



Possession policies drive down maintenance costs

ANALYSIS Understanding the relationship between cost and time can enhance the planning of maintenance and renewals through efficient resource allocation. Having experimented with fixed slots on several busy routes, Swiss Federal Railways is now rolling them out across more of its network.

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Allocating sufficient time for maintenance and renewals is a growing challenge confronting many railway infrastructure managers. Given a rising demand for rail transport, they face a difficult trade-off between assigning capacity to maintenance and track renewals, or earning more revenue by selling the slots to train operating companies for additional services.

Cutting back on maintenance is not an option, as infrastructure condition deteriorates continually under traffic, and postponing work frequently results in greater costs. If there has been substantial degradation in the meantime, delaying essential works can increase

life-cycle costs by orders of magnitude.

Postponing maintenance is not in the interest of the train operators, either, as poor infrastructure condition impacts on them too. Speed restrictions reduce capacity and track closures caused by asset failures will result in a less attractive service for their customers.

Swiss Federal Railways' infrastructure business is facing this challenge. Growing demand has seen service levels on many routes increase significantly over the past two decades, resulting in more wear and tear but requiring maintenance to be squeezed in to as short a time as possible. To minimise the need for rescheduling, and to avoid interfering with traffic during the busy morning and evening rush hours, much of the work, including track renewals, is done at night.

However, the nightly slots are getting shorter and sparser, as operators want to run more passenger trains into the late evening or beyond, particularly

with the growth of round-the-clock entertainment at weekends. With much freight traffic already moving outside the traditional passenger hours, this further intensifies the competition for capacity between traffic and maintenance.

Capacity allocation becomes crucial, as fitting maintenance into shorter slots increases the cost for a given volume of work. SBB Infra therefore asked R+R to review the impact of different possession times on the estimated cost of maintenance, in order to provide a basis for the development of more efficient and cost-effective strategies.

Time-dependent costs

Maintenance costs depend on several factors. The type of work undertaken is, of course, the main driver, and track renewals in particular are both expensive and time consuming. It is not usually possible to complete the work

Following a series of pilot projects, SBB introduced a 'fixed maintenance window strategy' for heavy maintenance and renewals in 2013.

in one possession, requiring several consecutive night shifts with up to 8 h of continuous track possession each. But there are other considerations too. The length of productive time in each possession was expected to be an important factor, but the influence of slot length on costs was not initially clear.

In co-operation with SBB Infra, R+R derived a quantitative cost model for track renewals by analysing the costs of sample projects in relation to the time available. This work also took account of the renewal techniques used, the length of track renewed and the distance between the work sites and the stabling places for the machines required.

Fig 1 plots the total cost of track renewal work against the time available. This enabled the infrastructure manager to estimate the impact of changing the length of a possession. For example, if the nightly possessions are shortened from 6 h to 5 h, the costs would increase by 8%, but if they are extended from 6 h to 7 h, then 6% could be saved.

The total costs are compiled from many different elements, including the price of the materials used, machine rental fees, staff wages, and so on. Things like material costs are independent of possession time, accounting for around 60% of all costs, but the other 40% are time-dependent (Fig 2).

Of course, the total amount and structure of costs for a given project can vary, depending on the maintenance method and working processes chosen. But the number of possessions can be reduced if each slot is extended, potentially freeing up track capacity for the operators and reducing the cost of providing replacement services.

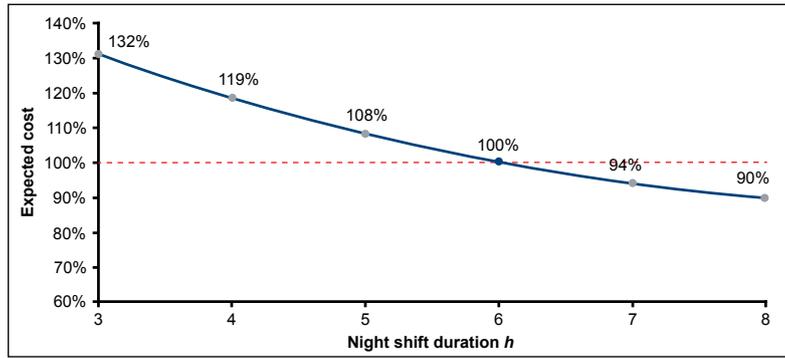
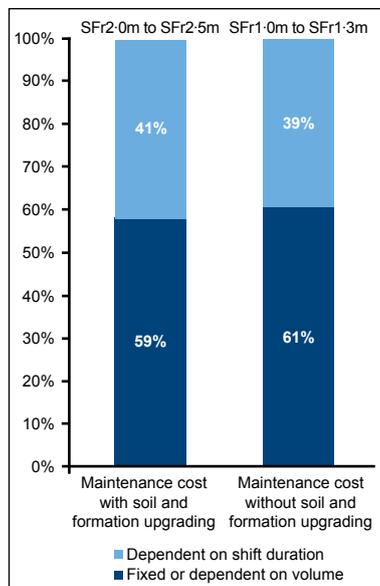


Fig 1. Predicted total cost of track renewal, including subgrade and formation improvements over a sample length of 1000 m.

Standard possessions

In 2009, SBB Infra commissioned a comprehensive audit to record the condition of its entire network for the first time. This revealed a huge backlog of maintenance work (RG 4.10 p40). To ensure a higher availability over the longer term, the government agreed to allocate an additional SFr600m per year for asset maintenance, bringing the annual total to approximately SFr2.1bn. Meanwhile, the utilisation of network capacity is continuing to grow; from 95.4 trains/day per km of main track in 2010, SBB Infra is currently forecasting a rise to 102 trains/day in 2015.

To fit the additional maintenance and expansion work around the higher use of the network, the SBB management board agreed to introduce a 'fixed maintenance window strategy', starting in 2013. This envisages longer engineering possessions, both in terms of track length and time, which will enable machinery and resources to be used more efficiently. And more tasks will be carried out in parallel within a single closure window.

Standard possession types have been defined for each section of line within the slot management strategy (Fig 3). The arrangements for implementing the standard possessions — such as the

start and end dates, seasons, and days of the week — are co-ordinated with the train operators well in advance.

Fixed maintenance windows

The use of standard possessions was tested on seven pilot sections in 2012 — four for maintenance and three for renewals. The pilots were evaluated in detail, to assess the financial impact compared with traditional methods and shorter possessions. The analysis also took account of the cost of replacement bus services, as well as diverting freight and passenger trains.

To avoid any disproportionate impact on rail operations, the possessions were scheduled outside peak hours, and accompanied by proactive and open communications to ensure customer acceptance. Table I shows the impact of the four maintenance pilot projects.

Longer possessions enabled a more efficient use of resources and allowed the clustering of different tasks within the same slot. The resulting synergies reduced the number of possession hours by an average of more than 30%. The cost savings depended on the route, the amount of work and the nature of the services using the line.

An off-peak daytime closure between

Left: Fig 2. Track renewal costs fall into two categories: those related to the length or volume of the work and those dependent on the duration of the possession slots.

Below: Fig 3. SBB is developing a range of standard time slots for maintenance, renewal and upgrading projects.

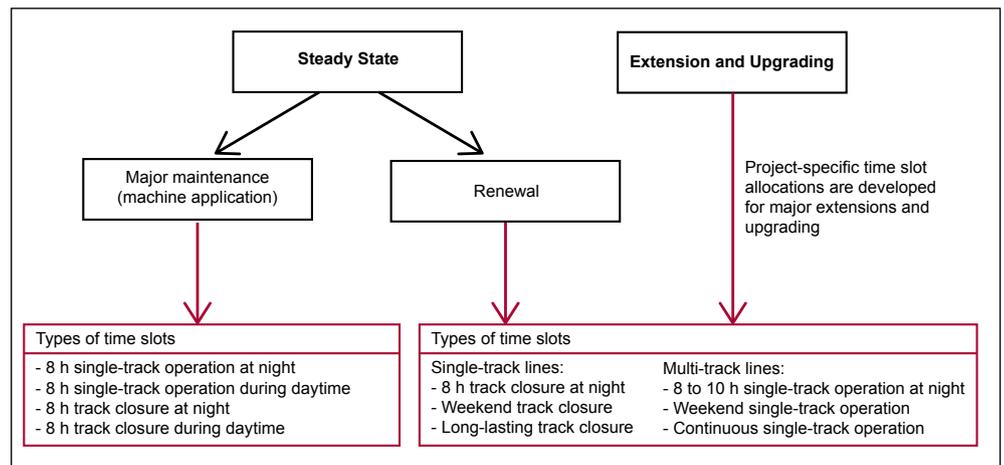
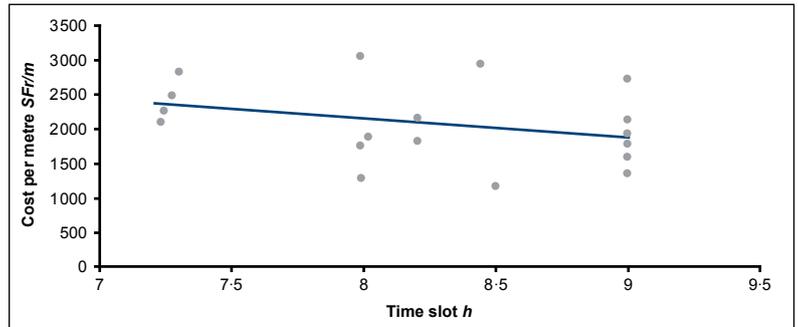


Fig 4. The relationship between time slot length and cost for ballast cleaning and replacement work, excluding outliers.

08.30 and 16.30 resulted in a net saving of 28% compared with conventional methods. An 8 h night slot with single-track working to maintain sections of double track generated savings of 22%. In the case of single-track lines, fixed maintenance windows increased the net efficiency by between 6% and 23%. However, it should be noted that this approach required more forward planning and preparatory work.



Track renewal efficiencies

The three track renewal pilot projects were undertaken on the Bex–Les Paluds, Zürich HB – Wipkingen and Aarburg – Zofingen routes. The standard possessions ran for 8 to 10 h at night and 44 h at weekends, with single-track operation past the worksite. Compared to conventional possessions, these projects showed a positive financial impact of between 7% and 22%.

Over the coming years, SBB expects to undertake up to 180 km of trackbed renewals each year. Closing longer sections of line under a more proactive possession regime should have a significant impact on costs. Retrospective analysis of various trackbed renewal projects involving ballast cleaning and replacement showed that extending the possessions from 7 h or 8 h to 9 h or more could deliver savings of up to 25% (Fig 4). These are largely related to resource optimisation and the improved utilisation of the various machines.

Following the positive experience with the pilot projects, SBB is planning to adopt a range of standard possessions for renewals and upgrading work, giving 8 h to 10 h of single-track operation, weekends with single-track

operation, continuous single-track operation over several days, and complete blockades, depending on the scale of work involved. These standard possessions will be introduced systematically and scheduled in agreement with the timetable planners.

A key factor in increasing the efficiency of renewal work on double-track lines is the use of continuous single-track operation, where the track spacing and safety regime permit. This makes it possible to achieve high productivity with heavy tracklaying machinery, avoiding the need to remove the equipment at the end of each shift and bring it back for the next.

Impact on passengers

The issues of service quality and customer satisfaction will need to be considered carefully as the standard slot strategy is expanded. During the pilot projects, SBB insisted that maintaining and safeguarding the transport chain took priority in all cases.

Passengers were directed to use alternative services or rail replacement buses. A variety of communication methods was used to inform

customers, including posters in trains and at stations, press advertising, amendments to the online timetable, and loudspeaker announcements.

Work was also undertaken to check whether the extended journey times would be acceptable. Passenger numbers were recorded and compared with the ridership that would have been expected if there had been no possession. No significant decrease was identified in either passenger numbers or revenues.

In general, there was a good customer acceptance of the pilot projects. There were a few negative reactions, but no more than would have been expected for conventional maintenance. However, it was difficult to measure passenger behaviour or customer satisfaction with the reduced service.

Very few freight trains had to be diverted. In most cases, consultation with the train operating companies enabled the affected services to be rescheduled to run earlier or later.

Expanding the strategy

SBB has now started to introduce fixed maintenance windows on key routes (Fig 5), with a view to phasing them in gradually on more lines over the next few years. Resource constraints mean that the strategy cannot immediately be applied network-wide. The planning and implementation of fixed windows requires significant effort in terms of co-ordination, logistics and resource allocation, as well as the need to comply with employment legislation.

During 2013, SBB brought in fixed maintenance windows on 11 more line sections, bringing the total to 15. This year a further 17 sections will be added, including several where work will be undertaken in off-peak daytime possessions. The project team is currently assessing which routes should form part of the programme for 2015.

The fixed window strategy is

Table I. Results of 2012 pilot projects for fixed maintenance windows

Route section	Lausanne – Sion	Hübeli – Lenzburg	Cadenazzo – Locarno	Ziegelbrücke – Linthal
Type of line	Main line	Regional line	Main line	Branch line
Fixed maintenance window	8 h single-track working at night	8 h total closure 08.30 – 16.30	8 h total closure at night	8 h total closure at night
Possessions required	30	10 (+ 5 night slots)	7	4
Impact on long-distance services (per slot)	3 trains diverted	None	None	None
Impact on regional services (per slot)	Bus replacement for 8 trains	Bus replacement for 28 trains	Bus replacement for 17 trains	Bus replacement for 8 trains
Impact on freight services (per slot)	1 train diverted	1 train diverted	None	None
Length of conventional possessions	4 to 5 h	5 h	4 to 5 h	4 to 5 h
Number of conventional possessions needed	140	84	14	17
Net cost saving	22%	28%	23%	6%

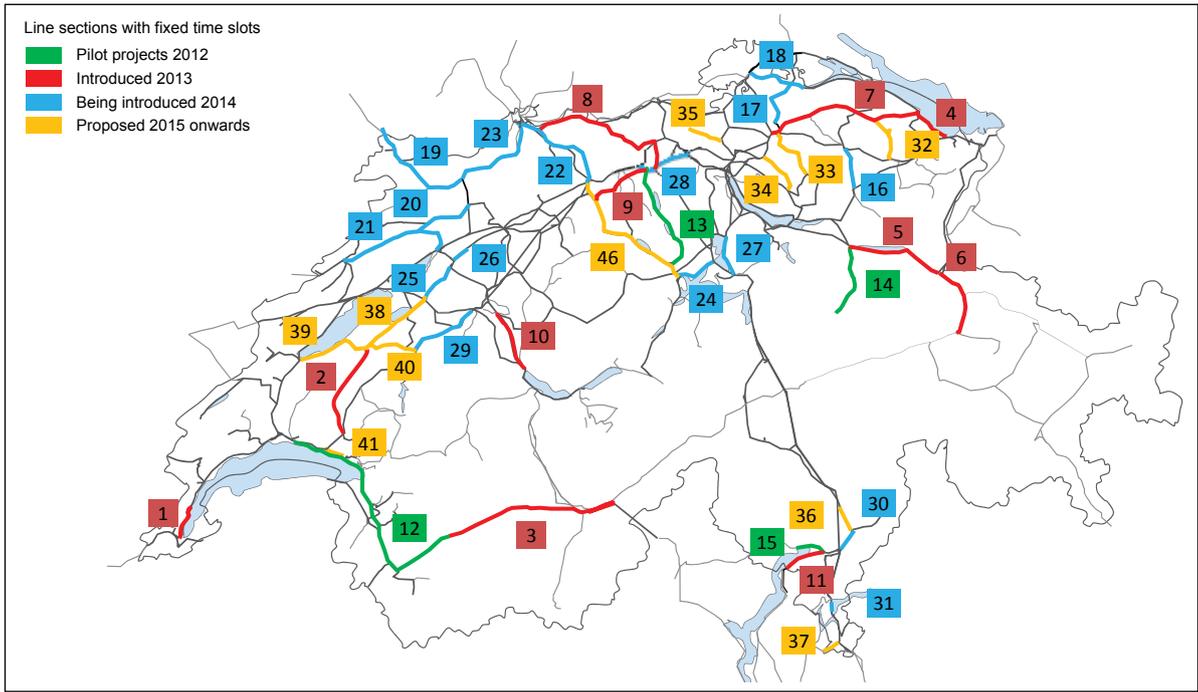


Fig 5. SBB Infra is introducing fixed maintenance windows on a growing number of routes between 2012 and 2015.

intended to ensure the systematic inclusion of infrastructure maintenance requirements into the planning of network utilisation. Possession windows should be an integrated part of the timetable and the timetable planning process.

Whereas it is not too difficult to allocate slots for routine maintenance, finding time for major renewals and upgrading projects is not so easy, as the capacity has to be reserved well in advance. In future, SBB envisages that both the maintenance and renewal requirements will be 'part of the timetable' across all planning horizons. Further development is expected to move towards a more integrated

capacity management regime, taking into consideration the needs of all network users — passenger services, freight and infrastructure.

Sharing the benefits

The new approach to slot assignments and fixed maintenance windows offers several advantages. From the train operators' perspective there is more predictability about the train services, and less need to inform customers about diversions or cancellations. For the infrastructure manager, having a negotiated time frame means that the maintenance projects can be planned more reliably. And last but

not least, timetable planners do not have to adjust the seasonal timetables to allow for major projects, as it is possible to build in standard allowances for a given number of temporary speed restrictions.

Extending the length of individual possessions, reducing the total number, and clustering the opportunities to undertake work in parallel all offer significant savings. Along with accurate planning and capacity management, SBB anticipates that the new strategy will help to reduce the overall cost of infrastructure maintenance by between SFr30m and SFr50m a year, or almost 10% of the total projected expenditure. ↩