INTERNATIONAL UNION OF RAILWAYS

unity, solidarity, universality

HOW TO ENHANCE SAFETY AT LEVEL CROSSINGS

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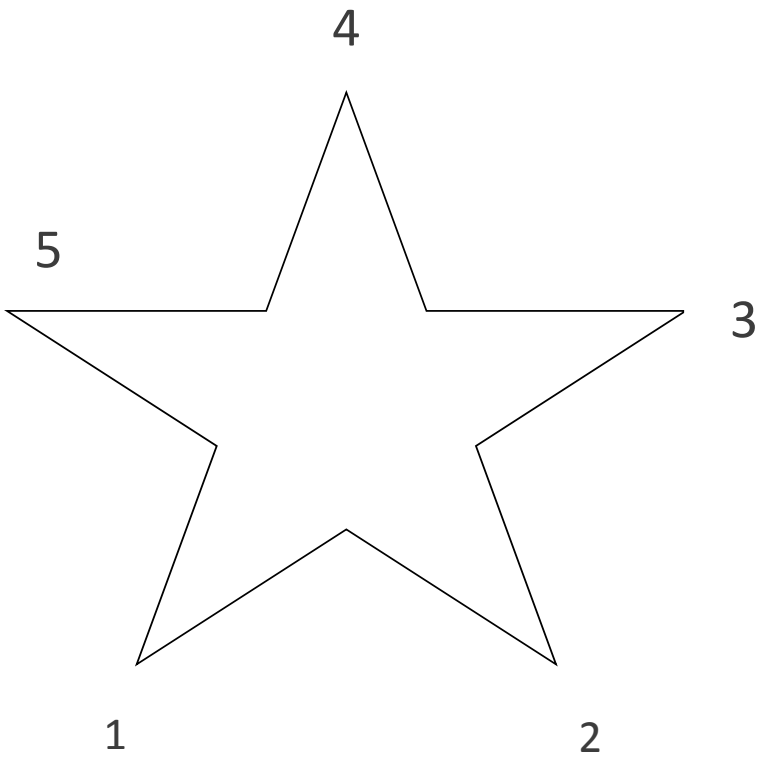
THE ROLE OF THE UIC IN THE RAILWAY SECTOR

General view at the UIC level :

1. **Platforms & Forums** : able to give the opportunity to experts from all over the world to discuss about project management, research, benchmarks, to face problems...
2. **Anticipation**: Definition possibilities of common rail technology strategies on a regional level but also worldwide = common rail standards
3. **Third "neutral party"** in different contractual or technical aspects
4. **Communication,** dissemination / training of future railway agents
5. **Representative** Sector at the UN (adviser for the general secretary), UNECE, World bank, other regional banks to support the railway sector

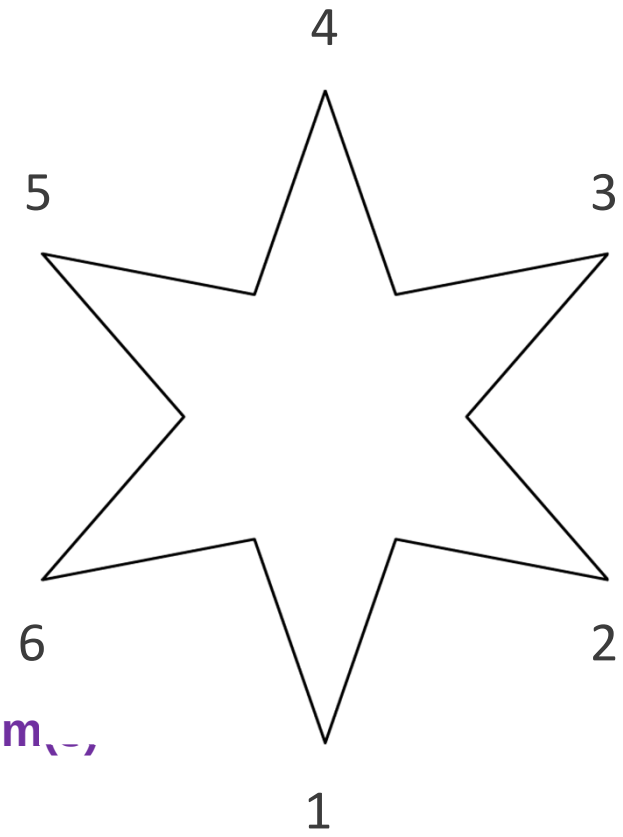


Our vision for the railway : transportation → mobility → accessibility to mobility → collaboration between modes

THE ROLE OF THE UIC IN THE RAILWAY SECTOR

General view at the Rail System Department UIC level :

1. **SAFETY** improvement – ERTMS – performance, safety, security
2. **DIGITALISATION** – performance improvement, contributions and risks
3. **ASSET MANAGEMENT** (technical and economic aspects)
4. **TRAFFIC CAPACITY upgrade – a**utomatization or Expertise to support operational processes
5. **SMART INFRASTRUCTURE** – new maintenance concepts
6. **ROLLING STOCK** – improvement, new maintenance concepts



The balance have to be master during all the life time of the system.

THE ROLE OF THE UIC IN THE RAILWAY SECTOR

RSD Strategy - Necessity of "system vision"

- A **system vision** is the heart RSD → RSF

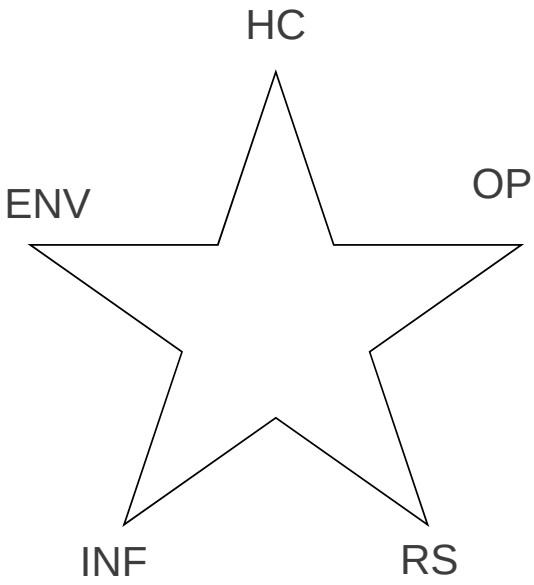
  - It links the past to the future through today;

  - It is the key to control and anticipate railway safety, performance and efficiency balance in an evolving railway system

- There is no railway without business and countries strategic visions, without anticipation of the national & international needs

- There is no railway without "technical control" by them self, no technical control without opening on national cultures and induced historical choices:

  why → what → how



THE ROLE OF THE UIC IN THE RAILWAY SECTOR

Digitalization and Level Crossing framework :

→ **Digitalization :** a real “disruption” for the railway processes.
UIC is working on three axes to find solutions:

1. Exploration of new possibilities offered by new technologies
2. Improvement of existing assets → POCs
3. Definition / Requirements / Design of assets of the future
4. Performance assessment / Business - Safety – Security – Availability - Maintainability

→ **Level crossings :** a real problematic that the railway have to face, considering different aspects regarding the operation principles, the culture, the history, the existing technologies

Ex : 3500 / 350 / 35 / 3,5 / 0,35 death/year

THE ROLE OF THE UIC IN THE RAILWAY SECTOR

UIC is managing complementary projects in this field :

- **SAFER LC** → European open call project
  → UIC represents railways with the support of universities, consultants
- **DIGIM** → Step 1 (2018) leaded by ViaRAIL : how estimate the closing time of LCs and advice the cars drivers about the best behavior (waiting or alternative route)
  → 6 railways members of UIC (RZD, CFL, ViaRAIL, RAI, FS, IRRB)
  → Step 2 (2019) : how to control the behavior of a driver approaching a closed LC et force them to brake and stop
  → Railway member list closed dec.2019 (at least the 6 previous one)
- **Overall safety at Level Crossings** (2017-19)
  → UIC European region project (ADIF, FS, FTA, INFRABEL, JBV, ÖBB, PKP, SNCF)
  → how to improve the safety at existing European LC using the new digital possibilities (IoT, AI, sensors, vital computers…) and the local operation principles
- **FRMCS**, **AI** for safety relevant application…

UIC is managing different complementary projects worldwide

DIGIM PROJECT – LC ASPECTS

Participation to the DIGIM Project

- ✓ Railways : RZD, CFL, ViaRAIL, RAI, FS, IRRB
- ✓ Leader : ViaRAIL
- ✓ Support : Waze

What are the aims of the project?

- ✓ Analyze the possible business impacts due to digital
- ✓ A specific issue to be treated : **safety at the existing level crossings**
  - → realization of a proof of concept is expected for each step
  - → the LC sub-project focused on the two following issues :
    - 1 - how to inform the cars, busses and lorry's drivers that the LC crossing will be closed due to operational issues (normal and degraded mode), maintenance, failure conditions ?
    - 2 – how to stop the cars, busses or lorries then they are approaching a closed LC ?

DIGIM PROJECT / LC ASPECTS – step 1

Step 1 of the DIGIM project:

What?

The project focus on digital technologies which could lead of quick wins for the railway business. During DIGIM1 project, a representative use cases is designed: How Digital can improve security at level crossings?

Why?

Create the conditions for safer operation of existing and future level crossings, in particular about the regulation of the announcement deadlines and the road-rail interface.

How?

Analysis of the present situation:
The current mean **to warn** a road user of an approaching train depends on the location, train speed, road usage. It goes from a stop sign to a full automatic warning device including bell, flashing lights and gates.

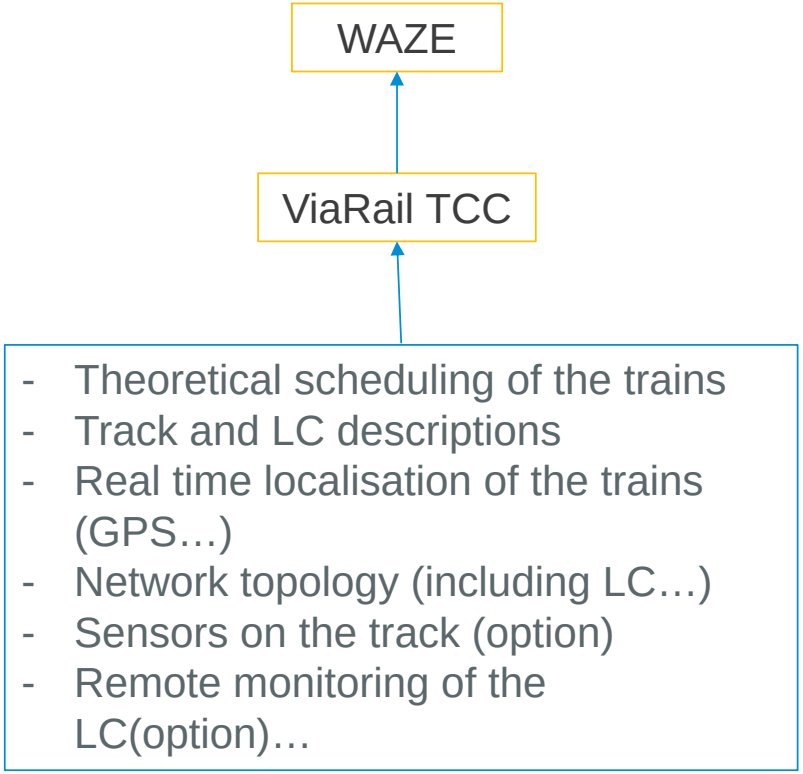
DIGIM PROJECT / LC ASPECTS – step 1

1 - **ViaRail** data treatment of all available informations

2 – **ViaRail** estimation of the real time positioning of the trains → real time impact of the status of the levels crossings (each 10s)

3 - **Communication to WAZE** of all useful informations application to inform the “car users having an iPhone with an Waze Apps” – all information needed to estimate the future closing time of the level crossing and closing time due to failures

4 – **WAZE** communicate the more efficient route regarding the predictive closing time of the level crossings (if the LC is closed, indicate an alternative route if more suitable)



DIGIM PROJECT / LC ASPECTS – step 1

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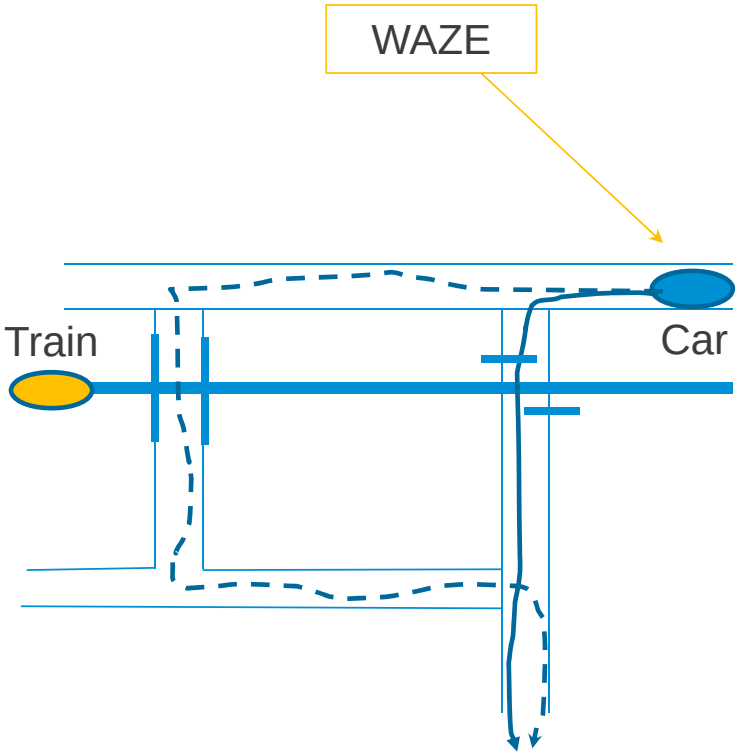


DIGIM PROJECT / LC ASPECTS – step 2

Step 2 of the DIGIM project:

What?

The project focus on digital technologies which could lead of quick wins for the railway business. During DIGIM2 project, a representative use cases is designed: How Digital can improve security at level crossings?

Why?

Create the conditions for safer operation of existing and future level crossings, in particular about the respect of the road ligth signals by the drivers.
.

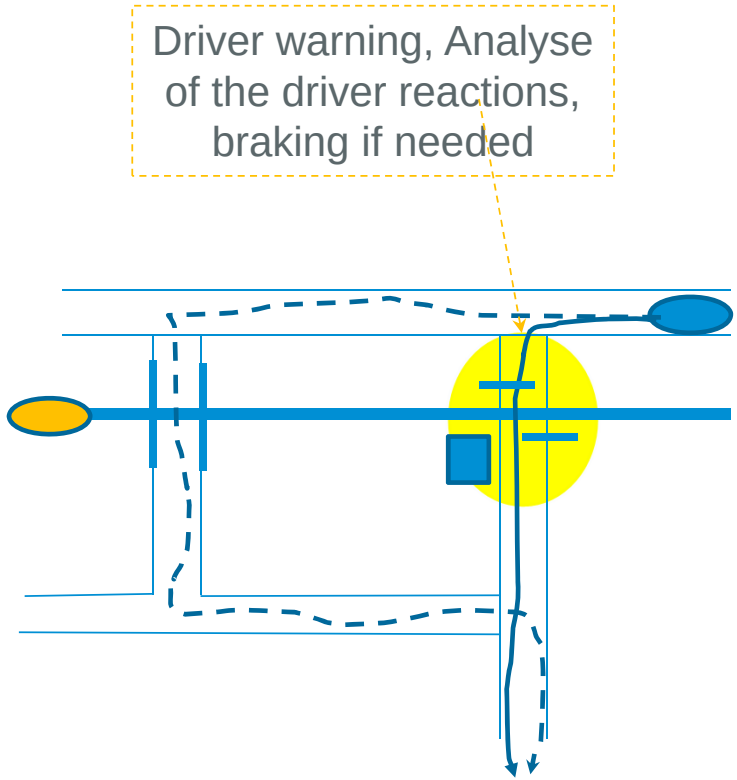
How?

Analysis of the present situation:
The current mean **to stop** a road user of an approaching train depends on the location, train speed, road usage. It goes to a full automatic stop of the car or lorry before the barriers.

DIGIM PROJECT / LC ASPECTS – step 2

The project will be process in 2019:

- **Leader:** ViaRail
- **Member contribution:** at least the 6 DIGIM1 members – open to UIC members until end of December 2018 – financing “in kind” by the members participating to the project
- **UIC HQ:** project management**,** redaction of a Guideline
- **Support**: Dassault (DS) and Valéo compagnies
  FIA (Fédération Internationale de l’Automobile)



IMPROVING OVERALL SAFETY AT LEVEL CROSSINGS

PARTICIPANTS: ADIF, FS, FTA, INFRABEL, JBV, ÖBB, PKP, SNCF Réseau

MAIN ACTION FIELDS:

1. **Improve train detection systems**
   By designing a train detection system, whose elements are located outside of the track to facilitate maintenance works (for track and signaling teams), able to detect not only train presence and direction but also the speed
2. **Closed barriers time optimization**
   By adapting closing time to the train speed we can decrease road vehicles waiting times and thus the tendency not to respect the barriers.
3. **Less periodic maintenance work, but increasing availability of LC elements**
   By monitoring LC elements we can act before failure occurs. Installing sensors and treating the obtained information with A.I. can preview future failures.
4. **Connecting the LC with “road world”**
   By use of mobile and TMC technologies send relevant information to mobile navigation devices. Road users can know in advance possible failures at LC and use alternative routes and even to be informed of open/closed status of LC in real time.

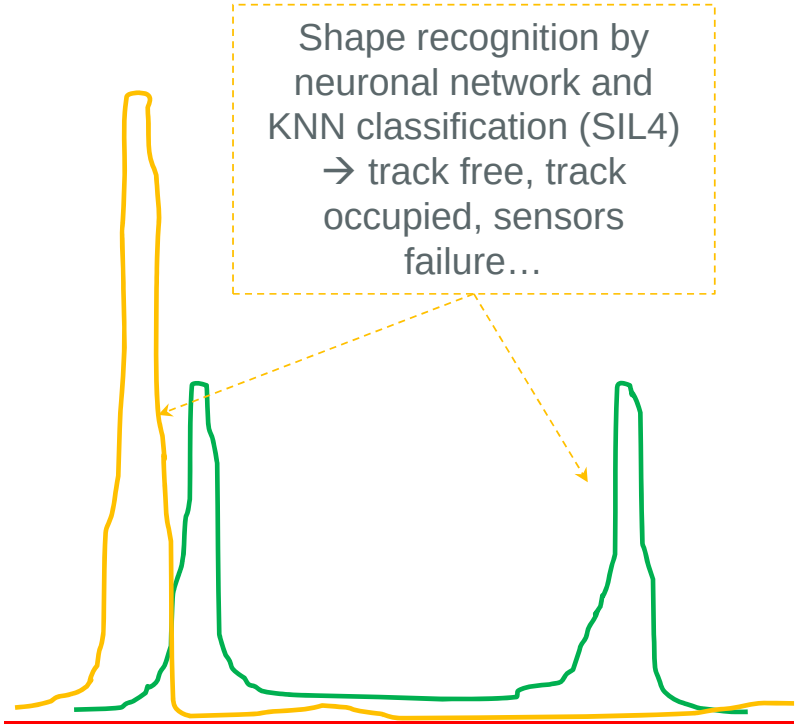
IMPROVING OVERALL SAFETY AT LEVEL CROSSINGS

1. Improve train detection systems

- Train circuits can be affected by track conditions (rust on track surface, leaves over the rail, etc.)…
- Axle counter can miscount with track machinery, be affected by electromagnetic interference…
- Elements on track are conditioning maintenance works.

How to improve

- External train detection and speed evaluation system (UIC POC realized)
  Develop a system to install out of the track to facilitate maintenance and reduce workers risk, detecting the train with optical systems, also detecting train speed
- Real time train detection et localization using the FRMCS functionalities (3GPP R16)



IMPROVING OVERALL SAFETY AT LEVEL CROSSINGS

2. Closed barriers time optimization

For lines with mixed traffic, level crossings can be closed for too long as the LC, must be closed on time for the fastest train.
Closing time on the LC can be adapted depending on train speed.

How?

On the base of the previous train detection device, Developing a new device (real time automata's formal proven, SIL 4), to calculate the right time for closing the LC, once known train speed.

Why?

To fulfil local laws and regulations, and reducing waiting times for road vehicles, decreasing the risk of violation.

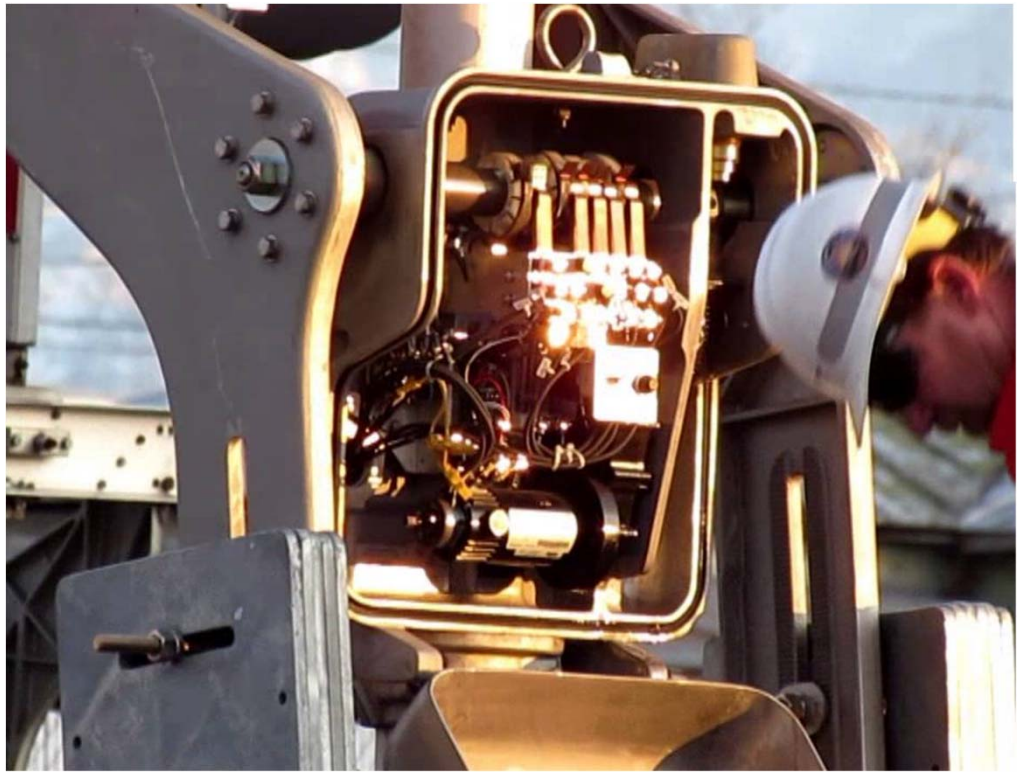
IMPROVING OVERALL SAFETY AT LEVEL CROSSINGS

3. Maintenance optimization

To improve maintenance operations at level crossing, optimizing scheduled work and reacting before failures.

How?

Installing detectors for all sensible components and detecting deviations with Artificial Intelligence, before the failure. System will send a warning to maintenance team if magnitudes are out of tolerance or a strange behavior is detected



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4. Connecting the LC with the “road world”

Sending information about LC status, can help road users to avoid conflictive points or traffic jams and improve their routes.

- Level crossings with ongoing maintenance operations or with failures, could be avoided by selecting a different route.
- Information can be shared by TMC system (traffic message channel) → Waze, etc.

➔ The results of DIGIM and SAFER LC projects will be taking into account

IMPROVING OVERALL SAFETY AT LEVEL CROSSINGS

WORK PACKAGES :

- **WP 1**: Survey on; level crossing technologies, norms and regulations, operation modes, available technologies, needs and requirements.
- **WP 2**: Train detection system. Outside of danger area (track vicinity) . Speed detection system
- **WP 3**: SIL 4 automata (add-on) to send “close barriers” order to existing LC, based on the information from train detection system (optimization of closing barriers delay, based on train speed)
- **WP 4**: Remote monitoring of LC parameters with different sensor and information treatment with A.I. to seek for possible indicators of future malfunction of LC. Reporting of alarms.
- **WP 5**: Broadcast of LC status to road users. Possible use of mobile apps (waze, google maps …) or TMC for GPS.
- **WP 6**: Prepare IRS and guidelines with the results and recommendations, and information about produced POCs (Open Source)

IMPROVING OVERALL SAFETY AT LEVEL CROSSINGS

WP1 : Regulations, technologies and norms benchmark

- Multiples countries = different regulations
- Sharing experiences to find other solutions
- Not necessarily great investments
- Take advantage of other countries experience

Common point: Vienna Convention on Road Traffic (8 Nov 1968)

Technology – Rules – Degraded modes – Maintenance procedures – Remote management ……..

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WP2 : Train detection system for LC

- External to the track
- Presence, direction and speed detection (acceleration?)
- As autonomous as possible
  - Power supply
  - Radio communication (FRMCS only radio bearer possible in the next future)
- Modular system to adapt to existing level crossing

OBJECTIVES:

No more elements on the track (easier maintenance)
Detect speed to be able to optimize barriers closure time.
Modular system. Less possible modification on existing LC.
Reduced civil works for installation

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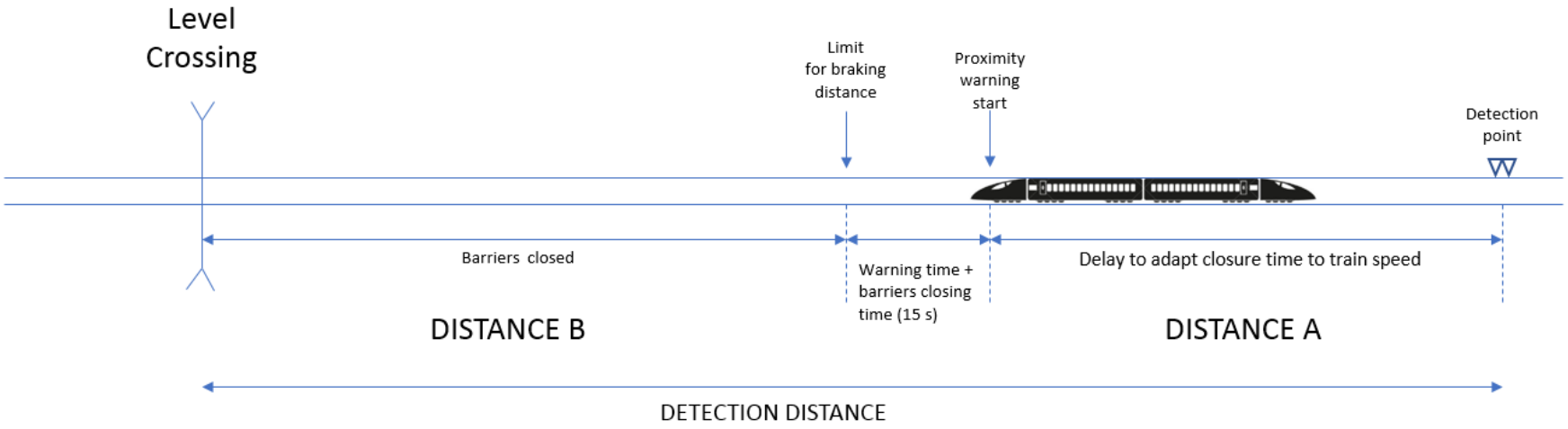
WP3 : Adaptive closure time for LC

To optimize road vehicles waiting time, based on train speed ➔ reduced risk of violations



- SIL4 formally proven automata
- Treatment of information from speed detection device
- Ability to command the starting of barriers closure process with minor modifications on LC

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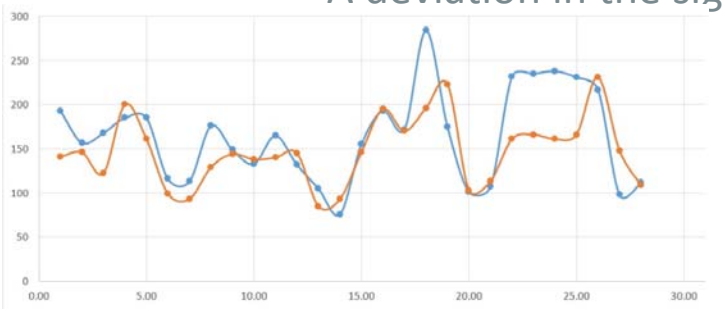
WP4 : A.I. for predictive maintenance

To monitor parameters and compare with previous signatures

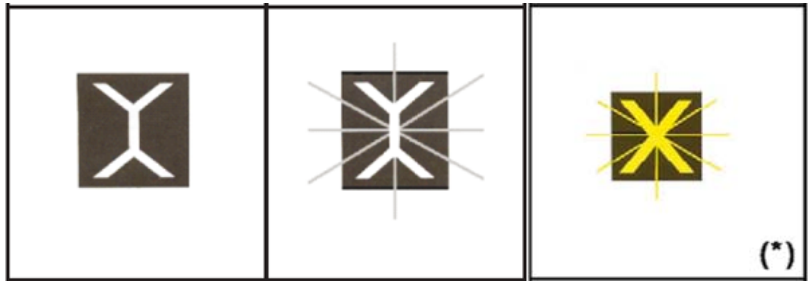
A deviation in the signature can be a warning before failure.



Radio communication between LC elements and LC box

From LC box a message can be sent to maintenance team

- Through fixed network.
- By radio link.
- By railway signal aspect



(*) Spanish case

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WP5 : Road vehicles information

Send LC information to road vehicles:

- Using waze
- Trough TMC (Traffic Message Channel)
- Other mobile phone APP

Possible information sent:

- LC open/closed
- Failure on LC

Better informed drivers can avoid problematic LC
Avoiding a LC with a fault can be safer for road vehicles

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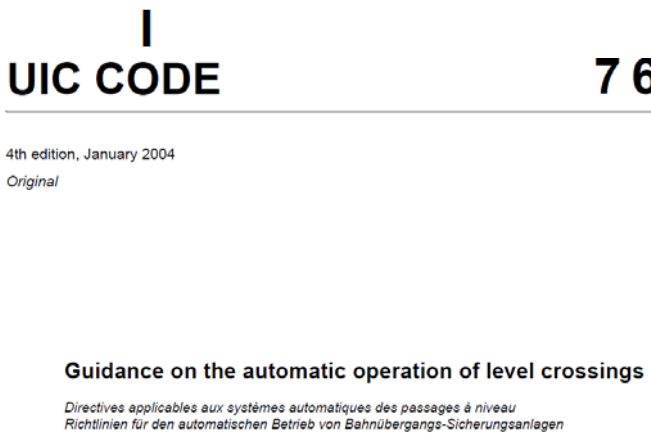
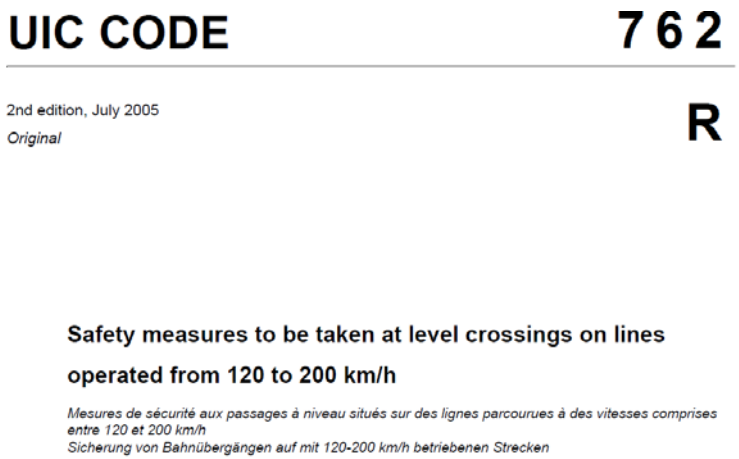
UIC Leaflets





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THANK YOU FOR YOUR PARTICIPATION

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