

# Contract Mining versus Owner Mining – The Way Forward\*

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## Abstract

Mining involves many operations such as rock breakage, materials handling, equipment maintenance, mine design, scheduling and budgeting. At one stage or the other mine managements often have to decide whether to undertake a major mining operation using their own equipment and personnel or to contract the operation out to a specialised mining contractor. By contracting out one or more of their mining operations, the mining companies can concentrate on their core businesses. This paper reviews contract mining and owner mining to determine the merits and demerits of each and how they affect the economies of the mining companies. The results show that the decision to adopt owner mining or contract mining is influenced by the life of the mine, the availability and use of capital, and that contract mining helps to reduce the cost of mines with short life spans. The general trends in the mining industry show that contract mining will be the way forward for most mines under various circumstances in the future.

## 1 Introduction

Mining involves operations such as mine design, drilling, blasting, equipment maintenance, scheduling and budgeting. Mine managements often have to decide whether to undertake all the major mining operations using their own equipment and personnel or to contract some or all of the operations out to specialised mining contractors. Contract mining is when the owners of a mine employ the services of specialist contractors to conduct the various mining operations such as drilling, blasting, equipment maintenance, processing operations, scheduling and budgeting where there is a legal agreement between the two parties that is enforceable by law. Owner mining, on the other hand, is when the owners of a mine use their own equipment and personnel in executing the operations. Most mining companies in Ghana and in the world as a whole employ either contract mining or owner mining systems.

Over the past two decades, there has been a rapid growth in contract mining worldwide. By contracting out one or more of their mining operations, the mining companies can concentrate on their core businesses while using specialists for rock breakage, raw materials preparation and materials handling. In the past, when owner mining was exclusively done, some mines tended to contract out one or two production operations because of their short duration. Today, contract mining operations range from exploration through the exploitation stage of mining up to the shipment of the final product. This paper attempts to study both systems to deter-

mine the merits and demerits of each and how they affect the economies of the mining companies.

## 2 Definition of Contract and Owner Mining

Contract mining and owner mining are mutually exclusive services. They provide alternative meanings that the selection of one precludes the other alternative from any further consideration since only one alternative is necessary to perform an operation (Mireku-Gyimah, 2005). The main difference between contract mining and owner mining is normally based on who has the most control over that particular mining operation. These operations include rock breakage (drilling and blasting), loading and hauling of ore and waste, mine design, equipment maintenance, scheduling and budgeting (des Bordes, 2004). This is most clearly demonstrated by which party owns and operates the mining equipment.

When a mining company undertakes all these operations using its own equipment and personnel, then the company is doing owner mining. On the other hand, if a mining company assigns some or all of these operations to a second party (contractor) then the company is engaging in contract mining. There is an increasing trend where most mines use contract mining services to mine the ore and waste, process the ore and to maintain their equipment.

There are several ways of comparing and analysing owner mining and contract mining economically. The main issues can be classified as corpo-

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rate, project specific, operational, cost and risk assessment (Kirk, 2002).

### 3 Contract Decision Factors

Some of the factors which influence the choice of whether to contract out mining operations or not include (Golosinski, 1998, Kirk, 2002, de Bordes, 2004):

- Where small mining companies are involved.
- An existing mine with ageing fleet but sufficient reserves to last for two or three years.
- Where a mining company wants to increase production for a short period.
- Nature and complexity of the works.
- Technical capacity, design and supervisory resources of the mine owner.
- The financial resources available and budget constraints.
- The size and duration of the project.
- The efficiency and the general economics of a chosen option.

The basic objectives of any contract process are (Golosinski, 1998) economy (value of money – result of competition), efficiency (cost effectiveness of process), equal access (non-discriminatory) and transparency (predictability, clear rules, disclosures).

#### 3.1 Types of Contracts

Several contractual agreements are used in contract mining. These can be broadly classified as traditional contract, risk sharing contract and strategic alliance contract depending on the mine life or duration of the contract, the certainty of rates and production volumes, the quantification of all risks involved in the project and the allocation of the individual risks to the party best capable in handling them (Golosinski, 1998).

The principles of contracting depend largely on the business outcomes for all parties involved, clear understanding of the individual and collective responsibilities and accountability, equitable balance of risks and rewards for the parties, encouragement of openness and co-operation between the parties, access to and contribution by the expertise and the skills of all the parties and encouragement to develop and apply innovative approaches and achieve continuous improvement (Golosinski, 1998).

#### 3.2 Contractual Options

Engineering contracts in both surface and underground mining are grouped under three main categories depending on the method by which payment

for the contractor's work is evaluated, the method by which the contract is selected and the method by which responsibility for the technical and administrative aspects of work is allocated (Bowen, 1997). The method of payment used in engineering contracts include lump sum contract, unit rate contract and cost reimbursable plus fee (cost plus) contract.

##### 3.2.1 Classification of Contractor Selection Methods

Methods that are employed to invite tenders from contractors are open tender, selective tender, nomination and serial tender (Atkinson, 1992). The principal options when selecting the contractor are either by a competitive tendering procedure or by direct negotiation with a selected contractor.

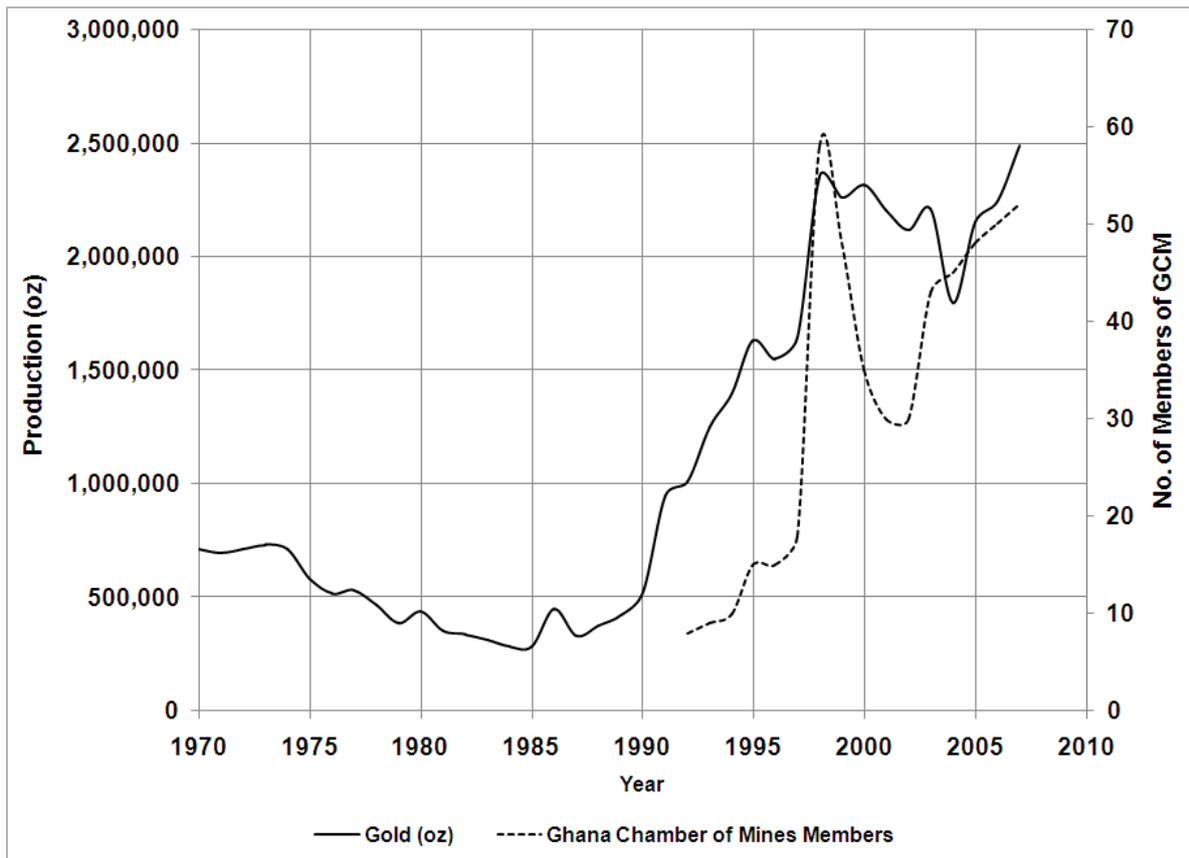
Competitive tendering procedure is the type of contract in which agreement is reached between the principal and a contractor following a formal competitive tendering procedure in which a number of contractors are invited to submit bids against a common set of tender inquiry documents. This is the most widely used form of contract and is suitable for engineering projects where the nature and the extent of the work under the contract can be defined clearly (Golosinski, 1998).

A sound method of contractor selection ensures confidentiality, transparency and fairness (Atkinson, 1992). In tendering, the mine owner sends an invitation to the contractors to tender for a job. The interested contractors reply with offers to the mine owner based on their unaided assessment of the commercial aspects of the job as specified in the tender document provided by the mine owner (Atkinson, 1992).

Nomination tendering is sometimes referred to as single tendering. It involves a single firm being invited to submit a tender for the proposed works. This method is usually applied where the client has preference for a particular firm often because of previous work done, business relationship or specified work (Atkinson, 1992). The advantages are early start of project is possible, technical and financial stability of contractor is guaranteed, reduction in aggregate cost of tendering and document compilation. The demerits include the fact that almost all the advantages of competition are eliminated and the possibility of higher tender price.

##### 3.2.2 Classification by Technical and Administration Responsibility

Engineering contracts involve the implementation of a number of varied tasks for which the responsibility must be established from the outset (Golosinski, 1998). The principal methods of classification include target cost contract, convertible contract, management contract, turnkey contract,



**Fig. 1 Gold Production and Ghana Chamber of Mines Membership from 1980 - 2007**

fast tracking contract and package contract (Atkinson, 1992).

#### 4 Growth of Contract Mining In Ghana

The growth of contract mining in Ghana has been phenomenal since the 1990s. Before the 1960s there were virtually no contract miners in Ghana except the Mining and Building Contractors (MBC) which was contracted to take care of all the major development work in the underground mines at AngloGold Ashanti (Obuasi Mine). The influx of mining contractors to Ghana started in the late 1980s with the introduction of companies like Minproc, Lycopodium, Marple, Ausdrill, Stanley Mining, African Mining Services (AMS), Taywood Mining Ltd. and Public Works (Anon., 2007). The growth of contract mining in Ghana is reflected in the Ghana Chamber of Mines (GCM) membership as shown in Fig. 1.

Gold production in Ghana over the past years has been almost directly proportional to the number of operating mining companies and hence the number of members of the Ghana Chamber of Mines. Gold production increased from 1 004 625 oz in 1992 to its peak of 2 608 102 oz in 1999 but dropped to 2 236 833 oz in 2002 and dropped further to 2 149 372 oz in 2005. In the same way, the member-

ship of the Ghana Chamber of Mines increased from 8 in 1992 to 58 in 1998, dropped sharply to 30 in 2002 but rose to 48 in 2005 and to 52 by 2007.

##### 4.1 Overview of Contract Mining

In Ghana, Tarkwa has the highest number of mining companies. Mining companies in Tarkwa are Gold Fields Ghana Ltd. (Tarkwa and Abooso Mines), Ghana Manganese Company, Nsuta-Wassaw, AngloGold Ashanti (Iduapriem Mine), Golden Star Resources (Bogoso/Prestea) Mine and Golden Star Resources (Wassa) Mine. As at 2004 there were about 14 operating large scale mining companies in Ghana. Over 80% of these companies have contracted out one or more of their operations to mining contractors and service companies.

Generally in Ghana, rock breakage and materials handling operations are done by mining contractors like the Mining and Building Contractors (MBC) at Obuasi, African Mining Services at Tarkwa, Obuasi and Chirano, Taywood Mining Ltd. (TML) at AngloGold Ashanti (Iduapriem Mine) and De Simone Ltd. at Bogoso and Prestea. Explosives companies in Ghana include MaXam Ghana Ltd. located at Tarkwa and African Explo-

sives Ltd. (AEL) located at Bogoso and Obuasi. Transport services are provided by Kingdom Transport Services (KTS), Western Transport Services (WTS), and the Ghana Private Road Transport Union (GPRTU). Under the National Health Insurance Scheme, medical services are provided by accredited hospitals like the Tarkwa Government Hospital, ABA Hospital Ltd., Hill Top Clinic and Rabboni Clinic all located in Tarkwa, Mines Hospital, Obuasi and the Prestea Government Hospital, Prestea. Laboratory and metallurgical analysis and services are provided by Transworld Laboratory Services, Metallurgical Laboratory and SGS Laboratory Services all located at Tarkwa. Security services to mining companies, banks and other private companies are provided by Property Protection Associates (PPA), Tarkwa, Magnum Security Ltd. and SecPoint Ltd. Catering services are provided by contractors like Gladys Catering Services (GCS) and Samperp Catering Services (SCS) all located in Tarkwa. Other service providers are Caterpillar and Equipment, Atlas Copco, Liebherr (supply and maintenance of mining equipment), Group 5 International (piping), Sandvik Ghana Ltd. (drill rods and bits) and Barbex Ltd.

Significant contracts that have been awarded to various mining contractors in Ghana over the past five years include a \$100 million mining contract to African Mining Services and a \$40 million haulage contract to Engineers and Planners Limited at Gold Fields Ghana Ltd.; \$20 million tailings dam contract to Bayswater Contracting and Mining (Pty) Ltd. (BCM Ghana Ltd.) by Newmont Ghana Gold Ltd. (Ahafo Mine). Also, other undisclosed contract amounts have been awarded to AMS by Redback Mining Ltd. (Chirano Mine); Taywood Mining contract by AngloGold Ashanti (Iduapriem Mine) and Excel haulage contract from Ghana Bauxite Company Ltd., Awaso. However, against the general worldwide trend towards contract mining, Gold Fields Ghana Ltd. switched from contract mining to owner mining at its Tarkwa and Abosso mines in 2004.

Table 1 shows the amounts spent on contract mining worldwide by region in 2005 (Amponsah-Mensah, 2006). It shows that the amount spent on contract mining was highest in Latin America (30%) followed by Oceania (21%). Africa and North America tied with 15% each while Asia and Europe had 14% and 5% respectively. Operations that are normally contracted out include waste stripping, construction and rehabilitation of waste dumps, drilling, selective mining, supply of explosives, processing (*ie* clearing of conveyor belts and general plant clean up), engineering (*ie* equipment overhauls, welding and boiler maker work and erection of power lines) and general services (*ie* catering, public transport, hostels and office cleaning, health services, etc.).

**Table 1 Amounts Spent on Contract Mining Operations Worldwide by Region in 2005**

No.	Region	Amount Spent on Contract Mining (\$ billion)	Percent of Total
1	Africa	\$13.00	15%
2	Asia	\$11.00	14%
3	Europe	\$4.00	5%
4	Latin America	\$25.00	30%
5	North America	\$12.00	15%
6	Oceania	\$17.00	21%

Source: (Amponsah-Mensah, 2006)

**Table 2 Typical Output Achieved by the Contractor versus Owner's Output**

Contractor Production Rates (bcm/hr)	Owner Production Rates (bcm/hr)
618	302
603	326
261	150
246	219

Source: Sampson (2006)

The life span of the mine has a great effect on the plan and the general operation. Mine owners spend a lot of money to get the project from the exploration and development stages to the actual exploitation stage before getting their monies back with some profit. This is because they may not be able to get the money used in purchasing equipment like dump trucks, dozers and graders back before the reserves get depleted. Because of this, mines with short life spans between one to six years are usually operated by contract mining rather than owner mining. On the other hand, mines with life spans beyond eight years are usually operated under owner mining (Roche, 1996).

Table 2 shows the production rates achieved by a company in Ghana which was initially under owner mining and changed to contract mining. It shows very clearly that the production rates of the contractor in ore mining and waste stripping operations are far higher than those achieved under owner mining. As well, a mining rate of  $8.10 \times 10^6$  bank cubic meters (bcm) commensurate with providing sufficient ore supply to both the Carbon-in-Leach (CIL) plant and the heap leach circuit was achieved as a result of an obvious increase in productivities (a 27% increase for the RH120) by the contract miner. The strategy of mining sufficient ore at an elevated cut off grade to supply the CIL plant was therefore achieved over the period of the contract (Sampson, 2006).

The key issue revolves around people, equipment

and grade of ore mined. All mining operations are dependent on the people who run them. Identifying the particular skills needed, then locating and retaining the best people for the job is common to both contract and owner mining (Kirk, 2002). If the people with the required skills and experience are not already in that organisation, the first step is to evaluate how difficult it will be to find, attract and retain these people. Contractors have an obvious advantage in already having a pool of trained and experienced personnel but the mine owner may also have experienced personnel or be confident of recruiting them.

One cost advantage that contractors may have is the ability to work their personnel on longer shift hours than the mine owner. The mine owner's employees are seen as long term employees and are entitled to day offs. The mining contractor's employees on the other hand are more likely to be interested in longer hours for more money and not be as concerned about the long term needs (des Bordes, 2004).

Industrial relations or union issues are also significant factors that favour the use of contract mining, given the industry's rigid, inflexible labour agreements coupled with the occasional significant wage increase demands by unionized workers.

Equipment flexibility is a strong point of contractors, especially in the most commonly sized equipment. Contractors have the experience and current cost and productivity data based on a large range of different mining equipment whereas the mine owner normally has a much more limited fleet and less direct operating experience. Contractors are also often able to mobilize additional, or replacement of equipment at short notice for short periods or to meet peak demands. An owner miner can still use hired equipment from contractors in the same way but it may require a lot more time and effort to organise and it may cost more (Kirk, 2002). A possible counter to the above contractor advantage is that the owner miner may be able to change the plan to suit the situation and the available fleet, compared to the risk of having to change the contract scope that could lead to an increase in the contract cost.

Grade control during mining is normally more important in selective mining operations such as in the shear zone hosted gold deposits which are very common in Ghana than in bulk mining operations such as coal or large low grade metal deposits. The mine owner usually determines the ore mining method although experienced contractors can often provide practical solutions (Roche, 1996).

The main issue is not so much the mining method but the required quality control over ore mining. The contractor has a profit-oriented perception concerning productivity and hence maximizes the

quantity or volume mined. Owner mining, on the other hand, may be more concerned about the quality of the ore that is mined, which may reduce loading productivity due to the extra care required in selective mining of the ore and adjacent waste (Kirk, 2002).

In terms of cost, the main considerations in evaluating who should do the mining are how significant the cost of mining is compared to the total mining costs; how sensitive the project viability is to mining costs; whether the mine owner should concentrate on other more value-added issues such as exploration, processing and marketing the final product; and whether the mining is cost critical in determining if the project is viable or a significant factor in determining mine life (Kirk, 2002).

In most cases, mining costs constitute significant proportions of total mining costs and therefore are significant in determining profitability (Bishop, 1968; Michaelson, 1979; Sullivan, 1990; Anon., 1993). The determining factor is what cost premium or margin is justified in employing contract mining instead of owner mining considering other important issues such as the corporate and operational issues. There is a very strong relationship between cost, benefit and risks (Kirk, 2002).

The contractor may have an existing mining fleet available at a significantly lower ownership cost than a new replacement particularly if there has been a change in exchange rates that affect new equipment supply prices. However, it is reasonable to expect that the contractor will include at least some equipment replacement cost in calculating contract prices, as well as including a profit margin not lower than the current cost of capital.

Apart from the contractor requiring a profit, there is often the cost of duplication of some functions. This usually includes site-based costs such as some duplication in management and administration and off-site based costs such as company related overheads that are common to both the mine owner and the contractor. Depending on the economies of scale and the relative efficiencies and competencies of management and administration between the two organisations, this cost may not be significant and could even favour the contractor. With changes in mining methods or processes and the continuous improvement in technology of most mining operations, it is expected that there will be some future savings or marginal cost increases in real terms (Kirk, 2002). For contract mining, the majority of savings would normally go to the contractor and at best the owner gets 50% of any savings. For owner mining, the majority of savings would go to the owner although suppliers or special service providers may earn a share.

If cost increases rather than decreases, the contractor may have to absorb this but only if the contrac-

tor's scope of work and contract terms and conditions were very clear on the specific issue. It is more likely that the owner will incur the majority of increases in costs in any event. Also, there is a greater risk that an owner miner would be less focused on reducing unit cost than a contractor, who has no other option than to improve profitability (Kirk, 2002).

**Table 3 Mining Cost for Owner Operation (1996 and 1997)**

Type of Cost	1996	1997
Mining cost, US\$('000)	6 227.00	12 527.10
Mining maintenance, US\$('000)	2 854.30	7 533.40
Total mining (include maintenance), US\$('000)	9 081.30	20 060.50
Total material moved, bcm	3 198 690	5 364 587
Mining cost (include maintenance), US\$/bcm	2.84	3.74
Mining cost (exclude maintenance), US\$/t	1.95	2.34

Source: Sampson (2006)

**Table 4 Mining Cost Achieved by Contract Mining (1998 - 2003)**

Year	Mining Cost, US\$ ('000)	Volume Mined, bcm	Unit Cost, US\$/bcm	Unit Cost, US\$/t
1998	17 587 800	4 551 611	3.86	1.46
1999	22 996 700	6 842 755	3.36	1.27
2000	23 090 500	7 436 758	3.10	1.17
2001	25 261 000	7 053 352	3.58	1.35
2002	25 312 100	7 325 323	3.46	1.30
2003	4 414 400	1 227 617	3.60	1.36
Total	118 662 500	34 437 416	3.45	1.30

Source: Sampson (2006)

Table 3 shows that the mining cost of a company prior to commencement of contract mining was US\$3.74/bcm in 1997. However, mining cost as tendered by the mining contractor was US\$2.79/bcm, which was 25.4% lower than the owner mining cost achieved.

Table 4 shows that the actual mining cost at the end of the contract period was US\$3.45/bcm which was 23.7% higher than the tendered rate by the successful contractor. However, the company's decision to change to contract mining paid high dividends and was a significant strategy for the survival of the company particularly as it happened during the period when there was a slump in gold price on the world market.

**Table 5 Sources of Risks and their Areas of Impact**

Sources of Risks	Areas of Impact
Technical	Ore reserves, costs, people, performance/timing
Management	Costs, people, performance/timing and organisational
Commercial	Ore reserves, costs, organisational
Economic	Ore reserves, costs, organisational

(Source: Anon., 2007)

## 4.2 Risk Issues

There are several risks in mining regardless of who does the actual mining. The mine owner bears the risk of geological modelling, grade control, mine design, geotechnical stability, environmental and community issues, and the instability of the market price for the end product (Kirk, 2002).

When evaluating contract and owner mining, the main comparative risk areas are equipment selection and matching, equipment performance (productivity, availability and utilization), quality and control of the ore mining, health and safety, human resources management, contractual and litigation issues and production or operating costs. The sources of risks found in every company are summarised in Table 5.

### 4.2.1 Risk Associated with Owner Mining

The risks associated with owner mining include planning (e.g. impractical pit width, road and ramp design, under-estimation of mining costs not covered by revenue, over-estimation of revenues to be earned), equipment selection, maintenance and supply problems, consumables (e.g. quality of products affecting mining performance, usage rate above plan, etc.), people (e.g. skill deficiencies of key personnel, poor safety and environmental awareness), cost estimation (using incorrect unit costs in calculations, escalation of costs higher than revenue increases, changes in interest rates, change in exchange rates), monitoring and control arising from grade control problems and loss of ore or excessive dilution (Anon., 2007).

### 4.2.2 Risks Associated with Contract Mining

The risks associated with contract mining also include equipment, consumables, people, under-estimation of costs, over-estimation of revenues, monitoring and control (Anon., 2007). Another risk found is litigation risk for the owner under contract mining where there is the potential for the contractor to lodge claims and pursue them in a

court of law or via the dispute procedures set out in the contract. In extreme cases, the contractor may decide to withdraw his services which can pose a significant security threat to the owner as he may have to mobilise a new fleet to ensure continuity of operations (Anon., 2007).

#### 4.3 Merits and Demerits of Contract Mining

There are several fundamental advantages and disadvantages of using contractors which underpin a long term industry for contract mining by providing real value to mining companies (Golosinski, 1994). The merits of contract mining include contractors could quickly deploy modern equipment and specialist work force addressing skills, staffing and equipment shortages; small mining companies could increase their scale of operations without making large investments in capital and labour; under-capitalized mining companies are provided with the means to develop their mines more rapidly and cheaply than if they had relied on conventional sources of finance; contract mining provides mines with improved operational and best practice cost efficiency, and effective performance and management systems, risk profiling and surviving beyond the boom and overcoming barriers to innovation.

The disadvantages with contract mining are job insecurity, few avenues for human development and selection of wrong contractors by large companies.

#### 4.4 Merits and Demerits of Owner Mining

The merits of owner mining include job security, avoidance of selecting wrong contractors, absence of litigation risks, total control of the mine operations, flexibility of operation and no tendering costs. The demerits of owner mining include high capital cost, high mining cost and greater risks involved.

### 5 Observations

From the foregoing analysis, it may be observed that:

- i. Mine managements often have to decide at one stage or the other whether to carry out the major mining operations using their own equipment and personnel or to contract some or all of the operations out to specialised mining contractors.
- ii. The decision to adopt owner mining or contract mining is influenced by the life of the mine, availability and use of capital. For companies with poor credit rating or short life spans, contract mining is preferred because it provides capital items such as mobile equipment or the contractor is able to obtain better

commercial terms for purchasing new equipment.

- iii. Contract mining helps to reduce the cost of mines with short life spans. Most mine machinery have economic lives of 4 or 5 years. Therefore, to buy new equipment for a mine with a short lifetime ( $\leq 5$  years), the owner will be forced to depreciate over a short period. On the other hand, a contractor usually depreciates the equipment over its expected life rather than on a project basis, since the equipment can be transferred from site to site.
- iv. While owner mining employees are offered long term training to develop their skills, contractors are not willing to invest in the long term training of their employees. Because of the relatively short term nature of their works, contractors always want to invest in the type of training that brings immediate results.
- v. Contractors have experience on current cost and productivity information based on a large range of different mining equipment whereas the mine owner would normally have a much more limited fleet and less direct operating experience.
- vi. The cost of owner mining is generally higher than the cost of contract mining because prices offered by contractors are generally fixed for the duration of the contract. Besides, owner mining is faced with more risks than contract mining.

### 6 Conclusions

The optimal option which is likely to be adopted by most mining companies in Ghana and in the world as a whole is contract mining due to the fact that it helps mine owners to finance their operations at reduced cost and minimized risk. Since direct mining costs make up over 40% of the total cost structure of any mine, it is necessary to conduct an in-depth analysis and some serious risk analysis before adopting any of the options. However, it is reasonable to conclude that as large orebodies get depleted and become scarce and new but smaller orebodies are explored and developed, where the prices of the minerals become very volatile and highly unpredictable or where there is political instability, contract mining will be the way forward for most mines under those circumstances.

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