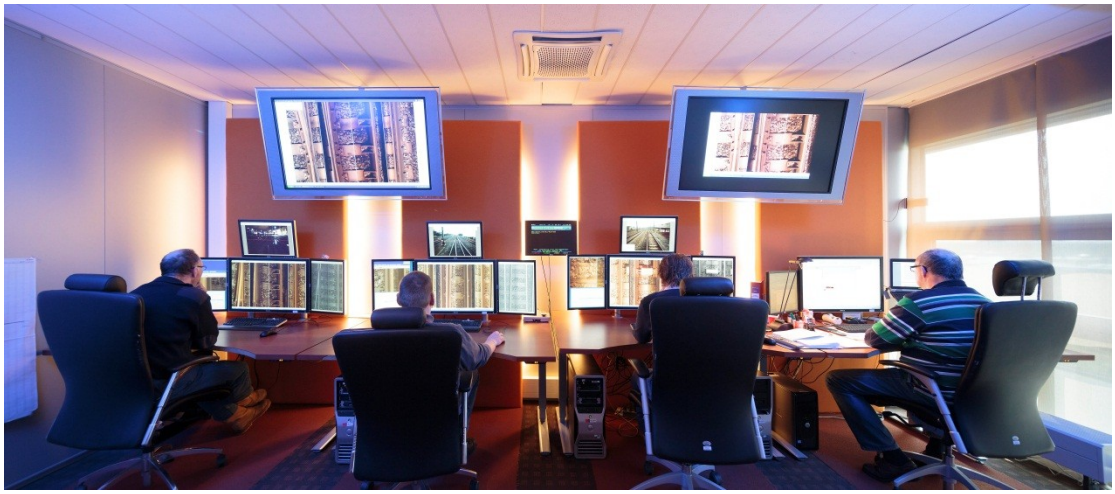
## Video Inspection, an introduction

There are all sorts of inspections to be done on or around the track. Depending on the network requirements, frequency of runs and use, track inspections can roughly be divided in three types:

- **Visual** daily/weekly inspections - more commonly known as foot survey (track and switches);
- **Maintenance** inspections - usually part of an annual maintenance plan;
- **Repair or performance** inspections- resulting from something (which might be) in need of repair.

Video inspection is specifically designed to replace the visual daily/weekly foot survey. The development of video inspection is originally a result of network owners and contractors wanting to find a solution to create a safer environment for their workers, but also to limit downtime and have a higher track availability.



**What does it look like**
An inspection vehicle will run the tracks and capture the imagery. In general the cameras will record a line scan with a side view and top view of the track. The top view includes any fastenings and other objects situated directly around the rail (roughly 30 cm on each side). Another camera will capture a panorama view (front and back) of the surrounding area. All this imagery is stored in a computer and the data is brought to an inspection area specifically designed for this purpose.

The images are presented as follows:
- One screen with the surrounding view;
- One screen combining the top and side line scan of the track in colour;
- One screen showing the track in black and white for more contrast in the imagery;
- One screen for close ups.

The video system should be fully integrated in the overall network to allow for e-mail and other information systems to be used by the inspectors. Each image is accompanied by GPS coordinates, name of track, kilometre indication and other information.

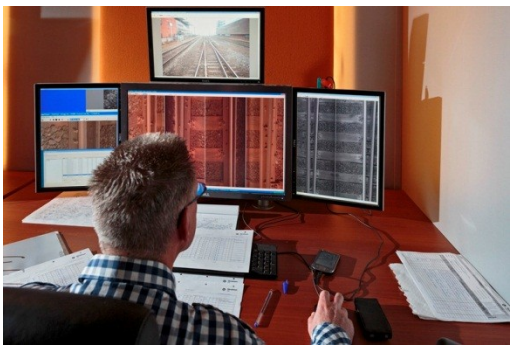
**What are the benefits**
The benefits vary with the way video inspection is integrated in the organisation. In general the benefits are:
- Less people in the track, improving safety;
- Less downtime, improving availability;
- Less costs for logistics, planning possessions, cars, etc.;
- More comfort for inspectors, air conditioned environment;
- Inspectors are easier managed, office environment;
- Imagery can be used for preparation of maintenance;

- Imagery can be used to check the work conditions and environment;
- Previous video runs can be used to show level of deterioration (settle discussions).

**What are the disadvantages**
The disadvantages, though limited, are mostly felt by the inspector. In general the inspector experiences the imagery in a different way. They feel that they can't see everything the way they can outside. They miss the sound of the train or the wagon. In general they miss the look & feel of the tracks. This leads to a transitional period where inspectors have to learn to identify new triggers. Some may prove to be very good video inspectors (highly concentrated) while others may not see anything. This will be discussed further in this document.

**What kind of technology is involved**
In general the data is stored on 500 GB SATA hard discs. However, the speed of modern technology allows for rapid change in size and weight of these discs. The choice for storing data on hard discs has to do with the sheer volume of data. Sending terra bites and terra bites over internet lines requires a highly sophisticated data network which is not readily available in most areas. The use of hard discs for storage is a practical solution to overcome this.

The video room will need a computer with a driver to read the hard discs; a minimum of four screens of different sizes; a desk in an area which can be darkened (for better view of the screen); a comfortable chair and peace and quiet for better concentration. Depending on what an organisation decides or may need, previous video runs can be stored or overwritten by a new run.
When previous runs need to be stored for a specific period of time the organisation has the option to keep (buy) the hard discs themselves or store the data on a separate server. It is advisable to at least store images of defects for future reference.



**Video inspection and the organisation**
***A: Frequency of runs***
The way video capturing and inspection of the imagery is integrated in an organisation depends on the requirements of the network. In general the video inspection follows the inspection frequency of the foot survey but can deliver the information of the entire run a lot quicker depending on the remoteness of the area. A network is usually divided in types of tracks and switches of which some need to be inspected more frequently than others. Taking this segregation as a lead the organisation will need to decide how fast the video will need to be delivered and the timeframe within which the imagery will need to be inspected. This could lead to agreements about the delivery time of the data between the network and the organisation which delivers the data.

Example:
Type A-switch data will need to be delivered two working days after capturing and viewed within one week after delivery (and acceptance of the data).

Type B-switch data will need to be delivered 4 working days after capturing and viewed within four weeks after delivery (and acceptance of the data). The same could be done for mainline tracks or certain (in)frequently used areas as a whole.

Another lead to decide upon frequency of video capturing runs is the FMECA (failure mode and critical analysis), which is based on safety, reliability, quality and contract requirements. The imagery will need to assist in answering questions about cause of failure, failure mode, condition of the error. Video inspection becomes an integral part of condition-based maintenance, use-dependent maintenance and fault dependent maintenance.

***B: Inspector***

Any given network will need a number of inspectors to do foot survey. Some of these inspectors have worked the same track or area for several years and know every bolt and sleeper. Others have less years of experience but know when something is wrong and in need of repair. When deciding to use video inspections, a new type of inspector will need to be selected and trained because:

- Not every inspector outside is able to work inside;
- Not every inspector is able to sit in a chair for a long period of time;
- Not every inspector is able to look at a computer screen for 45 minutes;
- Not every inspector is able to actually see anything wrong or missing in the imagery.

A selection process will need to be worked out, where two or more inspectors look at the same imagery and the results of what they see and report, is compared. The start up process also involves an instruction manual with examples of defects and a training session on how to use the system. Inspection frequencies will need to be decided upon, f.e. 45 minutes of continuous screening the images followed by a mandatory 15 minute break outside the room. Following best practise the inspector should not be taken away from the track. Video inspection duties are best combined with field work to keep the inspector in touch with the network.

***C: Defects***

An inspector starts by checking the delivered data for completion and usefulness: Is everything recorded and what is the quality of the images (f.e. a broken light may result in images too dark for inspection).

After acceptance of the data he starts viewing the images for a list of possible defects:

- Crossing frog: Hit, Damaged, Crack, Crack in needle
- Crossing: Hit, Crack
- Blade: Hit, Burr, Open, Crack
- Weld/fish plate: Crack, Broken
- Missing bolts

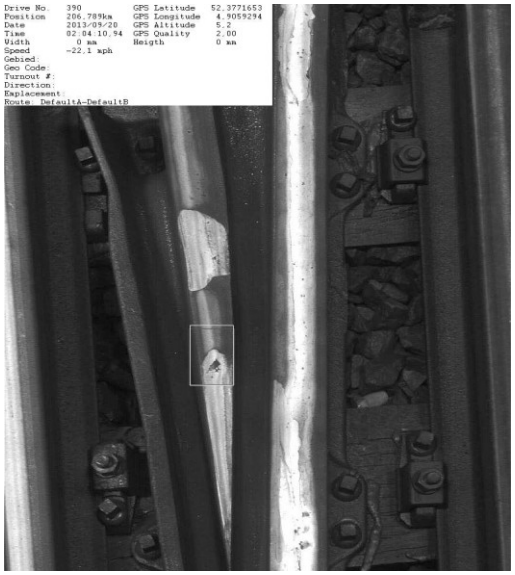
Defects are generally categorised in level of urgency: Urgent, short term, long term. Depending on the organisation urgent defects are best reported directly by the inspector to the crew in the field. If possible he will send a picture of the defect with the location imbedded in the picture to the emergency crew and stores this image for future reference.

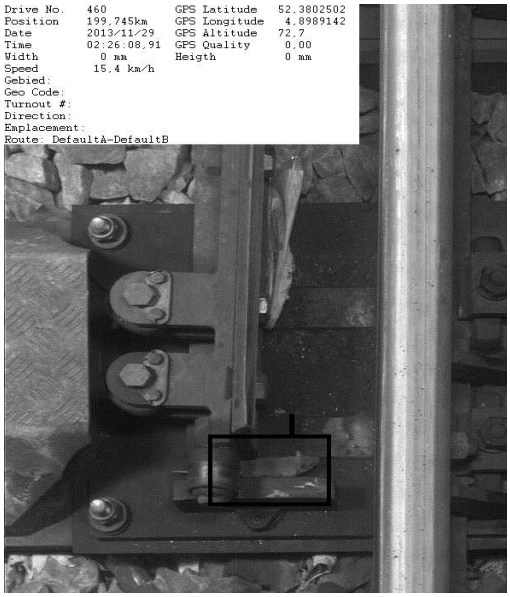
Short term defects will require maintenance planning. Depending on what type of control loop or theory an organisation uses the inspector should have the knowledge to determine whether or not the track or switch is safe, safe after action (low urgency), unsafe (high urgency) and then, if the video system is integrated in the overall network system, put in a work order or a request for a work order together with an image and the location of the defect.

The inspector can also first send the image to the appropriate supervisor for discussion or double check the image with previous runs to determine the level of deterioration.

Long term defects are always on the accompanying inspection list to watch and monitor.

In general the inspector has to answer one basic question when viewing the images: Do you expect the track or switch to be safe and fully functional until the next inspection?




**Implementation**
A pilot project is most likely the best way to start implementing video inspection into an organisation. In this way the specifics of what an organisation can and cannot do will become eminent. A list of questions to ask yourself before deciding on and/or implementing video inspection could be:

- How do you want to use video inspection?
- Which type of inspection would you like to be replaced by video?
- What will be inspected mainly, track or switches or both?
- Which type of track or switch?
- What will be the frequency of inspection? It is often more efficient to inspect all switches in a certain area than just the switches of a certain category?
- What is the best location for the video inspection room? Should there be more than one?
- What should the room look like?
- What is the best way to store the data?
- What system requirements do we need? Think of licenses.

Video inspection can be very useful to any rail organisation. It will create the opportunity to build a history of data to support maintenance plans. It will provide proof to supervising organisations when problems need to be analysed. It supports the organisation in its development towards more profound condition based maintenance and subsequently better asset management. It delivers managers a better control of what actually happens outside. It makes defects more understandable to anyone.