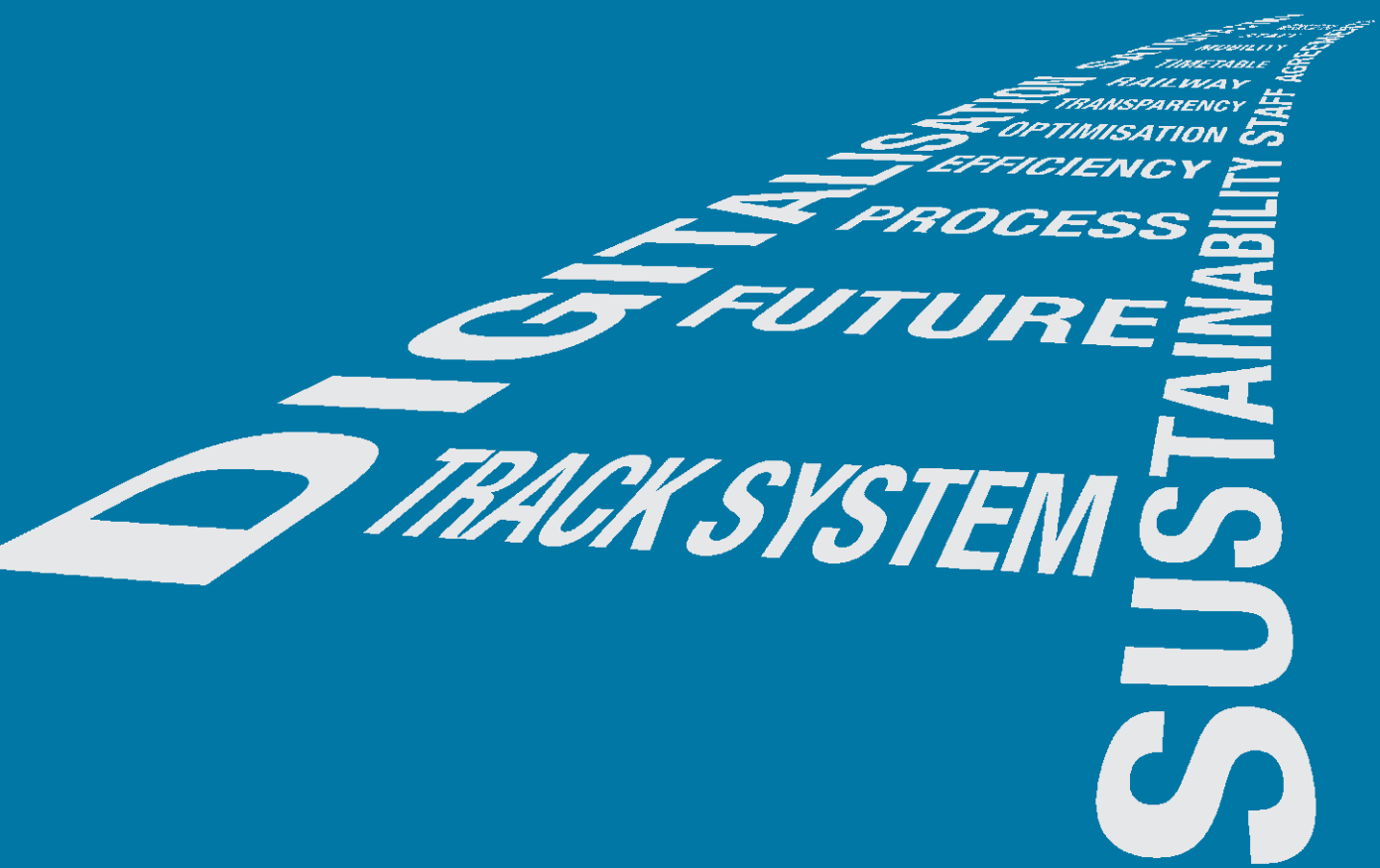
BEST PRACTICE
IN TRACK MAINTENANCE

Volume 1

Infrastructure Management

FLORIAN AUER



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Preface

The management of the railway infrastructure presents a high degree of complexity. Economic, legal, political and especially technical interrelations contribute to this. The objective of the series “Best Practice Track Maintenance” is to describe these interrelations in a structured manner for all parties involved.

Volume 1 “Infrastructure Management” provides an overview of the concerns and issues that infrastructure management faces, with special consideration to the permanent way. Managing railway infrastructure in an integrated and sustainable way requires a structured and methodical approach. Market orientation and environmental considerations do not oppose each other if they are considered jointly within the railway system.

The EU’s “Fourth Railway Package” provides clear guidelines for the future direction and harmonisation of the infrastructure managers’ tasks and processes. The aim is to unify the regulations and guidelines in the railway industry, which have evolved within historical and national contexts and therefore differ greatly. This book aims to illustrate the interrelations in order to promote an understanding for all stakeholders of the necessity of the Single European Railway Area. Ultimately, this will create a common basis for discussion among all those involved.

Best practice examples, mainly from Central Europe, will be used to demonstrate measures for targeted upgrades and improvements in track maintenance on existing networks. In many places infrastructure managers are confronted with a new generation of managers, which will accelerate a new direction in processes. Present-day information and communication technology offers many opportunities to make it far easier to collect and present the complex interrelations. Changing views of asset management and life cycle management will help to enable the implementation of a “transparent permanent way” or the “Railway 4.0”.

My heartfelt thanks go to my expert advisers and past and present employers: Graz Technical University, ÖBB-Infrastruktur AG and Plasser & Theurer.

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Florian Auer
Vienna, November 2017

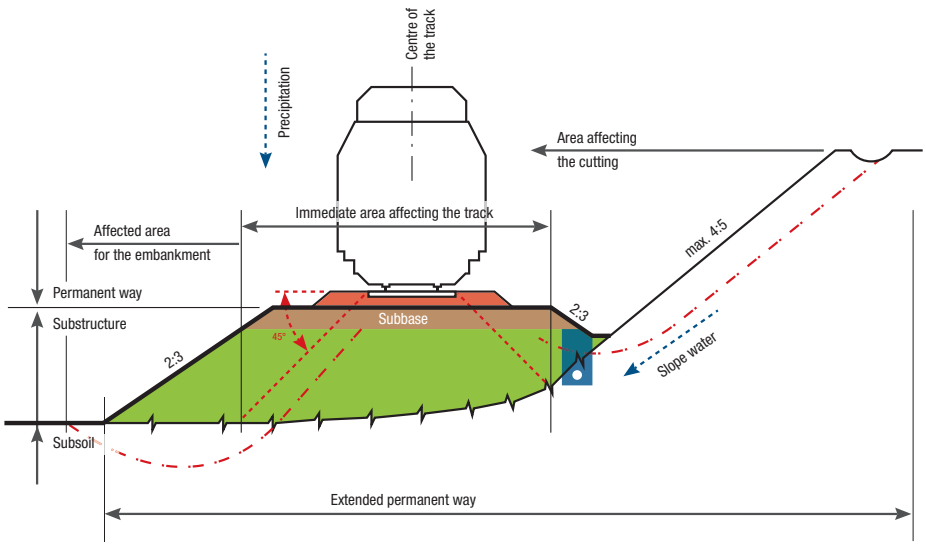

Fig. 3-2: The extended permanent way is the area relevant for the availability of the track system [3]

3.3 Developing a geodata infrastructure – INSPIRE

The manner in which relevant railway geodata is utilised is continually developed by the EU and other transport operators. The instrument of geodata infrastructure incorporates information from various stakeholders. The EU anticipates extensive synergies from this, e.g. from a simpler exchange of information among authorities.

According to **Directive 2007/2/EC of the European Parliament and of the Council "establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)",** all public transport operators, i.e. rail, road, waterway and aviation, must establish a common infrastructure for spatial information in order to improve the exchange of geodata information. Directive 2007/2/EC comes with a few implementing decisions that provide detailed definitions on meta data, geodata sets and network services and govern the monitoring and reporting of such. The term INSPIRE comes from the English "Infrastructure for Spatial Information in the European Community". [4]

Here, too, interoperability, this time that of data, is critical for the success of a project. The implementation of the directive will achieve improved availability, quality and accessibility of geodata, i.e. data with a direct or indirect reference to a

location. The primary objective is to use this information to enhance measures in environmental policy. [5]

Furthermore, due to extensive cross-linking of the data a wide range of possibilities to use the information in other subject areas will arise. According to Directive 2007/2/EC, the member states are responsible for providing and updating their geodata records. The configured network comprises search services, presentation services, download services, transformation services and options for calling up geodata services. At a community level, the Commission is responsible for coordinating INSPIRE. INSPIRE is based on the geodata infrastructures set up and managed by the member states. [6]

The "INSPIRE" geoportal (http://inspire-geoportal.ec.europa.eu/) makes the data listed available and also offers various additional services (see Fig. 3-3).

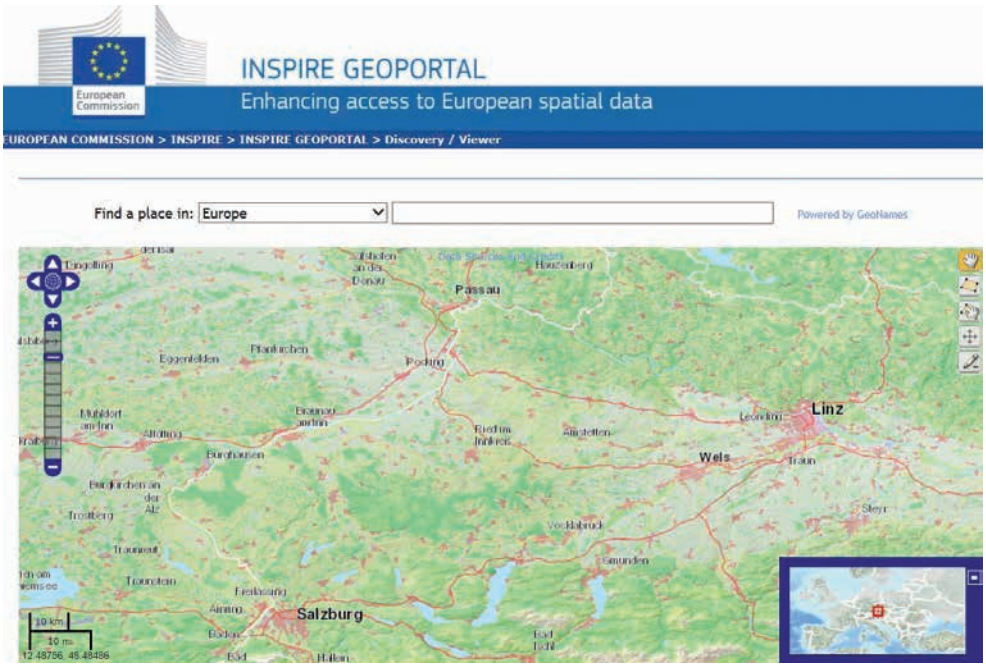

Fig. 3-3: The EU INSPIRE geoportal [7]

The data made available covers a wide range of subject areas, e.g. land register of areas of potential concern, nature reserves, designated land use, details on demographic development and many more.

In its proprietary infrastructure documentation system infra:gis ÖBB-Infrastruktur AG developed a link to all environmentally relevant data based on geo-referenced localisation. By merging the ÖBB land data with the Austrian register of areas of potential concern it was possible to achieve increased efficiency when handling various infrastructure projects. [8]

3.4 System documentation

The quality of system documentation has always been of particular importance. Over time, the development of documentation went through three main phases. It started in analogue format. Later this was replaced by spreadsheets, and currently these are being replaced by a third phase of the development, the complete and interconnected digitalisation of data based on a common network model.

Correct system documentation provides the basis for technical, commercial and legal aspects and issues.

3.4.1 Manual records

Track information, drawings, surveys and equipment catalogues in paper format were originally the documentation options for the railways. Providing this documentation in analogue format was extremely intensive for administrations. However, it also had inbuilt system advantages. In the development of the documentation greater emphasis was put on a uniform structure within the whole network area. Tasks and processes were clearly defined. A reporting mechanism was used for interfaces. The issuer of the respective documentation was responsible for the content. Organisational structure and documentation went hand in hand.

Fig. 3-4 shows a schedule of permanent way works from around 1960. By aligning data graphically to a location (distance markers or mileposts) the content was presented in clearly structured track information.

4.5.7 Technical safety management

Ensuring the highest level of safety in the railway sector is always a top priority. Here, a distinction must be made between different tiers of safety. “Technical safety” is highly significant with regard to life cycle management.

“Technical Safety” according to the Memorandum on the quality feature of “technical safety” published by the Association of German Engineers is defined as follows [124]: “The term ‘Technical Safety’ means that a technical system, plant, product fulfils its intended functions over a projected period of time (projected service life if applicable) and does not do harm to any protected legal assets if used appropriately, i.e. does not harm any persons or objects where the system, plant or product may be the cause for the harm. The reliability of the function over the projected service life is not a necessary component of safety provided that the loss of function does not result in an unsafe state.”

Fig. 4-42 depicts the factors influencing the safety of railway operations.

Factors affecting safety	
Hazards from the natural environment	
	Climate effects
	Physical effects
	Corrosion
Hazards from the technical environment	
	Exceeding the load capacities and forces
	Effects from the technical environment (e.g. chemical action on the overhead line)
	Reduction / increase in electrical resistances due to corrosion and fatigue
	Calculated requirements not being met due to manufacturing process
	Exceptional effects due to usage (e.g. in case of a derailment)
Human errors	
	Hazards not recognised subjectively or objectively
	Insufficient knowledge
	Insufficient information, misunderstandings
	Wrong decisions due to political pressure or false economy
	Negligence

Fig. 4-42: Factors influencing the safety of the railway track [125]

Besides technical and environmentally relevant topics the human factor must not be forgotten. The member of staff must have sufficient knowledge of technical and organisational issues. Digitalisation can play a supporting role, especially for depicting complex issues in a comprehensible way.

An honest company culture of lessons learnt and the increase in motivation arising from this can contribute to any potential failure hotspots just disappearing by themselves. In this context, the traceability of documentation is also important for achieving the best possible transparency. This is also referred to as “safety controlling”.

4.6 Environmental impact

People’s claim for ever increasing mobility impacts on the environment in different ways. For instance, through the use of land for setting up or expanding the transport network, the consumption of energy required for mobility or through the noise caused by traffic. Compared to other modes of transport, rail traffic is among the forms of mobility with the lowest impact on the environment. For example, one passenger kilometre by rail only uses about a third of the energy compared to a car. [126]

4.6.1 Energy consumption

In Europe about 28 % of the emissions of the key greenhouse gas (CO_2) are attributable to the transport sector. [127] For this reason, concerted efforts will have to be made in this sector in future in order to reduce emissions. Within the first EU package on climate and energy policy measures, the European Union committed to reduce its 1990 emissions by 20 % in 2020. In addition, the share of renewable energy sources should be increased to 20 % and energy efficiency improved by 20 %. These are the so-called **“20-20-20 targets”**. [128]

Building on the 2020 climate and energy package it is envisaged to reduce the level of the EU’s greenhouse gas emissions from 1990 by at least 40 % by 2030. The 2011 EU White Paper on transport indicates a target of 80 – 95 % reduction of emissions by 2050 compared to the levels of 1990. This corresponds with the result of the 2015 Climate Change Conference in Paris which aims to limit the rising temperatures as a result of global warming to below 2°C. The 2011 EU White Paper on transport mentions a reduction of the 1990 greenhouse gas emissions by a minimum of 60 % by 2050 for the transport sector. [129]

In order to support the reduction of greenhouse gases in a cost-efficient and economically efficient way, the European Union enacted **Directive 2003/87/EC "establishing a scheme for greenhouse gas emission allowance trading within the Community"**. Trading greenhouse gas emissions permits aims to achieve a significant reduction of emissions in Europe. The income from auctioning the permits shall contribute to further development of renewable energies. [130]

4.6.2 Noise

With **Directive 2002/49/EC** "relating to the assessment and management of environmental noise" the EU laid down guidelines for the definition and management of environmental noise. The directive defines environmental noise as unwanted and harmful sound. [131] This EU directive has been translated into national laws, e.g. the Federal Noise Control Act (Bundeslärmschutzgesetz) in Austria.

The aim of these legal instruments is the reduction of noise pollution. As a first step, the actual state of noise pollution is determined using environmental noise maps. In the next step, measures for noise reduction are developed. For planned construction or expansion of the existing rail network it makes sense to determine future or changing noise pollution in residential areas and, if limit values are exceeded, to identify the noise control measures required by carrying out noise assessment studies. [132]

4.6.2.1 Noise mapping in rail traffic

Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 established that all member states would have to draft a common basis for the development and amendment of community measures already in existence with regard to the noise emitted by the major sources of noise. A common data base and collection of criteria would create a common understanding with regard to the issue of noise within the European Community. [133]

The directive lays down a common approach to the reduction of harmful effects from environmental noise. The following measures are to be implemented gradually [134]:

- determination of exposure to environmental noise
- information being made available to the public
- adoption of action plans with a view to reducing environmental noise pollution

In the course of implementing the first EU-wide measure for noise mapping in 2007 considerable differences were found in the assessment methods as well as in the

Railway infrastructure management is a highly complex issue. Economic, legal, political and especially technical interrelations contribute to this. The aim of the series **Best Practice in Track Maintenance** is to describe these interrelations in a structured manner for all concerned. Particular attention will be paid to the subject of sustainability.

Volume 1 – Infrastructure Management – provides an overview of the issues that infrastructure management faces, with special consideration to the Single European Railway Area. Best practice examples from Central Europe will be used to demonstrate measures for targeted upgrades and improvements in track maintenance on existing networks. In many places infrastructure managers are confronted with a new generation of managers, which will accelerate a new direction in processes. Present-day information and communication technology will make it far easier to collect and present the complex interrelations. Changing views of asset management and life cycle management will help to enable the implementation of a “transparent permanent way” or the “Railway 4.0”.

The **e-book** is available upon registration. Users of devices with a pdf reader (PC, tablet, smartphone) will have electronic access to all the terms and references through a search function.

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