his requirements with regards to possible wedging or redrilling.
- Select the fishing tool.
- Carry out the fishing operation.
- Carefully inspect all equipment after the fishing operation before drilling is to continue.

2.2.5.3 Economics of fishing

Heinz (1989:255) states that almost any fishing problem can be solved if sufficient time and money is available, but that there is no point in persisting with a fishing job or drilling problem beyond the time or the cost that would be involved in replacing the tools and the hole.

Heinz (1989:255) proposes the following as a guide to the determination of the cost of the fishing operation on a daily basis.

FISHING COST = replacement cost of tools left in hole *plus*

- cost of fishing tools or rental thereof
- cost of fishing tool operators
- daily cost of the rig and personnel

When the total fishing cost is more than 50% of the cost of moving and redrilling or wedging, the fishing operation can be stopped. See also Table 4.7, page 106.

It is suggested that the daily cost of the rig and personnel should include the fixed overhead costs of such. It is also suggested that a statistical success rate of the type

of fishing to be undertaken, be taken into account. This data can only be obtained if comprehensive reporting on fishing operations and all other drilling activities are kept.

A reduction in fishing cost is possible through the use of the “shearashell” reaming shell design that can reportedly save time and possible lost equipment when the diamond bit has burnt in (Edwards, 1988:65).

Fishing operations far exceeding the cost of replacing lost equipment, wedging and redrilling of the appropriate portion of the borehole are known to have occurred in the past (practical experience). This was one of the factors which led to the idea of this study.

2.3 EXTERNAL ENVIRONMENTAL FACTORS AFFECTING THE COST OF DRILLING

2.3.1 Introduction

The external environment consists of those elements outside an organization, relevant to its operations. The external environment has both direct action and indirect action elements. (Stoner, 1982:61).

2.3.2 Direct action elements

Direct action elements are those elements of the total environment that affect and are affected by the organization’s major operations.

2.3.2.1 Geology

Decomposing intrusives, unconsolidated sands, hard conglomerates, cherts and glassy quartzites have a negative influence on drilling. Bit life and penetration rates are usually reduced by a large degree when the above-mentioned conditions are experienced in a borehole. Decomposing intrusives are sometimes impossible to penetrate and can lead to the abandonment of the borehole. Caving in a borehole leads to rods getting stuck in the hole and if attempts to retrieve the rods fail, it often leads to either the redrilling of the hole, or the insertion of a wedge and the redrilling of the section that has caused the problems. The decision to redrill or wedge the hole depends on the depth of the hole, the number of rods in the hole, the nature of the problem, the chances

of succeeding with the new attempt, the time available to the exploration company to complete the borehole and, inevitably, the costs involved. As most shallow orebodies have already been discovered, drilling has to go deeper to find economic deposits of whatever mineral is required and increases the risk involved.

The inability of the client to accurately predict the character of the rock to be drilled, complicates the planning, budgeting and decision making by the contractor.

2.3.2.2 Suppliers

Suppliers of equipment to the drilling industry can play an important role in the cost of drilling. The drilling “boom” period in 1987 resulted in an increase in the demand for equipment which led to an increase in prices. The relatively high inflation rate in South Africa, coupled to the above-mentioned factor, led to further increases in prices.

The reported shortage in the supply of rods, especially in 1987, led to the direct importation of rods by some of the drilling contractors. The effect of this action led to a request to the government by the manufacturers of drilling rods, for import protection because the rods were landed in South Africa cheaper than the locally produced rods (Personal communication). This situation has recently been addressed by a major manufacturer who now has the technology to locally manufacture high quality rods (Bennetts, 1990:9).

2.3.2.3 Labour

The establishment of labour unions and labour legislation in South Africa has put a new dimension to labour costs and labour relations in all industries with special reference to minimum wages and unfair labour practices.

The drilling “boom” has led to an increase in staff turnover with a resulting increase in costs in obtaining and training of new semi-skilled and skilled personnel.

A cutback in exploration by the major exploration companies and mining houses can plunge the undiversified drilling companies without any in-house protection into a depression (De Jager, 1990:93-94). This will also result in a loss of valuable expertise for the drilling industry if employees were to be retrenched.

2.3.2.4 Customers

Customer requirements change continuously due to their own learning curve, advances in technology and demand for different minerals. The most basic drilling need of customers in the exploration market is information in the fastest, surest and most economical way.

2.3.2.5 Competitors

Competitors, competing for market share, are almost always present in any market. To increase market share usually means the provision of superior customer satisfaction. The larger drilling companies all have their own respective “in house” diamond bit suppliers. This practice has some benefits but has disadvantages as well. The main disadvantage is that the total research and development costs in the industry, are much higher than would be the case when all contractors bought their diamond bits from a small number of bit manufacturers. The advantage is that competition is strong and that new products are continually developed in order to satisfy the demands of the customers for better performance at reduced cost.

2.3.2.6 Financial institutions

Banks and insurance companies can through their interest rates have a large impact on the costs, depending on the financing method used by the contractor.

The financing methods used will be governed by the monetary and fiscal policies prevailing at the time when financing is needed. The financial strength and policy of a company can also dictate the financing methods of the company.

2.3.2.7 Government and legislation

Legislation passed on the levies on industrial diesel fuel consumption caused some initial cash flow problems to some of the contractors. Government regulations must not be frowned upon, but seen as the protection of society and environment for the benefit of all.

2.3.3 Indirect action elements

2.3.3.1 Introduction

Stoner (1982:62) states that the organization is affected by the indirect action external environment in two ways.

- "Outside groups may have a direct influence on an organization, or they may influence it directly through one or more elements of its direct action environment.
- Indirect action elements create a climate - high technology, economic growth or decline, changes in attitude toward work - in which the organization exists and to which it ultimately has to respond." The complex interactions will be grouped in broad factors that influence the organization.

2.3.3.2 Technological variables

The recently imported oilfield rig is technologically very advanced in comparison to the most commonly used Sullivan 50 type machines. All the competitors are eagerly awaiting the results on its drilling performance to assess the feasibility of such a machine in the South African market and if they should follow suit. According to Anon. (1990c:15) these rigs are cost effective in a market niche of very deep and very fast drilling and drilling which requires wide separations between reef intersections. Anon. (1990c:13) also foresees that ultimately the costs of these machines will be competitive on a cost per metre basis with the more conventional rigs.

One major diamond drilling company modified and built their own hydrostatically driven drilling machines that reportedly should achieve less breakdowns at increased safety (Vorster, 1987:89).

The also recently developed polycrystalline diamond bits are still under assessment from contractors and have not been fully accepted as a possible replacement for the presently used impregnated and surface set diamond bits. (Telephone discussions with the field managers of the biggest drilling contractors). Tomlinson *et al.* (1990:1) see impact damage to the cutters as a major concern and the manufacture of tougher grades of PCD as a project of high priority to the Diamond Research Laboratory of the De Beers Industrial Diamond Division (Pty) Limited.

2.3.3.3 Economic variables

Rising costs, due to inflation, must never be overlooked in all planning and budgeting exercised by management. Counteracting the effects of inflation led to the inclusion of escalation clauses in the drilling contracts. Some contractors still use a once a year escalation approach to increase their prices. Boart International, a large drilling contractor, escalates their prices during July and December to minimize the effect of inflation (Lombaard, 1987:53).

A change in the Rand/Dollar exchange rate effects the prices of diamond bits directly. The reason being that although the bits are manufactured in South Africa and have a 100% local content, all diamond sales are based on the U S Dollar prices of diamonds on the international market.

2.3.3.4 Socio-cultural variables

The values and customs of a society establish guidelines that determine how most organizations and managers will operate (Stoner, 1982:68).

The work-forces of the drilling companies usually consist of a mixture of the different ethnic groups in South Africa, complicating the management of such. It is therefore necessary to lay down a specific set of guidelines within which management should operate. The guidelines should be flexible enough to accommodate all the different groups.

Company A appointed a woman as a charge-hand with some success. The effects of this on the attitudes of her subordinates should be carefully noted as it could lead to authoritarian problems which could influence production.

Black charge-hands have also been appointed in the drilling industry with a varying degree of success. This has in some cases, led to a change in attitude towards their work by some of the white charge-hands, and also increased the spirit of competition amongst the different drilling crews. This factor can be seen as beneficial to the profits of the drilling company. Acceptance of such blacks in the white drilling social society has unfortunately not yet been achieved by virtue of the political climate prevailing in South Africa.

2.3.3.5 Political legal variables

The fiscal and monetary policies of the Government and Reserve Bank also affect the drilling costs directly and indirectly. Tenders should thus clearly state that the prices tendered will change if changes in fiscal and monetary policies that will affect the drilling costs, occur during the life of the borehole.

Labour unions are going to have quite an impact on the labour costs once they have organized and established themselves in the drilling industry.

2.3.3.6 Climate and topography

Climatic conditions can also have an influence on the costs of drilling. Establishment of a drilling site can be seriously hampered by bad weather conditions. This leads to an increase in the non productive time of the rig and will subsequently increase the costs. When sites are established, enough consideration should be given to the design of the layout to provide for heavy downpours and possible flooding of the site. Prolonged dry weather conditions can lead to a drop in the water supply and can result in very high costs of transporting water to the site.

The topography must be inspected prior to a tender being submitted as drilling in mountainous terrains sometimes require that helicopters must be used for the transport of machines to the sites. Mountainous terrains usually require four wheeled drive vehicles to transport men and material to and from drilling sites. Suitable space for accommodation in the mountains can also be difficult to find, and the costs thereof must be considered before submitting a tender.

2.3.3.7 International dimension

The effects of boycotts on South Africa affected almost everybody, including the drilling industry. Increased fuel prices directly affected the drilling costs.

The lifting of sanctions by the western world should result in the latest technology being developed overseas, to become available here in South Africa.

2.4 INTERNAL ENVIRONMENTAL FACTORS AFFECTING THE COST OF DRILLING

2.4.1 Introduction

The internal environment refers to the aspects within the organization that management can influence. A brief description will follow on what is believed to be the most important internal environmental factors that have an influence on the costs of drilling.

2.4.2 Organization structure

A flat organizational structure combined with a centralized management approach can be cheaper in direct labour costs, but can be expensive in the longer term if the persons in the management and senior supervisory positions are not able to cope with the high work load that is usually part of such a structure. The opposite can be said of a tall organizational structure.

The structure to be used will be a function of the quality of the employers, (this will determine the degree of control and direct supervision required), the geographic distribution, and the amount of drilling machines.

2.4.3 Expertise

The level of expertise is a function of training and relevant experience of the employers, in all the relevant drilling aspects, and the management of such. Experience in fishing operations is very important in solving “down the hole” problems when and if they occur, as wrong decisions in fishing operations due to inexperience, can be very costly.

2.4.4 Communication and reporting

Bad communication between the drilling site and the first level of supervision (foremen) can lead to wrong decisions by the charge-hand which can be very costly to the company. This is especially the case in fishing operations.

Good communication between the drilling contractor and his client can also eliminate costly errors which sometimes occur when wedges are installed in the wrong direction without a written instruction from the client.

Incomplete reporting on activities on the drilling site, lead to the lack of comprehensive and functional data bases that can and should be kept by contractor and client alike.

Comprehensive reporting is of utmost importance in the evaluation of new products that are tested, for example, the efficiencies of chemicals, the penetration rates and lives of different types of bits in different rock types. The efficiencies of the different labour crews on each machine and their performance on the different shifts can only be assessed when complete and accurate reports are available.

Tendering for new work can only be done properly if the tender is based on data obtained from complete and comprehensive performance reporting from previous boreholes in areas regarded as similar to the one being tendered for.

2.4.5 Client requirements

Client requirements should preferably be fully documented in a formal contract stipulating all the technical details and procedures to be followed to avoid possible conflict at later stages. From practical experience this is known to happen quite frequently if the contracts are not too specific. The contractor should liase with the client on all the technical aspects before offering a tender to the latter to minimize the possibilities of misunderstandings that can occur during the course of drilling a borehole.

2.5 SUMMARY

As seen in this chapter the large variety of equipment that can be used in the drilling of a borehole is governed by mainly the client's requirements and the lithology to be drilled. The high costs of diamond drilling, up to an average of R1 400 per metre and a time related cost of between R30 000 to R40 000 per day (Anon., 1990c:3), necessitates that the costing system used within the company must be able to supply the necessary information required for the purpose of decision making, control and future planning and budgeting by the contractor and the client alike.

The effects of the environment should never be excluded in any decision making, planning and tendering activities done by the contractor and client as it plays an important role in the success of the operation.

CHAPTER 3

SOME MANAGEMENT AND COST ACCOUNTING PRINCIPLES CURRENTLY USED BY COMPANY A

3.1 INTRODUCTION

In this chapter the organizational structure of company A will be addressed, followed by some cost and management accounting principles currently employed. Emphasis will be on cost classification, apportionment and allocation, control, planning and budgeting. The above-mentioned is based on information gained during informal consultation with the former and current managing directors and the technical director of company A. (Cassettes recording in possession of author.)

Company A has six diamond drilling machines (rigs) of varying depth capacity and is in the process of converting all rigs to use wireline rods as described in the previous chapter (section 2.2.3.3, page 14).

Sub-contractors are used for any specialized work other than normal diamond core drilling, for example, percussion drilling, heavy transport for moving equipment between consecutive drilling sites, specialized pressure grouting, drilling fluid system maintenance if required by the client and many more tasks.

3.2 LIMITATIONS

Few actual figures were obtained from company A, due to the sensitivity of the information, and some of the figures used will be estimates (section 1.6, page 7). The standards which are used were supplied by Company A as well as some drill performance data. The rest of the data used was either calculated or induced from practical experience.

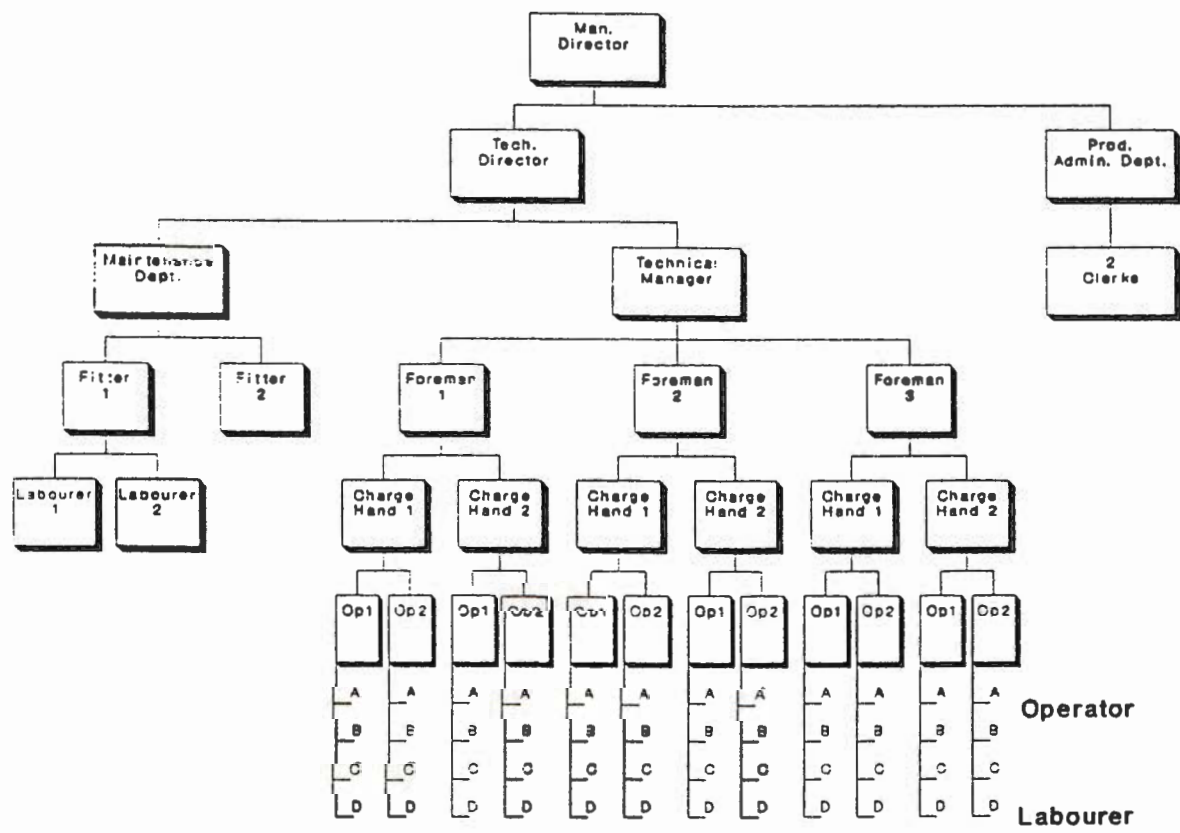
3.3 ORGANIZATIONAL STRUCTURE

3.3.1 General

Company A is a subsidiary of a larger holding company with one of the holding company's directors acting as the managing director. The managing director is supported by an administrative director and a technical director, who are supported by five clerks and a technical manager, respectively. The above-mentioned persons represent the head office staff for company A. The rest of the organizational structure is not fixed due to the variability of the geographical distribution of the rigs.

The structure that will exist in some form or other for most of the time can be seen in figure 3.1.

FIGURE 3.1 COMPANY A: ORGANIZATION CHART



The only exception is that of the post of foreman which sometimes does not exist if a rig is very isolated from the rest of the drilling rigs. When this happens, an experienced chargehand will be appointed to the rig and then occupy a senior chargehand position.

The maintenance department, previously resorting under the foremen, was found to be unsatisfactory because problems arose with authority on certain technical aspects and conflicting interests. The maintenance department presently reports directly to the technical director although they are not stationed at the head office.

3.3.2 Communication

Reporting is very centralized as all foremen and all chargehands report activities every day on three hourly intervals to the technical director. This is done for control purposes and to keep an almost daily pro forma income statement which can assist in decision making with regards to purchasing of materials, fishing action plans, cash flow budgeting and reporting borehole status to the clients on a daily basis.

Radio telephone communications are used in the case of remote and isolated drill rigs.

3.4 COST CLASSIFICATION

Based on the information supplied by Company A it can be seen that all costs are presently divided into three main categories, namely:

- Direct production costs.
- Indirect production costs.
- Administration and management costs.

3.4.1 Direct production cost

The direct production costs are divided into two categories namely:

- Direct labour cost.
- Direct material cost.

3.4.1.1 Direct labour cost

“The cost of labour used to convert raw materials to a finished product is defined as the straight wages paid to those employees who actually work on the product (straight wages exclude overtime). This labour cost, directly traceable to the product, is usually referred to as direct labour.” (Hansen, 1990:32.)

In company A all labour related costs are regarded as direct labour costs with the exception of the remuneration of the managing director and all the labour related costs of the administration department. This is seen as being in conflict with the definition of direct labour cost, “wages earned by production employees for the time they actually spend working on a particular product or process are called direct labour” (Morse & Roth, 1986:29), and will be further discussed in section 4.4.4.1 page 76.

□ Salaries

Salaries are received by all persons from the technical director down to the level of chargehand. This includes the fitters in the maintenance department but not their four labourers. No overtime is rewarded and production bonuses are paid monthly. Field allowances are paid to all employees staying on site in the field. A thirteenth cheque is paid to all personnel as a holiday bonus in the December industrial holiday period.

□ Wages

All employees below the level of the chargehand receive wages based on a standard rate per hour worked. Overtime is compensated for on a standard rate per hour. Field allowances, production bonuses and a thirteenth cheque are also paid to the waged workers. Daily food rations are issued to the waged workers and taxed according to the fringe benefit tax laws.

□ Company contributions

The company contributions towards workmen’s compensation, accident insurance, medical aid and pension funds, are all regarded as direct labour costs. Drury (1988:63) and Horngren & Foster (1991:43) agree with this practice as they see employment costs as a fundamental part of acquiring labour services. This should only be the case for direct labour and not include all labour costs. According to Heitger & Matulich (1986:31) and Hartley (1986:72) employee fringe benefits such as health insurance, vacation pay,

and pension benefits should be treated as production overhead costs. This latter view is shared by Matz & Usry (1984:175) who include the costs in factory overheads due to practical reasons. For practical reasons it was decided that company contributions will be regarded as production overhead costs and not as direct labour costs.

□ Labour reporting

A normal wage sheet of all the hours worked by the workers on site, is completed by the chargehand and controlled by the foreman. The wage sheets are used for the determination of the weekly wages and overtime payments. Appendix 3.1, page 136. Labour efficiencies of the different shifts cannot be determined from this system as no reference is made to what type of job was done because all different jobs are regarded as part of the drilling process.

The daily report that is completed by the chargehand can also be used to determine differences in production performance between the shifts. See appendix 3.2, page 137. Care must however be taken when these reports are analysed as the accuracy to which they are completed is doubtful because the reports are regarded as a 'threat' by the drilling crews. Should these reports be completed comprehensively and accurately for each shift, a very accurate and comprehensive data base could be constructed from it. This data can be very useful in the planning of future holes and tenders. It can also be used for the setting of performance standards to be achieved by the crews which can serve as an additional incentive to increase performance.

3.4.1.2 Direct material cost

Hansen (1990:32) defines raw materials "as those materials that actually become part of the product". Cherrington *et al.* (1985:27) state that direct material "includes the raw material components that can be physically identified with or traced to the finished product. They are distinguished from indirect materials by the ability to identify them economically with a finished product". The product of core, is not the end product of a transformation process of raw materials and therefore no raw material can be physically identified with it. There are some material costs that can however be traced economically to the product. Diesel and diamond costs can be used as an example of economically identifiable direct material costs.

The costs classified as direct material cost by company A are all consumable materials used in the drilling process. The different cost items entered on the income statement are as follows:

- Consumable material.
- Crowns.
- Rods.
- Fuel and lubricants.
- Corebarrels.
- Casing.
- Cables.

The inclusion of casing under direct material costs was identified as causing problems with the present system of expressing all costs as a percentage of turnover in the income statement because it is actually a cost item that is charged directly to the client on a cost plus basis and should therefore not be included under direct material costs. This practice has recently been discontinued and casing is now seen as a separate cost element.

3.4.2 Indirect production costs

Indirect production costs “include all manufacturing costs other than direct labour and direct material costs” (Cherrington *et al.*, 1985:28). The term indirect production costs used for costs such as insurances, fuel levies, rent, depreciation, lease payments and financing charges can be substituted by the term production overheads. The terms production and manufacturing costs are used interchangeably throughout the literature (Drury, 1988:29).

Costs items included under indirect production costs can be seen in appendix 3.3, page 138.

Company A does not differentiate between fixed and variable production overheads. Horngren & Foster (1991:271) distinguish between fixed and variable overhead costs as follows, “variable factory overheads have efficiency variances and no production volume variances. Fixed factory overhead costs have production volume variances but no efficiency variances”.

3.4.3 Administration and management costs

These costs can also be called head office overheads or central overheads and can be seen in appendix 3.3, page 138. The central overheads are classified as all those secondary costs which cannot be directly linked to the production process as such, and

are not part of direct labour, direct material or indirect production costs. It includes the following:

- Director's fees.
- Administration clerks salaries.
- Telephone.
- Water and lights.
- Office rent.
- Bank costs.
- Interest.
- Auditor's fees.
- Legal costs.
- Other.

3.5 COST APPORTIONMENT AND ALLOCATION

No standard form for the allocation or apportionment of costs to the different production centres could be obtained from Company A. The following cost apportionment, cost allocation sheet was drawn up after consultation with the technical director and a former managing director of the company, the latter also being a qualified cost accountant.

The information from Table 3.1, page 34, is then used to determine the cost performance of the different drilling rigs as summarized in the monthly operating results statement, Table 3.2, page 35.

3.6 COST CONTROL

3.6.1 Introduction

Various material cost control systems were introduced in the company to contain costs to the minimum. Direct material costs are regarded as the only variable costs and all other costs are regarded as to some degree be fixed or semi variable.

Because material costs can be regarded as being approximately 35% of the turnover of normal production performance, (verbal statement by the technical director), all the cost control systems concentrate on the direct material costs to try and keep it to a minimum.

TABLE 3.1 OVERHEAD COST APPORTIONMENT

OVERHEAD-COST APPORTIONMENT/-ALLOCATION SHEET

COMPANY A

COST ITEM	APPORTIONMENT BASE	
	DIRECT	n MACHINES
CENTRAL OVERHEADS		
Director's fees		x
Salaries		x
Telephone		x
Water&lights		x
Rent		x
Bank costs		x
Interest		x
Auditor's fees		x
Legal costs		x
Financing costs	x	
Other		x
PRODUCTION OVERHEADS		
Machines		x
-Depreciation	x	
-Maintenance	x	
-Lease payments	x	
Hire - equipment	x	
Stand - rent		x
- water & lights		x
- maintenance	x	
Loose tools		x
Diesel - levy	x	
Insurance - machines	x	
- accident		x
Admin costs	x	
-Copies, printing		
Field-allowances(occasional)	x	
Vehicle Costs		
-Hiring	x	
-Maintenance	x	
-Fuel	x	
-Licence		x
-Insurance		x
-Km costs	x	
-Depreciation		x
Accommodation	x	
Communication	x	
Sub contract costs	x	
Labour levies	x	

(Source: personal research)

TABLE 3.2 MONTHLY OPERATING RESULTS STATEMENT

MONTHLY OPERATING RESULTS STATEMENT

Week no. 4 XX/XX/19XX

	TOTAL	SUL 50 1	SUL 50 2	SUL 50 3	SUL 45	TONE
INCOME						
EXPENDITURE						
VARIABLE COSTS						
Consumable material						
Crowns						
Cables						
Fuel/lubricants						
Rods						
Loose tools						
Machine maintenance						
Workshop						
Vehicles						
WAGES & PROD. SALARIES						
CONTRIBUTION TO O/HEADS						
PRODUCTION OVERHEADS						
CONTR. TO ADMIN & MAN.						
ADMIN & MANAGEMENT						
OPERATING PROFIT						
PROFIT ON SUB-CONTRACT						
NETT OPERATING PROFIT						
NETT PROFIT (YTD)						

OPERATING STATISTICS

Month begin						
Month end						
Metres drilled						

(Source: Company A)

3.6.2 Inventory control

All intended purchases of material are discussed with the technical director who has to approve the purchases. Once approved, a comprehensive order is sent to the relevant supplier by means of a telefax machine. This procedure is followed to limit the purchasing of unnecessary material that sometimes occur if only an order number is supplied.

The information on the order is entered on a daily purchase statement and at the end of the day the relevant costs are posted to the different inventory accounts for the different contracts. The term contracts refer to the different rigs. The cost data are also entered on different cost statements for the different contracts which are communicated to the chargehands and foremen for their own cost control efforts. This cost performance is given to the crews to serve as an additional incentive to try and minimize costs and is also used in the determination of the production bonuses.

A requisition system from a store is used in the cases where the establishment of such stores are economically viable when enough machines are situated close to each other. The requisitions issued are submitted to the head office on a weekly basis for input on the computer for analysis and posting to the different accounts.

The daily reporting of activities and performance by the chargehands and foremen includes information on material used on site. A more comprehensive weekly report of consumed materials is given at the end of the week. Stock is taken at all the rigs on a monthly basis. This monthly stock report is controlled on site by the technical director or technical manager on a monthly basis.

When specialized equipment, for example, fishing tools, are drawn from the stores, the relevant contract is charged at a given daily rate for that piece of equipment. This practice is used to keep the drilling crews from neglecting equipment not in use and to prevent the purchasing of unnecessary duplicate sets of equipment.

3.6.3 Maintenance cost control

The different types of services required by the machines are categorized into separate classes depending on the complexity and the amount of expertise needed. The basic routine services and minor repairs are carried out by the chargehands and drilling crews themselves. To limit the unnecessary use of the maintenance department for minor repairs and servicing, a system is used where the contract is charged a certain

hourly rate for the use of the maintenance department. This helps to limit the transport costs of the maintenance department. This charge is only a book entry and not entered in any other account or statement.

The maintenance crew completes a plant report, table 3.3, page 38, on the general condition of the most important components and also checks on the servicing of the machines, whenever they visit a rig. This plant report serves as a control instrument for servicing done by the crew and can assist in preventative maintenance to be carried out before any major breakdowns do occur.

3.6.4 Diamond cost control

A monthly crown report, table 3.4, page 39, is completed by the chargehand with regard to bit type and number, reamer type and number and the metres drilled respectively. This report is reconciled with the inventory accounts and also used in the determination of the bit bonuses that are paid to the operators. It is also used in the planning and budgeting of future costs and to determine the performances of the different types of bits and reaming shells.

3.6.5 Cost summary

A monthly cost statement, summarizing the total costs incurred for the month, is prepared for each contract. This statement, in conjunction with a summary of the production performance data for the month, is used for a management report to the board of directors by the managing director.

3.7 PLANNING AND BUDGETING

3.7.1 Introduction

The only formal documents regarding any form of planning and/or budgeting that could be obtained from Company A was a yearly budget for expected metres to be drilled by each rig, Table 3.5, page 40, and an example of a budgeted income statement for the same year, Table 3.6, page 41. Unfortunately no actual figures were supplied with these budgets due to the sensitive nature previously mentioned.

TABLE 3.3 DRILL PLANT REPORT

DRILL PLANT REPORT

Company A

SITE: _____

DRILL RIG: _____

1. **OILS**

Remarks

Engine
Gearbox
Transmission
Hydraulic
Pump engine
T 98 gearbox
Pump crankcase

2. **FILTERS**

Remarks

Oil: engine
Air: engine
Oil: pump
Air: pump
Diesel: engine
Diesel: pump
Hydraulic

REMARKS3. **GENERAL**

Remarks

Engine clutch
Pump clutch
Engine gearbox
T 98 gearbox
Transmission
Hoist clutch
Drive sprocket
Main sprocket
Drive chain
Jockey sprocket
Drive shaft
Pump seals
Pump sleeves
Pump cups
Hoist brake
Hoist spacers
Quill shaft
" " seals
Crosshead bearing
Quillhead bearing
Hoffberg alternator
Alternator 24V
Alternator 12V

Remarks

Hydraulic pump
" " seals
Winch chain
Winch brakes
Winch P. blocks
Running sheave
Sheave wheels
Derrick
Elevator body
Elevator links
Elevator latch
Elevator spring
Elevator pin
D shackles
Water gauge
Hydraulic gauge
Radiator
Radiator cap
Radiator hoses
V-belts: fan
V-belts: hydraulic
V-belts: alternator

REMARKS

TABLE 3.4 MONTHLY CROWN REPORT

MONTHLY CROWN REPORT

Company A

SITE: _____

MONTH: _____

CROWNS

Date	Begin Depth	End Depth	Metres Drilled	Crown Type	Crown Number

REAMERS

Date	Begin Depth	End Depth	Metres Drilled	Reamer Type	Reamer Number

Signed: _____

(Source: Company A)

TABLE 3.5 BUDGETED METRES

BUDGETED METRES													
19xx-19xx													
PROD.DAY	21	18	19	22	18	21	21	18	22	8	20	18	
RIG	No	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB
SULL 50	1												
Start m		3280	2675	2775	2865	2985	3085	Est	170	494	890	1034	1394
Month m		25	w4 30	w8 30	120	100	100	20	324	396	144	360	324
End m		3305	2705	2805	2985	3085	3185	170	494	890	1034	1394	1718
Start m		2600	2700	2800									
Month m	w1	30	w5 30	w9 30									
Start m		2625	2725	2825									
Month m	w2	30	w6 30	w10 40									
Start m		2650	2750										
Month m	w3	30	w7 30										
SULL 50	2												
Start m		3356	3500	w1 120	w3 120	Est	Case	450	990	1422	1818	1962	2262
Month m		144	180	w2 120	w4 120	50	300	540	432	396	144	300	270
End m		3500	3680	3200	3680	150	450	990	422	1818	1962	2262	2532
SULL 50	3												
Start m		2205	2583	2853	3081	w2 50	Est	Case	510	1050	1512	1704	2124
Month m		378	270	228	120	w3 50	50	360	540	462	192	420	324
End m		2583	2853	3081	3201	3000	150	510	1050	1512	1704	2124	2448
Month m					w1 120								
End m					3000								
SULL 45	4												
Start m		265	Case	900	1242	1572	1842	2112	2364	2300	2290	Est	Case
Month m		235	400	342	330	270	270	252	245	w1 100	w3 110	50	324
End m		500	900	1242	1572	1842	2112	2364	2609	2400	2400	150	474
Month m										w2 105	w4 115		
End m										2400	2400		
SULL 45	5												
Start m		331	691	1123	1579	Est	350	728	1160	1592	Est	Case	500
Month m		360	432	456	80	50	378	432	432	150	100	100	432
End m		691	1123	1579	1659	350	728	1160	1592	1742	400	500	932
Start m					1400					1200			
Month m					w1 50					w1 50			
Start m					1395					1195			
Month m					w2 55					w2 55			
Start m					1390					1190			
Month m					w3 60					w3 60			
Start m					1385								
Month m					w4 65								
STONE	6												
Start m		1759	895	Est	350	748	1070	1385	1300	Est	400	544	844
Month m		50	w5 35	50	396	324	315	252	w1 50	100	144	300	324
End m		1809	930	350	746	1070	1385	1637	1350	400	544	844	1168
Start m		1650	890						1295				
Month m	w1	30	w6 40						w2 55				
Start m		1645							1290				
Month m	w2	35							w3 60				
Start m		1640							1285				
Month m	w3	40							w4 65				
Start m		900											
Month m	w4	30											

Est. = Establishment

Case = Drill casing and insert

w(x) = Wedge installation & drilling

Source: Presumed values based on personal experience.

: Altered information from Company A

TABLE 3.6 BUDGETED INCOME STATEMENT FOR 1991/92

BUDGETED INCOME STATEMENT FOR 1991/92

Company A

	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Febr.
TURNOVER												
DIRECT PRODUCTION COSTS												
Salaries												
Wages												
Co. contribution												
Leave & bonusses												
Field allowances												
Production bonusses												
Subcontract costs												
INDIRECT PRODUCTION COSTS												
Accident insurance												
Rations												
Consumable material												
Protective clothing												
Loose tools												
Fuel & lubricants												
Crowns												
Rods												
Cables												
Machine maintenance												
Rent – stand												
– equipment												
– cars												
Fuel – cars												
Water & lights												
Insurance machines												
Printing												
Travel & accommodation												
Depreciation machines												
Regional levy												
Hire purchase												
GROSS PROFIT												
ADMIN & MANAGEMENT COSTS												
NETT PROFIT/LOSS												
CUMULATIVE PROFIT/LOSS												

(Source: Company A)

3.7.2 Production planning and budgeting

3.7.2.1 General

The technical director is responsible for all yearly planning and budgeting of costs and income. He prepares a yearly production budget based on the expected metres drilled by each machine for each month from table 3.5, page 40. This planning is based on historical production information. A practical capacity of 75% of the designed capacity is used for the planning of future production rates in areas where no historical information is available.

The effect of the short production months, December and January, and the payment of the holiday bonuses result in a large drop in income and this effect is fully taken into account as these factors usually have a marked effect on the cash flow position.

The expected machine moves and casing costs are also planned in advance and entered on this production budget.

A major problem encountered with the production planning is the fact that definite completion dates of boreholes cannot be accurately determined due to the variable character of the geology that is drilled and unknown depths of the different target horizons. A hole to be drilled for another three weeks, according to the client, was known to continue for an additional five months before it was finally stopped. This is frequently the case when holes are drilled in an area where the geology is not well known to the client. The timing and magnitude of deflections are also very difficult to plan. This can have a great effect on achieving the production plan and budget, put possible strain on the cash flow situation and disrupt the scheduling of operations by the drilling contractor.

3.7.2.2 Monthly planning

A monthly inventory and production planning is done by the chargehands and checked by the supervising foreman. This planning is submitted to head office to be used in the monthly cash flow budgeting. Appendix 3.4, page 140.

3.7.2.3 Labour planning

All labour costs are regarded as fixed costs and are planned as period costs. A practice that is agreed to as the labour costs react like fixed costs, that is, they are fixed for

a given range and not variable per unit. Increases in salaries and wages are planned for and included in the budgeted income statement. The use of standard labour rates versus production rates are not used in the planning and budgeting processes.

3.7.3 Budgeted income statement

The technical director prepares the budgeted income statement after the completion of the production budget, Table 3.6, page 41. All costs budgeted for are based on historical information. The direct and indirect production costs are assumed to be in the same proportion to turnover as historical cost data indicated. Future price increases are taken into account when this budget is formulated.

The administration and management costs are planned and budgeted for by the administration director.

On the formal budgeted income statement supplied by Company A, (Table 3.6, page 41) the direct material costs are included under the indirect production costs. This will lead to incorrect comparisons when the actual figures are compared to the budgeted figures.

3.7.4 Budget control

The only budget control is where the actual costs incurred are compared to the master budgeted costs on a monthly and a year to date basis. Variances that exist have to be explained by the technical director. (Appendix 3.3, page 138.)

The budget is reviewed by the technical director on a monthly basis and adjustments are made if and when necessary.

Variable or flexible budgeting is not used in the control or budgeting process.

3.8 SUMMARY

The investigation into the costing system of company A, was very difficult because of the sensitivity of the information. A number of direct costs are reported on. It can be said that the information is however entered on a number of different documents and that there are discrepancies between some of the documents. If the data could be

captured into a single integrated costing system, an efficient and invaluable management accounting system could be designed to assist management in their decision making, control, planning and budgeting functions.

The production data that can be accumulated with the proper completion of the daily drilling reports, could be invaluable to management in their functions, for example, the determination of the efficiencies of the different crews.

In conclusion it can be stated that company A combines job-order and process costing into a hybrid costing system. The company uses different prices for different depth categories and combines it into period costs for the operating statement for each drill rig separately. This information can be misleading if cost performances of the different drilling rigs are compared based on their production performances.

CHAPTER 4

SOME COST AND MANAGEMENT ACCOUNTING PRINCIPLES

4.1 INTRODUCTION

This chapter will be devoted to the description of some cost and management accounting principles that could be applied to diamond drilling and the management thereof. The different costing approaches, cost accumulation procedures and cost classifications which are believed to be instrumental in achieving the objectives of this study, will be discussed. Some emphasis will also be put on the determination and allocation of overhead costs as well as material and labour costs. Budgets and variance analysis will also be discussed in less detail.

“Financial accounting focusses on how accounting can serve external decision makers. In contrast, management accounting is concerned mainly with its internal customers for accounting information.” (Horngren & Foster, 1991:4.)

Drury (1988:20) distinguishes between the two principles as follows, “cost accounting is concerned with cost accumulation for stock valuation to meet the requirements of external reporting, whereas management accounting relates to the provision of appropriate information for people within the organization to help them make better decisions”.

Considering the objectives of the study it is clear that the above-mentioned principles are necessary to meet these objectives.

I agree with Horngren & Foster (1991:4) that it is sufficient to say that cost accounting is a part of management accounting and a part of financial accounting.

Cost accounting systems vary in complexity and depend largely on the detail of information required by management. Cost and management accounting generally serves the following functions:

- external reporting
- planning and control
- special decisions (Morse & Roth, 1986:5).

Matz & Usry (1985:8-10) see the role of cost accounting important for:

- budgeting
- controlling cost
- pricing
- determining profits
- choosing between alternatives.

Horngren & Foster (1991:3) view the importance of cost accounting as:

- internal routine reporting to managers
- internal non-routine reporting to managers
- external reporting.

From the above-mentioned the importance of cost accounting is viewed as the internal and external reporting of cost information to assist management in their management functions of planning, budgeting, control, decision making and product pricing.

4.2 COSTING APPROACHES

The two main costing approaches, together with the concept of cost objectives, will be discussed in this section. The aim is to illustrate that there is no real difference in the costing approach that is used when income is determined. This is because diamond drilling can be regarded as a production environment where no raw material transformation takes place to produce the end product or core.

All core produced, considered to be sold when it is brought to the surface, does not result in complications as far as income statements are concerned, because beginning inventories, ending inventories and work in process are not present.

Some special cases do exist where the drilling contractor has to redrill some core at his own expense. This redrilling, which very seldomly occurs, will not be addressed in detail as it is not considered to be of great importance for the purpose of this study.

4.2.1 Cost objectives

A cost objective can be defined as “any activity or item for which a separate measurement of cost is desired” (Horngren & Foster, 1991:25).

Drury (1988:25) also defines a cost objective as “any activity for which a separate measurement of cost is desired”. Horngren & Foster (1991:26) subdivide the cost object into five as, activities or operations, products or services, projects, departments and programs. Drury (1988:25) supports this and also adds that a cost object includes anything for which one wants to measure the cost of resources used. The definition is accepted as adequate for the purpose of this study bearing in mind that “cost objectives are chosen not for their own sake but to help decision making” (Horngren & Foster, 1991:26).

Many cost objectives could be identified in diamond drilling but for the purpose of decision making, planning, budgeting and control, the following main cost objectives were singled out as the most important:

- The cost of the core produced in the different depth categories and rock types.
- The cost of operational and non-operational standing times for the different depth categories and different types of drilling techniques.
- The cost of the above-mentioned objectives for the different drilling techniques.
- The cost of establishment and de-establishment.
- The cost of site moves.
- The cost of overheads.

These cost objectives compare well with most of the costs asked for in tenders:

- Price per metre for different depth and rock type categories
- Establishment and de-establishment charges
- Site move charges
- Operational and non-operational standing time charges
- Historical production performance data is also required by the clients for their own planning and budgeting needs.

Many other rates are needed in the tender document, but as they are all functions of the rates already mentioned, it will not be discussed in any more detail.

Because all production and non-production activities are functions of time, it is therefore suggested that all costs be expressed as costs per time unit (hours), which can be converted into rates per metre where applicable or deemed necessary for tendering, planning or control purposes.

The consequences of an incorrectly determined (too low) tender price are well known and to be almost invariably “fatal” to any organization. This fact makes the determination of the correct costs of production one of prime importance to the organization.

4.2.2 Contribution approach

This approach is also referred to as variable costing, direct costing or marginal costing.

The contribution approach “allocates only variable manufacturing costs to products” (Drury, 1988:194). “Only prime costs (direct materials and direct labour) plus variable factory overhead expenses are assigned to inventories, both work in process and finished goods, and to the costs of goods sold.” (Matz & Usry, 1984:550-551.)

Costs such as depreciation, insurance, factory and property taxes that are a function of time rather than of production, are excluded from the cost of the product. No inventories and work in process are used and therefore the choice between the two approaches will depend on the objectives of management. This approach is not accepted because only direct material will barely qualify as a variable manufacturing cost, see section 3.4.1.2, page 31. Labour costs are treated as production overheads due to their fixed behaviour, see section 4.4.4.7, page 78.

4.2.3 Conventional approach

This approach is also called, absorption costing, traditional costing or full costing. “This type of costing assigns direct materials and direct labour costs and a share of both fixed and variable factory overhead costs to units of production.” (Matz & Usry, 1984:549.)

Conventional costing is a “method of inventory costing that includes all direct and indirect manufacturing costs (both variable and fixed) as inventoriable costs” (Horngren & Foster, 1991:289).

Drury (1988:194) refers to a conventional or absorption costing system as an approach that is adopted to allocate all manufacturing costs to products and to value unsold stock

at their total cost of manufacture. Non-manufacturing costs are charged direct to the profit statement and excluded from stock valuation.

This approach also revolves around the problem of stock valuation and is discussed in the next section.

4.2.4 Conclusion

One of the main points of difference in the debate between absorption versus variable costing revolves around the question of external reporting of the valuation of the stock. Because no beginning and ending inventories and work in process exist, one of the main points of criticism between the two methods is eliminated as there should not be any differences between the operating incomes determined by the two methods respectively for consecutive periods.

Horngren & Foster (1991:297) agree with Drury (1988:199) that as a general rule “whenever sales are equal to production, the profits will be the same for both the absorption costing and the variable costing systems”. This general rule can therefore be applied to diamond drilling as well because the core produced can be regarded as sold when it reaches the surface.

The general rule when “... production is in excess of sales, the absorption costing system will show a higher profit than the variable costing system” (Drury, 1988:199), would be applicable if inventory and work in process accounts were used and redrilling was done for the contractor’s own account.

This study is aimed at internal reporting to aid management in their decisions, and not to establish a financial accounting system. The differences in the two approaches is well illustrated in table 4.1, page 50 by (Horngren & Foster, 1991:297) and will therefore not be discussed in any more detail.

4.3 COST ACCUMULATION PROCEDURES

4.3.1 Introduction

In fulfilling the functions of a costing system as listed in section 4.1, page 45, the determination of the cost of an activity for reporting is one of the most important

TABLE 4.1 COMPARATIVE INCOME EFFECTS

COMPARATIVE INCOME EFFECTS			
	VARIABLE COSTING	ABSORPTION COSTING	COMMENTS
1 Fixed factory overhead inventoried ?	No	Yes	Basic theoretical question of when this cost should become an expense.
2 Production volume variance?	No	Yes	Choice of denominator volume affects measurement of operating income under absorption costing.
3 Treatment of other variances?	Same	Same	Underscores the fact that the basic difference is the accounting for fixed factory overhead, not the accounting for any variable manufacturing costs.
4 Classifications between variable and fixed costs are routinely made?	Yes	No	However, absorption cost can be modified to obtain subclassifications of variable and fixed costs, if desired.
5 Usual effects of changes in inventory levels on operating income: Production = sales Production > sales Production < sales	Equal Lower* Higher	Equal Higher~ Lower	Differences are attributable to timing of the transformation of fixed factory overhead into expense.
6 Cost-volume-profit relationships	Tied to sales	Tied to production and sales	Management control benefit: Effects of changes in volume on operating income are easier to understand under variable costing.
* That is, lower operating income than under absorption costing. ~ That is, higher operating income than under variable costing.			

(Horngren and Foster, 1991:297)

objectives of cost accounting (Horngren & Foster, 1991:3). The costs can be accumulated and allocated by one of three different methods:

□ **Actual costing**

A costing method that allocates actual direct costs to products and uses actual rates to apply indirect costs based on the actual inputs of the indirect cost application base.

□ **Normal costing**

A costing method that allocates actual direct costs to products and uses budgeted rates to apply indirect costs based on the actual inputs of the indirect cost application base.

□ **Standard costing**

A costing method that allocates standard direct costs to products and uses budgeted rates to apply indirect costs based on the standard inputs allowed for actual output. (Horngren & Foster, 1991:261.)

Matz & Usry (1984:38) state that an actual or normal historical cost system collects the costs as they occur but delays the presentation of results until manufacturing operations have been performed. The factory overhead is in most cases allocated to a job or process, and the actual costs and quantities are used for materials and labour.

In a standard cost system, all costs are predetermined in advance of production. Products, operations and processes are costed using standards for both quantities and monetary amounts (Horngren & Foster, 1991:261). Accounts are designed to collect the actual costs and the differences between the actual costs and the standard costs, called variances, are collected into separate accounts. These variances are analysed and management should react on the variances which exceed the accepted limits, favourable or unfavourable. Variance analysis will be discussed in more detail in section 4.5.3.2 on page 88.

“The actual cost system and the standard cost system may be used with either job order or process cost accumulation procedures.” (Matz & Usry, 1984:38.)

“Although standard cost systems are most often encountered in conjunction with process costing, they can be used in job order systems whenever it is possible to develop

standard costs for job components. Developing standard costs for job components also assists in bidding or pricing, planning, and control.” (Morse & Roth, 1986:612-613.)

It can thus be accepted that actual and standard costing can be used with either job order or process cost accumulation procedures. This is applicable in the case of diamond drilling as a hybrid between job order and process costing is needed to satisfy the specific needs of this industry. See section 4.3.1.2, page 52. It is important to note that when using standards it is imperative that those standards are based on comprehensive, accurate and relevant information using some form of statistical analysis as discussed in section 4.4.1.3, page 55. In general it can be said that a standard is as good as the information it is based on and the method employed.

4.3.1.1 The job order cost procedure

Job order costing “is used in those manufacturing situations where many different products, jobs or batches of products are being produced each period” (Garrison, 1991:66). Horngren & Foster (1991:93) state that in a job order costing system “product costs are obtained by allocating costs to a specific unit or a small batch of products or services that proceeds through the production steps as a distinct, identifiable job lot”.

Thus this procedure keeps the costs of various jobs or contracts separate during their manufacture or construction, that is, the firm produces products in readily identifiable batches that can serve as cost objectives for the job order system. (Hartley, 1986:70)

The variation by costing in lots can be used in the case of diamond drilling where different prices for different depth categories are tendered. The performances and costs for each depth category should then be accumulated to assist in the determination of actual and standard costs for each category.

4.3.1.2 The process cost procedure

“A process cost system accumulates production costs according to responsibility centers rather than batches and then assigns the cost of each center to the products processed by that center.” (Hartley, 1986:115.) Drury (1988:30) remarks that “process costing can be applied to an organization which produces many units of the same product during a period as an alternative cost accumulation system to job order costing.” Matz & Usry (1984:65), state that the cost of a single unit can be obtained by merely

dividing the total cost charged to a department by the total production of the department for a specific period.

The process cost accumulation procedure can be used in diamond drilling as the product core is manufactured under conditions of continuous processing as suggested by Matz & Usry (1984:65). Garrison (1991:129) summarizes the differences between job order and process costing as follows:

□ **Job order costing**

- Many different jobs are worked on during each period, with each job having different production requirements.
- Costs are accumulated by individual jobs.
- The job cost sheet is the key document controlling the accumulation of costs by a job.
- Unit costs are computed per job on the job cost sheet.

□ **Process costing**

- A single product is produced either on a continuous basis or for long periods of time. All units of product are identical.
- Costs are accumulated by department.
- The department production report is the key document showing the accumulation and disposition of costs by a department.
- Unit costs are computed by department on the department production report.

Hartley (1986:115) notes however that the main thrust of the process costing system is cost determination and not as a system that is intended to provide data for all possible uses.

To satisfy the needs of management with regards to cost control, decision making, planning and budgeting, it is suggested that the two above-mentioned procedures can be combined in a hybrid form, if the production of core is seen as a continuous process with the different depth categories as separate cost objectives within this process.

4.3.2 Cost units

Harper (1987:8) defines a cost unit as “ a unit of quantity of produce, service or time in relation to which activities may be ascertained or expressed”. In the drilling industry,

drill metres and hours are the most commonly used cost units for pricing and production performance measurements. Matz & Usry (1984:39) suggest that when either the job order or the process cost methods are used, costs must be accumulated for control purposes according to the unit in which the product cost is to be stated. The current use of metres and hours as cost units are therefore regarded as correct but with the possible differentiation in the metre rate to distinguish between the most basic rock types for which differences in production rates do exist.

4.3.3 Conclusion

When seen from a company accounting viewpoint, a diamond drilling unit can be seen as a contract with a contract number allocated to it. This is to facilitate the correct allocation and apportionment of costs to the different drilling units (rigs) in the company. The different depth categories and rock types reached as drilling progresses, can be seen as different processes within the production process. We can therefore assume that a combination of job order and process cost accumulation procedures can be used in the design of a cost system for a diamond drilling unit.

4.4 COST ELEMENTS

4.4.1 Cost classification

As previously mentioned, it is very important to determine the costs of drilling as accurately as possible to be able to use this cost data in a meaningful way in tendering, decision making, planning and control. All costs can be classified as either direct or indirect costs to the cost objective or activity, which in this case will be the determination of the cost of the product (core) produced at the different depth and rock type categories.

4.4.1.1 Direct costs

Harper (1987:13) defines a direct cost as “a cost that arises solely from the existence of whatever is being costed”. Horngren & Foster (1991:27) refer to direct costs “as those costs that can be identified specifically with or traced to a given cost object in an economically feasible (cost effective) way”. Gray & Ricketts (1982:525) refer to the physical relationship that has to exist between the cost and the unit of the product to classify a cost as a direct cost.

Direct costs are, for the purpose of this study, regarded as the costs directly related to the product that is to be costed. In this case the core drilled by each drilling unit is the product to be costed.

4.4.1.2 Indirect costs

Harper (1987:13) states that indirect costs do not depend solely on what is being costed. It implies some element of sharing a cost that is commonly incurred by two or more things to be costed. Indirect manufacturing costs are referred to as factory overheads. Indirect costs are “those costs that cannot be identified specifically with or traced to a given cost object in a economically feasible way”. Horngren & Foster (1991:27.) Indirect costs for the purpose of this study are regarded as the costs that cannot be related directly to the product in question. The classification of direct and indirect costs must be done with great care to not confuse indirect costs applicable to the product, with indirect costs applicable to the company. An example is the salary of the foreman. His time is usually divided between the rigs under his supervision and spent on:

PRODUCT	COMPANY
Transport of material and food	Administration
Fishing operations	
Routine supervision	Research and development

4.4.1.3 Fixed and variable costs

The cost behaviour patterns of all relevant expenditures in relation to the volume of manufacturing output should be carefully determined before they are classified as either fixed or variable costs (Cherrington *et al.*, 1985:421.)

It is agreed with Dominiak & Louderback (1988:18) that the classification should be reviewed regularly and costs reclassified should it become necessary due to changes in their behaviour.

☐ **Variable costs**

Variable costs are “those costs that vary directly with output” (Fischer & Frank, 1985:27). That is, “costs that change in direct proportion to changes in volume” (Dominiak &

Louderback, 1988:20). This means the amount per unit stays constant but total cost changes (Hartley, 1986:24).

Diamond costs, diesel costs and production bonuses should, within a relevant range for rock type and depth category, remain fairly constant if expressed as a cost per metre drilled.

☐ Fixed costs

Fischer & Frank (1985:27) state that fixed costs are those costs which are not responsive to changes in output in a relevant range of volume. It means that the cost stays constant in total but changes on a per unit basis with changes in production volumes. Dominiak & Louderback (1988:21) see that those costs that will remain the same in total over a wide range of volume can be called fixed costs.

Production bonuses are not regarded as a fixed overhead cost but as a direct cost. Examples of the fixed costs are depreciation and management's salaries.

☐ Semivariable costs

Semivariable or mixed costs are partly fixed and partly variable. This means that they "include both a fixed and a variable component" (Drury, 1988:33; Dominiak & Louderback (1988:57). Garrison (1991:174) states that semivariable costs can behave differently at certain levels of activity. Horngren & Foster (1991:335) generalize that a cost whether it is variable or fixed is affected by the time span considered in the decision situation.

In order to simplify the costing system it is suggested that all costs should be classified as either fixed or variable costs. The fixed portion of any semivariable cost and the degree of change in the variable part must be determined when comprehensive and detailed planning and sensitivity analysis are undertaken (Matz & Usry, 1984:152).

A number of, well documented, different methods can be used for the analysis of mixed costs, for example (Garrison, 1991:175-184; Horngren & Foster, 1991:337-348; Arnold & Hope, 1990:127-143):

- high - low method
- scattergraph method
- least squares method

- multiple regression analysis
- engineering approach
- learning curve

In the event of muds being used to condition a borehole some contracts do allow a minimum fixed amount plus a rate per metre drilled being charged. It can therefore be stated that depending on the type of contract agreed upon, mud costs could be seen as an example of a semivariable cost on a basis of cost per metre drilled. Electricity, telephone, renting of the radio telephones and transport can all be regarded as semivariable costs.

4.4.2 Factory overhead

4.4.2.1 Introduction

The planning and control of costs is one of the main objectives of this study and further aspects surrounding this should be discussed in slightly more detail. Of the three most basic cost elements, the allocation of factory or manufacturing overhead costs to products are always more difficult than direct material or direct labour. More detail on overhead costs will be given because of its importance in determining profits and break even points. The importance of the overhead costs must always be kept in mind when anything other than drilling is undertaken on the drill site, especially when determining the cost of a fishing operation or the determination of the cost of idle or non- operational time.

4.4.2.2 Definition

The term factory overhead is regarded as interchangeable with the term manufacturing overhead, which is also used by some authors.

Factory overhead costs are all costs other than direct material or direct labour that are associated with the manufacturing process as defined in section 3.4.2, page 32 (Drury, 1988:29; Harper, 1987:67).

The activity to be costed becomes important in this instance, for example, viewing the different drill rigs as cost objectives and using the product as cost objectives or activities. Some overhead costs behave as fixed costs and some behave as variable costs. The activity will depend on the needs of management of what is to be costed.

The behaviour of factory overhead and its relationship to the product itself and the volume of production, must be carefully considered before the products are charged with a fair share of the costs as a knowledge of the costs are fundamental to the planning and analytical processes for decision making purposes as well as for cost control (Matz & Usry, 1984:143 & 152).

4.4.2.3 Factory overhead application rates

Because of the difficulties associated with the tracing of all items of factory overhead to specific jobs or products, an arbitrary overhead allocation must be made. A pre-determined factory overhead rate permits an equitable and logical allocation of the overheads to the products or jobs. This predetermined rate is “calculated in advance” (Dominiak & Louderback, 1988:522) because the actual figures on the overhead costs are only available at the end of the applicable period. This provides a feasible method of computing product overhead costs promptly enough to serve management’s needs for both the job order and process cost accumulation procedures discussed earlier in sections 4.3.1.1, page 52 and 4.3.1.2, page 52 (Matz & Usry, 1984:144)

□ Overheads applied to job order costing

In job order costing, actual direct material and direct labour costs can be determined from material requisitions and time cards and entered on the job order cost sheets. See paragraph 4.3.1.1 page 52. “Overhead costs are predetermined from cost data to arrive at the total amount of overhead estimated for the activity level to be used in computing the overhead rate.” (Matz & Usry, 1984:144.)

“The allocation of overhead costs to products is accomplished by having the manager select an activity base that is common to all products that the company uses. Historically the most widely used activity bases have been direct labour hours and direct labour cost, with machine hours and even units of product also used.” (Garrison, 1991:71.)

The daily report of activities at the drilling rig can be used to determine the time spent on each of the activities, should it be required by management for planning and control purposes. The overhead costs are then applied to the different activities or products by means of a selected base at a selected activity level, for example, overhead costs can be allocated on a basis of direct labour hours incurred on producing the product or core, within the different depth categories. This can however lead to problems

when long periods of fishing are encountered because no core is produced when fishing is done.

□ Overheads applied to process costing

With a process cost system or unit cost system, unit costs are computed by dividing total weekly or monthly costs of each process by the output of that process. See paragraph 4.3.1.2 page 52 . The exact cost of each unit that is produced is not calculated by this method because process costing techniques charge materials, direct labour, and overhead to identifiable processes (production steps) through which units pass (Matz & Usry, 1984:144).

Fischer & Frank (1985:39) see that only the average cost per unit, and never a specific cost per unit, for the process is determined by dividing the cost of the process by the number of units produced. In this case it would be the total metres core drilled during the period under consideration.

4.4.2.4 Selection of overhead rate base

The primary objective in the selection of a base is to ensure a reasonable accurate application of overhead costs to the work performed by the different drilling units, in the different depth categories for the purpose of planning, budgeting and control, with specific attention to profits, costs, decision making and price determination.

The secondary objective being to minimize clerical costs and effort and provide timely product cost information (Matz & Usry, 1984:145; Heitger & Matulich, 1986:125).

The following bases can be used for the application of factory overhead.

□ A units of production basis

This is the simplest and most direct method of applying factory overhead, and is computed as follows according to Matz & Usry, (1984:146):

$$\frac{\text{Estimated factory Overhead}}{\text{Estimated Units of Production}} = \text{Factory overhead per unit}$$

Heitger & Matulich (1986:124) formulate it as follows:

$$\frac{\text{Estimated manufacturing Overhead}}{\text{Estimated volume of activity}} = \text{Manufacturing overhead rate}$$

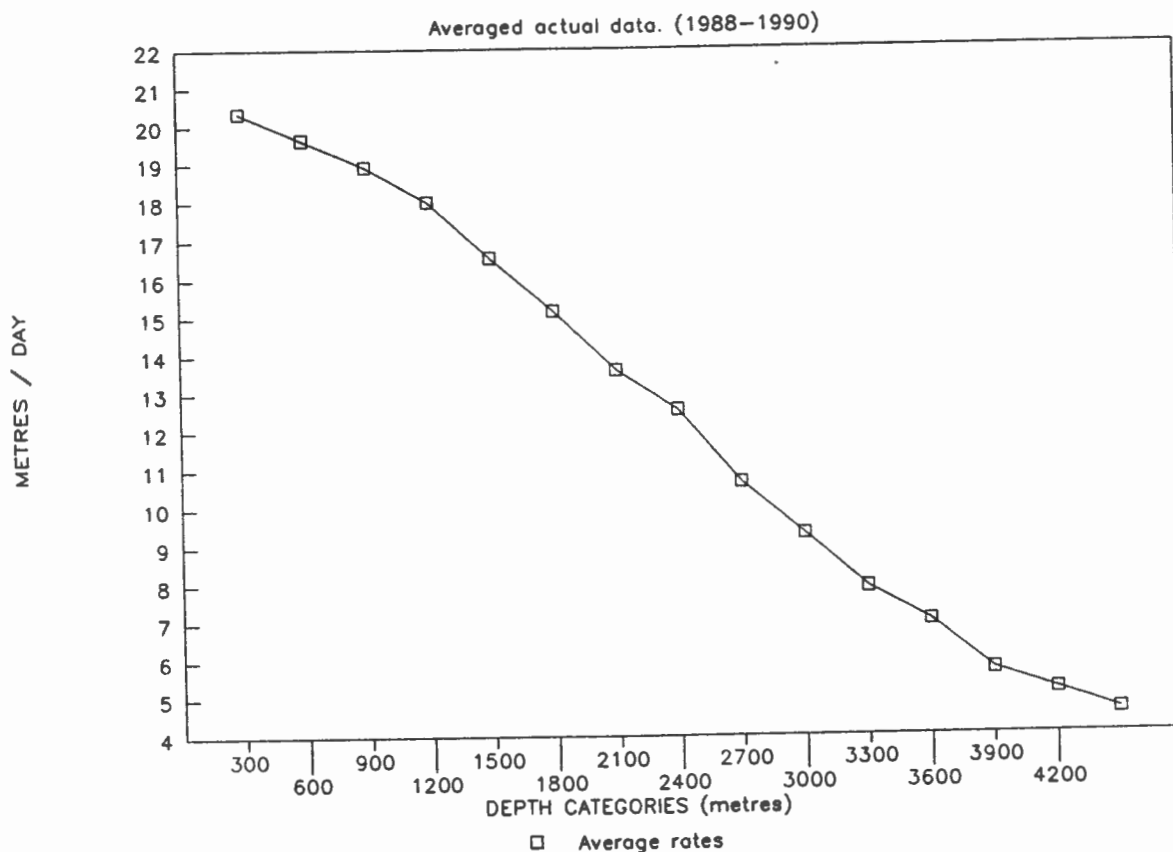
Drury (1988:522) uses the following calculation for the rate:

$$\frac{\text{Budgeted overhead for period}}{\text{Budgeted production activity for period}} = \text{Predetermined overhead rate}$$

The only differences between the calculations are the terminology used. The terms factory overhead and manufacturing overhead are interchangeable as well as volume of activity and production activity.

In this case the units would be metres drilled. This method will cause problems because of the decrease in the production rate as a borehole progresses deeper. See Figure 4.1, page 60 . The result will be that shallow holes with their higher production rates will be charged more than the deeper holes with lower production rates.

FIGURE 4.1 DRILLING PRODUCTION RATES



The following example can serve as an illustration.

	HOLE A	HOLE B
Present depth	600 m	2 500 m
Planned production	482 m	267 m
Equivalent production*	528,3 m	528,8 m

Assume factory overhead = R750 000:

Total planned production for all drilling units = 15000m

$$\text{Overhead rate} = \frac{R750\ 000}{15\ 000\ m} = R50\ \text{per metre}$$

Hole A overhead costs applied = R50 per m × 482 = R24100

Hole B overhead costs applied = R50 per m × 267 = R13350

* refer to table 4.2, page 62 for calculation of equivalent metres

Hole B should have a higher income for the month, due to the lower overhead costs applied to it for the month.

This can be overcome by converting the metres on a selected base to result in equivalent metres for the comparison of production in the different depth categories. Table 4.2, page 62, shows the conversion factors calculated from actual performance data, to calculate the equivalent production metres in each depth category. The term equivalent metres, used for a lack of a more descriptive term, does not refer to incomplete units of production in work in process, but is used only to compare the production performances of the different drill rigs with each other in terms of metres drilled per day or per hour for the different depth categories.

The literature refers to equivalent units of output as “the complete units that could have been produced given the total amount of manufacturing effort expended for the period under consideration” (Hansen, 1991:128).

The example will then be as follows:

Hole A overhead costs applied = R50 per m × 528.3 = R26415

Hole B overhead costs applied = R50 per m × 528.8 = R26440

TABLE 4.2 PRODUCTION RATE CONVERSION FACTORS

DEPTH CATEGORIES			PRODUCTION RATES		CONVERSION
			m/day*	m/hr~	FACTOR
0	-	300	20.35	0.848	1.000
300	-	600	19.64	0.818	1.036
600	-	900	18.93	0.789	1.075
900	-	1200	18.00	0.750	1.131
1200	-	1500	16.55	0.690	1.230
1500	-	1800	15.15	0.631	1.343
1800	-	2100	13.60	0.567	1.496
2100	-	2400	12.55	0.523	1.622
2400	-	2700	10.65	0.444	1.911
2700	-	3000	9.30	0.388	2.188
3000	-	3300	7.90	0.329	2.576
3300	-	3600	7.00	0.292	2.907
3600	-	3900	5.70	0.238	3.570
3900	-	4200	5.15	0.215	3.951

* metre/hour rate = metres per day / 24 hours

~ 0 - 300 m category is used as base

(Personal research of actual performances of different companies)

With the primary objective of the selection of a base being a reasonably accurate allocation of overheads to the different production units in mind, it can be seen that an overhead rate based on *units of production* can be regarded as an appropriate and fair basis to apply the overhead costs to the different drilling units, provided that equivalent units of production are used for the allocation.

Using the equivalent units of production as a base incorporates time as a basis for overhead allocation because the metres drilled in each category is a function of time. The use of equivalent metre rates should also be determined for the basic different rock types to make the allocation of the overheads more accurate and fair.

The major disadvantage of using an overhead rate based on units of production is when a rig is being moved or is involved in non- core producing activities, for example, grouting or extensive geophysical logging operations, will the overhead applied to the rig be lower than its counterparts. Overhead rates based on material cost are commonly used in organizations where a very good relationship between direct material costs and overheads exists. In this case there is no real direct relationship between material costs and overheads.

□ **Direct labour hours as basis**

The overhead application rate per direct labour hour is calculated as follows:

$$\frac{\textit{Estimated Factory Overhead}}{\textit{Estimated direct Labour Hours}} = \textit{Rate per Direct Labour Hour}$$

(Garrison, 1991:71; Heitger & Matulich, 1986:124)

The following example can serve as an illustration.

	HOLE A	HOLE B
Present depth	600 m	2 500 m
Planned production for month	482 m	267 m
Equivalent production*	528,3 m	528,8 m
Planned direct labour hours	2808	2808

Assume total factory overhead = R750 000
 Total planned direct labour hours = 154440 hours (presumed)

$$\textit{Overhead rate} = \frac{750\,000}{154\,440} = \textit{R4.86 per direct labour hour}$$

* refer to table 4.2, page 62 for calculation of equivalent metres

This method only has time as a basis and it is also regarded as being appropriate because the drilling rigs all have the same labour complement and all the rigs are

supposed to work the same hours. This method overcomes the disadvantage experienced in the previous method of using units of production as base.

Due to the above-mentioned fact that all the drilling rigs have the same direct labour complement it is suggested that direct labour costs can be treated as overhead costs and not as a direct cost in the income statement. This does not mean that labour costs should not be monitored and controlled. The reason for this suggestion is that when labour is included in overheads the overhead rate does increase and everybody will clearly see what the cost of idle time is and it could lead to improved planning and scheduling of operations.

It must be noted that should excess capacity develop due to unplanned circumstances, for example, no drilling contract for a machine, the relevant costs should be excluded from the factory overhead rate and from the product costs. "It should be treated as a deduction in the income statement. In many cases, it may be wise to dispose of the excess equipment." (Matz & Usry, 1984:435 & 436.)

In conclusion it can be said that using time as a base for determining the overhead rate is preferred to the use of production units for the reasons given. This overhead rate can then be used to determine the overhead cost per equivalent metre for the different rock types and depth categories. This will be discussed in more detail in paragraph 4.4.2.7, page 68.

4.4.2.5 Selection of denominator level

The activity level chosen as the denominator will have a direct effect on the overhead rate determined. The higher the activity level the lower the unit cost and vice versa (Matz & Usry, 1984:149; Heitger & Matulich, 1986:127).

The drilling rigs have to work a certain number of hours per month and the activity level is therefore the total number of drilling rigs in operation for the period under consideration, times the total amount of direct labour hours worked per drilling rig.

$$\text{Number of rigs} \times \text{planned direct labour hour per rig}$$

The denominator level becomes relevant when a cost per metre is calculated and for the purpose of allocating the overhead costs to the different drilling rigs and the different depth categories. The overhead cost per metre can be determined in depth categories

with the use of historical performance data to determine the average production rates for the two main drilling methods, conventional and wireline techniques as discussed in chapter 2, paragraph 2.2.3.3. on page 14 and 2.2.3.4. on page 15. These rates must be expressed in metres per hour to be able to calculate the overhead rates on an hourly basis.

The expected level of capacity becomes very important when the production planning is done. The term capacity does not refer to the maximum depth to which a particular machine can drill, but to the rate at which the metres of rock can be drilled. Four capacity concepts can be considered when the production planning is done, theoretical capacity, practical capacity, normal capacity and expected capacity (Cherrington *et al.*, 1985:427).

□ Theoretical capacity

Theoretical capacity refers to the upper limit of production capabilities from an engineering and economic viewpoint. This means the plant is operating “at full potential and at 100% efficiency” (Cherrington *et al.*, 1985:427).

“Theoretical capacity assumes the production of output 100% of the time.” (Horngren & Foster, 1991:301.) Because this capacity level is normally unattainable it is not considered to be of any use as a method of determining the activity base. (Hartley, 1986:84)

□ Practical capacity

Practical capacity refers to the more realistic production level at which machine breakdowns, machine maintenance and other idle time events are considered to be a normal part of operations. It is defined as the “maximum level at which the plant or department can operate efficiently” (Horngren & Foster, 1991:301). Drury (1988:87) defines practical capacity as the estimated maximum level of activity at which departments can operate. This concept assumes that all output that results from operating at the practical level could be sold, (Hartley, 1986:84 & 85). This is applicable in the case for diamond drilling if it is assumed that the machine will be operational for the full year.

Only when possible fishing time is planned for and included in this capacity can we assume that this method will be appropriate. A practical capacity of 65-75% of theoretical

capacity can be used, as this is regarded as a fair attainable capacity in this type of environment. (Verbal discussions with various companies.)

The use of tachographs can be invaluable to determine if the rigs are operating above or below the practical capacity if machine hours are used as a standard. The use of tachographs should be encouraged and should be used at all times.

☐ **Normal capacity**

Normal capacity or volume, “is the anticipated average level of activity which will satisfy average customer demand over a period of years, say 3-5 years, and thus includes seasonal, cyclical and trend factors” (Drury, 1988:87). Normal activity level is the “average activity that a firm experiences in the long term” (Hansen, 1991:77). Horngren & Foster (1991:302) regard the normal capacity as the “level of capacity utilization (which is less than 100% of practical capacity) that will satisfy the average customer demand over a period of years”.

It can therefore be regarded as a capacity that relates to consumer demand and is a long term planning and control approach. It is the level at which the company must operate in order to produce the average demand that can be expected for its products over a time period long enough to level out the highs and lows that occur in every business venture.

Because it is assumed that the yearly production planning is based on awarded contracts and that the drilling machines will work at their practical capacities, this method can be ignored. If the normal capacity is seen as production rates determined over a long period of time from historical data then it can be used for long term strategic planning.

☐ **Expected actual capacity**

Expected actual capacity or annual budgeted volume is “the anticipated level of capacity utilization for the coming year or other planning period” (Horngren & Foster, 1991:302). Drury (1988:87) sees it as “the expected level of activity over the coming year”. It can thus be regarded as a short term planning and control approach that advocates a rate in which overhead and production are based on the expected actual output for “the next planning period - usually one year” (Cherrington *et al.*, 1985:427).

This is an approach that could be used in diamond drilling as it is not always known if contracts will be awarded at the completion of existing ones. If the expected capacity of total consumer demand exceeds the capacities of all the machines in the industry, it can be decided whether additional machines must be purchased or rented or if expensive technology like wireline drilling should be used on all of the company's machines to increase production rates.

To summarize it can be stated that the capacity concept applicable to diamond drilling is a combination of the practical, normal and expected capacities. The normal capacity can be used as base for drilling in areas where sufficient historical data exist for use in the prediction of the production rates. The practical capacity can be used for drilling in unknown areas where little or no historical production data is available for the different rock types. The expected capacity can be seen as a combination of the two above-mentioned capacities for the period for which awarded contracts exist.

4.4.2.6 Inclusion or exclusion of fixed overhead costs

The controversy about the most appropriate method between absorption and marginal costing has raged for years and no attempt will be made to resolve this. Some of the advantages and disadvantages of the two different systems will however not be applicable to diamond drilling for the reasons mentioned in the following paragraph.

The main difference between the marginal costing and absorption costing approaches is the treatment of the fixed costs. Under marginal costing, fixed costs are treated as period costs. That means the fixed costs are written off in total within the period under consideration, as are marketing and administrative costs. The fixed costs are not included in either work in process or finished goods inventories.

Because work in process and finished goods inventory accounts are not used, there are no differences in the net operating incomes calculated by absorption and direct costing methods.

Dominiak & Louderback (1988:578) foresee difficulties for managers in predicting future income using absorption costing income statements for two reasons:

- “they must predict not only sales for that future period, but also production, and
- they must break down cost figures into their fixed and variable components, (i.e., managers must develop the information that is automatically provided when variable costing is used)”.

There is no real difference between sales and production as the product or core, is regarded as sold the moment it reaches the surface.

It is also stated that with variable costing the income is not influenced by production as variable costing income will vary with variances in sales. When absorption costing is used income could rise with falling sales. This is ignored due to the fact previously mentioned that production equals sales.

It is therefore suggested that the inclusion or exclusion of fixed factory overhead is somewhat irrelevant and will only depend on the complexity of the costing system required by management.

4.4.2.7 The calculation of the factory overhead rate

Calculations of the factory overhead rates can be done after activity levels have been estimated. The factory overhead rates can be determined separately for the fixed and variable portions of the overhead costs.

Horngren & Foster (1991:104) propose the following basic formula for the budgeted overhead application rate:

$$\frac{\text{Budgeted total factory overhead}}{\text{Budgeted total volume of application base}} = \text{Budgeted overhead application rate}$$

The following calculation can be made for calculating the fixed factory overhead rate with direct labour hours as base. A variable overhead rate based on direct labour hours can be calculated by using the previous formula substituted by the relevant units, after the variable overhead costs and the direct labour hours have been estimated.

$$\frac{\text{Estimated variable overhead}}{\text{Estimated direct labour hours}} = \text{Variable overhead rate}$$

(Horngren, 1991:104; Dominiak & Louderback, 1988:563).

The total factory overhead rate per direct labour hour will be the sum of the variable overhead rate *plus* the fixed overhead rate. This factory overhead rate per direct labour hour can also be determined as a rate per production day or a rate per production month or rate per calendar month. The use of a rate per time unit is preferred as discussed in paragraph 4.4.2.4 page 59. The *factory overhead rate per metre drilled*

in each depth category, can be calculated as follows using a factory overhead rate per time unit:

$$\frac{\text{Overhead rate/hour}}{\text{Production rate/hour}^*} = \text{Overhead costs/metre for each depth category}$$

- * the production rate must be calculated in metres per hour for each depth category for this calculation.

The following might serve as an example to illustrate the above formula using production days as base:

□ Assumptions:

- Total factory overhead R750000 per year
- 5 drill rigs in production
- 26 production days per production month
- 11 production months per year
- factory overhead allocated on number of rigs as base
- 267 metres of core produced in month in depth category 2400 - 2700 m

$$\text{Factory overhead per rig} = \frac{\text{R750 000}}{5 \text{ rigs}} = \text{R150 000/rig/year}$$

$$\text{Factory overhead per day} = \frac{\text{R150 000}}{26 \times 11 \text{ days}} = \text{R524.48/day}$$

$$\text{Factory overhead per metre} = \frac{\text{R524.48}}{267/26} = \text{R51.07/year}$$

This same formula can also be used to determine the overhead cost per equivalent metre as follows.

□ Conversion factor

- for 2400 - 2700m category = 1.911
 - for 2700 - 3000m = 2.188
- (Table 4.2, page 62.)

Equivalent metres for 267 m = 528.3 equivalent metres

$$\begin{aligned}\text{Factory overhead per equivalent metre} &= \frac{\text{R524.48}}{528.3/26} \\ &= \text{R25.812 /equiv. metre}\end{aligned}$$

This method can be used for the determination of the overhead cost per metre for any category or rock type provided that the data base has the necessary information. This will assist in determining tender prices for new contracts and renewal of existing ones. The effect of price increases on profits can also very easily be calculated. This rate can also be used in the determination of standing time rates which will be discussed in the next paragraph.

The existence of a comprehensive data base on production and cost figures can therefore again not be overemphasised. Optimistic production rates can result in the overhead being under applied and with adjustments being necessary at the end of the period under consideration. See section 4.4.2.9 page 71. Optimistic production rates can also lead to a too low tender price which can have grave effects on profits.

4.4.2.8 Standing time rates

The classification of fixed and variable costs is important because of the need for overhead rates to determine the costs of non-operational and operational standing times which are usually asked for in tenders. The classification of the costs was discussed in Section 4.4.1, page 54. Standing time rates refer to time related costs and not production unit costs. Standing time rates should therefore be calculated as rates in Rand per hour and not as Rand per metre.

Operational standing time refers to the use of the drilling machine (rig) for any purpose other than normal drilling operations, it includes for example surveying the hole, using the machine and rods to lower and pull the instruments, fishing, placing cement, washing the hole for chemical grouting, water acceptance tests, and geophysical logging of the hole using the rods to name some of the operations.

The operational standing time rate can be calculated as follows:

$$\begin{array}{rcl}\text{Overhead rate} & & \\ + & & \\ \text{Direct material cost rate} & = & \text{Operational standing time rate} \\ + & & (\text{R/hr}) \\ \text{Direct labour cost rate} & & \end{array}$$

The direct labour cost rate can only be added if direct labour is not included in the overheads as previously suggested.

The *direct material cost rate* must be determined from actual data accumulated in the cost data base for each depth category and for the different types of machines used.

□ **Example: Sullivan 50 drilling machine.**

- Direct material cost per depth category = x
- Diamond costs per depth category = y
- Time (machine hours) spent in category = z
- The formula will then be as follows:

$$\frac{x-y}{z} = \text{direct material cost rate}$$

Machine hours are used because the operational standing time rate comes into effect only when the rig is in operation.

Non-operational standing time refers to the machine standing idle, for example, waiting for instructions from a client, waiting for cement to set.

The overhead rate can be used for the computation of the standing time rates as normally required by the clients.

The non-operational standing time rate can be calculated as follows:

$$\text{overhead rate} + \text{direct labour rate} = \text{non-operational standing time rate in R/hour}$$

When the direct labour is included in the overhead rate, the non-operational standing time rate will be the same as the total overhead rate.

4.4.2.9 Over and under recovery of overheads

“As overhead rates are based on estimated annual overhead expenditure and an estimated activity level, is it very unlikely that the overheads charged to production will be the same as the actual overheads incurred.” (Drury, 1988:85.) Morse & Roth (1986:71) agree that “the total overhead applied to jobs during a given month is seldom equal

to the actual costs of the month". This means that there will be an under or over recovery of overheads whenever actual activity or overhead expenditure is different from the calculations used to estimate the overhead rate.

The most widely used method of disposing of over or under recovered overhead is to regard it as a period cost and write it off against the profit and loss statement of the current accounting period. "It can be treated as a deduction or addition to inventory" (Morse & Roth, 1986:71) or "as an adjustment to cost of goods sold" (Cherrington *et al.*, 1985:431).

The method of prorating underapplied overheads among the accounts where the costs of the year's jobs worked on, Work in Process, Finished Goods and Cost of Goods Sold, are lodged, will have the same result because Work in Process and Finished Goods accounts are not used due to the fact that sales equals production.

4.4.3 Material costs

4.4.3.1 Introduction

The classification of direct and indirect material costs is usually not very difficult, and will only be discussed in slight detail.

Material costs are classified as either direct or indirect costs depending on the type of cost and the traceability to a particular unit of finished product (Cherrington *et al.*, 1985:27).

Direct materials, defined in section 3.4.1.2. page 31 include the raw material components that can be physically identified with or traced to the finished product. They are distinguished from indirect materials by the ability to identify them economically with a finished product. *Indirect materials*, defined in section 3.4.2. page 32, lack traceability to the finished product and are included as an element of indirect manufacturing costs or manufacturing overhead costs.

Because diamond drilling is not a process where raw materials are transformed into units of output, the material costs refer mainly to materials used in the process of obtaining the product or core.

The cost item, loose tools, entered in the income statement could also be treated as a direct material cost because it can be controlled without too much input.

Utilizing historical information on all the different cost elements should assist in producing standard costs that could be used for planning and control purposes.

4.4.3.2 Material cost control

The use of practices such as minimum stock quantities and time to order, should be used in cases where the different drilling rigs are very far apart and have limited accessibility and also in the case where the rigs are closely spaced and a central store can be used. These practices can only be used if sufficient information is available to be analysed for this purpose.

Time to order or re-order level, which is the time an order should be placed, can be determined from the following formula (Glautier & Underdown, 1988:46; Heitger & Matulich, 1986:615):

$$\text{Time to order} = \text{maximum re-order time} \times \text{maximum usage}$$

The maximum order time for fuel must take the condition of the access roads in the rainy season into account because the trucks used for the delivery of the fuel cannot always get to the rigs when the roads are very wet and slippery.

Example:

$$\begin{aligned} &= 7 \text{ days} \times 400 \text{ litres} \\ &= 2800 \text{ litres} \end{aligned}$$

Minimum stock quantities on the different materials that are used on the rigs can be determined by using the following formula (Glautier & Underdown, 1988:46):

$$\text{Minimum stock quantity} = \text{re-order level} - (\text{normal usage} \times \text{normal re-order period})$$

Example:

$$\begin{aligned} \text{diesel fuel} &= 2800 - (300 \text{ l} \times 3 \text{ days}) \text{ litres} \\ &= 1900 \text{ litres} \end{aligned}$$

Economic order quantities can be determined for consumables like diesel, filters and core springs, especially in the case where a central store is used due to the proximity of the rigs. The following formula can be used to determine this economic order quantity. The different authors use different symbols for this formula, but their formulas are all identical (Drury, 1988:656; Horngren & Foster, 1991:742-743; Heitger and Matulich, 1986:606-607).

$$Q = \sqrt{\frac{2RO}{C}}$$

- Q = order size in units
- R = total number of units required for one period
- O = cost of placing an order
- C = cost of carrying one unit for one period

$$\text{Ordering costs} = O \frac{R}{Q}$$

$$\text{Carrying costs} = C \frac{Q}{2}$$

$$\text{Total costs} = O \frac{R}{Q} + C \frac{Q}{2}$$

(Cherrington *et al.*, 1985:403)

The following calculation for core springs can be used as an example using the following data:

- R = total number of units required for one period 1310
- O = cost of placing an order R30
- C = cost of carrying one unit for one period R0,5

Q Order size	200	300	400	500	600
Ordering costs $O(R/Q)$	196.5	131	98.3	78.6	65.5
+					
Carrying costs $C(Q/2)$	50	75	100	125	150
Total costs (Rand)	<u>246.5</u>	<u>206</u>	<u>198.3</u>	<u>203.6</u>	<u>215.5</u>

It is clear that the most economic order quantity is 400 springs. At present the industry is well served by the different diamond product manufacturers and the above-mentioned practices could be used for materials such as fuel, consumables, tools, routine maintenance spares, cables, casings and wedges.

Some form of quality control, with regards to sizes and types ordered, on materials purchased should be undertaken on site or at the central store as the use of substandard materials can lead to very expensive fishing, wedging or redrilling operations.

Material variances differ slightly from labour variances because material can be stored.

A material price variance is calculated based on quantity of materials purchased and *not* quantity used. It can be formulated as follows (Dominiak & Louderback, 1988:474-475; DeCoster *et al.*, 1988:192):

$$\text{material price variance} = \text{actual quantity used} \times (\text{standard price} - \text{actual price})$$

“The material quantity variance, or material usage variance, measures how well the physical resources were utilized.” (DeCoster *et al.*, 1988:193.)

This variance is calculated “in the same way as the labour efficiency variances” (Dominiak & Louderback, 1988:474.)

The variance can be formulated as follows (DeCoster *et al.*, 1988:193; Dominiak & Louderback, 1985:475; Garrison, 1991:368-369):

$$\begin{matrix} \text{material} & & & & & & & & & & & \\ \text{quantity} & = & \text{actual} & & \text{standard} & & \text{actual} & & \text{standard price} & & & \\ \text{used} & & \text{units} & \times & \text{quantity} & - & \text{quantity} & \times & \text{per unit} & & & \\ & & \text{produced} & & \text{per unit} & & \text{material used} & & \text{raw material} & & & \end{matrix}$$

Examples of material variance calculations can be seen in tables 4.3(b) and 4.3(c).

4.4.3.3 Conclusion

The planning and control of material costs are very important in any company and should therefore not be neglected in any form. As material costs comprise almost 30 percent of the total costs, this becomes even more important to ensure that everything possible is done to ensure that the minimum non-productive time is experienced due to material shortages and stoppages due to the use of inferior or faulty material.

4.4.4 Labour costs

4.4.4.1 Introduction

Labour costs, like material costs, can be divided into direct labour and indirect labour costs. Direct labour costs are those costs associated with labour involved directly in production of a particular product. Labour costs as defined by Hansen (1990:32) and Morse & Roth (1986:29), can be seen in section 3.4.1.1 page 30.

Examples of direct labour costs could be the salaries of the operators and the chargehands and the wages of the top men and the rod handlers, as they are the operators of the drill rig and responsible for producing the product or core. The labour costs of the foremen, maintenance personnel, technical manager and technical director can all be classified as indirect labour costs as they are all acting in either supervisory, supporting, advisory or managing capacities, and can be treated as manufacturing overheads. The labour cost of fishing operations should, as per definition, be regarded as indirect labour costs as the costs are not coupled to the production of output but rather the costs to get back into production.

4.4.4.2 Overtime

Overtime premium paid to workers is usually treated as a part of manufacturing overhead. In the case of Company A overtime is worked on every shift by every worker up to chargehand level. Therefore overtime is regarded as not being the exception to the rule but rather to be the rule. In this case overtime premium must be regarded as direct labour costs and not indirect labour costs.

4.4.4.3 Idle time

The cost of idle time in the form of wages paid for unproductive labour due to machine breakdowns, material shortages, bad weather and waiting for instructions should normally be treated as indirect labour costs. In this case the reporting system is not sophisticated enough to allow such calculations to be made. Added to this problem is the fact that overtime is regarded as direct labour and to identify which portion of the idle time must be calculated at the overtime rate and which portion at the normal rate will be extremely difficult or require a very complex system to allow such computations to be made.

Provided that the daily report and the production performance report are kept, the calculation of total idle time should not pose a major problem. The importance of the daily report is again evident.

4.4.4.4 Fringe benefits

Payroll fringe benefits are in most companies treated as manufacturing overhead with some exceptions (Matz & Usry, 1984:175) and (Morse & Roth, 1986:888).

In the case of Company A, fringe benefits are regarded as direct labour. As long as the fringe benefits of the direct labour are not mixed with the fringe benefits of the indirect labour, there should not be problems with this current practice. The portion of the indirect labour must be charged to the manufacturing overhead and not to the direct labour. The production bonuses of the foremen, calculated on the basis of the metres drilled by the drill rigs under his supervision, and although directly related to the production of the drill rigs, must still be charged to the manufacturing overhead and not to the direct labour as the relationship to the output is only in the calculation of the bonus.

4.4.4.5 Labour cost control

“Effective control over labour and labour related costs is achieved through (a) planning production requirements, (b) use of labour time and wage standards, (c) labour performance reports, and (d) appropriate payment for labour.” (Cherrington *et al.*, 1985:398.)

A major problem in labour cost control on a drilling rig is the fact that the production rates achieved are also greatly affected by technical factors. This causes problems in expressing labour costs as a function of the amount of metres drilled in a given period. To be able to do this accurately and fairly would require detailed time and motion studies to determine the breakdown on how the labour is spent at each job category.

In order to measure labour performance versus any budgeted labour costs, standards must be determined for the different operations that are to be measured. Two different standards can be determined for labour costs.

- A labour rate standard.
- An efficiency standard.

Labour rate standards are influenced by the prevailing market forces and are often established by means of collective bargaining with individuals or with labour unions (Matz & Usry, 1986:311). “Labour rate variances may be due entirely to external, uncontrollable factors, e.g. national and local wage awards for individual grades and skills.” (Arnold & Hope, 1990:335.)

Labour efficiency variance “or also called the quantity variance for direct labour, measures the productivity of labour time” (Garrison, 1991:371). To be of any use in drilling, it should be scientifically determined by means of time and motion studies. This should be done for both conventional and wireline drilling techniques.

The labour efficiency variance can be calculated at the end of a predetermined period by comparing the standard cost of the actual labour hours with the standard cost of the labour hours allowed for the actual output. Garrison (1991:370) formulates the labour efficiency variance as follows:

$$\text{Labour efficiency variance} = \text{std rate} (\text{actual hrs} - \text{standard hrs})$$

Standard hours refer to standard hours allowed for output. The labour rate variance is the difference between the actual cost of the actual labour hours and the standard cost of the actual labour hours (Morse *et al.*, 1984:30). See Table 4.3(a), p. 79 .

4.4.4.6 Labour reporting

As stated in chapter 2, section 2.4.4 page 25, the daily report should be comprehensive and accurately completed to serve as a labour performance report. It would then be possible to distinguish between idle time due to maintenance, breakdowns, material shortages and also time spent on actual production tasks like rod handling, that is the lowering and pulling of rods and the removal of the core from the core barrel and the actual drilling itself.

4.4.4.7 Conclusion

Labour comprises approximately 25-30 percent of the total costs in diamond drilling and must therefore be planned, controlled and budgeted for as accurately as possible to ensure that idle time is kept to a minimum and that maximum productivity is achieved. When this is done it should have a positive effect on the costs per metre drilled and eventually on the profits of the company. Well controlled and planned labour

costs can also serve as a motivation tool for the employees as they will then know what is expected of them if the standards are properly defined and communicated to them. A weekly and monthly production performance report is suggested in chapter 5 to deal with the problem of measuring idle time, production time and other production statistics. The suggested report could in time form the basis for the setting of labour efficiency standards.

TABLE 4.3(a) LABOUR VARIANCES

LABOUR VARIANCES					
COMPANY A					
For the period ending March 19XX					
ACTUAL COSTS		STANDARD COSTS OF INPUT		STANDARD COSTS ALLOWED	
Actual hours	14000	Actual hours	14000	Std. hours allowed	13050
Actual rate	<u>3.15</u>	Standard rate	<u>3.05</u>	Standard rate	<u>3.05</u>
	44100		42700		39802.5
		Labour rate variance		Labour efficiency variance	
		<u>-1400.0</u>		<u>-2897.5</u>	
		Total flexible budget variance			
			<u>-4297.5</u>		

Presumed data for illustration

DIAMOND VARIANCES

For the period ending March 19XX

Presumed data for illustration

DIESEL VARIANCES

For the period ending March 19XX

Presumed data for illustration

4.5 INFORMATION FOR DECISION MAKING

4.5.1 Introduction

The objective of this section is to consider the provision of financial information which will help managers to make better decisions in the short and the long term. Drury (1988:219), states that the distinction between long term and short term decisions is that the former cannot easily be changed whereas the short term decisions can be changed with reasonable ease. The capital investment in a new drill rig can be regarded as a long term decision which once taken and executed, is difficult to reverse.

4.5.2 Cost volume profit analysis

4.5.2.1 Introduction

DeCoster *et al.* (1988:69) state that cost volume profit analysis is commonly referred to as a breakeven analysis. It can be defined as “a systematic method of examining the relationship between changes in volume (that is, output) and changes in total sales revenue, expenses and net profit. As a model of these relationships, cost volume profit analysis simplifies the real world conditions which a firm will face” (Drury, 1988:173).

The objective of cost volume profit analysis is to determine what the effect of changes in the activity level or volume of output will have on the financial results of the company.

4.5.2.2 Basic assumptions

When using cost volume profit analysis certain assumptions are made when a real world situation is simulated. A list of basic assumptions underlying cost volume profit analysis can be summarised as follows (Cherrington *et al.*, 1985:208; DeCoster *et al.*, 1988:80; Wolk *et al.*, 1988:98):

- Cost data are available for manufacturing, selling and administrative activities. Costs can be classified as either fixed or variable.
- Variable costs change at a linear/constant rate per unit.
- Fixed costs remain constant.
- Volume is the only factor that affects cost.

- Unit selling prices do not change as the unit sales volume changes, i.e. the revenue line is linear.
- There is only one product, or if there are multiple products, the sales mix remains constant.
- There are no constraints on either production or marketing.
- Productivity remains constant. This is required for cost functions to be linear.
- All the units that are produced are sold in the same period. Stated differently, there is no significant change in inventory levels between periods. The analysis assumes that all costs incurred during the period are also expensed in the same period. For example, if production exceeds sales, some costs will be carried in inventory rather than expensed.
- There is a relevant range of validity for these and other underlying assumptions and concepts. The relevant range establishes the limits within which the volume of activity can vary and the sales and cost relationships can remain valid.

The applicability of point 8 in the assumptions is questioned when normal production metres are used for calculating productivity as a function of direct labour hours per metre drilled. Equivalent metres of production can be used to satisfy the assumptions mentioned above. Treating each depth category as a relevant range would make the breakeven analysis very complex.

4.5.2.3 Breakeven analysis

The breakeven analysis is done to determine the point at which all costs are covered and no profit has yet been made. This point is referred to as the *breakeven point*. Wolk *et al.* (1988:84) define the breakeven point as that volume "where revenues equal total expenses (fixed costs and variable costs). Horngren & Foster (1991:60) see the breakeven point as "that point of volume where total revenues and total expenses (total costs) are equal; that is, there is neither profit nor loss". Thus it can be said that the breakeven point is the point of sales volume resulting in zero net income.

4.5.2.4 Breakeven analysis in units

The breakeven point in units can be computed by dividing total fixed costs (FC) by the contribution margin provided by each unit.

$$\text{Breakeven in units} = \frac{\text{Total fixed costs}}{\text{Contribution margin per unit}} = \frac{FC}{P - VC}$$

The contribution margin per unit being the sales price (P) per unit minus the variable cost per unit (VC) (Horngren & Foster, 1991:62; Dominiak & Louderback, 1988:28; DeCoster *et al.*, 1988:71).

Example:

Data used from the flexible budget in table 4.4 page 88.

Activity level or relevant range = 800 equivalent metres

Sales = R123600

Variable costs = R43102

Fixed costs (including one - of costs) = R79557

Contribution margin per unit = $(123600/800) - (43102/800) = R100.62$

Breakeven point in units = $R79557/100.62 = 790.67$ equivalent metres

4.5.2.5 Breakeven analysis in Rands (sales)

The concept for determining the breakeven point in Rands is the same as it is for the breakeven point determination in units except that the contribution margin ratio is used in the computation (Horngren & Foster, 1991:74).

$$\text{Breakeven point in Rands} = \frac{\text{Fixed costs}}{\text{Contribution margin ratio}}$$

(DeCoster *et al.*, 1988:72; Dominiak & Louderback, 1988:28)

The contribution margin ratio is the ratio of the contribution margin to the sales and is computed as follows:

$$\text{Contribution margin ratio} = \frac{\text{Sales} - \text{Variable costs}}{\text{Sales}}$$

Example:

Data used from the flexible budget in table 4.4 page 88.

Activity level or relevant range = 800 equivalent metres

Sales = R123600

Variable costs = R43102

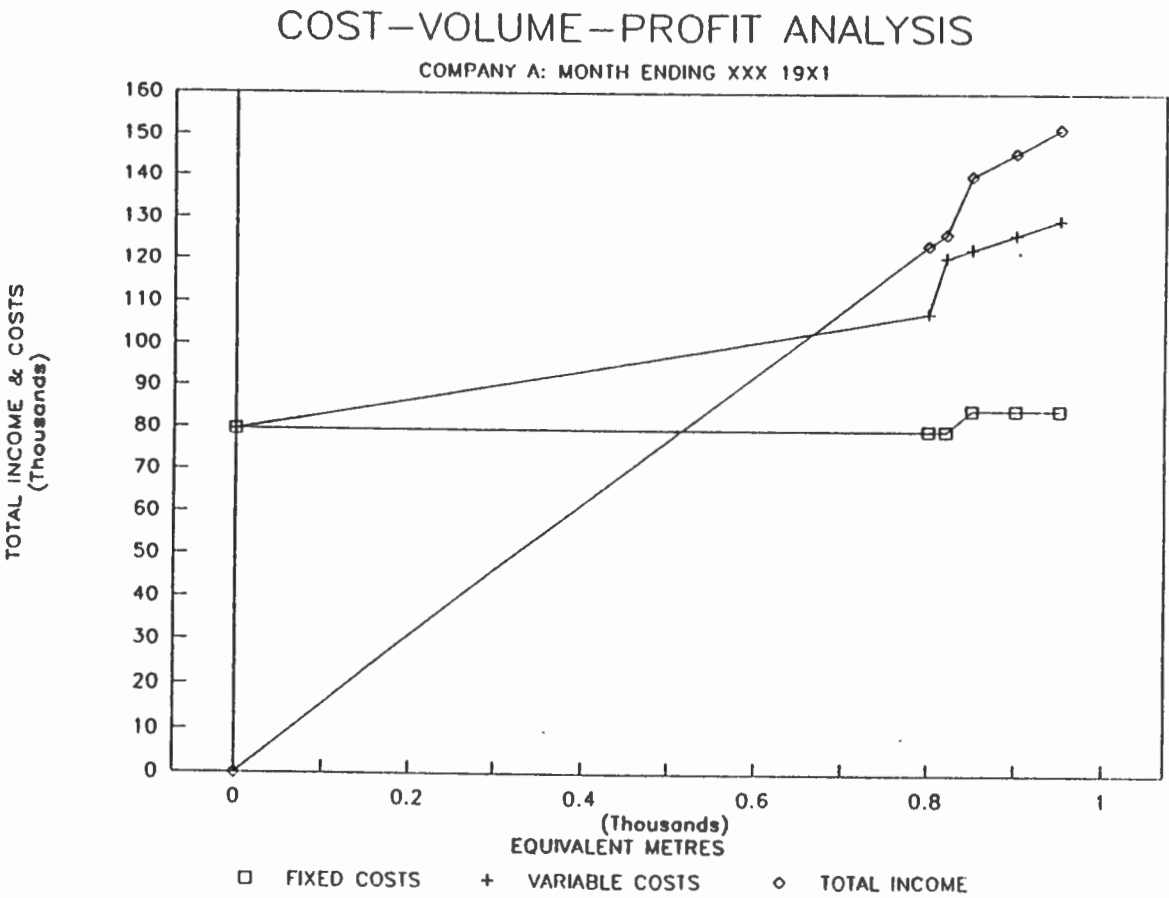
Fixed costs (including one - of costs) = R79557

Contribution margin ratio = $(123600-43102) / 123600 = ,651$ or 65.1%

Breakeven point in Rands = $R79557 / ,651 = R122207,37$

A graphical representation of the breakeven calculation is illustrated in Figure 4.2. page 84.

FIGURE 4.2 COST VOLUME PROFIT ANALYSIS



(Personal research of actual performances of different companies)

4.5.3 Performance reporting

A performance report is “a detailed report to management comparing budgeted data against actual data for a specific time period. In sum, performance reports are a form of feedback to managers” (Garrison, 1991:11). “Performance reports measure activities. These reports usually consist of comparisons of budgets with actual results.” (Horngren & Foster, 1991:5.) It can thus be stated that performance reporting forms an intergral part of the control function and provides feedback of results to management to aid decision making and planning.

Management is interested in the performances of the different drill rigs, and of the different contracts or even the performances of drill rigs in the same geologic province. To supply relevant and useful information for these needs there has to be some sort of performance reporting on what has been achieved by the company for the period under consideration.

4.5.3.1 Flexible budgets

Flexible budgets are used to get a better understanding of the variances which inevitably will occur whenever the master or static budget is compared with the actual results for a given period. Variances, if significant, should lead to investigation to determine the underlying causes which need remedies through appropriate action by management. "The basic idea of the flexible budget approach is that through a study of cost behaviour patterns, a budget can be prepared that is geared to a range of activity, rather than a single level." (Garrison, 1991:411.) A flexible budget is prepared for a range, rather than a single level of activity; it is essentially a set of budgets that can be tailored to any level of activity, (Horngren & Foster, 1991:213) and (Heitger and Matulich, 1986:360).

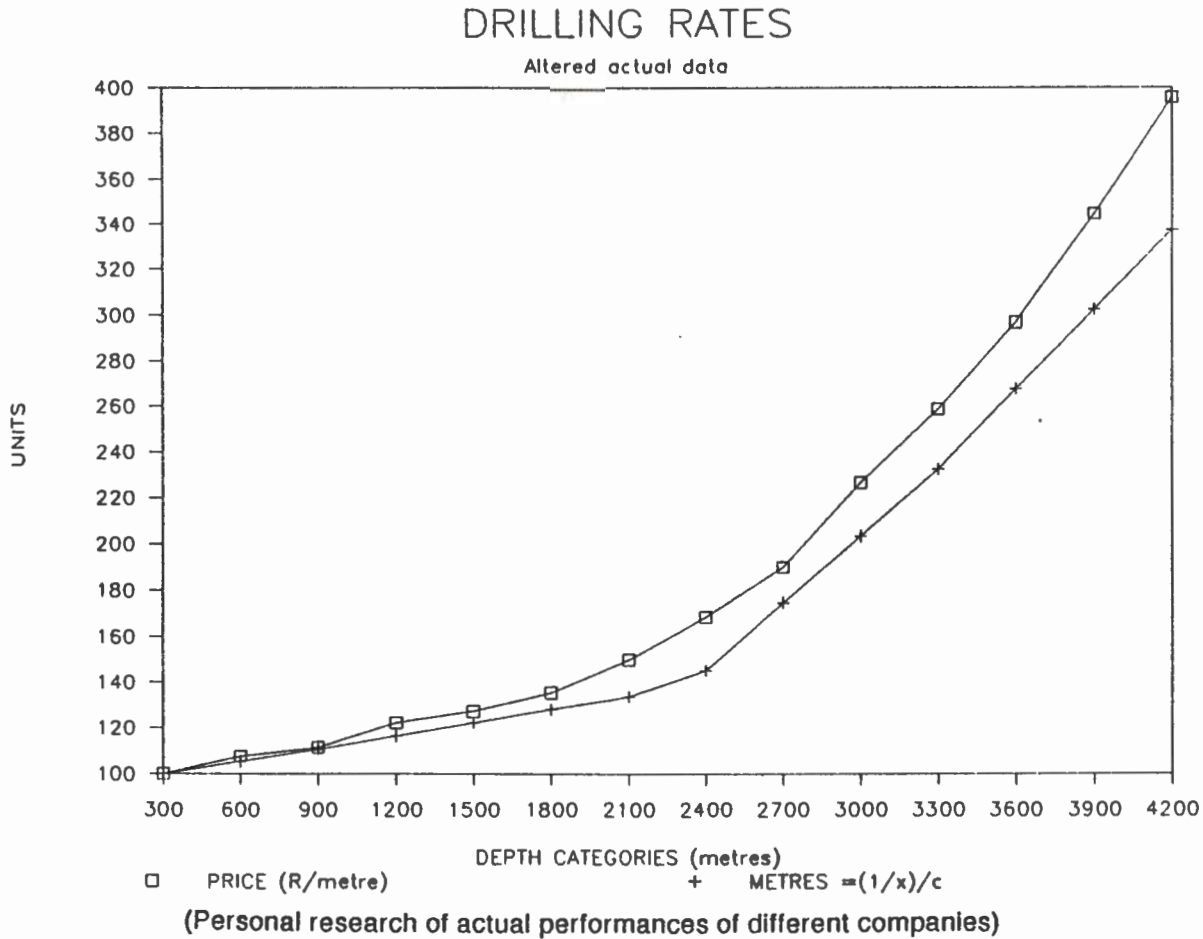
The basic steps in preparing a flexible budget are (Garrison, 1991:411):

- Determine the relevant range of the activity for the coming period.
- Analyze costs that will be incurred over the relevant range in terms of determining cost behaviour patterns (fixed, variable or mixed).
- Separate costs by behaviour, determining the formula for variable and mixed costs.
- Using the formula for the variable portion of the costs, prepare a budget showing what costs will be incurred at various points throughout the relevant range.

The present form of performance reporting used by Company A can be seen in Appendix 3.3 page 138, where an income statement is used for reporting on the year to date, present month figures and variances, as percentages of turnover. There is no reference to the activity level used for the budgeted figures. The flexible budget will be used in this case to investigate its applicability.

The use of equivalent production rates are again suggested to enable comparisons to be made between different rigs, as suggested in section 4.4.2.4 page 59. A problem that arises with the use of a flexible budget is the non-linear relationship between production rates and price per metre for the different depth categories see Figure 4.3 page 86.

FIGURE 4.3 DIAMOND DRILLING RATES



The difference can be ascribed to the increase in risk for an increase in depth. Risk is classified as being the increase in time spent to rectify a common downhole problem with increasing depth. Unfortunately there are as many definitions for risk as there are people involved in the drilling industry.

The time period for the flexible budget is most appropriately applied to short and medium term accounting periods (Chatfield & Neilson, 1983:492) and (Glaulier & Underdown, 1988:336). It is therefore suggested that the flexible budget should be used on a monthly basis as price increases on equipment are not fixed to certain definite periods and can occur at any time and management reports are required on a monthly basis.

□ Specific problems using flexible budgets

Numerous problems arose with the design of a flexible budget for this type of operation. Some of which will be discussed below.

- The non-linear relationship between the prices and the production rates, resulted in the introduction of an entry named “Risk Income”, to be able to have a standard cost per metre for the variable elements based on equivalent metres.
- All the variable costs are not always directly related to the production rates. For example: Fuel costs can also be inversely related to the production rate when fishing is encountered. It is however assumed that the production rates used for planning and budgeting already include a certain amount of fishing and can thus be used for the purpose of the flexible budget.
- Because labour costs behave more like fixed than variable costs, and are therefore regarded as fixed costs. Labour costs can be included as variable costs and not as fixed costs when units of input, such as machine hours, are used for the flexible budget formulae. Production bonuses are however directly related to the production and therefore included in the variable costs.
- Numerous non-recurring and unplanned costs can arise due to unforeseen and previously unknown zones of interest to the geologist on which he wants deflections drilled. Bad ground conditions can also result in costly and time consuming actions to be taken and are very difficult to plan for in advance. All these different costs are not variable or fixed and should be seen as separate from the rest. When such costs do occur they should be written off against the “Risk Income” previously mentioned.
- The daily reporting system that is used is not as yet fully utilized and analysed to supply data that can be used for flexible budget formulae based on units of input. This poses limitations on the use of the flexible budget for variance analysis such as efficiency variance. Drury (1988:496) specifically states that “it is essential that the flexible budget allowance is based on an output-based activity measure”. The reason is to prevent managers from obtaining higher budget allowances when they are inefficient. This view is shared by Horngren & Foster (1991:227), and it is thus agreed that units of output should be used in flexible budgeting. A system of utilizing the daily reporting data will be discussed in the next chapter when the proposed system will be discussed.

With the above-mentioned problems and limitations in mind, a flexible budget, with units of output as a common variable, was designed, Table 4.4 page 88.

TABLE 4.4 FLEXIBLE BUDGET

FLEXIBLE BUDGET							
Company A							
For the month ending XXX, 19XX							
UNITS (Equivalent Metres)	BUDGET FORMULA PER UNIT	VARIOUS LEVELS OF ACTIVITY (equivalent metres)					Remarks
		800	820	850	900	950	
INCOME	100	80000	82000	85000	90000	95000	
Risk Income	1.05	13600	14400	15150	15900	16665	
Establishment							
Casing							
Sub-Contract Income							
Wedging		30000	30000	40000	40000	40000	
Standing time							
Redrilling							
Other							
TOTAL INCOME	101.05	123600	126400	140150	145900	151665	
VARIABLE COSTS							
Direct Material							
Fuel & Lubricants	14.87	11896	12193	12640	13383	14127	(260 litres/day /machine x 103c/litre x 6 machines
Diamond costs	16.50	13200	13530	14025	14850	15675	R16.50/metre historical cost figures
Rods	6.00	4800	4920	5100	5400	5700	R480000x3.5% - 5% depreciation / 3000 metres
Cables	6.76	5408	5543	5746	6084	6422	Historical data supplied by company A
Corebarrels	6.13	4904	5027	5211	5517	5824	One corebarrel/month = R4800/783m = Price / average
Loose tools	2.50	2000	2050	2125	2250	2375	Historical data supplied by company A
Other consumables	4.00	3200	3280	3400	3600	3800	Historical data supplied by company A
Maintenance	9.71	7765	7959	8250	8736	9221	R38000/5machines/783m
Production Bonusses	2.00	1600	1640	1700	1800	1900	R2/metre above standard production
TOTAL VARIABLE COSTS	68.47	54773	56143	58197	61620	65043	
CONTRIBUTION MARGIN (R)	32.58	68827	70257	81953	84280	86622	
CONTRIBUTION MARGIN RATIO		56	56	58	58	57	
FIXED COSTS							
Production Labour							All fixed cost data were supplied by company A and therefore used as given.
Salaries	56500	11300	11300	11300	11300	11300	
Wages	8	4300	4300	4300	4300	4300	
Company Contributions	1	1167	1167	1167	1167	1167	
Leave & Bonusses	2	1300	1300	1300	1300	1300	
Field allowances	5	720	720	720	720	720	
Rations	2	960	960	960	960	960	
Levy fees (Black Labour)		0	0	0	0	0	
Immigration Permits		0	0	0	0	0	
Lease Payments		0	0	0	0	0	
Financing Costs (HP)		3800	3800	3800	3800	3800	
Rent Equipment		0	0	0	0	0	
Rent Buildings		150	150	150	150	150	
Water & Lights		30	30	30	30	30	
Insurance (Machines)		840	840	840	840	840	
Vehicle Costs		2520	2520	2520	2520	2520	
Rent		250	250	250	250	250	
Maintenance		100	100	100	100	100	
Fuel		300	300	300	300	300	
Licence & Insurance		120	120	120	120	120	
Depreciation							
Machines		4200	4200	4200	4200	4200	
Vehicles		2500	2500	2500	2500	2500	
TOTAL Fixed Manufacturing Costs		34557	34557	34557	34557	34557	
FIXED Admin & Management Costs		30000	30000	30000	30000	30000	
TOTAL FIXED COSTS		64557	64557	64557	64557	64557	
One-of Costs (As Per Contract)		15000	15000	20000	20000	20000	
OPERATING INCOME		-10730	-9299	-2603	-277	2065	

Presumed data for illustration

4.5.3.2 Budget variance analysis

For the manager to compare planned budgeted figures with actual results achieved, it is necessary to analyze the data in a meaningful way to determine the reasons for variances and to react if necessary to avoid unfavourable variances to occur in future.

Investigation of variations between actual results and budget goals is actually an investigation of variations between actual results and (i) historical results, (ii) standard costs and (iii) budgets because budgets are normally based on (i) and (ii). Variances can be labelled as either effectiveness variances, that is the variance between the actual and a predetermined goal or objective, and an efficiency variance, where efficiency refers to the optimum relationship between input and output (Horngren & Foster, 1991:217; Dominiak & Louderback, 1985:465). Smith *et al.* (1988:415) remark that effectiveness is measured by comparing the actual output to the original goals. He also states that efficiency refers to the relationship of inputs to outputs, that is how well the company controls the use of its inputs in generating the outputs.

The different variance analyses that will be addressed are those related to controllable costs with the emphasis on:

- Variance analysis for direct costs.
- Variance analysis for overhead costs.
- Variance analysis and revenue control.

The effect of variances in uncontrollable costs is not to be neglected but should be identified and alternative action be taken to try and minimize the effects thereof.

□ Budget variance analysis for direct costs

The control of direct costs through variance analysis is based on two principles:

- Management by exception when variances occur between the budget allowance based on standard costs and the actual expenditure recorded (Glautier & Underdown, 1988:328).
- Accounting responsibility when the responsibility of cost control is located with the manager having the responsibility for the costs under his control (Dominiak & Louderback, 1988:348).

When budget variances on direct material or direct labour are encountered, it indicates that the standard costs are not achieved. The budget variance can be defined as a difference between the budget allowance for the output achieved and actual spending on the output achieved (Horngren & Foster, 1991:215) and (Glautier & Underdown, 1988:328).

Horngren & Foster (1991:215) divide variances into two major categories:

- Variances from a revenue target, also called a scheduled production target. This is commonly called a sales volume variance but will henceforth be called a production volume variance and can be formulated as follows:

$$\begin{aligned} \text{Production volume variance} &= \text{budgeted unit contribution margin} \\ &\times \\ &(\text{master budgeted volume} - \text{actual production volume}) \end{aligned}$$

An example of the production volume variance can be represented as follows in a Performance Summary in table 4.5.

TABLE 4.5 COMPANY A: PERFORMANCE SUMMARY FOR THE MONTH ENDED XXX, 19XX

SUMMARY OF PERFORMANCE COMPANY A						
For the month ended XXX, 19X1						
	1	2	3	4		5
	ACTUAL RESULTS AT ACTUAL PRICES	1-3 FLEXIBLE BUDGET VARIANCE	FLEXIBLE BUDGET FOR ACTUAL OUTPUT ACHIEVED	3-5 PRODUCTION VOLUME VARIANCE		MASTER (STATIC) BUDGET
Equivalent Metres	850	–	850	30	F	820
Income	140150	–	140150	–9850	U	150000
Variable costs	51000	5204	45796	–4204	F	50000
Contribution margin	89150	–5204	94354	–5646	U	100000
Fixed costs + one-of costs	85000	443	84557	–5443	F	90000
Operating income	4150	–5647	9797	–203	U	10000

(Source: Presumed values for illustration)

- Variances arising from changes in unit prices, called price variances, and from inefficient utilization of inputs, called efficiency variances (Horngren & Foster, 1991:224).

Price variance = actual unit price – standard unit price × actual units purchased

See tables 4.3(a), (b) & (c) page 79 and following for examples of price variances in labour, diamond and diesel costs.

Horngren & Foster (1991:254) and Smith *et al.* (1988:424) define a standard formula for the efficiency variance as follows:

Efficiency = (actual inputs used – inputs that should have been used)
 $\times$
standard unit price of inputs

See tables 4.3(a), (b) & (c), page 79 and following for examples of price and efficiency variances in labour, diamond and diesel costs.

□ **Budget variance analysis for variable overhead costs**

Flexible budgets can be used for fixed and overhead costs. “The control of variable factory overhead requires the identification of the cost drivers for overhead items such as energy, supplies and repairs. Control increasingly entails monitoring non- financial measures such as kilowatt used, quantities of lubricants used and repair hours employed.” (Horngren & Foster, 1991:253.)

Horngren & Foster (1991:254-255) identify two major variances for variable overheads, i.e. - spending and efficiency variances. Smith *et al.* (1988:432) discuss a price and quantity variance. Garrison (1991:415-415) calls it spending and efficiency variances.

The overhead spending/price variance is calculated as follows (Garrison, 1991:416; Smith *et al.*, 1988:432):

Variable overhead price variance = actual hours (actual rate – standard rate)

Horngren & Foster (1991:255) formulate the variance as:

Variable overhead spending variance = flexible budget variance – efficiency variance

This is the same as the formula used by Garrison (1991:416) and Smith *et al.* (1988:432).

The variances that occur can be explained by either a change in the price of what is shown in the budget and/or it could have been affected by waste or excessive usage of overhead materials. The variable overhead efficiency variance is calculated as follows:

$$\begin{array}{l} \text{variable overhead} \\ \text{efficiency} \\ \text{variance} \end{array} = \begin{array}{l} \text{inputs} \\ \text{actually} \\ \text{used} \end{array} - \begin{array}{l} \text{inputs} \\ \text{that should} \\ \text{have been} \\ \text{used} \end{array} \times \begin{array}{l} \text{standard} \\ \text{unit price} \\ \text{of} \\ \text{inputs} \end{array}$$

“As a practical matter it can be said that the inefficiency is not the use of the overhead but rather the use of the base.” (Garrison, 1991:417.) The control of this efficiency variance lies with the person who is responsible for the control of the base.

□ Fixed costs and the flexible budget

“The ‘flex’ in flexible budget implies that only variable costs should be used.” (Garrison, 1991:418.) Horngren & Foster (1991:257) agree with this general statement. Fixed costs can be included in flexible budgets, and often for two reasons.

- Fixed cost is controllable by a manager and should be on his performance report.
- Fixed costs are needed in the flexible budget for product costing purposes (Garrison, 1991:418).

Glautier & Underdown, (1988:338) divide the variances for fixed overheads into two categories:

- *Expenditure variance* which is calculated as follows:

$$\begin{array}{l} \text{Fixed overhead expenditure variance} = \text{actual fixed overhead} \\ \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad - \text{budgeted fixed overhead costs} \end{array}$$

- The volume variance is calculated as follows:

$$\begin{array}{l} \text{Fixed overhead cost volume variance} = \text{budgeted fixed overheads} \\ \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad - (\text{standard fixed overhead rate} \\ \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \times \text{standard hours of the output achieved}) \end{array}$$

Garrison (1991:422-423) uses a different terminology to Glautier & Underdown (1988:338) namely budget and volume variances but the calculations are similar.

The budgeted fixed factory overhead rate is calculated as follows (Horngren & Foster, 1991:258):

$$\frac{\text{budgeted total fixed factory overhead}}{\text{some preselected production volume level of application}}$$

The preselected production volume level of application is also referred to as:

- denominator volume
- denominator activity
- denominator level
- normal or budget volume/activity

Examples of overhead cost variances using the data from the flexible budget in table 4.4, page 88, and the performance summary in table 4.5 on page 90.

Standard fixed overhead rate per metre = $R90000/820 = R109.8$

ACTUAL COST	FIXED BUDGET	APPLIED OVERHEAD ALLOWANCE
R85 000	109,8 x 820 = R90 036	109,8 x 850 = R93 330
EXPENDITURE VARIANCE	VOLUME VARIANCE	TOTAL VARIANCE
R5036 F	R3294 F	R8330 F

By using machine hours per metre drilled as the common variable, units of input and output are used, that is, machine hours are the time actually using the machine and metres drilled is the output achieved.

The following assumptions were made in the determination of the cost relationships:

- The number of machine hours per metre are inversely proportional to the production rate per depth category, as determined from actual performance data. The same

factors used for equivalent production rates are therefore used for machine hours in the different depth categories. See Table 4.2, page 62.

- A crew consists of three labourers and one operator.
- A practical capacity of 65% of the total time as operating time, is used as a standard. This was determined from actual data supplied by another company and is also regarded by various other companies to be a realistic capacity. (Verbal discussions.)

A flexible budget was designed as in table 4.4, page 88. This flexible budget is based on figures supplied by Company A. The budget formula per unit for each different cost element was also supplied by the company. These figures could not be verified and are regarded as being suitable for the purpose of explaining the concept of the use of the flexible budget and variance analysis. To illustrate the efficiency and price variances, a summary of performance (Table 4.5 on page 90), and a cost control performance report (Table 4.6 on page 94), was designed.

TABLE 4.6 COST CONTROL PERFORMANCE REPORT

COST CONTROL PERFORMANCE REPORT				
COMPANY A				
For the month ended XXX, 19X1				
	ACTUAL COSTS INCURRED	FLEXIBLE BUDGET	FLEXIBLE BUDGET VARIANCES	EXPLANATION
UNITS (Equivalent metres)	850	850		
VARIABLE COSTS				
Direct Material				
Fuel & Lubricants	220	239	19 F	
Diamond costs	14587	14025	-562 U	
Rods	5200	5100	-100 U	
Cables	5543	5746	203 F	
Corebarrels	9600	5211	-4389 U	
Loose Tools	2300	2125	-175 U	
Other consumables	3620	3400	-220 U	
Maintenance	8250	8250	0 F	
Production Bonusses	1680	1700	20 F	
TOTAL VARIABLE COSTS	51000	45796	-5204 U	

NOTE: The figures used in the Summary Of Performance and Cost Control Performance Report are pure hypothetical figures used to illustrate the use of these concepts.

In these particular circumstances, the two different costing approaches, direct costing and full or functional costing, will render the same results because no beginning and ending inventories of the final product and work in process accounts are used as the product of drilling, core, is regarded as sold the moment it reaches the surface.

There are also no real differences when either a job order or a process cost procedure is used because the costs of the core is determined for certain depth categories and possible rock types, and not for each and every metre that has been drilled.

The determination and application of manufacturing overhead to the different drilling units and the core drilled, depends on the requirements of management for decision making on planning, budgeting and control. Overhead application can be done on either a time basis (input volume) or an unit basis (volume of output). When based on a time basis like direct labour hours, it is based on units of input and the efficiencies of the different drilling units can be determined. When based on units of production, metres drilled, it becomes difficult to determine the efficiencies of the different drilling units in comparison with set standards. An overhead application based on equivalent metres of production, will be more fair than using straight metres of core drilled.

It is suggested that overheads should be based on time as it can then also assist in decision making on the economics of fishing operations as well as on maintenance decisions in make or buy situations. This rate can also easily be converted to a metre rate when tenders are submitted to the different exploration companies.

Flexible budgets as means of performance control can be of use if the standards are properly determined and equivalent metres are used for the determination of production performances of the different drilling units in the different depth categories and different rock types.

4.5.4 Financial statement analysis

4.5.4.1 Introduction

“One of the most important reasons for managers to analyze their firm’s financial statements is to evaluate the overall performance of the firm. Managers should be aware of total company performance, not just the performance of their particular areas of responsibility.” (Morse *et al.*, 1988:701.) Financial statement analysis refers to “management’s use of financial statement information in its decision making process” (Smith *et al.*, 1988:626).

Financial statement analysis involves the examination of the following (Morse *et al.*, 1988:701; Smith *et al.*, 1988:626):

- The company's earning performance.
- The company's financial structure.
- The company's long and short term debt paying ability.

"Another important aspect of financial analysis is tracking the firm's progress over time, which is done by comparing the firm's performance for the current period with several previous periods. To get an indication of future performances, it is useful to compare the firm's current performance to its past performances." (Morse *et al.*, 1988:702.) Smith *et al.* (1988:627) call this a horizontal analysis. Uliana *et al.* (1988:105) summarize that the objectives of financial statement analysis is "to examine a firm's financial position and returns in relation to risk, with a view to forecasting the firm's future prospects".

From the above-mentioned it can be stated that financial statement analysis is what is needed to achieve the objectives of this study and should be considered by any company.

This section on financial statement analysis is included in the study because it is regarded as important to any company to view itself as other competitors would and to ensure that the company is achieving its own financial goals and performance goals. A major limitation is the lack of financial information as previously stated, but it is felt that this section needs to be included never the less, to illustrate the concepts involved in financial statement analysis.

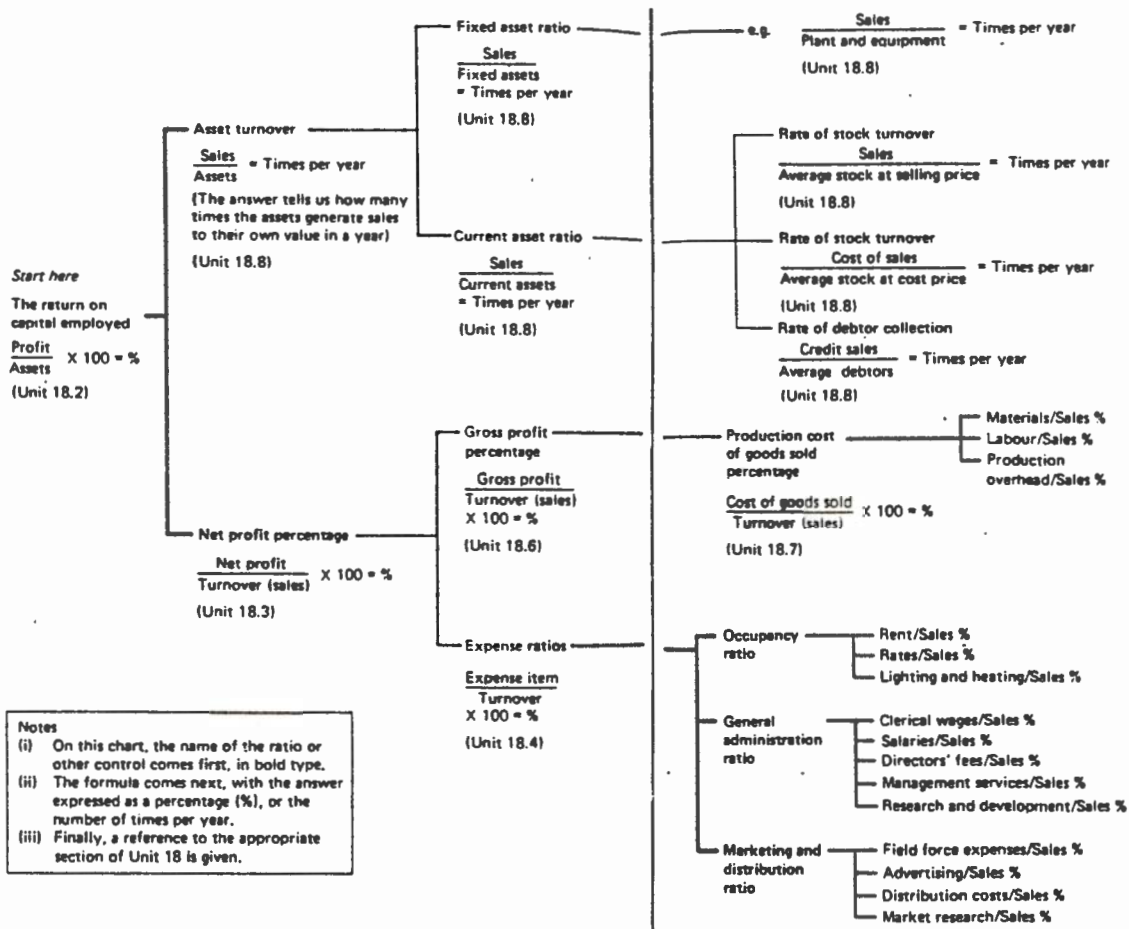
4.5.4.2 Procedures for financial statement analysis

Financial statement analysis measures may be divided into two main categories, *profit performance* and *solvency or liquidity*. The profit performance is examined by considering the return on capital employed and the other ratios which can be developed from it, as shown in figure 4.4, page 97.

□ Measures of solvency

"A major concern of any analyst is whether the firm will be able to meet its maturing financial obligations." (Uliana *et al.*, 1988:117.) Morse *et al.* (1988:703) describe the solvency position as "the ability of the firm to pay its debts as they become due".

FIGURE 4.4 A BRANCHING NETWORK DIAGRAM OF CONTROL RATIOS



SOURCE: Whitehead & Upson, 1982:302,303

Primary measures of short term solvency are the current ratio, acid test ratio, inventory (stock) turnover and number of days receivables outstanding. The debt-to-equity ratio and times interest earned measure are useful in assessing long term solvency.

The *current ratio* measures the relationship between current assets and current liabilities. The general equation is (Keith & Keith, 1985:56; Uliana *et al.*, 1988:117; Morse *et al.*, 1988:705; Smith *et al.*, 1988:638):

$$\text{Current ratio} = \frac{\text{current assets}}{\text{current liabilities}}$$

A ratio of 2:1 is often regarded to be the norm for this ratio but should be treated with caution because the adequacy of a particular current ratio depends on the (1) the composition of the current assets and how quickly they will convert to cash and (2) how soon current liabilities must be paid.

The *working capital* is computed as follows:

$$\text{Current assets} - \text{current liabilities} = \text{working capital}$$

$$\text{The ratio : } \frac{\text{Net working capital} \times 100}{\text{Sales}}$$

expresses the *working capital* as a percentage of sales and shows changes in working capital relative to the sales it is trying to finance. This is an important ratio to management when business is expanding (Morse *et al.*, 1988:705; Smith *et al.*, 1988:638).

The *quick ratio* measures the assets which can be quickly converted into cash, to pay current liabilities. It is also called the liquid or acid test ratio and the equation is:

$$\text{Quick ratio} = \frac{\text{Cash} + \text{Marketable securities} + \text{Current receivables}}{\text{Current liabilities}}$$

This quick ratio should be at least 1:1, that means there should always be sufficient funds available to meet all current liabilities. This ratio can vary for different types of industries. A 1:1 ratio is a “generalization as what creditors usually regard as satisfactory” (Smith *et al.*, 1988:639). Morse *et al.* (1988:706) refer to this ratio as an acid test ratio.

Days receivables outstanding measures “the number of days, on average, it took to generate sales uncollected at the end of the year” (Morse *et al.*, 1988:707) and is calculated as follows:

$$\text{days receivables outstanding} = \frac{\text{ending receivables}}{\text{average daily sales}}$$

Smith *et al.* (1988:641) refer to it as “average age of receivables”.

These calculations cannot be ignored although invoices are issued on a monthly basis and drilling is usually carried out on a contract basis with payment periods agreed upon. It is very important to ensure that debtors pay their accounts as soon as possible to avoid unnecessary strain on the cash flow of the company, especially in the case of the major drilling companies with a large number of machines, see section 5.4, page 117. The following example will stress the importance of this concept.

Assumptions:

- Number of machines = 50
- Average sales/machine/year = R950 000
- Interest on current balance = 15%/year

Days receivables outstanding	30	10
1 Sales (50 x 950 000)	R47 500 000	R47 500 000
2 Average daily sales: (1)/365	R130 137	R130 137
3 Interest loss: 0,15/365 x (2) x 30 x 30	R48 133	R5 438
4 Opportunity cost (revenue)	R42 785	

From this example it is clear that the days receivables outstanding must be kept to a minimum.

The *dept-to-equity ratio* measures the “total liabilities to total equity,” (Uliana *et al.*, 1988:122), and “shows the percentage of the firm’s assets financed by stockholders” (Smith *et al.*, 1988:637). This is calculated as follows:

$$\text{Debt-to-equity ratio} = \frac{\text{Total liabilities}}{\text{Total stockholders equity}}$$

The *debt ratio* also called *debt to total assets ratio* indicates the “percentage of total funds provided by creditors” (Uliana *et al.*, 1988:121). Smith *et al.* (1988:637) define it as “the percentage of the firm’s assets financed by shareholders”. The latter definition is preferred because the term, funds, can be misleading.

This ratio is calculated in the following way (Meigs & Meigs, 1984:861; Uliana *et al.*, 1988:121; Smith *et al.*, 1988:637; Morse *et al.*, 1984:708):

$$\text{Debt ratio or debt to total assets ratio} = \frac{\text{Total liabilities}}{\text{Total assets}}$$

“Because a financially sound business normally pays interest obligations out of current earnings, creditors are interested in the adequacy of earnings to provide payment of interest charges.” (Morse *et al.*, 1988:708.)

The *times interest earned*, is a measure of interest paying ability, and shows the relationship between earnings available to pay interest and total interest expense and is formulated as follows (Morse *et al.*, 1988:709; Smith *et al.*, 1988:637; Uliana *et al.*, 1988:121):

$$\text{Times interest earned} = \frac{\text{Earnings before interest and tax}}{\text{Interest expenses}}$$

No inventory ratios are calculated as there are no inventories of products that are produced. The core is regarded as sold the moment it is brought to the surface.

□ Measures of performance

“Operating performance is related to the broad objective of profitability. The basic activities that characterize a for profit organization are as follows (Morse *et al.*, 1988:709):

- Generating capital (equity and debt).
- Acquiring assets with capital.
- Using assets to generate sales and profit.
- Using profits to pay the cost of capital.

Smith *et al.* (1988:633) summarize the analysis as the ratios employed by the stockholders to help them evaluate management performance in using the resources of the entity to earn profits. The measures discussed below assist managers in evaluating the performances of these activities.

The *asset turnover ratio* “measures the ability of the firm to use its assets to generate sales”, (Morse *et al.*, 1988:709), and is computed as follows:

$$\text{Asset turnover} = \frac{\text{Sales}}{\text{Average total assets}}$$

Return on sales is a measure of the ability of the firm to generate profits from sales produced by the firm's assets" (Morse *et al.*, 1988:709). A general equation is:

$$\text{Return on sales} = \frac{\text{Net income} + \text{Net-of-tax interest expense}}{\text{Sales}}$$

The *return on assets ratio* "combines the asset turnover and the return on sales ratios to measure directly the ability of the firm to use its assets to generate profits" (Morse *et al.*, 1988:710). Uliana *et al.* (1988:123) see the "return on total assets measures the profitability of the firm as a whole in relation to the total assets." The computation is derived from these two ratios, discussed above, as follows (Morse *et al.*, 1988:710):

$$\text{Return on assets} = \text{asset turnover} \times \text{return on sales}$$

Uliana *et al.* (1988:123) define three different ratios and describe their merits:

$$\text{Return on total assets} = \frac{\text{EBIT}}{\text{Total assets}}$$

Earnings before interest and tax is used to compare firms in different tax situations and with different degrees of financial leverage.

$$\text{Return on total assets} = \frac{\text{EBIAT}}{\text{Total assets}}$$

Earnings before interest and after tax is conceptually the most correct approach. It excludes interest which is a financing cost but includes taxation which is an operating cost.

$$\text{Return on total assets} = \frac{\text{Net profit}}{\text{Total assets}}$$

Net profit after interest and tax. This tends to understate the return as the after tax cost of debt finance has not been removed. In this case the degree of financial leverage will have an impact on the return on total assets.

A variation of this ratio, the *return on investment* is commonly used for the evaluation of different investment opportunities and the comparison of performances of different

divisions. The net income used here must exclude the extraordinary items and disposals of segments of a business (Moore *et al.*, 1984:506; Keith & Keith, 1985:58).

Moore *et al.* (1984:512) suggest that the use of the current value of the assets should be used in the rate of return and return on investments ratios to result in a more realistic comparison between different periods. This suggestion is supported as the use of an outdated asset base (historical costs) can result in high rates of return on investment being reported while there is actually an opportunity cost attached to this if current values are used, and the return on investment is much lower if current values are used.

The net profit margin can be calculated as follows (Faul *et al.*, 1987:549):

$$\text{Net profit margin} = \frac{\text{Profit}}{\text{Revenue}} \times \frac{\text{Net profit}}{\text{Sales}}$$

4.5.5 Relevant costs for management action

4.5.5.1 Introduction

Product costing concepts and techniques are used to develop the historical cost information presented in general purpose financial statements. Management is interested in historical cost information primarily because it is useful in controlling current operations and planning future operations. An analysis of historical costs therefore provides for an excellent starting point in determining cost behavior (Horngren & Foster, 1987:300).

“Relevant costs (relevant revenues) are those expected future costs (expected future revenues) that will differ among competing alternatives.” (Horngren & Foster, 1987:300.)

“Because the relevant costs can be changed by management decisions, they should be included in any analysis prepared to assist in decision making.” (Morse *et al.*, 1988:43.)

Smith *et al.* (1988:21) state that relevant costs are “those that are different for the alternatives being considered”. Hansen (1990:383) defines relevant costs “as future costs that differ across alternatives”.

The definition of Horngren & Foster (1987:300) is preferred because the concept of relevancy should not be limited to costs only but should include revenue as well. This concept is well suited for application in the drilling industry where numerous decisions with financial implications are made, for example, when tenders are requested, fishing

operations are undertaken, new equipment is purchased to replace some old equipment, when a circulation fluid system is designed.

4.5.5.2 Relevant costs and differential analysis

“The key to effective cost analysis is to (1) identify the relevant costs (and revenues), and (2) organize them in a manner that clearly indicates how they differ under each alternative.” (Morse *et al.*, 1988:161.)

The consequences of each alternative can be divided into two broad categories (Horngren & Foster, 1991:369):

- qualitative - factors difficult to measure numerically
- quantitative - factors easily expressed in numerical terms.

□ Identifying relevant costs

“Identifying relevant costs is only part of the overall decision process that a manager should undertake.” (Hansen, 1990:385.) When this approach is used, only the costs and revenues that differ under each alternative should be included in the analysis.

- Future revenues may be relevant
Revenues, which are inflows of resources from operations, are relevant if they differ between the alternatives (Morse *et al.*, 1988:162).
- Outlay costs may be relevant
Outlay costs are future costs that require future expenditures of cash or other resources. It is erroneous to assume that variable costs are always relevant and fixed costs always irrelevant. Variable costs may not be relevant when decision alternatives have the same activity level. Fixed costs may be relevant if an increase or decrease in activity result in either an increase or decrease of fixed costs (Morse *et al.*, 1988:163).

Smith *et al.* (1988:208) also remark that “variable costs can be relevant or irrelevant; fixed costs can be relevant or irrelevant. Variable and fixed costs are defined in terms of how total costs respond to changes in activity, not in terms of whether or not the totals are different for alternative courses of action”. Cherrington *et al.* (1985:704) support this view.

- Sunk costs are never relevant

“Sunk costs describe past costs that are unavoidable because they cannot be changed no matter what action is taken.” (Horngren & Foster, 1991:384.) These costs are therefore irrelevant to decisions about the future. “Though the relevance of outlay costs is determined by the decision at hand, sunk costs (aside from possible tax consequences) are never relevant.” (Morse *et al.*, 1988:164.) When a decision is made to replace an old machine with a new machine, the book value of the old machine must be written off as a loss from disposal, and recorded in the statements of that year. This usually leads to reluctance by managers out of fear that it will lead superiors to question the wisdom of past decisions. From an economic viewpoint, a mistake made in acquiring the old machine cannot be corrected by the continued use of the old machine. This is a good example of a qualitative factor influencing decisions (Morse *et al.*, 1988:165).

Horngren & Foster (1991:384) suggest that the term sunk cost should be abolished. Because past costs are irrelevant, it is fruitless to refer to past costs as sunk costs. It is agreed that sunk costs (past costs) are irrelevant but the term, sunk costs, is too well imbedded to be abolished.

- Disposal and salvage values

Revenues are inflows of resources from operations. Disposal values of old equipment that are replaced are relevant cash inflows. Any salvage value available at the end of the useful life would also be relevant. A loss on disposal may have a favourable tax impact if the loss can be offset against taxable gains or taxable income (Morse *et al.*, 1988:165).

- Importance of time span

In the long run all costs, including costs classified as fixed for a given period, are relevant (Morse *et al.*, 1988:171).

- Opportunity costs may also be relevant

An opportunity cost is “the net cash inflows that could be obtained if the resources committed to one action were used in the most desirable other alternative” (Morse *et al.*, 1988:44 & 171). An opportunity cost “represent the measurable advantage of a forgone alternative,” (Cherrington *et al.*, 1985:707) and should be included in the relevant costs when decisions are made. Opportunity costs do not entail cash receipts or disbursements” (Horngren & Foster, 1991:377) and thus cannot be recorded in the accounting records.

It is thus agreed with Cherrington *et al.* (1985:701) that relevant costs are those costs that are useful in a particular decision situation and that they are expected future costs that differ among decision alternatives.

□ Differential analysis of relevant costs

“Differential analysis of costs is an approach to the analysis of relevant costs that differ under alternative actions.” (Morse *et al.*, 1988:165.) A differential analysis of relevant costs and revenues is preferred because (Morse *et al.*, 1988:166):

- Focus is only on those items that differ and provides a clearer picture of the impact of the decision at hand.
- A differential analysis contains fewer items and is easier, quicker to prepare and less confusing.
- In complex situations, such as multiple product or multiple plant firms, it is difficult to develop complete firm- wide statements to analyze all decision alternatives.

□ Predicting relevant costs

It is important to distinguish between relevant and irrelevant costs. Predicting the relevant costs may involve an examination of past cost trends. The prediction of costs becomes difficult when technology changes. Management would then have to rely on information supplied by the manufacturer. This information must be scrutinized in detail if the credibility of the supplier or information is suspect.

A cost prediction error is the difference between a predicted future cost and the actual amount of the cost when, or if, it is incurred. Because cost predictions may be inaccurate, management should determine how sensitive a decision is to prediction errors (Morse *et al.*, 1988:167; Horngren & Foster, 1987:322). If the difference between alternatives is relatively large, in relation to size of operating costs, the sensitivity to a prediction error should be relatively low. A three step procedure can be used to calculate the cost of the prediction error.

- “Compute the monetary outcome of the best action that could have been taken, given the actual value of the predicted variables.
- Compute the monetary outcome of the best action based on the incorrect value of the predicted value.

- Compute the difference between the monetary outcomes in steps 1 and 2." (Horngren & Foster, 1991:769-770.)

□ Example of differential cost analysis

The following might serve as an example of the use of differential costs analysis to aid decision making.

Assumed situation: A bit is burnt in at a depth of 2500m. A non-directional wedge, costing R1200 can be installed if the fishing operation is unsuccessful. The operational direct variable cost is R100/hr. The penetration rate in that depth category from historical data is 0.44m/hr. The direct cost of drilling at that depth is R300/m. Cost of equipment in hole is R3000.

Decision at hand: When (1) to stop fishing and/or (2) install a wedge.

TABLE 4.7 DIFFERENTIAL ANALYSIS OF RELEVANT COSTS

	FISHING	WEDGING
COSTS		
Predicted job duration (1)	48 hr	9 hr
Wedge cost (R)		1 200
Direct costs (2) (R)	4 800	900
Tool replacement (R)	1 000	3 000
Redrilling (3) (R)		900
Total cost (R)	<u>5 800</u>	<u>6 000</u>
Opportunity cost (4) (R)	5 306	
Total (R)	11 106	6 000
Net relevant cost (R)	5 106	

Notes:

- (1) Assumed historical performance data.
- (2) Hours x Rate (R100 = direct variable cost).
- (3) Redrilling R300 x 3m in 9hrs to get to previous depth.
- (4) Forgone revenue = difference in time $48-(9+9) = 30\text{hrs}$ X 0.44m/hr (drill rate) X R402 (price in category).

The prediction error sensitivity can be expressed as follows: The most critical prediction made is that of job duration for both alternatives. The prediction error can be very large if these times are guessed. When based on detailed analysis of accumulated historical data from the daily reports, this error should become small.

The prediction error, in Rands, in this case could be quantified as

- $3000+3(300)+1200+27(100) = \text{R}7800$
- $3000+3(300)+1200+9(100) = \text{R}6000$
- $\text{R}7800 - \text{R}6000 = \text{R}1800$

If this same situation is used for Heinz's suggestion in section 2.2.5.3, page 18 , we get, 50% of wedging cost = $\text{R}6000/2 = \text{R}3000$.

Thus, according to Heinz (1989:255), the fishing alternative should for this example not even be attempted because the cost of the tools in the borehole equals 50% of the wedging cost.

Based on the above analysis it is suggested that for this example, fishing should be attempted for one shift if the most experienced person believes there is a chance of success. If unsuccessful, a wedge should be installed as soon as possible.

Each fishing situation should be treated on merit and the situation fully appraised prior to any fishing attempts. Under no circumstances should the fishing decision be made by only the operator and/or chargehand. The foreman and technical director should be notified of the possible fishing situation immediately.

An important qualitative factor in this decision will be the confidence in the placing of the wedge and that it will remain in position. If the wedge moves it can jeopardize the borehole at a later stage, possibly resulting in expensive redrilling.

It cannot be emphasized enough that comprehensive reporting and data capture of all operations is very important and should be enforced and maintained at all times.

4.5.5.3 Pricing decisions

Many different factors influence pricing decisions and are well documented in the literature. The objective with the inclusion of this section is to illustrate the role of costs in the pricing decision.

There are three main factors in the determination of the price of products (Horngren & Foster, 1991:396; Morse *et al.*, 1988:179; Cherrington *et al.*, 1985:747):

- Customers - different customers have different preferences.
- Competitors - rivals' reactions or lack thereof.
- Costs - the maximum price is one that does not drive customers away, and the minimum price is zero.

“Probably the most widely used method of pricing a product is to estimate the unit cost and then add a percentage mark-up to this cost to provide a reasonable level of profit.” (Drury, 1988:298.) The major advantage of cost based pricing is that they are “understandable, predictable, explainable, and justifiable on objective criteria” (Cherrington *et al.*, 1985:748). Horngren & Foster (1991:402-403) regard fixed cost recovery, simplicity, price stability and price justification as the advantages of cost-based pricing.

The shortcomings of this method are that they generally do not take into account factors such as market conditions, product life cycles, or general economic conditions (Cherrington *et al.*, 1985:748). Drury (1988:301) reports the most important limitations of cost plus pricing as ignoring demand, circular reasoning, apportion base of fixed costs and the pricing floor.

“Cost-based pricing formulae encompass a variety of different methods which are used to establish the cost.” (Drury, 1988:298.) For example, total cost, manufacturing cost, variable production cost, relevant cost et cetera, may form the basis of the cost in the

formula (Horngren & Foster, 1991:397) and (Drury, 1988:298). The margin could be a fixed monetary amount or a percentage of the associated cost figure.

In a typical pricing decision, management uses cost information to arrive at an initial selling price. The other influencing factors are then evaluated to arrive at a final selling price, (Morse *et al.*, 1988:178).

The setting of cost based prices in are relatively straightforward if everything but the selling price is known (Morse *et al.*, 1988:178).

$$\begin{aligned} \text{Total revenue} - \text{total costs} &= \text{profit target} \\ (\text{Price} \times \text{output}) - (\text{fixed} + \text{variable costs}) &= \text{profit target} \end{aligned}$$

In diamond drilling, the product or core, can be seen as a single product but also as a multiple product due to the different depth categories and rock types, also referred to in section 4.2.1, page 47.

In a *multiple product company* the initial selling price is typically specified as “a cost *plus* a mark-up, stated as a percentage of the cost which is determined by the cost base used in the computations. Two possible cost bases that can be considered are variable costs and manufacturing costs” (Morse *et al.*, 1988:179). It is important to note that “the mark- up must be large enough to cover all fixed costs and the target profit” (Smith *et al.*, 1988:217).

This mark-up can be formulated as follows (Morse *et al.*, 1988:179):

$$\text{Variable cost markup} = \frac{\text{Predicted fixed cost} + \text{Target profit}}{\text{Predicted variable costs}}$$

Once the variable cost mark-up is determined it is used to determine the initial selling price of each product.

$$\text{Initial selling price} = \text{VC/unit} + (\text{VC/unit} \times \text{VC mark-up})$$

VC= variable cost

(Morse *et al.*, 1988:179; Smith *et al.*, 1988:216).

Using the data from table 4.5, page 90, we can calculate the following initial selling price per equivalent metre, to demonstrate the application of the concept.

$$\text{Variable cost mark-up} = (85000 + 4150)/51000 = 1.75 \text{ or } 175\%$$

$$\text{Initial selling price} = 60 + (60 \times 1.75) = \text{R}164.88$$

$$(\text{Variable cost/unit} = \text{R}60 = \text{R}51000/850)$$

The mark-up needed to (1) cover fixed costs and to (2) cover target profit can be determined individually as follows (Morse *et al.*, 1988:181):

$$1. \text{ Markup to cover fixed costs} = \frac{FC \times VC/\text{unit}}{VC}$$

FC = Fixed costs

VC = Variable costs

$$\begin{aligned} \text{Markup to cover fixed costs} &= \frac{85\,000 \times 60}{51\,000} \\ &= \text{R}100 \end{aligned}$$

$$\begin{aligned} 2. \text{ Markup to cover target profit} &= \frac{\text{Target profit} \times VC}{VC} \\ &= \frac{4\,150 \times 60}{51\,000} \\ &= \text{R}4.88 \end{aligned}$$

The initial price is therefore $\text{R}100 + \text{R}4.88 + \text{R}60 = \text{R}164.88/\text{m}$

In practice the predicted costs, based on a large information base, will be used to determine this initial selling price.

4.6 SUMMARY

During a literature study on cost and management accounting principles, a number of principles, applicable to diamond drilling, were identified and discussed in this chapter.

The main difference between the contribution (marginal) costing approach, and the conventional (full) costing approach i.e. stock valuation, is irrelevant because no beginning, ending or work in process inventories are applicable in diamond drilling. Sales are regarded as being equal to production because the product (core) is regarded as sold when it reaches the surface.

Either a job order or a process cost procedure can be pursued to determine the cost of the product. The procedure to be used depends on the cost objectives identified by management and/or the clients.

The cost objective or activity to be costed depends on management's need. The cost objective can be metres of core drilled, metres of core in different depth categories, rock type categories, contracts, geological provinces, drill rig types, et cetera. Cost classification depends on the behaviour and relationship of costs with the selected cost objectives.

Because the production rates of core and the associated costs are dependent variables of depth, see figure 4.1, page 60, and rock type, production rates are converted to equivalent units. See table 4.2, page 62. The current standard method of tendering requires prices to be quoted for different depth categories and also for some time related activities. The equivalent unit classification is regarded as necessary and applicable to the management functions of planning, budgeting and control. It can be used for the setting of performance and cost standards which in turn can be applied to variance analysis, see tables 4.3(a), (b) & (c), page 79 and following for performance reporting, see tables 4.5 and 4.6, at page 90 and 94 respectively.

A number of procedures were discussed which could be used in any company. An important function of management is to track the company's performance and progress over time. This is done by comparing the firm's performance for the current period with several previous periods to get an indication of future periods (Morse *et al.*, 1988:702). Opportunity costs is coupled to days receivables outstanding as an example, see page 99, on how these principles can be employed.

The concept of relevant costs can be successfully applied to decision making in the diamond drilling environment. A differential analysis of relevant costs to assist decision making is illustrated by an example of fishing versus wedging, see table 4.7, page 106.

CHAPTER 5

IMPLEMENTATION OF SOME COST AND MANAGEMENT ACCOUNTING PRINCIPLES

5.1 INTRODUCTION

With the main objectives of this dissertation in mind, section 1.3, page 3, some important cost and management accounting principles that could be used by a diamond drilling company for their cost control and management functions will be discussed, based on the preceding chapters.

The principles discussed will be those thought to have the largest contribution to effective and efficient management. The proposed costing principles are intended to be simple, easily understandable and to serve as a basis for management accounting which can lead to better control and understanding of costs, and can be introduced with the minimum of changes to the current system used by Company A.

This chapter will summarize the different costing approaches that can be used and then continue with a discussion on the proposed cost and revenue collection and recording, and the production information capture. This will be followed by a proposed reporting system of the above-mentioned data with regards to the frequency and statements that should be supplied to management.

5.2 COSTING APPROACHES

A choice between the two different approaches in costing, that is the contribution and the conventional approaches, as discussed in section 4.2, page 46, can be regarded as irrelevant as there is no difference between the operating incomes determined by either of the two methods due to no beginning and ending inventories of the product being present and no work in process accounts used.

A hybrid form of standard and historical (actual) costing can be used in combination with either a job order or a process costing procedure or a hybrid of the two. Standard costs can be determined from historical data and used in areas where enough historical information is available to set realistic standards for the different depth categories and the different rock types that are encountered.

A job order costing system based on a large historical cost data base, not necessarily related to the rock types, could possibly be more applicable when drilling in new areas for which no historical costs, performance data and detailed geological information are available, is undertaken. The client should however give some information on the rock types that are expected. If the rock types are completely unknown and very difficult and expensive to drill, the contract should allow for a possible renegotiation of the rates.

5.3 COST COLLECTION AND RECORDING

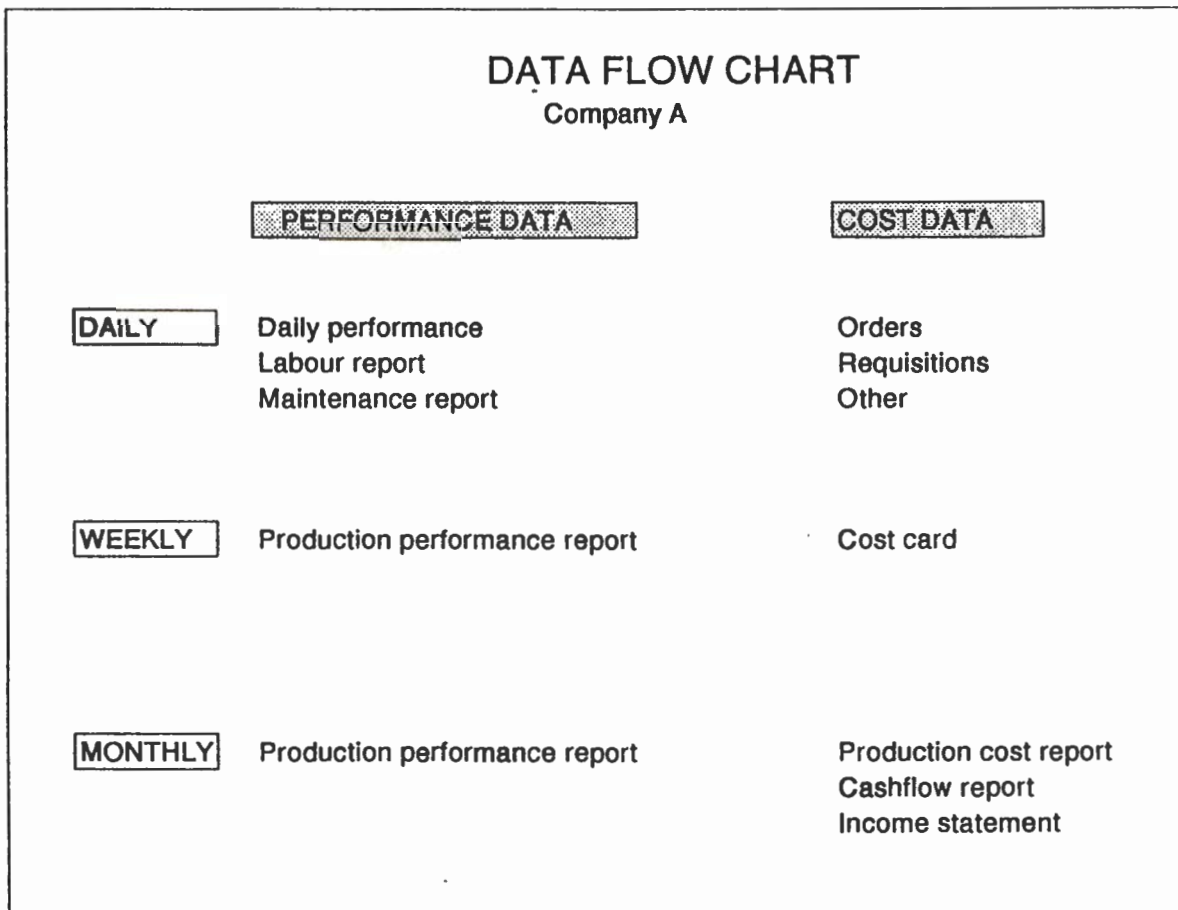
The present system of buying all items through the head office by means of orders makes the collection of costs very simple and easy and this should be continued for as long as it stays cost effective. The timing of collection and recording of the cost data is summarized in a flow chart in Figure 5.1, page 115.

5.3.1 Cost card

The recording of costs on a cost card, referring to each individual rig, once an order number is issued, should be implemented in order to be able to accurately trace the costs incurred by the different rigs.

All the costs incurred by the different rigs by means of either purchase orders issued by the head office or requisitions submitted to and issued by the stores, should be entered weekly on the cost card on a daily basis. The dates on which the different depth categories and major lithological changes are encountered can also be entered on the cost card to facilitate an easy determination of the cost performance coupled to production output and or rock type for each individual rig. An example of a cost card can be seen in Table 5.1, page 116.

FIGURE 5.1 DATA FLOW CHART



This cost card data can have a number of valuable uses:

- Management reporting.
- Standard cost determination for cost elements for the different rock types and depth categories.
- Goal setting for the drilling teams.
- Bonus determination based on revenue earned.
- Cost data for tender purposes.
- Data for detailed cost analysis.
- Cost control.

COST CARD

HOLE NO: ST1
CONT NO: AV234

MACHINE TYPE: SULL50
AREA CODE: OVS 1

DATE	30/06	01/07	02/07	03/07	04/07	05/07	06/07	07/07	08/07	09/07	10/07	11/07	12/07	13/07	14/07	15/07	16/07	17/07	18/07	19/07	20/07	21/07	22/07	23/07	24/07	25/07	26/07	27/07	28/07	29/07	30/07	31/07	PROG	RAND/	RAND/		
																																		TOTAL	METRE	EQ.METRE	
PROG DEPTH	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414	418	439	449	466	478	500	526	550	550	566	587	596	182				
EQUIV DEPTH	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420	424	446	456	475	487	510	538	563	563	580	602	611	191				
ROCKTYPE	L																				L	L	L	L	L	L	L	L	L	L	L	L	0	0	0		
HOLE SIZE	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ					
FUEL+LUBR																	55		92	203	111	111	111	184	92	166		193	184	184	212	1898	10.42	9.937			
DIAMONDS																	400			450						450		450					1750	9.613	9.162		
CABLES																																		0	0	0	
C/BARRELS																																	1100	1100	6.043	5.759	
RODS																																			0	0	0
LSE TOOLS		25	50																		250			50										375	12.060	1.963	
OTHER		60	90	500	200	50	55		25			55				300																		1325	17.333	6.989	
PROD 3GRUS																																			0	0	0
MAINTENANCE																									68								88	156	0.857	0.816	
ENG.COST																					250													250	1.373	1.308	
																																			0	0	0
																																			0	0	0
TOTAL		85	190	500	200	50	55	0	25	0	0	55	0	0	0	300	0	455	0	92	1153	111	111	161	252	92	616	0	193	634	1284	300	6864	37.71	33.93		
PROD TOTAL		85	225	725	925	975	1030	1030	1055	1055	1055	1110	1110	1110	1110	1410	1410	1865	1865	1957	3110	3221	3332	3493	3745	3837	4453	4453	4646	5280	6364	6864	6864				

TABLE 5.1 COST CARD

This will assist in the determination of the actual cost per metre that was incurred by the different drilling rigs. Fixed costs should be collected on a monthly basis and apportioned to the different rigs, and together with the cost card data, used to determine the profitability of each rig on a regular monthly basis.

5.4 REVENUE COLLECTION

This is one of the basic principles in any profit organization and every effort must be made in order to collect the accounts receivable as soon after the month end as possible. This has become even more urgent in the present high inflationary economic climate.

Invoices issued to clients should be accurate and complete as this will reduce the time spent dealing with queries from clients. The production performance report, Table 5.2, page 119, based on the daily reports, Appendix 3.2, page 137, can be used to finalise the invoices for work completed.

Some clients prefer a bill of quantities to be submitted for inspection before any final invoices are issued. It is clear that this bill of quantities must be reconciled with the daily reports as these reports are also used by the clients. The approved bill of quantities must accompany the invoice to the client as soon after approval as possible. This could assist in alleviating some cash flow problems which sometimes occur because of late payments by debtors due to the late issuing of invoices. The payment period should also be negotiated with the client to avoid possible cash flow problems as some companies have very complicated accounting systems and can take a considerable time before any payments are made. This payment period must be taken into account when the cash flow budgets are done.

5.5 PRODUCTION DATA

The term production data refers to the data which is directly related to the operational aspects of the drilling units. That is data related to drilling performance and labour utilization. The collection and recording of such data is also summarized in the flow chart in Figure 5.1, page 115.

The daily performance report which is completed by the chargehand on a hourly basis can be retained but it must be stressed that it should be done comprehensively and

accurately. This daily report gives a breakdown of the operations on an hourly basis and can be summarized into valuable management reports, see Appendix 3.2, page 137.

The three hourly telephonic reporting of the production performance can continue as it keeps management in touch with the different drilling units but it is suggested that this reporting is done on a daily basis or as exceptional reporting when problems are encountered to reduce costs. Radio telephones were found to work very well despite the high cost thereof. A foreman should be able to visit a rig at least once a day, depending on the distances between rigs involved and can then do his own reporting.

The daily performance reports should be submitted to the head office on a weekly basis for data capture. This production data can be coupled to the cost data to produce a useful cost control performance report that can be used by management for cost control and monthly reporting, as discussed in chapter 4, Table 4.6 page 94. The daily performance reports can also be summarized into production performance reports on a weekly and a monthly basis, Table 5.2, page 119.

5.6 REPORTING

For management to manage efficiently and effectively the necessary reporting of the different items and actions should be done at different set time intervals, Figure 5.1, page 115.

5.6.1 Daily reporting

Performance data and labour data should be entered on the daily production report and daily labour report as discussed previously in section 3.4.1.1., page 30.

Maintenance data by the maintenance personnel should be captured daily as to the type of work, time spent and the cost of items used at each rig. This report will enable management to distinguish between direct and indirect maintenance costs. The report should be kept at the rig and submitted at the end of the month together with the other reports. This report then serves as a monthly report on maintenance for the different types of equipment used for the month, Table 5.3, page 120. Detailed analysis of this information should be invaluable to management regarding equipment replacement and rent or buy decision making.

PRODUCTION PERFORMANCE REPORT COMPANY A

(Source: personal research)

PRODUCTION PERFORMANCE REPORT																																					
COMPANY A																																					
HOLE No:																																		DATE _____			
CONTRACT No:																																					
MONTH:	XX 19XX																																	WEEKS			
DATE	1	3	4	5	6	7	8	10	11	12	13	14	15	17	18	19	20	21	22	23	24	25	26	28	29	30	31	1	2	3	4	5					
HOURS																																					
MOBILIZATION	12	12	12	12	12	12	12	12	12	12	12	12	12	6																		84	66	0	0	0	
RIG UP																																	0	0	0	0	0
LOWER CASING																																	0	0	0	0	0
RUN RODS																	6						1	1			3						0	0	6	2	3
DRILL																	5	10	10	10	20	10	17	19	20	20	17						0	0	25	76	57
PULL RODS																								1			3						0	0	0	1	3
RUN INNER TUBE																	1	2	2	2	4	2	3	3	4	4	1						0	0	5	14	9
REAM																																	0	0	0	0	0
LOWER LOCK																																	0	0	0	0	0
LOWER WEDGE																																	0	0	0	0	0
BULL NOSE																																	0	0	0	0	0
PLACE CEMENT														6																			0	6	0	0	0
SET CEMENT																							3										0	0	0	3	0
DRILL CEMENT															6		10	10														0	0	26	0	0	
MIX MUD																																	0	0	0	0	0
CONDITION HOLE																																	0	0	0	0	0
CLIENT OPERAT.																																	0	0	0	0	0
CLIENT NON-OPER.																																	0	0	0	0	0
FISHING																																	0	0	0	0	0
WAITING															6	12	2																0	0	20	0	0
MAINTENANCE																																	0	0	0	0	0
BREAKDOWN																		2															0	0	2	0	0
RIG DOWN																																	0	0	0	0	0
																																	0	0	0	0	0
TOTAL HOURS	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	24	12	12	12	24	12	24	24	24	24	24	24	24	24	24	84	72	84	96	72	
QUANTITIES:																																					
START DEPTH	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414	418	439	449	466	478	500	526	550	566	587	414	414	414	449	550						
PRESENT DEPTH	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414	418	439	449	466	478	500	526	550	566	587	596	414	414	449	550	596					
DAILY ADVANCE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	21	10	17	12	22	25	25	16	21	9	0	0	36	101	46					
EQUIV. ADVANCE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	22	11	18	13	23	27	26	17	22	9	0	0	37	106	48					
No. RUNS DRILLED																	1	4	2	3	2	4	5	5	3	5	2	0	0	7	19	10					
REDRILL METRES																																	0	0	0	0	0
No. NORMAL TRIPS																	1							1			1	0	0	1	1	1					
No. I/TUBE TRIPS																	1	1	1	1	2	1	1	1	2	2	1	0	0	3	6	5					
No. FISH TRIPS																																	0	0	0	0	0
No. BITS USED																	1						1		1		0	0	1	1	1						
DIESEL USED																																	0	0	0	0	0
CEMENT USED																																	0	0	0	0	0
ROCKTYPE																	L	L	L	L	L	L	L	L	L	L	L										
WIRELINE																	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ	HQ										
CONVENTIONAL																																					

TABLE 5.2 PRODUCTION PERFORMANCE REPORT

TABLE 5.3 MAINTENANCE REPORT

MAINTENANCE REPORT							
COMPANY A							
FOR THE MONTH ENDED JULY 19XX							
CONTRACT NO.	AV 234	RIG MACH. TYPE		RIG			
RIG NO	ST1	WATER MACH. TYPE		PUMP			
		LIGHT MACH. TYPE		GENERAT.			
DATE	EQUIP'T	HOURS	ONSUM'L	CAPITAL	MACHINE	METRES	TOTAL
	TYPE	WORKED	SPARES	SPARES	HOURS		COST
01/07							
02/07							
03/07							
04/07							
05/07							
06/07							
07/07							
08/07							
09/07							
10/07							
11/07							
12/07							
13/07							
14/07							
15/07							
16/07							
17/07							
18/07							
19/07							
20/07							
21/07							
22/07							
23/07							
24/07							
25/07							
26/07							
27/07							
28/07							
29/07							
30/07							
31/07							
TOTAL							

NOTES:

RIG - MACH. TYPE CAT=1,DEUTZ=2,MERC=3,
 WATER - MACH. TYPE LIST=6,YAN=7,HONDA=8
 LIGHT - MACH. TYPE LIST=11,YAN=12,HONDA=13
 RIG TYPE SULL50=16,SULL45=17,TONE=18,TXL=19
 PUMP TYPE BEAN=21,KEMPE=22,?=23
 GEN. TYPE GEC=26,DELTA=27

(Source: personal research)

5.6.2 Weekly reporting

The daily reports on the performance data must be submitted weekly for data capture. This data, combined with the daily costing data and stores issues, are summarized into weekly reports to management. The production performance summary, Table 5.4, page 122, is done on a weekly basis with a total for a month end summary. The cost card, section 5.3.1, page 114, and Table 5.1, page 116, is updated on a weekly basis when the requisitions and daily reports are received. This cost card gives progressive totals of the different direct costs elements. The labour cost can only be entered at the end of the month when bonuses are calculated and paid.

5.6.3 Monthly reporting

The monthly reports are usually used by management to determine the effectiveness, efficiencies and profitabilities of the different rigs and of the company as a whole.

The most important monthly report will be the operating statement which has two parts, the cost control performance report and the summary of performance.

5.6.3.1 Operating statements

This report is actually the flexible budget used on a monthly basis. When done for each individual rig, management can concentrate on variances that have occurred and take remedial action if necessary. Care must be taken in cases where the variances could be due to incorrect budget formulae and or standards. This will however be evident after using the flexible budget for a number of months and the same variances occur consecutively. The relevant budget formulae and or standards will then have to be altered if management is convinced that it is impossible to reduce the variances by any other means.

□ Cost control performance report

This report is very useful to emphasize areas which need attention and can also serve as an additional motivational tool for the different foremen to increase the performance of the drilling rigs under their supervision. Table 4.6, page 94.

TABLE 5.4 PRODUCTION PERFORMANCE SUMMARY

PRODUCTION PERFORMANCE SUMMARY						
COMPANY A						
MONTH :	JULY 19XX		MACHINE TYPE:		SULL50	
HOLE :	ST1		AREA CODE:		OVS 1	
	WEEKS					MONTH
	1	2	3	4	5	
START DEPTH	414	414	414	449	550	414
END DEPTH	414	414	449	550	596	596
METRES DRILLED	0.00	0.00	35.50	101.0	45.78	182.27
EQUIVALENT METRES	0.00	0.00	37.35	106.2	48.16	191.75
GROUT METRES DRILLED	0.00	0.00	0.00	0.00	0.00	0.00
HOURS WORKED	84.00	72.00	84.00	96.00	72.00	408.00
OPERATING HOURS	0.00	0.00	36.00	93.00	72.00	201.00
NON-PRODUCTIVE HOURS	38.00	50.00	10.00	5.00	20.00	123.00
DRILL HOURS	0.00	0.00	25.00	76.00	57.00	158.00
SHIFTS	7.00	6.00	7.00	8.00	6.00	34.00
TRIP HOURS	0.00	0.00	11.00	17.00	15.00	43.00
NO. OF NORMAL TRIPS	0.00	0.00	1.00	1.00	1.00	3.00
NO. OF FISHING TRIPS	0.00	0.00	0.00	0.00	0.00	0.00
NO. OF BITS USED	0.00	0.00	1.00	1.00	1.00	3.00
DELAY TYPE:FISHING	0.00	0.00	0.00	0.00	0.00	0.00
WAITING	0.00	0.00	20.00	0.00	0.00	20.00
MAINT.	0.00	0.00	0.00	0.00	0.00	0.00
BREAK	0.00	0.00	2.00	0.00	0.00	2.00
CLIENT	0.00	0.00	0.00	0.00	0.00	0.00
EQUIV. METRE/SHIFT	0.00	0.00	5.34	13.28	8.03	5.64
METRES / SHIFT	0.00	0.00	5.07	12.62	7.63	5.36
METRE/HOUR WORKED	0.00	0.00	0.42	1.05	0.64	0.45
METRE/OPERAT. HOUR	ERR	ERR	0.99	1.09	0.64	0.91
METRE/DRILL HOUR	ERR	ERR	1.42	1.33	0.80	1.15
EQUIV.M/DRILL HOUR	ERR	ERR	1.49	1.40	0.84	1.21
AVERAGE RUN LENGTH	ERR	ERR	5.07	5.32	4.58	5.06
METRE/BIT	ERR	ERR	35.50	101.0	45.78	60.76
TRIP METRES						1788.0

(Source: Company B and personal research)

☐ **Performance summary**

This report, as previously mentioned in chapter 4 isolates the variances from the flexible budget and acts as an explanation between the actual results achieved versus the master budget (Horngren & Foster, 1991:215).

☐ **Efficiency variances**

The calculation of efficiency variances for the production labour will focus the attention on the efficiencies of the different drilling crews. Although it was suggested that direct labour be regarded as a fixed cost, the efficiency of the labour must be determined, Table 4.3(a), page 79. The diesel and diamond cost efficiencies can also be determined in the same way, see Tables 4.3(b) & (c), page 80.

5.6.3.2 Cash flow report

A monthly cash flow report and comparison with the original cash flow budget will assist in the determination of the future cash position. This could indicate the possible cash flow position for the next period and necessary steps can be taken timeously to overcome possible cash shortages before they occur, Table 5.5, page 124.

5.6.3.3 Income statement

The monthly income statement will give management the necessary information on the profit or loss that was made for the month. When the weekly production performance data are received and recorded with the relevant cost data from the cost card, a weekly pro-forma income statement can be supplied to management for analysis. Should abnormal variances occur when compared to the standards that were previously set, management can devise action plans timeously, to normalise the variances to acceptable levels. The weekly pro-forma income statements can be used for projections to the end of the month and can warn management in due course of potential cash flow problems that might arise from poor production or other events.

5.6.3.4 Balance sheets

The use of computers in financial and accounting systems results in the ability to generate a balance sheet for the company at any given moment. The benefits of this are that ratio analysis can be incorporated and presented with the balance sheet to

TABLE 5.5 CASH FLOW REPORT

CASH FLOW REPORT				
COMPANY A				
FOR THE MONTH ENDED XXX, 19X1				
	ACTUAL	PLANNED	VARIANCE	REMARKS
CASH OUTFLOWS				
OPERATING EXPENSES				
Trade creditors	156480	150000	-6480	
Sub contractors	5000		-5000	
Bonus	5000	2500	-2500	
Lease payments			0	
HP payments	22800	22800	0	
Insurance	4200	4200	0	
Rent	750	750	0	
Water & Lights	150	160	10	
Donations	150		-150	
Entertainment	200	150	-50	
Vehicle expenses			0	
Rent	500	500	0	
Maintenance	460	600	140	
Fuel & Lubricant	3800	4600	800	
Licenses			0	
Insurance	240	200	-40	
Telephone	850	700	-150	
Other	4000	5000	1000	
Sub total	204580	192160	-12420	
FIXED EXPENSES				
Admin & Managm't	5600	5000	-600	
Salaries & Wages	98600	98467	-133	
Fixed investments			0	
Loan repayments	20000	20000	0	
Interest	24000	24000	0	
Tax payments			0	
Dividends			0	
Other	750		-750	
Sub total	148950	147467	-1483	
TOTAL CASH OUTFLOW	353530	339627	-13903	
CASH INFLOWS				
Trade debtors				
Accounts receivable	412000	375000	37000	
Sundry Revenue		2500	-2500	
TOTAL CASH INFLOWS	412000	377500	34500	
NET CASH FLOW + (-)	58470	37873	20597	
Balance carried forward 20000	78470	89050	-10589	
Desired balance	10000	10000		
TOTAL CASH REQUIRED	0	0	0	

(Source: Presumed values for illustration)

serve as management information. Standards for this industry are not available due to the lack of published information and the reluctance of the different companies to supply such sensitive information. An example of a balance sheet obtained from a company is attached as Appendix 5.1, page 141.

It is suggested that ratio analysis is undertaken from historical balance sheets and that detail investigations are done in order to set acceptable standards for the different applicable ratios. This information can prompt timeous action plans to be devised by management should variances occur that fall outside acceptable limits.

5.7 SUMMARY

The need for comprehensive performance data capture and the transformation of this data into management reports cannot be over emphasized. This performance data, coupled to the cost information, should form the basis for the setting of cost and performance standards that can assist management in their control and decision making functions to ensure the continued profitable existence and possible growth of the company.

The reporting of the performance and cost data is crucial in this type of operation as big losses can be incurred if the wrong decisions are made on site. The current form of daily or exceptional reporting is supported and should continue and be enforced if not done.

The merging of the performance reports and the cost reports is also very important in price determinations for tender purposes. This should assist management in the determination of the prices in order to minimize the risk of tendering too low or too high in a very competitive industry.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

The conclusions and recommendations that are made, are based on personal experience of being a member of a company which is a client to different drilling companies in surface and underground exploration drilling, managing a number of smaller underground diamond drill machines on a mine, and on the information gathered in the course of, and presented in the preceding chapters of this study.

The theory of cost and management accounting is well documented in the literature and from the preceding study it is concluded that some of these principles can be implemented successfully in the drilling industry. Bearing the objectives of this study in mind, chapter 1, some principles that could possibly meet the objectives, were discussed. A basic costing system could be designed on either a spreadsheet or a data base, or both types of software packages, to provide the necessary relevant information to the individual decision makers. Custom designed software programmes are usually more expensive to develop and could be considered, if they prove to be cost effective, unless the expertise is available in the company.

6.2 THE PRESENT SYSTEM

The present system, as described in chapter 3, does take a number of the suggestions into account. It is however concluded that not enough emphasis is put on the collection and utilization of comprehensive performance data that can assist in the setting of various cost and performance standards. The present costing system also does not supply sufficient cost and performance information for the different depth categories to assist general planning and decision making by management. The use of equivalent metres in all the relevant types of performance and cost reports is strongly recommended as this should give a better method of comparing actual and planned performance and cost figures for the different rigs, contracts or geological provinces.

The present form of reporting all costs as a percentage of the turnover relies predominantly on the tendered prices. It can therefore be concluded that the company is very confident about their pricing policy and prices tendered are the only form of standards that are used. This practice is regarded as unsuitable as different contracts can have different prices and can therefore not be used as a measure of performance to compare the performances of the different drilling rigs. This practice can be employed if the company has only one standard contract and standard price for all the different clients. It is doubtful whether this will be the case in a very competitive market.

6.3 OBJECTIVES

Some applicable cost and management accounting principles were discussed and proposed with the objectives of the study in mind, chapter 1.

6.3.1 Primary objectives

It is regarded that the use of flexible budgets can supply more meaningful information for short term, operational cost and performance control than the present system in use.

The planning and budgeting for equipment replacement and maintenance should be reflected in the cash flow budget, table 6.1, page 131. If this is achieved the effects on the cash situation should be very obvious. This has the added advantage that external funding can be negotiated, if needed, well in advance of shortages actually materialising. Trend analysis utilizing the performance reports will be invaluable to operational management and strategic planning, budgeting and decision making.

If the ideas suggested are implemented and the system is designed in an integrated way on a computer, it is envisaged that a reasonably quick and accurate determination of costs will be possible. This can assist decision making by having the most recent performance and cost information readily available.

The setting of performance and cost standards should also be relatively quick if all the cost and performance data capturing is computerized.

6.3.2 Secondary objectives

The effect of the application of some of the mentioned principles on the slightly subjective secondary objectives is somewhat more difficult to determine.

The cost and performance information arising from the proposed applications of some cost and management accounting principles could be invaluable for planning, budgeting and control of operations by both the client and the contractor. The client can utilize the performance data from the contractor in his planning of exploration programmes as the client also has to plan and control his sources and flow of funds. This is very important as the reaction time on negative variances from the planned performances can range from one month to a year, depending on the availability of drilling rigs, the depths and rock types to be drilled and the scale of operations.

When a new contract is tendered for, the use of the most recent, reasonably accurate and relevant cost and performance information on not just depth categories, but rock types as well, could give the contractor the differential advantage of having based his prices on factual and relevant information, to be awarded the contract.

In the event of sudden, abnormal (that is much higher than the prevalent inflation rate) price increases, or unforeseen problem conditions, unknown to both contractor and client, are experienced in the drilling of a hole, a re-negotiation of contract prices should be easier if comprehensive cost information is available to determine the effect of such price changes or the effect of the difficult drilling conditions has on the viability of the project for the contractor and client alike.

6.3.3 Problem specification

The major problem, as stated in section 1.2 page 2, should be solved to a large degree if the proposed principles are applied. Whether the best decisions will be made is only dependent on the experience of the person(s) making the decisions.

The use of equivalent metres in the measurement of performances should enable management to compare the performances of the different drilling rigs with each other without using costs as a percentage of the turnover as a base which is regarded as unsuitable for the reasons already stated.

6.4 RECOMMENDATIONS

In respect of the application of some cost and management accounting principles to diamond drilling, the following recommendations are made.

6.4.1 Reporting

The existing daily performance report must be completed comprehensively for each day as this report forms the basis of almost the entire performance measurement system. This data is also used for the cost performance measurement of the different rigs and the company as a whole. Close supervision on this aspect should be kept at all times.

The present system of three hourly reporting of operations at each drilling rig keeps management fully informed on the state of operations and should reduce downtime when action plans must be devised and implemented if and when problems occur. This practice is highly commendable and should be strictly adhered to in the cases of inexperienced chargehands and or foremen.

With the 5422.76 metre world record borehole, Fortier (1988:7) regards the facts that no fishing, no breakdowns and a fairly uniform bit life was experienced, as being the key factors to this successful borehole. Should any fishing or breakdowns occur, the current reporting system should immediately supply the relevant information to management.

6.4.2 Cost classification

The present system of classifying all labour costs, with the exception of the managing director's salary, as direct production labour should be changed as proposed, that is, classifying these costs as fixed overheads. The measuring of the direct labour efficiencies must however not be ignored and should be monitored on a regular basis and used for the setting of realistic performance standards that could possibly be used in bonus calculations.

Saturdays should be included in the normal production time and not seen as an extra day in which additional metres can be drilled to achieve the monthly goals. This can have the effect that the employees may regard this as an optional working day and could result in below standard performances. This practice will also seriously affect the cost and production performance calculations used for the setting of standards which

in turn are used in a vast number of management decisions and in planning, control and budgeting functions.

6.4.3 Planning and budgeting

Due to the intimate relationship between planning and budgeting every effort should be made to ensure that the information used for these activities is as accurate and relevant as possible.

The planning of any future production should make use of the performance and cost data obtained from the daily reports and the cost cards which is summarized in the production performance reports and the cost control performance report Table 4.6, page 94, and the summary of performance Table 4.5, page 90.

The use of a monthly cash flow budget, Table 6.1, page 131, combined with a monthly cash flow report, Table 5.5, page 124, cannot be overemphasised as it can assist in buying decisions that could otherwise cause severe cash flow problems. This is very important in the case where the market is expanding and a company wishes to grow as well. Expansion is usually associated with a reduction on cash reserves of a company.

The flexible budget as a form of performance reporting should be seriously considered as a tool to assist management in their control functions.

The effect of the pricing decisions on the profitability of the company is of extreme importance and the use of cost and performance standards in the planning and control of operations should manifest itself in the eventual price determination for any contract tendered for.

An analysis of the information compiled in the maintenance reports could lead to a practice where equipment replacement can be included in the long term planning and used in the cash flow budgets. An example of such planned equipment replacement is given in Table 6.2, page 132. This information could also be used on shorter term planning where major maintenance of the major components can be planned for in advance. This will assist in the cash flow budgets as well as the production planning. This planned maintenance on components is necessary as the time spent on these actions, unexpectedly, can influence the cash flow and profit situations quite dramatically.

TABLE 6.1 CASH FLOW BUDGET

CASH FLOW BUDGET COMPANY A												
FOR THE YEAR 19X1 – 19X2				R000's				DATE				
	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEBR
CASH OUTFLOWS												
OPERATING EXPENSES												
Trade creditors	155.5	135.0	150.0	155.0	155.0	160.0	135.0	155.0	140.0	155.0	75.0	85.0
Sub contractors	5.0	2.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0
Bonus	5.0	4.5	2.5	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lease payments	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HP payments	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8
Insurance	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
Rent	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Water & Lights	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Donations	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entertainment	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	5.0	0.2	0.2
Vehicle expenses	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rent	0.5	1.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Maintenance	0.2	0.2	0.6	0.2	0.3	0.6	0.3	0.3	0.6	0.3	0.1	0.2
Fuel & Lubricant	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Licences	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insurance	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Telephone	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.3	0.5	0.7
Other	4.0	2.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Sub total	204.9	179.0	192.2	199.3	199.7	209.7	179.3	199.3	184.7	203.7	118.9	129.3
FIXED EXPENSES												
Admin & Managm't	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Salaries & Wages	98.5	98.5	98.5	98.5	98.5	98.5	98.5	98.5	98.5	196.9	98.5	98.5
Fixed investments	0.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loan repayments	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Interest	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
Tax payments	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
Dividends	0.0	0.0	20.0	0.0	0.0	20.0	0.0	0.0	20.0	0.0	0.0	20.0
Other												
Sub total	147.5	167.5	167.5	247.5	147.5	167.5	147.5	147.5	167.5	345.9	147.5	167.5
TOT CASH OUTFL	352.4	346.4	359.6	446.7	347.2	377.1	326.8	346.8	352.1	549.6	266.4	296.7
CASH INFLOWS												
Trade debtors												
Accounts recievable	420.0	400.0	375.0	375.0	400.0	380.0	430.0	375.0	400.0	170.0	180.0	375.0
Sundry Revenue	0.0	0.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
TOT CASH INFLOW	420.0	400.0	377.5	377.5	402.5	382.5	432.5	377.5	402.5	172.5	182.5	377.5
NET CASH FLOW + (-)	67.6	-53.6	-17.9	-69.2	-55.3	-5.4	105.7	-30.7	-50.4	-377.1	-83.9	-80.8
Balance carried forw	17.6	71.2	89.1	19.8	75.2	80.5	186.3	217.0	267.4	-109.8	-193.6	-112.8
Desired balance	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
TOT CASH REQ'D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	119.8	203.6	-122.8

(Source: Presumed values for illustration)

TABLE 6.2 PLANNED EQUIPMENT REPLACEMENT

PLANNED EQUIPMENT REPLACEMENT COMPANY A											
FOR THE PERIOD 19X1 - 19XX										DATE	
RIG TYPE		19X1	19X2	19X3	19X4	19X5	19X6	19X7	19X8	19X9	19XX
RIG 1 Suff 50	Item Cost	Engine 30000	Hoist 20000	Transmis. 15000	Pumps 17600	Tower 21000	Generator 18000	Engine 30000	Hoist 20000	Tranmis. 15000	Pumps 17600
RIG 2 Suff 50	Item Cost	Generator 18000	Engine 30000	Hoist 20000	Tranmis. 15000	Pumps 17600	Tower 21000	Generator 18000	Engine 30000	Hoist 20000	Tranmis. 15000
RIG 3 Suff 50	Item Cost	Tower 21000	Generator 18000	Engine 30000	Hoist 20000	Tranmis. 15000	Pumps 17600	Tower 21000	Generator 18000	Engine 30000	Hoist 20000
RIG 4 Suff 45	Item Cost	Pumps 17600	Tower 21000	Generator 18000	Engine 20000	Hoist 15000	Tranmis. 10000	Pumps 17600	Tower 21000	Generator 18000	Engine 20000
RIG 5 Suff 45	Item Cost	Transmis. 10000	Pumps 17600	Tower 21000	Generator 18000	Engine 20000	Hoist 15000	Tranmis. 10000	Pumps 17600	Tower 21000	Generator 18000
RIG 6 Tone	Item Cost	Hoist 10000	Tranmis. 8000	Pumps 17600	Tower 15000	Generator 18000	Engine 15000	Hoist 10000	Tranmis. 8000	Pumps 17600	Tower 15000
SUB TOTAL		106600	114600	121600	105600	106600	96600	106600	114600	121600	105600
MODS											
AX	Quantity Cost										
BX	Quantity Cost			600 45000				200 24000			
NQ	Quantity Cost			400 45000							
CRD 76	Quantity Cost	11000 935000	7000 595000	11000 935000	7000 595000	11000 935000	7000 595000	11000 935000	7000 595000	11000 935000	7000 595000
CRD 101	Quantity Cost										
OTHER Truck	Cost					150000					
TOTAL		1041600	709600	1146600	700600	1191600	691600	1065600	709600	1056600	700600

- NOTES:
1. All figures in Rand are quoted at 19X1 base rates.
 2. No provision for escalation is made.
 3. All figures are hypothetical and for illustration only.

PLANNED MAINTENANCE COMPANY A FOR THE PERIOD 19X1 – 19XX DATE													
PROD. DAYS		21	18	19	22	18	21	21	18	20	8	20	18
RIG TYPE		MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEBR
RIG 1 Sull 50	Item	Engine			Tower			Transm.				Pumps	
	Cost	15000			5000			7000				2000	
	Hrs	120			24			24				12	
RIG 2 Sull 50	Item	Tower					Engine			Hoist			
	Cost	5000					10000			4000			
	Hrs	24					120			12			
RIG 3 Sull 50	Item			W/line					Pumps				
	Cost			2000					2000				
	Hrs			8					12				
RIG 4 Sull 45	Item		Transm.			Tower							W/line
	Cost		7000			5000							2000
	Hrs		24			24							8
RIG 5 Sull 45	Item			Engine									
	Cost			10000									
	Hrs			120									
RIG 6 Tone	Item	Tower						Transm.					Engine
	Cost	5000						7000					8000
	Hrs	24						24					120
TOTAL COST		25000	7000	12000	5000	5000	10000	14000	2000	4000	0	2000	10000
TOTAL TIME (hrs)		168	24	128	24	24	120	48	12	12	0	12	128

- NOTES:
1. All figures in Rand are quoted at 19X1 base rates.
 2. No provision is made for escalation.
 3. All figures are hypothetical and for illustration only.

TABLE 6.3 PLANNED MAINTENANCE

6.4.4 General

More general recommendations can include the possible use of a cheap personal computer on each drilling site to make the capture of data more productive and it will also eliminate confusion which always exists when another person is capturing data from handwritten sheets.

Tenders should be designed to not include any “grey” areas which can cause confusion and disagreement between the client and the drilling contractor. It is suggested that the drilling contractor should measure the rock quality designations, (RQD’S) of the rocks when it is extracted from the core barrel. This is the best place to measure the RQD’S, and can also be used in quantifying bad ground conditions which are usually a grey area in contracts and frequently leads to a dispute between the contractor and the client. This practice will also enhance the service a contractor is providing to the client and it is believed that this will be accepted by most of the geologists and rock mechanical engineers involved.

Contractors should try and plan strategically together with their clients as both parties can benefit from such an exercise.

6.5 SUMMARY

The current stagnant dollar gold price coupled with a “high” inflation rate which results in the curtailing of exploration budgets (De Jager, 1990:96), is responsible for a declining diamond drilling market. In this scenario it becomes more important for drilling companies, especially those without in- house protection, to take a closer look at their costs and performances to enable them to adapt their operations to stay competitive. One way of obtaining the competitive “edge” is to tender the lowest possible prices without sacrificing quality. This is attainable with dedicated, effective, efficient and comprehensive operational management which includes cost control, planning and budgeting.

From the preceding study it is concluded that numerous cost and management accounting principles exist which can and should be applied to diamond drilling in a very competitive market.

APPENDICES

APPENDIX 3.1

"WAGE SHEET"
LOONSTAAT

VAN:.....

TEREIND:.....

19.....

19.....

OPERATEUR

TOEGANG

STANGIOLP

POS

AIDIC

T

11

32

DAG	NORMALE URE	OORTD URE	BONUS	VELD- TOELAAG	PROJEK NR	HOPE ANSTELLING	DICHTSREINIGING	TARIEF ANPASSING	BEEN VERANDERING
11									
12									
13									
14									
15									
16									
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5									
6									
7									
8									
9									
10									
Totale ure									
Tarief Bedrag									

LOONSTAAT BEKONTROLEER:-

LEIDERHUIS:

VOORNAAM:

LOONSTAVING WORD KLERKEE ERKEN:-

TOTAAL

PAYE: PERSEONAL PARTICULARS OF EMPLOYEE

1. SURNAME:.....

2. DATE OF BIRTH:...../...../19.....

3. NAMES IN FULL:.....

4. ADDRESS:.....

5. MARK THE APPLICABLE BLOCK WITH X

MARRIED ☐

NOT MARRIED ☐

DIVORCED ☐

6. UNMARRIED CHILDREN INITIALS AND SURNAME & DATE OF BIRTH

1...../...../19.....

2...../...../19.....

3...../...../19.....

4...../...../19.....

5...../...../19.....

6...../...../19.....

7...../...../19.....

8...../...../19.....

7. INCOME TAX NUMBER:.....

8. IDENTITY NUMBER:.....

9. I CERTIFY THAT THE INFORMATION GIVEN IS CORRECT

.....

DATE..... SIGNATURE OF EMPLOYEE.....

NEW EMPLOYMENT/AMMENDMENTS

WAGE:-RATE

HOOR FIELD PRODUCTION

.....

MANAGER:.....

DATE:...../...../19.....

RESIGNATION/DISMISSED

NAME:.....

DATE OF LAST SERVICE:-

...../...../19.....

REASON:-

.....

.....

.....

ADMIN. ONLY

LEAVE DAYS:.....

PERSONNEL DEBTS:-

U. I. F. CARD:-

(Source: Company A)

(Source: Company A)

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ACTIVITY RECORD										ACTIVITY CODE						
DAY SHIFT					NIGHT SHIFT					DISTRIBUTION OF HRS			ITEM	DESCRIPTION		
TIME	LOWER ROOS	DRILL	PULL ROOS	BREAK DOWN	OTHER	TIME	LOWER ROOS	DRILL	PULL ROOS	BREAK DOWN	OTHER	A			B	C
06h00 - 06h30						18h00 - 18h30									1	RIG UP
06h30 - 07h00						18h30 - 19h00									2	LOWER CASING
07h00 - 07h30						19h00 - 19h30									3	PULL CASING
07h30 - 08h00						19h30 - 20h00									4	PLACE CEMENT
08h00 - 08h30						20h00 - 20h30									5	CEMENT SET
08h30 - 09h00						20h30 - 21h00									6	DRILL CEMENT
09h00 - 09h30						21h00 - 21h30									7	REAM
09h30 - 10h00						21h30 - 22h00									8	LOWER PIPE A LOCK/O
10h00 - 10h30						22h00 - 22h30									9	LOWER WEDGE
10h30 - 11h00						22h30 - 23h00									10	BULL NOSE
11h00 - 11h30						23h00 - 23h30									11	RIG DOWN
11h30 - 12h00						23h30 - 24h00									12	MIX MUD
12h00 - 12h30						24h00 - 00h30									13	CONDITION HOLE
12h30 - 13h00						00h30 - 01h00									14	SURVEY/GEO. LOG
13h00 - 13h30						01h00 - 01h30									15	FISHING
13h30 - 14h00						01h30 - 02h00									16	WAITING
14h00 - 14h30						02h00 - 02h30									17	NO WATER
14h30 - 15h00						02h30 - 03h00									18	PULL INNER TUBE
15h00 - 15h30						03h00 - 03h30									19	LOWER INNER TUBE
15h30 - 16h00						03h30 - 04h00									20	SERVICE MACHINE
16h00 - 16h30						04h00 - 04h30									21	
16h30 - 17h00						04h30 - 05h00									22	
17h00 - 17h30						05h00 - 05h30									23	
17h30 - 18h00						05h30 - 06h00									24	
SHIFT TOTAL						SHIFT TOTAL									25	OTHER - SEE REMARKS

A = OPERATING HRS. B = STANDBY HRS. C = CONTRACTORS HRS.

REMARKS:—

APPENDIX 3.3

INCOME STATEMENT

Company A

Average % of turnover, for the 6 months ending XX/1991

	average %	Rands
INCOME		
Sales	97.55	1219375
Establishment	0.59	7400
Casing	0	0
Sub-Contract Income	1.77	22175
W.I.P. Settlement	0	0
Other Group Income	0.08	1050
TOTAL INCOME	100.00	1250000
COSTS		
MATERIAL COSTS		
Fuel & Lubricants	8.83	110375
Bits	9.31	116375
Rods	9.01	112625
Cables	2.12	26500
Casing	0.63	7875
Corebarrels	0.67	8375
Loose Tools	4.12	51500
Consumable material	6.67	83375
Maintenance machines	5.60	70000
Protective clothing	0.22	2750
TOTAL MATERIAL COSTS	47.18	589750
LABOUR COSTS		
Salaries	8.42	105250
Wages	9.37	117125
Wages apportioned	0.14	1750
Director's bonuses	0	0
Production Bonusses	1.57	19625
Co. contr. Pension	1.07	13375
Co. contr. Medical	0.26	3250
Co. contr. Spouse insurance	0	0
Co. contr. Insurance	0.03	375
Co. contr. W.C.F	0.07	875
Leave & Bonuses	1.6	20000
Field allowances	2.43	30375
Sub contractor's expenses	1.96	24500
Rations	1.86	23250
TOTAL LABOUR COSTS	28.78	359750
INDIRECT PRODUCTION COSTS		
Accident insurance	0.15	1875
Office maintenance	0.13	1625
Fuel levy	0.67	8375
Rent office	1.65	20625
Rent equipment	2.21	27625
Security	0.03	375
Water & lights	0.07	875
Insurance machines	0.33	4125
Printing & copying	0	0
Rod inspection	0.07	875
Accomodation& Travel Local	0.03	375
Vehicle rent	0.24	3000
Vehicle fuel	1.32	16500
Vehicle maintenance	0.47	5875
Vehicle licence	0.03	375
Depreciation machines	3.37	42125
Depreciation vehicles	0.48	6000
Immigration & Medical	0	0
H.P. Financing	2.53	31625
Lease payments	0	0
TOTAL INDIRECT PRODUCTION COSTS	13.78	172250
TOTAL PRODUCTION COSTS	89.74	1121750

INCOME STATEMENT (Continued)

Company A

Average % of turnover, for the 6 months ending XX/1991

	average %	Rands
ADMIN & MANAGEMENT COSTS		
Group Admin & Management	0	0
Salaries	1.59	19875
Recruitment	0.05	625
Personnel lunches	0.06	750
Life insurance	0	0
Furniture maintenance	0	0
Office machine maintenance	0	0
Rent office machines	0.03	375
Printing & copying	0.06	750
Stationary	0.07	875
Telephone & postage	0.27	3375
Computer services	0.05	625
Kilometre claims	0.32	4000
Accommodation & Travel Local	0.01	125
Accommodation & Travel Abroad	0	0
Vehicle rent	0	0
Vehicle fuel	0.03	375
Vehicle maintenance	0	0
Vehicle licence	0	0
Depreciation- furniture	0	0
Depreciation- office mach.	0.07	875
Depreciation- vehicles	0	0
Subscriptions & training	0.01	125
Presents & bouquets	0	0
Fines	0	0
Regional services council	0.08	1000
Legal fees	0	0
Bank charges	0.16	2000
Interest - Bank	0.2	2500
Interest - Other	1.72	21500
Lease payments	0.05	625
H.P. payments	0	0
Accounting-secretarial fees	0.06	750
Oudit fees	0.1	1250
Donations	0.01	125
Marketing	0.06	750
Entertainment	0.24	3000
Asset sale, profit/(loss)	0	0
Interest recieved	0.06	-750
Other income	0	0
Other expenses	0	0
Profit/(loss) to B/Sheet	0	0
TOTAL ADMIN & MANAGEMENT COSTS	5.36	65500
TOTAL COSTS	35.1	1187250
NETT INCOME BEFORE TAX	4.9	62750
COMPANY TAX		
NETT INCOME AFTER TAX		

(Source: % from Company A)
: R figures presumed)

APPENDIX 3.4

MONTHLY INVENTORY PLANNING

Company A

Month.....19XX

Site.....

Hole size:

NXC..... m

NX..... m

CHD..... m

BXH..... m

BQ..... m

INVENTORY REQUIRED FOR MONTH

1.1 CROWNS: Planned metres metres/crown = REAMERS =

Landing Rings

Core springs

Locking coupling

Stabilizers

Cages

Shutoff rubbers

Inner tubes

Adapter coupling

1.2 PUMPS

Cups

Gaskets

Sleeves

Valves

1.3 JAWS

Chuck jaws

Clamp inserts

1.4 CONSUMABLES

Teepol

500 W Light bulbs

Waste

150 W Light bulbs

1.5 CABLES

20mm Hoist cable

Wireline cable

1.6 LOOSE TOOLS

Wrench Hooks

Wrench Heels

Chaintong jaws

36"

36"

24"

24"

18"

18"

Chaintong chains

1.7 FUELS & LUBRICANTS (litres)

Diesel

Cutting oil

Copper grease kg

Remula

Rotella

Spirex

E.P.2 Grease kg

Rod grease kg

Tellus

1.8 RODS

In stock m

Required m

1.9 OTHER

Signed

Date

(Source: Company A)

APPENDIX 5.1

BALANCE SHEET SUPPORTING SCHEDULES

COMPANY A

Rek. No Beskrywing		HUIDIG		JAAR TOT DATUM		
		Werklik	Begroot	Werklik	Begroot	Vorige Jaar
AANDELEKAPITAAL						
001101 Gewone Aandelekapitaal						

continued on next page

BALANCE SHEET SUPPORTING SCHEDULES

(continued)
COMPANY A

Rek. No Beskrywing		HUIDIG		JAAR TOT DATUM		
		Werklik	Begroot	Werklik	Begroot	Vorige Jaar
LENING TOEGESTAAN						
115145 Maatskappy B						
Sub-Totaal =						
BELEGGING						
116244 Aandelekapitaal Mpy B						
116245 Oordragskoste: Aandele						
Sub-Totaal =						
BEDYFSBATES						
120253 Onvoltooide Voorraad						
120256 Verbruiksvoorraad						
120257 Voorraadaansuiwering						
120261 Handelsdebiteure						
120262 Personeeldebiteure						
120266 Sal & Lone Afhandelsrek.						
120267 Salaris: Filiale						
120268 Afwagrek:Verkoop Bates						
120269 Vooruitbetaalde uitgawes						
120282 Deposito's						
120285 Kleinkas						
Sub-Totaal =						
BEDRYFSLASTE						
130151 Handelskrediteure						
130152 Spes. Kred. Mpy. 4						
130157 Spes. Kred. Mpy. B						
130158 Spes. Kred. Mpy. C						
130160 Krediteure Mpy 4/Stange						
130171 Voorsiening Mpy Belasting						
130172 Ontv. v. Inkomste L.B.S.						
130179 Onopgeëisde Lone						
130181 Voors. Opgelope Uitgawes						
130182 Voors. Ouditfooie						
130183 Voors. Verlofgeld						
130184 Voors. Verlofbonusse						
130191 Bankrekening						
130193 Bank salaris Filiale						
130194 Kooperasie A						
130196 Kooperasie B						
130197 Dividend aanbeveel						
Sub-Totaal =						
Kontrole Totaal =						

(Source: Company A)

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