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QR NETWORK

UT3 Parallel Comparison Exercise

Supporting Document

Life Asset Register - National Comparison

301001-00190

18-Aug-08

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QR NETWORK
LIFE ASSET REGISTER BENCHMARK
LIFE ASSET REGISTER - NATIONAL COMPARISON

SYNOPSIS

As supporting documentation to UT3 parallel active comparison exercise Queensland Rail Network commissioned WorleyParsons to carry out a desktop 'overview' national benchmarking study on QR and QCA values applied to estimations of 'average' asset life residual values.

Disclaimer

CONTENTS

EXECUTIVE SUMMARY

This report provides some current engineering and commercial views on values applied to rail assets in regards to estimation of "average" residual life of the asset. The report provides a broad "overview" and comparative review of current figures used by access authorities nationally and assumed by engineers proficient in track maintenance and rail operations. The report makes a general comparison and applies a broad "rationality" test between these figures, those proposed by Queensland Rail and QCA adjustment of these figures

The report was compiled based on the expertise of WorleyParsons' professional engineers and comparable data used previously in the formation of residual asset life registers. The results indicate a fairly general affinity between these figures and QR given figures, with differences being difficult to argue under the terms of such a broad assessment. However, in reading these results caveat lector, as the comparative review has been done only on the "final" residual life figures and the author considers that a realistic comparison must also involve a review of the methods by which these averages have been formulated, as well as a comparative review of the many variables involved.

The calculation of residual life of an asset is a complex function dependent on a variety of factors the foremost of which are;

- The level of maintenance applied to the asset;
- Geographical and climatic conditions under which the asset is functioning;
- The level and extent of usage of the asset;
- The stress under which the asset is put under at usage.

Hence it is normal to expect that a range of residual life figures should be applied to any asset which is subject to different variables under the above conditions. Once the figures for this range are compiled the actual life would be expected to fall within the higher range of the bell curve. Further details and recommendations on the affect of these variables have been included in the summary of this report.

1. INTRODUCTION

1.1 As part of the independent review for the UT3 Access undertaking 2008, Queensland Rail commissioned WorleyParsons to undertake a national comparative assessment on industry accepted asset lives in relationship to QR asset life figures and QCA adjusted values. WorleyParsons were requested to submit a brief report compiled from professional engineering and commercial experience of Australian industry accepted norms, including justification and/or empirical evidence for any significant inconsistencies from those accepted by QR or QCA.

1.2 To provide "holistic" comparisons which include both commercial and engineering national industry views, WorleyParsons conducted the review in two parallel phases.

Phase 1 included discussions with engineers and railway professionals in regards to accepted asset lives and known assumptions used to predict overall life, based on their experience within each state of Australia. The engineering assessment was compiled through a process of examination of QR conditions and then the application of robust engineering rail asset maintenance and budgeting experience to determine what would be considered "fair" and "reasonable" based on nationally accepted assumptions. Results are then compared with the predicted QR and QCA adjusted lives and comments given. Through this process a consensus was reached which reflects the opinion of experienced professionals in the field using assumptions drawn from national experience.

Phase 2, which was conducted in parallel, serves as a comparative commercial assessment to complement the figures given in Phase 1. These figures were compiled from discussions with commercial professionals who had previously been involved in similar exercises for other state authorities. The figures given in this exercise were based on known accepted figures and knowledge of the QR system conditions to apply the appropriate life expectancies. In view of confidentiality it is not possible to give further details on the exact references where these figures were obtained.

Phases 1 & 2 are undertaken for the following major asset items:

- Track;
- Structures and Ancillaries; and
- Signals and Communications

Each section of components was reviewed separately and where inconsistencies were found, the reasons for these have been stated where possible.

A table summary of all results is included in Appendix A.

Structure of the report

1.3 The report is structured in the following manner:

- Chapter 2 covers Track assets (rail, sleepers, ballast etc) and discusses the given average life in the manner as described above. Where there is considered insufficient data to comment, this is highlighted;
- Chapter 3 covers Structures and Ancillaries as above;
- Chapter 4 covers Signals and Communications as above; and
- Chapter 5 details conclusions and details additional data required to ensure a more robust assessment of the asset life register.

2. TRACK (INCLUDING TURNOUTS)

Overview

Asset Class Description	Adjusted Life (QCA endorsed)	QR's Fixed Register	Engineers Assessment	Auth. 1	Auth. 2
Railway Track - Heavy[1] : Goonyella / Blackwater	35	30	20-30		6-60
Railway Track - Medium[2] : Goonyella / Blackwater	35	45	25-35		7-62
Railway Track - Light[3] : Goonyella / Blackwater	35	45			
Track Turnouts - Heavy: Goonyella / Blackwater	35	20	15-20	20	4-30
Track Turnouts - Medium & Light: Goonyella / Blackwater	35	25	15-20	20	5-32
Railway Track - Heavy: Moura	40	30	20-30		6-60
Railway Track - Medium: Moura	40	45	25-35		7-62
Railway Track - Light: Moura	40	45			
Track Turnouts - Heavy: Moura	40	20	15-20	20	4-30
Track Turnouts - Medium & Light: Moura	40	25	15-20	20	5-32
Railway Track - Heavy: Newlands	44	30	20-30		6-60
Railway Track - Medium: Newlands	44	45	25-35		7-62
Railway Track - Light: Newlands	44	45			
Track Turnouts - Heavy: Newlands	44	20	15-20	20	4-30
Track Turnouts - Medium & Light: Newlands	44	25	15-20	20	5-32
Timber Sleepers			5-15		

[1] Assumed to be 26tal and over
[2] Assumed to be 20tal – 26tal
[3] Assumed to be under 20tal

2.1 In general it was felt that all of the track on the Blackwater/Goonyella systems should be considered "heavy", as even the "back roads" are required to take 20 tal diesels. Hence, it is considered only figures for "heavy" and perhaps "medium" for the 47/53 kg sections are to be considered relevant.

For "track", it is considered that each separate component, i.e. sleepers, rail and ballast are to be considered. The following paragraphs detail the assumptions and considerations made to reach the overall track component.

Engineering assessment

Sleepers

2.2 Prestressed concrete sleepers were mainly considered for this exercise, as the coal system uses mainly this type of sleepers.

2.3 In summary, both the QR and NSW designs are fairly conservative for the axleloads on those systems, and a high emphasis has been put on longetivity with respect to design of components, i.e. high percentages of fly ash in concrete, adequate steel cover to reinforcement and prestressing wires, etc.

2.4 In comparison, AN/ARTC and others tend to put less inherent reserve strength in their design and hence these can be easily damaged by derailments and other such factors. Subsequently, they have a lower design life of around 50 years at 10 Mgta (Million gross tonnes per annum). Design life (under/within design loadings) of QR and NSW designs are normally anticipated at 100 years plus at 10 Mgta.

2.5 As it is assumed that many of the sleepers in the QR system are now at least 20 years old and the tonnage exceeds the design limits. The professional opinion is that the assumed 20 year remaining life for some sleepers would not be unreasonable. Hence we do not believe that the QR assessment of 30 years for the "heavy" track is illogical, nor is it significantly different from the 35 years assessed by the QCA. It is believed that the method of assessment is not likely to be that accurate to warrant dispute over the differentiation without doing some more detailed analysis of the asset.

Rail

2.6 QR and NSW both have extensive lengths of 47 and 53 kg rail - particularly on the QR network lower tonnage areas - branch lines off-mainline to the individual mines. Most of the newer rail is 60 kg, with 50 kg on the Rolleston Branch.

The older rail of 47 kg and 53 kg is generally known to be poorer quality steel, and, while the same general profile, has less wearable steel than on the heads of 50 and 60 kg rail. Hence, we would expect the 47 and 53 kg rail to have less life to condemnation, and to have higher numbers of defects.

2.7 Manufacturers provide published rail lives. However, reaching these published figures has more to do with good rail management, i.e. grinding etc, and gross tonnages than with years. Through experience it would be expected that rail life in the heavy high tonnage areas would be in the order of 20 years life. This would apply to all Australian heavy haul railways and it would be expected only to be reduced through poor maintenance practices.

2.8 As QR has a reputation for efficient rail life management, we would expect their rail life to be on the high side of any norm and hence 20 – 30 years is considered reasonable.

Ballast

2.9 The life of the ballast is dependent on a variety of factors, i.e. formation conditions, ballast material, gross traffic, axle load and traffic type. However, from professional experience, the general expectation is that ballast life should be around 30-40 years. Hence we consider that the life given by QR is reasonable, in consideration of the tonnages and type of traffic that they are running.

Summary: Track

2.10 Hence, in consideration of the above, professional opinion considers that the lives given by QR for heavy track are reasonable. However, if we accept these lives it seems logical that we give a greater asset life to the "medium" track in view that it should be carrying less tonnages and traffic. Hence we consider that a life of 30-40 years would not be unreasonable for this type of track this is consistent with the QCA adjusted life figure of 35 -40years.

We reiterate that at this level of analysis, a difference of 5-10years is difficult to dispute and qualify without further detailed assessment of the asset.

Turnouts

2.11 Turnouts of 50 kg rail do not exist on QR. Therefore QR would not have any medium weight turnouts and would be using 60 kg turnouts throughout "heavy" and "medium" track sections. Industry acceptance for turnout life under the conditions in the coal systems would be expected to be in the order of 15-20 years, or a figure less than the equivalent rail.

The swing-nose turnouts used by QR should have a longer life than fixed crossing turnouts, thus the 20 years given by QR is not unreasonable. Similarly a difference of 5-10 years is difficult to dispute and qualify without further data; therefore we would assume that a figure in-between the 20yrs given by QR and the 35yrs given by QCA (i.e. 25-30yrs) would be considered appropriate.

In general, turnout life is hard to define. Typically, individual turnout components are replaced when they wear out and it is difficult to say what the life of a turnout as a single entity is.

Commercial Assessment

2.12 The results under "Auth 1", "Auth 2" have been obtained through professional experience in developing guidelines for other regulatory authorities in regulating fixed asset lives for interstate railway operations.

2.13 It is to be noted that most of the assessments looked at have not provided a "single entity" figure but have provided a matrix of figures which is dependent on a variety of factors, hence care has to be taken when making assumptions in regards to the comparison. The guidelines for calculation of asset lives take in aspects for each individual component, and figures for "total" components such as for "track" were not supplied. In comparison both the QR and the QCA register gave only one overall figure which we assume is meant to cover all 'variables' within one 'average'.

Variables included in asset life matrix calculations include factors such as:

- Total tonnage (range 0 Mgta to >20 Mgta);
- Curvature of the track in metres radius (<400 or >800 & tangent);
- Type of sleeper;
- Ballast; and
- Jewellery (fasteners, clips, pads etc).

An attempt has been made to compile the breakdown of these components to give averages of:

- 30 years rail life for track <10 Mgta and curvature 400-800 m radius;
- An average of 25 years for high tonnages;
- An average of 30 years for medium tonnages;
- An average of 30 years over the whole matrix.

However, these assumptions must be treated with care as they are fairly broad because they take an average over several different curvature conditions. To provide a more meaningful result a comparison of the historic empirical data from which the fixed figures were obtained with the ranges given would need to be undertaken.

In addition, much of the data is defined for individual components, rather than a single entity, i.e. the following asset lives are given:

- Sleepers – 50 years;

- Ballast – 25 years;
- Jewellery – 25 years;

As opposed to a single item "track", hence it is in the authors' consideration that a robust detailed comparison was not able to be made. It is recommended that if further comparison is to be made that a similar breakdown and matrix build up of variable factors in the calculation of asset life be undertaken.

3. STRUCTURES AND ANCILLIARIES

Asset Class Description	Adjusted Life (QCA endorsed)	QR's Fixed Register	Engineers Assessment	Auth. 1	Auth. 2
Bridges: Concrete Rail Bridges - heavy	50	100	50		100
Concrete Culverts & Pipes – Heavy	50	100	20-30		50
Concrete Culverts & Pipes – Medium	50	100	40-50		50
Steel Pipe Culverts - Heavy	50	50	20-30		
Steel Pipe Culverts - Medium	50	50	40-50		
Earthworks: Cuttings	50	100	100		100
Earthworks: Embankments	50	100	100		100
Administration Buildings	38	40	10-20		
Building Facilities	38	20	10		
Computer Systems	38	3	3		
Training Equipment	38	10			
Fences	38	20	20		15
Floodlighting	38	20	20		20
Unsealed Roads	38	99			
Control Systems (Signal – Non vital)	38	15	10-20		20
Train/Track/Environment Monitoring Systems	38	25	10-20		

Engineering assessment

Bridges

3.1 It is assumed that most bridges on the system are prestressed concrete and have been designed to a minimum of 50 year life. QR designs tend to be fairly conservative and as a rule a high emphasis has been put on longevity in regards to components. Within design axle loadings (i.e. usage of the asset to design function limits) and with an effective maintenance regime the professional "on-the-ground" opinion is that a 100 year life is expected. However, excessive traffic or loading beyond design limits and curtailments of required maintenance, reducing the structure to stress or fatigue conditions, could significantly affect this figure. Reductions can only be truly assessed through a rigorous structural assessment, modelling the design of the structure and the maximum loadings.

3.2 Strengthening bridges upgrades the capacity to allow for original design life to be maintained with the increased loading. The original Blackwater PSC bridges (50% of the original bridges before duplication) are known to have been strengthened to allow loading increases from 20 tal to 26 tal. It is anticipated that for these bridges and others that have been similarly strengthened, a 50 year design life would be reasonable. This endorses the QCA Endorsed adjusted life figure.

Culverts

3.3 As with bridges within design limits, concrete culvert design life can be expected to be around 100 years. However, as culverts are not strengthened when track axle loadings are increased, structures built before the upgrades could be under extreme stress or fatigue conditions and in some cases it would be reasonable to expect that the 100 year life will not be reached, although the amount of curtailment would need to be assessed on a structural individual design basis.

Culverts on the Blackwater to Gladstone system and the Collinsville to Kaili section may be rated for 16 tal, 20 tal or 26 tal - depending on when inserted. The very early ones are 16 tal - the 1970s upgrade of the Blackwater system was to 20 tal - and the more recent work was to 26 tal - and the culverts will only be replaced when they fail.

Professional opinion suggests that in these circumstances a high percentage - say approximately thirty percent - of these culverts can be expected to fail within the next 10 - 20 years, whereas culverts constructed at 20 tal may have a residual life of 30 – 50 years. In the circumstances, on heavy track a conservative figure of between 20-30 years is considered reasonable, and both the 50 year QCA endorsed figure and the 100 year figure given on the QR asset register are considered optimistic.

3.4 The residual life of steel pipe culverts is significantly influenced by other factors such as corrosion and abrasion, but the implementation of concrete inverts may prevent premature rusting and deterioration. In addition, steel pipe culverts can be severely affected by piping or leakage deteriorating the structure behind the steel interface. The loading factors as mentioned above also apply. As a general rule 50 years life is applied to a new structure. However, as with bridges, if extreme loading and adverse conditions are being applied, then the structure needs to be assessed individually and applying a broad assessment is considered a risk, considering the relatively high risk of failure of these structures if conditions deteriorate.

Earthworks

3.5 The life of cuttings and embankments is heavily dependent on due maintenance being carried out and environmental and geographical factors inherent in the area (i.e. type of rock/soil/slope gradients etc). If correct maintenance is carried out and effective drainage and optimum environmental conditions are present, these should have indefinite life.

However, anecdotal evidence indicates that many rail embankments were built when standard requirements regulatory today were not in place. It is considered that the 100 years quoted by QR confirms an economic limit estimate of indefinite life, and on a broad basis this could apply. It is recommended however that a limit not be applied to this asset, and the earthworks be considered on a site by site basis in consideration of the main factors which affect earthwork stability.

Other

Administration Buildings and Building Facilities

3.6 Substantial buildings would need a minor refit every 10 years and major refit every 20 years - even if basic frame was kept. Transportables and semi transportables, minor offices and lunch rooms etc , would be expected to have a design life within 10-15 years.

This is significantly less than the figures both by QCA and QR.

Computer Systems

3.7 The renewal of computer systems is dictated by changes in requirements, advances in technology and discontinuation of software patches or similar support from the supplier. Hence the calculation of 'asset life' in this regard is not considered appropriate.

However, the figure was confirmed from professionals within the information technology industry who agreed with the QR figure of 3 years for this component. It is uncertain where the figure used by QCA of 38 years was obtained, it is assumed that this is a typographical error in the spreadsheet.

Training equipment

3.8 No information obtainable.

Fencing

3.9 In a heavily used railway, a stock proof fence is essential. If such fencing is used, the proposed life of 20 years is considered reasonable unless the asset is subject to extreme adverse conditions such as flood or fire.

Floodlighting

3.10 In average conditions and usage, 20 years is considered reasonable based on the technology and any change of purpose etc. This confirms QR asset register.

Unsealed roads

3.11 The life of unsealed roads is significantly dependent on a variety of factors – i.e. flooding and climate conditions, traffic, formation, maintenance etc. In optimum circumstances, a rural outback unsealed road may have an indefinite life. However in areas where there is heavy rain or other adverse conditions road life may be under 10 years. The extent and quality of maintenance is a significant factor in determining the life of the road asset.

Under average conditions and usage, unsealed roads will require major reforming every 10 years. Roads prone to formation/drainage issues may require reforming prior to this and may require more frequent gravel resheating. However this might be regarded as cyclic maintenance and the figure given in the register may refer to an estimate of design life, exclusive of reformation.

Control Systems – non-vital

3.12 These are likely to be technologically redundant in 10 - 20 years.

Track/Environmental monitoring systems

3.13 These are likely to be technologically redundant in 10 - 20 years.

Commercial Assessment

3.14 Unfortunately figures for all the components were not obtainable. However an overview of the figures obtained indicates that there is correlation between the figures accepted and QR fixed Asset Register.

4. SIGNALS AND TELECOMMUNICATIONS

Asset Class Description	Adjusted Life (QCA endorsed)	QR's Fixed Register	Engineers Assessment	Auth. 1	Auth. 2
Control Systems (Signals)	30	10			20
Level Crossing Protection	30	25			20
Train Protection Systems	30	15			
Signal Interlockings - Relay	30	30			
Signal Interlockings - Mechanical	30	40			
Signal Interlockings - Processor	30	15			
Field Equipment & Cables	30	25			
AWS Magnet					
Signal Signage					10
Electric Points					
Telecommunications: Data Network Equipment	30	15	10-20		20
Telecommunications: Linking Network Equipment	30	15	10-20		20
Telephone Exchange Equipment	30	20	10-20		20
Electrical System Equipment: Traction Supply Transformers	35	20	20		20
Electrical System Equipment: Traction Power System Equipment	35	20	20		20
Power Distribution: Traction Power Distribution	35	50	20-30		

Engineering assessment

Telecommunication systems

4.1 Experience has indicated that life of telecommunication systems is usually driven by technology and/or operational redundancy4 of the systems rather than perceivable "life expectancy" of the individual components. Experience to date has indicated that various telecommunication systems are likely to be technologically redundant in 10 - 20 years.

Electrical Systems

4.2 Experience has indicated that similar to the above, the life of electrical systems is also usually driven by technology and/or operational redundancy of the systems rather than perceivable "life expectancy" of the individual components. Although it is expected that these systems should have a longer technical life than telecommunication systems, experience to date has indicated that it is unlikely to be much beyond 20 years.

Power Systems

4.3 Experience has indicated that similar to the above, the life of power systems is also usually driven by technology and/or operational redundancy of the systems rather than perceivable "life expectancy" of the individual components. Although it is expected that these systems should have a longer technical life than either of the above systems, experience to date has indicated that it is unlikely to be up to 50 years and a technological redundancy of around 20 – 30 years is considered more reasonable.

Commercial Assessment

4.4 Unfortunately figures for all the components were not obtainable. However an overview of the figures obtained indicates that there is correlation between the figures accepted and QR fixed Asset Register.

[4] Where technologically redundant implies that the system is no longer supported by the manufacturer /software/hardware supplier and operational redundancy implies a change in operational limits (i.e. increases in axle load, changes in train types, etc) which no longer are able to be supported by the system.

5. SUMMARY

5.1 In summary, other than for specific components such as turnouts, the QR given life appears "generally reasonable" and greater uniformity was found between these figures and figures obtained from the independent professional review. Disparities between QR and QCA adjusted figures were generally minor, and in consideration of the range of asset life calculations where variables are used to assess residual life, it is difficult to argue the differential without a more in depth analysis of the asset geographical conditions and design criteria, current/historical/future usage and maintenance lag/history.

5.2 It appears that the QCA figures neither attempt to reflect the traffic differences on the different systems, nor do they effectively differentiate between heavy, medium and light services, nor between components such as plain track and turnouts, nor between design differences such as over 800 m radius curvature and straight track.

5.3 The biggest differences between figures from QCA and QR for Railway Track occur in the heavy category. Our quick assessment has concluded that most of QR's lives could be realistic depending on the confirmation of definition of heavy.

5.4 The figures given were considered quite broad, not only did they not factor for the different variables which have significant effect on asset life, but they also often 'bunched' the various components. For example 'track', where a calculation for a life for track has been assessed when the ballast is renewed at a different interval to the rail and sleepers. To be able to make a comparative assessment the author has 'averaged' the components to obtain the 'best' average figure for the whole life of the asset, however, this is not considered ideal and it is highly recommended that these figures be broken down into components and that a matrix be developed which allows consideration of all the significant variable factors which influence asset life.

5.5 In summary, it is not considered that the figures proposed by Queensland Rail, or the adjusted figures given by the QCA accurately reflect the variations that need to be considered. Little modification is given even under the usage (tonnage) variable. It is recommended that if these figures are to truly reflect the potential asset life, which is an essential factor to ascertain when planning maintenance programs and/or budgets, a more comprehensive analysis is undertaken where these variables are taken into account. This type of analysis would provide a more robust and valuable assessment of asset life.

5.6 It is considered that some assets are better expressed in Million Gross Tonnes (MGT) rather than years. This would be considered the case for rail, sleepers (concrete or steel, not timber), switches and crossings, ballast. There are additional factors to be considered such as axle load and speed, but it is recommended that further assessment include MGT rather than years.

5.7 Some assets 'life definition' requires further clarification. For example does ballast undercutting after 8 years mean that the ballast life is only 8 years, at what percentage return does ballast undercutting become renewals (and life is determined) or maintenance (life is rehabilitated),or is ballast life only determined when the whole of the ballast is discarded and replaced with new?

5.8 As a similar definition problem as above, the replacement of Signal and Communication equipment is rarely replaced as a whole, mostly the replacement involves components only (i.e. switch rail, stock rails, crossings, etc) At what point of component replacement is life expiry officially termed?

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 endeavors 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.