Value Engineering in Process Design

by

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1.0 THE CONTRACTING SCENE

After the oil price slump in 1986 we realised that future projects would only succeed if the lifecycle cost showed an adequate return on investment. This emphasis from the contractor had not been so essential earlier when oil prices were robust and returns were high.

During this time there has also been dramatic changes in the operator companies to reduce costs. They are concentrating on oil and gas production and product sales. This has permitted large reductions in staff and the contracting out of many services they had previously done for themselves. This has led to the involvement by the contractor in the development of the operators' business plans and the pursuit of greater productivity for the oil and gas field developments.

Value engineering has been established as a core decision making process to engineering and process design. More recently with the advent of alliance type contracts the contractor involvement has become more useful as the engineering and total development economics have been studied together. On top of this the introduction of CRINE has led to the use of a zero base for each selected concept. Additions to the minimum design for any facility are only applied to enhance the safety and the net present value (NPV) of the development.

2.0 DESIGN TECHNIQUES

2.1 CLIENT CONCEPT SCREENING PROCESS

In the development of the oil and gas field the operator carries out his screening process and produces a development plan. He goes through the laborious procedure of requesting tenders for further design work and selects a contractor. The contractor is tasked with providing sound costings for the job and the most cost effective design. Although each party applies cost saving techniques the design is done in two halves.

The following sequence is the approach that was typically used in the past by major operating companies to judge whether a field was suitable for development:

- Reservoir engineering develops production profiles and relevant well data. Usually three different production profiles are developed, the 10, 50 and 90 cases representing the likely probability of the reservoir producing in that way
  Engineering use the reservoir data and profiles to assess topsides design and relevant transport alternatives
  CAPEX and OPEX estimates are developed for each alternative based on the equipment list, rough layout and jacket size. The CAPEX estimates are based on norms using historical data from previous projects and estimated weights for equipment, bulks and structural steel
  Data in the form of a report is returned to the asset whose economist then compares the options based on revenue, rate of return etc.
- The asset evaluates the results from the economist and compares them with any technical and reservoir risks. and then decides if further development work is required
- If results look favourable, engineering is asked to carry out more detailed study work for the favoured options to increase definition and to reduce costs. Reservoir engineering are asked to continue evaluation work to quantify reservoir performance risks.

There is no direct link between the potential revenue and the CAPEX / OPEX costs as they are generally developed by different parts of the client's organisation, although this is less likely in smaller organisations. A full picture of all the cost drivers within the development are sometimes not appreciated by the different departments involved.

Optimising of revenue against CAPEX / OPEX is iterative involving the above process being repeated a number of times. Due to the involvement of a number of specialists, and different technology centres e.g. engineering, reservoir, and economics, the process is slow and cumbersome with the result that possible options are ignored or discounted due to the time required to evaluate them.

2.2 CLIENT DECISION BASIS

In the development of an oil field or gas field the asset manager may be given some targets by which the value of the development will be judged against others.

Some typical performance targets may be:
- A total development cost of say <$3/bbl
- Lifting costs of say <70 cents /bbl)

In the initial design and estimating phases the development costs may be assessed at say $2.5/bbl, but with lifting costs of 95 cents/bbl. Therefore the project will be reworked to reduce the lifting costs. This will probably result in a higher development cost, and the developer may go through several cycles of trying to balance the two yardsticks to achieve both. Having estimated that both can be achieved the design will be confirmed. But that does not necessarily mean that the lowest life of field costs have been achieved.

This method is now to be discouraged. There was a long time restricted feed-back loop, for the design cases being assessed. Although there was lots of complex comprehensive expertise input to the process, often the people were working in isolation and concentrating on their own prearranged targets. They were working on discrete detailed elements within an engineering design.

This working method had high conceptual design costs, but still did not identify the best solution for the job.

The operator would then go out to a contracting company to develop the selected design case(s).

2.3 CONTRACTORS' TRADITIONAL APPROACH

When the contractor has secured the contract for the front end design of the development options, his remit is to cost the options, and identify savings to minimise these costs.

The client has studied the well data and produced the production profile to achieve the performance targets. The contractor assumes this is fixed and designs the production facilities, He uses optimising techniques, but the parameters he cannot change, those determined by the field development plan, restrict his opportunities.
There is no feedback to reservoir production analysis so the production facilities cannot be optimised for life of field costs. Or rather, can only be optimised for the field development plan selected.

The contractor has a traditional method for applying life cycle costs to the design. See Fig 2.1.

This process cannot handle change without excessive cost. The life cycle of the design development for the field is very long and the involvement of the contractor is on a very short time frame.

The mechanism for achieving accelerated decision making means that there are changes to the way in which some individuals contribute to the project. The schedule based changes described previously can also be described in the form of flow chart differences.

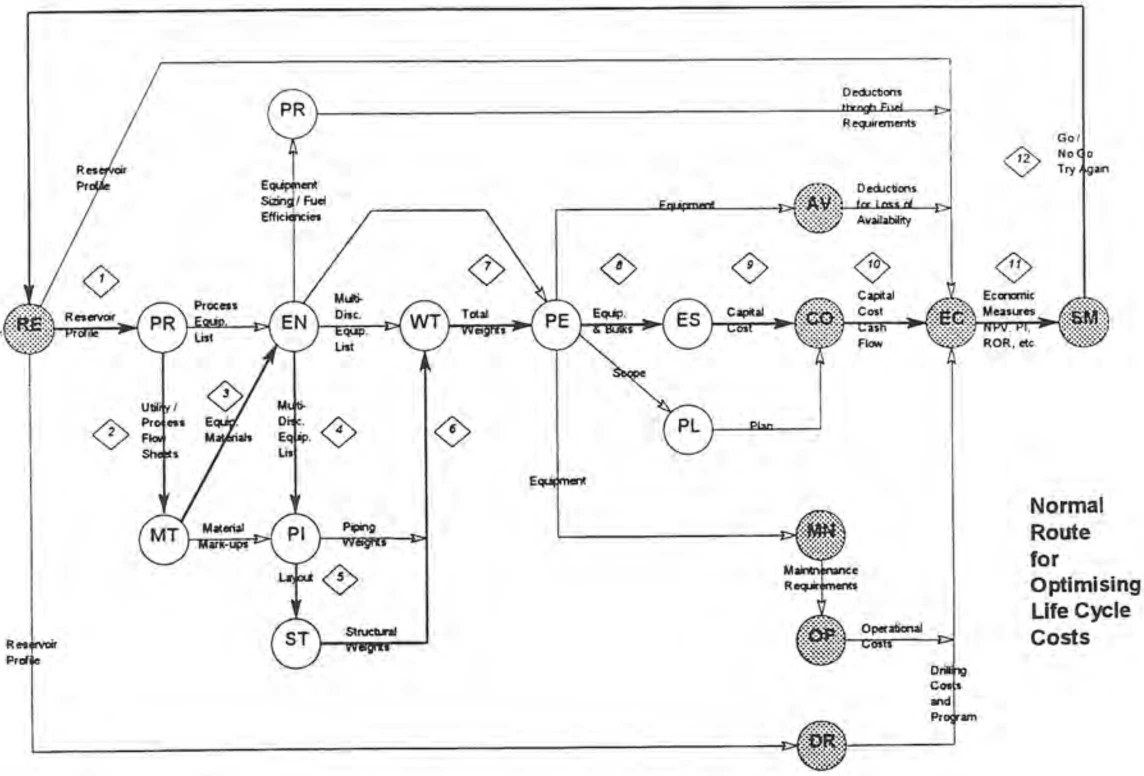

Fig 2.1 Traditional Flow Chart for life cycle costing

2.4 WHAT HAD TO BE DONE

What had to be done was to reduce the time frame for the assessment of options; have closer co-operation between facilities design and production profile selection; and provide a method for the evaluation of changes that would improve overall productivity with rapid assessment of options.

This was achieved by the adoption of the value model and having trained people with the particular job function of managing the model, the Value Manager.

3.0 THE VALUE MODEL

3.1 VALUE ENGINEERING

The contractor had to improve techniques to get a faster turnaround of the economic analysis. The tool had to be able to address the overall development evaluation, provide multiple option capability and significantly reduce the time for the feed back. The tool developed is Value Engineering. The mechanism for achieving accelerated decision making means that there are changes to the way in which some individuals contribute to the project.

The advantages of the Model are achieved by instead of applying sophisticated discipline specific tools to a set of provided engineering information, downstream disciplines are asked to simplify their inputs into something which can be modelled in a database or on a spreadsheet. Whilst the accuracy of the individual contribution will be compromised, the approach is much more in keeping with the likely quality of the primary input, the equipment list, at the early stages of design

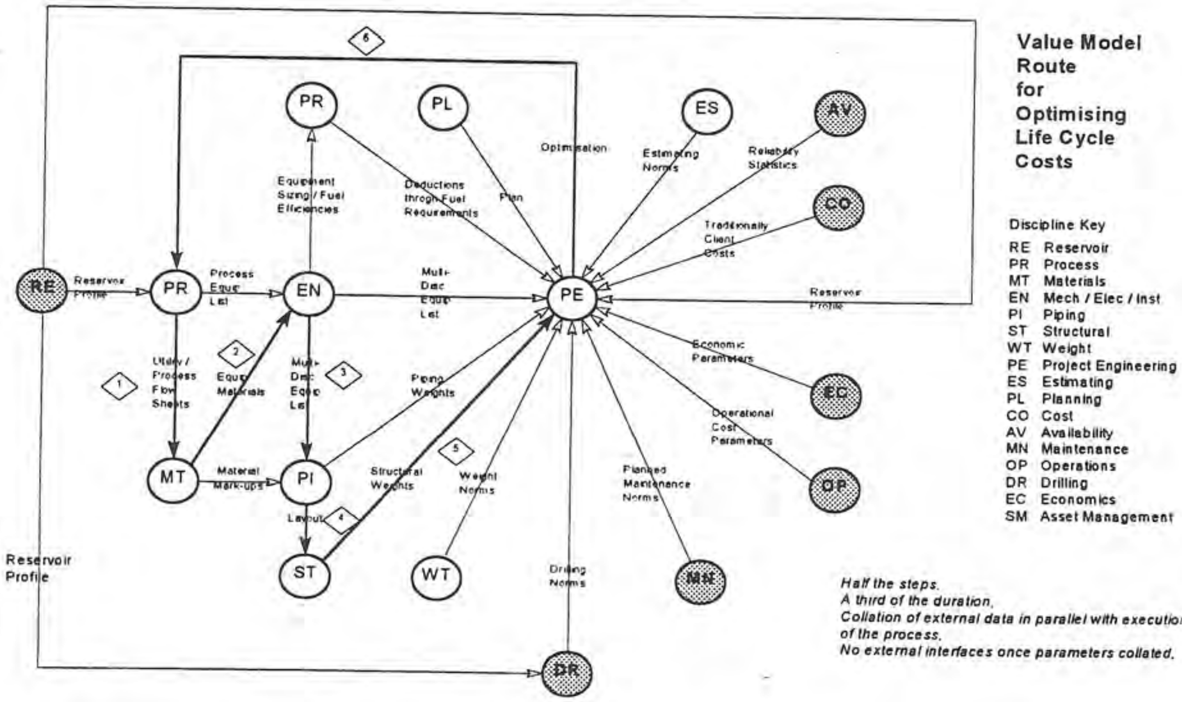

Fig 3.1 The Value Model Approach to Life Cycle Costing

The method allows simultaneous working, reduces the steps by half and collation of external data in parallel with execution of the process. There is rapid evaluation of change and no external interfaces once the parameters are collated.

The net result is that in a given period of time a greater number of options can be assessed and so a more optimal solution likely to be achieved.

This approach requires a different relationship with many traditional project functions. It also brings the economic impact of design change much closer to the originators of those changes - the engineers. Furthermore it recognises that the main driver during concept selection and early front end engineering is essentially the equipment list, and that the results produced by the sophisticated tools often employed by downstream disciplines, are only as good as the input data allows.

3.2 ALLIANCING

The use of value models became an integral part of the alliancing approach to project organisations. The alliancing was new in that it:

- invited contractors to participate in developing the total economic viability of the project
- extended the target plus style of contract to cover non-CAPEX issues
- recognised the value of continuity between design phases of the project, and the value of early participation by fabricators, installers, suppliers and other traditionally downstream parties
- embraced the functional approach and behavioural and cultural changes which are being advocated by CRINE and NORSOK.

3.2.1 Key Success Factors

In the execution of a development project certain targets are set to measure success. These are called Critical Success Factors, and are: Safety; CAPEX; OPEX; Contract Gas Date; Availability; Constructability and External Opportunities (flexibility to take on change)

For the Critical Success Factors to mean anything, they must be converted into measurable units against which performance can be monitored and challenged. Given that there will always be a requirement to make trade-offs between each of these factors, that it is desirable to have a unit which can reflect time, and that it must be sensitive to the context of the project, the obvious choice is money expressed as present value.

3.2.2 Quantification of Key Success Factors

Whilst the unit may be obvious, the relationship between factor and money is less obvious:

- Safety: in order for safety risks to be As Low As Reasonably Practical (ALARP), whether it is liked or not, there has to be some form of relationship between economics and quantified safety measures such as Potential Loss of Life. However, this has to be taken in the context of the commercial viability of the project
- CAPEX and OPEX are more traditional, although the latter is quite difficult to estimate when in the context of an existing operation. Sub-measures such as maintenance technician man-hours, direct costs of spares, unit complexity of substructure (number of jacket legs), and the number of additional equivalent process units can be used to prorate the existing operational budget
- Contract Gas Date can be converted to the cash flow loss arising from lost production. Account can be taken for gas penalty. In the case where a development supplements declining reservoir production, it is interesting to note that trade-offs can be made between cost and schedule. Start-up dates need not be cast in concrete
- Availability can be converted to percentage loss of revenue, as can the use of utilities such as fuel gas
- Constructability can be considered as part of the CAPEX
- External Opportunities can be measured in terms of the potential overall economic added value of the opportunity. The importance of having an understanding of overall economics cannot be overstated if effort is not to be wasted in the early studies.

3.2.3 Development of Risk and Reward Incentives

Traditional contracts can be awash with almost arbitrary liabilities which can be extremely difficult to enforce in law. The Alliance approach makes use of stated incentives and commitments which in theory should replace all such liabilities. In practice, whilst for some alliance projects contract purity has been achieved in that there were no such additional clauses, other alliance contracts still retain them.

The initial approach on the BP Cleeton Project was to try and align all Alliance parties to some form of single overall economic measure based on the "value model", and to take this value and support it by measurement during operations.
It was demonstrated how much each of the contributing factors impacted total economics, and what the swing in values was likely to be via risk analysis.

For a variety of reasons; inability to influence, inappropriate risks, lack of common understanding, and difficulty of measurement, this model was simplified to CAPEX, Availability, and Gas Penalty, with essentially linear relationships between percentage change in outcome versus financial risk and reward.

This was supplemented by a project commitment to continue to make decisions on the basis of overall economics.

As an example, the CAPEX graph is illustrated in Figure 3.2.

Whilst availability takes into account reliability, which in turn has a direct impact on the main OPEX driver of maintenance technician man-hours, when taken alone it is an unbalanced measure. The theoretical model incorporates difficult to measure partial non-availability, it is dependent on maintenance strategy, affected by sparing philosophy, and difficult to apply beyond OREDA availability norms.

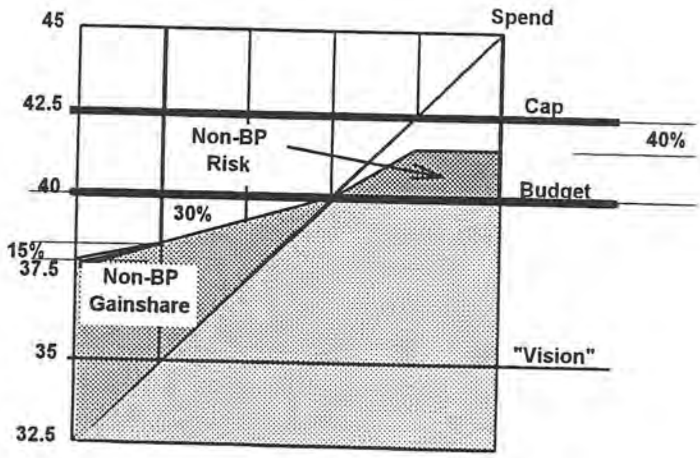

Fig 3.2 CAPEX and Risk Reward Relationship

Given these difficulties and limitations the approach favoured is essentially to make use of a fairly standard CAPEX risk/reward pot as described above, but to formally supplement it with an off-line overall economic trade-off pot which allows the base CAPEX target to be adjusted to reflect life cycle issues. This provides the necessary incentive for the design team who have greatest influence on life cycle outcome. As is the case with Cleeton, there should be a commitment to treat justified post start-up remedial work as CAPEX.

In the case of underwriting OPEX, this should be done on the basis of calculated final targets set immediately prior to the operational phase, not on theoretical estimates generated early in front end engineering.

a) Life Cycle Costing

Fundamental to setting up quantified key success factors and to setting risk and reward targets is the requirement to create a complete life cycle costing model which can be used on an interactive basis by the project. This life cycle or "value model" contains simplified versions of all of the elements which contribute to development economics; capital and operational cash flows, economic parameters, and, if applicable, drilling costs and revenue streams

b) Management of Risk and Opportunity

Once a base case has been established risks and opportunities are identified, some of which can be significant. Associated with risks are the actions required to mitigate and assess their impact, and in the case of opportunity, actions to evaluate and realise their value.

The basis of this is the establishment of an actions database, which, in addition to collating actions arising from other sources, such as minutes of meetings, also manages and reports on ongoing risks and ideas for. This is naturally coupled to the life cycle cost perspective originating from the other value activities.

c) Process Design

The development of the value model has provided the process engineer with a valuable tool. In the development of design options he must consider total costs. Assessment cannot be made on CAPEX alone. However, making variations for capital expenditure and operating costs can have knock on effects that are not always so obvious. The use of the model will give the true value of design options and so will lead to a more optimal design.

4.0 THE BP CLEETON PROCESS DESIGN CASES

The value model is used throughout the project to maintain a constantly updated costing for the project. This gives the overall picture for the project. However, this design tool is available to help make design decisions on discrete portions of the work. In the examples below the process engineer used the model to test the overall effects of major design selections and not just the basic cost of the items under study.

The value model prepared for this project was used as a tool to determine project economic criteria in the process design. It was used, in particular, for the calculation of overall NPV, for evaluation of:

- field development options, eg comparisons of different reservoir profiles and compression power alternatives
- equipment process design optimisation, eg comparison of single stage and two stage compression
- vendor equipment selection, eg comparison of competing vendor gas turbine drivers for the required compression power.

These applications all use the value model in its full form so that the sensitivity of the design aspects such as those indicated above on the overall project economics may be evaluated. This ensures that all relevent factors such as CAPEX, OPEX, discount rates, sales revenue, tax take out and availability are considered and overall project NPV is examined for the sensitivity of the design aspect under review. These examples illustrate the application of the value model in more detail.

4.1 FIELD DEVELOPMENT EVALUATION

The BP Cleeton Compression Project involves the addition of a compression platform to the existing Cleeton and Ravenspurn platform facilities, which were installed in the late 1980's, to allow production of the Villages gas field in the Southern North Sea.

FEED studies were carried out to establish the optimum compression design which would maximise the return on the investment in the new facilities. Reservoir studies had determined that installation of compression facilities would allow both an early increase in production (which was required by the Asset in order to meet increased gas production targets for the S North Sea) and would also increase overall gas recovery from the reservoir. This would allow economic operation of the Villages field to be extended beyond the current predicted life of the facilities.

The Conceptual and FEED development was carried out by an Alliance team in which John Brown provided the engineering input working closely with a small in-house BP Client team and supported by BP specialist engineers when necessary and as determined by the Alliance. Later in the project the Alliance was expanded to include the compressor vendor, installation, hook-up and commissioning contractors.

Conceptual studies were carried out to develop compression platform designs for a range of compressor driver powers between 5 MW and 13 MW. This range was selected after consideration of gas turbine powers avaliable from vendors. BP reservoir engineers developed a range of production profiles for the various power options and these were used to carry out economic assessments of Sales Gas Revenue over the reservoir life. Typical profiles are shown in Fig 4.1 and provided quarterly production data over the reservoir life.

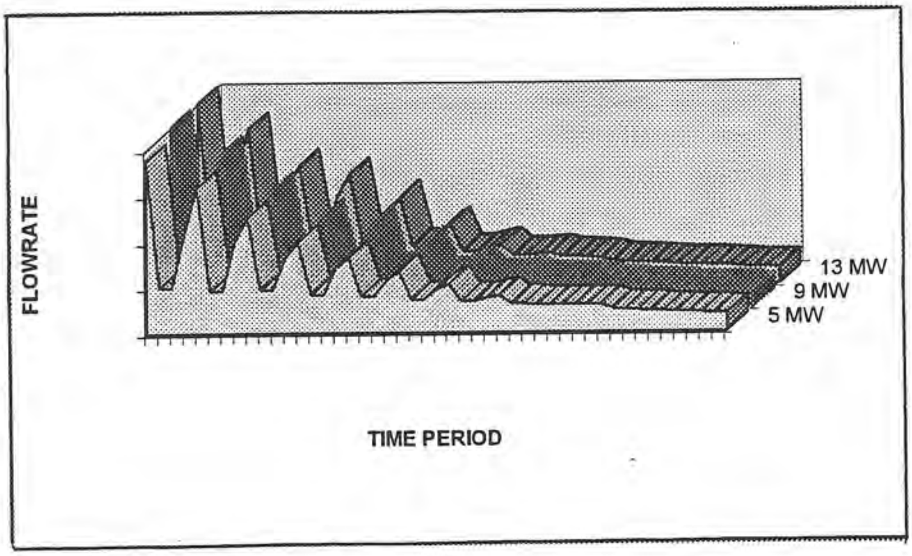

Fig 4.1 Typical Production Profiles

The economic Key Success Factors including CAPEX, OPEX, Sales Revenue, Abandonment, NPV and Capital Efficiency (simplistically NPV/CAPEX) for each compressor power development option were calculated using the value model. The compressor options considered at this stage included use of either single stage or two stage compression to provide early indication of the likely optimum arrangement but this was a second order sensitivity to selection of the optimum power for compression and was further studied later.

Typical results were as follows (with costs normalised to CAPEX cost of the 9 MW option = 100 units) :

Case	5 MW	9 MW	13 MW
CAPEX	90.4	100	108.2
OPEX	14.8	16.1	20.0
Gas Revenue	320.3	356.5	356.1
Abandonment	12.6	12.9	13.4
NPV	202.6	227.6	240.7
Capital Efficiency	1.81	1.87	1.62

These results indicated that selection should be between a 9 MW and 13 MW machine and further considerations in addititition to those factors listed above needed to be taken into account in order to arrive at a final recommendation. These included:

- The greater the compression power, the higher the sales revenue in the first few years
- The higher compression power can meet a given gas deliverability with less wells allowing delay of drilling new wells
- The greater the compression power, the less the potential back out of Villages gas required in order to allow tie-in of new gas entrants into the facilities.

Taking into account all of the above the 13 MW driver option was selected for the Compression project. The value model proved to be a powerful tool in the decision making process by providing overall life of reservoir economic criteria which allowed rapid evaluation of the development options under review and provided a dynamic interface between the reservoir engineers, process and discipline engineer inputs and Asset management inputs. It was no problem for instance to accommodate late changes or developments in reservoir predictions or economic factors such as gas price, tax take out or discount rates so that decisions could be made on the latest information.

4.2 COMPRESSOR PROCESS DESIGN OPTIMISATION

Using the value model developed for the conceptual studies further optimisation work was carried out to conclude the compressor design based on the selected power option. This work comprised the evaluation of single stage versus two stage compression. At this point the compressor vendor had been selected and it was possible to work closely with the vendor to optimise the design. It was required to design a compressor for a range of Villages gas production profiles and also to consider the impact on the design and the project economics of accommodating new gas into the facilities. This required an iterative methodolgy with the main interfaces being between the reservoir engineer, process engineer and compressor vendor with the value engineer ensuring the correctness of the overall economic evaluation.

Preliminary work had indicated that the basic compressor selection provided the options of:

- single stage design with suitable rewheeling later in life
- initial single stage compressor design capable of modification to two stage operation with suitable rewheeling and the provision of additional interstage scrubbing and intercooling equipment
- two stage compression from the start of life with suitable rewheeling later in life.

The design procedure used was as follows:

- The reservoir engineer developed production profiles for both single stage and two stage compressor operation (see Fig 4.2) . Use of two stages of compression meant that the end of life reservoir suction pressure could be reduced from 21 bara to 12 bara with overall increased gas recovery. Two alternative production profiles were produced in each case representing lower and upper well investment programs.

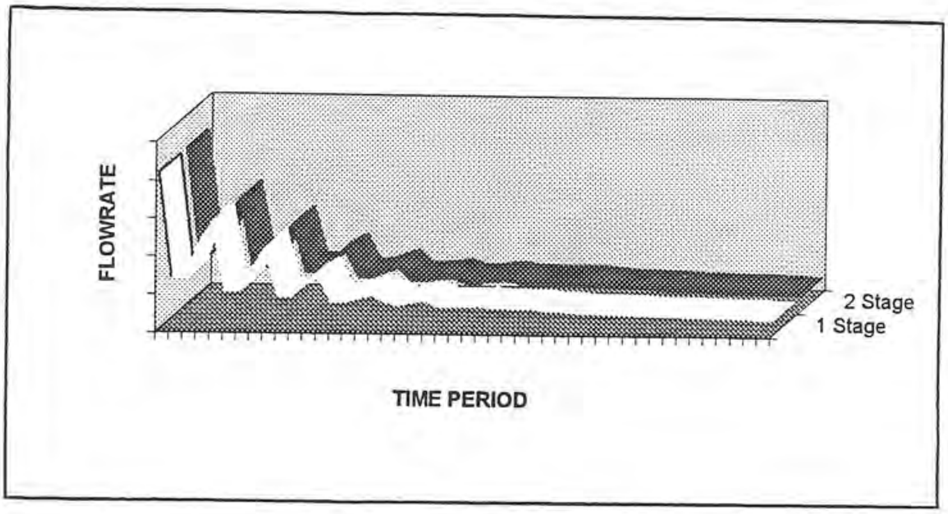

Fig 4.2 Typical Production Profiles

- The compressor vendor prepared compressor designs for the single and two stage compressor arrangements. Any modifications to the production profiles required to match the compressor curves were identified. CAPEX and OPEX data were provided including fuel consumptions on a quarterly basis. Flexibility of designs for accommodating new gas was determined.
- The reservoir engineer reviewed the compressor vendor modifications to the production profile to confirm acceptability
- Process design of scrubbing and cooling equipment was carried out and costing done. Any layout and cost impact of single and two stage designs were determined
- Input of CAPEX, and OPEX data into value model and calculate project economics for the various compressor options
- Prepare evaluation report on compressor staging for Asset management review.

Typical value model results for the single versus two stage economics were (Costs normalised to CAPEX for single stage option set to 100 cost units):

Case	Single Stage	Two Stage
CAPEX	100	101.9
OPEX	19.5	20.2
SalesRevenue	341.6	342.6
NPV	215.7	214.0

The value analysis demonstrated that the single stage design was the most economic solution. This proved to be the case although a two stage design within a single casing but with intercooling is inherently more efficient than a single stage in terms of fuel consumption. However, this advantage was not realised in the specific case studied because:

- in the early years interstage cooling is not required and hence no benefit was obtained from two stage operation in this period
- when intercooling is installed the two stage compressor operates at a final suction pressure of 12 bara compared to 21 bara for a single stage machine although the thoughput of gas is similar in each case
- the overall effect is a greater power requirement and greater fuel gas consumption for two stage operation in later field life. This significantly reduced the amount of extra sales gas production resulting from operation at the lower reservoir pressure.

It should be noted that the above study required the handling of large amounts of data to cover the necessary detail to evaluate all the options. Transfer of data between specialist engineers in spreadsheet and database format greatly simplified the work involved and provided the means for direct input to the value model. The value model used as a tool in this situation allowed the important design issues to be quickly identified and provided a sound economic basis upon which the process design could be optimised.

4.3 GAS TURBINE DRIVER SELECTION

The process optimisation studies determined the gas turbine driver power range required and competitive tender resulted in two possible machine selections each from different vendors.

Full vendor information was obtained with respect to CAPEX and OPEX, taking into account fuel consumption efficiency data, servicing intervals, spares requirements and maintenance downtimes, reference installations and reliability data.

The value model was used to compare the life cycle economics of the two turbine drivers being considered. The procedure used was :

- Reservoir production profiles were produced for each of the turbine drivers for two different well investment programs. The production profiles took account of a slight difference in the available powers of the two machines and so represented slightly different overall gas recovery yields from the reservoir. This data was used to calculate Sales Revenues on a quarterly basis over the reservoir life
- Using the vendor data, the fuel consumption for each machine was calulated for each quarterly production period taking into account the degradation in performance between service intervals. Fuel requirements were subtracted from gas production to give available Sales gas rates for revenue calculation
- All the above data including CAPEX and OPEX costs, and maintenance costs were input to the model.

Typical value model results for a given well investment program were :

	GT Driver A	GT Driver B	Cost Delta (B - A)
CAPEX	100.0	100.8	0.8
OPEX	21.5	20.5	-1.0
Sales Revenue	332.7	335.3	2.6
NPV	204.8	207.7	2.9

It can be seen that the life cycle economics in terms of NPV favoured Driver B although this was the more expensive CAPEX option. Note that the CAPEX is the total facility cost and that the Driver B equipment cost was some 8% higher than that for Driver A. Use of the value model allowed rapid comparisons of the sensitivity of the analysis to the various assumptions made in the input data, particularly for example, in the production profiles assumed or vendor claims of fuel efficiency and degradation rates. This assists in the assessment of confidence levels and risk factors as inputs to the decision making process.

4.1.4 Summary

The work carried out on the Cleeton project demonstrated how the value model could be used for detailed studies in the process design. The value model is primarily designed to give the project overall NPV, but it can then be applied at the next level of detail. The equipment selections are tested against the whole job impact and the sensitivity of all aspects can be tested.

5.0 APPLICATION TO RESERVOIR MANAGEMENT

5.1 INTRODUCTION

Experience has demonstrated that the commercial viability of offshore projects is affected as much by reservoir management as it is by facilities development. Reservoir management affects cost and the time value of drilling, which can contribute half of the cost outlay, and has a significant effect on process equipment sizing.

The traditional approach typically provides a fixed set of production profiles, as seen by the reservoir engineer, against which the process engineer extracts the various peaks and designs the equipment around. In practice reservoir prediction is highly uncertain and is managed in any case during operation. It is therefore not fixed but variable. If an efficient loop exists between designer and reservoir engineer the profile can usually be adjusted to allow greater optimisation of the equipment cost / timing / revenue trade-off.

This was demonstrated in another North Sea project which is described below.

5.2 NORTH SEA OIL DEVELOPMENT

This particular project was a conceptual study which involved the addition of subsea reception and separation facilities onto an existing installation.

5.2.1 The Approach

Whereas the Cleeton model described in the previous section provided a tool suited to assessing the incremental value of adding compression facilities in a FEED design, the approach adopted for this project was even more aligned to a value based approach:

- In order to identify the building blocks necessary for value decisions, a most expensive case scenario was identified which assumed that all wells could be brought on stream immediately within a continuous drilling programme. This created a requirement for maximum processing (the "Full Hit" case)

- An equipment list was developed and simple mechanical sizing and costing data sheets added to the model for each type of equipment. This meant that if the process sizing criteria changed weights and costs would also change
- Each equipment item was categorised into system, and weight norms applied to generate typical weights for non-equipment items. Each system had an exponential scaling equation applied so that coarse what-ifs could be conducted on a system by system basis

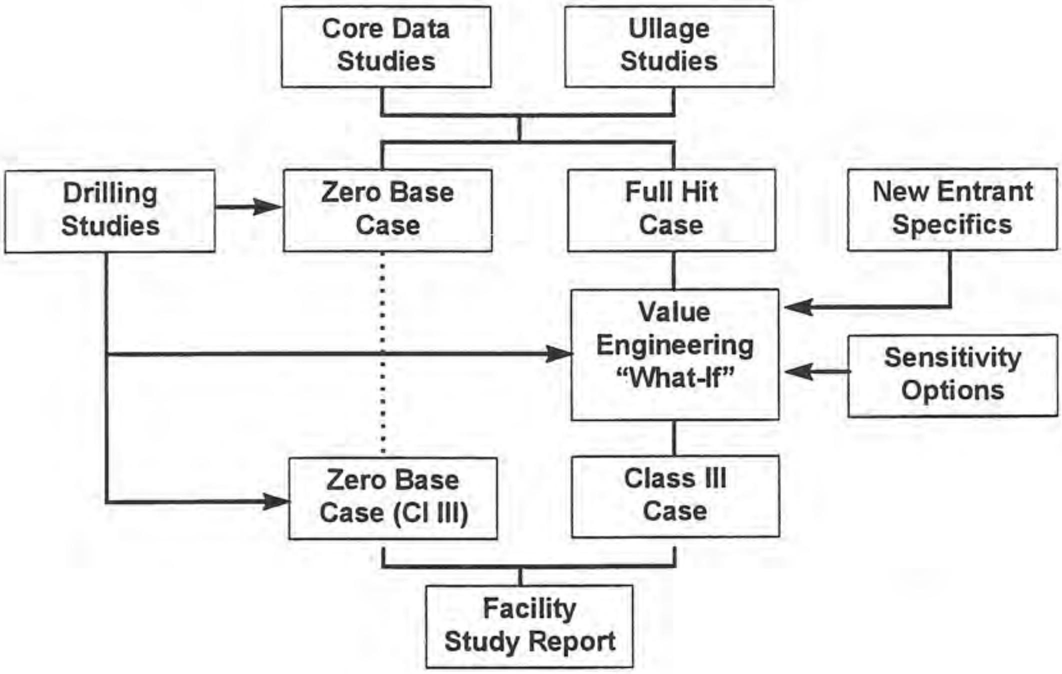

Fig 5.1 Schematic of value model

- The weights and equipment costs were brought together into a coarse module costing sheet which applied typical costs per tonne for bulk materials and fabrication, thus providing a dynamic feel for total fabricated cost of the option
- Each well had associated production streams and drilling costs
- A development plan spreadsheet was developed which generated cash flows for each of the cost / revenue streams and which allowed for "what-ifs" to be applied to programme

- Finally, economic criteria and revenues were added to allow overall economics to be assessed
- In order to validate scaling factors and identify step changes, the costs were also developed for the minimal solution
- As implied in the figure the value engineering approach then made use of this model to test, on a coarse basis, changes to process design options and the associated incremental effect, particular on weight, and therefore cost.

5.2.2 The Application

The above approach minimised multi-discipline engineering effort and provided input into the process of optimising the development scheme. In particular it identified the opportunity for minimising water treatment and total fluid handling process design criteria whilst at the same time retaining oil stream production. This maintained high value revenue, since early production could still be achieved, but reduced throughput later in life as the wells watered out and the revenue stream had less relative value.

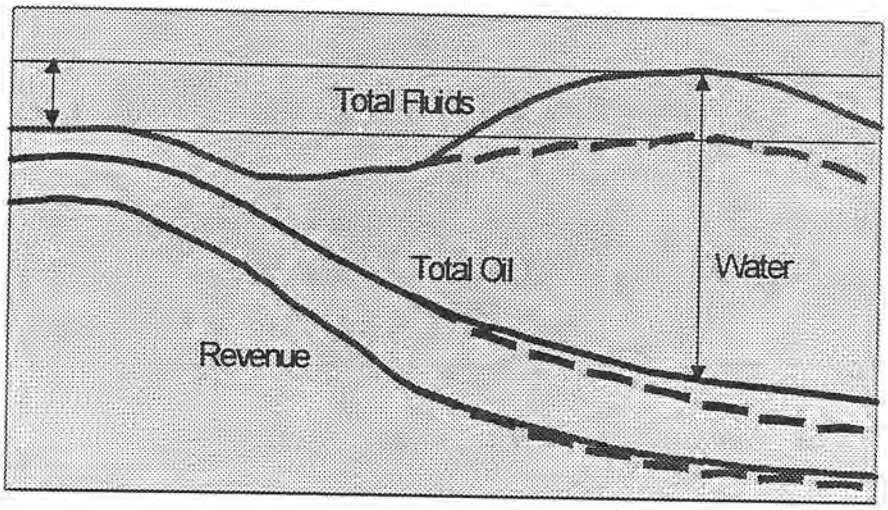

Fig 5.2 Production Rate and Revenue with Time

5.2.3 Other Projects

The success of this value approach in identifying opportunities, reducing time-scales, and keeping engineering costs low now means that it is being applied across a number of projects.

In a current project, as in the above case, the whole FEED execution strategy is driven by a requirement to establish value awareness at the earliest stage possible in the process. The technologies involved are all leading edge and the requirement to have close co-operation between reservoir, drilling, and capital engineering has already evidenced itself in terms of modifying what would traditionally be fixed reservoir characteristics to allow them to fit within capital efficient process boundaries. Drilling programme and reservoir management issues are also being challenged in order to optimally balance the economics.

6.0 Conclusions

The development of value engineering and the value model has provided the process engineer with excellent tools. The benefit of the tools is that economic process selection can be made on the whole project effect (NPV) and not just on the CAPEX and OPEX of a discrete item of equipment.

The value model is setup with the assistance of the process engineer and is strongly influenced by the equipment list.

At the field concept level the value model allows the process engineer to interact with the reservoir engineer, so that difficult to run multiple cases of reservoir production can be evaluated. Reservoir production rates can be set to give the best processing equipment sizing cases for optimum project NPV.

The benefits of value engineering are greatly enhanced in alliance type projects, where client data is more readily available, and the client and contractor portions of the design development can be integrated.

The value engineering approach, however, does not escape 'political' issues associated with a project. The predetermined fixed parameters can be quite extensive in which case the value model is of most benefit only to equipment selection issues

The value engineering technique allows rapid assessment of the project's main design parameters and welcomes a simplified assumptions approach. This allows the generalist rather than the specialist to set the pace of the value model development. This is essential in order that the process engineer may have a model that is sufficiently well developed at an early stage of the project to be of any use at all.

The value engineering benefits are that cost effective installations can be designed with good knowledge of the most sensitive design parameters. The designs will be fit for purpose and show the optimum compromise of reservoir engineer, process designer, maintenance and operations and asset business objectives.

reservoir engineer, process designer, maintenance and operations and asset business objectives.

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