More railway for the money

Through data-driven life cycle management

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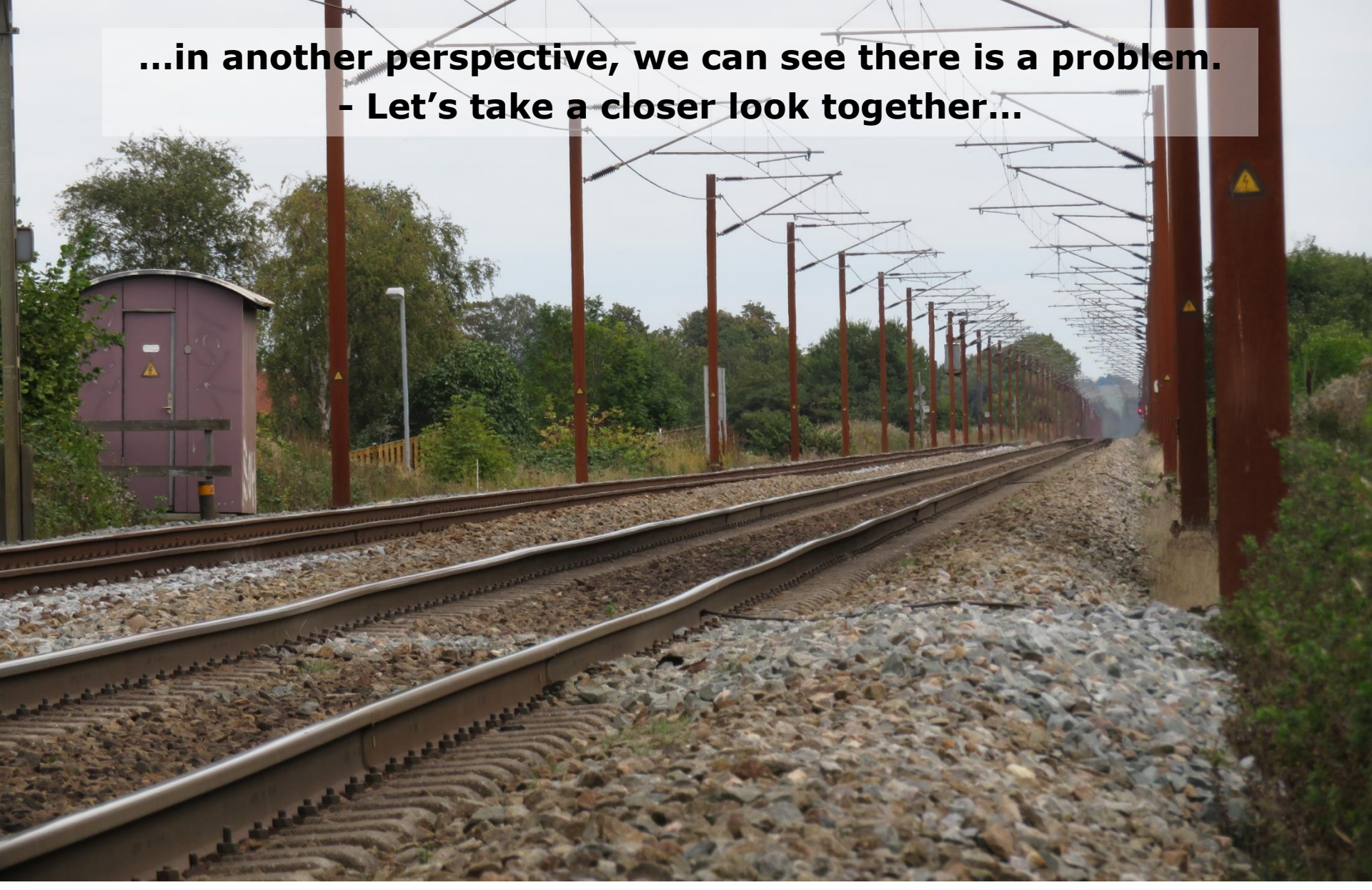
Here is a railway line. It looks good, but up closer…


…in another perspective, we can see there is a problem.
- Let’s take a closer look together…

Introduction

What this presentation is about

- How Rail Net Denmark uses linear asset management software, that combines master data and measurement data in a linear environment, to make smarter life cycle management

- Specifically by identifying problem and solution for the shown track
- I'll show you how we have done it, by telling you:
  - What linear assets are
  - How data is presented as linear data
  - An example of using integrated data sources to smarter LCM:
    Strategic renewal planning with ground penetrating radar
    - GPR is more accurate than mathematical models based on track geometry and probably 90% cheaper than conventional drilling on €/km

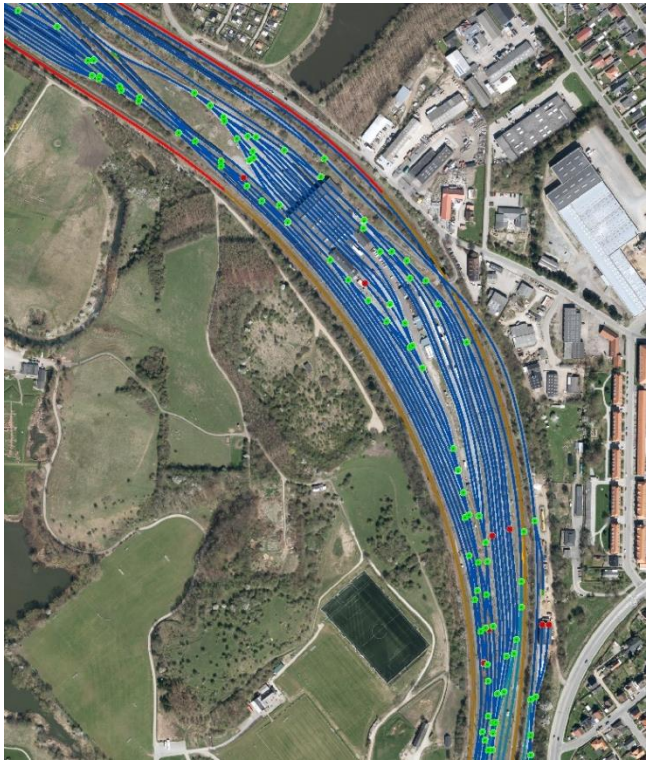
- Maybe you can use it in your country
- Maybe we can work together on making it even better

Linear assets

An asset can be many things…

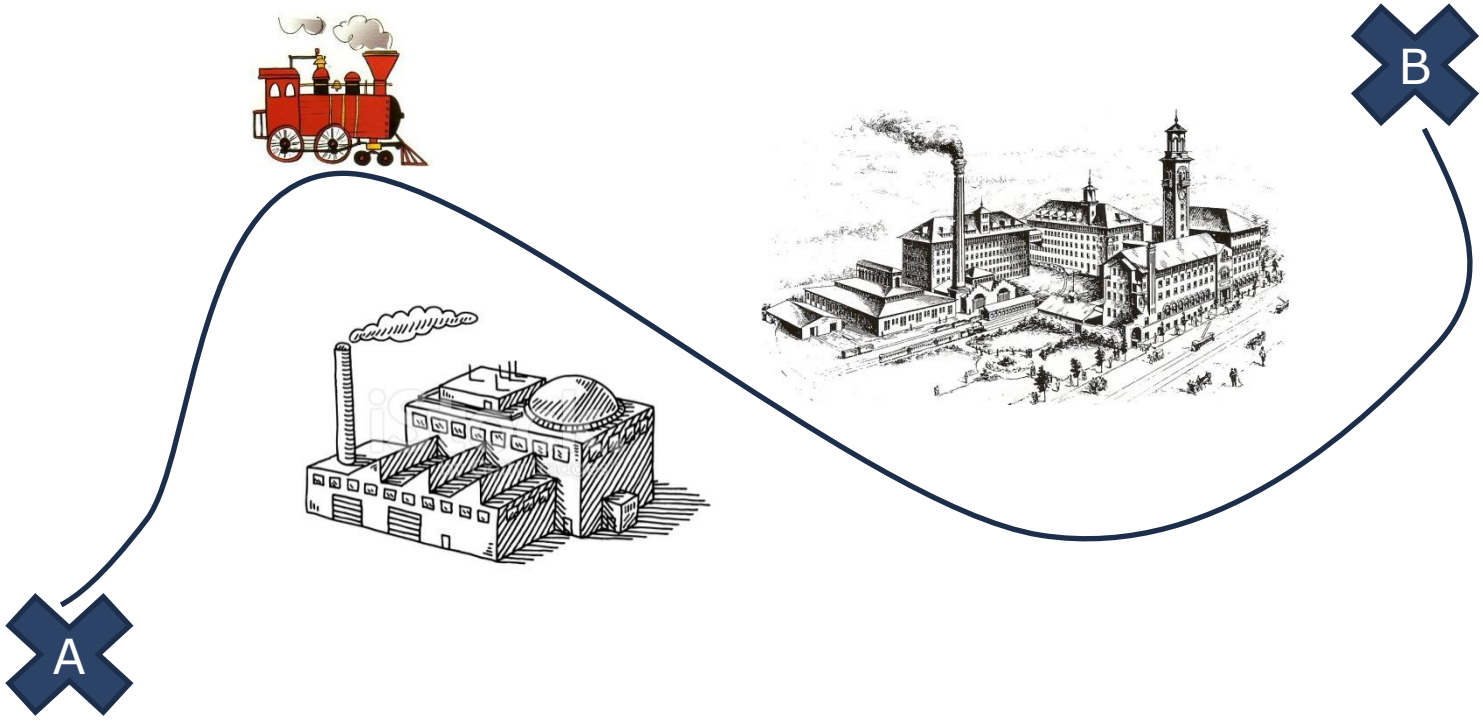
Linear assets

”My” assets are railway tracks – in all kinds of shapes



Linear assets

Which is great for running trains from A to B, as a straight line is not always possible…



Linear assets

But analyzing specific issues can better be done using diagrams. This requires that the track gets a *linear* representation

Comparable to making a 3D sphere into a 2D map

Linear assets

By representing the infrastructure linearly, as a track from one mileage to another, data can be presented on a diagram

Linear asset management in **IRIS**SYS

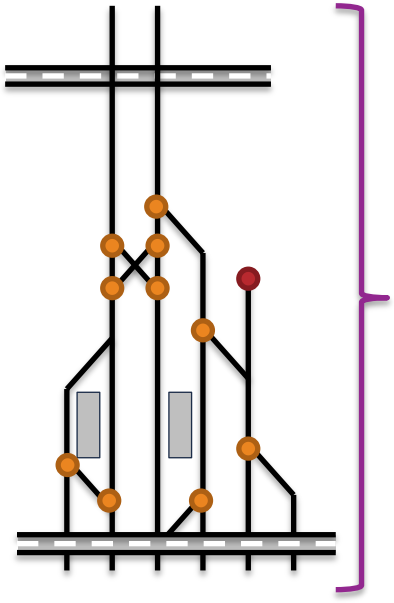
Components needed to make an effective system

Asset data

- Bridges
- Level crossings
- Curvature
- Etc.

Infrastructure model

- Tracks
- S&Cs
- Line definitions
- Etc.



Each object identified by:
- Line number
- Track/S&C number
- Mileage from/to

Measurement data

- Track (geometric, corrugation etc.)
- Rails (ultrasonic, eddy current)
- Ballast (ground penetrating radar)
- OCS (height, zigzag, thickness)

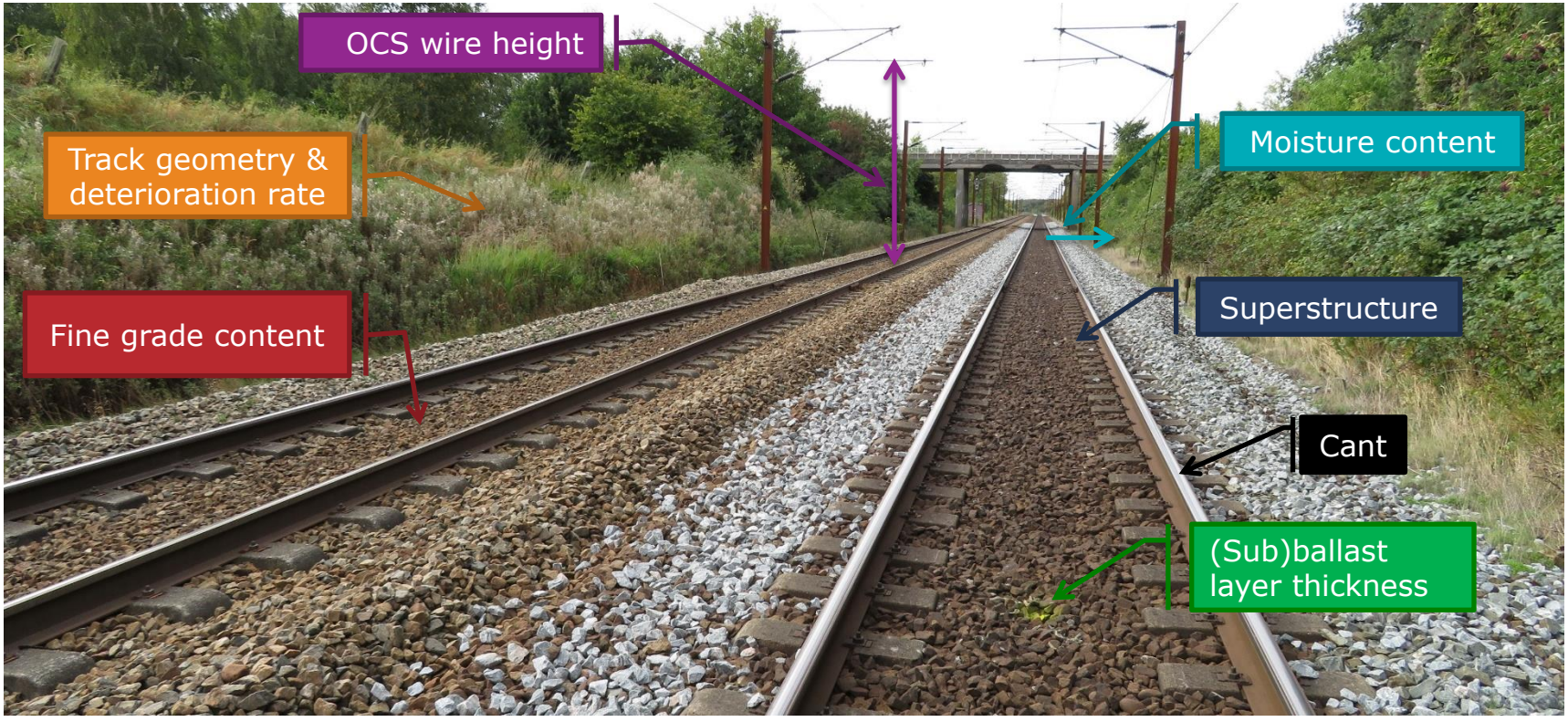
Case study

Strategic renewal analysis

- The track mentioned in the introduction is to be renewed in 2019
  - and the track geometry clearly has a problem, but…
    - …what causes the problem?
    - …what kind of renewal is needed? What is possible?

To figure that out

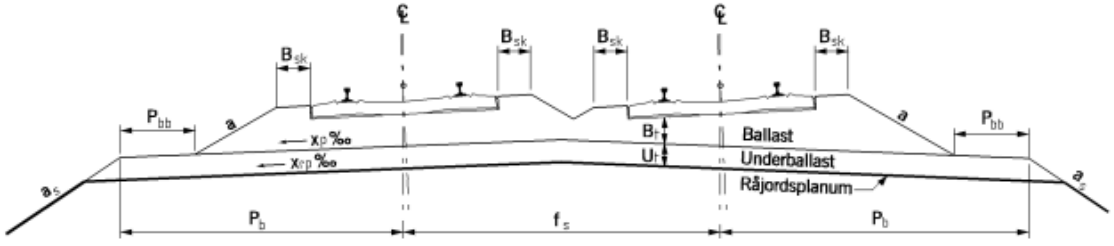
We need to know something about the assets



Asset data comes from different sources

Some is master data and design regulation

Asset	Needed for	Source
Superstructure	Thickness of rail/sleeper as reference, and demands for layer thicknesses	Master data
Cant	If applicable, there is special demands for layer thicknesses	Master data

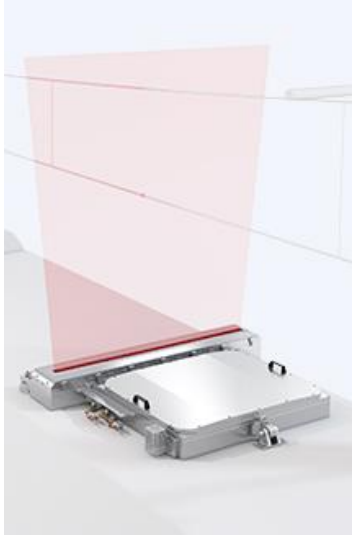


Element	V≤160	160<V≤200	200<V≤250
Ballast shoulder width, Bsk	0,40 m	0,55 m	0,50 m
Inclination, a	1,5	1,5	1,5
Ballast thickness, Bt	0,30 m	0,30 m	0,35 m
Subballast thickness, Ut	0,15 m	0,25 m	0,30 m
Base layer width, Pb	3,00 m	3,00 m	3,80 m
Base layer inclination, Xp	40 ‰	40 ‰	40 ‰

Asset data comes from different sources

Some from universal measuring cars

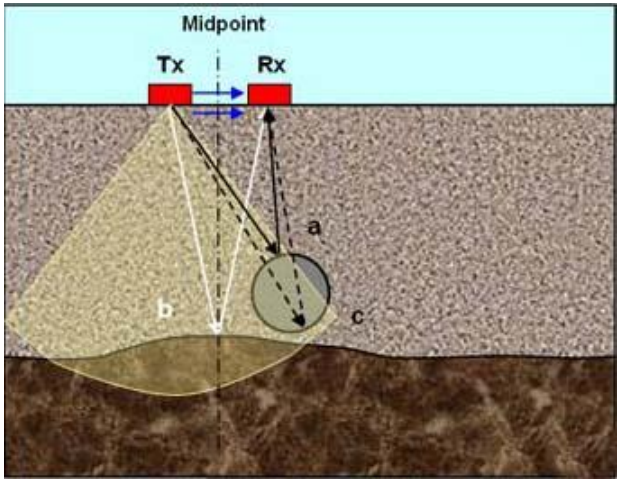
Asset	Needed for	Source
Track geometry & deterioration rate	Unstable track geometry indicates need of ballast cleaning	Measuring car
OCS wire height	Clearance height to OCS wires must be ensured	Measuring car



Asset data comes from different sources

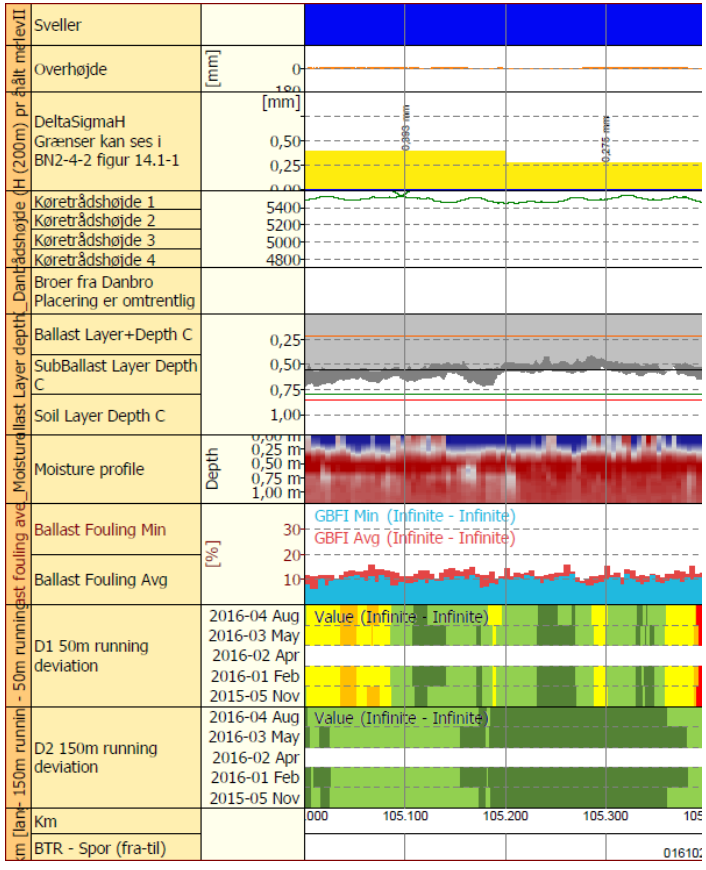
And some from ground penetrating radar

Asset	Needed for	Source
(Sub)ballast layer thickness	Design criteria must be obeyed	Ballast drillings GPR measurement
Moisture content	Indicates if there is a drainage problem	GPR measurement
Fine grade content	Fouling limits must be obeyed	GPR measurement



All asset data is combined as linear assets

A huge amount of information presented in so it is easy to read



Type of superstructure

Amount of cant

Calculated longitudinal level D1 deterioration rate model
Blue=Normal | Yellow=Frequent tampings (<3 years)

OCS wire height measurement
Green=Normal | Blue=Exceeded alert limit | Red=Too low

Approximate position of bridges

GPR measured layer thicknesses (calibrated by drillings, 1/km)
Light grey=Ballast | Dark grey=Subballast
Orange=Sleeper bottom | Green=Exceptional regulation | Red=Normal regulation

GPR relative moisture index
Blue=Wet | Red=Dry

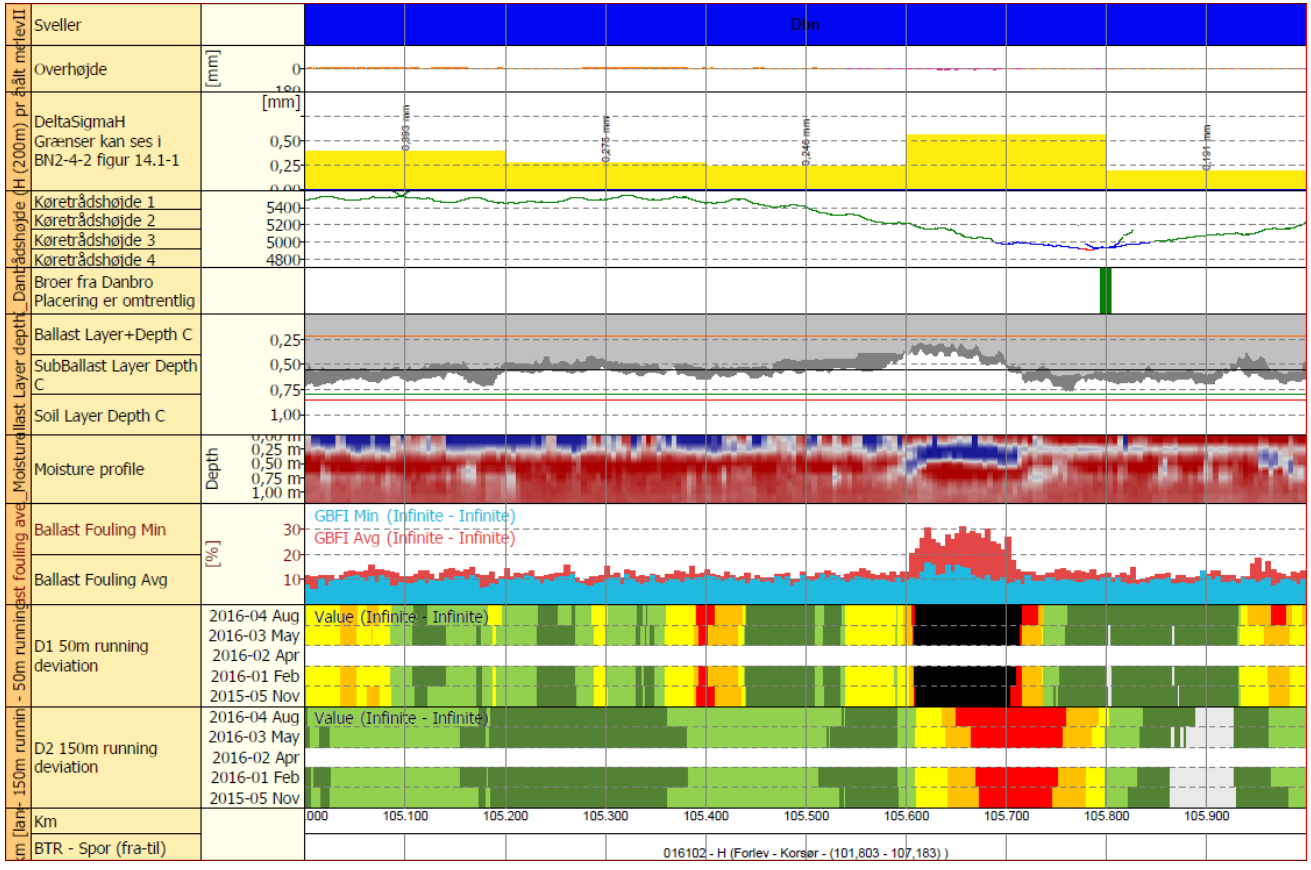
GPR fine grade content (calibrated by sieve tests)
Blue=Minimum | Red=Dry

UFM measured longitudinal level D1 σ_{50m} over time
Green=Low | Yellow=Intermediate | Red=High | Black=Critical

UFM measured longitudinal level D2 σ_{150m} over time
Green=Low | Yellow=Intermediate | Red=High | Black=Critical

If we look at the specific track in question

Then a lot of pieces falls in place in the puzzle



High deterioration rate

Inadequate layer thickness
Orange=Sleeper bottom
Green=Exceptional regulation
Red=Normal regulation

High moisture index

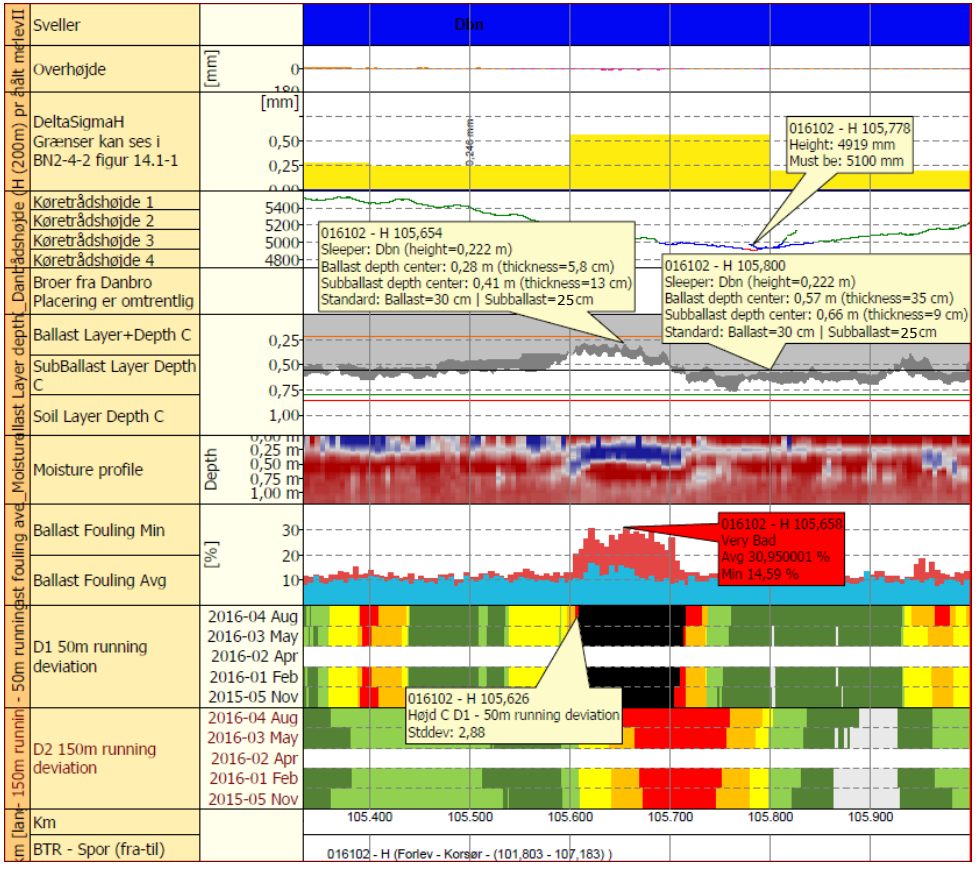
High fine grade content

Constant poor short wave geometry

Developing long wave geometry

What to do about it?

Let’s take a closer look at the information



- The track geometry is unstable indicating need of ballast cleaning
- There is a bridge which causes the OCS wire height to be lowered
- At present it is 180 mm lower than it should be at renewal
- Just under the bridge there is sufficient ballast, while 16 cm of sub ballast is missing
- As there is no room upwards, this can only be solved by making a new track bed

Conclusion

To summarize

- Use of linear assets is useful for:
  - Making it possible to overview huge amount of information in a single view
  - Combining data from different sources
- One example is use of master data, track geometry-, OCS- and GPR-data for determining need of track bed renewal

- This combined use of data makes it possible to make smarter renewal planning – and get more railway for the money

If there is time… then I have a commercial

If any of you is interested in knowledge sharing, please do not hesitate to contact me. Here is an overview of our linear asset management software and interfaces: