TECH4RAIL

ILCAD 2017 – THE ANTI-COLLISION LC
OBSERVATIONS

- 15,000 LCs on rail lines currently being operated

- Between €40 million and €50 million invested annually in the program to improve LC safety:
  - Between 150 and 300 improvement operations per year (SAL2 automation, diode modules, overhead lights, etc.)
  - Replacement of LCs with other structures representing between €5 and €40 million (between three and eight per year)

- Investments to improve safety are financed by the government. Since funding is decreasing every year, SNCF Réseau is forced to either finance activities itself or reduce the number of safety improvement operations.

- Constant accident rate: between 110 and 150 collisions per year in the past five years.

- In 2016, SNCF Réseau saw noteworthy safety incidents involving heavy vehicles which could have been catastrophic, resulting in train deaths.

- SNCF needs to develop new solutions (equipment and/or procedures) to improve safety/cut costs for more LCs.
THE TECH4RAIL PROJECT

- Develop innovative solutions with new breakthrough technology
- Accelerate development (simulations, virtual reality, testing platforms on a dedicated site, etc.)
- Forge new partnerships (industrial companies not in the railway industry, academics, start-ups, etc.)
- Work with other Tech4rail teams (self-driving trains, precise train geo-location) for collective brainstorming
- Monitor and benchmark international activities
- Centralize and coordinate LC initiatives within the SNCF group
#1 DEVELOPPER UN PREMIER TRAIN AUTONOME POUR 2021-2023
Sponsor: F. IZARD

#2 EXPLOITATION PAR INTELLIGENCE ARTIFICIELLE
Sponsor: J. C. LARRIEU

#3 SIGNALISATION ALLEGEE
Sponsor: C. SOLARD

#4 LOCALISATION DES TRAINS
Sponsor: B. SCHAER

#5 PN ANTI COLLISION
Sponsor: F. DELOPRE

#6 ENERGIE STOCKAGE ET NOUVEAUX VECTEURS
Sponsor: G. DESNOST

#7 SMART MATERIALS
Sponsor: X. OUIN

#8 NOUVEAUX SYSTEMES DE MOBILITE
Sponsor: R. PICARD
Accidents resulting from failure to respect the highway safety code

In all, 98% of collisions are the result of the failure to respect the highway safety code.

The number of deaths is very variable, depending on the type of user (TE, PL, bus, heavy vehicle, pedestrian, cyclist, etc.), the type of locomotive, the speed of impact, the angle of impact, the number of occupants in the vehicle, possible projectiles, the presence of hazardous goods.

This is why we have provided a specific breakdown of the number of collisions in this diagram (2010-2016 period).
## INSTALLING ANTI-COLLISION LEVEL CROSSINGS
### PRIORITY ACTION AND IMPACTS

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| Predictive accident analysis | Behaviour analysis  
Equipment toolbar/risks |  |  |
| Improve prevention barriers and guardrails | Install obstacle detectors equipped with a lighted red fusee | ✔️ | |
| | Improve road profiles |  | ✔️ |
| | Anti-intrusion plates, lights on railway barriers, skirting barriers, diode lamps, etc. |  | ✔️ |
| Objective: have a smart LC connected to the railway/road network | New solutions: light barriers, lights on decking, ... (tests for LCs and road vehicles) | ✔️ | |
| | Replace flashing light with a traffic light and test it | ✔️ | |
| | Test communications with drivers and urban furniture | ✔️ | |
| | Prepare for the arrival of driverless cars | ✔️ | ✔️ |
| | Communicate with trains for faster announcements | ✔️ | ✔️ |

- Reduce the number of accidents by 60%
- Reduce the number of accidents by 40%

### PARTNERS

- Mermecc
- Honeywell
- Continental
- NEW EARTH
- Continental
- VEDECOM
- SNCF
TESTING IN PROGRESS 1/2

LCs equipped with obstacle detectors
- Testing is carried out in two phases:
  - phase 1: equipment on a few LCs is tested to assess system effectiveness, particularly in terms of false alarms (which result in no impact on rail traffic)
  - phase 2: connection of the obstacle detector to a lighting system, informing the train conductor when an obstacle has been detected on the tracks
- Honeywell and Mermec equipment put into service on four sites in Rhône Alpes and Normandie; IHI equipment used in the Ile-de-France region
- A few false alarms were recorded, particularly involving pedestrians, which required investigations
- New lighting is also being developed at the same time; impacts on high-level regulations are being assessed (phase 2)
- Assessment of phase 1 testing and launching of phase 2 at the end of 2017

New radar sensor systems with an obstacle detection module
- On January 31, 2018, France’s interior ministry transferred management of 80 radar sensor systems installed on LCs to SNCF
- A new radar system with an obstacle detection module is currently being studied

Reliability of driverless car technology for detection purposes
- Specifications are being developed with Continental to compare reliability criteria/costs/performance for automobile technology
TESTING IN PROGRESS 2/2

- Lights on barriers
- Diod lamps
- Flexible signs
- Skirting barriers
- Anti-intrusion plate
- Telephones and LC barriers
ROAD PROFILES
CONTEXT AND SOLUTIONS BEING CONSIDERED

A few tragic examples of vehicles that became stuck on tracks

![Balbigny 2011: 1 person injured](image1)
![Saint Médard 2011: 2 dead and 45 people injured](image2)
![Nangis 2015: 37 people injured](image3)
![Ormoy 2015: no injuries](image4)
![Voglans 2016: 1 dead](image5)

In terms of the risk analysis, two types of barriers could cause a vehicle to become stuck on the tracks:
- Engineers are testing obstacle detection systems that could provide protection,
- Identifying and improving road profiles around LCs could help prevent such situations.

TODAY

SNCF must provide resources to survey profiles around LCs:
- Tipule
- Topographical survey

Following the renewal of the track/ballast and intermittently for certain LCs

TOMORROW

LC profiles will be available automatically within a few minutes, with a level of accuracy making it possible to identify scratches on the pavement

We need to expand our policy for measuring LC profiles, particularly in designing all LCs in point zero
ROAD PROFILES
CONTEXT AND SOLUTIONS BEING CONSIDERED

TODAY
Example of survey with Tipule tool

TOMORROW
3D imaging provides better accuracy of the road profile, showing marks on decking and pavement
Highlight the worst profile line
Perform simulations for crossings for different types of vehicles or by inputting vehicle size manually (cantilever, axle distance, etc.)
ROAD PROFILES
CONTEXT AND SOLUTIONS BEING CONSIDERED

Example of a complex LC, where a polyline provided by classic topography (green line) is superimposed upon photogrammetric 3D terrain, indicating a difference in altitude between the traditional topographical rise and the natural terrain.

This difference may be explained, among other things, by the accuracy of the survey, with a larger number of points than with a classical topographical survey or with Tipule.
ROAD PROFILES
SOLUTIONS BEING CONSIDERED

TOMORROW

Augmented reality provides a number of possibilities:

> Virtual visits at LCs by embedding simulations for various types of vehicle
> Visualize area to be redesigned or improve the profile

Profile design tool:
http://mecpn.smart-aerial-machines.com/
ROAD PROFILES
EXPECTED IMPROVEMENTS

- Improve 3D survey quality for LCs with a level of accuracy indicating scratches and pavement quality
- Improve accuracy with the onboard system; survey is conducted at road level rather than being offset

- Time to determine road profile
  - Today: several hours, based on traffic; 3 to 5 hours in the company of an SNCF officer
  - Tomorrow with the onboard system: 15 minutes with no SNCF officer being required

- Current limitations of our tools: Tipule tool does not manage low-level crossings
- The new tool makes it possible to generate crossing scenarios using a road vehicles database, which can be configured to add new vehicles with different cantilevers
- A 3D profile makes virtual visits possible and allows for surveys to be carried out for equipment (e.g. measure the height of lights), without personnel having to go on site
- 3D technology also makes it possible to visualize the area surrounding the LC over a great distance, in addition to the advanced signalling system.
- This new tool is consistent with the LC line with respect to maintenance and engineering service needs

Other solutions, such as lasergrammetry technology onboard trains, do not make it possible to survey LCs in a curve and against a road curve and cannot be used in a vehicle stopped behind a half-bar when the LC is closed
DESIGNING NEW LCS

NEXT STEP

- Before the LCs for 2030 are developed, transitional phase incorporating new equipment that is compatible with current relay technology and future technologies

- Tests for the current and medium-term versions of the project to verify compatibility of new equipment with LCs equipped with relay technology

- Tests to announce trains using non-track equipment (radio, GSM, 4G, ERTMS, protocol for self-driving cars, etc.) at speeds exceeding 120 km/h

- We could test the following using these LCs:
  - Flashing lights (also testing light intensity depending on conditions)
  - Decking equipped with lighting
  - Communication between LC and urban furniture
  - New light barriers
  - New alarms adapted to the environment
  - Etc.

- Behaviour study using virtual reality simulations
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