AURIZON

NETWORK

Annex R

(Confidential) Worley Parsons – Marginal Costs Variabilities – Contemporary and Accepted Theorems, 18 August 2008

WorleyParsons

resources & energy

Incorporating JWP & Patterson Britton

EcoNomics

QR NETWORK

UT3 Parallel Active Comparison Exercise

Support Document

Marginal Cost Variabilities

Contemporary and accepted theorems

301001/00190

18-Aug-08

WorleyParsons Rail
Transport and Urban Development
Level 9 Centenary Square
100 Wickham Street
Fortitude Valley Qld 4006 Australia
Tel: +61 7 3319 3700
Fax: +61 7 3244 9699
www.worleyparsons.com
WorleyParsons Services Pty Ltd
ABN 61 001 279 812

SYNOPSIS

As supporting documentation to UT3 parallel active comparison exercise Queensland Rail Network commissioned WorleyParsons to carry out desktop international and national review of contemporary research and theorem in the assessment of variables for the calculation for short run and long run marginal costs in rail infrastructure maintenance.

This paper is a literature review of contemporary research in this field and a brief discussion of the appropriateness of this research to local Queensland issues found in the Queensland coal network systems.

Disclaimer

[redacted]

CONTENTS

EXECUTIVE SUMMARY

"Marginal costs are those variable costs that reflect the cost of an additional vehicle or transport unit using the infrastructure. Strictly speaking they can vary every minute, with different transport users, at different times, in different conditions and in different places" (EC White Paper, 1998, p.10)

As part of the UT3 Parallel Active Comparison Exercise, Worley Parsons were commissioned to conduct a broad overview desktop review and summary on the current theorem, research and thinking in regards to the structure of costs and charges in relation to marginal cost fixed and dynamic variable components.

This report presents two accepted hypotheses and then goes on to explore contemporary research literature from which the basic theorem exploring the dynamic components variable usage charging from international railway industry views and practices are built. Econometric cost functions are investigated in regards to their potential applications in relation to the introduction and usage of lags and leads of dependent and independent variables.

The report concludes with a summary of movements in variable inclusions in the UK and US, and gives recommendations for future considerations in the next access charge regime.

1. INTRODUCTION

1.1 This section sets out how this report fits into the wider "AT3 Review" and the objectives of the review. It highlights the current theorem and thinking in relation to variables within the usage charge regime, and discusses the two theorems presented in the objectives of this report. The discussion theoretically confirms how marginal cost estimation of both variable and fixed components in railway infrastructure wear and tear are an important component in the calculation of unit rates and subsequent calculations of costs and the access tariffs to recuperate those costs.

1.2 The paper goes on to discuss why the costs in AT1 are fixed (or not variable) in the short term by referring to the documents which formed a basis for this thinking. Any revisions, or proposed future movements to the base thinking behind these documents, are explored. Costs in AT1 include a variety of traffic and infrastructure variables which are described here yet exclude the dynamic aspects of the cost structure – i.e. ignore the possibility of the cost live in time to be affected by costs or other aspects in other time periods

1.3 Current research and references of current work being undertaken are used to substantiate the arguments presented and to introduce new concepts such as the application of lag and leads of dependent and independent variables into infrastructure costs.

1.4 The report concludes with a brief discussion on potential independent variables and unobserved effects and current industry thinking in the choice of these variables.

Objectives of this report

1.5 The theorems presented and substantiated in the following discussion are:

- System is maintained to a fit for purpose standard in the short term and reduction in traffic would not affect the maintenance program;
- Where volumes increase, the ability to get on track reduces and maintenance deficit may occur (and this may flow through to a second year).

Definitions of short and long run marginal costs

1.6 Despite a thorough review of literature and many theoretical discussions and equations representing the criteria for the estimation and inclusion of short and long run marginal costs, to our knowledge there is no given accepted "time" period that defines a "short" or a "long" run that may be readily applied to railway maintenance costs.

1.7 Fundamental Theorem (Newbery 1998) defines the short run marginal cost as the cost that equals the average cost.

1.8 A textbook distinction is made between short-run and long-run marginal cost. The former takes as unchanged, for example, the capital equipment and overhead of the producer, any change in its production involving only changes in the inputs of labour, materials and energy. The latter allows all inputs, including capital items (plant, equipment, buildings) to vary.

1.9 A long-run cost function describes the cost of production as a function of output assuming that all inputs are obtained at current prices, that current technology is employed, and everything is being built new from scratch. In view of the durability of many capital items this textbook concept is less useful than one which allows for some scrapping of existing capital items or the acquisition of new capital items to be used with the existing stock of capital items acquired in the past. Long-run marginal cost then means the additional cost or the cost saving per unit of additional or reduced production, including the expenditure on additional capital goods or any saving from disposing of existing capital goods. Note that marginal cost upwards and marginal cost downwards may differ, in contrast with marginal cost according to the less useful textbook concept.

1.10 In a railway definition short – run marginal cost pricing may be regarded as prices set to reflect the additional costs to a society/community/supply chain associated with an additional kilometre traveled or an additional trip made, given that the capacity of the transport network is held constant[1].

[1] Nash, C (2003) "Marginal cost and other pricing principles for user charging in transport: a comment"

2. RAILWAY MAINTENANCE IN A DYNAMIC CONTEXT

Description of the system

Our approach to this problem is based on several basic observations, these are:

2.1 The deterioration of a railway system is considered a dynamic process, i.e. dynamic because it changes with time. Key processes are considered to be

- Unplanned random events (such as adverse climatic conditions, accidents, etc.);
- "planned" or anticipated events which include usage, where usage is defined as the passage of traffic; and
- "exposure conditions" (i.e. the aging effects of general environment).

All of these factors will (individually and combined) affect the deterioration process of the system, and hence each will have a direct effect on the "level" of maintenance activity required to maintain the capacity and existing condition of the system.

2.2 On a mature rail system most of the infrastructure-related activity is conducted with the objective of maintaining the capacity of the existing system, i.e. maintaining it as current "fit for purpose".

2.3 The standard maintained or the rules which define the infrastructure-related activities are determined in order to ensure traffic safety and control and "good" performance of the infrastructure.

2.4 The proceeding discussion has assumed the approach that maintenance generally responds to the same drivers and damage processes which eventually lead to drive asset renewals.

Key processes – causal relationships

2.5 Every component and individual track has a "life" or a baseline which defines the time span between two renewals, or survival. Survival data is the time until a component fails to perform its intended function. The general theory and concepts of survival analysis are well defined and can be found in the work of various authors (Kiefer 1988, Lancaster 1992, Klien and Moeshberger 2002).. The survival function S states the probability P of an individual track segment (or component) surviving beyond time x.

$$S(x) = P(X \geq x) \qquad \text{eq. 2.1}$$

2.6 The fundamental theory developed for road maintenance (but applicable to any transport mode (Link and Nilsson 2005)), is that this time span is decided by aggregate traffic, where the amount of traffic that a road could handle is decided upon in the design phase, that is, short run marginal cost of road damage equals average cost (Newbery 1988). Lindberg (2002) has extended this theory and from Lindberg's model we can define the life time of a track segment as:

$$X = \left[\frac{\otimes (q)}{q} \right] e^{-mX} \qquad \text{eq 2.2}$$

Where X is the renewal interval; and

$\otimes$ is total tonnage that the track can accommodate between two renewals;

q is annual tonnage; and

m is non-traffic related deterioration

2.7 In this approach the total tonnage is a function of actual annual traffic as opposed to a constant which is predicted in advance, and non-traffic deterioration will also shorten the survival rate through the form e^{-mX}.

The model assumes the track has an initial quality Q, which is reduced through traffic volumes and non-traffic adverse factors over time (Figure 1). This theory is accepted and adopted in the calculation of future renewal intervals, indicating a negative association between q and X, that is more traffic will shorten the renewal interval and renewal will take place at X* (that is, an exponential of the original answer X rather than at X. Comparing the two alternatives gives the marginal cost associated with the increase in traffic.

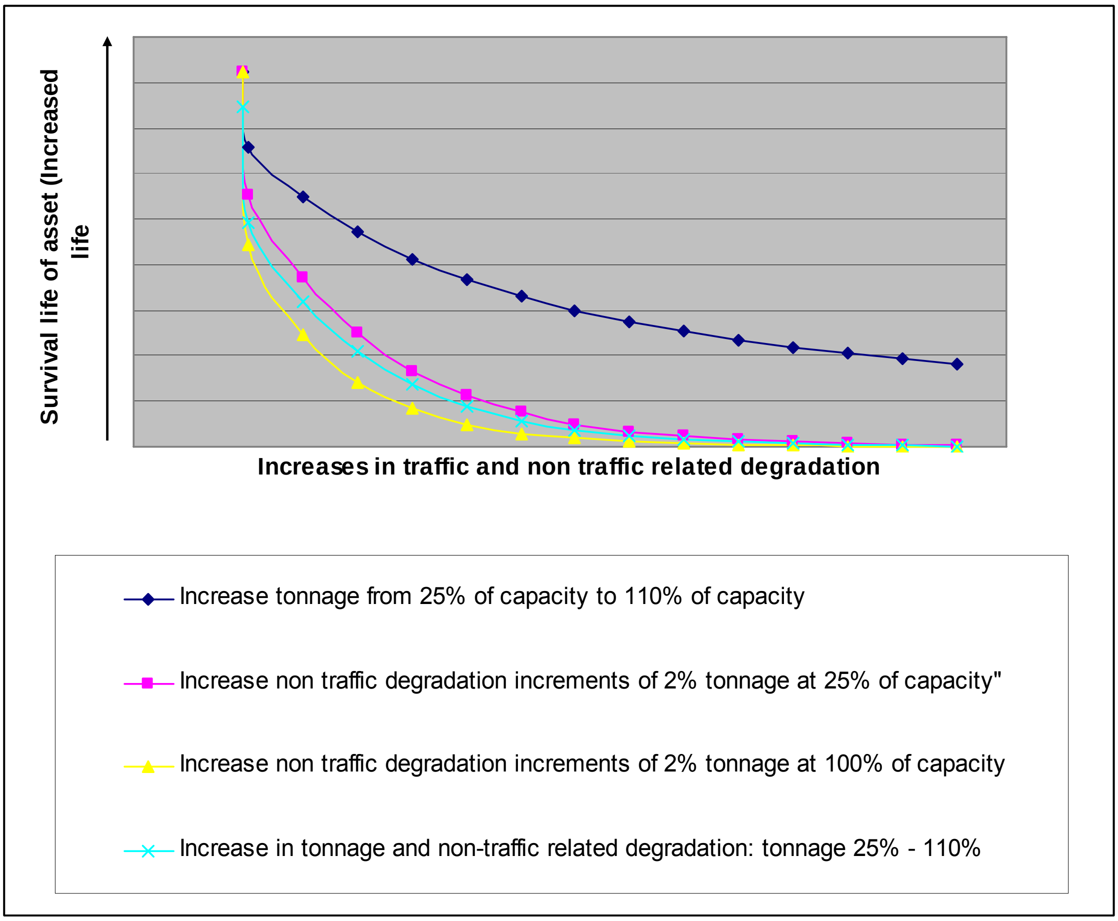

Figure 1 Survival data under traffic and non related traffic degradation

Figure 1 demonstrates the concept underlying equation 2.2. As is seen, the impact of increased tonnage substantially affects the total survival data for the asset. Hence we see that to maintain the life to the required capacity, the level of maintenance-of-way activity needed will increase, and subsequently have a direct effect on the cost of operations. The yellow line indicates the duplicitous effect of the two combined, demonstrating a faster incline or increased deterioration rate.

Conceptual issues relating to the calculation of M

2.8 There is no doubt that track maintenance is not totally dependent on usage; maintenance of railway formation and drainage is almost entirely dependent on topography, soil types, rainfall and other weather factors such as wind and temperature. Relaying, re-railing and rail profiling are almost totally tonnage dependent but re-sleepering is mostly time dependent at low-medium densities (e.g. 5Mgta), especially where timber sleepers are installed, but sleeper life is increasingly affected by traffic as tonnage increases. Resurfacing and ballast undercutting are responses to a mix of tonnage and time-dependent effects. As a rule, as traffic increases, the ratio of variable to total costs increases as the costs which are tonnage-related form an increasingly large proportion of the total[2].

2.9 Key processes to equations 2.1 and 2.2 are given as traffic and non-traffic related deterioration (for example foundation/climatic conditions). The accepted theorem indicates that both of these processes move the output (i.e. the deterioration of the system) closer to the point where it must be rehabilitated, that is towards closure of a component of the system, and therefore, unless the shortening of original survival data is acceptable to the operator, this bears a direct effect on the level of maintenance required.

2.10 Thus we can see that maintenance behavior on a mature section of railway track becomes a process driven by trains, gross tones and environmental conditions. Assuming that gross tkm and train km are main drivers for wear and tear costs, each additional vehicle-mile and/or gross tonne imposes a "variable" maintenance cost because it moves "forward in time the point at which the infrastructure must be rehabilitated[3]"

2.11 Therefore if we take the survival of a component or individual track section to be equal to t., the implementation of each or combination of additional variable factors will move the point for rehabilitation forward and t will become t-n, where n is a function of the previous factors and is dependent on several varieties of conditions. As n increases and total survival time decreases, maintenance costs and requirements to maintain the asset "fit for purpose" will increase, the decision to renew the asset being assumed to be taken where discounted life cycle cost of operating and maintaining the asset in the future exceeds the discounted sum of the renewal cost.

2.12 However, where traffic decreases in the short term, and there is a reduction of $\otimes$, q and m, then X* will not become X without some rehabilitation work being conducted. Simplistically, a short term reduction in traffic and usage will not result in the point in time for rehabilitation becoming (t-n+n), as the point of deterioration and the length of the renewal interval is a historic point in time. This shows that it is not good practice to reduce maintenance in response to–short term traffic reductions even though an increase in traffic in the short term will have a direct effect on the asset survival data. Thus we are able to see that a reduction of traffic in the short term cannot reduce the maintenance requirement.

2.13 In the approach where survival rate is shortened through the form e^{-mX}, we see that the calculation of mx is an exponential function and hence we see potential time and usage degradation becomes a more predominant influence as an exponential of increasing traffic density and tonnage.

[2] "Review of Variable Usage and Electrification Asset Usage Charges: Final Report" Booz/Allan/Hamilton for Office of Rail Regulation, June 2005
[3] Ivadi, Marc and McCullough, Gerard " Railroad pricing and revenue-to-cost margins in the post-staggers era"

Maintenance lags; repercussions

2.14 From the above discussion, it is evident that if we consider the effects of maintenance lag, the impact in theory to survival time will become (t-n-n), i.e. (t-2n). This means there could be fluctuations in costs between years even if traffic volumes are constant. That is, if too little is spent on one year, theoretically it will come out as a need to spend more the coming year. Hence costs in year t, depend on costs in year t-1, hence the exploration of a lag structure of the dependent variable is warranted.

2.15 In theory this would suggest that the costs in year t will also be impacted by any time delays between traffic volumes and maintenance activities. Current research in Sweden by Banverket, has found support for a stationary cyclic pattern for maintenance with a negative first-order autoregressive coefficient of -0.56, that is, maintenance in t-1 has a cost reducing effect on maintenance in t. This supports the hypothesis that costs are oscillating around a mean over time to keep the track in a "steady state" and hypothetically reduction in maintenance in t-1 will have regressive cost increasing effect on maintenance in t. Anderson (2007) puts forward that the coefficient for lagged dependent variable simply works as a scale factor between the short-run and long-run effects:

$$\hat{\gamma}_{LR}^{M} = \frac{1}{\left(1-\hat{\beta}_3\right)} \cdot \left[\hat{\beta}_2 + 2.\hat{\beta}_3.\left(\ln TGT_{it-1}\right)^2\right] \quad \text{Eq 2.3}$$

Where $\hat{\beta}_1$ is the estimated coefficient for the lagged dependent variable, $\hat{\beta}_2$ and $\hat{\beta}_3$ estimated output coefficients, and TGT is total gross tones.

2.16 Thus research to date has shown that a relationship exists between the effects of maintenance in t-1 as a cost reducing or cost increasing effect on maintenance in t. However lack of empirical robust short run data makes applying any firm conclusions a problem, a longer time-series of robust data is required to make these current studies more reliable and of use in a cost regime. However, the recommendation is to consider that such relationships are present and should be considered within the ratio of marginal and average costs[4] in the long run in the estimation of cost recovery.

2.17 Finally in view of confirmation of the relationship between t-1 and t, we can postulate that in any areas where there are (or will occur) any reductions in opportunities for track possession, or cancellations of planned maintenance activities due to reductions in maintenance, then the total costs of maintenance in the following years will be higher.

[4] Button, K (2005) "The economics of cost recovery" Journal of Transport Economics and Policy, Vol 39 no.3 pp. 241-257

2.18 This analysis has shown the potential effect of infrastructure costs in t due to effects in t-1. Subsequent analysis would be to examine if quality, measured as train delays and speed restrictions, also can be proven to have a relationship and affect quality in t, when costs are reduced for a limited period in t-1.

Costing methodologies: Current research

2.19 Recent research has used econometric cost functions to check the robustness of accepted marginal costs estimates through the introduction of lags and leads of both dependent and independent variables. This research has indicated that both lagged traffic and costs affect the cost structure, but to date these results are uncertain due to limitations in data. This is an area of ongoing research, with particular work being undertaken in Sweden, Norway, Austria and UK[5].

2.20 To our knowledge there are no published cost methodology studies involving micro-level data for railway maintenance costing from individual US railway organisations. Few empirical studies have been undertaken in Europe but the only published studies at a micro-level to date are Swedish studies[6]. The current model in Sweden uses a pooled data set with infrastructure maintenance costs as dependent variable.

[5] Anderson, M (2007) "Fixed effects estimation of Marginal Railway Infrastructure Costs in Sweden"
[6] Nash, C (2005) Rail Infrastructure Charges in Europe, Journal of Transport Economics and Policy, 39(3), 259-278

3. POTENTIAL VARIABLE DRIVERS

Baseline

3.1 In order to calculate the "variable", a robust base line has to be determined from which base costs can be established and subsequently increments can be determine to calculate "marginal costs". As demand for capacity increases, theoretically a time will be reached where the efficiency and costs of maintaining current operations exceeds the cost of "enhancement" to allow for the capacity increases (in asset terms a "whole of life" versus "renewal" approach). At this point the "base" plus "marginal" will become the "base" after completion of the enhancement and marginal variables will need to be re-calculated taking into account the effect of the "enhancement".

Unobserved effects

3.2 In addition to observed infrastructure variables, there may be other factors which also have a strong impact on the cost of operation and maintenance. Managerial skills and approaches for example, may differ greatly between districts and sectors, methods and processes, allocated freedoms for decisions on budget spending at different levels between different sectors. Although it is difficult to incorporate such effects, it should be recognised that these may have a strong impact on unit costs between sectors.

Independent infrastructure variables

3.3 Infrastructure maintenance operation and costs on the Queensland Rail Coal systems is dominated by undercutting, the need for which is exacerbated by excessive coal spillage. Due to the extent of the problem, activities in this cost group have a relatively short time horizon as opposed to the expected time horizon for these activities in other railways. Undercutting activities are in some cases needed at 7 years as opposed to once every 30-40 years elsewhere, in order to prevent the track from premature degradation and to maintain "safe operations" and a "stable state".

3.4 Network Rail's preliminary view of 30% variability with ballast renewal has been found to be "too low" and a "figure of the order of 50%" has been found to be more appropriate[7]. This projection is based on NR's current view that conventionally-maintained ballast requires replacement after the passage of traffic of the order of 800MGT. Considering the dominant effect of coal spillage on the system and that the return on undercutting is of the order of 20%, it would be reasonable to assume that variability of this component on the system would be in the order of 80-90%.

3.5 The weight of a train is unlikely to greatly influence the need for ballast undercutting due to coal spillage only, however the number of trains (or the amount of spillage "averaged" per train) will. In

[7] Booz/Allen/Hamilton 2005 "Review of Variable Usage and Electrification Asset Usage Charges: Final Report"

this case maintenance activity will be more driven by number of trains (or rather amount of "potential spill" and/or number of trains that are overloaded or traveling with "damaged" bottom discharge doors, or coal clogged bogies and undergear) rather than train loads – other activities however are likely to be driven by gross tones carried. A possible suggestion may be a separation of the two groups, i.e. an aggregation of costs on infrastructure operation and maintenance, at least from an output perspective.

3.6 Track "standard" is highly regulated – Queensland Rail has best practice and nationally accepted standards for construction, renewals, inspections and maintenance. In theory "base line" costs and practices will be determined and guided by these set requirements in safety and safe working practices as well as the defined engineering and process standards.

Independent output variables

3.7 Output from the track is currently measured in traffic volume, gross tones kilometres per year.

4. SUMMARY AND CONCLUSIONS

Findings

4.1 Main findings from current research confirm a strong positive duration dependence with more than proportional increase in shortenings of "life" or "survival data" on the asset with respect to accumulated traffic. The elasticity or rail age with respect to traffic is higher for freight trains than for other traffic[8].

4.2 When volumes increase survival data decreases unless appropriate maintenance is undertaken – the lack of this maintenance will affect both the performance of the asset in t, but also in t, (t+1), (t+2)…… so that survival data becomes, t, (t-n), (t-2n)……. Logically, when train volume increases, so will service volumes so that potential costs from delays will increase exponentially as the more paths affected, the greater the propensity for trains to knock-on and exacerbate the effect. The ability to recover from an incident is potentially decreased, the probability of delays increased and subsequent knock-over into possession availability and maintenance windows increased. This will further exacerbate the ability to get on track and the possibilities that maintenance deficit may occur.

Research and Movements

4.3 The only published studies of railway infrastructure costing using micro-level data to date are Swedish studies. Cost functions are based on econometric techniques which use regression analysis in order to assess the possible significance of unobserved effects and variables[9]. Regression analysis is also used in the calculation of variable increments and impact in costs in Canada and US[10].

4.4 These studies confirm that dynamic aspects of rail infrastructure costs are critical to explore in the future in order to explore optimum lag structures of both dependent and independent variables.

4.5 Studies in the UK and initial emerging conclusions from the ACR2008 indicate there is prima facie evidence that costs and variable charges have diverged from what was specified in ACR2000 and following ACR2003, when the increases of revenue were seen to be funded through increases in fixed charges only with no increase in variable changes[11].

4.6 The timing of implementation of any revised charges is a central element of the SOCC review – where consideration will be made whether to implement changes at the start of the Control Period

[8] Anderson, M (2007) "Marginal Railway Renewal Costs: A Survival Data Approach"
[9] Baltagi, B.H. (2005) "Econometric Analysis of Panel Data" 3rd Edition, John Wiley & Sons, Chichester, UK
[10] Canadian Transportation Agency "Overview of the Agency's Regulatory Cost Model"
[11] McMahon, Paul (2005) "Structure of costs and charges review: Emerging Conclusions"

4 (CP4) in April 2009 following the Periodic Review 2008 (PR2008) currently under way with its final conclusions in October 2008[12].

4.7 Updated variable usage costs will be included in the revisions introduced in 2008 with the possibility of reductions in the variable figure or "discounts" given for those who implement mitigation measures and can "demonstrate that they have minimized, and are continuing to minimize, spillage from their wagons"[13]. Or alternatively as from discussions one can assume that the past and current actions of system users, through train overloading and hasty unloading t the ports has impacted on system maintenance requirements, it may be more appropriate to impose a surcharge, or at minimum defer any discount until the maintenance burden has been eliminated.

Emerging Principals and methodologies

4.8 Principal of short-run/long run marginal cost pricing translates into the need to measure three components of cost for the addition of extra traffic:

- Cost imposed by the additional use comprises additional maintenance and renewals costs;
- Cost imposed should reflect that the "reference" train does not spill coal, which, with studies undergone so far, would be considered as a fallacy. Reference train data should reflect the amount of coal loaded and speed through the unloaders, so that a charge may be levied when these values are breached;
- Marginal cost imposed on other infrastructure users, in terms of delays, congestion, accidents and opportunity costs (scarcity costs);
- External cost imposed outside the transport system (i.e. environmental or accidents)

4.9 Current research has yielded results from introduction of lags and leads of dependent and independent variables in the cost function

$$\gamma_{LR}^{M} = \frac{1}{(1-\beta_1} \left[\beta_2 + 2.\beta_3.(\ln TGT_{it-1})^2\right]$$

Where β_1 = the estimated lagged dependent variable

12 http://www.networkrail.co.uk/browseDirectory.aspx?dir=%5CRegulatory%20Documents%5CAccess%20Charges%20Reviews%5CPR2008&pageid=2893&root=

13 Network Rail Rail (2008) "Network Rail April 2008 Strategic Business Plan update, Structure of Charges"

Where β_2 = estimated output coefficients

Where β_3 = estimated output coefficients

In the example process increases the overall short-run marginal cost per gtk 30% – decreases long-run estimate decreases 15%

4.10 Current research is being conducted into whether quality (measured as train delays and speed restrictions) can be maintained for operators when costs are reduced for a limited time period – at time of writing there are no published results

4.11 Considering the variation between the recent individual studies, the results are convergent in terms of cost elasticities with respect to output. When controlling for the cost base used in each study[14] there seems to be evidence for the maintenance cost elasticity with respect to output of gross tonnes to be in the range of 0.2-0.3, i.e. a 10 percent change in output gives rise to a 2-3 percent change in maintenance costs. This indicates significant economies of density from increasing output on a fixed track. These findings are in fact in line with what Borts[15] finds in the literature written some 70-100 years ago, although they refer to scale economies in vertically integrated railway organisations in the US[16].

Issues

4.12 Main issues in the implementation of principals and contemporary research theorem is the lack of robust historical data, which is a problem for railways worldwide. In addition in the case of Queensland Rail, there is a particular need for engineering studies of the contamination problem specific to Central Queensland.

4.13 Another issue is the lack of current confidence in costing disciplines in new degradation models despite their acceptance in the engineering field.

[14] Wheat, P (2007) “Generalisation of Marginal Infrastructure Wear and Tear Costs for Railways, Mimeo, Institute for Transport Studies, University of Leeds, Leeds, UK

[15] Borts, GH (1954) “Increasing Returns in the Railroad Industry. Journal of Political Economy, 62(4), 316-333

[16] Anderson, M (2007) “Empirical Essays on Railway Infrastructure Costs in Sweden”

5. RECOMMENDATIONS

5.1 Costs for wagon spillage are a recognized impact on the asset in relationship to reduced life of track components[17]. The current coal spillage charge of 20%[18], adapted from and set up by the ORR (Office of Rail Regulation) in it's review of freight charges in 2001, will be altered to reflect the findings from the recent August consultation paper on coal spillage[19] and reflected in future structure of charges developed in the UK. The Consultant recommends that a similar study be conducted to calculate the extent of the spillage and costs on the North Queensland coal network and results used to determine the appropriate mark-up. In comparison to the issues at ESI it would not be unreasonable to assume that the current charge of 20% is low.

5.2 Further work on understanding variable cost causation is required and should be undertaken perhaps on a line by line basis to ensure that track access charges are sufficiently cost-reflective and provide the appropriate incentives to implement mitigation measures were costs are perhaps avoidable.

5.3 Consideration of the breakdown of costs by system or route to allow for unobserved variables.

5.4 A comprehensive detailed bottom-up estimation to establish base costs and a base cost scenario model which will reflect engineering standards, knowledge and key-cost drivers. From that determine the increment to be used in calculation of "marginal costs. Potentially this may need the collection of several more years of raw data to ensure a robust empirical result.

[17] "Network Rail April 2008 Strategic Business Plan Update: Supporting document: Structure of Changes" (2008)
[18] As defined in the equation $M = C_t D_t S_t A^{0.49} S^{0.64} USM^{0.19}$, where D is type-specific constant for costs due to spillage (1.2 for coal hoppers, 1 for all others), Bullock, D (2007), "Variability of infrastructure costs – recent developments in UK

[19] Coal Dust Spillage Costs, Halcrow Group Ltd, March 2008

6. QUALIFICATION

6.1 In preparing this report WorleyParsons has exercised the degree of skill and care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering design principles.

6.2 WorleyParsons has used all reasonable endeavours to inform itself of the parameters and requirements of the project and has taken all reasonable steps to ensure that the report estimate is as accurate and comprehensive as possible given the information upon which it is based.

6.3 It is not intended that this report represent a final assessment of the feasibility of the project.

6.4 WorleyParsons reserves the right to review and amend all calculations, cost estimates and/or opinions included or referred to in the report if:

(a) Additional sources of information not presently available (for whatever reason) are provided or become known to WorleyParsons; or

(b) WorleyParsons considers it prudent to revise the report in light of any information which becomes known to it after the date of submission.

6.5 WorleyParsons does not give any warranty nor accept any liability in relation to the completeness or accuracy of the report.

6.6 If any warranty would be implied whether by law, custom or otherwise, that warranty is to the full extent permitted by law excluded.

6.7 All limitations of liability shall apply for the benefit of the employees, agents and representatives of WorleyParsons to the same extent that they apply for the benefit of WorleyParsons.

6.8 This report is for the use of the party to whom it is addressed and for no other persons. No responsibility is accepted to any third party for the whole or part of the contents of this report and cost estimate.

6.9 If any claim or demand is made by any person against WorleyParsons on the basis of detriment sustained or alleged to have been sustained as a result of reliance upon the report and cost estimate or information therein, WorleyParsons will rely upon this provision as a defence to any such claim or demand.