Rural Water Supply Network

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Danert, Luutu, Carter & Olschewski

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Cost-Effective Boreholes

Costing and Pricing

A Guide for Water Well Drilling Enterprises

Summary

This field note is written for water well drilling enterprises as well as other agencies which manage, or are involved in drilling projects. Using a step-by-step approach it gives clear guidance on how to cost and price the construction of drilled water wells. It also provides tips on business management with an emphasis of the realities faced in many countries in sub-Saharan Africa. Once you are familiar with this field note, you will be in a much stronger position to calculate drilling costs, consider prices and deal with business realities.

There are five distinct steps to costing and pricing: (1) the basic costs of running your business; (2) analysis of tender documents; (3) setting out the cost components; (4) calculating your costs and (5) determining your price. Within each step a number of key issues need to be considered. Costs are broken down into siting, mobilisation, drilling, casing/completion, well development/pumping test and pump installation. Practical, worked examples enable the reader to easily follow the costing method. The field note sets out bills of quantities and considers how to deal with risks and uncertainties as well as the tender process. Key advice for effective management is also given.

The authors of this field note sincerely hope that it helps drilling enterprises to develop and flourish, and thus contributes to improving water supplies, particularly in the developing world.

Contents

Glossary

Assets are what a business owns or is due (e.g. equipment, buildings, vehicles, creditors, money in the bank and cash).

Bidding process to contract award: When a client such as a Government body or NGO follows a bidding process for borehole construction work it issues a tender document and calls for **tenders** from several contractors. The tender document includes **specifications** for the work, a **bill of quantities** and contract details. Tenders are submitted by the contractors bidding for the work and subsequently evaluated against a set of criteria. The winning contractors are selected on the basis of their price, experience and ability to perform the work. There may be subsequently be a process of negotiation between the client and the contractor before a **contract** is awarded.

Bill of Quantities (BoQ): are used in the construction industry to set out (itemise) materials, labour, transport and other items alongside their associated costs. They enable a contractor to price the work for which he or she is bidding.

Contract: an agreement between two or more parties. It is usually enforceable by law or through arbitration.

Direct costs (or **cost of sales**) mean all of the costs incurred for producing the particular goods or services that you sell. In the case of a drilling enterprise these would include labour, fuel and equipment depreciation or hire costs for the job.

Expenditure (or **expenses**) is the sum of the direct costs, overheads, interest payable and taxes.

Gross profit (or **gross operating profit**) is calculated by taking the sales and subtracting the direct costs.

A **Job Card** is a standard form (or card) which the contractor uses to record all of the details of the job (such as preparation, management and travel time, time to set up in the field, drilling speeds, consumables used and fuel consumption).

Net profit is calculated by (i) taking the total revenue and subtracting the total expenditure or (ii) the gross profit minus overheads, tax and interest.

Other income is money received which is not directly related to the product or service of the enterprise.

Overheads (or expenses) are the money spent to run a business that is not a direct cost. Overheads include office staff, rent (office, warehouse), equipment depreciation (computers, printers, office furniture), utilities (water, electricity), communications and other items such as stationery and fuel for office running.

Pre-qualification is a process whereby the financial, managerial and technical resources and competence of a company to execute and complete the work required are assessed. It enables public sector purchasers to identify the most suitable suppliers to invite to tender for contracts.

A **Performance bond** (or **bank guarantee**) is issued by a bank (or insurance company) to guarantee satisfactory completion of a project by a contractor. Thus if a contractor fails to complete the construction of a borehole as set out in the contract specifications (e.g. if he goes bankrupt), then the client is guaranteed compensation for monetary loss up to the amount of the bond. The purpose is to demonstrate the credibility of the contractor and guarantee performance as per the terms of the agreement.

Revenue (or **income**) is the sum of the sales and other income.

Sales refer to the amount of money generated from the sale of goods or services.

A **Specification** is a set of requirements that need to be met by a service, product or material.

Tender: an offer to undertake an act such as constructing a borehole. The party submitting the tender (i.e. the tenderer) is bound to perform the act to the party to whom the offer is made.

Turnover is the total amount of money that a company earns for the goods and services that it sells (i.e. the revenue) over a certain period of time (usually a year).

Introduction

Increasingly Governments are responsible for water supply planning, regulating, monitoring and coordination. They are ceasing to directly drill water wells for rural and urban dwellers. Meanwhile, private drilling enterprises are growing in number to fill the gap, with even public enterprises sub-contracting drilling work to the private sector. Former Government staff members are among those establishing private drilling companies.

A healthy and competitive private drilling sector can improve progress towards the Millennium Development Goals (MDGs). The procurement of high quality drilling services benefits national development and good quality construction work underpins the long term sustainability of water supplies.

Usually private enterprises construct water wells under contract to national or local Government or NGOs. Sometimes they work is directly for institutions such as schools and clinics or individuals. Unfortunately there are numerous cases of drilling enterprises operating in sub-Saharan Africa going bankrupt, or simply not able to be competitive. One of the problems is lack of realistic costing and pricing for their work.

All too often tender documents are submitted which are unrealistically low in price, due to competition or as companies become desperate for work. Alternatively, drilling enterprises price their work far too high, due to lack of competition, a belief that they can technically outbid others or make quick profits. However, even if companies bid too high or too low, they should do this with good knowledge of the estimated costs.

The full costs for the construction of water wells and associated consultancy services are not always properly considered. Many companies are not able to properly cost their services. It is common for certain business costs such as overheads or depreciation to be ignored; or for the needs of the business and family to be woven together in such a way that the enterprise cannot grow, as it meets family demands. There are even cases of '*gross profit*' being confused with '*net profit*´ or '*turnover*'.

Costing is also a challenge for public enterprises which often receive subsidies to cover overhead costs and even to purchase machinery. Most of them do not keep an accurate inventory of their fixed assets and hence fail to properly estimate depreciation costs. They can receive machinery, accessories, spare parts and consumables that are not considered as costs.

Lack of proper hydrogeological data of the sites to be drilled and limited experience of drilling supervisors has a major influence on cost as they determine the drilling time. Further, the numerous risks involved (such as drilling non-productive wells, getting bogged down in poor roads while travelling to site, variations in fuel prices, exchange rate fluctuations, uncertainty of when one will actually be paid, difficulty in accessing spare parts) mean that determining the price to quote is difficult. However poor costing and pricing means that many companies do not develop or, at the end they collapse, with the little capital that they had eroded away!

This field note is based on available information, and tools, discussions with drillers and analysis of drilling costs. We sincerely hope that it can assist drilling enterprises to realistically calculate their costs, determine competitive prices and thus flourish! It should also be of assistance to agencies as they design tender documents.

Figure 1: Schramm-T6HB Drilling Rig

Five steps to cost and price drilling works

It is common for an enterprise to quote the cost of drilling a metre of hard rock based entirely on what others in the market quote, with the hope that at the end of the day, some profit will be made. We call this *business based on hoping for the best.* This is unsuitable in the long run. Surely you can do better by identifying the costs, considering the risk and determining the expected profit!

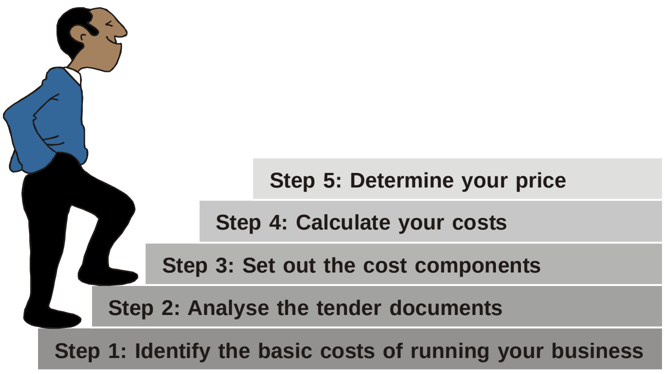
Many people do not distinguish between the COST of drilling to the contractor, and the PRICE quoted to the client. In Box 1, we point out the difference. It is important that you understand your costs before you decide what price you will charge for your work.

Box 1: Definition of Cost and Price

COST refers to what the drilling contractor **spends** for the job.
PRICE refers to what the contractor **charges** the client.
PRICE includes profit (or loss); COST does not.

To help you, we have broken down the process of costing your work and deciding what price to charge into five easy steps (Figure 2). For each step, you need to do some calculations, and think a bit before moving to the next. If you find that your costs are too high for the market, you may need to recalculate. What you need to remember, is that even things that you may take for granted actually cost money (e.g. Box 6).

Figure 2: Costing and Pricing Steps for Drilling Enterprises



Step 1: Basic costs of running your business

In order to calculate reasonable prices, and stay in business, you need to fully understand the cost structure of your enterprise. The glossary provides definitions of revenue, overheads, net profit and gross profit.

It is essential that you **properly understand your overhead costs** and apportion these to the jobs that your business undertakes. Our experience indicates that for water well drilling contracts, overhead costs are usually 10-20% of the contract value. More than half of this can be spent on tender winning expenses! Your experiences however, may be different.

To understand your cost structure, you need to consider the following questions:

- Is drilling just one part of the enterprise? What proportion of overhead costs should be charged to the drilling work (e.g. office staff, taxes, office rent as set out in the glossary)?
- Do you have to pay interest on a loan, and if so, in what time frame? Box 2 provides guidance to calculate interest repayments for a loan.
- Does your drilling team comprise company staff or contract workers? What salaries, allowances and insurance need to be paid?
- What taxes do you need to pay, and when?
- Do you have enough hard currency and what is the exchange rate? Remember that exchange rates fluctuate. Can you easily access hard currency?
- What are the current fuel prices? These can also change in the future.
- Do you have insurance costs (e.g. for equipment loss or damage and injury of personnel)?
- What are your communication costs (particularly between the field and headquarters) as these can be considerable?
- How much cash do you have in order to keep your business operating (cash flow)? We shall come back to this in step 4.
- What is the market for drilled water wells likely to be over the coming months and years? How is the work spread out in terms of location and work through the year?
- What is the likely productivity of your drilling equipment (Box 3)?
- Do you own drilling equipment and vehicles or hire them? If you own equipment, how are you going to depreciate its value? What is the time over which you will depreciate the equipment (amortisation period)? Box 4 provides some guidance.

Box 2: Loan Repayment and Interest Payments

If you decide to **borrow money from a bank** to buy your equipment, you will need to pay back this amount plus the interest. Assume you buy a small to medium-sized drilling rig $170,000 and that you borrow the entire sum from a bank at an interest rate of 20% per year, paying back over a five year period. If the loan and interest are paid monthly you will pay back $4,430 per month for 60 months (i.e. 5 years x 12 months). This is repayment of the $170,000 loan plus $95,807 in interest. In other words, for a loan of $170,000 you will pay back $265, 807.

If you borrow $170,000 over a ten year period at 20% interest per year, and the loan and interest are paid monthly, you will pay back $3,231 per month for 120 months (i.e. 10 years x 12 months). This amounts to repayment of the $170,000 loan plus $217,779 in interest repayments. In other words, for a loan of $170,000 you will pay back $387,778. Borrowing money is not cheap!

It is hard to find loans for more than five years to buy water well drilling equipment in sub-Saharan Africa. However, your drilling rig may last for ten years. If you just have one rig that means making sure that you earn enough money to pay back the loan in five years.

In Microsoft's software Excel, you can use the PMT function to help calculate the repayments (capital and interest) of a loan. The help function in Excel provides a good explanation of how to use the PMT function.

The table below provides examples of loan and interest repayments for three different amounts borrowed at an interest rate of 20% over a five year period.

Amount Borrowed	**$500,000**	**$170,000**	**$80,000**
Total Interest	$281,787	$95,807	$39,450
Total Repayment	$781,787	$265,807	$109,450
Monthly Repayment	$13,030	$4,430	$1,824

Box 3: Rig Productivity

If fully utilised water well drilling equipment can construct over 100 wells per year. In India in the 1990s, private firms were drilling about 150 wells per year. Unfortunately, the markets in African countries are not as large in India, and generally work flow is not as steady. It is thus more common that African enterprises drill 20 to 70 wells per year.

Rig productivity is also affected by the knowledge, understanding and autonomy of site supervisors. A driller can be kept on-site for a very long time waiting for decisions to be taken. It is common for drilling supervisors to be fresh college geologists or hydrogeologists. Lack of experience and dependency on their bosses for decision-making consumes time on site and thus reduces overall rig productivity. It is rare for enterprises to be paid for this idle time.

If you have to depreciate the value of your rig over a short time period, very low rig productivity will means that the cost of each well is high. This is because the cost of the rig has to be recovered over a smaller number of wells. However, it should also be noted that lower rig productivity means that the equipment will last longer.

Depreciation means to spread the value of an asset (such as your drilling rig) over its lifetime. Depreciation is the reduction in the value of an asset due to its use, passage of time, wear and tear, rust and decay. By reserving the money that you have made to cover the depreciation, you are able to later replace the equipment. Box 4 provides an explanation of how depreciation cost is calculated. As the compressor, rig and other equipment all have a different lifetime the depreciation actually needs to be calculated for each item. In some cases you will assume that the equipment has a residual value at the end of the depreciation period.

It is worth noting that in Ethiopia it is not up to the drilling companies to decide on how to depreciate their equipment. The tax law states that a drilling rig depreciates over 5 years on a straight line basis regardless of the number of hours works or number of wells drilled. Depreciation should be investigated carefully, as other countries may have similar tax laws.

Box 4: How to Calculate Depreciation

Depreciation refers to the value that a particular item loses over time. A computer which has been used for 5 years is worth much less than a brand new one! Over time, the car **depreciates** in value.

If you want to save up to replace your drilling equipment, compressor and vehicles, or pay back a loan you took to buy them, you need to take full account of depreciation and charge your clients for it.

Example 1 shows how to calculate depreciation. Example 2 looks at the effect that rig productivity has on how much you may need to charge a client for the equipment.

Example 1 - Depreciation

Drilling equipment is assumed to have a life span of 10,000 working hours (e.g. 1,000 hours/year) over ten years. Assuming an eight-hour working day, this would equate to 125 days per year for ten years or 1,250 days in total. This is a 34% utilisation i.e. 125 days/365 days.

In order to calculate the daily depreciation cost in this example, divide the capital cost by the total number of days the equipment is used (i.e. 1,250).

Capital Cost (of the rig)	$500,000	$170,000	$70,000
Depreciation Cost per day (i.e. capital cost/no of days used)	$400	$136	$56
Depreciation Cost per hour (i.e. capital cost/no of hours used)	$50	$17	$7

Example 2 – Rig cost in relation to rig productivity

In order to recoup this amount from the work undertaken, the depreciation cost is passed on to the client. The table below sets out the rig cost per well for five different rig productivity rates. It shows that if there is regular work, and thus rig productivity is high, the **cost per well** is lower. Although it should be noted that equipment that is used less will also last longer, and would thus have a residual value at the end of the five year period.

Rig Productivity (wells per year)	10	20	30	50	100
Rig Cost per well	$3,400	$1,700	$1,133	$680	$340

As a rule of thumb, Rowles (1995) states that a brand new water well drilling rig can be expected to have a lifespan of about 10,000 hours. Some of the drillers consulted in Nigeria claim that their rigs last for 20,000 hours. However, you need to decide upon a realistic figure!

Step 2: Analyse the tender documents

In order to prepare a sound and reasonable offer you need the tender documents and all annexes as well as other relevant information from the client. You will base all your prices on what is written in these documents. Items that are ambiguous or unclear should be clarified. Where omissions are spotted then cover these items with caveats or assumptions. The specifications in the tender document give you the basis for calculating your costs (step 4 below).

Here is a list of some basic issues that need to be considered. These should be clearly stated in the documentation.

- What are the registration and licensing requirements?
- How many wells have to be drilled and where are they located? The number of wells is usually defined but the exact locations are sometimes not specified. If this is the case, you will need to make some intelligent guesses.
- In terms of transport, what are the road conditions and is access to the sites safe?
- How are the wells to be sited, and is it your responsibility? Well siting can be undertaken by the client, contracted to a consultant or the responsibility of the driller.
- Does the tender document specify the depths to be drilled? What are the specified drilled and completed diameters? What kind of rig will you use and is it of the right capacity? A large rig is more costly than a small one. If depths or other important details are not stated these should be clarrified or added as assumptions in your quotation.
- What information is given with respect to geology and hydrogeology? If information is limited, you will need to find out more from other sources.
- Will you be paid for every metre that you drill? Will you be paid for wells that are not successful, and if so, in what manner? Remember that when mud drilling in sediments you will only know if you have been successful once you have installed your casing and screens!
- Does the tender include a bill of quantities (BoQ) such as those given in Table 10 or 11? Study it carefully and remember that mistakes are common! Will the contract include siting, the completion of the platform or pump installation as well as drilling? Which type of pump will be installed?
- What borehole logging and water quality testing requirements need to be fulfilled?
- What will be the time-frame for the work to be completed? Which season will you have to work in (e.g. rains) and how will this affect the logistics?
- What are the requirements for restoring the site once drilling is completed?
- What are the payment conditions? What currency will you be paid in, and what happens if there are significant currency fluctuations? Will you need to take payment delays into consideration? Do you have sufficient cash flow and currency to pay for labour, materials and fuel until the contract sum is paid?
- Is a percentage of the contract sum retained for a defects liability period? If so, how much effort and money will it take to recover this amount?
- How will the tender be evaluated?
- Does the client send a supervisor? What are his responsibilities? Does the client pay the cost of transport and lodging for the supervisor (in practice) or is this your responsibility? What is the process of approval for the completed well, and is this undertaken in stages? Will you be paid for waiting time (also known as standing or idle time)?
- Would it be better to tender for this work on your own, or should you consider forming a consortium?

Box 5 lists some of the main tender types, contract and payment terms that actually exist in the water well drilling industry in sub-Saharan Africa! There are many aspects of a contract which are not clearly set out in the tender documents.

Box 5: Types of tenders, contracts and payment terms

Variety may be the spice of life, but when it comes to tender documents, the variety of contract and payment terms are very difficult to deal with. Here are examples:

- Tender includes detailed information on the specific sites and geology. The Bill of Quantities (BoQs) include mobilisation, estimated total depth to be drilled in different formations. Driller is supervised full time and paid for every metre drilled and installed as well as waiting time (actually, we have not found such a clear document).
- Tender only gives a vague indication of area (e.g. district) where the wells are to be drilled. Driller is expected to site the wells. BoQ is included and will be used for tender evaluation but driller will be paid a lump sum for each successful well. This is often called a "*no water no pay*" contract**.**
- Tender document includes a BoQ. Locations are given but not the depths. Contract document will be a terms of reference (ToR) with one line describing the work and no additional documents. Payment will be a fixed agreed sum as stated in the ToR.
- Tender document includes general comments on siting. Hydrogeologist will approve well design and installation of screen and plain casing but the driller will not be paid if the well is not successful.
- Time of year that the work will be carried out is uncertain but the contract states that if the contractor chooses to work through the rainy season, losses incurred due to poor access during the rains are at the contractor's expense.
- Mobilisation is included in the BoQ, but transport between sites is hidden in other items.
- Well design to be submitted to site supervisor for approval before the final installation of casings and screens. However it is known that the site supervisor will not be on site full time. There is a clause stating that there will be no reimbursement for standby time should the contractor be delayed for any reasons.
- Contractor expected to file a drilling report for unsuccessful wells, even though he is not paid anything for them.
- The drilling enterprise is responsible for paying the supervision by an organisation which represents the client.
- Contractor effectively works for two clients: Government issues the contract. The support agency pays half the money and the Government pays the other half. Contractor is responsible for chasing two different organisations for payment.

If tender documents, and the contract terms are unreasonable, then talk to the client suggesting that they are unacceptable. Accepting unrealistic terms and conditions can give you trouble later on.

It is easier to deal with such challenges through a professional drillers association than for each contractor on its own. If there is no association in your country, consider trying to establish one. The formation of a highly professional drillers association makes it much easier to address many of the above challenges.

Step 3: Set out the cost components

There are different ways to calculate water well construction costs. Table 1 provides six components, which include costs for data, capital equipment, vehicles, fuel, materials/consumables and labour. Note that siting, platform casting and pump installation for the water supply are not always the responsibility of the driller.

Table 1: Six Cost Components for Water Well Construction

Siting	**Data:** Remote sensing, maps, documents and access to groundwater and drilling databases **Capital equipment:** Geophysical survey equipment **Vehicles**: Depreciation (plus taxes) and/or hire **Labour:** Staff salaries or consultancy fees **Fuel:** for transport of equipment to site
Mobilisation & demobilisation	**Capital equipment:** Depreciation and/or hire of drilling rig & compressor **Vehicles:** Depreciation (plus taxes) and/or hire **Fuel and lubricants** for the compressor & rig and vehicle getting to site **Labour:** Staff salaries and allowances or hired labour charges (i.e. of men to site and back)
Drilling	**Capital equipment:** Depreciation and/or hire of drilling rig, drilling string, compressor & maintenance costs **Vehicles**: Depreciation (plus taxes) and/or hire **Fuel, lubricants and consumables** for the compressor & rig (e.g. foam, polymers) and vehicle running around **Labour**: Staff salaries and allowances or hired labour charges on site
Casing & Completion	**Capital equipment:** Depreciation and/or hire or drilling rig & compressor (if still on site), welding machines, generators and crane trucks **Vehicles**: Depreciation (plus taxes) and/or hire. **Fuel:** Casing installation and vehicle running around. **Materials/consumables:** Plain casing & screen, gravel, sand, cement, electrodes and others **Labour:** Staff salaries and allowances or hired labour charges for installation of casing and completion
Well Development & Pumping Test	**Capital equipment:** Depreciation and/or hire or drilling rig (if still on site), compressor as well as generator and pump **Vehicles**: Depreciation (plus taxes) and/or hire **Fuel and lubricants** for compressor, generator and pump and vehicle running around **Labour:** Staff salaries and allowances or hired labour charges for well development and pumping test
Platform Casting & Pump Installation (e.g. handpump or submersible pump)	**Vehicles**: Depreciation (plus taxes) and/or hire **Fuel and lubricants** for transport **Materials/consumables:** e.g. pump, cement, aggregate, sand, stones, bricks, formwork, water **Labour:** for platform casting and pump installation

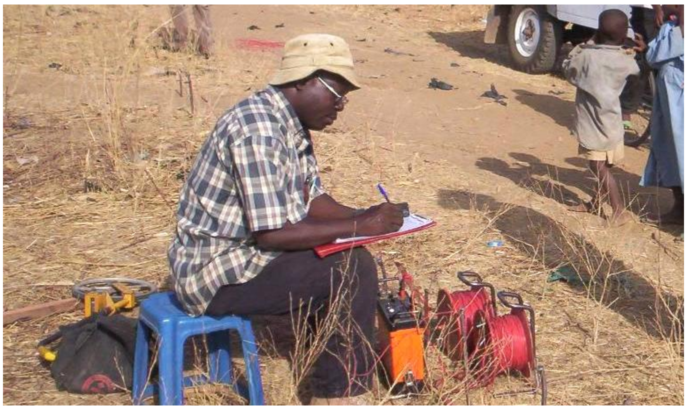
3.1 Siting

Siting refers to the process of selecting a site at which to drill the water well. It is important that this is done properly, to determine the appropriate equipment and logistics, minimise the risk that the water well is dry or low yielding and to take the needs of the community into consideration.

Water well siting involves desk review (includes study of geological and hydrogeological maps and drilling records from the area). Communities and local well diggers can also provide useful information. If groundwater is relatively easy to find, it is usually not cost-effective to use complex siting techniques. In cases where groundwater is not available everywhere, geophysical techniques are commonly used. MacDonald *et al.* (2005) provide an overview of siting techniques. The final selection needs to take community preferences into account.

In some cases siting is undertaken by a consultant, who may also supervise the drilling. In many countries, the drilling contractor is expected to site the well, and is shouldered with the blame if it is dry, i.e. *"no water no pay"*. The driller and the community may be expected to locate two or three suitable sites within a particular village, in order of preference.

Figure 3: Siting – Resistivity Survey in Niger State, Nigeria



3.2 Mobilisation & Demobilisation

Mobilisation refers to getting started on the job, moving personnel, equipment and materials to the drill site. Demobilisation refers to shifting back to base. Cost calculations must consider:

- Distance from drilling enterprise base and material suppliers to the site and the time it will take to get there.
- Road conditions: access can be difficult and costly.
- Depreciation or hire costs of the equipment i.e. drilling rig, compressor, support vehicles, drill pipe and tools (Box 4).
- Depreciation or hire costs of the vehicles to carry personnel and materials (casing and screen, gravel, cement, drill fluid, fuel, water).
- Cost and quantity of fuel for transport.
- Personnel cost (salaries, fees, allowances).

Usually, a contract is awarded for the construction of more than one well. In this case, you will consider the cost of mobilisation and demobilisation only once, plus the cost of moving between different drilling sites. To reduce costs one would cluster wells with similar hydrogeology and proximity. Unfortunately we know that this is not always the case!

3.3 Drilling

When calculating drilling costs, you need to consider:

- The fixed cost of the equipment (hire or depreciation). As outlined in Box 5, the depreciation cost depends on the capital cost, lifetime and utilisation of your equipment. Alternatively it may be stipulated within the national tax laws.
- Running costs are influenced considerably by the price of fuel (which fluctuates), lubricants and drilling consumables (e.g. drilling fluids) and drilling speed.
- Drilling speed and time to drill depend on the geology, the state of your equipment, drilling method, drilling crew, site supervisor and their interpretation of the contract documents. Remember that you will not be drilling all of the time. You often need to wait around while your client takes a decision (i.e. waiting, idle or standing time), or to solve technical problems. This time tends not to be paid for.
- Maintenance costs. This is not free and should not be forgotten! Older rigs usually have higher maintenance costs. Lack of spares and consumables for drilling on the local market can render maintenance expensive and even delay projects. There is thus need to consider additional costs incurred for importation.
- Labour costs. The more people you have in the crew, the more expensive it is, but you need sufficient skilled and unskilled labour. Labour requirements depend on the equipment and a minimum crew may even be stipulated in national regulations.
- Vehicle costs. Vehicles usually remain on site while drilling continues, to carry out necessary day-to-day errands, collect casing or completion materials or for well development. Their cost should thus be considered.

3.4 Casing and completion

Surface casing may be required to support the formation during drilling. Once drilling has been completed, the well-screen and casing needs to be installed and the gravel pack, grout, sanitary seal and backfill placed. It is essential that specifications are followed and good quality materials for the casing and gravel pack are used. Casing cost varies with diameter and material. Your equipment and vehicles may remain on site for all, or part of the time that you are installing and completing the well so remember to consider depreciation (Box 4).

3.5 Well Development & Pumping Test

Once construction is completed the water well needs to be cleaned and developed. Subsequently pumping test is required. You may also need to sample and undertake water quality analysis. The costs comprise equipment, labour and fuel as well as the depreciation of the drilling equipment and vehicles if they remain on site (Table 1), as well as the cost of water quality testing. Remember that fuel costs change but that this is difficult to predict.

3.6 Platform Casting & Pump Installation

Construction of the wellhead may also include the slab and soak-away. It is better to have a separate crew to do this so as to avoid tying up the drill crew and equipment, or you may even choose to sub-contract. Sufficient time should be allowed for platform casting and pump installation. These are the only visible items and will be seen after the drilling equipment has left. Professionalism should dictate a quality of workmanship which should result in further work. Note that the cost of the pump often represents a small percentage of the final cost when other charges are also taken into account as detailed in Table 8.

Step 4: Calculate your costs

A cost calculation example, based on the six components given Table 1, is described below and set out in tables 2 to 6. The example is based in the following assumptions:

- Driller is responsible for well siting
- Distance from base to well site of 100km
- Well specifications: one well drilled at 6" diameter and cased with 4" nominal casing; drilled to 50m depth (20m overburden material and 30m rock drilling)
- Driller is responsible for platform casting and pump installation

4.1 Siting

In some countries, the use of geophysical techniques for siting is routinely included in tender documents, even when it is not required (e.g. in the case of well-understood regional aquifers), or when the results are not easy to interpret (e.g. resistivity is difficult to interpret when there are ironstones, lateral variation in lithology, aquifers at great depth or built up areas).

Nevertheless, it is important to be clear about how much water well siting actually costs (unlike the contractor in Box 6). You need to take labour costs (office and field-based), depreciation of your equipment and transport into consideration. Remember that transport costs include the vehicle depreciation and road taxes, as well as fuel. Siting is an item which may also be subcontracted to a qualified consultant.

For our worked example, we shall assume that siting costs $400 (for equipment, labour, transport, supervision and reporting).

4.2 Mobilisation & Demobilisation

A simple method for determining the mobilisation and demobilisation costs for three different types of drilling equipment are shown in Table 2. Drill rig costing: (a) US$ 500,000; (b) US$ 170,000 and (c) US$ 70,000 have been used for the example. It has been assumed that the mobilisation and demobilisation each take 8 hours. Lighter rigs are cheaper and require fewer vehicles and personnel than heavy rigs, so mobilisation and demobilisation costs are less (Table 2). Clearly, if your competitors have large expensive drilling rigs and you have cheaper or lighter equipment but can still undertake the work according to the specifications, then you are at an advantage.

Box 6: We own the equipment, so it is free!

In 1997, Aquatech Enterprises (owned by Anthony Luutu) was implementing a contract in Eastern Uganda. While drilling Anthony realized that one of the selected drilling sites would not yield sufficient water and had to quickly identify a new site. This involved a fresh study of the maps, the use of geophysical survey equipment and a pick-up and driver to transport the equipment to the site from the Kampala office, some 200 km away.

When Anthony calculated the costs, he realised that it would be cheaper to hire somebody locally to undertake the survey. He estimated that the firm would charge **$275** (i.e. vehicle hire and driver for half a day at $65; geophysical survey machine hire at $60; consultancy fee for professional at $150). He contacted the firm about 30km away and asked for a quotation for the work. However, the firm sent a quotation for only **$150**.

This appeared to be very low but Anthony hired them all the same.

Once the work was successfully completed, Anthony asked why the price had been so low. He was astounded by the answer: "*I don't have to hire a vehicle or a machine. We own them, so they are free. I just have to charge my fee for doing the work*". This is one of the many stories of unrealistic costing practices! If the cost of the equipment is not included, there will be no funds available for replacement when necessary.

Table 2: Calculation of Mobilisation & Demobilisation Costs for two days of travel i.e. one to the site and one back to base (note that this is intended as an example and not as recommended figures – contact RWSN for details of all the assumptions made)

Mobilisation	Calculation Method	Unit	Amount (US$)		
			(a) 500,000	(b) 170,000	(c) 70,000
Drilling Rig	Depreciation cost of rig converted to daily rate based on 10,000 hours (10 years lifespan at utilisation rate of 125 days per year, i.e. 34% utilization). Assumes that mobilisation and demobilisation take one day each of 8 hours.	per well (2 days of travel)	$800	$272	$112
Vehicles	Rental market rate/real running costs of: (a) truck-mounted rig, truck and compressor and 2 pick-ups, (b) truck and trailer, truck and compressor, and 1 pick-up; (c) pick-up and trailer for rig; pickup for compressor.	per well (2 days travel)	$827	$442	$300
Fuel and lubricants	Fuel consumption 20 to 30 litres/100 km depending on type; overall travel distance of 260 km; Fuel price: 1.10$/litre. Vehicles as above.	per well (2 days travel)	$543	$400	$226
Labour	Salaries & allowances for driller, assistant, hydrogeologist, labourers, security & drivers: (a) 12 persons; (b) 8 persons; (c) 6 persons	per well (2 days travel)	$536	$424	$384
Total (mobilisation and demobilisation)			**$2,706**	**$1,538**	**$1,022**

4.3 Drilling

As we are now talking about the actual drilling, it is worth once again stating the importance of using the right type of drilling equipment for the job required. Use of a heavy and expensive drill rig (e.g. capable of drilling to 500 metres) to construct a 5 inch diameter hole to a depth of 50 metres costs you much more than using a lighter rig. In order to be competitive it is important that the rig purchased will provide the best results in the local market-place according to the ground conditions. In Tables 4 and 5 below, we set out an example using equipment that costs US$ 170,000. Try and work out costs using more expensive and cheaper equipment on your own and compare the difference!

It is vital that you know how much your drilling operation costs! You can use a job card to track fuel and materials so that the drilling costs are less of a mystery. Table 4 sets out an example of drilling costs. Part (i) shows the fixed costs, which are incurred for every working hour. Part (ii) gives the running costs for every metre drilled (in rock and overburden).

Determine what your maintenance costs are. Ray Rowles (1995) points out that "*When you are turning you are earning*". It is worth investing in preventative maintenance, and having key spares in stock so that you do not lose money on site! We have made some assumptions about the lifetime of the drill string, hammer, hammer bit and drag bit based on advice from our friend Ray Rowles (1995). These components do not last forever and thus need to be depreciated (Box 5). The cost of these items depends on the type of your equipment and where you operate.

The information from Table 3 is used as a basis to calculate the total drilling cost. We have made this example simple, by assuming that the drilling costs per metre are the same for all depths. In actual fact, drilling gets more expensive with depth (e.g. because heavier drill pipe and increased distance to carry drill cuttings requires more energy, or telescopic drilling may be used). A job card can help you to record the information needed to calculate these costs in more detail.

The *rig costs per hour* and the *running costs per metre* from Table 3, together with costs of labour, fuel, vehicles and temporary casing are converted into a cost for the well, taking the drilling speed and depth into account, as shown in Table 4. The cost of drilling the particular formation (overburden or rock of certain depths) is calculated.

The drilling speed has a particular bearing on the cost. In this example, the drilling cost is $40 per metre. However, when you come to deciding on the price to charge for every metre drilled, you need to consider other hidden costs such as standing time (also known as idle, or waiting time) if these are not recoded in the BoQ. We shall come back to this in Step 5 Determining your Price.

Table 3: Drilling Costs (note that this is intended as an example and not as recommended figures)

i) Items to consider when calculating rig costs per hour (independent of geology and depth)					
Item		**Assumptions and Explanation**			**Cost [$/h]**
A	Depreciation of rig	Rig cost $ 170,000, depreciated over 10,000 hours (Box 4, Example 4). **This needs to be charged for every working hour during the assignment.**			$17.00
B	Maintenance of rig	Assumption: 5% of depreciation			$0.85
ii) Running costs per metre (dependent on geology and depth)					
Item		**Assumptions**		**Explanation**	**Cost [$/m]**
		Lifetime (metres)	**Unit Cost [$]**		
C	Drilling string	20,000	15,000	Convert to US$/m by dividing replacement cost by lifetime, e.g. for drilling string 20,000/15,000	$0.75
D	Drag bit	300	500		$1.67
E	Hammer	3,000	8,000		$2.67
F	Hammer bit	300	1,200		$4.00
Item				**Explanation**	**Cost [$/m]**
G	**Running Cost in Overburden in $/m**			Sub-total of drill string and drag bit in [US$/m] = C + D = 0.75 + 1.67	**$2.42**
H	**Running Cost in Rock in $/m**			Sub-total of drill string, hammer, hammer bit in [US$/m] = C + E + F = 0.75 + 2.67 + 4.0	**$7.42**

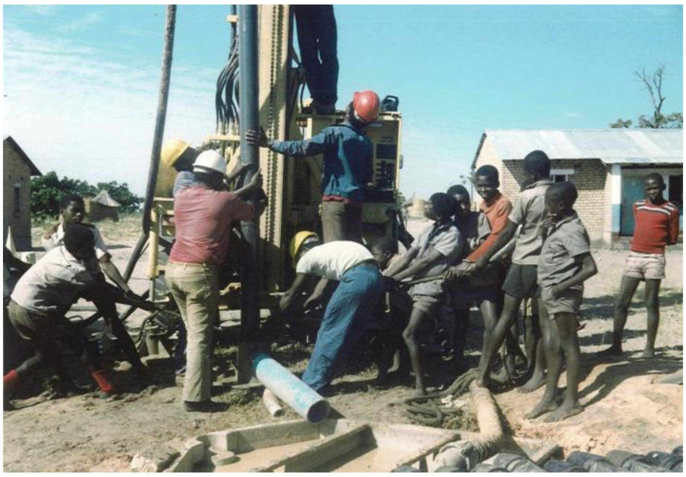
Table 4: Drilling Cost Example: 50 m deep borehole (20 m overburden and 30m rock); drilling speed average 4m/h. (note that this is intended as an example and not as recommended figures).

Drilling Specification		
Item		**Value**
J	Overburden depth	20 metres
K	Rock depth	30 metres
L	Total depth	50 metres
Assumptions		
M	Average drilling speed	4 metres per hour
N	Drilling Time =Total depth / Average drilling speed = L/M = 50 / 4	12.5 hours
P	Fuel cost	1.10$ per litre
Q	Rig fuel consumption rate	5 litres per hour
R	Hourly cost of rig lubricant consumption	$1 per hour
S	Compressor fuel consumption rate	28 litres per hour
T	Hourly cost of compressor lubricants (and foam if used)	$1.5 per hour.
U	Hourly depreciation of compressor	$30 per hour
V	Hourly mud pump cost (depreciation, mud, fuel, lubricant).	$13 per hour
W	Hourly labour cost (n.b. assumption same as "Labour" in Table 2, scenario (b), i.e. $212 per 8-hour day)	$26.5 per hour
Y	Hourly vehicle cost while on site (n.b. assumption same "Vehicles" in Table 2, scenario (b) i.e. $221 for an 8-hour day)	$27.6 per hour
Z	Temporary Casing 3 metres at a cost of $50/metre (note that this depends on depth, and the risk of losing the casing)	$150
AA	Time not drilling (e.g. waiting for decisions to be taken or repair)	2 hour
Calculation		
Item	**Explanation**	**Cost for the well**
Depreciation of Rig	= Hourly rig depreciation x Drilling Time = A x N = 17.00 x 12.5	$212
Maintenance of Rig	= Hourly rig maintenance x Drilling Time = B x N = 0.85 x 12.5	$11
Rig Running Costs in Overburden	= Overburden depth x Running Cost in Overburden in $ per m = J x G = 20 x 2.42	$48
Rig Running Costs in Rock	= Overburden depth x Running Cost in Rock in $ = K x H = 30 x 7.42	$223
Fuel and lubricants for rig	= (Rig fuel consumption rate x fuel cost x Drilling Time) plus (rig lubricant consumption rate x Time to drill) = (Q x P x N) + (R x N) = (5 x 1.1 x 12.5) + (1.0 x 12.5)	$81
Cost of mud pump	= Hourly mud pump cost x Overburden depth / Average Drilling speed = V x J / M = 13 x 20 / 4	$65
Cost of compressor and fuel (when drilling in hard rock)	= (Compressor fuel consumption rate x fuel cost x Rock Depth / Average Drilling Speed) + (Hourly depreciation of compressor x Rock Depth / Average Drilling Speed) + (Hourly cost of compressor lubricants and foam x Rock Depth / Average Drilling Speed) = (S x P x K / M) + (U x K / M) + (T x K / M) = (28 x 1.1 x 30 / 4) + (30 x 30 / 4) +(1.5 x 30 / 4)	$468
Labour cost for drilling	= Hourly labour cost x Drilling Time = W x N = 26.5 x 12.5	$331
Cost of Vehicles to remain on site	= Hourly vehicle cost x Drilling Time = Y x N = 27.60 x 12.5	$345
Cost of Temporary Casing	= Temporary Casing Assumption =Z	$150
Cost of Standing Time	= (Hourly rig depreciation x Standing Time) + (Hourly labour cost x Standing Time) + (Hourly vehicle cost x Drilling Time = (A x AA) + (W x AA) + (Y x AA) = (17.00 x 1) + (26.5 x 1) +(27.6 x 1)	$71
Drilling Cost for the well		**$2,005**
Drilling Cost per metre		**$40.1/m**

4.4 Casing and Completion

Table 6 sets out the prices of uPVC and steel casing of different diameters from Nigeria in mid 2008. Steel casing is considerably more expensive than uPVC. It is very important to undertake your costing according to the well specifications.

Figure 4: Installation of Casing



It is important to remember that the price of materials can vary according to world demand and the price of oil and steel. Screen and casing is particularly vulnerable to this. By the time award of contract occurs there may have been a price increase. You should also consider the cost of collection and delivery of these materials and of course of damage in transit, which frequently occurs. If you carry the materials as stock items, you may have bought them cheaper than the current price. Your quote should allow for the replacement cost.

Table 5: Prices of Casings and Screens (Abuja, Nigeria, 2008)

uPVC	Price for 3m length	Price per m
4 inch plain casing	$27	$9
4 inch screen	$30	$10
110 mm plain casing	$33	$11
110 mm screen	$34	$12
6 inch plain casing	$60	$20
6 inch screen	$66	$22
Steel	**Price**	**Price per m**
150 mm plain casing (threaded)	$762 (for 12 m)	$64
150 mm screen (threaded)	$636 (for 3 m)	$212

Table 6 sets out the costing for casing and completion of the 50m well specified in this example: 40m with plain casing and 10m screen. The casing and completion is assumed to take 5 hours (equivalent to 6 minutes per metre well depth). The cost of labour is included as well as the drilling equipment and vehicles, which remain on site. Note that material transport was covered in the cost of mobilisation. In order to avoid aquifer contamination it is essential to include a sanitary seal. No short cuts should be taken in this regard.

Table 6: Cost of Casing and Completion for: 110 mm diameter uPVC lined borehole 50 m depth (40m plain casing; 10m screen;) Time to install is 5 hours (an average of 6 minutes per metre).

Casing and completion	Unit	Qty	Rate	Amount
Rig Depreciation	hr	5	$17	$85
Labour	hr	5	$26.5	$132
Vehicles	hr	5	$27.6	$138
110 mm uPVC plain casing	m	40	$11	$440
110 mm uPVC screen	m	10	$12	$120
Gravel Pack	bag	7	$7	$49
Sanitary Seal (Cement)	bag	1	$20	$20
Sanitary Seal (Bentonite)	bag	2	$35	$70
Total Casing & Completion				**$1055**
Casing & Completion $/m				**$21.1/m**

4.5 Well Development and Pumping Test

Unfortunately, well development is a key aspect of water well construction that is often overlooked by drillers and supervisors. Proper well development requires skill, an understanding of the hydrogeology, sufficient time and care. If a well is not properly developed it will not work properly, will silt up, cause excessive wear or even breakdown of the pump and may result in abandonment of the well by the end users. Certainly this is not something that you wish to happen to your well! Well development should be quoted for correctly and carried out for the prescribed time.

Pumping Test is important to evaluate the productivity of the well and to determine the size of pump to be installed. A well drilled for a hand pump installation may need only 4 to 6 hours of testing if the development stage indicated an abundance of groundwater. However where the pump is chosen according to the productivity of a well then it is essential that a thorough pumping test is carried out.

When calculating the cost of well development and pumping test, you need to consider the depreciation (or hire) cost of the compressor, pump and generator and the length of time and type of pumping test involved.

Figure 5: Well Development using Compressed Air

Table 7 sets out an example of the cost of well development and pumping test. The duration and hence actual cost of well development is not known until it is completed and the water is clean of fine materials. You will thus need to estimate your costs, based on prior knowledge of the area and available information.

In this example it has been assumed that the drilling rig only remains on site for the well development but that it is not on site for the pumping test, hence the inclusion of compressor depreciation only.

Table 7: Cost of Well Development and Pumping Test (constant rate test of four hours pumping and four hours recovery)

Item	Unit	Qty	Rate	Amount
Well development (with compressor running for 3 hours, using 28 litres of fuel per hour)				
Compressor Fuel Cost	litres	84	$1.1	$92
Depreciation of Compressor	hr	3	$30	$90
Depreciation of Rig	hr	3	$17	$51
Vehicles	hr	3	$27.6	$82.8
Labour	hr	3	$26.5	$79.5
Sub-Total Well development				**$396**
Well Development cost per hour				**$132/h**
Pumping Test (Pump and generator runs for 4 hrs)				
Fuel Costs	litres	20	$1.1	$22
Depreciation of submersible pump, generator and water level instruments.	h	4	$7	$28
Labour (installation, recovery & documentation only)	h	8	$4	$32
Sub-Total Pumping Test				**$82**
Pumping Test cost per hour				**$20.5**
Total well development and pumping test				**$478**

4.6 Platform Casting & Pump Installation

Specifications for the platform, the drain and soak-away vary from place to place. It is essential you take full consideration of the cost of the materials, transport and labour. Rather than detail all the items here, we are going to assume a cost of $300 for platform casting, and move onto the cost of the pump.

Table 8 gives you a breakdown of the cost components of a handpump with an example. The total cost of purchase and installation is a lot more than the basic price. Note that the costs will vary with local conditions as well as the quantities procured.

Table 8: Cost components for international procurement and installation of a handpump (with example)

Cost component	Remarks	Example
Sales Price Freight on Board (FOB)	Often the smallest amount	$385
Seafreight & Insurance		$60
Clearing & Forwarding	Depending on procedures can be a lengthy process	$60
Customs Duty - VAT	If duty exempt, the process of reimbursement can be lengthy	$40
Storage Cost	Normally done in the centre warehouse of the dealer	$35
Re-packing	From container to the lorry	$45
Transportation to warehouse	Lorry transport (often many kilometres)	$40
Storage	Normally done in the warehouse	$15
Transportation to Drill Site	Often many km on the pick-up truck	$100
Installation	Depends on the pump	$40
Caretaker Training	Unfortunately not always done	
Capital Cost/Pre-financing/Risk	Capital to purchase pumps can be tied up often for long periods, the private sector needs to calculate these costs	$115
Total		**$935**

Summary of the Costing Example

Table 9 shows the cost of the six key components that were outlined in Table 1. The total cost for this example is $6,393. Note that this cost includes the well siting, and the cost of platform completion and pump installation. However, items such as water quality testing and well disinfection are not included. This example gives indicative prices for a sample well and should not be used as working rates. Overheads, profit and taxes need to be added to determine a final price. We shall consider this in step 5.

However, before moving on, we suggest that you look back at the example and consider if there are any places where realistic cost-savings could be made, without compromising the quality of your service.

Table 9: Summary of Costing Example: Total cost of a 110 mm diameter uPVC lined borehole 50m deep drilled by drilling rig costing $170,000, depreciated over 10,000 hours.

Item	Unit	Qty	Rate	Amount
Siting	Lump sum	1	$300	$400
Mobilisation & Demobilisation	Lump sum	1	$1,540	$1,538
Drilling	m	50	$40.1	$2,005
Casing & Completion	m	50	$21.2	$1,055
Well Development & pumping test	Lump sum	1	$460	$478
Platform Casting & Pump Installation	Lump sum	1	$935	$935
Total Cost				**$6,411**
Average Cost $ / m				**$128.2/m**

Step 5: Determine your price

When determining your price it should take into account the above steps because that way you are confident you can determine a price that you are comfortable with. With that knowledge you are in a position to refine your price according to the local market. Box 7 shows the extent to which prices can vary even in the same country.

Box 7: Drilling Prices Vary Considerably

Depth, geology, fuel costs, distance to and between sites, competition between drillers, **economies of scale** (size of a contract) and **market prices** play an important role in the price of a borehole e.g. three examples below.

Borehole details	Total Cost ($)	Cost per m ($)
110 mm uPVC, 50 m deep, basement complex	3,300	66
110 mm uPVC, 80 m deep, sedimentary	6,000	75
150 mm steel, 150 m deep	17,500	117

The above data is taken from one country (Nigeria) in 2008. It shows the extent to which prices can vary. Such data can only be used as a **very rough** indicator for cost estimations, but not as a benchmark.

Remember, that you need to distinguish between the COST to carry out the work and the PRICE which you quote to the client (defined in Box 1). To calculate your price, you need to consider:

- Mobilisation, drilling, casing and completion, well development and pumping test, and platform casting and pump installation costs (as outlined in step 3 and 4)
- Overhead costs and interest payments (see glossary)
- Taxes such as value added tax (VAT)
- Risks associated with the work
- Uncertainties regarding payment terms
- Profit, outlook of business and expectation of the development of the market.

Pricing water well drilling work is a challenge due to lack of information, uncertainties regarding when you will be paid, risks, and lack of transparency in the tender process. Determining the price to charge is an art as well as a science!

When quoting you want to be realistic with your rates. Contracts are not always awarded to the cheapest bidder. Speed of response, quality of work, best equipment for the job and trusted relationships all come in to play. Despite this, the price is likely to be the most important factor and that relates to an efficient business and having the right equipment for the job.

You may decide to put in a very low bid so that you can win the confidence of a new client or build up your profile. Alternatively, you may be so confident of winning the tender that you decide to put in a higher price to a particular client.

Offered prices can be binding so you need to make sure that your prices are calculated very carefully and checked before you submit the tender. However, preparing a Bill of Quantities (BoQ) and winning a tender does not always mean that you will be paid according to the BoQs you submitted. Clients may want to negotiate further.

Other Issues for Consideration

Bill of Quantities

Tender documents usually include a Bill of Quantities (BoQ). The BoQ provides a format for you to set out your PRICE for various items. There is no worldwide standard BoQ for water well drilling. They vary considerably in terms of detail and what is included or excluded. Sometimes you will be expected to site the well (therefore include the cost). You may also have to include the cost of the pump and its installation.

Some BoQs will be well-written, others badly with glaring omissions or more often you get a rehashed version. With careful thought you can always turn it into a successful offer as long as you think through all aspects of the job and all possible variables. Items that cannot be predicted or estimated or where the risks involved are too great can be excluded by assumptions or caveats. Always read the tender document very carefully. Some BoQs include a line for *overheads and profit*, while in other cases this is simply integrated into all the other items. In some cases, set up of the rig is integrated into mobilisation or drilling while in other cases it is considered separately. Tables 10 and 11 provide two sample BoQs for a contract of **ten wells**.

Table 10: Sample (i) Bill of Quantities for 10 wells: each with an average depth of 50m, i.e. total depth 500m.

	Description	Qty	Unit	Unit Price	Total Price
1	Borehole Siting	10	each		
2	Establishment of Base Camp	1	each		
3	Mobilisation and demobilisation of equipment and personnel	500	km		
4	Set up of rig and move between sites	400	km		
5	Drilling borehole of 6" diameter in soft overburden	200	m		
6	Supply, install and withdraw temporary casing	10	each		
7	Drilling borehole of 6" diameter in basement rock	300	m		
8	Sampling and Borehole Logging at 3m intervals	10	each		
9	Supply and installation of 110mm outside diameter, uPVC casings of 10 bar pressure rating	400	m		
10	Supply and installation of 110mm outside diameter, uPVC screens of 10 bar pressure rating. (Slot size 0.5mm)	100	m		
11	Supply and place approved filter pack around screens according to specification[1]	0.8	m^3		
12	Supply and installation of inert backfill	10	each		
13	Borehole cleaning & development till water is silt free	30	hour		
14	Pumping Test according to specification	10	each		
15	Provide and place cement grout	10	each		
16	Water Quality Analysis and borehole disinfection	10	each		
17	Well capping	10	each		
18	Installation of India II hand-pumps in accordance with specs.	10	each		
19	Completion Reports	30	each		
20	Waiting (or standing) Time		hour		
	Sub-total				
21	Overheads and profit -15%				
22	Value Added Tax (VAT)- 20%				
	Total				

[1] This is the annular volume between the drilled hole and outer casing: 150mm diameter hole; 110mm diameter outside casing = 8 litres/metre, which is equivalent to 0.8m^3 for 10 wells each with 10m of filter pack.

In Table 11, items have been streamlined, with the profit and overheads incorporated into the rates for the various items. Note that BoQs are not problem-free. We have found examples where there is no item included for moving between the drill sites, or where the specified drilling depths, casing and screen do not make any sense!

Table 11: Sample (ii) Bill of Quantities for 10 wells: each with an average depth of 50m, i.e. total depth 500m.

	Description	Qty	Unit	Unit Price	Total Price
1	Mobilisation	1	each		
2	Moving between sites	9	each		
3	Drilling	500	m		
4	Casing and Completion	500	m		
5	Gravel Pack and Development	100	m		
6	Pumping Test	10	each		
7	Backfill and well completion (including water quality analysis)	10	each		
8	Installation of handpump and accessories.	10	each		
9	Completion Reports	30	each		
	Sub-total				
	Value Added Tax (VAT)- 20%				
	Total				

Dealing with Risks and Uncertainties

You need to decide how to load the different items in the BoQs. Information on the type of contract that will be issued and knowing your client will help you to understand how to price your work so that you are paid fairly, for example:

- If there is a significant risk of drilling a dry borehole, and payment is according to the BoQs, you can consider increasing the price of the mobilisation and drilling as you will be paid for these items even if the wells are dry.
- If you are only paid for successful wells (i.e. *no water no pay*), you need to consider your pricing strategy based on the percentage risk involved. You will have to increase the price of each successful well to cover your costs if risks are high. It is important to find out about the drilling conditions so that you can determine an appropriate price.
- If there is considerable uncertainty about site location, and you are paid a fixed sum, you need to be sure that your price for mobilisation is realistic.
- If security is a major problem, you need to cover the risk of loss of equipment, or insurance in your price. We know of a water well drilling enterprise in Nigeria who lost all his equipment when it fell off a boat!
- Moving between sites in rural areas with poor accessibility can take even more time than actual drilling. Time is lost when vehicles get stuck. This can happen on the road or a few metres from the drilling site. When pricing the mobilisation (and moving between sites) allow for these expected problems.
- In the case of a client that pays very late, you may need to consider fluctuating exchange rates and interest and inflation, and may need to charge a higher price to cover the cost of borrowing money.

The Tender Process

Every country and institution has its own defined tendering procedures. However these procedures are not always adhered to in practice. In a decentralised environment, District Local Governments or District Assemblies tend to award small contracts (e.g. five wells or fewer). Also, work is often shared out between the companies tendering. There can be social pressures with respect to tender award, e.g. *"Joe was given the contract last time, so John should get it this time round"*. Political pressure to favour companies who are linked to, or owned by officials also exists. In addition, some enterprises may be favoured as they provide larger kickbacks than others.

The expectation to pay an informal 'reward' for being awarded with a contract is not uncommon in many countries, and in fact in some cases, companies are even expected to pay before the contract is awarded! It can be common practice to *"oil the wheels"* in order to get paid for the work done. "Underground movement" is a term that has been used to describe pressure put on to companies to undertake works at unrealistically low prices with promises of future (and better) contracts. This field note is not condoning such practices, merely stating the reality.

From the perspective of the contractor, if kickbacks are too high (sometimes as high as 40% of the contract price), either the construction quality will be compromised, or company profits will suffer considerably. Both of these will have long-term, negative consequences for your business, and for the health of the drilling sector as a whole. In the long term, it is in your interest that the tender process includes a pre-qualification process, and is clear and transparent.

Regular audits of the procurement processes and the physical audit of the works done with results published are one mechanism to improve the tender process. However, advocating for such measures is not something that can be undertaken by one drilling enterprise alone. An association of professional drillers (discussed below) may be able to exert pressure.

Sub-Contracting by brief-case companies

There are numerous cases throughout sub-Saharan Africa of so-called drilling companies without adequate capacity 'winning' contracts. These companies in turn sub-contract work to other, professional companies. As a result the profit on each project is shared among two companies, which can lead to low or no growth of your (genuine) company.

Although some contracts officially do not allow sub-contracting, in practice, these clauses are often ignored or not enforced. In one particular country, it was common practice for the *"fake"* company that won the tender to come to the site and cover the equipment of the genuine company with its logo-filled stickers!

The problem of sub-contracting has rendered companies who have the capacity and skills to undertake work as redundant or not able to maintain their equipment. This is an issue which clearly needs to be addressed. Good licensing and regulation of private water well drilling enterprises (and NGOs), or a professional drillers association are ways to tackle this problem.

Effective Management of your Business

Water Well Drilling is not Easy Money

Many people think that there is a lot of money, and that huge profits can be easily made in the water well drilling industry. They often do not realise that venturing into water well drilling is a big step into a business that is highly capital intensive and fraught with risk. Like all other businesses, establishing a drilling enterprise requires very good knowledge of the nature of the business.

Performance Bond

In many drilling contracts, a performance bond (see glossary) is required. The cost depends on the size of the job, as the bond is normally a percentage of the total volume of work. It is generally 10% for Bank bonds and 25% for insurance bonds of the total contract sum.

Maintaining Equipment and Stocking Spare Parts

Equipment whether new or old needs maintenance and will suffer inevitable breakdowns. It is wise to stock expected items that suffer from fatigue or wear out. A good maintenance programme should always be in place. It is not uncommon for drilling rigs in Africa to stand unused for months while spares are ordered from abroad. Ray Rowles (1995) told us to try to stock common spares so that you can keep your equipment "*turning*".

Business and the family and its effect on cash flow

In countries with poverty, high unemployment and virtually no state social security, as well as high value placed on kinship, patronage is important. Throughout sub-Saharan Africa, it is unusual to find anyone with income who does not support others without. Social pressures are such that it is very hard for enterprises to hang on to cash, or charge friends and family for goods and services from the business. Many small businesses therefore have little or no savings.

In fact when you are operating a business, people think that you have money all the time. To quote Anthony Luutu: "*Many times when I tell my relatives that I have no money, they just don't believe it. Everybody thinks that you have money and you just don't want to assist them*". Many people have failed to separate business from family resulting in no savings or cash flow and thus the collapse of the business.

Just as water stagnates if a river stops flowing, businesses cannot survive without cash flow. The authors are familiar with companies that look for money every time a new job comes up. However, such an approach makes it very difficult for a business to survive in the long term, never mind grow.

We thus advise you to try to separate the business from the family. This is not easy. One way to handle it is to ensure that you are paid a salary in line within what the business can afford, and perhaps an annual bonus if the company performed particularly well. All other money should be kept within the business.

Professionalism

In numerous sub-Saharan African countries there is no register of drilling enterprises, or licensing. As a result, genuine water well contractors end up competing with brief-case companies, and there is no regulation of the sector.

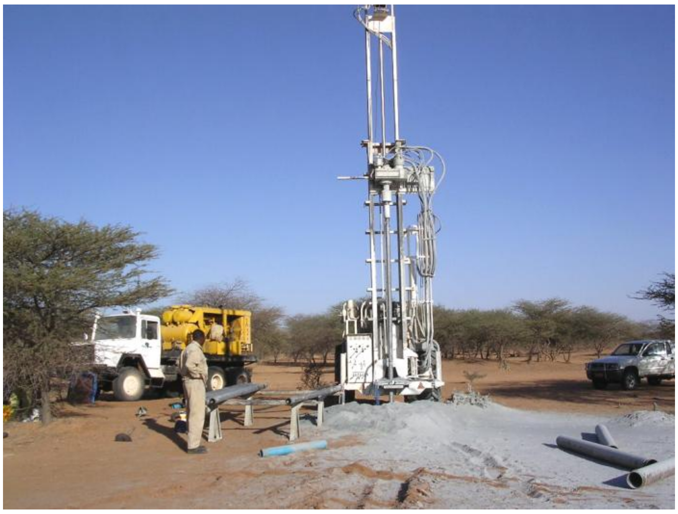
Registration and licensing of drilling contractors is extremely important as a basis for quality assurance. Where regulation of drillers takes place, such as in Kenya, the drillers are required to renew their licences on an annual basis. Equipment and human resources are appraised. Regulation can make sure that only competent drillers are able to pre-qualify to tender, can help to ensure that minimum standards are adhered to and can ensure compliance with the requirements to submit borehole logs and water quality testing results.

As drillers it is often difficult to associate with competitors. However the formation of a professional drillers association has many advantages. As a group, drilling enterprises are in a much stronger position to advocate for changes to VAT, better access to information on groundwater and drilling conditions and genuinely fairer contract terms and conditions.

Thus, if there is no drillers association in your country, or region, talk to your competitors and find out which challenges you face that can be solved together. Over the past few years, drillers associations or drillers-forums have been set up in Ethiopia, Kenya, Nigeria, Mozambique and Uganda. In 2008, the Mozambican Drillers' Association successfully lobbied the Government of Mozambique to amend unrealistic contract terms in a large co-funded programme.

From a social and economic perspective it is an advantage to the country when the know-how and revenues from drilling remain in the country. Exchange of experiences, for example could be coordinated by a drillers association.

Figure 3: Water Well Drilling in Burkina Faso



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About the authors

Kerstin Danert of Skat is the coordinator of the Cost-Effective Boreholes Flagship of the RWSN. She has extensive experience of private and public sector water supply institutions. **Anthony Luutu** is a hydrogeologist and director of Aquatech Enterprise, a Ugandan consultancy and water well drilling company. **Richard Carter** is Head of Technical Support at WaterAid. He has worked in consultancy, academia and with Governments and NGOs in many countries of Africa and south Asia, focusing especially on groundwater development. **André Olschewski** of Skat has wide experience in procurement of drilling contracts and business engineering.

Contact

The Rural Water supply Network (RWSN) is a global knowledge network for promoting sound practices in rural water supply.

RWSN Secretariat
SKAT Foundation
Vadianstrasse 42
CH-9000 St.Gallen
Switzerland

Phone: +41 71 228 54 54
Fax: +41 71 228 54 55
Email: rwsn@skat.ch
Web: www.rwsn.ch

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