ORR Best Practice Study

Visit to Switzerland - 9 September to 14 September 2007

Contents

Executive Summary

The visit to Switzerland was arranged around four full days of meetings and interviews, half a days cab ride and a visit to a night time work site. The visit was arranged and hosted by SBB and took place between September 9th and 14th 2007.

The expectation before the visit was that we would see an organisation focused on engineering work taking place in very short night time possessions. In reality the Swiss are very capable of doing this but are now looking very closely at the cost of working in short possessions and are looking for opportunities to take longer possessions where the efficiencies are much better.

The enhancement strategy for the rail network is focused on improvements to the clock face timetable structure and the government target of increased percentage of passenger and freight usage compared to roads.

The SBB network has a very high density of points and these have a very high reliability. Monitoring equipment is considered to be very successful in anticipating failure and allowing attention by technicians before delays occur.

SBB have an asset database system (DfA) which currently supports track maintenance & renewal work. SBB took 6 years to develop it and 6 years to populate it but are confident that it is a powerful tool. It is kept up to date because those who use the system take the lead in making any updates.

Every OLE stanchion has a survey reference point and all these have been recorded over a period of 10 years. Using these reference points absolute track geometry can be applied all over the network, the Swiss system is called Toporail.

The length of time needed to develop and introduce these last two issues indicate that SBB have been able to maintain a stable strategy for many years allowing focussed progress towards clear objectives. It was however noted that financial pressures are now beginning to cause SBB to consider more closely how it can proceed on a reduced budget.

1. Purpose

To gather examples of best practice in terms of railway engineering in Switzerland. Switzerland was selected because ORR had learned that it has a good KPI system in operation, clear government expectations for the rail network, and a good asset management database. The Swiss system is highly utilised, and they have a good punctuality record.

Meetings on key asset areas were held so that ORR could get a feel for the condition of the Swiss network and gain an understanding of how the Swiss railway asset base is managed.

The SBB policies and practices will be used to inform ORR's assessment of the October 2007 Strategic Business Plan submission from Network Rail and of the asset policy documents. The review of the latter commences in early October.

2. Introduction

The main body of this report comprises notes on each meeting in the order they occurred between 9th and 14th September 2007 inclusive.

The results of our interviews are described and the appendices include especially prepared responses to the advance questions. Most interviews had prepared presentations

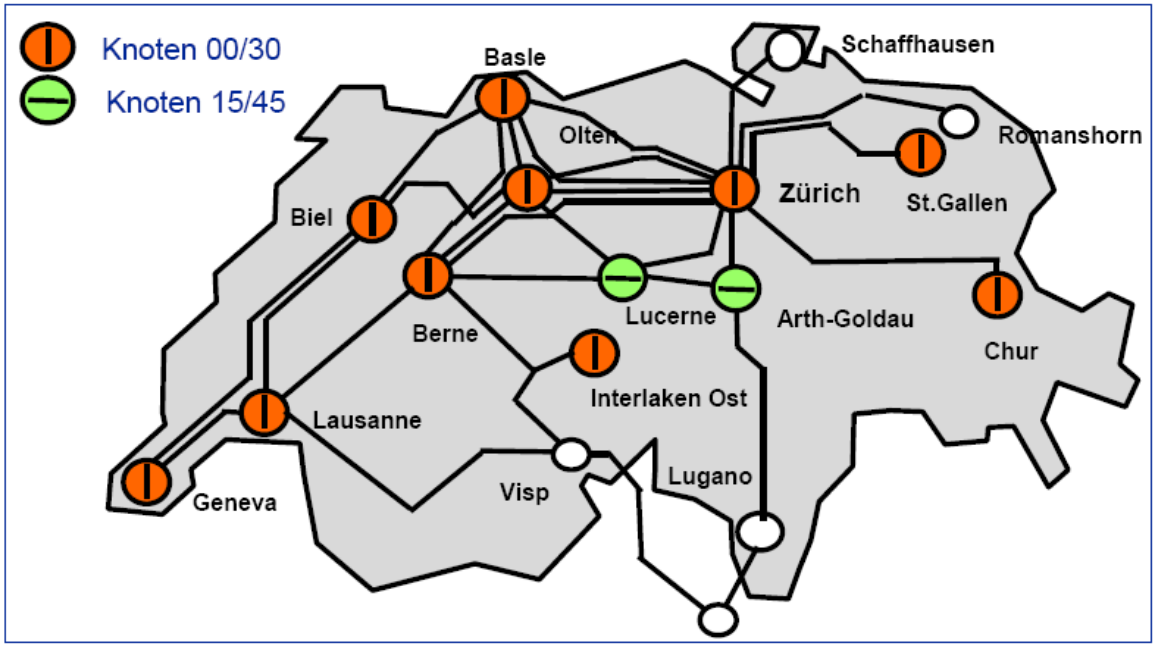
The ORR team comprised Ian Maxwell (Signalling Adviser), Richard Swain (Structures Adviser) and Huw Davies (consultant from Lloyd's Register Rail Limited).

3. Background

A significant factor influencing strategy and government policy on Swiss railways is the lack of fossil fuel resources in Switzerland. The use of oil based products to power transport is, as a consequence, discouraged. The Swiss rail network is almost entirely electrified while trolley buses and trams make appearances in many towns and cities.

Swiss government policy is to encourage as much passenger and freight movement onto the railway, the primary KPI for the passenger and freight train operating divisions of SBB is based on the percentage of movements on the rail network compared to roads.

To help encourage passenger traffic the timetable strategy has been devised to provide clock face departure times every half hour from all the main stations (hubs)



Journey times are devised so that trains arrive at the orange hub stations just before the hour and half hour, and leave just after the hour and half hour. At the green hub stations the process is similar but are based on 15 and 45 minutes passed each hour.

The consequence of this approach is that the hub stations are quiet for much of each hour but for 5 – 10 minutes each half hour are full of interconnecting trains. Passengers therefore can be confident of good connections all day long at all hub stations.

Enhancements to the network are justified on the basis of the benefit the work has on the effectiveness of this timetable philosophy. Funding from the government to support this objective and to ensure that the network is maintained in a condition that is very reliable has previously been readily available. It would appear that there is now considerable pressure to reduce the level of funding. Some evidence of the effect of this on track quality was noted during the series of meetings.

Swiss railways have been known for their ability to carry out engineering activities in very short week-night possessions often on a single track with the parallel track open using bi-directional signalling. Many parts of the network have such levels of traffic, even through the night, that this is the only option available. By contrast there are routes where this is not such a problem and longer possessions can be taken with full line closure. The Swiss are therefore able to demonstrate how the length of available possession affects the work efficiency.

Comparison of assets with the UK:

Asset	Switzerland	UK	Units	Ratio: Switzerland / UK	Ratio: Swiss /UK Per route km
Track	7,400	32,000	km	1 / 4.3	1/0.84
Route	3100	16,000	km	1 / 5.3	
Switches	13,000	20,400	No	1 / 1.5	1/0.31
Signals	31,000	40,000	No	1 / 1.3	1/0.25
Bridges	5,900	44,000	No	1 / 7.4	1/1.45
Retaining walls	7900	17,000	No	1 / 2.2	1/0.42
Tunnels	260	327	km	1 / 1.2	1/0.25
Signal Boxes	730	930	No	1 / 1.3	1/0.25
Stations	800	2500	No	1 / 3.1	1/0.62
OLE	7,400	7,800	km	1 / 1.1	1/0.21
Trains daily	9,000	17,400	No	1 / 1.9	1/0.38
Passengers daily	860,000	3,100,000	Per day	1 / 3.6	1/0.70
Tons of cargo daily	220,000	297,000	Per day	1 / 1.3	1/0.26

4. Meetings and Site Visits

4.1 Programme and organisation of fact finding visit

Monday 10th September 2007, 11:15am – 12:15pm.

Meeting at the offices of SBB, Luzern with Peter Jedelhauser, Infrastruktur Projekte-Management

Peter Jedelhauser SBB principal contact for the visit and leader of the project management division provided a simple introduction to SBB. A presentation entitled 'SBB – the Swiss Railway: driving ahead' provides more detail.

SBB basic facts and background

- SBB is 100% owned by the Swiss federal government

- There are 28,000 employees
- 9000 trains run each day
- The network has ~3000km of route (not track) of which 1750 is double or more track. The whole network, apart from some sidings, is electrified.
- There are 860,000 passengers travelling each day
- 220,000 Tonnes of freight move each day, the freight market is quite different to Britain with a mix of internal Swiss freight, cross border in particular the north south movement from Germany to Italy. There is still a wagon load business thus there are eight marshalling yards on the network. Substantial numbers of lorry trailers are carried.
- SBB has the second highest (after Dutch railways) passenger numbers per route km per day in Europe. Britain was not indicated on the graph.
- A graph drawn from a UIC report showed SBB to be the highest train km per track per day in the world , in other words the most intensively used network in the world. This presumably excludes Metro operations such as KCRC.
- The organisation structure shows four principal parts of SBB reporting to the CEO along with many support functions such as IT, HR etc. Those four functions are Passenger traffic, Freight traffic, Infrastructure and Real Estate.
- There are over 50 other (not SBB) railway companies in Switzerland. See Swiss Railway Landscape slide. These are all in some way regulated by the BAV which is the Federal Government office for transport.
- The biggest is the BLS which has significant infrastructure and operates over other infrastructure inc SBB. It is a standard gauge operation. Its historical origins relate to the Cantons wishing to have their own railways and routes through Switzerland. Some of these other railways are narrow usually metre gauge such as the RhB line.
- In the past 10-15 years there has been some amalgamation of various companies to reduce the number.
- The non SBB railway are known as private railways. However most are substantially or entirely owned by either the canton or commune. Thus ultimately being public bodies.
- Freight operates on an open access basis with Swiss and foreign (DB, Italian etc) railway operators running freight services as well as some independent commercial operations. Access charges are the same for each operator and SBB does not get reduced rates. However the charges are low to assist with the government's objective of moving from road to rail.

Make vs. Buy debate

There is a brief presentation to supplement these notes. Simply put, SBB retains more of the process the smaller and more complex the job is where railway operational interfaces are greater. Control of projects is retained by SBB at all times. Examples of contracting out are bridge design, catenary renewal, major line upgrade works and large track renewals plant. Construction contractors are used for big projects but under SBB control.

SBB carry out feasibility consultancy projects in house due to a series of bad experiences in the past. An example of such an exercise currently underway is related to the additional capacity which the new Gotthard tunnel will provide. This means that one of two other lines to the north of the tunnel route can be enhanced to take advantage of the extra capacity. The decision about which line and what enhancement should be provided is being evaluated by SBB in conjunction with the Federal and Canton governments based on SBB technical work.

Typical cost breakdown of track renewals job involving replacing rail, sleepers and ballast is provided. This shows that SBB personnel account for 26% of the costs. This includes planning staff for the whole process from several years before the execution of the work. Materials account for 38% of the total cost which is similar to NR costs.

What are the success factors that SBB sets itself and is measured by AND what are the drivers of SBB operations?

- There is a four yearly 'performance agreement' which the Swiss parliament approves for SBB. This arrangement has been running for about 15 years following major restructuring of the railways to bring it into accordance with various EU directives. Note, although Switzerland is not an EU member it chooses to apply the directives.
- Punctuality is seen as the prime measure of success. This is defined as being arrival within 5 minutes of timetable. There is a weighting applied to different routes, those being busier and more important having a higher rating than those on quiet routes.
- Train paths shall be optimised. The timetable is based on a fixed timetable with train connections at major stations (hubs) repeated every 30 minutes. Consequently there are optimisation issues at bottlenecks.
- Investment costs shall be optimised. This generally means lowest cost taking account of the anticipated reliability and performance of what is being built. If something is likely to cheap but unreliable it will not be built/used. This reliability issue will often drive investment decisions.
- To balance the budget and achieve what is called a 'black zero', i.e. to spend all, but not overspend, the budget each year.
- The infrastructure operation sees its role as 'our purpose is to enable the success of the operators'.

Section Summary

Issue no.	ORR Issues for PR08
1	SBB always keep close control of their projects. Portsmouth could be seen as an example of what can go wrong without close control. Have Network Rail learnt the lesson?

2	Within SBB the train operating divisions have the key output objectives. The role of infrastructure is to enable the success of the operators. Should Network Rail take this approach?

4.2 Organisational framework, processes & safety

Monday 10th September 2007, 13:15pm – 15:00pm.

Meeting at the offices of SBB, Luzern with K. Waser, Local Personnel Manager SBB and with H.Furer, Head of Civil Engineering

Training and Apprenticeships *(presentation powerdocs 285043)*

- Described a highly structured training progress chart for employees starting either as apprentices or as engineers.
- Apprentices will work through a series of modules developing their skills sometimes in basic engineering functions and sometimes in railway specific knowledge.
- SBB do take on some graduates straight from university, but prefer to take them on after they have gained a few years experience elsewhere.
- Engineers will typically be taken on at age 30 – 35 with some previous experience in small engineering firms, usually rail related and having undertaken work previously for SBB.
- The average age for Project Managers is approximately 45 years.
- Engineers that leave SBB often progress into big business, engineering or other industries. However, many stay with the company until retirement.
- The personnel department appears highly supportive and promotes further development, be it studying for a second degree or encouraging attendance on course such as finance and management.
- SBB encourage a thorough Project Management approach which incorporates reviews of completed projects to assess the lessons learnt.
- There are generally four levels of management within SBB, ranging from the workers to the leaders. Levels are subdivided.

- Apprenticeships are offered for workers and run for three years, and offer a route for obtaining formal qualifications that could be taken to other companies and industries.

- SBB do not have a retention problem regarding staff. This is because they offer interesting work, good wages and the railway in Switzerland is perceived as being a good employer and career option, giving the employees status.

- Team leaders within SBB tend to move around the country in order to gain variety in their experience.

Safety – Risk Management *(presentation powerdocs 285041)*

- SBB use a system of risk management known as TOP:

- T = Technical Measures, E.g: Remove the risk (stop trains)
- O = Organisational Means, E.g: Fence of the worksite (use barriers)
- P = Personal Measures. E.g: Use PPE (manage residual risks)

- This gives a hierarchy for risk elimination, aiming to remove the risk, and guard against it if it cannot be eliminated.

- SBB produce all regulations for the Swiss railway. This is soon to change as responsibility will be passed to the Swiss Federal Office of Transport.

- During on site work, the Safety Chief is the person responsible for safety on site, and he also undertakes technical work. He must be with his group of workers at all times. If he wants to separate from the group, another safety chief should be appointed.

- On site, the Safety Guard is identified by his white helmet and does not undertake other work. He announces warnings to the workers.

- The level of safety training that workers get depends upon the job they will do on the railway. It can be between 0.5 and 9 days in duration and is renewed every 2 years.

- Whilst working on the railway, a single person is responsible for himself. Two workers are responsible for each other, three or more people require a Safety Guard.

- Safety can cost up to 10% of the total project cost. Sometimes it can be as high as 25 to 30%. If electronic equipment is used costs can be reduced to 3% of the total.

- Team Leaders (Project Managers) determine safety requirements for their jobs by using SBB rules.

- SBB are becoming more conscious of safety, through education of their staff.

- Work procedures are independently reviewed to ensure that they are safe.

- The last SBB employee killed was over 20 years ago although 1 contractor was killed last year, 2 in the year before.

It appears that safe methods of work are inherent in work statements and that risk assessments as we know them in the UK (i.e. tabulated numerical assessments) are not undertaken.

Section Summary

Issue no.	ORR Issues for PR08
3	Typically safety costs are 10% of project but SBB found that using electronic systems reduced this to 3%. Is this valid for Network Rail and if so should there be more equipment used?

4.3 Regulatory framework & financing

Monday 10th September 2007, 15:15pm – 17:15pm.

Meeting at the offices of SBB, Luzern with Dr Frank Schley Bundesamt fur Verkehr (BAV) and Peter Konig SBB Infrastruktur Finanzen und Recht Vertrage Netz

There are two PowerPoint presentations which were given to ORR. These notes supplement those presentations and highlight certain key issues.

Financing of railways *(presentation powerdocs 285046, 285050)*

The PowerPoint presentations provide substantial detail on this topic.

There is a strategic government objective of shifting from road traffic to rail. This has been supported in several pubic referenda on investment and railway policy. This is the underlying rationale for funding of the railways within the structure now in place. It is recognised that the railways will not be self financing and that state support to achieve the objectives is required. One aspect of this policy is the investment in the new Lötschberg and Gotthard tunnels costing many CHF Bn.

On a more routine basis the financial targets for SBB are that long distance passenger services should make a profit, that regional passenger traffic should get a subsidy and that freight should make a profit but this last one is proving difficult to achieve.

The performance agreement is the instrument used to provide funding to SBB. There are objectives, described earlier, linked to KPI's which SBB has to meet. However if they do not meet them there is currently no sanction. There are no financial penalties for train delays payable by any party.

Approx 3Bn CHF per annum is received by the infrastructure organisation of SBB. This is made up of track access charges, grants from Federal and Canton governments, and other sources. This pays for maintenance and renewal of the existing infrastructure and enhancement projects such as new routes and station reconstructions. It does not fund the huge tunnel projects on the Lötschberg and Gotthard routes.

To allow long distance passenger and freight the opportunity of meeting their financial targets of making a profit and breaking even respectively, the track access charges levied relate only to the marginal cost of running the train. This was a political decision when setting up the new financial structure of the railway in 1999. It was recognised that the railway system as a whole would need subsidy and the government has chosen to provide that support directly to the infrastructure part of SBB. Additionally regional passenger services need financial support. Therefore if long distance passenger and freight only pay modest track access charges they have the opportunity of meeting their financial targets. These track access charges reflect only the marginal cost of running the train.

The annual payment from the Federal Government to SBB infrastructure for maintenance, renewal and projects is about 2Bn CHF. Of the 3Bn CHF received each year by SBB infrastructure about 650m CHF is from track access charges paid by operators of passenger and freight services. Further income is derived from real estate rentals and the Cantons fund enhancements to the network where they are deemed to be of local benefit such as S-Bahn upgrades.

4.4 Absolute Track Geometry

Tuesday 11th September 2007, 08:15am – 09:30am.

Meeting at the offices of SBB, Luzern with Peter Guldenapfel (Leiter Fahrbahn Track Engineer)

These notes accompany a slide presentation *(powerdocs 285066)*. Absolute track geometry is known as Neu Gleis Versicherung (NGV)

- SBB use PALAS system which is sold by Mattisa but can be used on Plasser or other tampers.

- SBB have had discussions with Network Rail and Grant Rail about its application to CTRL in the past 2 years.

- PALAS uses survey data based on the land survey of the country it is in. It does not use GPS satellites which is the significant difference from the EM Sat system.

- SBB have 100% coverage of their running lines with survey pins for mounting targets and most of the track has design data (x,y,z) stored although some minor routes only have x and y data. This took from 1987 until 1997 to carry out. Pins are fixed to OLE masts usually but also platform walls etc where no mast is present. Masts are spaced at ~45m.

- Tamping companies have access via the web to the relevant track design data to download prior to working.

- When tamping the system measures/surveys and tamps in the same pass, i.e. it calculates and works at the same time. The rate is normally about walking pace.

- After a tamping run the finished alignment can be measured with a small hand trolley if required.

- Data is measured and stored to +/- 3mm in all three dimensions.

- Costs to implement (survey, install datums and upload design to database) are estimated at CHF 6,700 per single track KM and 9,700 per double track km. To implement this over 10km double track takes about 20-24 person days.

- The accuracy of the z dimension is claimed to be better using PALAS than EM Sat due to the fact that it is linked to the land survey rather than the GPS system.

- The system is linked to the DfA (Database of Fixed Assets) which is described in more detail in the notes of a subsequent meeting (see section 4.7).

- Although SBB had decided to invest in the system they had not foreseen some of the benefits which have since emerged. The technical benefits are listed on the presentation, highlights include:
    - Track design can be consistently reproduced easily
    - Tamping design is automated

- Data stored in DfA, which is used for work planning
- Linked to land survey
- Long wave track geometry errors are eliminated

- SBB are convinced that the system is of great benefit and brings them improved track quality, reduced maintenance cost, reduced track forces and gauging benefits amongst others.

- Difficulties/ downsides encountered ….
  - Resistance to new ideas by maintenance staff (now overcome)
  - Need for a good land survey, if this is not available then it has to be created.
  - At locations of ground instability (areas of peat were cited) the reference datums move and need checking before use to reference them.

Section Summary

Issue no.	ORR Issues for PR08
4	SBB are convinced that absolute geometry brings benefits to track quality plus future efficiencies through automated design. Are Network Rail convinced and what are they doing about it?
5	Have Network Rail attempted to cost the survey work necessary to create the core data needed?

4.5 Cab ride: Luzern – Lausanne - Zurich

Tuesday 11th September 2007, 09:55am – 16:00pm.

Cab Ride with Peter Guldenapfel (Track engineer) and Andreas Rufener (Operations)

Route in morning Luzern Zofingen Bern Romont Lausanne
Route in afternoon Lausanne Yverdon-les-Bains Neuchatel Biel Olton Zurich
Both routes travelled over the new high speed route between Olton and Bern/ Soloturn with 200kph permissible speed.
Notes of interest but in no order other than as they occurred from observation or discussions

- Train speed at start of platform 85kph before stopping. This is much higher than TPWS and defensive driving current allow in Britain.

- There has been an attempt to avoid raising the entire platform surface to 550mm which is the new standard at some minor stations by erecting what

looks like a 300mm wide steel shelf/platform at the edge of the original platform. This has however caused problems for partially sighted people.

- No scrap material was observed throughout the entire journey except two extended lengths of rail awaiting collection.

- The SBB network has frequent goods sidings at stations and many depots/ industrial private sidings. Virtually all appeared in good condition and the majority had wagons in them. We were advised that the average length of goods haul is only 30km. The financial arrangements make rail competitive with road in terms of pricing and the service is reliable. Most sidings have 40kph entry speed.

- Most tunnels, both new and old, had at least small lights every ~100m. Some newer tunnels had much better lighting and ~1.5m wide walkways alongside the track. Staff are no longer permitted to work in tunnels under traffic. New tunnels were twin bore where required, not a pair of single bore tunnels unless expedient.

- It is evident that there has been considerable work to enhance the network by building new sections of track, by doubling single lines over the past 20-30 years.

- Concrete S&C bearers were noted generally where the S&C was not relatively old.

- Noted several fixed track warning systems (lights flashing) at for instance the first ~2km from Luzern station where track runs in cuttings and curves, also at several track renewal sites.

- When running along the recently built new route between Olton and Bern a maintenance access way was evident for road vehicles over much of it. However even this route does not have lineside fencing over country sections. Animals and people straying on the line are not a problem. It was evident that there were far few crossovers than on the rest of the network and no lineside industrial plants along the new high speed route.

- Train fitted with ETCS and ran over new line fitted with ETCS level 2. Line also has lineside signals which were functioning but will be switched off when trials reach a satisfactory conclusion.

- GSM radio is being provided with a roaming facility from GSM Swiss

- Bridges built in the last 40 years or so, appear to be exclusively concrete. Some overbridges are masonry arches (few) and some are steel decks (few but more than masonry).

- Rail grinding machines both Plain line and S&C, were observed parked in sidings. These are operated by contractors. SBB are putting a lot of effort into determining the optimum rail profile to suit the wheel and the optimum grinding interval. They are undertaking research with the Technical University in Graz who are building predictive rail wear models to assist SBB grinding planning.

- SBB are moving to a policy of monoblock sleepers rather than the historical practice of installing twin block sleepers where concrete is specified. Concrete is specified on higher grade routes where possible. Some sites such as platforms where there is shallow ballast depth and raising the rail level would be difficult have steel sleepers instead.

- The SBB network has relatively little track which is straight. The route seems to be one curve followed by another as the trains make their way through the terrain. There are significant gradients frequently encountered 1:50 being the steepest. There appeared to even be switches on vertical curves. Switches are frequently positioned on horizontal curves due to constraints of the terrain.

- Travelled over a Y switch and the turnout road of conventional switch at 200kph, swing nose crossing at both.

- When traveling on the tilting train (bombardier built using a gyroscope to detect differences in cant to control the tilt) the tilt rate and degree was quite pronounced at speeds up to 150kph on a route which was not built for high speed running and therefore full of reverse curves. However it was comfortable to ride on.

- Travelled at 150kph through a old tunnel with a fixed OLE contact rail rather than wire due presumably to limited clearances.

- 140kph is max permitted speed over a level crossing.

- New tunnels are twin bore not necessarily single bore. No derailment protection noticed.

- Over part of the 200kph route the track is single line and sighting is poor. No staff may work under traffic on this line.

- Very few staff were observed on the track at all. Those who were present were either inspecting or surveying. Where work was taking place it was construction activity behind a barrier.

- There are extensive cutting slopes strengthening works in place. Rock bolting, grading and concrete spraying are used. Sometimes in combination.

- Passed the site of a recent major earth slip caused by prolonged heavy rain, between Flamatt & Schmetten. Line was blocked for 3 weeks. Ballast had been washed away and the embankment had dropped by 20cm. TSR (part 50kph, part 80 kph) still in place and considerable engineering still evident. Appeared to be over 1 mile in length and work included stabilisation, vegetation removal, grading of sides & new ballast.

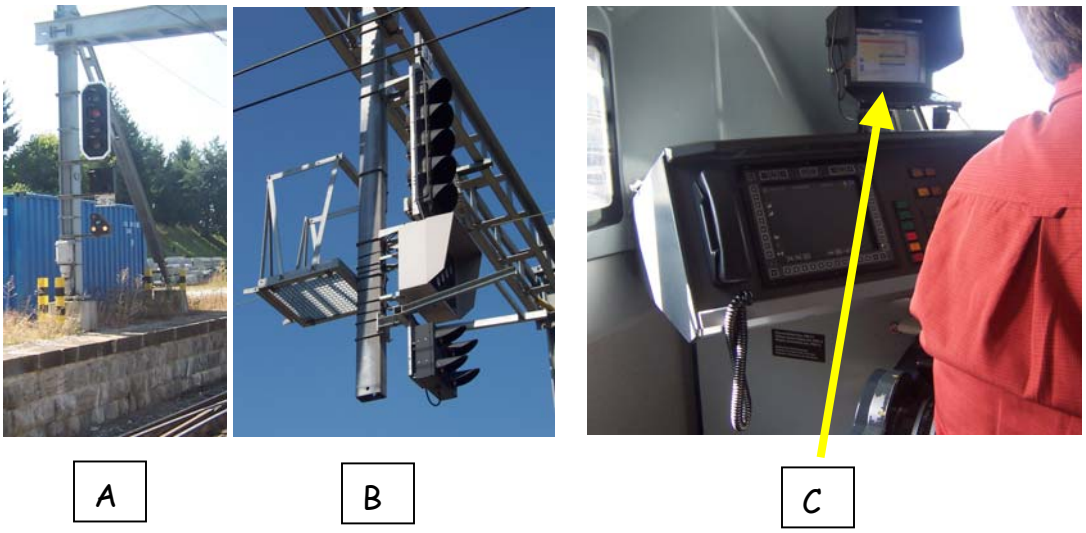
- Structures observed included:
    - Earth slopes; graded grass slopes in good condition including French drains
    - Rock slopes; areas with sprayed concrete covering with rock bolts
    - Retaining walls; stone, reinforced concrete, cabion, contiguous piled with sprayed concrete.
    - Over Bridges; mostly concrete carrying roads (relatively new); some stone arch with stone abutments & wing walls, several stone arched strengthened with concrete arch

- Short section of slab track observed on underpass close to Zurich Hbf.

- The quantity and complexity of S&C at station approaches far exceeds what Network Rail would normally provide. Many slips, and diamonds evident.

- Occasional signals fixed to OLE rather than separate post (photo A).

- In Berne station signals fixed to gantry without any fixed access (photo B). Staff need portable wooden ladder to access and require OLE isolation. If a bulb fails it is replaced by an OLE technician and not by S&T staff (see powerdocs 287744 for SBB e-mail).



- Cabs in all trains have a display system with details equivalent to the sectional appendix plus stopping and timing info for the driver (photo C). Screen scrolled on through the timed info on the assumption that the train was running on time. If the train becomes late the relevant info could be lost!

- Second and third trains was fitted with wing mirrors for the driver to observe side of train in conjunction with door operations. Mirrors are retractable but did not have to be retracted before starting to move.

Issue no.	ORR Issues for PR08
6	SBB using University of Graz for predictive rail wear model, used for optimised rail grinding. We know that OBB also use this university for expertise in track systems. Network Rail should be encouraged to make contact.

4.6 Signal Box visit: Zurich Altstetten

Tuesday 11th September 2007, 16:30pm – 18:00pm.

Signal Box visit with Felix Laube (related presentation powerdocs 288200)

Felix Laube is head of Operational Research within Infrastructure tasked with a "Value Change" process to review how the railway operates. This seems to be a very wide ranging remit that challenges established ways of running the railway.

Interested in the activities of RSSB research and would welcome the chance to understand better if there is any overlap in areas of interest. Already has UK involvement through the railway course run by University of Birmingham.

- Observed functioning signalbox which controls 345 pts and 306 signals. 34 staff involved and 6 required day time. Also manage local customer info systems on stations.

- System includes ARS type system which takes data from timetable system and displays details about route sections train will take. Connections with other trains or specified train sequence can be imposed.

- Changes to train plans are entered into this system normally but signaller can manually set routes from his screen.

- New format system being introduced for the key station that displays the platforms as vertical lines and time was shown going down the screen. It shows actual train occupations as history and planned occupations for the future.

- Additional train info, vehicles type and weight, can be displayed by hovering mouse over train.

Felix Laube comments:

- His networking model may not work for UK because our TOCs do not generally want a matrix type network but rather a linear railway. Swiss have a matrix network with a key station or hub at each node.

- For SBB Passenger and Freight sectors are measured by Government by their market share (passengers in trains cw on the road; tonnage of freight on rails or road). Determining future demand is key; while this is possible for passenger it is virtually impossible for freight.

- Train dispatch is an issue for SBB because passengers expect door to stay open until departure time and not close to allow the train to depart on time.

- Believes that capacity improvements possible through process management without building new infrastructure particularly in the congested areas.

- When talking about dwell times, he stated that the Swiss system is not based on minimum requirements [as in the UK] but on suitable times to allow what ever it is to be done.

- Hub concept employed in Switzerland only works because all the stakeholders, eg the infrastructure owner, TOC and Government have bought into it. This principle is important as it changes the entire travel philosophy. This sort of working is not possible in the UK as the TOCs can only go from point to point, and has little interest in coordinating train movements at interchanges.

4.7 Database of Fixed Assets

Wednesday 12th September 2007, 08:30am – 10:00am.

Meeting at the offices of SBB, Luzern with Karen Bennett, Infrastruktur Assetmanagement and Marcel Rimer

These notes accompany a slide presentation *(hard copy only available)*. During the presentation the database was demonstrated in live mode.

- The DfA is a GIS based system with information about all of SBB's infrastructure assets. It stores data as CAD files and alphanumeric data. It contains locational information about all assets referenced to the national Swiss land survey.

- It is based on standard off the shelf GIS software with a bespoke application added to it.

- The timescale for its implementation is as follows:
    - 1989 Feasibility study
    - 1991 Development
    - 1995 Start full role out
    - 2001 Completed at a cost of 85m CHF.

- Annual maintenance costs are 14.4m CHF. The slide claims to bring in benefits valued at 22.6m CHF each year.

- There are 140 users allowed to update and amend the data throughout SBB. No other people have edit rights. Only SBB staff have edit rights although external contractors can view sections of the DfA relevant to their project. Access to DfA can be made throughout the system at engineering maintenance and project offices.

- The extent and quality of the track asset data is maintained as it is constantly used with the absolute track geometry system. This process ensures the data is kept up to date.

- SBB are expanding the extent of the DfA over time including more types of information.

- We were shown a demonstration of the system which allowed a user to zoom in on a particular area of the network and obtain detailed information about for instance a type of signal.

- Reports can be produced in many different formats to suit the user. There are always demands for more report types.

- A user group meets regularly to give feedback to the DfA system managers.

- It is used for planning and work management for track work. This is a huge strength of the system as it ensures that the data is always current. This is not the case for other asset types. Maintaining the currency of the data is a big challenge.

- The slides show estimated savings in planning costs for doing infrastructure projects with and without the DfA. The greatest savings are claimed for trackwork jobs at 25% of planning costs. This is in part as track jobs require a lot of time spent surveying if that information is not already present.

- SBB are planning to change the software supporting the DfA as its GIS software is coming to the end of its life after which the suppliers will not support it. They expect to spend 4-5m CHF upgrading the system.

- It is certainly an impressive tool which provides a huge amount of information about what is out on the track provided it is accurate. The challenge of maintaining the accuracy is the biggest management issue for DfA.

- The real future benefits seem to be related to building the links between this system and other IT systems that SBB do and will use for managing the infrastructure.

- SBB indicated that they were happy to talk to other railway administrations about the application of the DfA and indeed sell them the system if they wished.

Issue no.	ORR Issues for PR08
7	SBB now see savings on planning costs for jobs outweighing the ongoing running costs of the DfA system. Biggest savings relate to track renewal jobs. What intentions does Network Rail have to introduce an asset database?
8	Whilst encouraging Network Rail to develop an asset database, ORR need to note that SBB took many years to develop the system. It is not a quick solution.

4.8 Asset Management

Wednesday 12th September 2007, 10:30am – 17:00am.

Meeting at the offices of SBB, Luzern with Daniel Kuster, Infrastructure Asset Management

These notes accompany a very extensive slide presentation *(powerdocs 285054)*.

- The strategic objective of transfer from road to rail has had the time frame for achieving it extended from the original 5 years due to the slower than hoped for progress (slide 5).

- The definitions of maintenance and renewal are similar to those we would recognise. They are funded by different budgets within SBB (MFP=P&L and MIP=Balance sheet) (slide 8).

- Slide 12 provides an financial breakdown in Euro for SB annual maintenance (Unterhaltung) and renewal (Erneuerung). Track is yellow and signalling is blue. The split is 32% maintenance and 68% renewals.

- Maintenance and renewal philosophy shows that investing in concrete sleepers with their longer life span in comparison to wooden sleepers has a reduce life cycle cost for the track. SBB are installing concrete sleepers where possible in mainlines. Steel is put in secondary lines and yards. Wood is used only where necessary such as situations where there is a shallow ballast depth due to an underbridge (slides 14 – 22).

- Graz University has developed a mathematical model for track degradation (slide 29).

- 80 year life for the formation rather than 40 as with conventional formation is claimed by investing in high quality formation with a sealing layer of bitumen based material and good drainage. By getting these right, the renewal and maintenance costs of track are kept low for much longer. Only a very small quantity of this high quality formation is implemented currently ~1km per year. It requires much longer possession that normal formation renewal works (slides 30 –32).

- Second life system (SLS) for resetting screws holding down base plates in principally S&C but also Plain line. Network Rail are trying out the system currently (slide 37).

- Interesting to note that visual inspection occurs only every 14 days irrespective of line speed or tonnage (slides 40 & 50).

- Slides 42-46 illustrate output for various track quality programmes to enable decisions on maintenance intervention to be made based on objective evidence. This is much as available to NR staff.

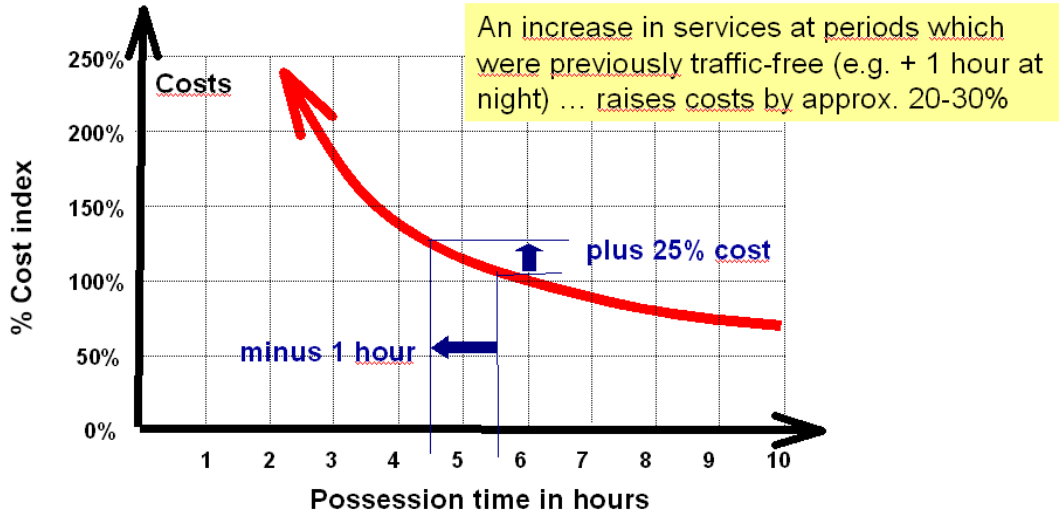
- UIC system of scoring the condition of track components to try and provide objective consistency across all of SBB thereby ensuring that renewals decisions are consistent (slide 49).

- Aggregate measure of track quality across the whole of SBB over time. The time of improvement from ~1985-1995 is due to better tampers, adoption of absolute track geometry, installation of monoblock concrete sleeper starting, some work on reinforcing the subgrade at poor sites. The deterioration from about 2000 is due to rising traffic levels and budget restrictions. There is discussion within SBB about whether to allow the trend to continue or whether to spend more money on maintenance etc and arrest the fall (slide 55).

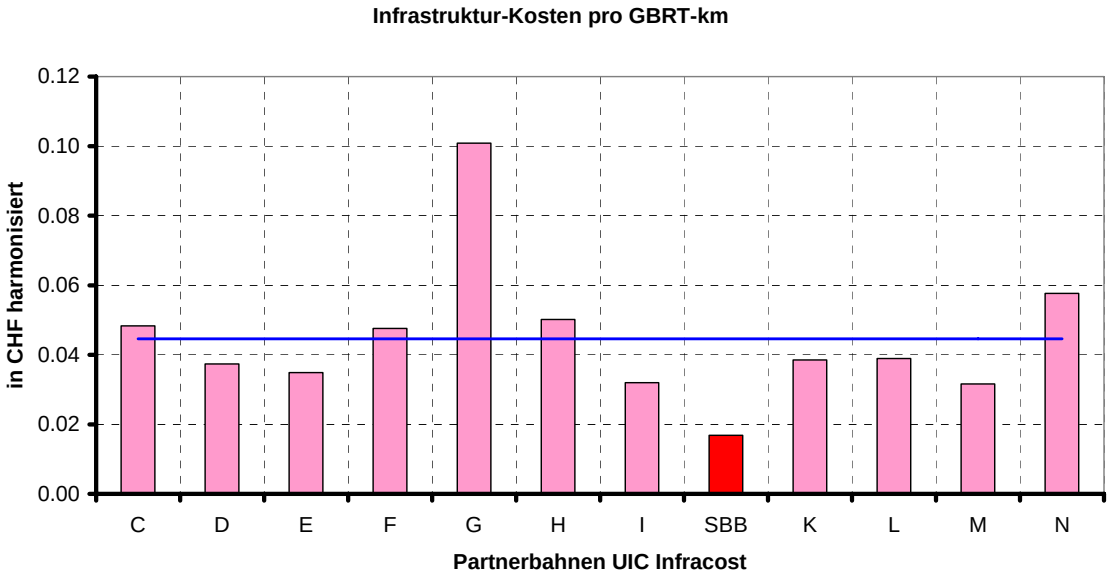
- Slides 66-68 illustrate different types of OLE and a fixed contact bar for use in tunnels etc up to 250kph

- Slides 70-95 are a collection of maintenance, asset management and programme management philosophy and rules. Slide 91 shows the age distribution of sleepers. Red=Steel, Blue=wood, green=concrete monoblock. SBB has decided to no longer install twin block and only install monoblock where the sleeper is concrete. They believe that the life span and performance of a monoblock is better and the cost difference is negligible. With mechanised maintenance the weight factor is not an issue.

- SBB data indicates that track maintenance costs are significantly affected by possession length. A reduction from 5½ to 4½ hours results in an increase in costs of 25%.



- Results which are from a benchmarking study with some other European networks indicates that SBB costs for infrastructure are less than all the others in the study on the basis of per tonne km travelled. Not sure where Network Rail is in there. Food for thought (slide 114).



- Under sleeper pads are being trialed (slide 127)

- Rail grinding is very important to SBB, they believe that by getting the correct maintenance grinding regime, the life of the rail can be doubled compared to no grinding. This is something worth pursing with NR to see what lessons can be learnt. Graz University have been assisting SBB with their grinding planning (slide 129).

Issue no.	ORR Issues for PR08
9	SBB claim to double the life of the formation by investing in a sealing layer of bitumen combined with good drainage. Should Network Rail be investigating this approach?
10	SBB use a UIC devised scoring system for assessing the condition of track components. Do Network Rail know about this and have they considered using it?
11	Expert support from Graz University has helped SBB improve rail life through better rail grinding. Has Network Rail investigated this?

4.9 ETCS

Thursday 13th September 2007, 10:30am – 12:00pm.

Meeting at the offices of SBB, Berne with Jan Richard Infrastructure ETCS Business Management

These notes accompany a slide presentation *(powerdocs 285055 & 285056)*.

- Explained that in cab signalling was needed to achieve higher line speeds than lineside signalling on the Zurich – Berne route so that train journeys could be made to fit into the timetable requirements. ETCS was chosen because it met all the requirements and fitted in with European plan.

- For SBB network generally the migration to ETCS will be driven by obsolescence of existing ATP equipment (ZUB)

- Migration assumes that train operators may continue to use ZUB equipment until it is no longer available. Euro balises will use a packet 44 message to transmit data to an ETM on board that decodes message to ZUB equipment. Non-ETCS fitted trains need the ETM fitted and then pick up ZUB data from standard ETCS Eurobalise. By 2016 all track mounted ZUB equipment will have gone

- Level 1 ETCS will progressively be upgraded to level 2

- Tom Harris MP had a VIP trip on an ETCS train on 11th September

- SBB agree that level 2 offers some capacity increase but their interest is more focused on the potential to increase line speed where needed (Swiss speed limit with lineside signals is 160 kph/100 mph).

- Concerns about reliability of the Alcatel AzLM axle counters (due to EMC issues) has resulted in the equipment being duplicated and a 1 out of two logic being applied.

- Current ETCS systems are using version 2.2.2 software. On train software will have to be upgraded but track software does not need to be. New lines (eg Gotthard) will be fitted with 3.0.0 but timing of these projects may make this very optimistic since 3.0.0 is some way off being available.

- An exercise has been carried out to determine what changes are required to the infrastructure around Bern to meet the expected 2020 demand. This has been costed at 1.6Bn CHF for track, bridges signals etc. However if ETCS is used in place of conventional signalling SBB expect to be able to save 900m CHF from that figure by reducing the amount of civil engineering construction and still achieve the capacity requirements. It is not clear whether the 900m

saving is purely the saving in non signals costs and whether the apparent scheme cost of 600m would need the costs of ETCS adding.

- Existing ETCS failures are mostly EVC (most common cause), DMI or the odometry. Over all reliability is less than 1 minute per train per week. Failures are also occurring due to driver set-up errors.

- Lesson Learnt to date from implementation
    - Have a fully completed standard and spec before starting design work.
    - Have a detailed and developed plan in place.
    - Have control of the process and stay very involved with the supplier

4.10 Signalling & Telecommunications

Thursday 13th September 2007, 15:00pm – 17:00pm.

Meeting at the offices of SBB, Berne with Daniel Gerber, Infrastruktur Sicherungsanlagen und Automation and Stefan Andermatt, Sicherungs- & Telecomanlagen

A general discussion on the performance of S&T equipment without any formal presentation took place. From time to time they produced spreadsheets or presentation material with relevant data. The comments identified here reflect the sequence of discussions.

- Reliability of points is generally good – 0.07 failures per year per switch (Network Rail is about 5 times higher). But they have greater problems with switches for high speed turn out speeds (which require 8 machines), currently 1.33 for Thales and 1.84 for Siemens (ie about 20 times more unreliable).

- SBB use rollers fitted to the slide chairs but initially found these made things worse. Now they believe they are set up correctly and are very good.

- In general, S&T failures run at about 20,000 minutes per month with particularly bad failures hitting 4000 – 5000 minutes. The breakdown of failures by percentage is:
    - Points 24%
    - TCs & Axle counter 21%
    - Interlockings 30%
    - Signals 11%
    - Remote Control 6%
    - Power Supply 8%

- The high level of interlocking failures is at variance with UK experience.

- As in Austria, no point stretcher bars are used and no mechanical back drives. Higher speed switches use additional machines (See powerdocs 287742 for subsequent explanation from SBB).

- SBB have fitted some points monitoring equipment (Strukton). Happy with this equipment and now out to tender to fit 300 more at approx. 3,000CHF each. [Strukton claim to have stopped all point failures on those fitted]

- SBB are experiencing cable theft but only from depots and not from the lineside with working circuits.

- Train detection is about 50% track circuit and 50% axlecounter (total 30,000), choice is determined by weight and density of traffic. Axle counters are not fitted in stations if there is a risk of vehicles rolling back over counters.

- Maintenance frequencies appear to be similar to UK. TC full test is once per year. Teams are normally 3 or 4 persons including safety duties.

- Testing of an interlocking involves as much offline testing as possible and then commissioning with lots of people in a short period of time. Currently no competence requirement for testing but this looks to be changing.

- Renewal strategy is more likely to be driven by operational needs to change the layout or to centralise control. Unusual to renew an interlocking because of condition of equipment. SBB do not seem to suffer from wire degradation and believe relay interlockings can last for 60+ years. SBB still have the design skills to modify their relay interlockings.

- SBB have a plan to centralise all signal control into 4 control centres in the next 10 years. SBB rely on contractors for detailed design and build of the units but SBB staff will do the trackside work and all the final testing.

- SBB have their own facilities to fabricate and refurbish point machines (Bahn Technik Zentrum at Haggendorf) and believe that this saves them a lot of money compared to buying in new machines.

- In recent years S&T have had to turn around problems of performance and are now reducing train delays despite increased traffic. They believe this is down to continuous improvement and attention to detail.

- They suggested that their moto could be “never satisfied”.

Issue no.	ORR Issues for PR08
12	SBB are very enthusiastic with their condition monitoring on points. Should Network Rail copy this?

4.11 Site visit

Thursday 13th September 2007, 22:00pm – 24:00pm.

Site visit to a Engineering Possession at Biele with Xaver Imwinkelried, Infrastruktur Bau Management Olten

(Presentation powerdocs 285080)

The planned visit was to observe the Puscal train in action during part of a a short overnight possession. This train removes 18m sections of rails and sleepers, removes ballast then replaces with new.

The presentation indicated that the SBB work plan anticipated 54m (ie 3 sections) completed in mid week shift at a cost of 2,200 CHF per m.

Unfortunately the previous shift had ended with a two vehicle collision causing damage to the Puscal machine. The observed possession therefore involved a small amount of maintenance tamping.

The possession was for a single track and taken at about 23:00. During the following hour the open track saw at least half a dozen trains passing (both freight and passenger). Approaching trains were announced by flashing lights and an audible alarm system installed for the section of line being worked on.

4.12 Track Access Charges & Possession Management

Friday 14th September 2007, 09:15am – 11:15am.

Meeting at the offices of SBB, Berne with Bruno Zurfluh, Infrastructure Train Path Management and Christian Looser, Infrastruktur Trassenmanagement

Track Access Charge *(presentation powerdocs 285073 & 285084)*

- There are about 30 train operators using the SBB network.

- Operators pay track access charges to SBB to run on the infrastructure. The costs are built up by a series of factors. There is a menu of prices which considers a long list of items that are added together to come up with the cost for a particular service.

- There is a minimum charge which is essentially based on the weight and distance the train travels and costs for stopping at stations @ 5CHF for a major station stop and a further 5 CHF to depart. There is another amount known as the contribution margin. This is a fixed proportion of the ticket price. This is calculated as 8% of the cost of a ticket on long distance passenger ticket and 14% of the cost of a ticket on regional passenger traffic. Freight also pays a contribution margin. Ancillary services are charged further to both of the elements described above. These cover items such as shunting, use of routes outside normal published times etc. There is a slide which shows how this is put together.

- There is a slide which indicates the factors taken into account when calculating other railway administrations charges. However this is not correct in the case of the UK where the variable track access charge i.e. that paid per mile travelled is calculated using Mini Marpass which assesses the damage caused to the track for each vehicle type.

- ORR to provide contact at Network Rail to SBB for discussion about Mini Marpass.

- The track access charges make up 50% of the cost of operating the network. Not sure what exactly the term ‘operating’ covers in this context.

- SBB are now looking at how track access charges can be changed to drive certain incentives which they do not do at the moment. The medium term objective is to incentivise capacity utilisation. There is a Government led review known as “Rail Reform 2” that is expected to change the pricing system in 2011.

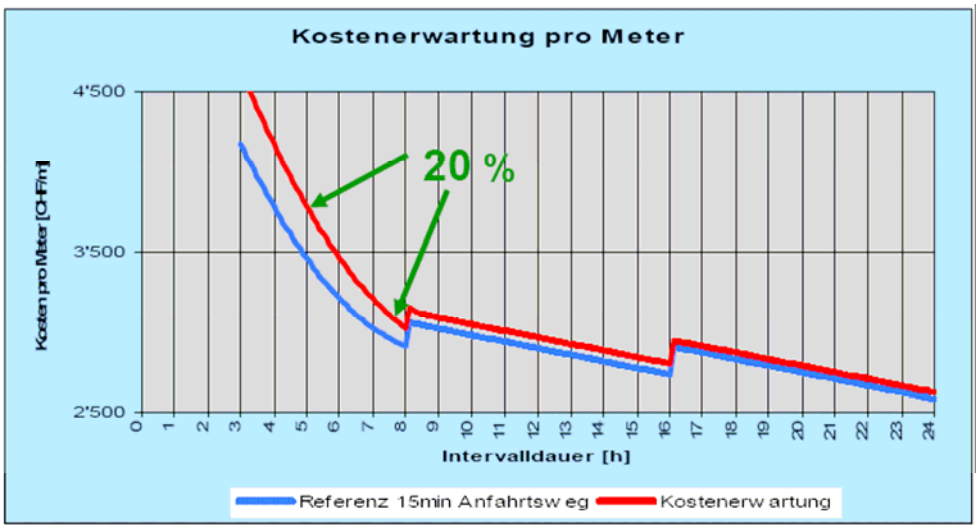
- Examples of a typical track access charge are:
    - A 500 Tonnes train from Bern to Zurich would pay ~700CHF of which ~300CHF is contribution margin as this is a high quality busy route. The track access charge on this route of 700CHF will cover approx 75% of the cost of providing the route for that train.
    - Some other routes may only have a contribution margin of 100CHF from a track access charge of 500CHF. Thus contributing less to the operating cost of the train.

Possession Management *(presentation powerdocs 285071)*

- Trassenmanagement is the group within SBB who plan possessions and are balancing the needs of train operators and the infrastructure management organisations. They are looking at how possessions can be planned to serve the needs of both of these groups. They are examining how work can be clustered together into larger and longer duration possessions. In the event that there is a dispute between SBB infrastructure and a non SBB operator about possessions there is an arbitrator who is external to SBB.

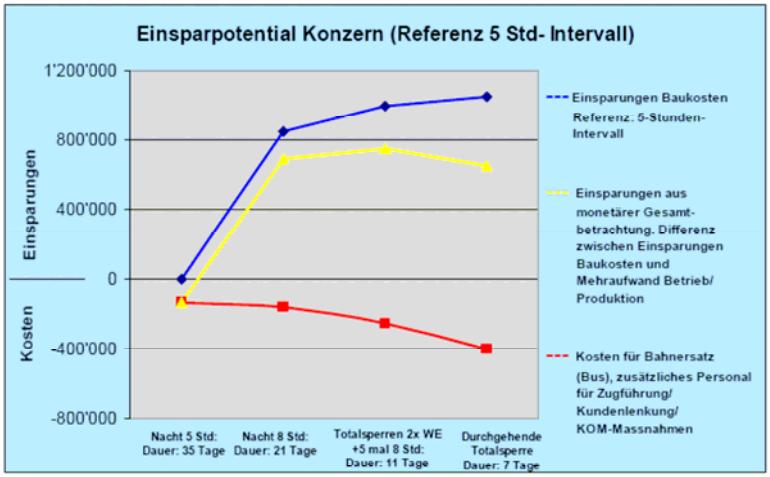
- There is an interesting chart of the number possessions by duration. As would be expected. maintenance (Unterhalt) require shorter possessions whereas renewals (Erneuerung) requires longer possessions. The balance changes between 6 and 7 hours duration. Only 3% of possessions are longer than 12 hours.

- SBB have been evaluating the total cost of doing work in possessions of different durations. A slide shows how unit costs for track work fall steeply from 3 hour possessions to 8 hour possessions. This is not surprising but confirms what is widely surmised. After 8 hours the rate of decline in unit rate is much slower.



- A subsequent slide shows how undertaking a 3500m track renewal in different possession lengths affects the total cost of the works. These models and the analysis is being used to drive changes in the possession planning process. This slide indicates that once possessions are at least 8 hours in length the total cost of the work differs little when using 21 x 8 hours, 2 x 48 hours plus 5x8hours or 7 days total shutdown. Although this analysis does not take into account the lost revenue it does consider the cost of buses etc.

The conclusion from this is that once possessions are at least 8 hours the deciding factor about what type of possession regime to adopt is based on other factors such as what type of railway is SBB aiming to provide.



- Example: renewal of ballast and tracks over a 3500m section with 344m of total reconstruction, Buchs SG – Sevelen line, 2008
- Only hard factors (group cash-out) were taken into account, though soft factors may also be considered

- Conclusion 1: The higher the construction costs, the greater the potential for savings.
- Conclusion 2: If a possession necessitates bus replacement services, all possible renewal and maintenance works must be addressed simultaneously with due consideration of life-cycle costs.

- SBB is moving toward a possession strategy outlined on the slide essentially trying to tailor possessions to the work, having fewer longer possession (interesting move from the traditional approach), clustering work to reduce the number of individual possessions and planning work further ahead to allow train planning to take account of the possession planning process and its outcomes.

- SBB demonstrated the tool which they have developed to evaluate the costs of doing work under a variety of different possession regimes. It is a large excel spreadsheet. The spread sheet has a large quantity of rate cost data and production data to enable different scenarios to be tried out and a conclusion arrived at as to what the optimal possession pattern for a particular job. From British perspective this is interesting and could easily be adapted to add the costs of schedule 8 possession charges. The cost to the industry as a whole is not shown as the impact on the fare box is not calculated. However this could be added if there was an algorithm to determine that for a particular route.

Issue no.	ORR Issues for PR08
13	SBB have analysis system that allows them to simply assess the effect on cost of varying the possession strategy. It was suggested that it could be easily modified to suit Network Rail.
14	SBB now look to cluster jobs together to optimise possession useage.

5. Conclusions

7-day Railway

One of the main reasons for selecting Swiss Railways was the fact that they were known to provide what is commonly described as a 7-day railway ie their possession management allowed train services to continue virtually 24 hours a day seven days a week.

It was clear from our visit that for much of their network they do have to keep tracks available for train running most of the time. Achieving this involves the use of very short possessions (typically 5 or 6 hours) over night and limiting the possession to a single track with the parallel track open to traffic.

It was also clear that SBB have looked closely at the cost impact of this style of working and can show that the effect on unit costs is significant for very short possessions.

Railway Objectives

The Swiss government places key objectives on the train operating parts (freight and passenger) of SBB to achieve specific share of the traffic within Switzerland. The key objective of the infrastructure part of SBB is to facilitate the achievement by the train operating parts of their objective.

Absolute Track Geometry

The preliminary activities to allow absolute track geometry to take place in Switzerland took 10 years to complete. Despite this level of effort and commitment, SBB now believe that they have benefited from the ability to store and use detailed, three-dimensional measurements of its track.

SBB were able to identify a range of benefits from using absolute track geometry and were able to provide resource costs associated with creating the survey data.

Asset Database (DfA)

The asset database (DfA) provides SBB with a central resource of all planned and built assets. SBB currently are able to use this for project planning, tamper machine control & renewals planning. Future opportunities include integration with train control systems and service management.

SBB believe that they are now seeing benefits that outweigh the running costs with track renewal activities being one of the main beneficiaries.

Once again the timescale for developing the system to a productive stage has taken many years and some considerable commitment from the DfA project team.

Point Failures

SBB presented evidence that their considerable population of points are now generally very reliable. Their Signal Engineers suggested that they have improved performance through a continuous improvements and attention to detail. In particular they have fitted condition monitoring in key areas and are now planning to fit many more.

They did identify their high speed turn outs (which require up to 8 machines) as being far less reliable. Their experience of using switch rollers was initially poor but with more precise set-up these have become very effective.

Barriers to efficiency gains in the UK

Both the absolute geometry and asset database have taken SBB many years to create and bring to a position of being productive. The commercial stability needed over periods as long as 10 years to see such projects through without any initial payback may be unachievable within the UK where a 5-year funding cycle would create great difficulties to the justification.

6. Acknowledgements

Peter Jedelhauser, Infrastruktur Projekte-Management and Karen Baumgartner who made the detailed arrangements for the meetings

All from SBB who generously donated their time to ORR.

Appendix 1 Associated Documents held in Powerdocs

Subject		SBB Personnel	PowerDocs reference to Presentation	PowerDocs reference to ORR notes
Programme and organisation of fact finding visit		Peter Jedelhauser	Hard Copy Only	285022, 285318
		Karin Baumgartner	285034	
Organisational Framework, processes and safety	Training	K Wasser	285043	285025
	Safety	Heiniek Furrer	285041	285326
Regulatory Framework and Financing		Frank Schley	285046	285351
		Peter Konig	285050 & 258053	258506
Absolute Track Geometry System		Peter Guldenapfel	285066 & 285067	285319
Cab Ride		Peter Guldenapfel & Andreas Rufener	See hard copy of the timetable / driver instructions	285030, 285320
Visit to Signal Box in Altstetten		Felix Laube	None Received	285031
Database of Fixed Assets		Karen Bennett	Hard copy only	285640
Asset Management		Daniel Kuster	285054	285639
ETCS		Jan Richard	285055 & 285056	285641 & 285433
Signalling & Telecommunications		D Gerber, S Andermatt, Mr Arnie	None received	285525 & 285642
Site Visit - Biel		Zaver Imwinkelried	285080	
Access Charges / Network Access		Bruno Zurfluh	285073, 285084 and Hard Copy of his team organogram	285643
Possession Management		Christian Losser	285071	
Business Cards			288211 & 288212	
Correspondence on access to signals		S Andermatt	287744	
Correspondence on points		R Habegger	287742	

Appendix 2 ORR Issues for PR08

This appendix collects together all the issues raised within each of the sections 4.1 to 4.12.

Issue	Question for NR
1	SBB always keep close control of their projects. Portsmouth could be seen as an example of what can go wrong without close control. Have Network Rail learnt the lesson?
2	Within SBB the train operating divisions have the key output objectives. The role of infrastructure is to enable the success of the operators. Should Network Rail take this approach?
3	Typically safety costs are 10% of project but SBB found that using electronic systems reduced this to 3%. Is this valid for Network Rail and if so should there be more equipment used?
4	SBB are convinced that absolute geometry brings benefits to track quality plus future efficiencies through automated design. Are Network Rail convinced and what are they doing about it?
5	Have Network Rail attempted to cost the survey work necessary to create the core data needed?
6	SBB using University of Graz for predictive rail wear model, used for optimised rail grinding. We know that OBB also use this university for expertise in track systems. Network Rail should be encouraged to make contact.
7	SBB now see savings on planning costs for jobs outweighing the ongoing running costs of the DfA system. Biggest savings relate to track renewal jobs. What intentions does Network Rail have to introduce an asset database?
8	Whilst encouraging Network Rail to develop an asset database, ORR need to note that SBB took many years to develop the system. It is not a quick solution.
9	SBB claim to double the life of the formation by investing in a sealing layer of bitumen combined with good drainage. Should Network Rail be investigating this approach?
10	SBB use a UIC devised scoring system for assessing the condition of track components. Do Network Rail know about this and have they considered using it?
11	Expert support from Graz University has helped SBB improve rail life through better rail grinding. Has Network Rail investigated this?
12	SBB are very enthusiastic with their condition monitoring on points. Should Network Rail copy this?

Issue	Question for NR
13	SBB have analysis system that allows them to simply assess the effect on cost of varying the possession strategy. It was suggested that it could be easily modified to suit Network Rail.
14	SBB now look to cluster jobs together to optimise possession usage.