PROGRESS TOWARDS AN INTEGRATED MANAGEMENT INFORMATION SYSTEM AT WESTRAIL

R Wilkinson
Assistant Manager Information Services
Western Australian Government Railways (Westrail)
Westrail Centre
West Parade
EAST PERTH WA 6000

ABSTRACT

In two years, the Westrail computing environment has developed from a basically batch processing operation to a non-stop on-line one, servicing many remote sites. The final objective is an integrated management information system relying on data entered at source and being readily available to all levels of management.

Progress towards this objective is described together with some of the managerial and technical problems encountered on the way. The more unique of the applications are discussed.

INTRODUCTION

For some years, Westrail has recognised that an important element in its drive for improved efficiency is the increased use of computer technology in the management of data over all facets of its operation. Particularly in the last three years, the major drive has been towards the objective of an integrated management information system, capturing data wherever possible at source and validating and processing it for timely presentation in whatever summary form is required to all levels of management and staff.

Although the objective has remained much the same since this strategic plan was formulated, the Westrail environment has been changing rapidly. With the abandonment of less than car load traffic and an emphasis on staff reduction and other efficiency measures as the concept of a competitive Westrail approaches reality, the demand for fast, accurate information has increased many fold. Our limited resources have been directed towards satisfying this demand at the expense of delaying the eventual objective. The direction, however, has been maintained.

Another factor giving rise to short term deviations and a sometimes apparent piecemeal approach to the development of an integrated system is the situation which undoubtedly exists in many organisations, only those applications with obvious tangible benefits have the full backing of management. In an integrated system, benefits can be increased significantly over the total of the individual sub-systems by the synergetic effect of them working together, but the full benefit can only be realised if the final objective is kept constantly in mind during the design of each application.

The application which has had the biggest impact at Westrail has been the Rollingstock Control System. Although not in practice a central part of the integrated system, in a strictly accounting sense, it has enabled tight control to be maintained over the organisation's major capital assets and has introduced computing to all levels of staff throughout the network. VDU's are now situated at every major Westrail site in Western Australia and traditionally conservative railway staff have accepted their presence and learnt to use them without trauma.

By the end of 1986, a further major system will be installed in the Railway Workshops at Midland, 15 kms from Perth, to plan and control all the maintenance, construction and repair of Westrail's rollingstock. Another large group of personnel will need to be trained in computer concepts and the adoption of new procedures far different from the traditional ones of the last one hundred years.

Over the past two years, Westrail's computing environment has grown from 2 shift mainly batch processing operation with a single remote on-line site to a 24 hour, 7 day week operation servicing 38 remote sites. The traffic operation is now fully dependent on the computers. Technically, the problems of change involved the acquisition of sufficient know-how to keep the system tuned and reliable and to give the user the response time he needed. Training and recruitment overcame these difficulties to some extent although it was not appreciated until almost too late that procedures had to be specified in detail and in writing to meet every conceivable problem with equipment, software and people. In all it required 8 weeks of operation involving many night time calls to produce a stable system.

Management problems were concerned with the critical sequencing of activities involving equipment acquisition and installation, software testing and, most importantly, the training of several hundred users with virtually no knowledge of computers. Training had to cover proper keyboard use, computer concepts and a thorough knowledge of particular applications. Most new applications involved the complete abandonment of the traditional paper based procedures for a computer based system reliant on data in almost real time. These changes had to be made overnight and certainly in all the critical areas were successful.

This paper describes the Westrail computing environment, the strategic objectives and some of the more interesting and innovative applications which are in use. Gradually also, integration of certain major applications across the various Australian railway systems is occurring.

THE WESTRAIL ENVIRONMENT

As shown in Figure 1, Westrail operates in the south west of Western Australia from Geraldton in the north to Albany and Esperance on the south coast and to Kalgoorlie in the east. Across the Nullabor Plain east of Kalgoorlie, the Trans-Australian railway is the responsibility of the Commonwealth controlled Australian National.

In the year ended June 1985, the organisation employed approximately 6 882 people and carried 22M tonnes of goods traffic 4 330M net tonne kilometres on 6 000km of track. The network comprises both standard and narrow gauge and is mostly single track.

The annual revenue is approximately $258M of which only $8.5M is earned from country and interstate passengers, hence it can be seen that the railway task is primarily one of moving freight. This freight comprises 5.2M tonnes of grain and agricultural products, 11M tonnes of ores and minerals (bauxite, nickel, mineral sands, alumina), 2.1M tonnes of coal and oil and 1.3M tonnes of intersystem traffic.

At its administration headquarters in Perth, Westrail operates two mainframe computers, an IBM Group 12 and an Amdahl 470/V7 sharing 13 gigabytes of disc storage and four 6 250 bpi tape drives. Two IBM 3725 Communications Controllers running VTAM/NCP support 60 remote VDU's and 45 printers and local controllers support a further 50 VDU's and 6 printers.

Each computer system operates under VM/CMS which controls two DOS/VSE machines, each with 8 partitions, and approximately 150 individual virtual machines. Apart from MANTIS and conventional languages like COBOL and FORTRAN, MARK IV is used for the generation of reports and SAS is proving extremely popular with all levels of user to input, manipulate and report on a large variety of data. CICS is used as the teleprocessing monitor.

In addition to the mainframe system, Westrail operates a centralised word processing and telex message switching system based on a Honeywell DPS 6. Several microprocessors are also used for both general and dedicated tasks, the general policy being to rationalise on either Cromemco or IBM equipment.

With the introduction of the Manufacturing Resource Planning System at the Midland Workshops, a computer similar in size to the IBM 4381 Group 2 with 4 gigabytes of mass storage will be installed at Midland to operate the 150 new VDU's. There will be a communication link to the Perth site.

THE STRATEGIC OBJECTIVE

The long term data processing objective shown in Figure 2 is to build an integrated management information system providing information to all levels of management. Detailed data will not necessarily all be held centrally but more probably at two main centres and to a lesser extent at half a dozen district centres. Every centre will however provide at least summary data on a regular basis to a central location in Perth. The overall strategy is to input and update as much of the data at source as possible, to gather it into a general ledger and specialised databases and to make it generally available at the earliest opportunity in the form of reports and screen enquiries. Those centres which require them will be equipped with personal computers to retrieve data and to manipulate it further as required.

The principal systems involved in the strategy are:-

- Payroll and Appropriation

  A new database payroll system was commissioned in September 1984.

- Personnel Information Management System

An in-house designed SAS system was put into general use in early 1986 and is being enhanced as required.

- Materials Supply

  The cataloguing and inventory control sub-systems were commissioned in 1979. Purchasing and accounts payable sub-systems are due for implementation in early 1986.

- Centralised Freight Accounting

  Commissioned in 1980 for intrastate accounts and extended to include the interstate RADAR system in 1982.

- Rollingstock Control

  Commissioned in August 1984, but under heavy development since that date.

- Passenger Reservations

  Interstate reservations linked to AUSTRES in Melbourne in June 1983. Feasibility of intrastate reservations currently being studied.

- General Ledger, Accounts Payable, Fixed Assets

  Planned for implementation in 1986/87.

- Production Control

  Implementation work commenced in September 1985 and scheduled for full production within 18 months.

ROLLINGSTOCK CONTROL SYSTEM

Development commenced in late 1982 jointly with Australian National but it soon became apparent that one system could not easily meet the differing requirements of both railways. Both parties subsequently went their separate ways but exchanges of ideas continued and it has been ensured that an interface will exist for the automatic updating of intersystem wagon movements between the two systems.

Another factor that became apparent early during the system design was the large amount of data entry that would be needed to track the movement of up to 10 000 vehicles and to record the details of commodity, mass, destination, consignee etc. It was estimated that on the average each vehicle would be reported three times a day. Considerable ingenuity was used to produce the system as illustrated in

Figure 3 based on number takers reporting by radio directly to VDU operators who are able to enter the majority of data by moving the screen cursor to the relevant wagon and entering only changes in data. Wagons may be on trains or in yards or sidings, thus if a wagon is not on the displayed list relevant to the specified train or location, the operator knows immediately that an incorrect report has been made and can investigate. Key punching errors are virtually eliminated, especially important as many of the operators have had little key punching experience.

At the smaller or remote locations, telephone reports are made to the nearest input centre or detach/attach reports delivered when the train arrives.

The main features of the systems are:-

- A data communications network of 40 VDU's and 35 printers connected to the Westrail Centre mainframe computer by the railway's own telephone lines.
- Radio communications on a dedicated frequency at major marshalling yards.
- A real time record of the location and status of all wagons and locomotives.
- Shared access to the real time and historical data on all rollingstock for operational, maintenance, statistical and accounting purposes.
- The application of computer technology to train operations, thus virtually eliminating the problem of paperwork and greatly reducing the number taking and clerical staff required.

The system is divided into six modules:-

- Train Operations

  This basic module provides for the entry of all data concerning vehicle and train movements and load status. All data is entered on or as near a real time basis as possible. On-line enquiry on the current status of any vehicle, train or class of vehicle is available and daily reporting of vehicle location and movement history is provided.

- Wagon Supplies

  Via this module, wagon and container requirements are entered centrally and alert messages automatically sent to the relevant

Marshalling Yard or District Transport Office. These orders are accessed by the operational areas who enter the actions taken.

- Train Operating Statistics

  On a weekly, monthly and annual basis, data is extracted from the train operations database and manipulated using SAS to produce statistics on train movements, loads and commodities carried. This information is useful for measuring the performance of all groups involved with train movements and in the longer term has significance in planning track maintenance and upgrades.

- Wagon Accounting and Recording

  This module extracts information on loaded wagon movements from both the Train Operations database and the Centralised Freight Accounting System. The two sources of data are matched to ensure that revenue has been received for all loaded vehicle movements. Vehicle turn-round times at loading/unloading points are analysed and reported on if demurrage charges are due.

- Vehicle Maintenance

  This module provides for the recording of details on maintenance work performed on each vehicle. Subsequent analysis will assist in streamlining the maintenance function and the identification of non cost effective areas of maintenance. By recording every movement of a vehicle, the rollingstock system will permit a maintenance schedule based on kilometrage rather than on a time or needs basis as at present.

- Locomotive Scheduling

  This module provides a proposed operating schedule for locomotives for one week ahead, maximising the useful work of each locomotive. Many factors and constraints have to be considered such as axle loads, trailing loads, track grades, fuel efficiency etc.

The system so far described is for the computerised control of rollingstock operating within Western Australia. Each State railway has either a manual or computerised system which monitors wagon movements either individually or by class within their own state. The monitoring of the movement of intersystem wagons throughout Australia is the responsibility of the CENWAG cell of Railways of Australia based in Melbourne.

CENWAG are currently implementing a computerised system to process the telex information received from all intersystem transit points to improve the control and distribution of intersystem rollingstock. Ideally, to provide a more up-to-date and error free picture, the incoming data needs to be transmitted regularly from computer systems such as that being used by Westrail. Westrail, Australia National and New South Wales are able or close to achieving this ideal and the CENWAG system is being modified to receive data from any prescribed source.

PASSENGER RESERVATIONS

Over the past few years, the three Eastern States railway systems have installed their own intrastate passenger reservation systems, but as these systems are on different types of computer, communication between them is not easily established. With the current rapid advance of communications technology, there is no doubt that within a year or so the cost of linking the various computers will become acceptable and a nationwide reservation system based on the existing systems implemented. The interstate railway network is shown in Figure 4.

To improve the utilisation of accommodation on intersystem trains and to quickly supply the customer with information on available seats, especially near to departure time, it was necessary to establish a procedure which allowed access to and updated data in as near real time as possible. The old method consisted of allocating blocks of seats to a particular railway system and replenishing them as required. A few days before departure all unbooked accommodation reverted to the controlling railway, normally the State of the train's departure point, and any further bookings had to be made by telephone or telex to the departure point. The allocation system was obviously inefficient as it could not react fast enough to unusual demands and late bookings were difficult to make.

It was decided during 1982 to link Westrail and Australian National to the Victorian Railways system in Melbourne, at that time known as VICRES but later renamed AUSTRES, using Telecom's Digital Data Service (DDS) as the communications medium. The link-up was commissioned in June 1983. Currently,a double entry system is used in Melbourne and Sydney to keep the two intersystem reservation systems in parallel but this effort is minimised by keeping as many trains as possible on one system only. Discussions are taking place within Railways of Australia to establish common data communication protocols between railway systems to permit computer to computer communication and single terminal access to all computer systems.

Probably the two major difficulties with an interstate reservation system are that many journeys involve more than one train and that it is necessary to utilise efficiently accommodation which is booked for only part of the journey. AUSTRES allows the operator to enter the required origin and destination of a journey and the date of travel and it will display the timetable and seat availability of the trains involved. If accommodation is not available on the requested date, the system will search two weeks either way for the nearest available date.

Colour is used to differentiate am/pm in timetable screens, to highlight to the operator accommodation which is booked elsewhere on the journey and should therefore be booked in preference to accommodation free for the complete journey, and to highlight information requested by the operator. An interesting feature of the system is the way in which coach plans are displayed showing the location and direction of seats, whether smoking or non smoking, and highlighting the seats which are free and best meet the passengers requirement. If accommodation is booked by group it is linked and displayed as a group and operations such as confirmations and cancellations can only be performed on the complete group unless the operator deliberately overrides the link.

AUSTRES is a menu driven system and has proved easy for the operator to learn and use. Hardcopy reports are kept to a minimum, the only regular output being conductors' sheets just prior to departure, notification of trains that are 90% booked and lists of overdue unconfirmed bookings which are investigated manually. Waiting lists are held by the computer and if suitable cancellations occur or additional accommodation is added to a train, passengers on the list are automatically booked. Many other reports are available on request including statistical and audit listings.

Currently, AUSTRES terminal sites exist throughout Victoria, at main centres in South Australia and in Perth and Sydney from which reservations may be made on all intersystem trains and Victorian country services.

AUSTRES has recently been re-written with a re-structured database to integrate the many improvements that have been added over the period of its intensive use. Major enhancements requested by railway systems have also been included.

TRAIN SCHEDULING

At the 10th ATRF Conference Nedeljkovic and Norton (1985) described the development of computerised Train Scheduling at Westrail. Briefly with a railway system which consists primarily of single tracks with passing loops, a problem faced in both the long and short term is that of scheduling trains to meet and pass with the minimum of delay. Timetables can be established to achieve the minimum delay objective but if trains are delayed due to breakdown, weather conditions etc, a new passing schedule has to be developed by the train controller within a few minutes. Sometimes also additional trains are run at short notice.

Over the last two years, Westrail has developed a computerised system which within minutes can calculate a new optimum passing strategy for a line or network from timetables and geographical data. If trains are running late alterations are made to the standard timetables and the program re-run by the train controller.

The output is in the form of a train diagram as shown in Figure 5 with time on the horizontal axis and the distance along a section represented on the vertical axis. Currently the train controller commences with a daily train diagram which he modifies manually when required as the day proceeds. For minor changes, he can still use this practice but if necessary a new train diagram can be produced quickly by the computer.

During the past year, the Single Line Train Scheduling system has continued to be enhanced but more importantly is now used by the Traffic Branch to schedule trains on selected lines. It has been purchased by New Zealand Railways and other organisations are showing interest.

CONCLUDING REMARKS

During this presentation, the Westrail organisation and its computing environment have been described together with the more unique of the applications. The integrated nature of the applications has been emphasised as it is felt that the final objective of a completely integrated system is now achievable probably within the next two years, together with the resulting benefits.

In practice, the final target is not stationary. The Westrail environment is constantly changing and with it the range and type of information required. Applications based on old technology require re-writing to make them more efficient and new applications become apparent as users' understanding and innovation grows or improving technology makes more sophisticated systems possible.

Finally, it is interesting to note that in general the morale of the professional computing staff at Westrail is high and consequently the turnover of staff is relatively low. As salaries do not appear to be a significant contributor, it is assumed that the innovative nature of the systems, a clear strategic plan and the support and participation of the majority of management and staff for computer technology have created a motivating environment.

REFERENCES

Nedeljkovic N B and Norton N C (1985) "Computerised Train Scheduling" 10th Australian Transport Research Forum, Vol 2, pp 105 - 123.

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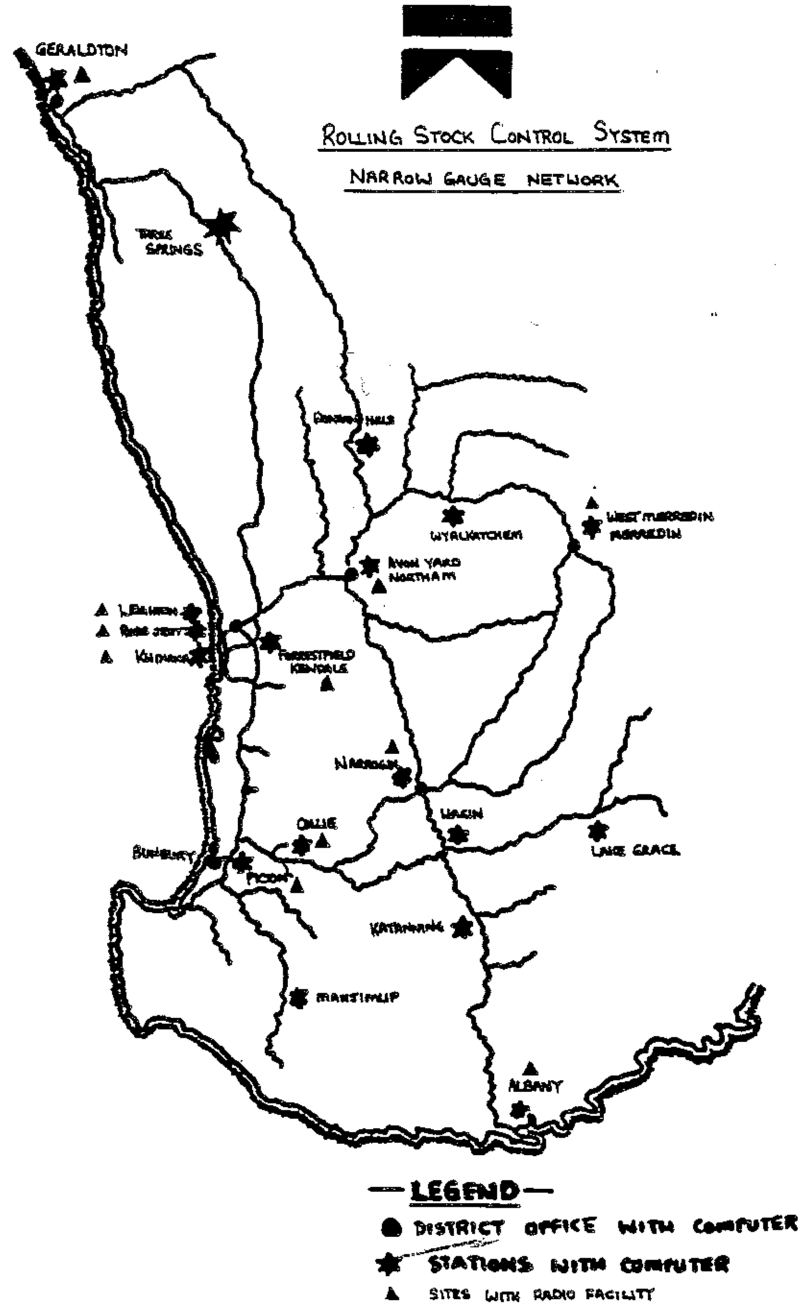

Figure 1. Remote Terminal Sites

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WESTRAIL E.D.P. OBJECTIVE

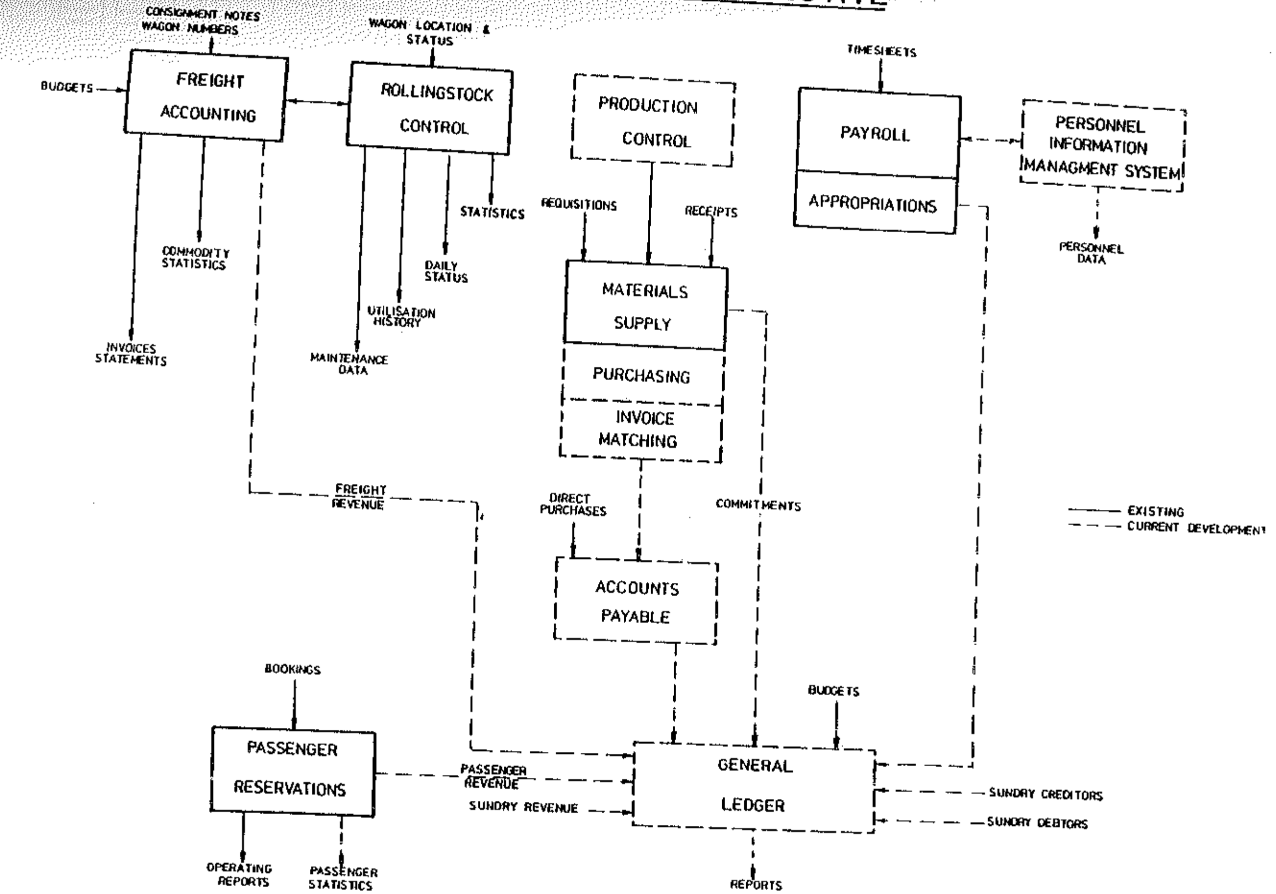

Figure 2. Integrated System Objectives

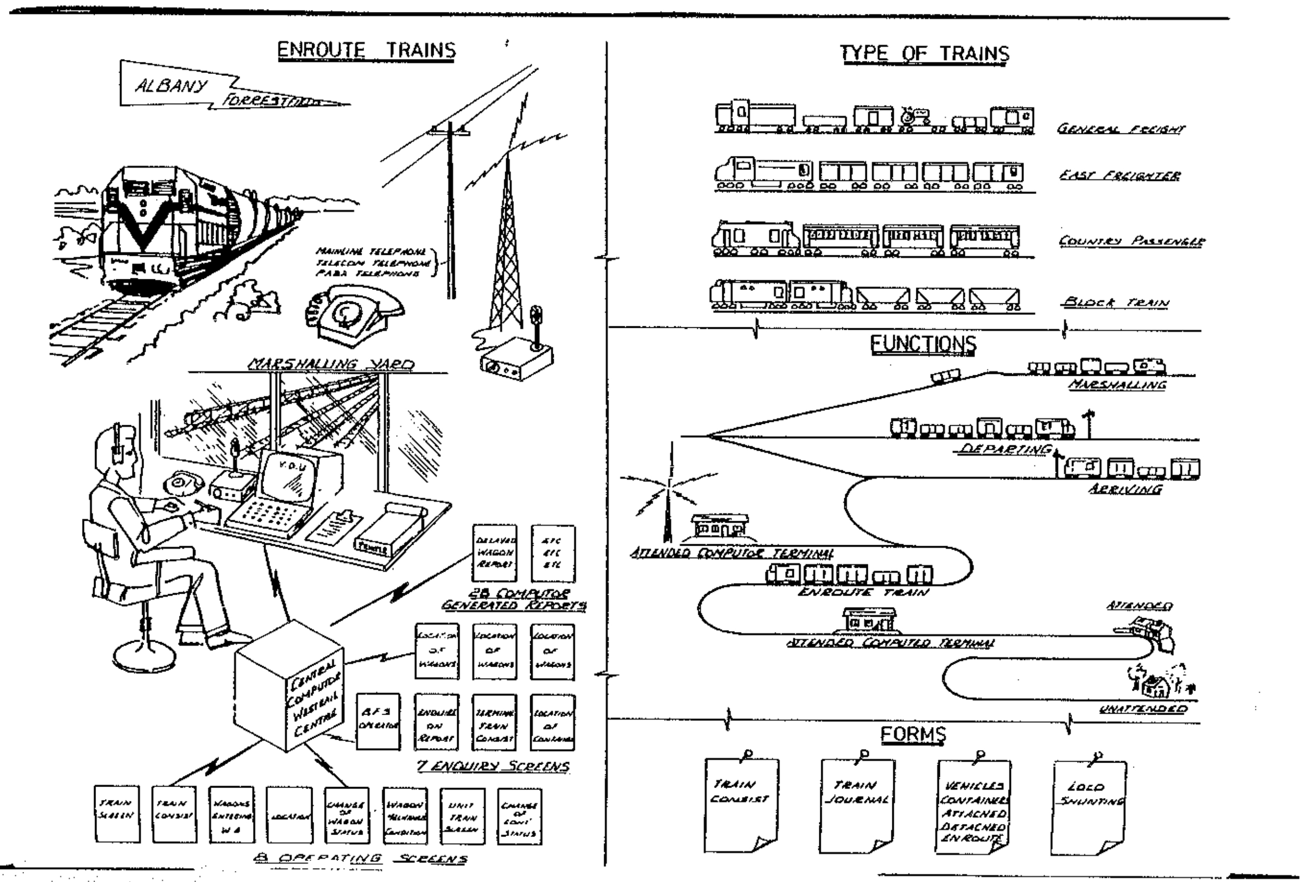

Figure 3. Rollingstock Control Operational Procedures

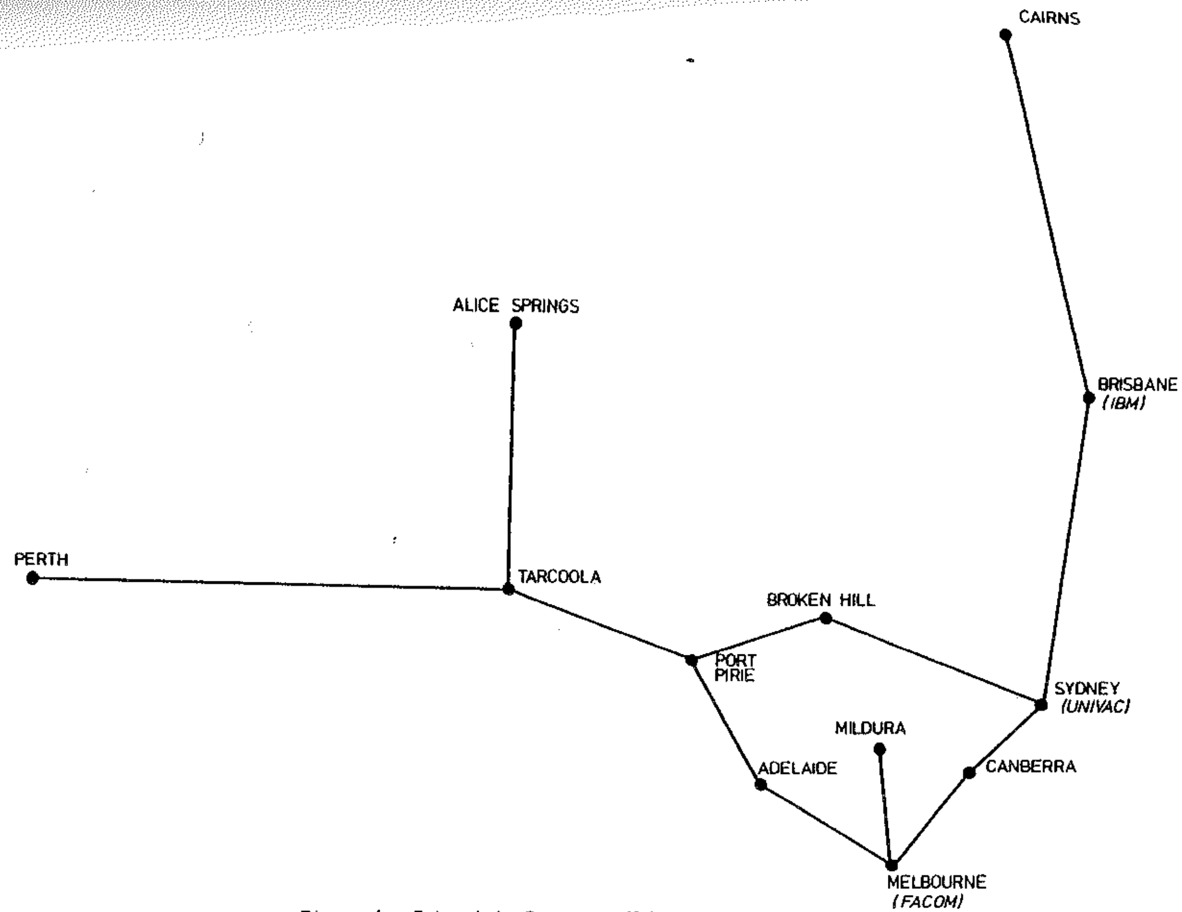

Figure 4. Interstate Passenger Network

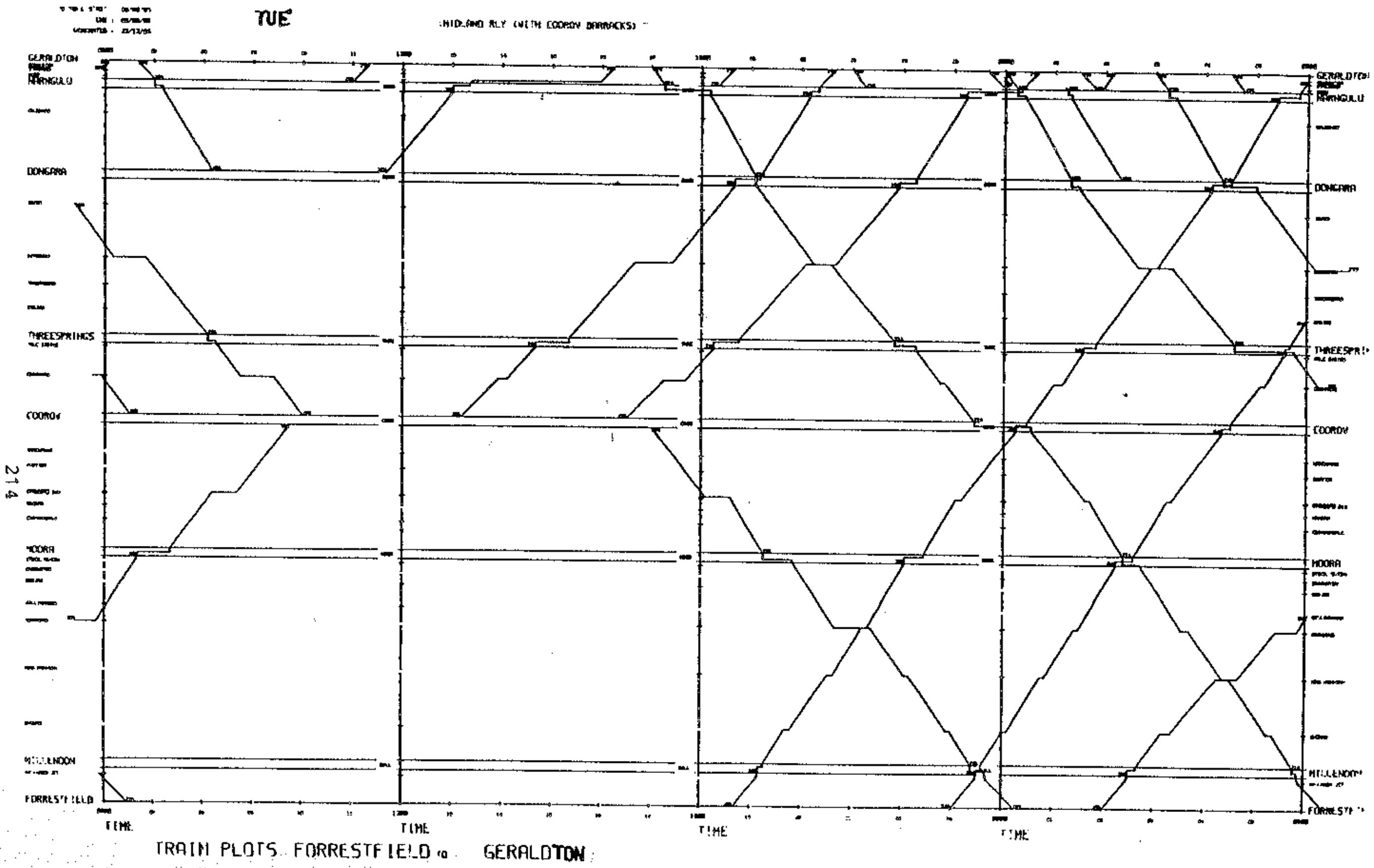

Figure 5. Train Scheduling Diagram

Philip G. Laird

Senior Lecturer, University of Wollongong,
P.O. Box 1144, Wollongong, N.S.W. 2500

AUSTRALIAN FREIGHT RAILWAYS IN THE TWENTIETH CENTURY

Abstract

The development of Australian Government railways this century, and the various steps in extending standard gauge track are considered. Proposals for new railways such as Alice Springs to Darwin, further gauge standardisation, and reconstruction of the Sydney-Melbourne line are also discussed.

A summary is given of railway electrification and the current operations of the five Government rail systems in Australia. Road-rail competition for freight is considered along with the recent role of Federal Governments in facilitating rail improvements. A more efficient rail network is advocated instead of continual subsidization of road and rail freight transport.