COST MODELS AND FINANCIAL CONTROL IN WESTRAIL

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ABSTRACT: *A detailed study of the cost incurred in operating the Western Australian Government Railways has been instigated. It has already produced a much better understanding of the way that costs are generated by the operations of Westrail. There is also more appreciation of the lack of knowledge in the case of some quite important costs. As a result of this study, cost models and costing procedures have been developed to aid in the planning and control of Westrail operations. The developments have provided both a valuable aid for examining and monitoring overall performance as well as a means of cost prediction for a wide variety of alternative situations.*

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INTRODUCTION

During 1975, an intensive campaign was mounted in Westrail to obtain better cost information. It was proposed to examine the costs for all segments of the $100 million p.a. railway operations with the primary aim of improving cost predictions for a wide range of different operating options.

Before this study was made, the only operating cost information available was that provided by the conventional responsibility accounting and budgetary control accounts. However although this accounting system satisfied essential financial reporting and budgetary control needs it had been realised for some time that it did not meet all cost requirements in the present day environment where increasing competition is being experienced, both from other transport modes and from other Governmental funding needs. In particular it did not provide decision oriented information about our many segments of operations. For example it did not give:

- the cost of the haulage of wheat
- the cost of the haulage of coal from Collie to Perth
- the cost of operations on a particular section of line
- the cost of the Perth to Bunbury passenger service.

Furthermore, the limited cost information that was available to aid cost prediction was in need of updating and upgrading. Better cost information was needed to enable relative costs to be predicted for different types of locomotives and wagons under different operating conditions. A track maintenance cost function was necessary to enable costs for different track conditions and traffic intensities to be predicted.

In principle, the data needed to calculate these costs could be specified and measured but the subsequent analysis and processing would not be possible until the data had been collected for a reasonable period, say five years. The aims of this study were therefore twofold. Firstly, it was to specify just such a data set for collection and analysis in the future. Secondly, it was to extract as much information in a useful form as was possible from the existing data. This paper will only report the results for the second objective.

OUTLINE OF THE STUDY

The initial step was to undertake a survey of the existing cost information. In Westrail, expenditure is reported to the level of management primarily responsible for incurring it. A two part coding system has been designed to suit the needs of analytical budgeting and this produces a total of about six thousand cost classifications. These initially form a coding against the branch or sub branch of the railway and are further subdivided against cost centre codes which allocate detailed costs to individual managers or districts. In Appendix 1, examples of the account headings are given. It shows the branches and sub branches with their ranges of account numbers and then for the Traffic Branch, it gives an example of the type of allocation made. For example, there are different numeric codes for office expenses, road motor vehicles, training of staff, accrued leave, etc. These are subdivided to the Chief Traffic Manager (Chief Clerk), Districts Traffic Superintendents, etc. or to the different districts such as Robb Jetty, North Fremantle - Leighton, City etc. While this type of information is very necessary in controlling the expenditure under areas of responsibility, it is not very helpful when trying to determine or predict, the costs applicable to a variety of operating options.

What was needed, therefore, was to analyse these accounts and to develop new unit costs or cost prediction models using elements from these accounts combined into new aggregations. The second stage of the study was to determine what particular aggregations should be made and therefore what unit costs and cost prediction models should be determined. The following is the resulting list of cost models:

- terminal operations
- train crews
- rolling stock maintenance
- locomotive fuel and maintenance
- way and works maintenance
- general superintendence & administration
- provision of capital assets.

The third stage in this study was to use these cost models and this new cost information in order to evaluate different operations and to compare alternative courses of action. It was intended that costs should be developed for the following:

- commodities
- branch lines
- new traffics
- particular existing traffic segments or services
- capital expenditure proposals (new and replacement plant & equipment)
- different operating patterns & methods.

In order to implement this study, a special task force was formed by means of temporary secondments from within Westrail. This special group undertook as much of the unit cost development work as was possible within 12 months. The task force also undertook substantial work in using the unit cost information so developed for the assessment of commodity costs, the first of the applications listed. This paper will outline the methods used to obtain the unit costs and will list the cost models developed. It will also outline how these unit costs were used in determining the different commodity costs. Before doing this however, it will be necessary to explain the methods used to determine the variability of costs.

VARIABILITY OF COSTS

The key information required to enable cost predictions to be made is the knowledge or determination of cost variability patterns. As a means of obtaining a first approximation of these variability patterns, cost analysts generally aim to divide costs into fixed and variable components. This concept is well-known and straightforward in principle (A.I.C.A. 1965), but in practice it is dependent on the particular time interval being considered.

In the very short term, for example a few days, most costs in a railway operation are fixed. On the other hand, in the very long term such as hundreds of years, all the costs could be considered as being variable. The type of decision being made in practice falls between these two extremes and the problem of distinguishing short-term and long-term cost differences is particularly exacerbated by the long physical lives of plant and equipment in the railway system, by the wide geographic spread of the basic establishment and by a severe restraint on the rate at which the number of staff can be reduced.

As long run costs are involved in most policy and planning decisions, the first objective adopted for the study was to endeavour to assess those long run costs which are likely to have application to Westrail planning over the next few years. The practical working guidelines adopted were to consider a volume range from minus 50% to plus 100% of the current activity level and to consider a time period up to 40 years ahead. This long period was considered in order to allow plant and other resources to be adjusted to the most efficient levels appropriate to the level of traffic being carried. Because discounted cash flow evaluations often require a blending of both short-term and long-term costs and because short-term costs are relevant for many daily operational decisions, a second objective adopted was to note any information relating to short-term costs where they differ from the long-term measures. These short-term considerations will not be reported in this paper, however, which will be confined to a consideration of long run costs where long run costs are defined, as above, to be the steady equilibrium state relevant to the level of traffic under study.

The average long run variability of the costs was determined by graphical analyses (to test non-linearity), regression equations and technical experience. The aim of the regression analysis was to produce regression equations which had a constant term, representing the fixed cost element, and a linear term the coefficient of which indicated the unit variable cost for the appropriate output or activity. Where there were several different measures of the activity level a comparison of their respective correlation coefficients was used to determine which was the best to be used for cost predictions. In some cases, data extending back ten or twenty years were used after being adjusted to a common price level. In other cases, cross section analyses were made on data for a single year by grouping various cost centres undertaking similar functions (for example data for different stations or for different maintenance depots).

Where the regression approach did not yield significant results it was necessary to rely on the technical experience of railway staff. This involved analysing the labour, materials and services expenses recorded against each account and trying to assess what these expenses would be over a range of activity levels. In addition, appropriate money values must be identified with the resources concerned. Consequently, the method relies upon the full cooperation of cost centre supervisors, budget officers and cost analysts and the personal knowledge and experience of the officers concerned. Sometimes, it was necessary to assume a minimum basic establishment level for an activity. This cost was then regarded as the fixed cost component and the balance at the current activity levels was considered as the variable cost and assumed to vary at a constant rate over that range of activity.

The different approaches were used where appropriate in order to obtain what was considered the best cost model in each individual case. Wherever possible, the regression and the technical experience results were reconciled and in what follows, the best estimate for each cost will be given. Frequently, technical judgments were modified in the light of regression indications and sometimes additional data were collected before the final model was produced. The remaining part of this paper describes the models that were developed and their application to commodity costing.

MODELS DEVELOPED

Terminal Operations

Unit costs for terminal operations such as freight and parcels accounting, loading and unloading of freight, and shunting of wagons were developed to be used, in particular, for the assessment of commodity costs. In Westrail, these terminal costs are labour intensive and form a very substantial part of the variable costs that can be attributed to commodity groups, particularly in the case of the "smalls traffic" commodities. They were considered in two sections; station staff activities and yard shunting activities.

Station Staff Activities

The analysis and development of unit costs for the activities of station and freight terminal staff were founded upon the expenditure recorded against these aggregate cost headings. The two prime accounts were also increased by the addition of overheads, such as leave and payroll tax, that were related to direct labour expenditure.

In view of the eventual aim of tracing the variable content of these costs to commodity groups, an attempt was made to segregate the costs into activities such as accounting, freight handling and train working. That is, both logic and previous investigations indicate that some commodities required much more accounting work per tonne than others while some commodities required loading and unloading and others did not. Therefore, it seemed to be necessary to make the segregation into activity groups and to separate fixed and variable cost elements in order to trace the variable costs attributable to different commodities.

For the purpose of segregating station and freight terminal costs into activity sub groups, a special survey was made of all stations and freight terminals. A questionnaire form backed up by a number of on-site investigations was used to gather the information for this segregation. From the survey data, indicative costs were calculated for each station and freight terminal segregated into the following activities:

freight accounting
parcels & passenger accounting
freight handling
parcels handling
train working
general duties

Statistical information was then gathered from a sample of waybills and from existing records so that the following were also available for each station:

number of consignments
number of L.C.L. tonnes
number of trains

From an analysis of this cost and statistical information and consultations with Traffic Branch Budgeting and Planning Officers the following cost model was developed for unit costs averaged over the whole Westrail system.

$$SC = a + b1\ X1 + b2\ X2 + b3\ X3 + k$$

where

Sc = total station and freight terminal costs
a = the fixed cost component
b1, b2 and b3 = unit cost co-efficients
X1 = No. of freight consignments
X2 = No. of L.C.L. tonnes
X3 = No. of train hours
k = a lump sum constant cost for all passenger and parcels working (unit costs were not derived for these)

Yard Shunting Activities

A similar process was followed for yard shunting activities as that outlined above for station staff activities.

Again a questionnaire survey was employed and in this instance the aim was to segregate yard shunting costs in accord with shunting time spent at all yards on:

- terminal placement and clearance of wagons (an attempt was made to discriminate by commodity types and between station precinct and private siding shunting, but a broad average was adopted because of the dubious nature of the information obtained).
- marshalling of wagons or trains
- shunting for grain transfer
- shunting for grain sidings
- shunting for gauge transfer
- shunting at wharves
- shunting of passenger trains
- shunting for departmental purposes.

The costs or expenditure accounts that were covered in this segregation into the above shunting activities included those for shunting staff, locomotive fuel and maintenance and locomotive capital charges. The resulting model for unit costs was:

$$YSC = a + b1\ X1 + b2\ X2 + b3\ X3 + b4\ X4 + b5\ X5 + b6\ X6 + k$$

where

YSC = total yard shunting costs

a = the fixed cost component

b1, b2, b3, b4, b5, b6 = unit cost co-efficients

X1 = No. of wagons shunted at terminals

X2 = No. of wagons marshalled

X3 = No. of wagons shunted for grain transfer

X4 = No. of wagons shunted for grain sidings

X5 = No. of wagons shunted for gauge transfer

X6 = No. of wagons shunted at wharves

k. = a lump sum constant for passenger train shunting and for shunting for departmental purposes.

Train Crews

A cost model was developed for freight-train crew costs only because the crews for passenger trains vary substantially with particular services. The freight train crew consists of a driver, fireman and guard and accounting records separate these costs from passenger-train crew costs.

As well as direct labour for drivers, fireman and guards the cost model developed covered associated overheads such as leave, payroll tax, superannuation, training and guards' uniforms.

Time series regression analyses undertaken indicated that variations in these costs were very closely correlated with train hours and that there was a small fixed cost component. As this fixed component could be attributed to maintaining a basic depot labour pool, the regression indication was accepted and a cost model was developed of the general form:

IC = a + b1 X1

where

IC = train crew costs

a = a fixed cost component

b1 = a unit cost co-efficient

X1 = no. of train hours

Rollingstock Maintenance

A pre-requisite to the development of unit costs or cost models for predicting wagon and locomotive maintenance costs was the analysis of the variability of the substantial ($10 million p.a.) overhead costs of the Mechanical Branch.

Mechanical Branch Overheads

The aim of the analysis of these Mechanical Branch overhead costs was to determine the extent of their variability so that the variable content could be included with direct costs in the unit costs to be developed for wagon and locomotive maintenance.

Mechanical Branch overheads comprise a wide variety of expenses which are incurred at maintenance and repair depots located at strategic centres throughout the railway network. These depots include the principal Midland Workshops, which undertakes new construction and manufacturing work as well as maintenance, and a large modern maintenance complex at Forrestfield, as well as a number of relatively smaller and more lightly equipped country depots. Expenditure charged to overhead accounts includes indirect labour and materials, power and other supplies, maintenance of plant and machinery, penalties and allowances on labour, leave allowances, and the supervision and administration of all Mechanical Branch operations.

Because of a lack of adequate data suitable for regression analyses the assessment of variability, in the case of these overheads, was based largely on experiential assessments. On site discussions were held with cost centre supervisors and estimates were derived of the overhead resource requirements that could be regarded as an essential minimum threshold level. These resources were converted to costs and treated as the 'fixed' overheads while the balance of overhead expenses were related to direct labour as a variable cost overhead rate.

A further complication encountered was the wide range of overhead rates for the various cost centres in the Midland Workshops. In the circumstances investigations were made to test whether an overall Midland Workshop average rate would suffice for all types of work. It was found necessary to use different rates for maintenance and construction works because of the different proportions of these works in different cost centres. As far as other depots were concerned it was found to be sufficient to use a system average for all wagon maintenance depots and a system average for all locomotive maintenance depots.

Wagon Unit Costs

When considering the 'direct' costs for wagon repairs and maintenance, the main problem encountered was the separation of the account aggregate costs to obtain costs for the different wagon classes or types. This separation was achieved by sampling physical records of the work performed over a two year period, by extracting information on the frequency of wagon 'shoppings' over a six year period, and by using engineering estimates of resource requirements for particular wagon servicing at given distance and time intervals.

Engineering estimates were also used to separate the costs into those that are dependent on time (e.g. painting) and those that are dependent on utilisation (e.g. brake block renewals).

Variable overhead costs were then added to the direct costs in accord with the overhead rates discussed above, and finally the costs were converted to a unit cost. The average kilometres per annum for each type of wagon which were used for this conversion also had to be collected by a special sample survey. (The sample was derived from Guards Train Journals).

The final costs could be expressed in the form below for each of 32 distinctive wagon types.

Wi = b1 X1 + b2 X2
where
Wi = Cost p.a. for wagon type Wi
b1, b2 = unit cost co-efficients
X1 = No. of Wi type wagons
X2 = No. of wagon kilometres for Wi type wagons

Examples of the 32 'wagon type' groupings for which these costs were developed are:

Narrow gauge four wheel flat top wagon
Narrow gauge bogie wheel louvred covered wagon
Narrow gauge bogie wheel refrigerated wagon
Standard gauge bogie wheel open box wagon

While the cost information developed did provide indicative information for the costing of existing traffics by commodity groups, it became evident in the course of the study that better basic cost accounting records were still needed to permit assessment of reliable information for:

- determining optimum wagon replacement programs
- planning optimum servicing schedules
- assessing accurate wagon maintenance cash flows over a project life, when project evaluations require such accuracy.

Locomotive Unit Costs

The computation of unit costs for various locomotive types or classes was a simpler and more objective process than the wagons' assessment because subsidiary accounting records giving expenses incurred for each class of locomotive were available. Statistical records of annual kilometres, fuel usage, and trailing gross tonne kilometres were also available by locomotive class and this further eased the task and improved the reliability of the end result.

In fact the unit costs or cost models developed for locomotive classes were similar in many respects to average costs per kilometre that have been produced for many years for statistical purposes. However two significant differences in the new costing models that were produced are:

(i) Only variable overhead costs are included in the costing models whereas 'full absorption' overheads have traditionally been included in the statistical average costs.

(ii) The costing models separate costs for periodic hostling and servicing and treat these as time dependent costs. The balance of costs are treated as being variable with utilisation. On the other hand the statistical costs are a simple average per kilometre.

Correlation tests were made in an endeavour to establish which of the utilisation measures - kilometres, gross tonne-kilometres, hours, or litres of fuel used - is the most closely correlated to, and likely to be the best predictor of, locomotive maintenance costs. These tests indicated that there was little to choose between the various units and therefore the traditional units - kilometres for mainline locomotives and hours for shunting locomotives - were chosen.

Separate cost models were developed for 14 classes of mainline locomotives and 9 classes of shunting locomotives. All of these 23 models were of the general form:

$$Li.C = b1\ X1 + b2\ X2$$

where

Li.C = Cost p.a. for the class of locomotive Li

b1, b2 = unit cost co-efficients

X1 = No. of locomotives in class Li

X2 = No. of kilometres p.a. by class (in the case of mainline locomotives)

<u>or</u> No. of hours p.a. by class (in the case of shunting locomotives).

<u>Way and Works Maintenance</u>

The development of cost models to predict way and works or track maintenance costs has been tackled many times in the past (B.T.E. 1975, A.R.E.A. 1962, 1972; B.R.E. 1964; Meyere 1964) by railway cost researchers. Invariably the difficulties caused by the cyclical nature of the costs, the time difference between cause and effect, the lack of sufficient basic data, and the large number of variables affecting the costs (e.g. distance, traffic volume, axle loads, track curvature, track standards, location, number of structures, type of signalling) have resulted in the cost models developed being subject to many reservations.

Westrail did have a previous cost model designed to predict system-wide average costs for varying traffic intensity levels, but this was in need of updating and, if possible, refinement to discriminate for particular track sections and operating conditions.

The study involved extracting and analysing three years' labour, materials and 'other' expenditure for 34 selected sections of line, for approximately 50 account classifications concerned. The 34 sections, which were selected from almost 100 sections, included a sample of 5 to 7 sections for each of the six main standards or classifications of track existing in Westrail. The sample for each classification was therefore limited but this was necessary because of accounting, statistical and operational problems affecting other sections, and because of the volume of work that would have been involved otherwise.

Because of the inherent nature of the costs the various expense classifications were considered under the following groupings:

Track maintenance - caretaker
Track maintenance - cyclic
Structure maintenance
Signalling & telecommunications maintenance

Cost functions were developed for each of the above groups of costs. These cost functions covered only the direct costs for sections-of-line maintenance and deliberately omitted costs for major yard maintenance although these had been averaged over sections-of-line in the previous Westrail cost model. However, recent accounting innovations enabled yard maintenance costs to be separated and this was considered desirable to avoid inflating and distorting section-of-line information.

Caretaker Maintenance

Labour costs were calculated from a manpower planning schedule which was related to gross tonnage levels per km of track. Material and 'other' costs were added based on sample measurements at various gross tonnage levels for sections judged to be typical.

Cyclic Maintenance

Contractors' charges for the various forms of cyclic maintenance work were readily obtainable but the real problem was to determine cyclic intervals for varying track conditions and traffic levels. Eventually these intervals were estimated based upon the limited experience of cyclic maintenance to date, a survey of literature available on the subject, and engineering judgement. The costs for operation and maintenance of cyclic maintenance equipment by Westrail also required to be specially derived to complete the assessment of mechanised cyclic maintenance costs.

Structure Maintenance

Costs for the maintenance of bridges and culverts, station and administration buildings, residences and stockyards were built up for a range of traffic volume levels by examining the particular accounts involved and selecting, with the aid of engineering judgement, typical costs at various tonnage levels. An aggregate cost function was then calculated.

Signal and Telecommunication Maintenance

From an examination of the section of line accounts, typical costs were extracted for various types of signalling. As the principal differences depended on the type of signalling a step cost pattern was indicated and so a smooth cost function was not calculated.

Cost Functions

The cost functions or cost models developed for each category of maintenance were of the form:

$$Yi = ai\ X^{bi}$$

where

Yi = cost per track km

ai, bi = coefficients

X = gross tonnes p.a.

The decreasing curvilinear form indicated is in accord with previous Westrail cost functions and other track maintenance cost functions developed elsewhere (A.R.E.A. 1962).

Although an effort had been made to develop separate cost functions for different track classifications the final result was again a system average result. However, the separate cost functions for caretaker and cyclic cost maintenance, for structures maintenance and for different types of signalling; the exclusion of yard costs from these cost functions; and the information available to enable variations in costs to be made for variations in the cyclic maintenance intervals, all contribute to enable cost predictions to be adjusted to provide greater accuracy for specific sections of line and specific circumstances. The composite cost function was tested against the actual Civil Engineering Branch expenditure concerned and was found to agree to within 1.5% in total. For particular sections, though, the difference was as high as 20%.

General Superintendence & Administration

Another cost category examined was the large and varied group of expenses that have become known in Westrail as general overheads. These include the total expenses of central management and administration Branches (Commission and Secretary's, Accounts and Audit, Commercial Management and Management Services) and the substantial superintendence accounts of the operating and way and works Branches (Traffic and Civil Engineering). Other general overheads which were similarly treated but will not be considered further in this paper were stores issue and control expenses, insurance funds, superannuation and pension schemes, capital charges on central administration and workshop buildings and on sundry minor plant and equipment, and a variety of relatively minor expense accounts.

Administration Branches

Because the expenses of running the administration Branches are so indirect in relation to operational working it is extremely difficult to determine or predict how they will vary with changes in traffic volume. The aim of the study was to devise a means of predicting this variability, again with primary emphasis on medium to long-range volume and time horizons, and to determine whether this variability could be associated with particular traffic segments or commodities.

Assessments were made for each of the Branches concerned by means of analysis of staff cadres by sections and consideration of the functions of each section. Budget officers for each Branch were consulted in these analyses. In these detailed analyses it was possible to note particular positions and particular sections whose work was entirely associated with particular traffic segments. However, these amounted to a very minor content of the total costs and although they were noted for future reference they were not specially treated in the cost model eventually developed.

The experiential assessments gave the proportions of costs in each of the administration Branches that could be considered as fixed and variable. These results were compared with a regression equation based on gross tonne kilometres and after some compromise a cost model was established viz:

IAC = a + b1 X1

where

IAC = the total costs of the management and administrative Branches

a = a fixed cost

b1 = a unit cost per million gross tonne km

X1 = gross tonne kilometres (in millions)

Traffic and Civil Engineering Branches

A similar approach was adopted for the Traffic and Civil Engineering Branch superintendence accounts as with the management and administrative Branches.

Endeavours were made to find correlations between Branch superintendence and various particular measures of the operational activity levels of these Branches but again a far better correlation was evident with total Westrail gross tonne kilometres than with other indepedent variables.

Consequently, a cost model was developed in the same form as that for the management and administrative Branches. The two models were then readily amalgamated into one.

Provision of Capital Assets

As depreciation and interest charges recorded in the accounts are based on historical or original costs dating back many years in the case of some assets, it was realised that these would not be relevant for a cost prediction model.

However, to maintain reconciliation with the accounting records in the assessment of commodity costs, and to recognise that some capital costs would be variable in the time period and volume range under consideration some expedient arbitrary assessments were made.

Historical depreciation on locomotives, and a related proportion of interest charges, were treated as variable on a locomotive kilometres basis. Similar charges for wagons and ancillary motor vehicle charges were treated as variable pro-rata to the number of vehicles. A proportion of the 'rails and fastenings' content of depreciation and interest on way and works assets was also treated as variable. The variable proportion assessment was based on engineering formulae relating rail life to gross tonnes, and gross tonne kilometres was used as the means of allocating the variable cost component derived.

All other depreciation and interest charges were treated as fixed costs. In view of the irrelevance of the accounting data used, a cost prediction model was not developed for these costs.

APPLICATION TO COMMODITY COSTING

Having developed this new cost information, how can it be used? Two broad categories of use can be identified,

i.e. a) to aid planning
b) to aid cost control

The cost models and unit costs developed provide a means of estimating costs for a wide range of operating alternatives and they will therefore obviously play an important part in the planning, evaluation and choice of future operations. It is now possible to assess more readily and reliably the financial implications of encouraging or discouraging particular commodities, of opening new sections of line or closing existing ones, and of investing or dis-investing in particular wagons, locomotives, terminal facilities and track configurations. To date the use of the new cost models and cost information has been concentrated largely upon the application to commodity costing.

A special commodity cost analysis project has been completed and in this all Westrail freight and parcels traffic (15 million tonnes p.a., 4000 million net t-km p.a.) was analysed under 49 homogeneous commodity groupings. Two principal objectives of this project were:

a) To produce a report styled after a 'direct costing' accounting statement, showing revenue, variable costs and contribution to fixed costs, for each commodity, but showing fixed costs in total only.

b) To ensure that some analysis was made and information developed regarding the variability of all of Westrail's expenditure.

The methodology involved the examination of all Westrail expenditure accounts for one fiscal year, the re-arrangement of these into activity groups, the separation of all costs into fixed and variable components, and the tracing or assignment of the variable components to commodities. Fixed costs were not allocated to commodities in this study. (Detailed analytic procedures for allocation of fixed or joint costs, e.g. Joy 1971, Kolsen 1975, would require considerably more work but a simple 'Direct Cost/Joint Cost ratio' (Victorian Railways 1973) could be readily applied if required.)

Costs for unit train operations were specially assessed and allocated directly to the particular commodity concerned. Other variable cost elements that could be assigned directly to particular commodities were also distributed (e.g. intersystem wagon repairs to intersystem traffic). The balance of variable costs in each activity group were then allocated to the appropriate commodities using the physical measures which had been established as those most closely correlated with changes in particular activity costs (e.g. station accounting was allocated in accord with the "number of consignments" applicable to each commodity).

This project was underway before all the unit costs in the cost models had been determined. Wherever information was available regarding the variability of costs from these other studies it was used, but a number of cost areas were especially analysed for this project. Reconciliation was maintained with the total Westrail expenditure for the year concerned to ensure that all recorded costs were considered and treated.

Although system average unit costs were used for terminal activities, some differences between sections of line were recognised in the line haul costs. For example, train crew cost differences per net tonne kilometre for different sections of line were taken into account by allocating total train crew costs first to sections of line, in accord with the actual train hours for the sections of line, and then allocating these section-of-line costs only to commodities using the sections.

The resulting commodity cost report gives cost information under the headings listed in Table 1. The information also provides an average variable cost model for each of the 49 commodities in the form:

C1.C = b1 X1 + b2 X2

where

C1.C = average variable cost for commodity C1

b1, b2 = unit cost coefficients

X1 = net tonnes of commodity C1

X2 = net tonne kilometres for commodity C1

The commodity cost report provides a comparison of costs for different traffic segments and any adverse results, either absolute or relative to other commodities, are brought to notice. The average variable cost model enables planning calculations to be made about the effect of expanding or contracting traffics in particular commodities or groups of commodities. With this ability to assess or predict costs for operating options the means is provided of obtaining a control measure against which actual performance can be monitored.

In the future development of its corporate planning processes, Westrail is aiming to use the various cost sub models to extend and refine existing corporate financial models. These system-wide computer models will consider all cash flows (operating costs, capital costs and earnings) and have the capacity to quickly evaluate the implications of numerous policy and operating options. Such information complements the responsibility accounting and budgetary control system by adding a dimension which transcends branch responsibility boundaries and focuses attention on decision options, i.e. the options of how, whether and where to reduce costs or services, or to increase rates, and the converse. Cost reports involved in the development of wagon and locomotive costs, track maintenance costs and terminal operations costs will draw attention to adverse relative costs and trends for different equipment and locations. Obviously this should lead to closer cost control and financial savings to Westrail in the long-term.

CONCLUSIONS

The intensive effort of the Cost Research Task Force to develop better cost information, without waiting for the implementation of new cost accounting procedures, has resulted in the development of a number of cost models which have direct and current use for special project evaluations, economic planning and cost control. The cost models developed are summarised in Table 2.

These models form a basis for refining the corporate planning processes by providing system-wide models capable of assessing the financial implications of numerous operating alternatives. Objectives could then be set in terms of those actions which should be taken and actual performance could be monitored against the cash flow models.

The cost studies themselves have identified those areas where the present cost accounting and data collection procedures are adequate and others where these procedures need attention to provide information in a more useful form. Concurrently with giving attention to these procedures the next step is to integrate the sub models into a single system-wide operational model. After that, there remains the problem of implementing the corporate planning processes then possible.

It is therefore evident that this is not the end; rather it is the beginning of a new phase in the development of financial and economic management where higher standards will be demanded by an increasingly competitive environment.

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TABLE 1

SUMMARY OF COMMODITY ANALYSIS INFORMATION

1. <u>Summary Information</u> (for each of 49 commodities)

    Revenue
    Total Variable Costs
    Contribution to fixed costs
    Fixed costs (total only - not by commodity)

2. <u>Average Cost Information</u>

    2.1 Terminal Costs (per net tonne, by commodity)

    for: Station accounting
    Train working
    Yard shunting
    Marshalling
    Terminal placement
    Grain transfer
    Wharf
    Transhipping

    2.2 Line Haul Costs (per net tonne km, by commodity and by sections of line)

    for: Train crews
    Locomotive fuel
    Locomotive maintenance
    Wagon maintenance
    Track maintenance

    2.3 Sundry Costs (per net tonne km, by commodity and by sections of line)

    for: Superintendence and administration
    Road ancillary services
    Internal freighting costs

    2.4 Capital Charges (per net tonne km, by commodity and by sections of line)

    Locomotives
    Wagons
    Road vehicles
    Trackworks

TABLE 2

SUMMARY OF UNIT COSTS OR COST MODELS DEVELOPED

(b's represent various unit cost co-efficients associated with X volume measures)

Station and Freight Terminal Costs

= a + b1 X1 + b2 X2 + b3 X3 + k

where a = a fixed cost

X1 = no. of consignments

X2 = no. of LCL tonnes

X3 = no. of train hours

k = a lump sum for all passenger and parcels costs.

Yard Shunting Costs

= a + b1 X1 + b2 X2 + b3 X3 + b4 X4 + b5 X5 + b6 X6 + k

where

a = a fixed cost

X1 = no. of wagons shunted at terminals

X2 = no. of wagons marshalled

X3 = no. of wagons shunted for grain transfer

X4 = no. of wagons shunted for grain sidings

X5 = no. of wagons shunted for gauge transfer

X6 = no. of wagons shunted at wharves

k = a lump sum for passenger train shunting and departmental working.

Wagon Costs (32 models for 32 wagon types)

= b1 X1 + b2 X2

where

X1 = no. of wagons

X2 = no. of wagon kilometres

Mainline Locomotives (14 models for 14 locomotive classes)

= b1 X1 + b2 X2

where

X1 = no. of locomotives

X2 = no. of locomotive kilometres

Shunting Locomotives (9 models for 9 locomotive classes)

$$= b1\ X1 + b2\ X2$$

where

X1 = no. of locomotives

X2 = no. of locomotive hours

Way and Works Maintenance

$$= D\ (Yc + Ym + Ys + Ye)$$

where

$Yc = a1\ X1^{b1}$, X1 = gross tonnes p.a.

$Ym = a2\ X1^{b2}$

$Ys = a3\ X1^{b3}$

Ye = r, s, t or v (constants depending on type of signalling)

D = track kilometres

Train Crew Costs (freight)

$$= a + b1\ X1$$

where

a = a fixed cost

X1 = train hours

Superintendence and Administration

$$= a + b1\ X1$$

where

a = a fixed cost p.a.

X1 = gross tonne km

Commodity Costs (49 models for 49 commodity groups)

$$= b1\ X1 + b2\ X2$$

where

X1 = no. of net tonnes for the commodity

X2 = no. of net tonne km for the commodity

APPENDIX 1

CLASSIFICATION OF OPERATING EXPENSES ACCOUNTS

Branch, Sub-Branch etc.	Account Numbers
Commission and Secretary's	1000-1099
Accounts and Audit	1100-1199
* Traffic	1200-1399
Refreshment Services	1400-1599
Road Services	1600-1799
Commercial	1800-1899
Management Services Bureau	1900-1999
Mechanical	2000-2399
Motive Power	2400-2599
Civil Engineering	2600-2799
Signal and Telecommunication	2800-2899
Stores	2900-2999

* TRAFFIC

1200	Superintendence
1202	Office expenses
1203	Stationery, printing and advertising
1204	Office machines and equipment
1205	Minor capital works
1206	Road motor vehicles
1207	Other expenses
1209	Training of staff
1211	Uniforms, other wearing apparel, etc.
1212	Telecommunication staff
1214	Tarpaulines and lashings
1216	Hiring of passenger and freight rolling stock
1218	Printing and distribution service
1219	Printing and distribution service - rebates
1220	Sick and compassionate leave
1221	Annual leave and public holidays

1222	Long service leave - wages
1224	Long service leave - salaries
1227	Accrued leave
1229	Credits from other votes
1230	Station staff
1232	Signalling staff
1234	Yard staff
1236	Lighting and heating of stations, yards, signal cabins etc.
1238	Supplies and services for station, yards, signal cabins etc.
1240	Freight staff
1242	Transfer of freight (Gauge to gauge)
1244	Transfer of grain
1246	Under-floor conveyor system
1248	Mechanical handling equipment
1250	Running staff - suburban passenger
1252	Running staff - country passenger
1254	Running staff - freight
1256	Indirect expenses (running staff)
1258	Barracks
1260	Servicing and supplies - coaches
1261	Servicing and supplies - wagons
1265	Road ancillary service
1270	Injuries to employees
1276	Metric conversion

SCHEDULE OF COST CENTRE CODES

(a) Head and District Offices: Cost Centres

Code	
HC	Chief Traffic Manager - Chief Clerk
HS	Chief Traffic Manager - Staff Section
HR	Assistant Chief Traffic Manager (Works & Research)
HO	Assistant Chief Traffic Manager (Operations) - Other than cost centres within each district.

MD	District Traffic Superintendent, Metropolitan District
WD	District Traffic Superintendent, South Western District
CD	District Traffic Superintendent, Central District
ED	District Traffic Superintendent, Eastern District
SD	District Traffic Superintendent, Southern District
ND	District Traffic Superintendent, Northern District

(b) Depots and Districts: Cost Centres

Code	
MR	Robb Jetty
ML	North Fremantle - Leighton
MP	City
MK	Kewdale
MF	Forrestfield
MO	Metropolitan district - all other depots and stations
	South Western District
WO	All depots and stations
	Central District
CA	Avon (including Northam)
CO	Central district - all other depots and stations
	Eastern District
EM	West Merredin (including Merredin)
EK	West Kalgoorlie (including Kalgoorlie)
EO	Eastern district - all other depots and stations
	Southern District
SO	All depots and stations
	Northern District
NO	All depots and stations