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Synopsis

"Capital and Operating Cost Forecasting for a Distribution System Due Diligence" – Ralph Parmella, PB Associates and Ron Millard, PB Power

As a consequence of the growth in privatisation of public utilities around the world the divestment and purchase of such utilities has become a highly competitive process. The traditional methods used to undertake due diligence on these utilities suffer a number of shortfalls, which can severely effect a potential purchaser's ability to produce an accurate view of the business and to determine the risks of ownership. To overcome these difficulties the authors have applied bottom up modelling techniques, which provide a view of the likely operational and capital expenditure requirements of the business. The sensitivity of the forecasts to changes to asset lives, asset age profiles, unit costs, planning criteria, asset utilisation, load growth and maintenance or asset replacement strategies etc can be determined, allowing the potential investor to assess his level of risk.

An alternative growth capital expenditure forecasting model has been developed, which is sufficiently detailed to enable major technical aspects to be assessed by using two or more segments representative of different load density areas of the network. The segmented approach provides a compact, but extensive computer model, which is easier to operate than a more detailed model of the complete network.

The non load related capital forecasts, or replacement forecasts, are generated by a similar "bottom up" modelling process. The model uses age-based replacement, which is based on average engineering lives that are assigned to each asset class. A condition factor is applied to each class of asset in order to simulate actual replacement practice.

The "bottom up" Operating Expenditure and Maintenance Model produces total operating and maintenance expenditure indices by asset class. Indices can be generated using actual expenditure from the purchasers own business and the expenditure of the business being investigated by asset class. The paper describes these modelling tools and discusses their application in a due diligence.

"CAPITAL AND OPERATING COST FORECASTING FOR A DISTRIBUTION SYSTEM DUE DILIGENCE"

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1. INTRODUCTION

As a consequence of the growth in privatisation of public utilities around the world the divestment and purchase of such utilities has become a highly competitive process. The traditional methods used to undertake due diligence on these utilities suffer a number of shortfalls, which can severely effect a potential purchaser's ability to produce an accurate view of the business and to determine the risks of ownership. Disclosure data provided as part of the acquisition process is invariably incomplete and difficult to interpret. The data that is missing from the data room is often also of concern.

To overcome these difficulties the authors have applied bottom up modelling techniques, which provide a view of the likely operating and capital expenditure requirements of the business.

In the acquisition of an electricity distribution utility the capital expenditure models provide an estimate of the non-demand and demand related capital expenditure required by the business over a long time horizon. The capital forecasts that the models produce can be compared with the capital expenditure and forecast data available from the disclosure documents. The sensitivity of the forecasts to changes to asset lives, asset age profiles, unit costs, planning criteria, asset utilisation, load growth and maintenance or asset replacement strategies etc can be determined, allowing the potential investor to assess his level of risk. Capital investment trade-offs against operating expenditure can be readily evaluated.

Current levels of operating and maintenance expenditure need to be examined in such a way as to identify the levels of efficiencies that can still be achieved by the potential purchaser by optimising the asset management strategies of the business. The potential purchaser also needs to demonstrate to the financiers that the business is "value for money" by identifying the scope for improvement.

The conventional top down "benchmark" comparison method where annual expenditure and forecast expenditure at a high level is examined and compared has the disadvantage that one is not always comparing like with like. Ratios such as expenditure per customer, expenditure per MWh, expenditure per number of employees, etc. can be misleading where the distribution businesses have different asset bases or mix of assets.

Often the potential purchaser is the owner of a distribution business elsewhere and hopes to bring his expertise to bear in optimising the new business. The levels of expenditure and degrees of efficiencies achieved in his business are well known to him and this knowledge should be used in the due diligence process.

The "bottom up" Operating Expenditure and Maintenance Model (OPEX Model) produces total operating and maintenance expenditure indices by asset class. Indices can be generated using actual expenditure from the purchaser's own business and the expenditure of the business being investigated by asset class. Large differences in expenditure requirements between the "existing owner model" and the "new owner model" may indicate areas where efficiencies can be achieved using the potential purchaser's asset management and operational methods. The levels of these efficiencies can also be quantified.

The modelling techniques described above and their application in a typical due diligence process are described in the following sections.

2. TASKS UNDERTAKEN ON COMMENCEMENT OF THE DUE DILIGENCE

A typical time schedule for the sale of a utility could be as follows: -

Issue Information Memorandum	Fri 12/05/00
Indicative Bids	Fri 16/06/00
Data Room Period	Mon 26/06/00 – Thurs 03/08/00 (39 Days)
Management Presentations	Mon 26/06/00 – Fri 30/06/00
One-on-One Meetings	Mon 03/07/00 – Fri 14/07/00
Final Bids	Fri 04/08/00

It is obvious that the degree of confidence that a consultant will have in his predictions relating to the expected levels of operating, maintenance and capital expenditure is directly dependant on the level of detail contained in the information that is made available. Data is often difficult to evaluate either because it is hidden amongst a mountain of irrelevant information, or because it does not form part of the disclosure information. Nevertheless all sources of data need to be examined.

The Information Memorandum (IM) issued by the selling agent for the distribution business under the hammer is typically full of historical, high level financial data and Board Reports. There is seldom any significant detailed expenditure or technical data to allow anything more than broad assumptions to be made. The potential purchaser and his financial advisers therefore use the IM to decide whether to submit an indicative bid and to determine the probable magnitude of the bid.

Generally, it is only after the indicative bid has been accepted that the potential purchaser appoints consultants to assist him during the due diligence phase. The consultant’s team has to be mobilised at short notice.

The period given in the above example of a due diligence schedule is 39 days. It is probable that at least 3 weeks will be necessary prior to final bid submission for final financial modelling by the financial advisers and Board approvals by the stakeholders for the final purchase commitment. The client also requires time to evaluate the consultant’s recommendations.

Generally the consultant is given three weeks or less in which he has to undertake the following tasks:-

- Read and evaluate the data available in the dataroom and in the public domain
- Identify the assets involved in the sale
- Inspect a sample of the assets to the extent that this is possible given the access that is permitted
- Derive load and non-load related capital forecasts and OPEX forecasts using appropriate data
- Interpret the results, consider sensitivities of the results to changes to input data and assumptions and make recommendations to the client and their financial advisers.

Access to the assets or personnel of the distribution business may vary from "open door" to none at all but generally some access is arranged albeit on a formal basis. This is useful particularly when the business has a large number of indoor substations for example, and less necessary for a rural type network where equipment can be examined “through the fence". Some degree of inspection is essential to enable the consultant to identify asset classes and typical configurations used in this particular network. As unit replacement cost information from the disclosure documents is likely to be sparse an opinion needs to be formed on the equipment and construction standards applicable to the particular business. Suitable “standard costs” can then be obtained from the consultant’s in house costs database.

The consultant’s due diligence team has to examine all available sources of data in order to ensure that the models produce meaningful results. Where information is not available suitable assumptions have to be made in deriving appropriate data based on the consultant’s experience.

Generally, the consultant’s forecasts and sensitivity analysis are based on the budgets and historical expenditure revealed in the disclosure documents. With this limited information it is difficult to make valid comments regarding the levels of expenditure or to make comparisons with expenditure in similar businesses that will have different features. These differences will be technical in nature, for example they will be due to topography, customer density, historical factors. The differences will also be commercial in nature, for example in the levels of outsourcing of services.

The approach that is described in more detail in the following sections allows the consultant to present an independent forecast of the likely levels of expenditure. These outputs can then be compared with data from the specific business and sensitivities explored.

3. LOAD RELATED CAPITAL EXPENDITURE

Load related capital expenditure includes expenditure for both new connections and deep-seated system development due to load growth on the system. This expenditure also covers load movement or “churn” within the distribution system, for which there may be no associated overall load growth.

Drivers for load related capital expenditure would include the forecast rate of load growth on the network, the location of that growth and also the level of spare capacity in the existing network. The level of expenditure will also be influenced by security and reliability considerations and these will impact on the quality of the installation and the level of redundancy built into the system. Security and redundancy requirements will be influenced by the political environment and may well be mandated by legislation or regulatory determination.

Supply security may be a significant driver for non-load related capital expenditure where there is an ageing network. An older network, or one with assets in poor condition, can be expected to be less reliable than one where the asset base is relatively young. A conscious decision may be taken to adopt a conservative approach to asset replacement in order to improve reliability by reducing the average age of assets on the network.

The network planning criteria adopted by the distribution company, including those encompassing relevant statutory regulations, will be identified and reviewed and the results of the planning studies will be compared with such criteria. In particular the capacity of the sources of power and the distribution system to support the forecast demand under credible outage conditions as well as normal network operating conditions will be assessed. Ratings of plant including short circuit levels will be assessed as part of the condition assessment work.

In order to derive load-related capital expenditure requirements it would be necessary to review the system development plans proposed by the distribution business to meet the future load growth and to identify the effect of the plans on the capital investment requirements. The planning criteria used by the planners in deriving these forecasts would also need to be reviewed.

Typically the information required to derive the data used in populating the load related capital forecast model would include the following: -

- Forecast load growths for different network segments
- System coincident maximum demand
- Maximum demand for various network levels or diversity factors
- Subtransmission single line diagrams
- List of subtransmission lines
- List of zone substations with basic data
- List of HV feeders with basic data
- HV/LV distribution substation data
- LV Line data
- Planning guidelines/criteria or standards
- Budget unit costs for network augmentation works
- Basic replacement cost data for selected assets

Typical segments of the network identified from the single line diagrams would be selected and modelled to represent the different fundamental variations in network design practices and/or network topography. For example, for a distribution network there is generally a fundamental difference between the nature of a rural network, an urban network and a central business district (CBD) network. A rural network frequently comprises long overhead lines with low customer densities, in contrast to a CBD network, which frequently comprises comparatively short lengths of underground cables and high customer density.

Each segment would be populated with the typical interconnected asset classes normally contained within that segment. For each voltage level, for each asset class, in each segment, typical data would include;

- Physical scale (e.g. length of typical lines, number of customers)
- Technical parameters (e.g. Network design voltage levels, capacity)
- Installed cost of each asset class

The segment would be developed with sufficient data and series connectivity to allow an approximate load flow calculation to be undertaken using the algorithms in the model. A load flow calculation identifies the steady state nature and performance of the system, in terms of loading on the components (assets) and voltage levels at different points along the network. The model also would undertake fault level and loss calculations.

Each asset class in a segment would also be assigned typical fault statistics to enable an approximate measure of the typical interruption performance of the style of network represented by each segment.

The underlying technical nature of the model therefore mirrors that of sophisticated power system analysis software normally used by power system planners. The software tools used by planners however, would include much more exact representation and connectivity of the actual network. The segment model is not intended to replicate such work undertaken using these more sophisticated tools. Instead, representing the network using typical segments, and then multiplying the segments by an appropriate scaling factor can provide a flexible model which may be used to readily formulate an overall view of the distribution or transmission network from limited detail of the network in question.

This technical model provides benchmarks for load related expenditure, through calculation of the marginal cost of reinforcement (MCR). When the MCR is applied to network utilisation curves and load growth projections, forecasts of load related expenditure is produced.

The results of the model can now be compared with the forecasts and budgets produced by the businesses planning engineers. Our experience shows that these comparisons will give a good indication of the long-term capital expenditure trend and as can be seen in Table 1 below the model provides a capital forecast that is related to the forecast load growth. The forecast expenditure for different levels of growth can be readily compared.

Table 1

YEAR	**99**	**00**	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Load Related Expenditure Forecast		10	11	12	12	12	12	13	13	13	14	14	14	14	15	15	15	15	16
Company Actual Expenditure	18	20																	
Company Budget Expenditure			17	18	21	27	28	28	28	28	28	28	28	28	28	28	28	28	28

From our experience the **Load Related Expenditure Forecast** produced by the model is consistent with the likely requirements for the distribution system that has been modeled. The **Company Actual Expenditure** in the above table indicate actual expenditure in the first two years that is considerably higher than the model predicts. While there may be good reasons for this expenditure due to specific requirements of the network at that point in time it is considered unlikely that this expenditure profile is necessary in the long term. The large differences suggest that either load related expenditure is being misallocated or the augmentation requirements are being grossly overstated.

The “independent” load related expenditure requirements derived through the modeling process indicate that capital expenditure should be further investigated and that reductions in forecast expenditure may be possible.

4. NON-LOAD RELATED OR REPLACEMENT CAPITAL EXPENDITURE

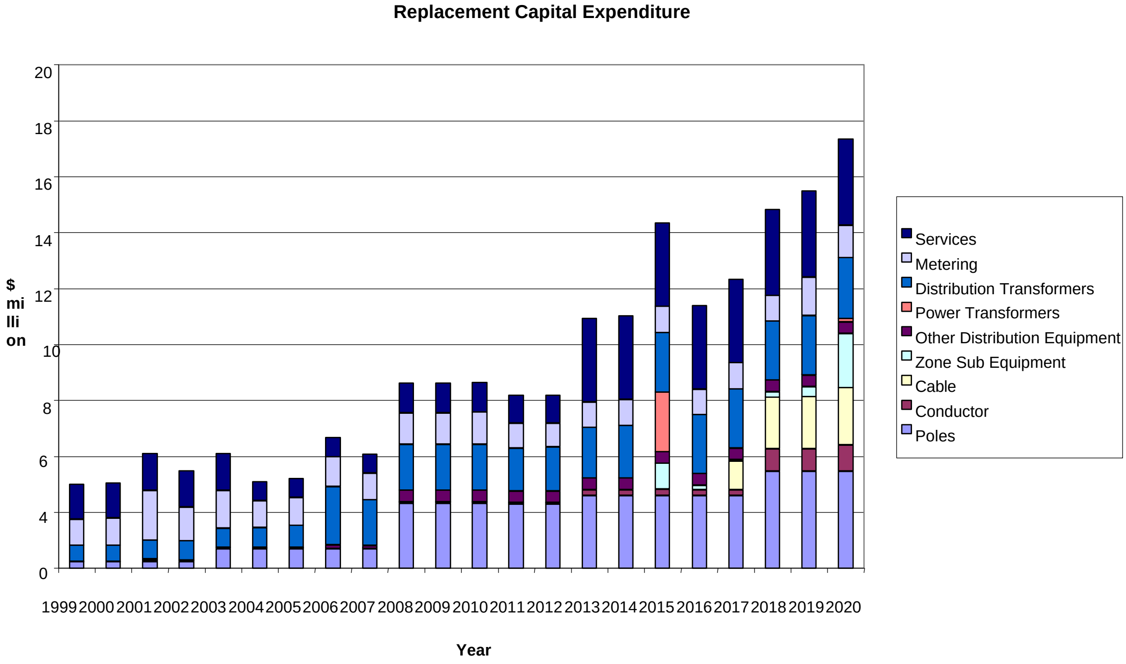
The asset replacement model is designed to provide an economic analysis of the network asset base and can be used to directly generate a system asset valuation based on ODV or alternative accounting methodology.

However the model is versatile and can also be used to generate a substantiated capital expenditure programme for non-demand based asset replacement.

The model is based on the premise that all assets have a finite engineering life and that if network integrity is to be maintained (or improved), provision must be made to replace all assets at some stage. In basic terms therefore, the model is populated with the different network asset classes, their replacement cost and their age profiles. The model then calculates a future annual expenditure for asset replacement, assuming that all assets are replaced when their specified life is reached. However, asset replacement is not calculated on the basis of age alone for the following reasons:

- The condition of individual assets will vary. Some assets will require replacement well before the end of their forecast engineering lives while others can be left in service longer than their age would indicate.
- Replacement due to age alone may result in unacceptable resource constraints over a short timeframe.
- An asset replacement strategy based on age alone may allow the average age of the network assets to deteriorate to the extent that overall network integrity is put at risk.
- The output of the asset replacement feature of the model is an asset replacement expenditure profile extending over a period of, typically twenty to twenty five years

A typical replacement capital expenditure forecast by asset group is shown below:-



A facility for repair and maintenance (R&M) type expenditure is also included in the model. By assigning each asset class with an R&M cost together with an assessment of the likely maintenance regime, a future forecast of maintenance expenditure trends and costs can also be produced. In providing information for the due diligence process and the business plan for the utility being examined, the following areas can be assessed providing additional benefits beyond the normal due diligence process:

- Testing the cost effects of different asset replacement strategies in a consistent and quantified manner.
- Forecasting capital expenditure requirements for asset replacement.
- Measuring business risks associated with different asset replacement strategies.
- Preparing asset valuations taking into account a changing asset baseline.
- Identifying future trends in capital expenditure and smoothing resource requirements.
- Identifying the impact of different cost drivers on future asset replacement expenditure.

5. OPERATING AND MAINTENANCE EXPENDITURE

The disclosure information will normally allow simple comparative indices to be calculated, such as revenue and expenditure/customer, revenue and expenditure/unit of electricity sold, revenue and expenditure/km of overhead line or underground cable.

Financial and economic data can be analysed to determine the points of differences between the company being investigated and other similar companies in order to highlight the areas where improvements could be made. The financial data needs to be analysed and normalised using the customer base, electricity sold and kilometres of line serviced.

This top down approach, using data that is generally available in the public domain, presents a very limited view of the likely efficiency present in the company. What is required is a bottom up approach that allows direct comparisons to be made of expenditure by asset class. When these indices are compared to similar indices of the client, who often manages a distribution business elsewhere, meaningful assessments can be made of the levels of efficiency currently being achieved and what may be achievable using the proven operational practices of the client within the target business.

The Operating and Expenditure Model takes the expenditure activities of the company and maps them to the asset classes identified in the non load related capital forecast model.

The expenditure breakdown can be as detailed as the cost recording information of the company allows and the number of activity codes can range from 20 to over 200.

The expenditure per asset is then mapped to general grouping as required. An example of the mapping and groupings are shown in Table 2.

Table 2

Asset Categories ® O&M Activities ¯		Zone Substations	Distribution Transformer	Circuit Breakers	Sectionalisers / Reclosers	Overhead Lines (Conductor)	Overhead Lines (Poles)	Underground Cables	TOTAL CHECK
Code	**Description**								
E01	OH Line emergency maintenance					50%	50%		100%
M02	OH Line planned maintenance					50%	50%		100%
M03	Subtransmission cable route inspection							100%	100%
E02	UG cable emergency maintenance							100%	100%
E04	Distribution sub emergency response		100%						100%
E05	Switchgear Repairs	40%		35%	25%				100%
M04	Vegetation Management					50%	50%		100%
M05	Preventative distribution sub maintenance		100%						100%
M06	Protection routine testing	70%		15%				15%	100%
O01	Operating – subtransmission system	25%		25%		20%	20%	10%	100%
O02	Operating – distribution system				10%	40%	40%	10%	100%
M13	Zone Sub inspections	100%							100%
M15	Zone Sub condition monitoring	80%		20%					100%
M16	Sub property maintenance	30%	30%	30%	10%				100%
M03	General Inspections	15%			25%	30%	30%		100%

From the information provided by the Operating and Expenditure model, ratios of expenditure by value of asset can now be made which can be compared directly between companies as indicated in Table 3.

Table 3

Asset Category	Company "A"		Company "B"		Company "C"	
	Emergency	**Planned**	**Emergency**	**Planned**	**Emergency**	**Planned**
Zone Substations	0.09%	1.2%	0.1%	1.4%	0.08%	4.2%
Distribution Transformers	2.4%	0.18%	0.5%	3.6%	0.09%	6.90%
Circuit Breakers	0.8%	0.98%	0.9%	1.24%	1.6%	4.34%
Sectionalisers and Reclosers	0.78%	0.08%	1.1%	0.9%	0.78%	2.8%
Overhead lines	1.88%	0.66%	1.24%	0.48%	3.88%	1.66%
Underground cables	0.08%	1.6%	6.66%	0.46%	0.07%	2.88%

Some conclusions that can be made from the above are: -

- Company "C" spends considerably more on planned maintenance of zone substation equipment with a marginal improvement in emergency expenditure compared to companies "A" and "B". This may indicate that the planned maintenance procedures are not effective and should be investigated further. This may also indicate an area where efficiencies in the maintenance process can lead to savings. The magnitude of these potential savings can be determined.

- The higher expenditure by companies “B” and “C” on distribution transformers planned maintenance results in a lower emergency expenditure. This would appear to indicate that this expenditure is resulting in improved performance and a review of the reliability statistics can prove or disprove this. Again this may indicate an area where Company “C” has already optimised expenditure in order to achieve certain reliability objectives.

The above comparisons are meaningful because they are between similar assets in different companies and not necessarily affected by the quantities of the asset in the class or the different asset mixes in each company.

6. CONCLUSIONS

The methodologies and models described in this paper allow potential purchasers of utility businesses to obtain a view of the potential risks and rewards inherent in the business which is not provided by the normal due diligence process. From relatively sparse data sets the models allow the potential purchaser to quantify the capital and operational expenditure requirements of the business and to identify potential efficiencies in the business. Using a modern equivalent asset replacement approach the models also provide a view of the gross and net values of the business and the depreciation requirements of the business which can be used to drive the financial business plan. The methodologies described allow the potential purchaser to examine the capital cost, operating cost and performance trade-off and to examine the sensitivity of the business plan assumptions to variations in the operational and asset management policies of the target company. The authors have utilised the methodologies and models described in the paper in assisting a number of clients in the successful acquisition of utility businesses.

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