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THE RATIONAL USE OF RAILWAY RESEARCH IN GRAIN TRANSPORT: THE VICTORIAN EXPERIENCE

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ABSTRACT: *This paper examines the potential to achieve significant cost reductions in the rail haulage of grain by a more rational integration of rail with other resources employed in domestic grain distribution (e.g. road transport, grain handling resources). Options for rail cost reduction have been evaluated using a case study approach.*

These options range from increasing train size to development of consolidated grain collection points, or sub-terminals, on the rail system. Simulated grain train operations on the Benalla-Oaklands line formed the basis of the case study.

The views expressed in this paper are those of the author and not necessarily of VicRail Management.

THE RATIONAL USE OF RAILWAY RESOURCES IN GRAIN TRANSPORT: THE VICTORIAN EXPERIENCE

INTRODUCTION

The recent Victorian Transport Study (August, 1980) and an independent study of rail costs and charges in the transport of Victorian grain (Transmark, 1980) have, amongst other things, focussed interest on the relative costs of rail and road modes in the transport of grain.

This issue has similarly been addressed by the NSW Grain Handling Enquiry (February, 1981), as also (in very broad terms) has the cost interface between the grain handling/storage and transport functions. There is little doubt that all of these studies recognised the complementarity which exists, at least potentially, between rail and road in the transport of bulk grain. However, none addressed, in detail, the problems and prospects of achieving a more rational balance in the application of rail and road resources to this task.

By definition for the purposes of this paper, a more rational balance of resources in grain distribution (including storage and handling, as well as transport) will have been achieved when the total cost of these resources has been minimised.

Viewed from the standpoint of the domestic grain distribution system, this would mean minimising the cost of moving grain between farm gate and ship's hold. Fragmented control of the resources comprising the total grain distribution system has made achievement of this objective very difficult in practice. Complete operational integration of these resources is a necessary prerequisite to minimising the total cost of grain distribution.

This paper cannot pretend to adequately come to grips with the problem of minimising the total resource costs of the grain distribution system. Instead, it is hoped that it can at least provide insight into the potential which exists to achieve a significant reduction in the rail component of these costs, by better integrating the linehaul function of rail with the handling and storage function of the elevator authority and the local road delivery function of the grain farmer or road haulage contractor. Specifically, this is seen to be best achieved by replacing multiple point rail collection of grain from local silos with direct road delivery from farms to consolidated country elevators, or sub-terminals, from which final delivery to port terminals would be by single origin/destination block trains.

Rail economies will arise by this means but they will also arise to a lesser extent from less fundamental changes in the grain distribution system e.g. through increases in train loads or rail collection from a reduced number of local silos.

This paper outlines the longer term strategies available to rail systems in their quest to apply their resources to the grain transport task more productively. It then seeks to test the relative merits of these specified strategies from the point of view of achieving substantial reductions in rail operating cost. This is done with the aid of a case study - the costing of strategy options in this instance being based on simulated rail movements of grain from stations on the Benalla-Oaklands (NSW) line.

FUTURE RAIL STRATEGIES FOR MOVEMENT OF GRAIN

As rail charges typically account for anything up to 60-70%[1] of the Victorian farmer's total cost of transferring his grain from farm to port, the development of an improved grain distribution system must give due weight to the need for rail cost reduction. Invariably, this cost reduction will require a more rational use of rail and other resources than has hitherto been the case.

It might be argued that the continued handling of a massive peak grain movement task (coinciding with the annual grain harvest) represents an inefficient use of railway resources - and there would be substantial merit in this view. Indeed, the recent study of rail costs and charges in the transport of Victorian grain (Transmark, 1980) has estimated that the rail system's recovery of avoidable costs during the grain peak would drop to a rate of approximately 55%, from a rate of 75% on a year-round basis.

The alternative to stretching limited rail resources to handle a peak traffic requirement is the installation of more buffer storage somewhere in the grain distribution system. This storage can either be provided on-farm or in the grain elevator system itself.

If on-farm storage is to be provided, facilitating legislative amendments would be required[2] and an appropriate scale of financial incentives would have to be devised to ensure that farmers would provide sufficient on-farm buffer storage to eliminate peak demands on the elevator and rail systems.

1 Based on wagon load rates applying to the maximum length of grain haul on the Victorian system as at August 1980.
2 Current grain marketing legislation requires direct delivery of grain to the elevator system to enable farmers to receive advance payments from the Australian Wheat Board.

If, on the other hand, the grain elevator system were to provide buffer storage, then corresponding financial incentives would be required to ensure that this additional storage was forthcoming.

In each instance, the resulting efficiencies in the rail operation could be translated into incentives through rail rates (and, in the latter instance, handling charges as well).

Whilst it would be desirable to take action to reduce the magnitude of the grain movement peak, there is also considerable scope to take initiatives which would result in rail cost reduction on a year- round basis.

The two aims are not necessarily mutually exclusive, although concurrent satisfaction of both might not be the most cost effective solution in every instance.

It is the purpose of this paper to test the potential pay-off from adopting alternative rail operating strategies which would result in year round, as distinct from peak period, cost reduction.

Without exception, all of the rail improvement options examined in this paper will require some level of capital commitment by the railways, grain handling authorities, or both. Because responsibility for this expenditure is a fragmented one, it is not possible here to comment fully on the net financial returns available from each strategy after allowance for capital costs.

Rather, it is proposed to comment on the relative improvement in rail operating cost available from implementation of alternative train operating strategies, leaving any detailed discussion of the grain storage/ transport cost trade-off to future papers.

Indication of the potential for rail cost reduction nevertheless provides a useful benchmark for the future resolution of this trade-off.

The rail improvement strategies examined in this paper are:-

i) Increase the size (i.e. trailing gross tonnage and length) of bulk grain trains for a significantly less-than-proportionate increase in train operating costs.

ii) Reduce the number of silo clearings on grain branchlines and operate grain dedicated block trains between a lesser number of stations and major hinterland or seaboard terminals.

iii) As an alternative to (ii) above, restrict rail operations to block train shuttle services between consolidated country receival facilities (sub-terminals) and seaboard terminals.

iv) Accelerate the turnround of trains at seaboard and country grain terminals by increasing rail loading and discharge capacities and exclusively operating modern bottom discharge bogie rollingstock.

All of the above strategies can be applied either individually or in combination with any other strategy(ies). None is mutually exclusive.

A number of general observations can be made about each strategy.

Strategy (i) is likely to be expensive in terms of the capital commitment necessary to provide the fixed infrastructure which would be compatible with the operation of long trains.

Depending upon the size of trains which it is desired to operate, this infrastructure is likely to include extended passing loops on single line sections, together with expanded siding and grain handling capacity at country and port elevator locations. Expanded handling capacity is not an absolute pre-requisite for the operation of this strategy, but its cost effectiveness is likely to be significantly lessened in the absence of improved train loading and discharge capability.

Implementation of strategy (ii) will in most cases require extension of siding trackage at key country silos and may require some expansion of rail outloading capacity at these locations.

Similar comments would apply to strategy (iii) except that the scale of investment required in this case is likely to be proportionately greater than for strategy (ii) and, in addition, may need to include provision for expanded storage capacity at inland sub-terminals.

Implementation of strategy (iv) would most likely require large scale expansion of both rail and grain handling facilities at country and (in particular) port terminals. This strategy also implies the possibility of a compatible expansion in either port storage or ship loading capacity, or both.

RATIONAL USE OF RAILWAY RESOURCES IN GRAIN TRANSPORT

THE CASE STUDY REGION

The line between Benalla in north-eastern Victoria and Oaklands in the Southern Riverina district of N.S.W. is 126 kms long and serves a total of twelve local grain silos and two ground (bunker) storages, as depicted in Figure 1. The largest single grain storage facility on the line, with a capacity of 34,000 tonnes, is located at Yarrawonga. Other storages range in capacity between 4,100 tonnes (at Telford) to 13,300 tonnes (at Oaklands). No single elevator facility on the line has a rail outloading capacity greater than 120 tonnes, or the equivalent of 5.5 four wheel open wagons, per hour.

Grain is moved direct by rail and road from stations on the line to the major seaboard storage at Geelong, which is 388 kms by rail from Oaklands.

Unlike the Wimmera and Southern Mallee grain growing districts of Victoria which feed grain into major inland sub-terminals at Marmalake and Dunolly respectively, the north-eastern district does not have a major consolidated receival and storage facility capable of accepting a major proportion of the region's "overflow" production. ("Overflow" is here taken to mean the difference between the total of current harvest receivals of grain and the total storage capacity available at local silos)

Consequently, grain must be moved direct from local storages to Geelong as soon as the former become full.

Prior to April, 1980, the Oaklands line had only limited capacity to accept fully laden "VHGY" bottom discharge hopper wagons as load restrictions still applied to the final 61 kms of line between Yarrawonga and Oaklands which was still laid in light (30kgs/metre) rail. Thus, bulk grain was conveyed principally in four wheel open ("GY") wagons, with up to 44 such wagons per train consist[1].

The progressive relaying of the final section of line in 40kgs/metre rail resulted in the removal of restrictions on the use of fully laden "VHGY" wagons and the 1980/81 harvest season saw the operation for the first time on the line of blocks of these wagons. In general, these wagons are operated in standard blocks of 22 wagons each.

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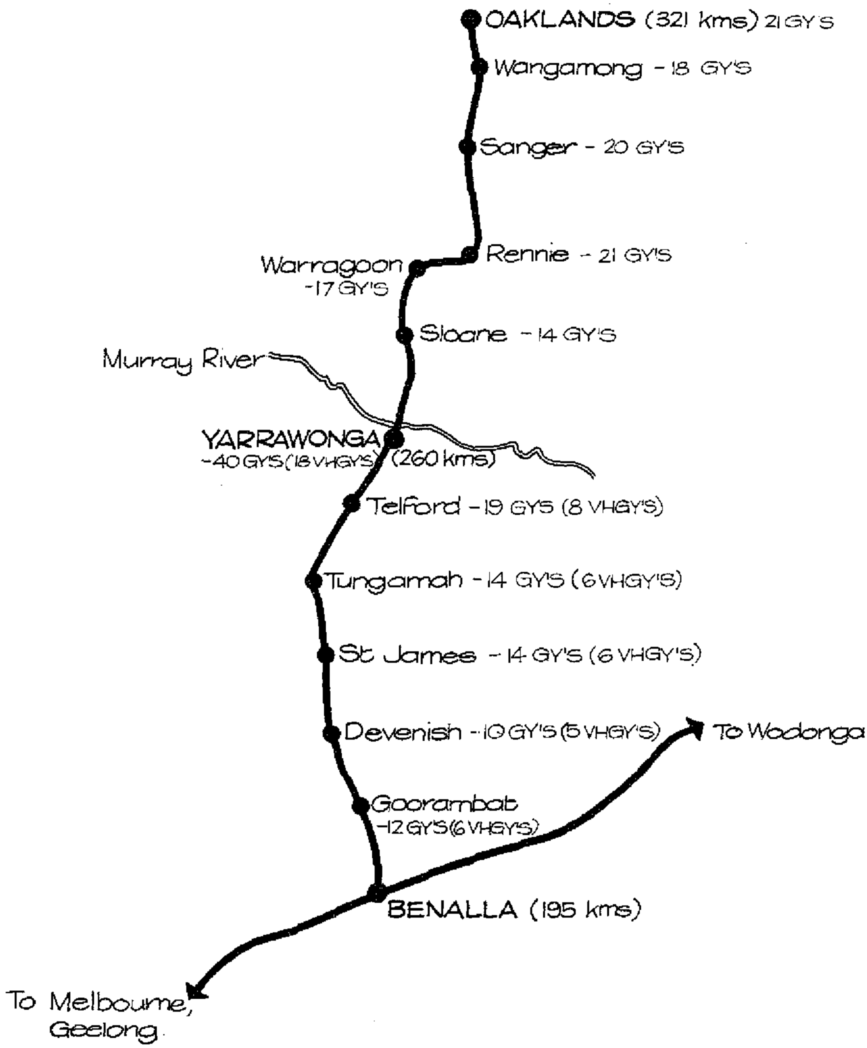
1 The "GY" wagon has a payload capacity of only 22 tonnes of bulk wheat and requires an average of about 7 minutes for discharge at port terminals, using manual unloading techniques. The "VHGY" wagon, on the otherhand, is a self-dumping bottom discharge wagon with bogie suspension and a payload capacity of about 56 tonnes of bulk wheat. With the limited discharge belt capacity currently applying at Victorian port terminals, a "VHGY" wagon requires approximately 5 minutes for complete discharge, but in the absence of significant belt capacity constraints has the potential to discharge in 2 minutes.

FIG 1:

THE CASE STUDY REGION



Note:- All Locations possess a grain outloading capacity of 120 Tonnes per hour

Limited grain outloading and siding capacities at most stations (see Figure 1) impose the continued operation of multiple stop or "wayside" trains on the Oaklands line.

During the peak or "overflow" period, operating schedules for the line allow for delivery of empty wagons to about five stations on "down" journeys (i.e. from Benalla to Oaklands) and for collection of the same wagons in loaded condition on return "up" journeys (i.e. from Oaklands to Benalla).

Off-peak movements, however, can involve stopping of trains at nine or more stations on the line.

In some instances, grain is still moved off the line in "casual" wagons attached to scheduled trains. However, such movements usually apply only to the conveyance of special grades of grain for export or for the flour milling trade.

The creation in 1978 of a grain distribution buffer zone covering the Riverina area, secured for the Victorian grain handling system a greater share of grain from southern N.S.W. This development contributed to the lifting of the grain traffic task on the Oaklands line during an average harvest year from approximately 50,000 - 70,000 tonnes to about 120,000 tonnes, (or about 5450 four wheel wagon equivalent trips per annum).

During 1979-80 - a Victorian record grain harvest year - a record grain task of 339,000 tonnes was handled on the line (equivalent to approximately 15,450 four wheel equivalent wagon trips).

CASE STUDY OPTIONS FOR COST SIMULATION

For the purpose of analysis, the rail operating strategies specified earlier have been translated into a total of six options which have been costed on the basis of simulated rail movements of grain between Oaklands and Geelong. Each option corresponds to one or more of the specified rail operating strategies. The first of these options, representing a typical off-peak movement pattern for a four wheel wagon train consist forms a base case against which the relative costs of the other five "improved" rail operating options are evaluated.

In each instance, the costs relevant to the evaluation are <u>incremental train operating costs</u>, including those costs associated with train crewing, locomotive running and maintenance, wagon and brakevan maintenance and attributable track maintenance.

Costs were generated with the aid of the VicRail Freight Traffic Costing Model.

The train operating regimes assumed for each option are depicted in Figure 2. All options, with the exception of Options 5 and 6, assume a rail operation from Oaklands. The latter two options,on the other hand, assume direct road delivery of grain from farms in the catchment area to a sub-terminal located at Yarrawonga, thence a "shuttle" rail movement between Yarrawonga and North Geelong.

The effect of increased train size is evaluated in Options 3-6 inclusive. Train consists of up to 32 VHGY wagons can be accommodated without significant upgrading of existing rail route and terminal facilities. An increase in train size to 50 VHGY wagons will, however, require considerably more extensive upgrading of rail facilities. In addition, Options 5 and 6 will require substantial upgrading of both sub- terminal and port grain handling facilities.

The train costing parameters associated with each option are set out in Table 1. All options assume block movement of grain (i.e. trains are comprised of blocks of wagons conveying grain only, although varying types and grades of grain may be conveyed in different "blocks" on the same train).

For cost simulation purposes, motive power is allocated to train consists in direct proportion to the assumed gross trailing load of the particular train and the ruling grade load applying over each section of the route (i.e. no significant surplus of motive power is assumed to apply over any section of route).

The crew hours assumed for each cost simulation are based on information derived from sampled train running records covering a two week period in each of December, 1980 and March, 1981.

Estimates of crew hours for all options therefore allow for route congestion delays which commonly occur on some of the more heavily trafficked sections of the route, e.g. Seymour - Newport; Newport - North Geelong.

Options 1-4 reflect the current conventional pattern of operation in which full trainloads are broken up into small blocks (of approximately 20 four wheel wagon equivalents) in North Geelong yard and are then hauled the remaining kilometre to the GEB terminal by a shunting locomotive.

In these cases, railway crews are not used for the grain discharge operation and crew hours include only the time taken for the return linehaul movement Oaklands - North Geelong, for local transfer between North Geelong and the G.E.B. terminal and "stopping" time at all loading points on the Oaklands line.

FIG 2

ALTERNATIVE RAIL OPERATING OPTIONS: BENALLA - OAKLANDS LINE

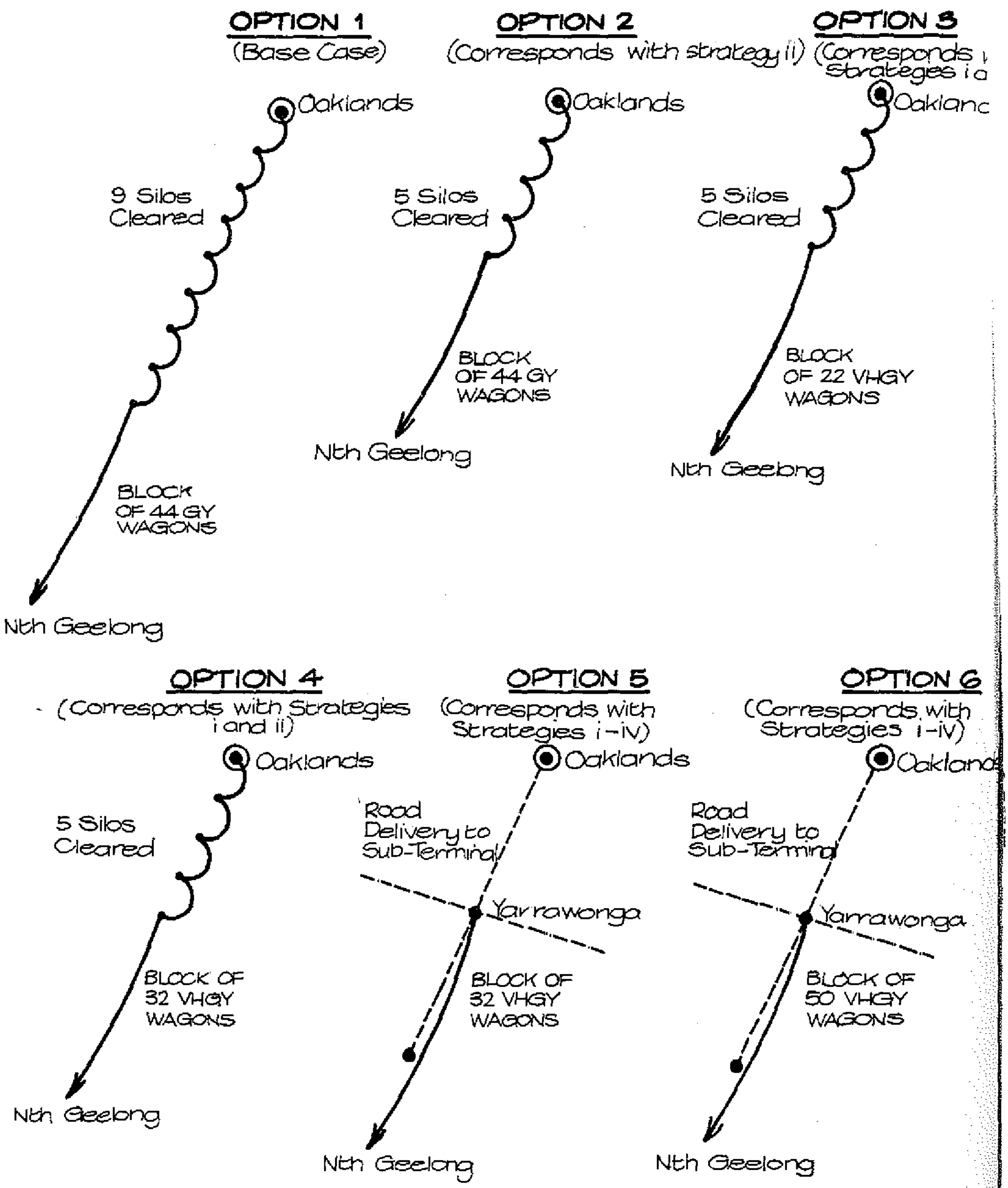


TABLE I: CASE STUDY COSTING PARAMETERS

	OPTION 1	OPTION 2	OPTION 3	OPTION 4	OPTION 5	OPTION 6
Origin/Destination :-	Oaklands, NSW/Grain Elevators Board Terminal, North Geelong				Yarrawonga/Grain Elevators Board Terminal, North Geelong	
Route Distance (Return Trip) :-	776 kms				654 kms	
Train Consist :-	44 "GY" wagons, plus brakevan		22"VHGY" wagons, plus brakevan	32"VHGY" wagons, plus brakevan	32"VHGY" wagons plus brakevan	50"VHGY" wagons, plus brakevan
Train Status :-	Grain Block Train stopping at 9 stations, Benalla-Oaklands	Grain Block Train, stopping at 5 stations, Benalla – Oaklands			Grain Block Shuttle, operating between Sub-Terminal and Port only	
Train Payload (Net Tonnes)	968	968	1232	1792	1792	2800
- Forward :-						
- Return :-	0	0	0	0	0	0
Trailing Gross Tonnes						
- Forward :-	1389	1389	1697	2457	2457	3825
- Return :-	421	421	465	665	665	1025
Crew Hours Per Return Trip :-	49.6	43.6	43.6	43.6	30.9	32.6
Locomotive Combinations :-	2 "T" Class Benalla-Oaklands-Benalla 1 "X" Class Benalla-Nth Geelong -Benalla, banked by "T" class Seymour-Wallan 1 "Y" Class Nth Geelong Yard-GEB Terminal		2 "T" Class Benalla-Oaklands-Benalla 1 "X" Class Benalla-North Geelong-Benalla, banked by "B" Class Seymour-Wallan 1 "Y" Class Nth Geelong Yard-GEB Terminal	"X" plus "T" Class Benalla-Yarrawonga-Benalla 2 "X" class Benalla-Wallan, banked by "T" Class Seymour-Wallan 1 "X" Class Wallan-North Geelong-Benalla 1 "Y" Class North Geelong Yard-GEB Terminal (Opt.4 only)		2 "X" plus "T" Class Benalla-Yarrawonga-Benalla 2 "X" Class Benalla-Nth Geelong -Benalla, banked by 2 "X" Class Seymour-Wallan
Wagon Turnround :-	3.7 days	3.5 days	2.5 days	2.5 days	1.5 days	1.6 days

Options 5 and 6, on the other hand, reflect an altered method of operation in which full trainloads are hauled by mainline locomotives directly over the grain discharge point, via a balloon loop connected to discharge tracks at the GEB terminal[1].

In these cases, railway crews are involved in the discharge operation and estimates of crew hours include an allowance for the time involved in loading, unloading and train preparation (i.e. train examination and servicing) at country and port terminals respectively in addition to train running time between these points.

For both Options 5 and 6, it was assumed that an outloading rate of 1000 tonnes per hour would be available at the envisaged sub-terminal (by comparison with the present maximum of 120 tonnes per hour at existing local silos) and that a minimum actual discharge rate of 2,000 tonnes per hour would be available at the upgraded Geelong terminal (representing a 2½ fold increase in the current discharge rate[2]).

These assumptions translate to respective average loading and discharge times of about 3.4 minutes and 1.7 minutes per VHGY hopper wagon. To these times were added average vehicle inspection and preparation times of approximately 1.7 minutes per VHGY wagon, to produce estimates of total cycle times at country and port terminals.

For the purposes of this analysis, wagon turnround time is defined as the time interval between successive outward loadings of a given wagon at a given location. For Options 1-4, turnround times are assumed to be sensitive to the fixed train running pattern and frequency specified in current grain operations timetables as well as to actual loading/unloading and train preparation time at terminals.

However, the altered method of rail operations assumed for Options 5 and 6 would mean that trains would directly arrive and depart at and from the grain terminal, rather than the North Geelong Yard. Therefore a continuous operating cycle rather than a fixed timetabled movement was assumed in the case of both options, contributing to the assumption of significantly reduced wagon turnrounds in both cases.

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1 A balloon loop scheme has been approved for the Geelong grain terminal and at the time of writing it is expected that the loop will be in partial operation for the 1981/82 harvest.

2 Current upgrading plans for the Geelong grain terminal call for ultimate installation of a receival facility with an actual belt capacity of 3,000 tonnes per hour.

CASE STUDY RESULTS

The results of the case study cost simulation have been expressed in index number format. This has been done to preserve the confidential nature of the cost data, without, at the same time, greatly diminishing the value of the simulation exercise as a measure of the relative potential of alternative rail operating strategies to achieve significant cost reduction.

In this instance, the incremental costs per net tonne kilometre associated with Option 1 constitute an index base against which the movement in the costs of the other five options has been measured.

TABLE 2: INDEX OF SIMULATED COSTS - CASE STUDY OPTIONS

OPTION	INDEX	RELATIVE REDUCTION IN COST (%)
1	100	-
2	92.8	7.2
3	72.5	27.5
4	59.5	40.5
5	56.2	43.8
6	53.6	46.4

Options 1-3 in effect represent the current "state of the art" in terms of the rail movement of bulk grain in Victoria, whilst Options 4-6 represent an "improvement" of present rail operating methods.

Significantly, the above results indicate that the greatest percentage reduction in rail incremental operating cost occurs as trainloads are increased from 1389 gross tonnes, or 44 GY wagons (Option 2) to 1697 gross tonnes or 22 VHGY wagons (Option 3).

Identical crew and locomotive hours have been assumed for both options, leaving only a wide variation in the wagon turnround assumptions for each (3.5 days for Option 2, as compared with 2.5 days for Option 3).

The effect of extended wagon turnround on incremental operating costs is not significant (although, clearly, the effect of extended turnround on rollingstock requirements, and hence capital costs, can be quite dramatic). For example, an increase of one day in the turnround of wagons under Option 3 would add less than 2% to the incremental operating cost per net tonne kilometre for the option. This is because only wagon maintenance costs are affected by a change in the turnround cycle and these are spread over the total net kilometre task for each wagon.

Thus, a major part of the cost reduction which might be achieved by implementing Option 3 rather than Option 2 could be attributed to the effect of increased train size.

This is also true of the cost reduction which might result from implementing Option 4 as compared with Option 3. In this case, trainloads would increase from 1697 gross tonnes or 22 VHGY wagons to 2458 gross tonnes or 32 VHGY wagons, leaving all other principal variables unchanged.

Rail cost reductions would continue to result principally from increased train size, at least up to the point at which Option 6 (trainloads of 3825 gross tonnes, or 50 VHGY wagons) is implemented. This option has the potential to almost halve incremental train operating costs by comparison with the base case (Option 1), but it would generate only a 10% reduction in incremental operating costs by comparison with Option 4.

Thus in terms of rail operating cost reduction only, the principal benefits of the two sub-terminal options (i.e. Options 5 and 6) would appear to flow from their potential to increase train size rather than their potential to reduce wagon turnrounds.

However the sub-terminal concept does have the potential to confer other financial benefits on the rail system as will be discussed in the following section.

It is useful to reflect at this stage on the reasons for the dominant influence of increased train size on the above results.

The first is the relatively fixed nature of crew costs. It matters little whether a train is comprised of twenty or fifty wagons - it will essentially require the same crewing resources (two enginemen and a guard) and its requirement of <u>running</u> hours (i.e. exclusive of time involved in loading and unloading) will be roughly the same.[1]

1 A factor working to vary the level of crew cost with increased train size is the application of tonnage allowances under Enginemen's Awards. However in practice, application of these allowances adds very little to incremental costs per net tonne kilometre for an average length of grain haul.

Other cost elements are also relatively fixed in nature. A larger train will make relatively little additional demand on running time and signalling capacity. A larger train, it is true, will require greater inputs of motive power, but these inputs increase as a stepped function of additional tonnage, thereby allowing train loads to increase within some range without incurring additional cost penalties (other than those associated with marginally greater fuel consumption). There is also evidence to suggest that within broad limits defined by the axle loading of currently operated locomotives and rollingstock (on the Victorian system at least), track maintenance costs will not increase in direct proportion with train size, their rate of increase being restrained by residual track maintenance cost elements which are not tonnage related.

Thus, in confirmation of the results obtained in the cost simulation exercise, there would appear to be considerable potential to reduce the unit (per net tonne kilometre) cost of grain train operations by increasing train size. This may be achieved within certain limits without a dramatic expansion of rail or grain handling infrastructure.

WIDER IMPLICATIONS OF CAST STUDY OPTIONS

Analysis of the results of the case study cost simulation exercise must be tempered by a realisation of the wider implications of the various evaluated options, in particular, the two sub-terminal options. The principal implications of these options may be stated as follows:-

Altered Patterns of Local Grain Delivery

The sub-terminal concept depends on the acceptance by farmers of a change in the pattern of their grain deliveries to the elevator system. This change would require direct delivery by road to a sub-terminal rather than to a local silo, particularly during the peak of the grain harvest.

In many instances, this may involve local road haulage over a greater distance than that to which the farmer has become accustomed.

A recent study conducted by a consultant on behalf of the Grain Handling Section of the Victorian Farmers and Graziers Association [Trapnell, 1980] attempted to measure the extent of the rail rate incentive which would be required to compensate farmers for direct delivery of their grain to a sub-terminal.

After allowing for the trade-off which would typically confront farmers in terms of their own vehicle operating costs and travelling and waiting time, the study concluded that the "breakeven" distance for delivery of grain from the farm to the elevator system might be approximately 50 kilometres.

The rail rate incentive required to encourage farmers to deliver grain to a sub-terminal over this distance was calculated at $1.00 per tonne. In the case study region this would equate to a rail rate discount of approximately 7%.

Infrastructure Requirements

Development of sub-terminals at key locations throughout the grain catchment area would require a substantial commitment of capital, principally on the part of the grain handling authority. Figures quoted by the Victorian Grain Elevators Board at the recent Australian Grains Industry Conference [Transport Committee, Australian Grains Industry Conference, October 1981] indicate that the cost of constructing a modern vertical silo is approximately $100 per tonne of capacity. On this basis, the doubling of storage capacity at Yarrawonga to permit sub-terminal rail operations, for example, would cost approximately $3.4 million (or an annual equivalent cost of about $477,000 at a discount rate of 14% over 50 years). This figure would not include the cost of installing rapid outloading facilities which would be required to maintain accelerated turnround of long block grain trains.

Compatible facilities for the handling of these long block trains would also in all probability be required at port terminals.

Here also there would be a need to construct improved rail handling facilities, e.g. balloon loops, to permit the rapid throughput of block grain trains. Track construction costs of approximately $250,000 to $300,000 per kilometre can typically be contemplated.

In addition, there may be a need to undertake selected rail route improvements (e.g. construction of extended crossing loops on single line sections, installation of automatic signalling systems) where operation of long trains is likely to be constrained by limited route capacity.

Where it is necessary to install automatic or C.T.C. signalling systems, the cost will vary greatly depending upon the type of system adopted but is likely to be within a range of $25,000 - $60,000 per kilometre.

Rollingstock Requirements

By contrast with the minimal impact of reduced wagon turnrounds on train operating costs, the effect of turnround reduction on rollingstock requirements and, hence, capital costs, can be quite dramatic.

The deteriorating structural condition of aged four wheel "GY" wagons engaged in Victorian grain traffic is likley to require their replacement with modern bogie hopper "VHGY" wagons by 1990.

Rollingstock requirements for grain traffic must be based on the total requirement of wagons during peak grain movement periods - typically during the main harvest "overflow" period.

In 1979/80, approximately 40% of the annual rail grain task was handled during three 4 week accounting periods.

This distribution has been applied to the grain task on the Oaklands line in that year to estimate the potential effect of reduced turnrounds on the rollingstock replacement programme, as follows:-

TABLE 3: ESTIMATION OF GRAIN ROLLINGSTOCK REQUIREMENTS, OAKLANDS LINE

(Based on estimated peak grain task of 136,000 tonnes during 1979/80)

Wagon Type	Turnround	Estimated No. of Trips in 12 week peak period	Tonnes Hauled per Wagon during peak	Total Wagon Requirement (No.)
GY	3.7 days	16	352	387
VHGY	2.5 days	24	1344	102
"	1.5 days	40	2240	61
"	1.6 days	37	2072	66

The wagon turnrounds used in this analysis coincide with the turnround assumptions used for case study Options 1, 3, 4, 5 and 6.

If a 2.5 day turnround could be achieved with the operation of VHGY hopper wagons (as per Options 3 and 4) approximately 102 such wagons would be required to replace 387 GY wagons in grain traffic on the Oaklands line.

If, however, VHGY wagon turnround could be reduced to 1.5 days (as per Option 5) only 61 wagons would be required to replace GY wagons in this traffic.

This represents an effective saving of 41 wagons which if valued at a current unit construction cost of $60,000, would amount to a total saving of approximate $2.5 million.

The corresponding saving at a wagon turnround rate of 1.6 days (Option 6) would be $2.2 million.

It can then be seen that the substantial potential improvement in wagon turnround allowed by the sub-terminal concept could produce very significant savings in the rollingstock requirements for a given grain traffic task.

Branchline Rationalisation

Development of a sub-terminal grain distribution concept would offer scope for rationalisation of parts of the grain dedicated network of branchlines in Victoria. Approximately 800 kms of rail route in the Victorian grain areas is still laid in 30 kg/metre rail, preventing the use of fully laden hopper wagons and main line locomotives and restricting speeds to 24-32 kms/hour. A typical cost for maintenance of these branchlines is about $3,000 per kilometre per annum. Relaying of these lines in heavier rail is estimated to cost a minimum of $30,000 per kilometre.

Thus there are very real incentives in some instances to seek opportunities for more cost effective road movement of grain from short, lightly trafficked branchlines. These opportunities could at least in part be realised with the development of grain sub-terminals.

CONCLUSION

There appear to be significant opportunities for the more rational and cost effective use of rail resources in the transport of grain. These opportunities depend upon the more efficient integration of rail with other resources employed in grain distribution in such a way that the total cost of the domestic grain distribution function, covering the movement of grain from farm to ship's hold, is minimised.

From a railway operating viewpoint, there is considerable potential to reduce grain traffic costs by a) increasing train size and b) reducing the number of grain collection points on the rail system. Options for the latter range from a minimal reduction in the number of silo clearings by rail to development of consolidated grain collection points, or sub-terminals.

The case study has demonstrated the potential to achieve sizeable savings in rail resource costs. Whether these opportunities can be realised will ultimately depend upon a co-operative approach to the resolution of the complex grain storage/transport trade-off by all parties involved in grain distribution.

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