

# Cost effectiveness of ERTMS in Sweden



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# Introduction

The government has assigned the main responsibility for the deployment of ERTMS in Sweden to Trafikverket (Swedish Transport Administration). This assignment includes accounting for and presenting the costs of the global project and outline the benefits for infrastructure owners and users of the railway.

The signalling system is an important part of the railway system that contributes to safety and also enhances the possibility to organize traffic for better use of capacity on the railway. Today a number of different signalling systems are used throughout Europe. Trains that are crossing borders therefore have to be equipped with several signalling systems and the driver of the vehicle must be trained to use any one of them. ERTMS is a common European signalling system aiming at facilitation of border crossing traffic and replacing existing systems with a new generation of Control Command system. The current signalling system in Sweden, as in Norway, is ATC (Automatic Train Control).

The implementation plan for ERTMS is legally binding for the member states and the Swedish plan includes the part of the railway network called corridor B (mainly Southern Main Line).

## Impact assessment

Besides enhanced interoperability ERTMS will have a number of impacts for train operators, passengers, freight customers and infrastructure owners. In short, these effects concern:

- Increased safety
- Reduced maintenance cost
- Reduced investment cost
- Reduced cost for traffic management
- Enhanced capacity and increased maximal line speed

The total investment required for implementation of ERTMS in the Swedish railway network has been estimated to 28-33 billion SEK (this includes the infrastructure where the system is already installed), whereof 7-8 billion concerns corridor B. The total sum includes both investments in the infrastructure (25-30 billion SEK) and on-board equipment (2,6 billion SEK).

Benefits and costs of ERTMS are unevenly distributed. Benefits will mainly be gained by the society and the infrastructure owner in form of lower costs for maintenance, reinvestment and new railway establishment. The costs are however carried by both infrastructure owners and vehicle owners. For vehicle owners (and society) there will be benefits from increased capacity, higher maximal line speed and higher operational speed, especially for freight trains. The magnitude of these impacts is however difficult to capture and calculate, even if attempts have been made, as in the study summarized below. In addition, a long period of time will elapse between the time for investment and time for revenue.

The current decision is that investment in new on-board equipment should be fully carried by the owner of the vehicle, i.e. no National Financing Scheme exists in Sweden. This increased cost for the

operators could influence the competitiveness of the railway towards other modes of transport. Also, the balance between stakeholders could change, this as a consequence of differences in mean investment per vehicle (as there is a high cost for the first vehicle in a series there will be a disadvantage for operators with few vehicles of one type). It might be difficult for some smaller operators to finance the investment as it has to be made within a short duration of time.

## Impact on infrastructure costs

### Signalling system costs

The implementation of ERTMS means that the current signalling system ATC is replaced. In terms of cost this leads to that reinvestments in the signalling system will be performed earlier than it would when keeping the current signalling system. This cost concerns on the first hand the Southern Main Line.

Seen over the whole calculation period the implementation of ERTMS means a lower cost than keeping the existing ATC system. The difference is that ERTMS leads to higher costs until 2035, after which ERTMS probably will mean lower costs.

### New investment costs

When establishing new railway links ERTMS will mean lower cost for signal measures compared to ATC.

### Maintenance

The cost for maintenance of the signalling system will be lower with ERTMS.

## On-board equipment

In order for rail vehicles to be able to operate on ETRMS-equipped tracks they have to be equipped with ERTMS on-board equipment. During the migration period it is also necessary to have an STM-module installed that translates signals from the existing signalling system. As the existing signalling systems differs from country to country an STM module is needed for each country where the vehicle is operating.

There are around 1600 vehicles in Sweden that will require the equipment. Sweden has, as many other countries, chosen the so-called vehicle strategy for the implementation. This strategy means that the vehicle equipment will be installed before starting roll-out of ERTMS trackside. Thus, all vehicles trafficking an ERTMS link will have to be equipped before the system is taken into operation.

The ERTMS on-board investment is estimated to be around 1,6 – 2,7 billion SEK for vehicles that need to be converted in connection to the implementation of ERTMS on Corridor B and about 2,6-4,4 billion SEK for the total implementation. The span in the sums above refer to assumptions about whether the costs for type approvals will be shared between stakeholders and whether there will be a loss of income in connection to the conversion.

Investments for type approvals (installation in the first vehicle in a series) is significantly higher than serial installations but accounts for a limited part of the total cost (400-720 million SEK totally). The cost for in vehicle equipment has another distribution over time than the cost for the signalling system

in the infrastructure. This is due to the fact that vehicles operating on tracks equipped with ERTMS must have the on-board equipment as well as the STM-module.

## Summary of performed CBA study

Below is a summary of a CBA study performed in May 2013 by the Swedish Transport Administration.

In addition to the interoperability, i.e. the enhanced possibilities for border crossing operation, ERTMS has impacts for infrastructure owners, who will gain from lower cost of operation and maintenance, as well as for the train operators and their customers, gaining from the increase of available capacity and maximal line speed. In the study calculations on socio-economic benefits for passenger trains are presented. The benefits for freight trains were not included in the calculation, neither were possible impacts from interoperability nor safety.

The general premises used for passenger forecast and calculation are the same as for all other infrastructure investments in Sweden.

Implementation of ERTMS on the Swedish railway system is a process extended in time. The complete railway network is estimated to be equipped by 2035. By 2025 the Swedish part of corridor B will be equipped with ERTMS and the traffic can start benefitting from the enhanced capacity. In the calculations it was presumed that the traffic impacts would start by this year and then gradually increase as the new signalling system is installed. In a sensitivity analysis the benefits were calculated on the premise that the impacts emerge after the full implementation, i.e. in the year of 2036.

In the calculation the capacity increase from ERTMS is valued by the help of a calculation method established by UIC. The method is described in UIC leaflet 406 and is used to describe the capacity situation on a larger network in a brief way. According to theoretical calculations the headway between trains could decrease by one minute for all train types. In the calculations the traffic volume is presumed to be constant and the effect is taken out as shorter time-table times. Another way to gain from the increased capacity would be to increase the number of trains while keeping the time-table unchanged. In reality, a combination of these two ways will probably be chosen.

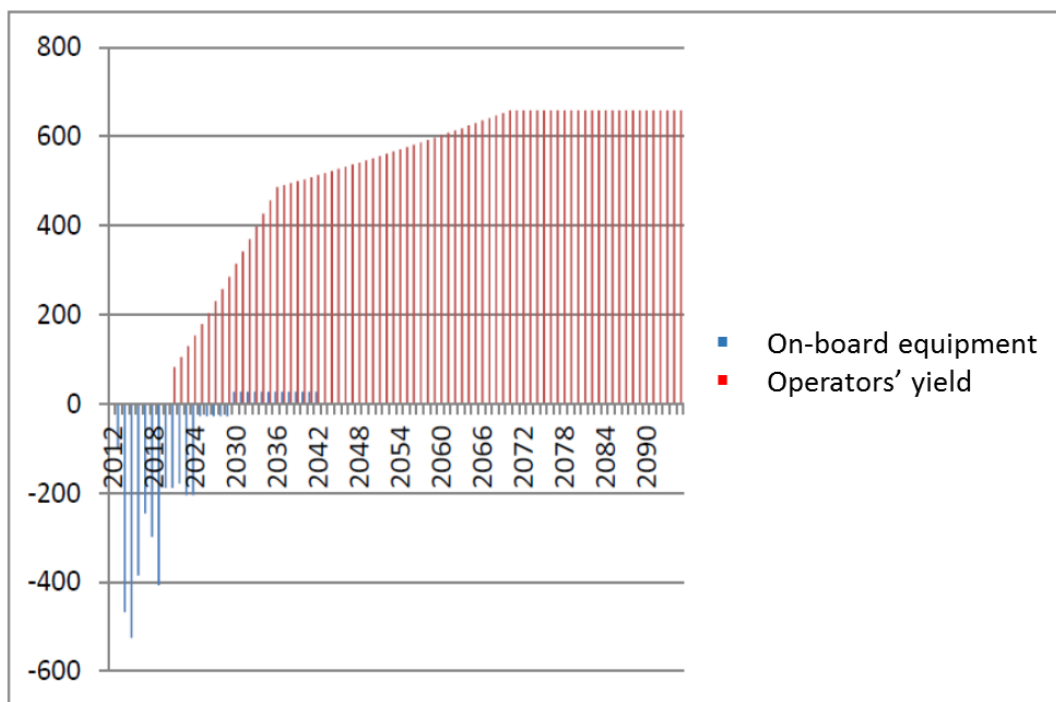
The net present value of the gathered impacts by the ERTMS is calculated to 26,5 billion SEK in the main analysis and to 21 billion SEK in the sensitivity analyses. In the table below the distribution of the different impact posts of the main analysis is shown. In the sensitivity analysis it is the net value from the increased capacity that will be lower.

<b>Socio economic Net Present Value</b>		
<b>Infrastructure</b>	reinvestments in system ERTMS compared to ATC	+3400
<b>Passenger train operators</b>	Vehicle equipment	-2700
	Increased capacity (ticket fees, operational costs)	+8600

<b>Passengers</b>	Increased capacity (shorter travel time)	+17300
<b>SUMMARY</b>		+26500

The study concludes that the problem concerning implementation of ERTMS is that costs and benefits are very unevenly distributed over time, with high initial costs and benefits emerging much later.

The distribution of cost and revenue for the train operators over time is shown in the picture below.



Figur 1 Train operators' financial costs and income from ERTMS over the calculation period

It is not until 2025 that the train operators' yearly revenue from ERTMS will exceed the costs for installation of ERTMS on-board equipment.

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