ORR Best Practice Study

Visit to Austria Railways
9-12 July 2007

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Executive Summary

The visit to Austria was arranged around four full days of meetings, interviews and site visits with OBB, Swietelsky and Plasser & Theurer, between July 9th and 12th, 2007.

OBB believe they have made substantial cost savings in the last 10 years due to a focus on a life cycle cost (LCC) approach to track asset management. A significant dependency was noted on university research to develop the necessary understanding that supports the life cycle cost analysis.

Their LCC approach is based on renewing track to a very high quality, then maintaining it at optimum interventions, calculated by the use of advanced condition monitoring.

During the visit the ORR team gathered many policy and specification choices that OBB have used to deliver these cost reductions. These will be used to assess Network Rail's SBP submission in October 2007, in particular the asset policies and their justification.

The OBB life cycle cost approach has only so far been implemented within track engineering, although there are intentions to roll this out to other disciplines.

1. Purpose

To gather examples of best practice in terms of railway engineering in Austria. Austria was selected because ORR had learned that it had adopted a life cycle approach to managing its track assets. However, meetings on other key assets included signalling, bridges and tunnels.

The OBB policies and practices will be used to inform ORR's assessment of the October 2007 submission from Network Rail.

2. Introduction

The main body of this report comprises notes on each meeting in the order they occurred between 9th and 12th July 2007 inclusive.

The results of our interviews are described and the appendices include especially prepared responses to the advance questions. There was a difficulty in understanding what specific costs provided to us included or excluded due to the broader definition of infrastructure in Austria and the split of the two infrastructure organisations. Therefore where cost information is included in the report it should only be used in general terms or as indicative cost information.

Some supplementary information requests (particularly cost data) from OBB have been made, but nothing further has been received yet.

The ORR team comprised Ian Maxwell (Signalling Adviser), Andrew Wallace (Track Adviser) and Richard Spoors (consultant from Richard Spoors Associates).

3. Background

The Austrian railway network is approximately one third the size of the UK network, although some routes carry very high freight tonnages. The railway system is universally bi-directional, with a high number of turnouts allowing much greater operational flexibility than in the UK. All tracks are able to run traffic in both directions at full linespeed. This allows maintenance and renewal activities to be carried out very efficiently usually during longer possessions than in the UK.

Due to declining asset condition and train performance, in 1996 Austrian railways commenced a programme of work that aimed to increase cost transparency and move to a life cycle cost approach in order to improve efficiency and train performance. OBB believe they have now largely achieved this for track assets.

Austrian Railways implemented a major restructuring in January 2005. For the role of Railway Infrastructure Manager they created two organisations. These new structures were designed around the flow of expenditure, thus separating maintenance and renewal. A full and detailed understanding of these two

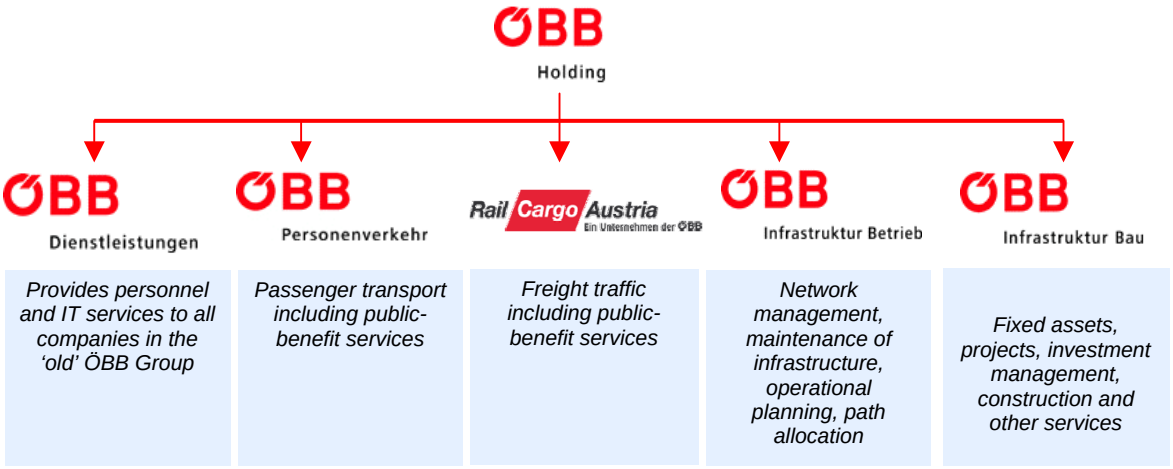
organisations proved difficult, and many people interviewed were not satisfied with the ‘new’ organisation. We were left with the impression that further refinements around asset management organisation and processes were likely in the near future.

Environmental issues were clearly very prominent in Austria. Wind turbines were noted all around Vienna and OBB generates a significant proportion of its electrical requirement from hydro-electricity. There is also considerable demand for noise barriers beside railways and motorways. For OBB this is becoming an increasing financial burden, driven mainly be Austrian legislation.

Key facts and figures of the Austrian Railway compared to UK

Measure	Austria	UK	Units	Ratio	Notes on UK data
track	11,600	30,000	km	1:2.6	
switches	17,000	20,383	no.	1:1.2	
bridges (incl f/b and culverts)	16,511	81,200	spans	1:4.9	
tunnels	150	335	km	1:2.1	
trains daily	7,500	17,400	daily	1:2.3	approx passenger only
kilometres daily	400,000	1,352,051	daily	1:3.4	incl passenger & freight
passengers daily	537,000	3,100,000	daily	1:5.8	passenger journeys daily
tons of cargo daily	255,000	297,000	daily	1:1.2	total freight lifted

OBB operate the railways in Austria. A holding company is supported by 5 businesses as shown below. In total these represent the complete railway operations within Austria for both infrastructure and train operating requirements. Our interest has particularly focused on the infrastructure businesses, Infrastruktur Betrieb and Infrastuktur Bau.



The split between these two businesses has been hard to understanding but we believe that the split reflects two separate forms of funding for the infrastructure within Austria. Betrieb is funded directly by the Government and is responsible for maintaining the existing railway while Bau is funded through loans from banks and is responsible for renewals and enhancements to the network.

Historically OBB has been an engineering led organisation, but the current fiscal-led arrangement (since 2005), and the separation of maintenance and renewals, has caused difficulties within the engineering functions that we spoke to, partly because it has required engineering specialists in both businesses and partly because the decisions on whether to maintain or renew assets is increasingly being determined on the basis of funding availability and not best practice.

The OBB representatives we met regarded the Austrian rail regulator to be primarily concerned with competition regulation.

All parts of OBB submit outline 6 year funding requirements, with the first year comprising a detailed plan. The annual plan is funded, but the six yearly plan is not.

The network is categorized as follows:

Category	**Description**	**Plain Line track (km)**	**S&C (no.)**
A	Mainlines and key diversions	7,420	7,511
B	Secondary	1,391	4,605
C	Rural	1,367	4,599
		10,178	16,715

The category A main lines and key diversionary routes account for approximately 90% of maintenance and renewal costs.

The majority of our discussions therefore relate to the category A routes.

There are significant capacity pinch-points in Austria, but the key ones are currently being dealt with by the construction of 100km+ new routes (2no.) and upgrading one route from double track to four-track.

4. Meetings and Site Visits

4.1 Meeting with OBB on Track Strategy and Policy

Monday 9th July 2007, 10am – 12:30.

Meeting at the offices of OBB Infrastructure Bau AG, Praterstern, Vienna with Dr Schilder, Permanent Way Engineer, Dr Veit University of Graz and Dr Auer, Infrastructure Services.

N.B. Notes below include information from a supplementary meeting on Tuesday 10th July 2007, with Dr. Auer on the same subject matter

The object of the meeting was to establish some key facts concerning the management of permanent way by adopting a life cycle cost approach, and to understand how OBB has benefited from research and development undertaken with Technical Universities in Austria.

- In 1996 the Head of track maintenance and renewals for OBB set an objective to have a better understanding of the physical drivers for maintenance, their costs and to make the rail engineering costs more transparent (a ‘glass’ railway).
- The main driver for this project was:
    - To reduce the large number of temporary speed restrictions in force on the OBB network at this time (1996).
    - To manage their assets economically
- OBB asked the Technical University of Graz to help with the work and Dr Veit, professor of railway economics became involved. Working with engineers from OBB he modelled the track system into 5 classes for gross tonnage, 4 classes for radii, 3 classes for rail weight and 4 classes for the track sub-soil or formation.
- The above classes defined 60 different combinations so that the whole of the OBB network could be modelled by using these 60 ‘standard kilometres’. A combined maintenance and renewal strategy for the duration of the service life was then devised for each standard km. This specified the renewal components, and every maintenance intervention until the end of its service life. Variations in maintenance and renewal were tried until the optimum life cycle cost was reached. This led to 60 standard kilometre tracks, each with their own M&R strategy based on optimum life cycle costs.

- The assumed service lives for plain line track vary from 15 – 39 years depending on tonnage, radii, rail section and formation stiffness.
- The assumed service lives for S&C vary from 19 – 44 years depending on tonnage, radii, rail section and formation stiffness.
- Intervention frequencies for tamping vary from once every year to once every 8 years, again this depends on the tonnage, radii, rail section and formation stiffness. Further details are in the file, “Austrian Basis Track Strategy”, document reference #279321.
- Having started to work with the University of Graz it was decided to bring Professor Veit into OBB as a consultant to understand how the railway was managed, and to help deliver the LCC strategy.
- The track strategy is based on renewing the track system to a high initial quality, therefore minimising maintenance interventions and maximising asset life, until the renewal cycle commences again.
- Reusable materials are cascaded to lower category routes. Components are returned to a central depot, refurbished and stored until re-used.
- By 2002, the speed restrictions had been greatly reduced with 0 on the main lines (although we were told that financial pressure today means TSRs are raising again with 135 as the latest year-end forecast)
- One reason for the efficiency gains between 1996 and 2005 was the move from largely fixed interval maintenance to condition based intervention. This required a major investment to better understand the condition of the track assets via investment in new technology for the OBB track recording coach.
- OBB now consider that they have moved on from “front-line opinion”, towards more measurable criteria for renewal decisions.
- OBB’s inspection regime does no longer include frequent manual track inspections (NR undertake weekly manual inspections on most primary routes). OBB track inspection today is almost exclusively by high speed recording car measurement on average every 6 months
- S&C detail inspections are carried out six monthly to manually capture geometry and gauge information with a digital gauge with readings taken at pre-determined measurement points, marked up on the rail.
- The history of gathered S&C inspection data is summarised on the central database, together with all other track data. It is accessible to all front-line engineers and senior management.
- Every eight weeks the Section Manager is required to observe the track under his control by train or foot. Manual inspection should be undertaken once per annum to locations on the section where weaknesses are known to exist. Section Managers are required to identify and correct

exceedences to defined limits to track geometry from inspection data supplied to them.

- Track renewals is mostly undertaken within single line blockades with Bi Di signalling and trains passing at 80 kph. Track in tunnels has historically been relayed in slab track. No single line working is permitted in twin track tunnels.
- There is no means of measuring out of round wheels on international traffic at the moment. This is seen as a risk. OBB complimented UK Wheelchex system, although they are currently rolling out their own more advanced and comprehensive vehicle monitoring system (see ARGOS system later).
- OBB lubricates rails with on-train wheel lubricators, on every locomotive. These were installed before the break-up of the national railways (in the UK all are track-side based – NR/TOCs have contractual problems with fitting lubricators on trains due to warranty, liability, maintenance issues etc). OBB only have track-side lubricators at special sites such as 180 metre radius curves on the Semmering line with 20 million gross tons per annum.
- The performance of the 52 areas within OBB are benchmarked against each other using the 60 std km, each having a standard life cycle cost with assumed maintenance operations throughout the asset life. Hence actual maintenance input can be compared to the assumed norm for the type of track modelled to identify best/worse performers and inform management actions (ref. Stix)
- On all primary routes OBB totally renew track rather than piecemeal component replacement. This policy is supported by the LCC modelling which, due to the exponential deterioration of track (linked to cost increases during the track life), the highest possible quality of renewal is necessary. This should achieve maximum component life and reduce costly more frequent maintenance interventions.
- Piecemeal component replacement has been assessed by University of Graz. Three lines were investigated by analysis of costs and found to be more expensive. University of Graz also assessed the costs associated with low levels of renewals (in Hungary and Yugoslavia) and identified greater whole life costs.
- OBB track policy can be summarised by:
    - Renew to highest quality, then maintain with the objective to maximising asset life, before finally renewing and cascading material.
    - Most financial benefit is to ensure longest ballast life, by treating formation and fixing drainage

- Under sleeper pads are specified on all primary routes. They increase sleeper/ ballast contact area from typically 11% to 30%. For less than 1% of renewal cost, OBB claim the improvements are as follows:
    - Increased service life of ballast (reduced attrition and less tamping)
    - Less grinding (possibly zero on good formation sites)
    - Less rail pad wear
    - Longer rail and sleeper life

  Track quality records provided some evidence of these benefits, comparing sections that were fitted with under-sleeper pads and those that were not.
- Ensuring delivery of LCC approach
    - University of Graz trained local “trackmasters”
    - Renewal proposals need to be backed up by right level of evidence / performance as measured by track recording cars
    - Renewal proposals should match age of model, but this is not a pre-requisite
    - Maintenance plans based on LCC standard kms
    - Continue training regions until achieved, some lag behind others.
- Grinding – OBB do “very little” on straight track. Compared to Network Rail’s frequency on straight track which is every 45 EMGTPA (was every 30EMGTPA).
- Prof Veit is proposing to install frame sleepers under IBJs to ensure longer life (note: not sure if this presents tamping difficulties)
- OBB recently started to measure rail inclination. This gives them an indication of rail pad wear (essential for LCC management of sleeper), and performance of the fastening/sleeper system. Allows them to plan the optimum times for re-padding depending on tonnage, radii, pad type etc.
- OBB also recently started measuring equivalent conicity, to inform their rail management programme
- OBB (together with research by University of Graz) have concluded that limestone ballast has approximate 30% less service life than granite/metamorphic ballast.

Section Summary

Issue no.	ORR Issues for PR08
1	High track renewal quality is paramount to achieving low life cycle costs. How is NR planning to ensure this is delivered by its contractors in CP4 to the forecast unit costs?

2	The activity with the greatest effect on reducing life cycle cost is providing a good formation and ensuring drainage system is effective. How will NR ensure they deliver the right volume of drainage, at the right locations and specification in CP4?
3	For efficient track asset management and to facilitate the move from reactive maintenance to predict and prevent, asset information knowledge needs to be accurate, sufficiently broad and appropriately available to frontline staff. Is NR's web portal sufficiently developed for this?
4	Does NRs specification for ballast ensure that softer material (such as most limestones), with significantly shorter service lives, are not used?
5	The case for under-sleeper-pads seem very convincing. Are NR assessing the use of these – particularly for modular S&C?
6	Is NR's investment in research and development adequately targeted and funded to deliver economic and world class strategies?
7	Is NR planning to measure rail inclination and equivalent conicity to ensure optimisation of its maintenance and renewal interventions?

4.2 Meeting with Swietelsky, Track Renewals Contractors

Monday 9th July 2007, 13:00 – 19:30

Working lunch followed by visit to Offices, Depot and track renewal site visit near Fischamend, Vienna.

Swietelsky is a privately owned Austrian civil engineering contractor who now has 25% of its business in the track renewal and maintenance business across Europe and beyond. Their turnover last year was 1.4 bn Euro. They have 1,000 employees in the rail sector. In 2003 the company made a joint venture with First Engineering and won a contract from Network Rail to develop and operate the three high output track renewal trains and support machines purchased by Network Rail. They therefore have experience of work in central Europe, Africa and the UK.

- They do not use contract labour. All staff are company employees, who operate and maintain the machines
- With the exception of the UK machines, plant is wholly owned by Swietelsky. They purchase the necessary high output machines in order to win contracts
- They undertake their own maintenance in large workshops to which their plant is returned each winter when central European work stops due to cold temperatures.

- Machines are operated and maintained by dedicated crews. Each January and February the crews are based at the workshops where machines are given necessary overhauls in preparation for the next 10 months of work. This is also the opportunity for staff training either in house or with the manufacturer, Plasser and Theurer.
- There is strong competition in Europe, with possibly excess capacity. Therefore contractors in this sector have to develop productive strategies to win work. This was demonstrated by Swietelsky's development of a single track renewal train that renews ballast, rail and sleepers. This innovative but huge and long machine was developed in conjunction with Plasser and Theurer. Once it had passed proving trials in Austria, by cooperation with OBB, Swietelsky won a major contract in Southern Germany to renew 51 KM of rails sleepers and ballast in 6 weeks.
- OBB normally let contracts for track renewal and maintenance work which include a 3 year job-bank of 'committed' work. This appears to give the contractor the security to invest in innovation and new plant to increase efficiency.
- OBB's track tamping contract is framework based but requires a machine output of a minimum 1,800 metres per hour with post execution quality measurement requirements (this requirement is significantly higher than Network Rail's contracts). This obliges contractors to invest in modern productive machines. Also the OBB specification requires every tamping shift to be undertaken with a ballast regulator and dynamic track stabiliser.
- Safety is uppermost in Austria as it is in the UK. However, the emphasis is on trust through a directly employed and highly experienced staff. There appeared to be much less formal safety documentation than in the UK. Recording of safety statistics and reporting of injuries appeared much less onerous than in the UK.
- Since the restructuring of railways in Europe, Swietelsky have commenced the purchase of locomotives to haul their trains and the training of their own drivers with associated train operator safety cases. They have a fleet of more than 10 diesel locos to haul their trains in possessions and two state of the art mainline 'Taurus' electric locos for transit between sites. They saw the need for self propelled on track machines to have a 120 kph capacity in the near future (72 mph).
- Swietelsky found some working practices in the UK difficult to understand and felt that the UK rail safety regime was a barrier to entry for most mainland rail contractors. Without partnering with First Engineering they would not be in the UK.
- They have found it very difficult to speak directly to Network Rail decision makers

- They also observed that possession time in the UK seemed generally poorly utilised and work specifications were of a poorer quality than in most other European countries.
- Swietelsky stated that they have discussed with NR an opportunity to bring a UK mothballed RM85 and Harsco TRT back into use, undertaking any engineering modifications necessary, providing Network Rail first enable them to trial the machines to observe their performance and establish what upgrades were required. No response to date has been received from NR.
- In Europe it is much more common to renew the foundation of the track when total track renewal is being undertaken. This is good practice, as frequently it is the breakdown in the formation that leads to deteriation in the geometry and increasing intervention and cost by maintenance. Lack of attention to track drainage is the most common cause of formation instability and where this has lead to breakdown renewal is required. We learned that this was a priority for the Austrain Railways and specialist machines had been developed to replace the material that provides a stable base for the ballast layer. OBB specify a modulus of elasticity for the formation layer of 80 Ev2/m²for existing tracks and 110 Ev2/m²for new construction. When contractors undertake this work the resultant output is tested for compliance and consistency as a key factor to deliver the service life of the new track it supports. Where renewal of the formation is undertaken by a special renewal train the old ballast is screened and the clean ballast reused, while the dirty ballast is crushed to be mixed with new material to produce the formation blanket.
- It was noted at the site visit that the new ballast constitution was a larger stone size than in the UK
- There is a common European perception that the current UK safety and economic/incentive framework are driving an overly risk-averse approach, resulting in low productivity, e.g. fear of possession over-run, long ‘no-work’ periods at beginning and end of possessions
- The observation was made that the quality of work is a lower consideration within UK compared to Europe, with track renewals often being laid on poor quality formations – thus greatly increasing whole life costs
- Modular S&C – Sweiltelsky did not fully understand why the UK was developing a new modular S&C system when VAE already have a proven system.
- OBB currently do stiffness tests on the formation to test its compliance for the specified renewal job. They also measure track geometry delivered by renewals contractors, to ensure the standards are met. Any re-work is done at the contractors expense. Network Rail do not enforce their construction quality standards for track renewals. This is historically due to

the absence of a measuring process that would capture exactly the extent of the renewal site, and also probably a belief by some UK contractors that the specification is too good to be achieved without a significant change in working practices and skills.

- During a site visit to observe a mid-week single line track renewal the renewal train was 13 years old and the crew had been with it since it was new from Plasser and Theurer.
- NR have previously stated that the life of their HO fleet to be 15 years. Sweitelsky are confident that they can keep them going for 40 years.
- The renewal site was 2.5km long, it had previously had a total formation and ballast renewal, and at the time of the visit a track renewal machine was renewing the rail and sleepers. The blockade was 2 weeks long on one line, the other track was open at 80kph
- A road rail excavator was working ballast in the sixfoot, while adjacent line was open. The safety system involved flashing lights and an alarm to warn of approaching trains (not believed to be in place in UK).
- Such a long duration possession and the method of working allowed is not normal in UK and hence NR would unlikely to be able to match the outturn unit costs. This method of working is also quite common in other parts of the world.

Section Summary

Issue	ORR Issues for PR08
8	Reducing take-up and hand-back time in possessions is planned by NR. How will the effect on unit cost be modelled for the CP4 submission?
9	Is NR procurement strategy effective in identifying best practice and introducing new technology quickly? Why is NR policy to purchase machines when most European administrations leave ownership to the contractors?
10	Is NR approach and mitigation against possession over-run risk adverse? Is it justified in terms of lost production every shift – is there guidance to differentiate mitigation measures for work on different parts of the network?
11	NR's assumed design life of HO kit seems very low (c.15 years) compared to contractor estimates – why is this so and what are the unit cost implications of this?
12	Why is the Harsco TRT and Plasser MOBC, not yet redeployed?
13	Reducing axle counter re-set times and using sweep trains is causing lost productivity. Will these be reduced for CP4 to increase productivity?
14	NR uses a mixed fleet of mostly old and some new tampers and regulators. The old ones have lower leases than the new machines but

	suffer from lower productivity, lower reliability and lower quality output. How can NR show that this approach is the most economic in the long term?
15	Do NR specify criteria to decide whether old track formations need to be renewed or not? When renewing formations, do NR specify moduli of elasticity of completed work?
16	Did NR assess VAE's modular S&C system, and if so, why was it discounted?

4.3 Meeting with OBB, Renewals and Investment Finance

Tuesday 10th July 2007, 9:00 – 9:45. Followed by meeting with Dr. Auer from 9:45 – 11:30, (extension of previous day's meeting therefore notes are above)

Meeting at offices of OBB Infrastructure Bau AG, Wilhelmstrasse 64/2/6, with Mag. Gilbert Trattner, Board Chairman, OBB Infrastruktur Bau AG

Mr Trattner was the senior member of OBB through whom arrangements had been made for the ORR visit. He made a presentation (included in the appendices) of the background to the 2005 restructuring and the work of his organisation.

Most of this information is used in the introduction and background section of this report. The full presentation provides further background and is included in the appendices.

4.4 Meeting with OBB, Track Strategy and Policy

Tuesday 10th July 2007, 9:45 – 11:30. Meeting with Dr. Auer - extension of previous day's meeting therefore notes are under Monday 10am meeting.

4.5 Meeting with OBB, Track Recording and Database team

Tuesday 10th July 2007, 12:00 – 17:00. Working lunch followed by meeting at OBB offices with Dr. Presle, Mr Zottl, Mr Stix and Mr. Brimmer.

Track recording and analysis

The main driver for OBB's investment in measuring and analysis systems was their objective to reduce life cycle costs (benefits recorded within 6 years) by managing assets more economically. LCC optimisation depends entirely on being able to intervene at precisely the correct location and correct time. The following are the key features of the OBB measuring and analysis system:

- EM 250 and EM 80 track recording vehicles
- Track geometry parameters and single defects
- Rail wheel calculation of equivalent conicity
- Tunnel profiles referenced to the track

- Access via Intranet applications

The ARGOS comprises

- Intelligent local measurement stations for a continuous measurement of loaded axles
- Objective – to limit damage of OBB track due to poorly maintained/loaded trains
- To stop or warn trains, and charge appropriate access charge reflecting track damage
- Three levels of measurement stations, able to be located on a risk based assessment.
- Level 1 – detects derailed trains ahead of entering tunnels. This was a safety requirement for new tunnels being built.
    - where there is derailment risk in order to detect a derailment and stop a train
    - Installed at the entrance to all new tunnels
    - Straight line train control
- Level 2 – prevention of derailment and alarm to detect vehicles that may damage the track
    - Measures twist
    - Measures wagon loads unbalanced
    - Measures out of square wheels
- Level 3
    - Instability of train
    - Noise and vibration
    - Lateral and longitudinal forces (Q and Y forces)
    - Proposed to be 5 sites in Austria, (system being rolled out)

4.6 Meeting with Plasser and Thuerer, Manufacturer of on-track plant

Tuesday 10th July 2007, 20.00 – 23:00 working dinner

Wednesday 11th July 2007, 07:30 – 19:00, Meetings on train to Linz, followed by presentation and discussion and tour of Plasser and Theurer depot at Linz, Austria. Plasser attendance Ing. M. Schnetz, H. Pilgerstorfer, Ing. R. Wenty, B. Lichtberger and S. Stride.

Train journey Vienna Westbahnhof to Linz

- Locomotive hauled ‘inter city’ train with 200 kph stock

- 95 km journey with one intermediate stop. Scheduled for 100 minutes
- Core route of OBB who have plans to upgrade the route over the next 8 years to increase speed and capacity
- Mountainous section through the Vienna Woods for the first 40 kms west of Vienna with slow speeds on current alignment. Some new construction west of St. Polten with very smooth 160 kph including some new tunnels with slab track.

Meeting with Rainer Wenty, Marketing Director; Bernhard Lichtberger, Technical Director; Markus Schnetz, Technical Sales Director and Herbert Pilgerstorfer, Managing Director, PMPS West Ealing at the offices of Plasser and Thuerer, Linz.

- Video explaining world wide role of P&T since 1953
- Detailed presentation on track maintenance and the development of Plasser and Theurer machines to provide an efficient and productive technical solution to support the Life Cost Cycle of track
- Development of productivity in the track tamping process through machine development
- Review of the business case to show that new machines are a sound investment and can reduce unit costs of track maintenance when compared with old machines such as the 1975 07 series machines
- Development of machines to economically maintain concrete bearer switch and crossing layouts without overstressing components
- Ballast distribution machines – aimed to limit ballast drops, by redistributing ballast from incorrect to correct positions.

After a working lunch an inspection of machines under construction was made before returning by train to Vienna.

Section Summary

Issue	Question for NR
17	Ballast distribution machines appear attractive to UK due to high volume of ballast on UK track, but located in wrong places and thus not providing its correct function. Has NR assessed the business case?
18	ORR observed excellent ballast and cess profiles with very good drainage properties evident along all of the routes travelled within Austria. This indicated a clear focus on drainage management. Does NR's drainage work plan (which informs CP4 forecasts) include cess lowering and cess cleaning to ensure resilient and economic track performance?

19	NR track renewal contracts have not historically appeared to incentivise contractors to improve productivity and innovate. Following conclusion of the 6 to 4 exercise in September 2007, how will contractors be incentivised to innovate?

4.7 Meeting with OBB, Tunnels

Thursday 12th July 2007, 10:00 – 12:00.

Meeting at Offices of OBB Infrastructure Bau AG, Praterstern, Vienna with Dipl.-Ing. Josef Koinig, Head of Tunnelling, Engineering Services and Trainee Bernhard Deixler.

- Mr Koinig described the general arrangements for the maintenance and construction of new tunnels before taking the ORR team through the questions sent in advance from ORR.
- Summary is given below, but see OBB presentation slides for full details.
- 150km (94miles) of tunnel within OBB
- Vast majority are aged between 1840 – 1919
- Mostly masonry construction, few brick.
- Detail inspection every 4 years, with visual inspection every year
- due to new routes and expansion of existing routes there have been 28 new tunnels built since 1990, with 10 more under construction
- Cost of maintenance €7.5m for 150km = €50 / km
- Compare to UK €27m for 320km = €84 / km
- Maintenance rate for old tunnels (1840 – 1919) = €23/m (not consistent with above overall figure)
- Maintenance rate for new tunnels (post 1990) = €40/m. This is higher because problems are usually more serious and harder to find (presumably rarer as well)
- Safety arrangements for old tunnels. Too expensive to retrofit escape routes. Some slab tracking can sometimes provide enough space for safety recess or narrow walkway. A rescue train is available, but effectiveness is doubtful due to time to get there.
- New tunnels – see presentation for details of safety provisions.
- Planning – 1 year detail annual plan, but 7 year forecast (with no guaranteed funding)
- Maintenance funding levels have not varied very much over time. With exception of the last 2 years where funding is low because OBB head considers condition is so good that they can afford a maintenance holiday.

Also new organisation put in place in 2005 does not have a single point of accountability for M&R, and therefore there is conflict.

- Investment in new tunnels however is currently very high
- Inspections – manual + radar. Manual tapping inspections mark up voided areas for future monitoring (do NR do this? They haven't on the tunnel inspections I've been on when I was a trainee
- Database – part on computer, but still lots on paper files

4.8 Meeting with OBB, Signalling

Thursday 12th July 2007, 12:00 – 14:00.

Meeting at Offices of OBB Infrastructure Bau AG, Praterstern, Vienna with Ing. Johann Berger, Head of System and Products (electrical), Ing Erwin Steiner, Planning and Development.

- Mr Berger described the general arrangements for the maintenance and renewal of signalling before taking the ORR team through the questions sent in advance from ORR
- Maintenance activities are specified in company procedures. Existing equipment often requires 1 – 3 monthly inspections but all new designs of equipment will have as a minimum 6 monthly schedules.
- Joint P.Way/S&T maintenance have been tried but their preferred method is to have multiple teams working within a single blocked section of line.
- Track Access requires green zone working where linespeeds are 160kph or greater, or where the signaller is remote.
- There is currently no train delay payment system but they are expecting something similar to be introduced.
- Highest cause of signalling failures is signal lamps followed by track circuits/axle counters then point detection. They have not been able to evolve to LED signals because the very long feed cables (up to 7km) causes problems with current proving.
- Condition monitoring is only now beginning to be applied widely. First applications were fitted to equipment inside tunnels to reduce the need for access. Current roll out is to use the VAE Roadmaster 2000 Light.
- Train detection policy is to use jointed track circuits in busy stations areas axle counters elsewhere. Believe that the risks from errant resetting of an axle counter section is much higher in a busy station where trains can be standing for some time. For tamping all axle counter heads need to be removed and restoration is completed using the first scheduled train running at reduced speed.
- The equivalent of the SEU is based purely in the number of point ends and the unit cost is approx €250,000.

- Contracts are let for detailed design and installation. OBB to final testing
- Austrian signalling interlocking rules (SRS) appear to be much simpler than UK practice and control tables are not considered necessary. This makes interlocking design and testing much simpler, quicker and cheaper. UK complexities are at least partly the result of attempts to increase capacity.
- They believe that stability of the SRS, technology and contracting process has help to control costs and increase knowledge of what is required.
- OBB work on the basis of a 40 year life for relay interlockings and possibly 30 years for computer based systems (but this is not yet fully established). They do not suffer from poor cables particularly although in some interlockings have wires with crumbling insulation. 5 yearly examinations used to update the expected life.
- ERTMS implementation plan is on hold due to funding and technical issues. GSM-R implementation very similar to UK but already reducing no. of lineside phones where possible.

Section Summary

Issue	ORR Issues for PR08
20	Will Network Rail ensure that new equipment has longer maintenance frequencies to help reduce costs
21	Network Rail is developing a modular signalling system with simplified interlocking rules. Need to investigate their anticipated effect on costs.

4.9 Meeting with OBB, Bridges

Thursday 12th July 2007, 14:00 – 15:30.

Meeting at Offices of OBB Infrastructure Bau AG, Praterstern, Vienna with Ing. Josef Teufner, Bridge Maintenance, and Dipl.-Ing Roman Fila, Head of Bridge and Structures, Engineering Services

Mr Fila described the general arrangements for the maintenance and construction of bridges before taking the ORR team through the questions sent in advance from ORR. See OBB powerpoint presentation for full details.

- Average ages: concrete (41yrs), steel (59), masonry -stone and brick (116yrs). Average 55 years.
- Number of bridges 6,947, culverts 4,884
- Total length of bridges 232km
- Annual cost bridges (M&R) €35.5m – Inspection and maintenance €10.5; Renewal €25m
- Annual cost culverts (M&R) €2.5m – I&M €1.3; Renewal €1.2m

- Inspections every 2 years, includes immediate repairs
- Detailed inspections every 4 years
- Inspection regime is the same regardless of route category
- Max axle load is 22.5tonnes, but new bridges designed for 25tonnes x 1.21 to allow for future increases
- Funding is being reduced every year, and there is current pressure to be more efficient
- This has resulted in TSRs increasing, now total of 50 in place, an increase on last year, and is now becoming a performance issue
- Bridge assessment awards a mark for every main element (1-good, 2-maintain, 3-heavy maintain, 4 and 5 – renew)
- Planning – 5 year detail plan for every bridge, and a 10 year forecast for future workload.
- Historical variations are small
- Database – currently all on paper, but future should be moving towards electronic storage
- Policy A, B, C for maintenance regime is similar to NR
- Bridge re-constructions in possessions. Mostly commonly renew in 5 hours, by constructing a temporary bridge adjacent to old one, divert railway during construction.
- Bridge strikes – no problems today, but 20 years ago it was a big problem. They have solved by installing protection beams / concrete edge profiles to vulnerable bridges.
- Elastic mats on masonry arches have been found to help reduce stresses
- LCC cost model produced but by Professor Veit, but not implemented, not clear why but possibly due to organisation/ management issues

4.10 Site Visits

Three site visits were included during the Austrian visit.

Monday 9th July

Observed a Swietelsky high output track renewal train in operation while single line operation over the other track was in place. Trains were passing quite frequently at speeds in excess of 30 mph while track work continued.

- The site visit was to a mid-week single line track renewal the renewal train was 13 years old and the crew had been with it since it was new from Plasser and Theurer.
- NR currently have estimated the life of their HO fleet to be 15 years. Sweitelsky keep them going for 40 years.

- The renewal site was 2.5km long, it had previously had a total formation and ballast renewal, and at the time of the visit a track renewal machine was renewing the rail and sleepers. The blockade was 2 weeks long on one line, the other track was open at 80kph
- A road rail excavator was working ballast in the sixfoot, while adjacent line was open. The safety system involved flashing lights and an alarm to warn of approaching trains (Not believed to be in place in UK).

Such a long duration possession and the method of working allowed is not normal in UK and hence NR would unlikely to be able to match the outturn unit costs. This method of working is also quite common in other parts of the world.

Wednesday 11th July

Visit to the Plasser & Theurer factory in Linz to inspect the manufacture of machines for many customers worldwide.

Thursday 12th July

Brief visit to look at point operating machines at Wien Nord-Praterstern station. Noted that stretcher bars are not used and the whole S&C area is very clear making mechanised maintenance of the track quite practical.

5. Conclusions

N.B. Further cost information is awaited from OBB to check the high level costs per tonne km, in order to indicate relative overall efficiency compared to UK.

Research and Development

- There are clearly very strong links between OBB and technical universities in Austria, both in terms of specific research projects (specification, LCC policy), and in follow-up secondment of key personnel to ensure the resulting policy is effectively implemented. For example by training front line engineers and auditing regional engineering organisations.
- There are also strong collaborative links between OBB, Contractors and suppliers, with contracts that guarantee a certain amount of work to encourage investment in innovation and new plant.

Life Cycle Cost approach to track management

- OBB started to move to a LCC approach in 1996 and within 6 years maintenance costs had decreased by 28% (check), while traffic and price indexes both had increased. They achieved this by:
    - An investment in research and development which identified cost drivers, and maintenance and renewal strategies in terms of a life cycle cost approach

  - a major investment to better understand the condition of the track assets via investment in new technology for the OBB track recording coach. This allowed better condition based intervention.
  - high quality track renewals, with contractors being measured for compliance with standards. This ensured maximum asset life and lower life cycle costs
  - focussed investment in drainage and formation treatment, because OBB have found that this results in greatest reduction in whole life costs
  - investment in absolute track geometry to reduce wear and tear of components and minimise maintenance interventions
  - specifying complete track renewal on primary routes (as opposed to piecemeal replacement) due to the higher quality achieved which delivers longer asset life

- Once established, the LCC approach offers economies such as:
  - Longer asset lives by ensuring high initial quality is achieved by contractors
  - Optimum intervention based on accurate and informed condition knowledge
  - Very few manual inspections e.g. once every 6/12 months (NR once per week on primary routes)
  - Less maintenance such as tamping and grinding
- OBB now consider that they have moved on from “front-line opinion”, towards more measurable criteria for renewal decisions.
- The OBB design and layout of track condition information was excellent, provided very clear messages, and is available to all front-line track engineers and senior management.

Barriers to efficiency gains in the UK

Some significant barriers for NR to achieve comparative methods of working were anticipated as follows:

- Bi-di operation providing longer midweek possessions without significant operational restrictions is not generally available in UK
- Train density is generally not as concentrated in Austria
- Professional skills of work force and technical competence may be greater than UK – NR can achieve similar, but how long will this take?
- UK has narrower track intervals and smaller structure gauges:
  - new machines need a bespoke design to UK gauge and requirements, particularly safety case requirements

    - combined with more conservative safety approach, means that engineering access for track renewals is shorter due to more lines being needed to be blocked to provide safe working area
  - Signalling principles fixed for 15 years….cf UK changes
  - Limited red zone working means that costs are high, e.g. cost for track surveys appear substantially higher than in other European countries.
  - Axle counter re-setting at end of possessions. OBB use first service train at reduced speed. In UK TOCs don't like this, therefore engineering train needs to do the sweep, requiring more "dead time" at the end of possessions

Procurement

- OBB let contracts for track renewal and maintenance work which include a 3 year job-bank of committed work. This gives the contractor the security to invest in innovation and new plant to increase efficiency, and reduce lease rates
- OBB contracts specify quality and productivity. NR's contracts do not seem to hold the contractor to account for quality specifications.
- OBB appear to have a much less prescriptive safety regime

Signalling

On the basis of discussion signalling costs possibly 60% of those in UK (Bayer) Signalling interlocking principles standard across the network and unchanged in 15 years, contributing to simpler design, shorter testing and lower costs (Bayer)

Bridges & Tunnels

Policies and practices for old stock appear the same

OBB inspection is more frequent than NR – every 4 years versus every 6 years, probably due to weather extremities and topography.

6. Acknowledgements

Michael Zuzic, retired head of civil engineering, OBB who made the detailed arrangements for the meetings

All from Plasser, OBB and Sweitelsky who generously donated their time to ORR.

Appendix 1 Associated Documents held in Powerdocs

Pre Meeting Questions

Subject area	Specific person	Powerdocs ref
Track: Life cycle costs	OBB, Veit & Schilder	279374
Track: Contracting renewals	Sweiltelsky, Heinrichsberger	284178
Railway Policy & finance	OBB, Trattner	279375
Track: Large yellow plant	Plasser & Theurer	279373
Tunnelling	OBB	279372
Signalling & Telecoms	OBB	279370
Bridges	OBB	277634

Written Responses and Information gathered

Subject area	Specific person	Powerdocs ref
OBB Trattner presentation	M. Trattner	279326
Swietelsky	H. Heinrichberger	279558
OBB Basis Track Strategy	Dr. Auer	279321
OBB Track Measurement	Presle & Stix	279327
Business Cards	All	279389

Appendix 2 ORR Issues for PR08

This appendix collects together all the issues raised within each of the sections 4.1 to 4.10.

Ref no.	ORR Issues for PR08
1	High track renewal quality is paramount to achieving low life cycle costs. How is NR planning to ensure this is delivered by their contractors in CP4 to the forecast unit costs?
2	The activity with the greatest effect on reducing life cycle cost is providing a good formation and ensuring drainage system is effective. How will NR ensure they deliver the right volume of drainage, at the right locations and specification in CP4?
3	For efficient track asset management and to facilitate the move from reactive maintenance to predict and prevent, asset information knowledge needs to be accurate, sufficiently broad and appropriately available to frontline staff. Is NR's web portal sufficiently developed for this?
4	Does NRs specification for ballast ensure that softer material (such as most limestones), with significantly shorter service lives, are not used?
5	The case for under-sleeper-pads seem very convincing. Are NR assessing the use of these – particularly for modular S&C?
6	Is NR's investment in research and development adequately targeted and funded to deliver economic and world class strategies?
7	Is NR planning to measure rail inclination and equivalent conicity to ensure optimisation of its maintenance and renewal interventions?
8	Reducing take-up and hand-back time in possessions is planned by NR. How will the effect on unit cost be modelled for the CP4 submission?
9	Is NR procurement strategy effective in identifying best practice and introducing new technology quickly? Why is NR policy to purchase machines when most European administrations leave ownership to the contractors?
10	Is NR approach and mitigation against possession over-run risk adverse? Is it justified in terms of lost production every shift – is there guidance to differentiate mitigation measures for work on different parts of the network?
11	NR's assumed design life of HO kit seems very low (c.15 years) compared to contractor estimates – why is this so and what are the unit cost implications of this?

12	Why is the Harsco TRT and Plasser MOBC, not yet redeployed?
13	Reducing axle counter re-set times and using sweep trains is causing lost productivity. Will these be reduced for CP4 to increase productivity?
14	NR uses a mixed fleet of mostly old and some new tampers and regulators. The old ones have lower leases than the new machines but suffer from lower productivity, lower reliability and lower quality output. How can NR show that this approach is the most economic in the long term?
15	Do NR specify criteria to decide whether old track formations need to be renewed or not? When renewing formations, do NR specify moduli of elasticity of completed work?
16	Did NR assess VAE's modular S&C system, and if so, why was it discounted?
17	Ballast distribution machines appear attractive to UK due to high volume of ballast on UK track, but located in wrong places and thus not providing its correct function. Has NR assessed the business case?
18	ORR observed excellent ballast and cess profiles with very good drainage properties evident along all of the routes travelled within Austria. This indicated a clear focus on drainage management. Does NR's drainage work plan (which informs CP4 forecasts) include cess lowering and cess cleaning to ensure resilient and economic track performance?
19	NR track renewal contracts have not historically appeared to incentivise contractors to improve productivity and innovate. Following conclusion of the 6 to 4 exercise in September 2007, how will contractors be incentivised to innovate?
20	Will Network Rail ensure that new equipment has longer maintenance frequencies to help reduce costs
21	Network Rail is developing a modular signalling system with simplified interlocking rules. Need to investigate their anticipated effect on costs.