RAILHOW

Achieving High Performance of the Railway Infrastructure

The new challenges for the Infrastructure Managers

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...what is this presentation about...

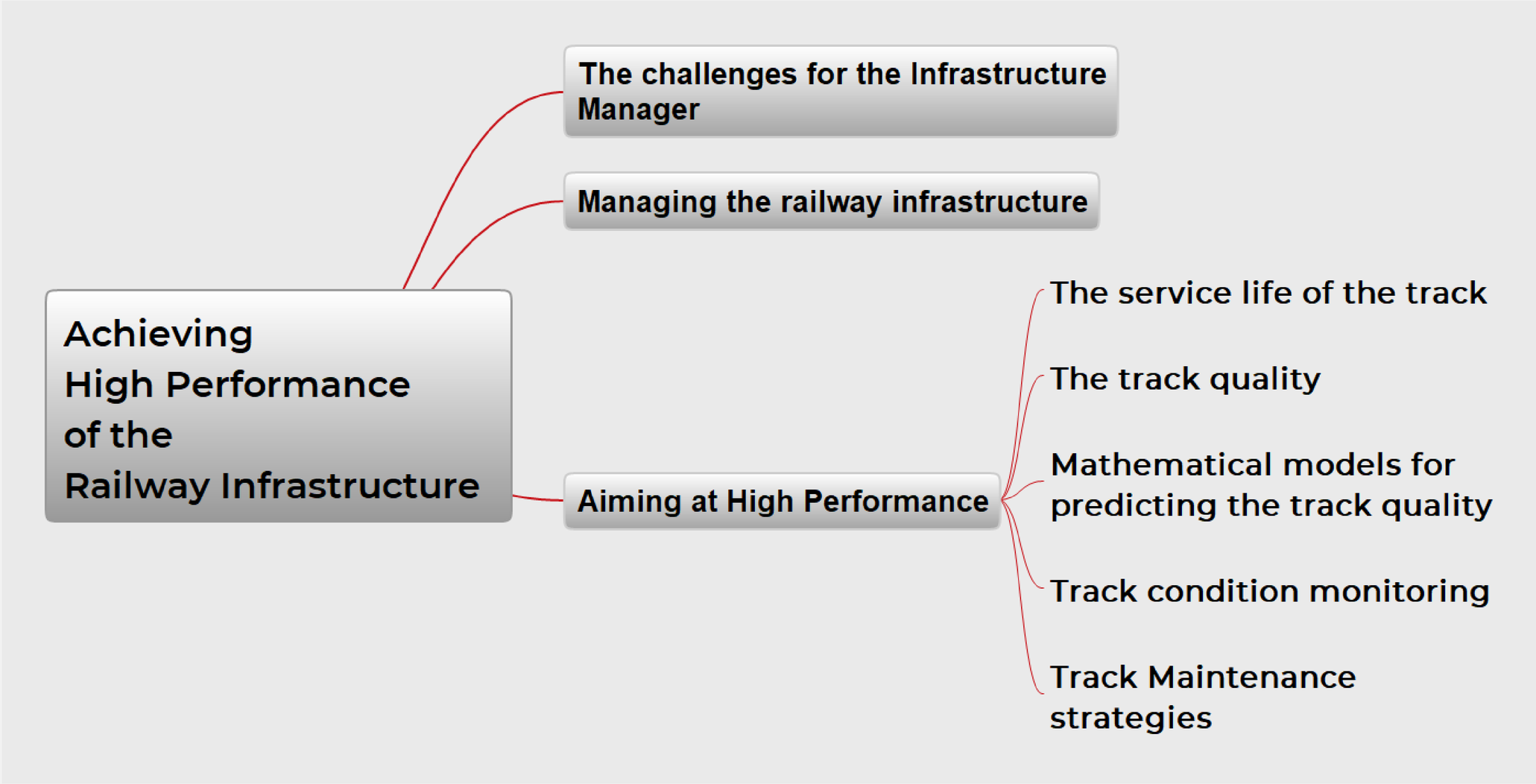
The Infrastructure Manager faces the following challenges, to be fulfilled all at the same time:

- Ensure the safe operation of the railway infrastructure
- Decrease his costs for the management of the railway infrastructure
- Increase the efficiency of the railway infrastructure.

The presentation is about to discuss all mentioned challenges. Following aspects are highlighted:

- the role of the Infrastructure Manager as also his objective to achieve high performance
- the importance of good quality of his assets. The railway track will be presented as an example.
- how to predict the quality of the railway track by using mathematical models
- effectively monitoring the track condition, and finally
- how to extend the service life of the railway infrastructure by choosing the best maintenance strategy.

Presentation Structure

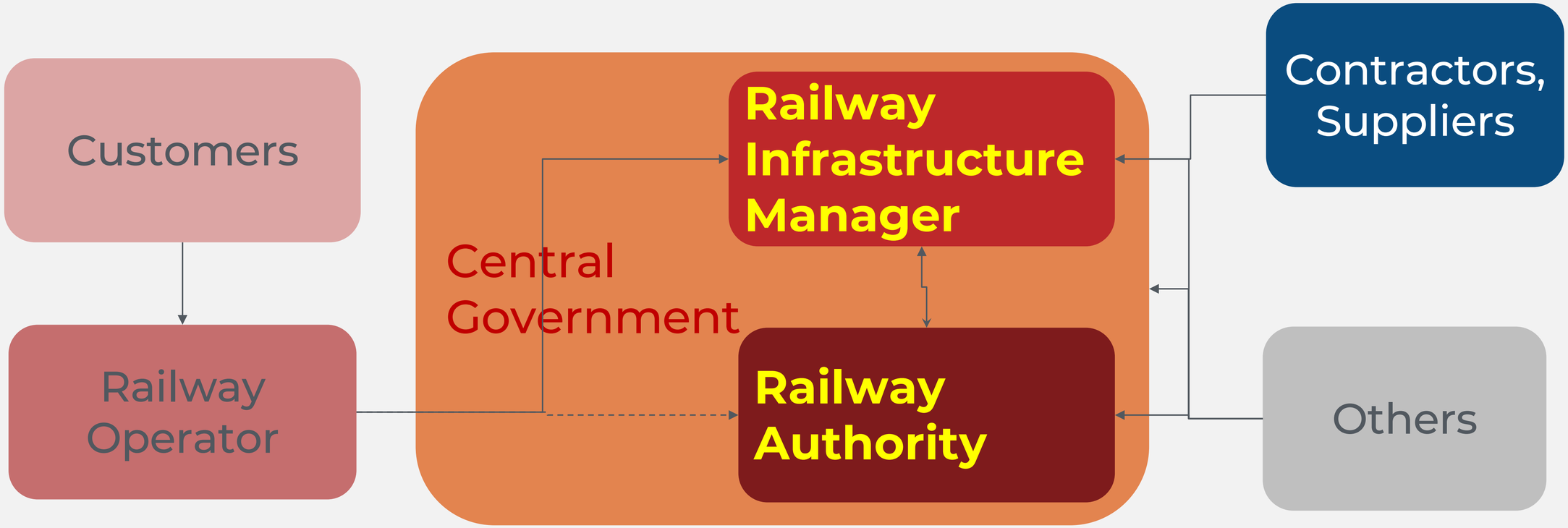


The challenges for the IM

IM = Infrastructure Manager

The Stakeholders of the Railway Sector

simplified

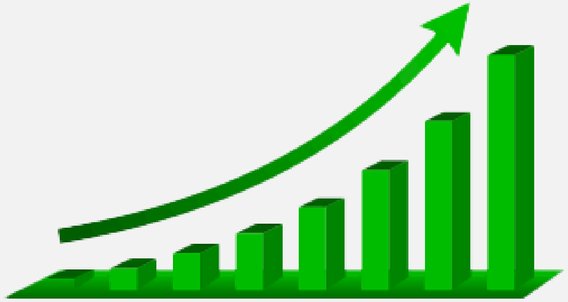


The Infrastructure Manager and the Government –
The new requirements to the IM

Reduce of funding

Cost reduction

Review of
current practices, finding ways of better functioning, set up new strategies

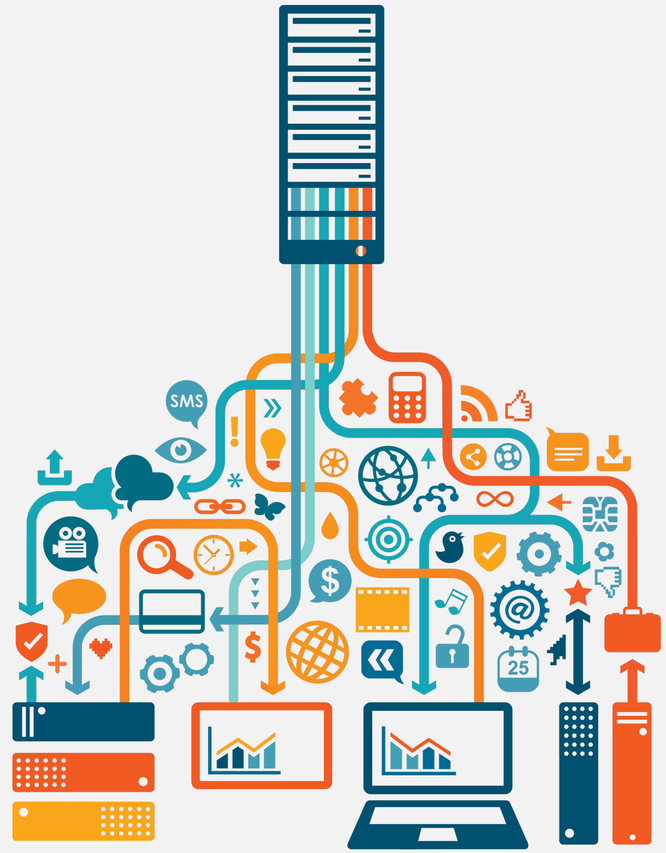


Target: performance improvement of the railway system

Challenges for the IM

The Infrastructure Manager faces the following challenges, to be fulfilled all at the same time:

- Ensure the safe operation of the railway infrastructure
- Decrease his costs for the maintenance of the railway infrastructure and the traffic management
- Increase the efficiency of the railway infrastructure.



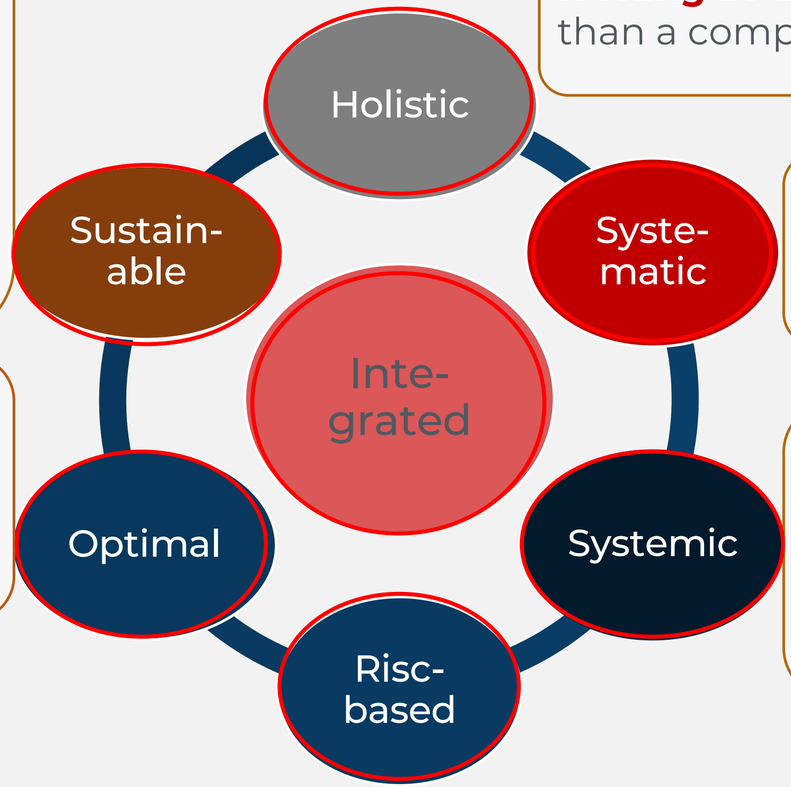
Managing the Railway Infrastructure

Example: the railway track

Key principles and attributes of asset management

considering the **long-term consequences of short-term activities** to ensure that adequate provision is made for future requirements and obligations (such as economic or environmental sustainability, system performance, societal responsibility and other long-term objectives)

looking at the whole picture, rather than a compartmentalized approach



a **methodical approach**, promoting consistent, repeatable and auditable decisions and actions

establishing the **best value compromise between competing factors**, such as performance, cost and risk, associated with the assets over their life cycles

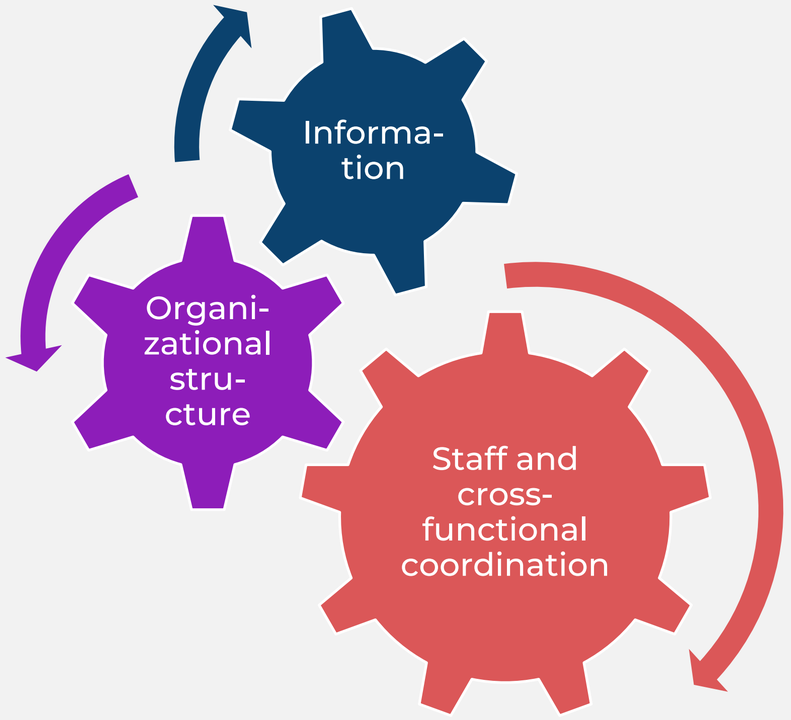
considering the **assets in their asset system context** and **optimizing the asset systems value** (including sustainable performance, cost and risks) rather than optimizing individual assets in isolation

Integrated: recognizing that interdependencies and combined effects are vital to success. This requires a combination of the above attributes, coordinated to deliver a joined-up approach and net value.

focusing **resources** and **expenditure**, and setting **priorities**, **appropriate to the identified risks** and the associated cost/benefits

Elements of successful implementation of asset management

- The following enabling elements are also considered to be essential for the successful asset management:
  - an organizational structure with clear direction and leadership;
  - staff awareness, competency, commitment and cross-functional coordination;
  - adequate information and knowledge of asset condition, performance, risks and costs, and the interrelationships between these.



Aiming at high performance

The service life of the track

The track deterioration

- At t=0 initial quality Q_0
- Track begins to deteriorate
- On time t_1, - intervention limit: maintenance actions
- Track quality Q_1 ($Q_1 < Q_0$)
- And so on..
- When the intervals become very short, the track must be replaced
- The service life of the track is at its end

Service life of a track is "the period of time over which the track provides adequate performance and function with anticipated maintenance but without major repair being necessary".

Typical service life cycles

Action on the track	Traffic load	Frequency
Tamping	40-70 mgt	4-5 years
Grinding	20-30 mgt	1-3 years
Ballast cleaning	150-300 mgt	12-15 years
Rail renewal	300-1000 mgt	10-15 years
Timber sleeper renewal	250-600 mgt	20-30 years
Concrete sleeper renewal	350-700 mgt	30-40 years
Fastenings	100-500 mgt	10-30 years
Ballast renewal	200-500 mgt	20-30 years
Formation renewal	> 500 mgt	> 40 years

The Track Quality

The importance of high initial quality

…. As discussed before …..
The challenges for the IM

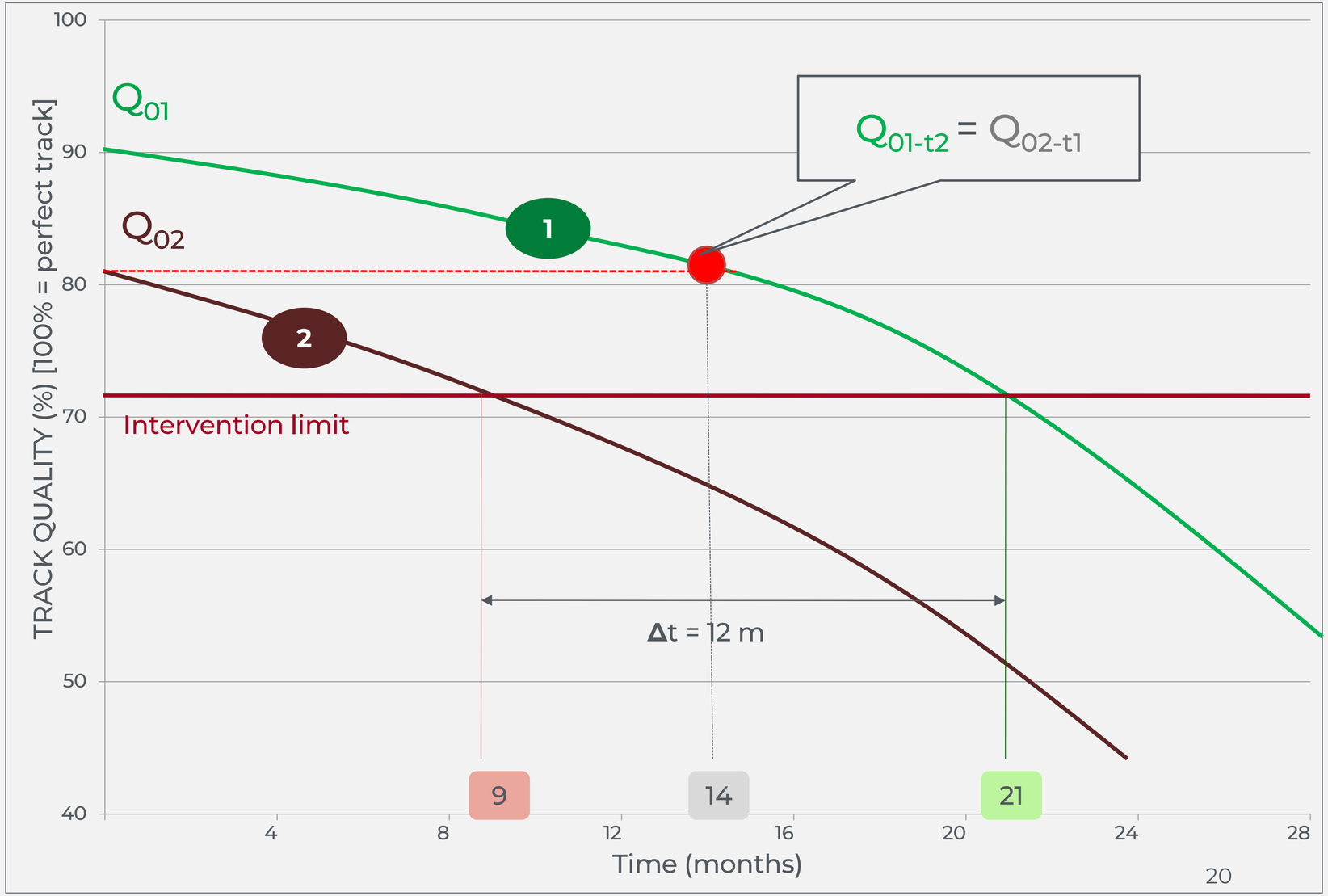
The Infrastructure Manager faces the following challenges, to be fulfilled all at the same time:

- Ensure the safe operation of the railway infrastructure
- Decrease his costs for the maintenance of the railway infrastructure and the traffic management
- Increase the efficiency of the railway infrastructure.

- The Infrastructure Manager has to optimize his way of operation. The only way to achieve this target for the maintenance of railway infrastructure is included in the word “Quality”.
- If the Infrastructure Manager can achieve to get a new track of high quality, to maintain it with the optimum maintenance strategies, he will be able to manage a track with low costs and a high efficiency.

The importance of good initial quality (1)

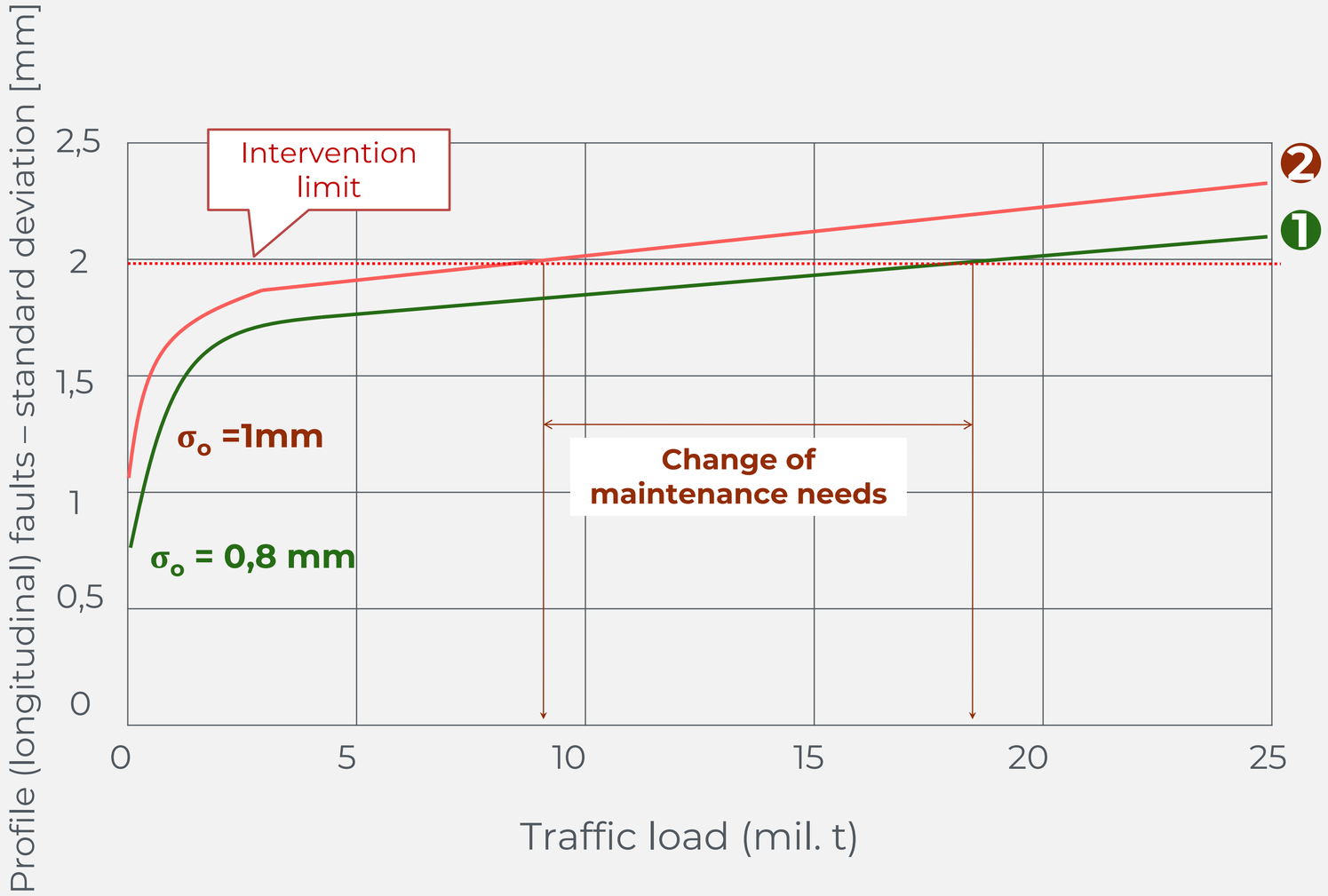
- Example of two tracks (1) and (2)
- initial quality of two tracks doesn't differ so much
- BUT there is a significant difference in the starting of maintenance needs.
- Track (2) reaches intervention limit earlier (month 9) than track (1) (month 21).
- Track (1) after 14 months reaches the initial quality of track (2)



The importance of good initial quality(2)

- the track faults of the two tracks are very similar at the beginning of their life
- there is a significant difference in the starting of maintenance needs.

σ is the standard deviation of the profile (longitudinal) faults



❶ High quality track

❷ Track of almost high quality

Mathematical models for predicting the track quality

The track deterioration model

Experience:
Good track behaves well (deteriorates more slowly),
Poor track deteriorates faster

Deterioration depends on the (initial) quality level:
Track behaves according to its quality

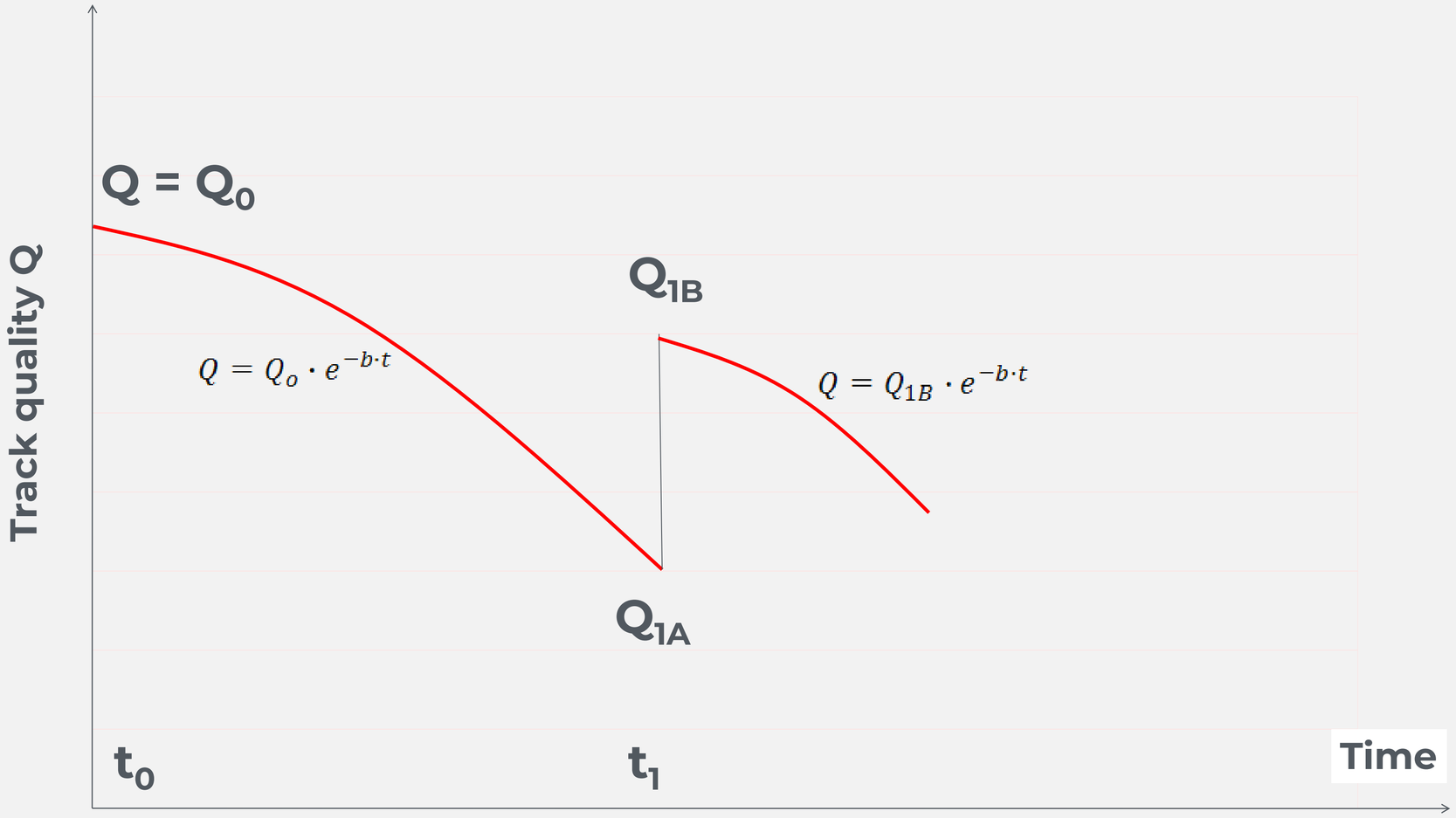
$$Q = Q_o \cdot e^{b \cdot t}$$

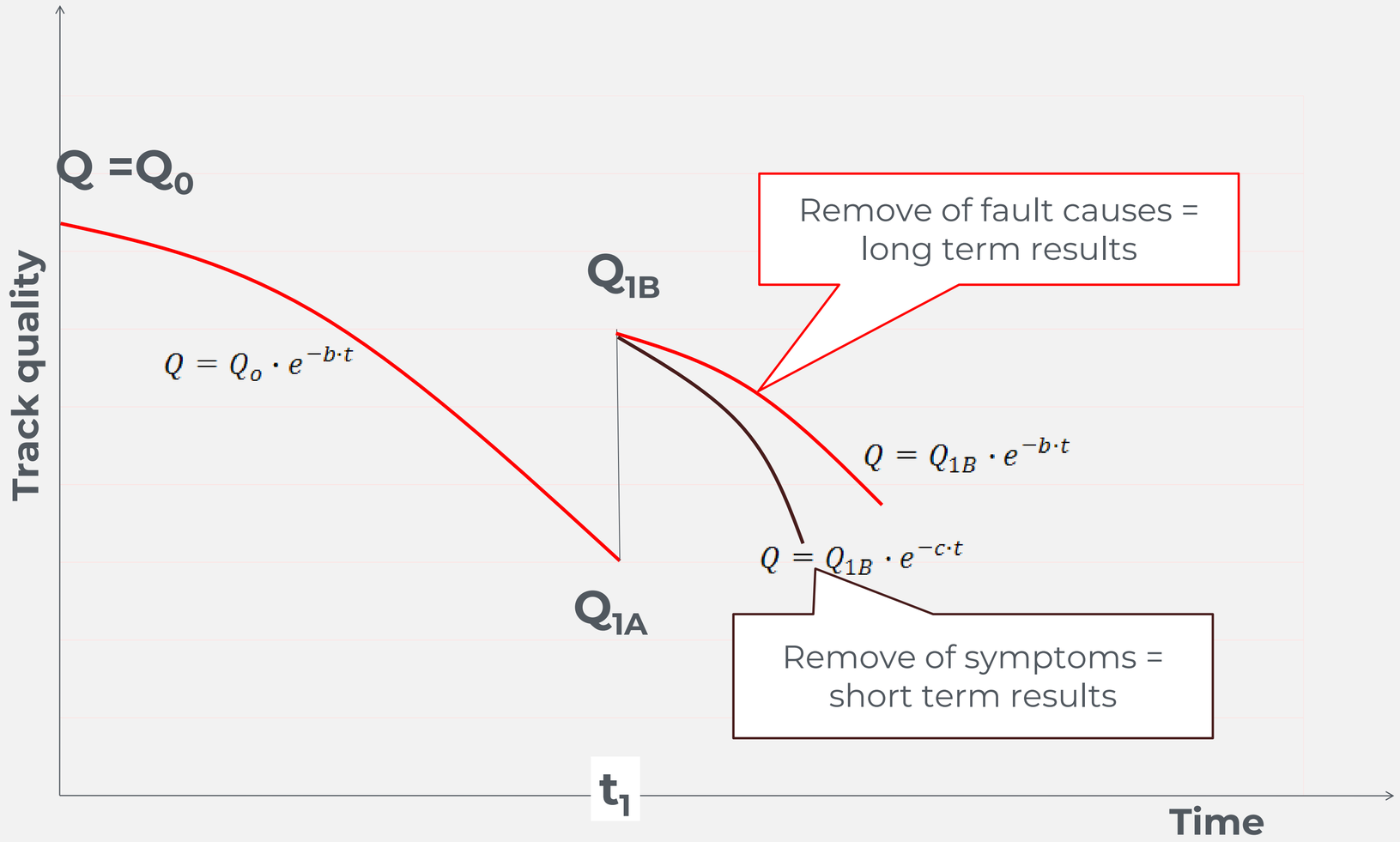
e = Euler number = 2.7182....
b = deterioration rate
t = time

LCC = Investment costs + Maintenance costs + Operational hindrances

Source: Prof. Peter Veit, Technical University of Graz, Austria

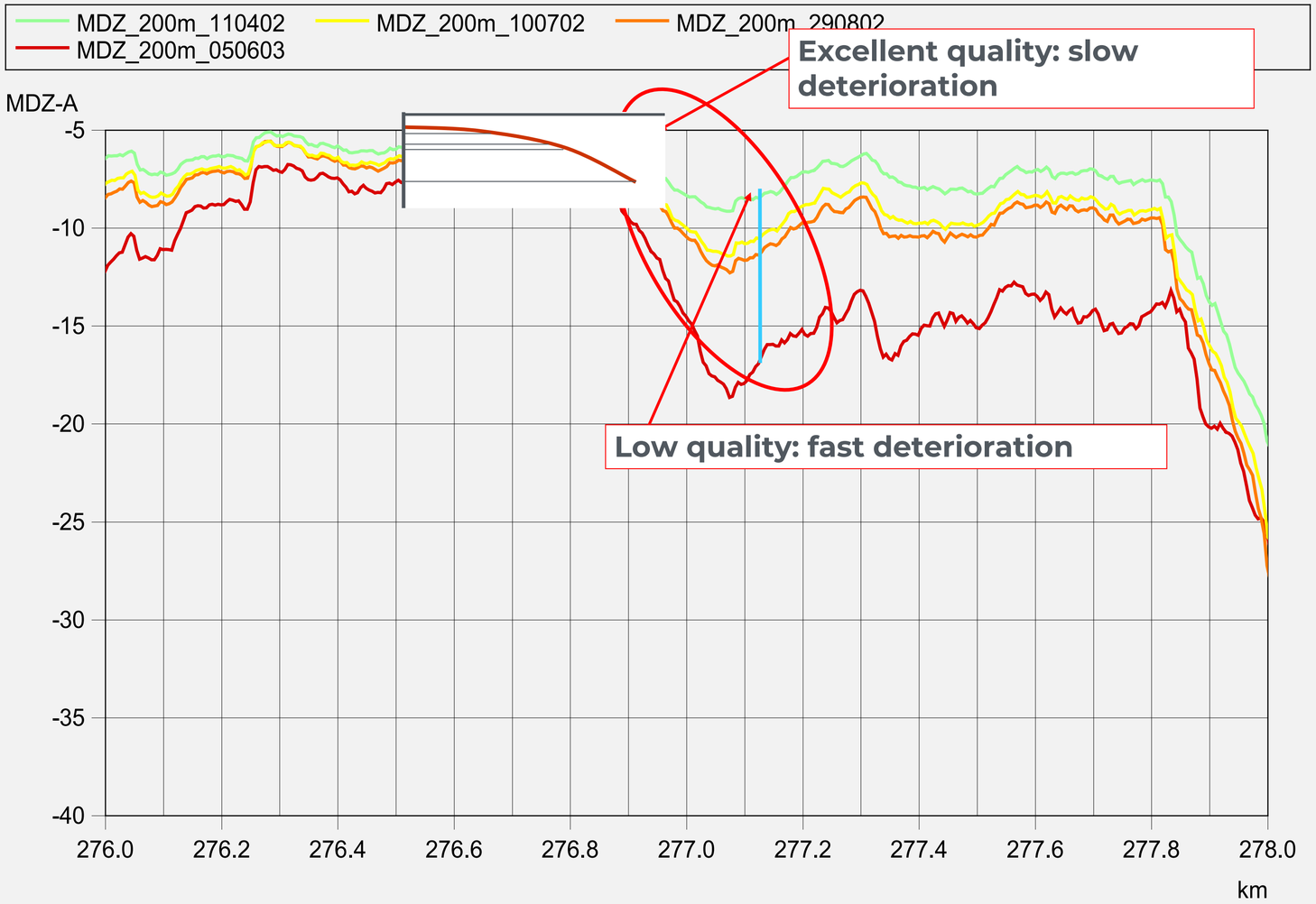
The development of the track quality




Q =Q0
Track quality
Q1B
Remove of fault causes =
long term results
Q = Qo · e−b·t
Q = Q1B · e−b·t
Q = Q1B · e−c·t
Q1A
Remove of symptoms =
short term results
t1
Time

The analysis of the track behaviour

The current track condition and its history enable us to calculate the deteriorating factor b for specific segments and define specific investment and maintenance strategies for each one track segment



Source: Prof. Peter Veit, Technical University of Graz, Austria

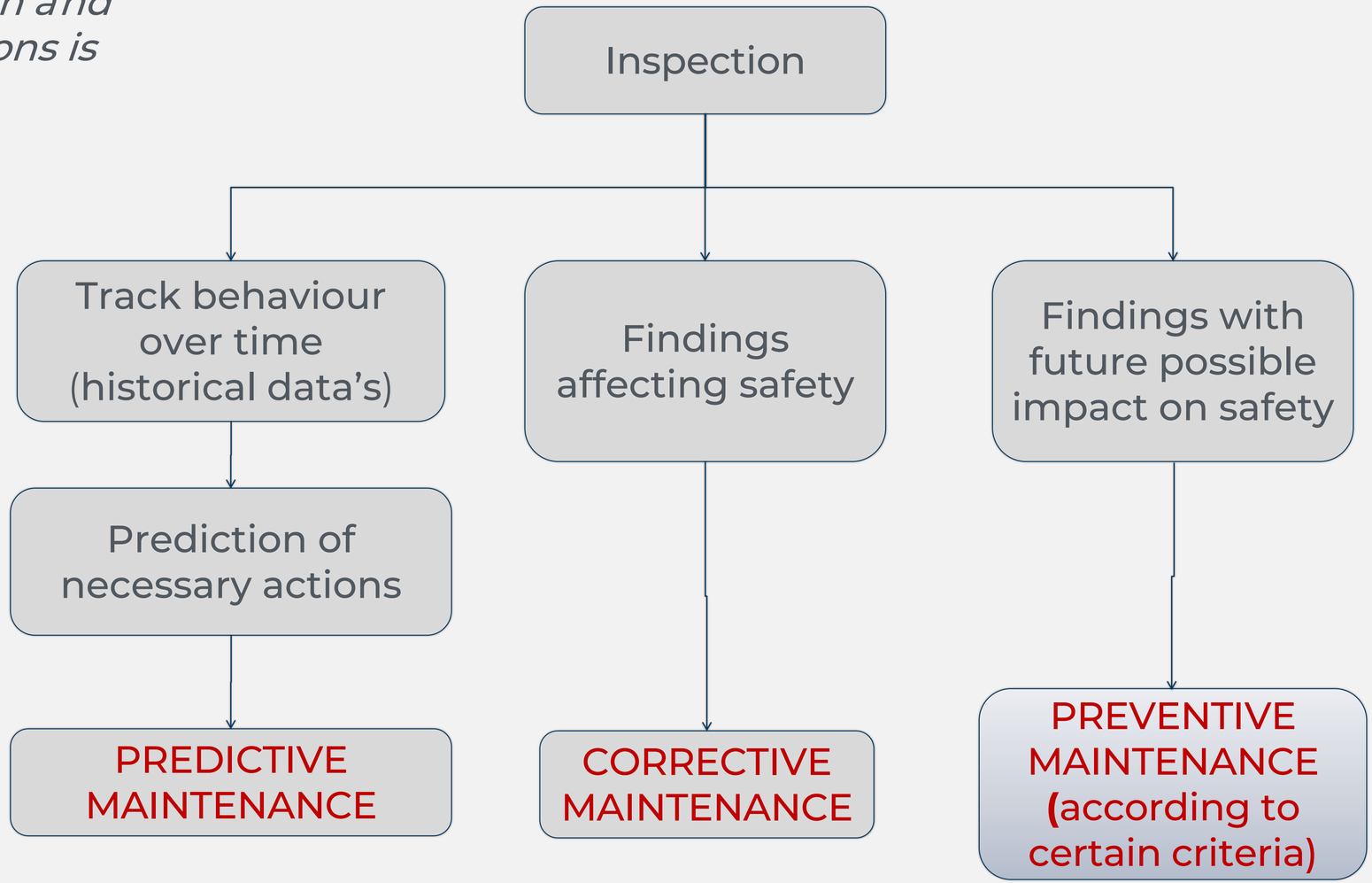
Track condition monitoring

A top-down approach for track condition monitoring

- Infrastructure Managers in order to improve their performance,
  - must take the right decisions and
  - control their processes,
  - supported by the right information analysed intelligently,
  - based on the right monitoring data collected wisely, and
  - applying the right standards

Track inspection

In the figure, the relation between the inspection and the maintenance actions is presented



Track Maintenance Strategies

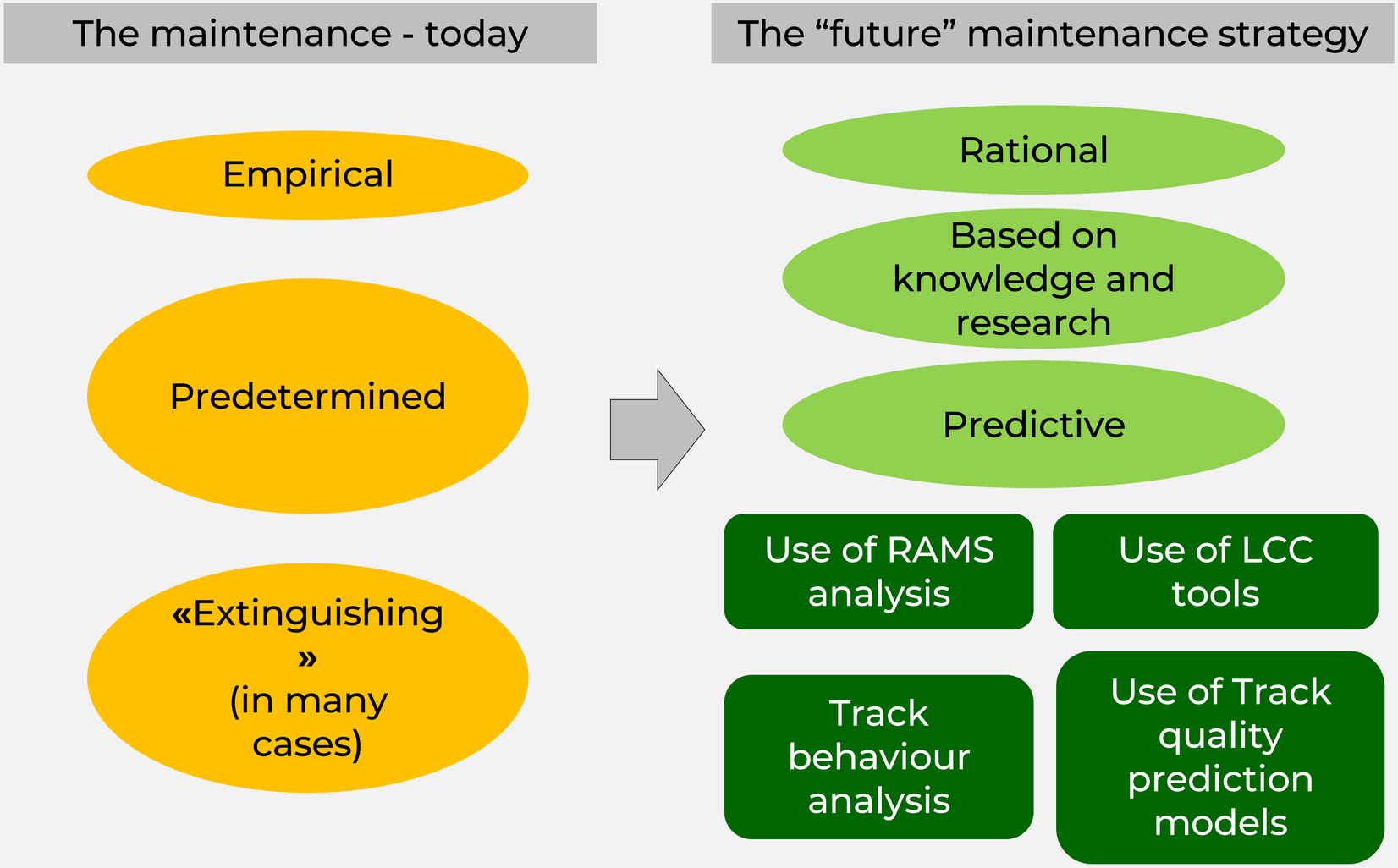
Investment and maintenance

- The sole purpose of investing is a high initial quality.
- The sole purpose of maintenance is to assure that this initial quality leads to an extension of the service life of the track
- Investment and maintenance should be viewed as elements of a strategy for the superstructure.

Lack of maintenance,
delayed or improper maintenance of the track
devalues the investment,
as far as decreasing its service life

Source: Prof. Peter Veit, Technical University of Graz, Austria

The rational maintenance strategy

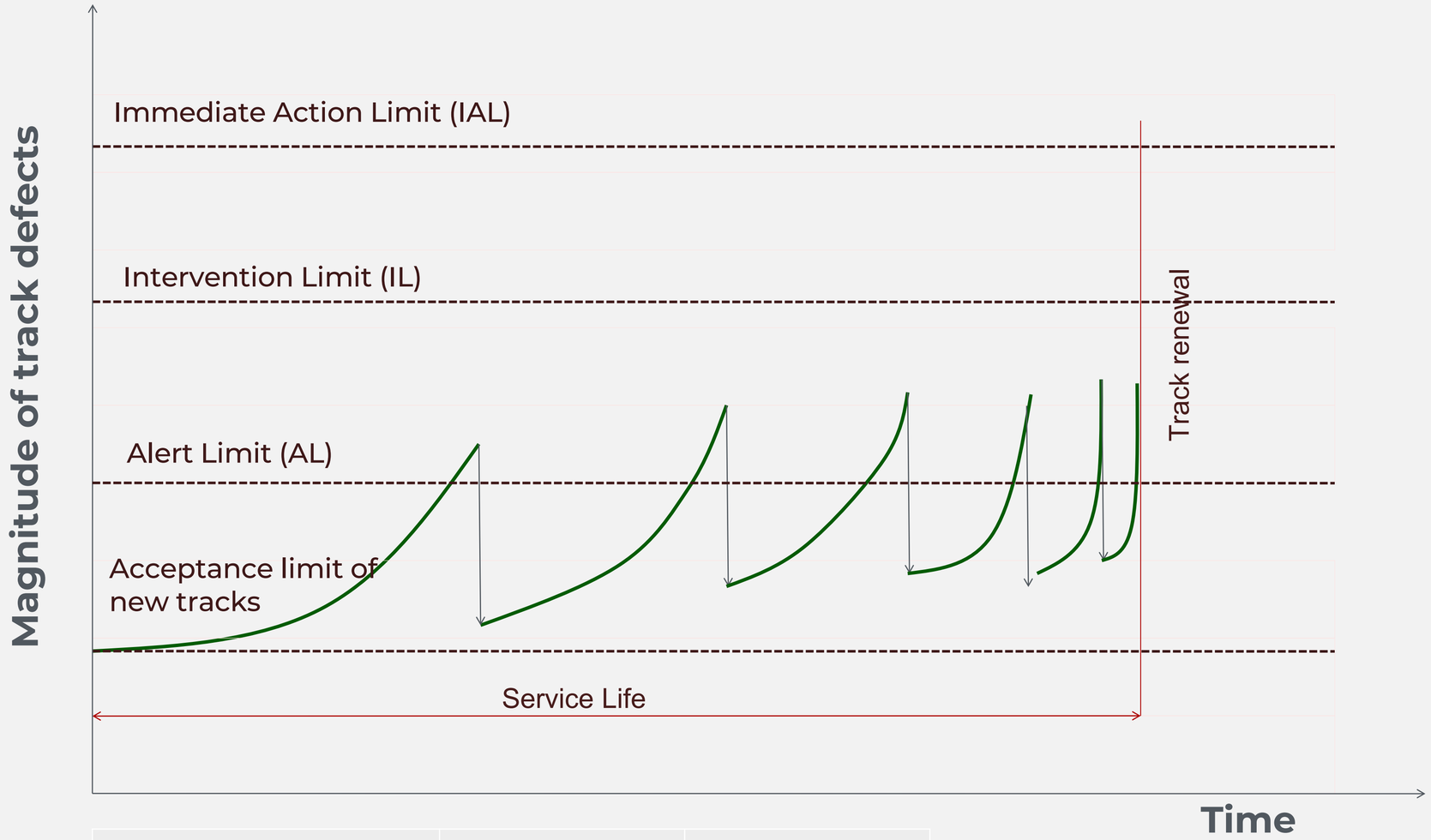


Source: Prof. Peter Veit, Technical University of Graz, Ausria

Maintenance strategies affecting the service life of the track

Maintenance Policy of IM A

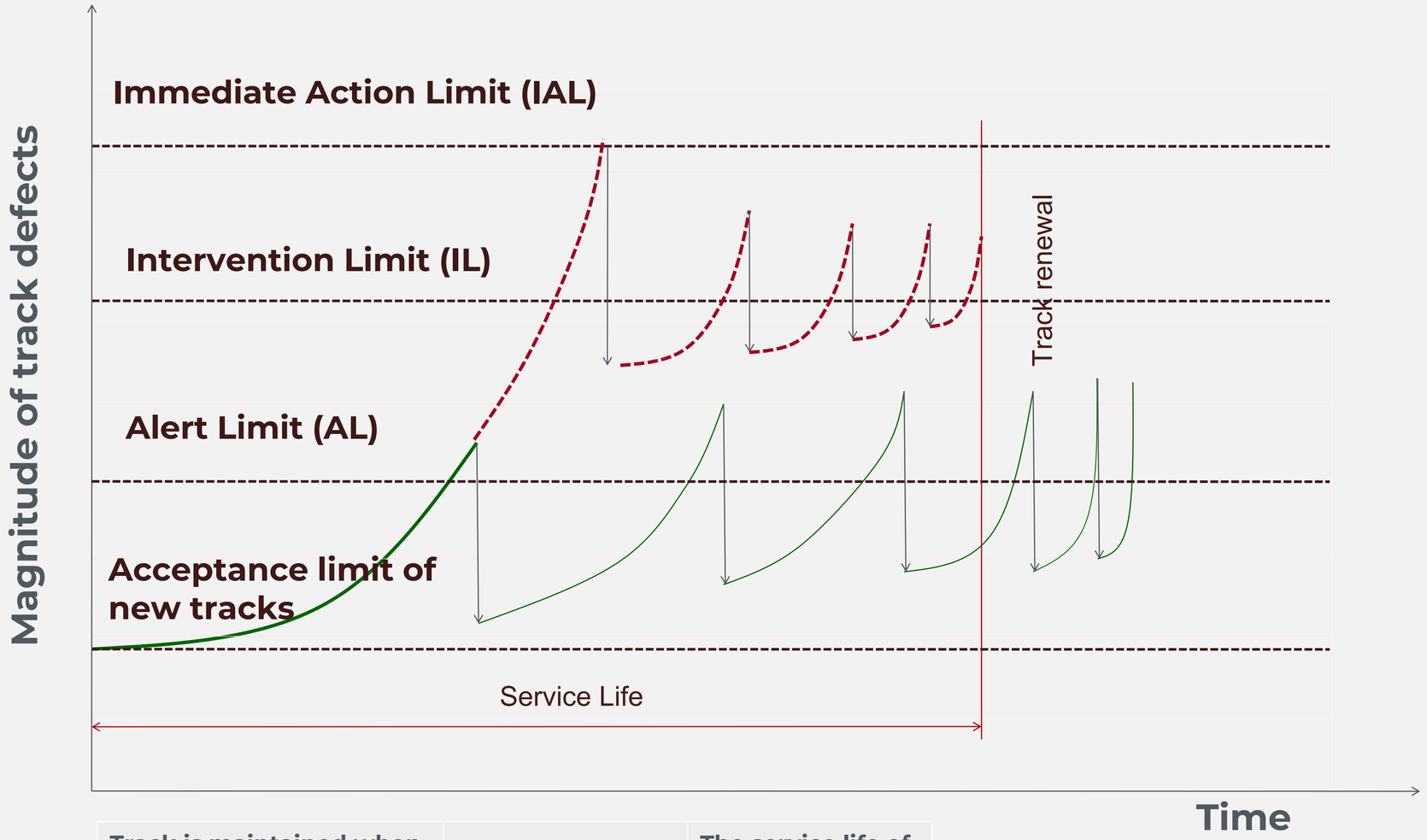
- Infrastructure Manager A intervenes with the appropriate maintenance actions, when the track defects exceed the Alert Limit AL, but before they reach the Intervention Limit IL



Track is maintained when the magnitude of track defects is between AL and IL	Track quality remains good	The longest possible service life is reached

Maintenance Policy of IM B

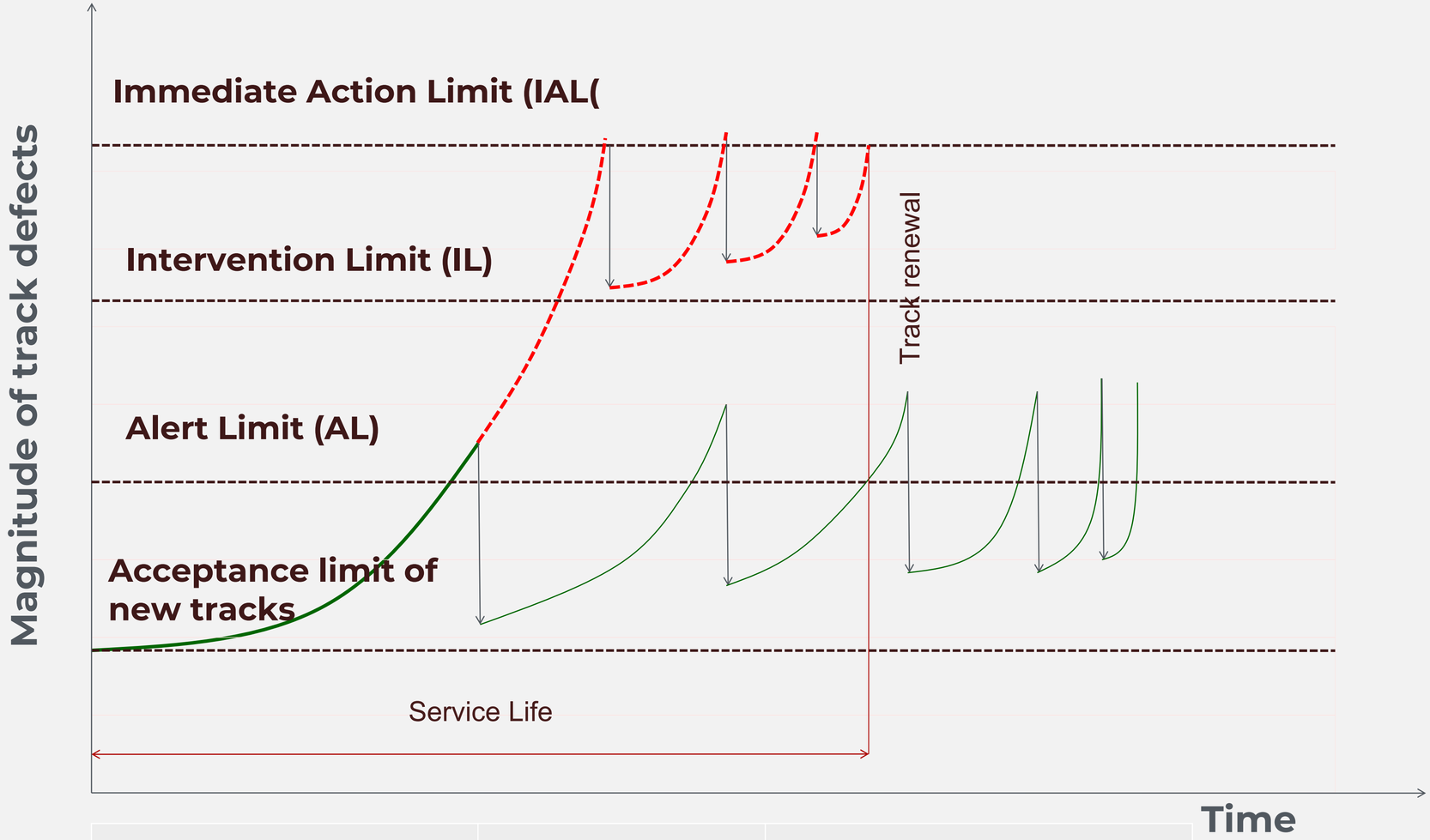
- Infrastructure Manager B intervenes with the appropriate maintenance actions, when the track defects exceed the Intervention Limit IL, but before they reach the Immediate Action Limit IAL
- The service life of the track maintained is shorter than the respective service life of the track of Infrastructure Manager A.



Track is maintained when the magnitude of track defects is between IL and IAL	Track quality is moderate	The service life of the track is shorter than that of IM A

Maintenance Policy of InfraMan C

- Infrastructure Manager B intervenes with the appropriate maintenance actions, when the track defects exceed the Intervention Limit IL, but before they reach the Immediate Action Limit IAL
- The service life of the track is shorter than the respective service life of the track of Infrastructure Managers B and A.
- The track is very costly to maintain, due to a very frequent maintenance and the limited durability of the track,



Track is maintained when the magnitude of track defects reach IAL	Track quality is not good, but safe due to a high maintenance frequency	The service life of the track is much shorter than that of IM A. The track is very costly to maintain.

Guiding principles for an effective track

1. Try for an initial high track quality
2. Keep water away from the track surface
3. Make an effective design and as simple as possible
4. Maintain when required
5. Be environmentally astute
6. Train staff
7. Respect and keep historic values

Conclusion…

- It is important to extend the service life of our assets, by applying proper maintenance strategy
- Rational actions can reduce the maintenance costs and extend the service life of the railway infrastructure
- So by applying this, the Infrastructure Manager will be able at the same time to:
  - Ensure the safe operation of the railway infrastructure
  - Decrease his costs for the maintenance of the railway infrastructure and the traffic management
  - Increase the efficiency of the railway infrastructure.

I would like to thank you for your attention!

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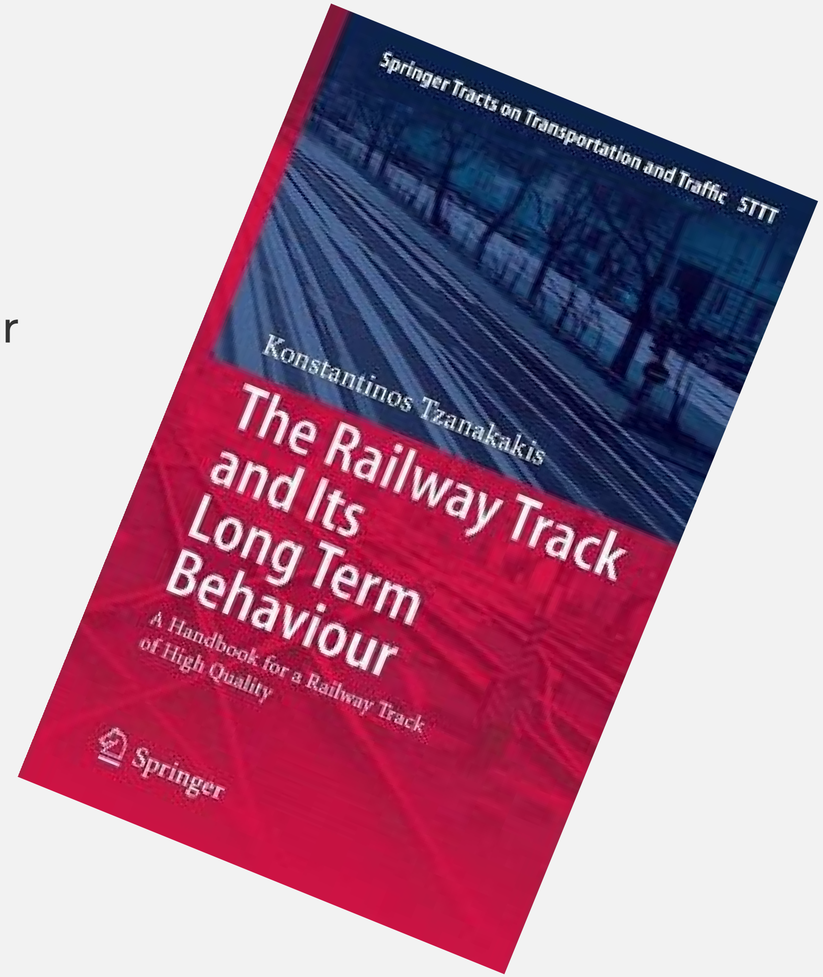
A few words about me....

- Civil Engineer (MSc.) - University of Hannover in Germany
- Master Executive MBA degree - Athens University of Economics & Business.
- Over 30 years of experience in the railway sector, including eight years in Director positions at Greek Railways Organization
- 2006 - 2013 the Head of the Railway Systems Directorate.
- 2013, 2014 development of the Omani National Railway Network.
- 2015-today, Senior Railway Expert at the Ministry of Transport and Communications in Oman.

… get more information…

The Railway Track and Its Long Term Behaviour
A Handbook for a Railway Track of High Quality



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