

Designing cycle layouts beside and across tram lanes to increase safety

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Context

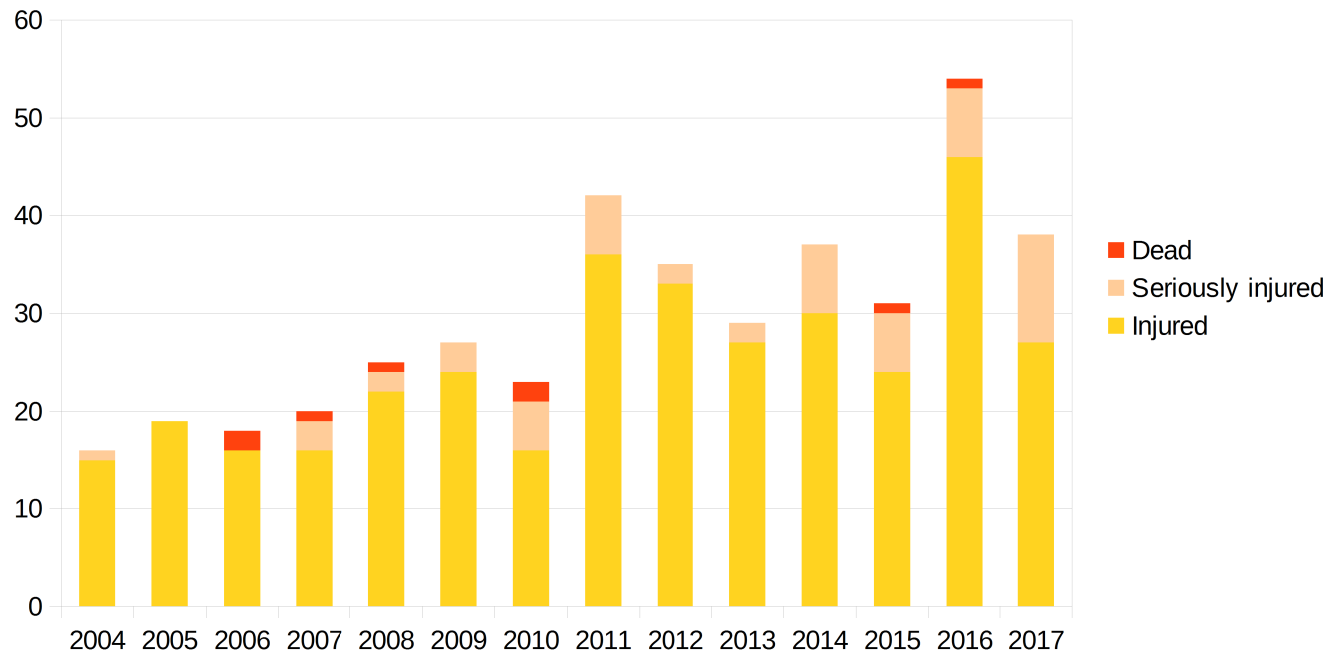
- Bicycle and tramway : 2 alternative modes of transport from car, with different willings
- Collisions of tram-cycle is increasing

Cycle third party	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Collisions	40	40	41	39	31	64	50	56	63	72	87	93
Cycle victims	18	19	25	24	22	39	29	25	35	28	51	36

- A Cerema study (2014) named Tram/cycle interaction in french tram networks => a need to create or improve cycle layouts parallel to tram lanes

Distribution of victims of bicycle-tram collisions

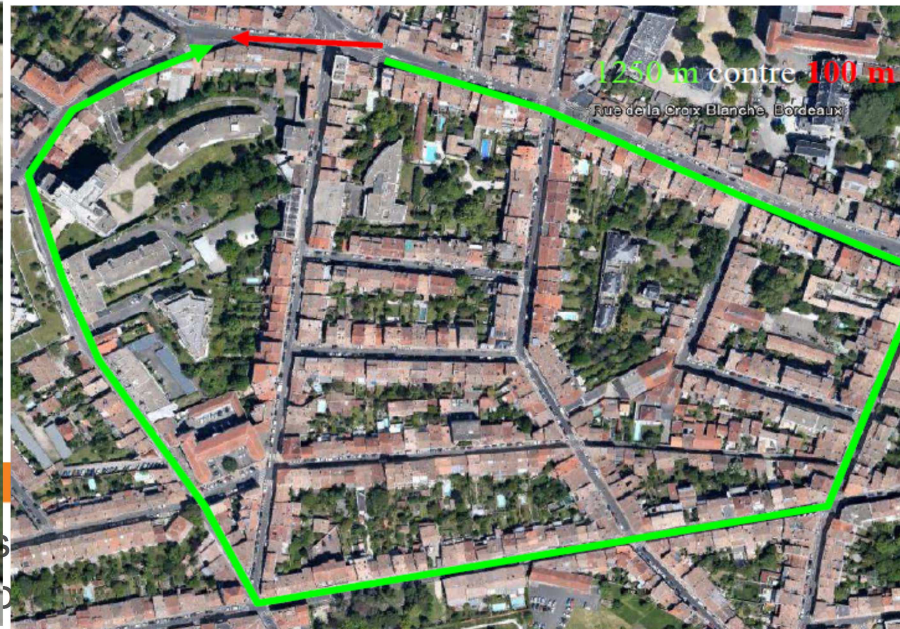
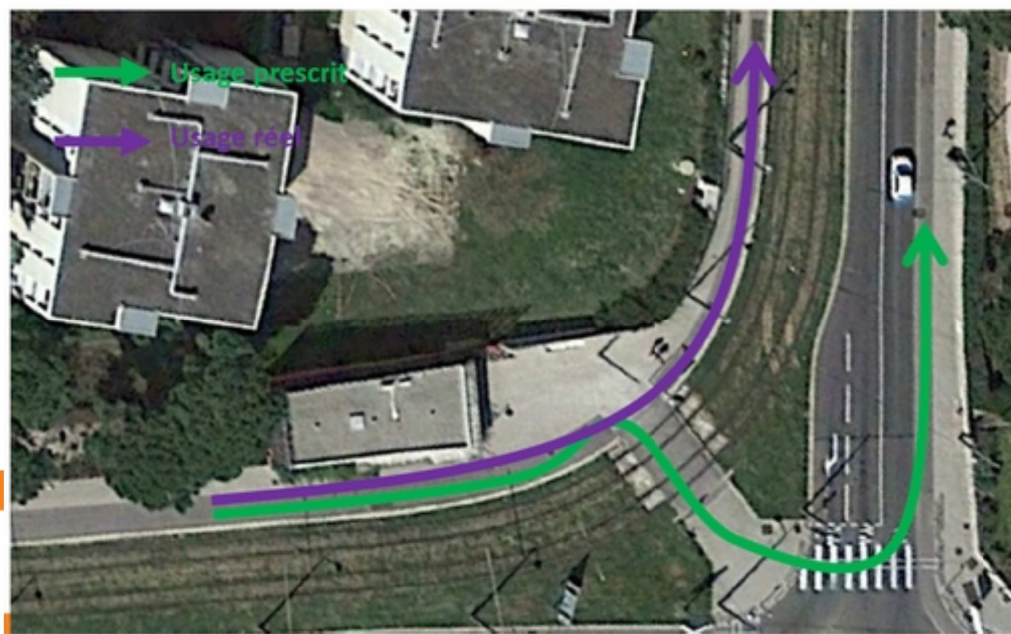
Number of victims of bicycle-tram collisions - Evolution 2004-2017



- 60 % of collisions make victims

Main attractive goals for cycle layouts

- Route as direct as possible
- Continuity and interconnection
- Lisibility
- Comfort
- Safe trip (real and perceived)
- A fun trip/attractiveness



Identify specific issues for cycle layouts close to tram lanes

- **Interaction notion :**
which is a situation where a user has to adapt his behaviour to avoid a collision with another user or with infrastructure.
Here cyclist and tram driver are these users
- **4 types of layout sections :**
 - Junction
 - Pedestrian/cyclist crossing
 - On-street/off-street section
 - Station

Identify specific issues for cycle layouts close to tram lanes

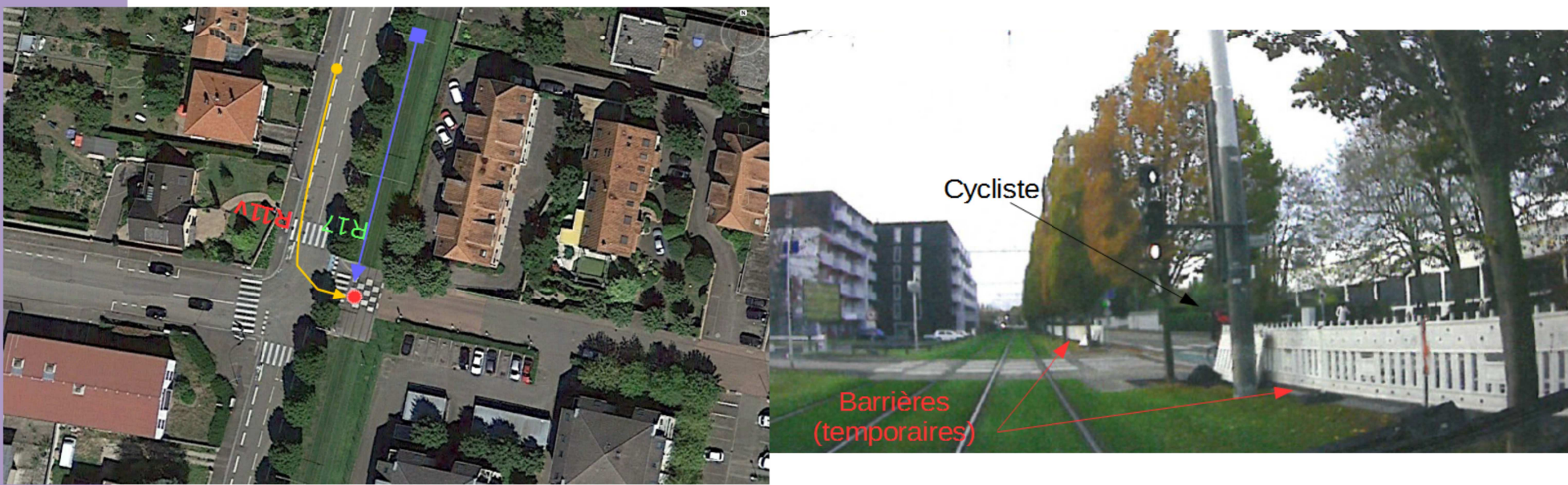
- A precision on configuration and status of each interaction
- Looking at some accident reports implying cyclist and tram, pointing factors that could have led to the accident :
 - Human factor from tram driver and cyclist
 - Infrastructure factor
- Safety objectives suggested per each type of interaction

Junction

- Junction 1 (*every configuration*) :
 - A cyclist goes parallel to tram track and wants to turn in the junction using roadway. When crossing the tram track, he is hit by a tram
- Safety objectives :
 - Improve co-visibility between tramway and cyclist
 - For cyclists, improve the perception of a coming tram
 - Ensure the coherence of traffic signs for cyclists turning in the junction according to all other users (tram and others)

Junction

A cyclist goes parallel to tram track and wants to turn in the junction using roadway. When crossing the tram track, he is hit by a tram
50 km/h speed limit road



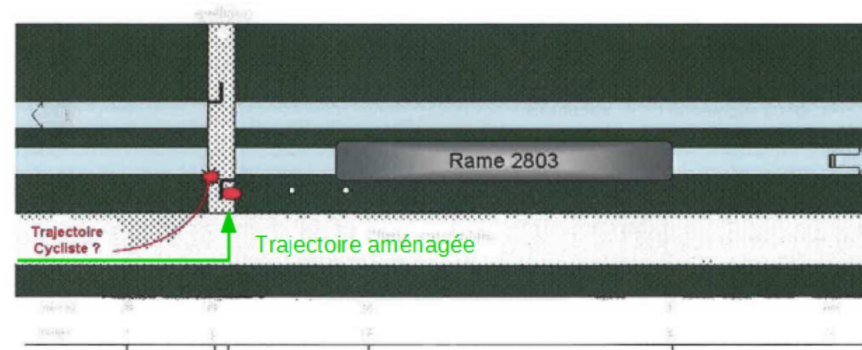
- Human factor(s) possible(s) :
 - Cyclist : not comply with signalisation (traffic light is red for cyclist)
 - Tram : Non optimum brake
- Facteur(s) Infra possible(s) :
 - Mask of visibility created by barriers

Pedestrian/cyclist crossing

- Interaction 2 (*toute configuration*) :
 - A cyclist goes parallel to the tram track and use a p/c crossing suddenly, taking the tram driver by surprise
- Safety objectives :
 - Promote co-visibility when approaching crossing for both tram and cyclist
 - For cyclists, improve the perception of a coming tram
 - Provide a right angle between tram track and p/c crossing
 - Limitation of the use of p/c crossing only when necessity or need

Pedestrian/cyclist crossing

A cyclist goes parallel to the tram track and use a p/c crossing suddenly, taking the tram driver by surprise
Tram track without car circulation



- Human factor(s) possible(s) :
 - Cyclist : not comply with priority rules, not wear a cyclist helmet, excessive or unadapted speed
 - Tram driver : N.A.
- Infra factor(s) possible(s) :
 - Lack of marking signs, p/c crossing geometry isn't consistent

On-street/off-street section

- Interaction 1 (*toute configuration hors site banal*) :
 - A cyclist goes on the tram track and is hit by a tram
- Safety objectives :
 - In 50 km/h speed limit roads, improve cycle layouts attractiveness
 - In calm circulated road :
 - Make sure motorised vehicles comply with speed limitation
 - Design two-way cycle paths in one-way streets
 - If the flow of cyclists is important, design a dedicated path for cyclists (shared bike lane, bike path free of cars)

On-street/off-street section

A cyclist goes on the tram track and takes the tram driver by surprise

50 km/h speed limit road



On-street/off-street section

A cyclist goes on the tram track and takes the tram driver by surprise

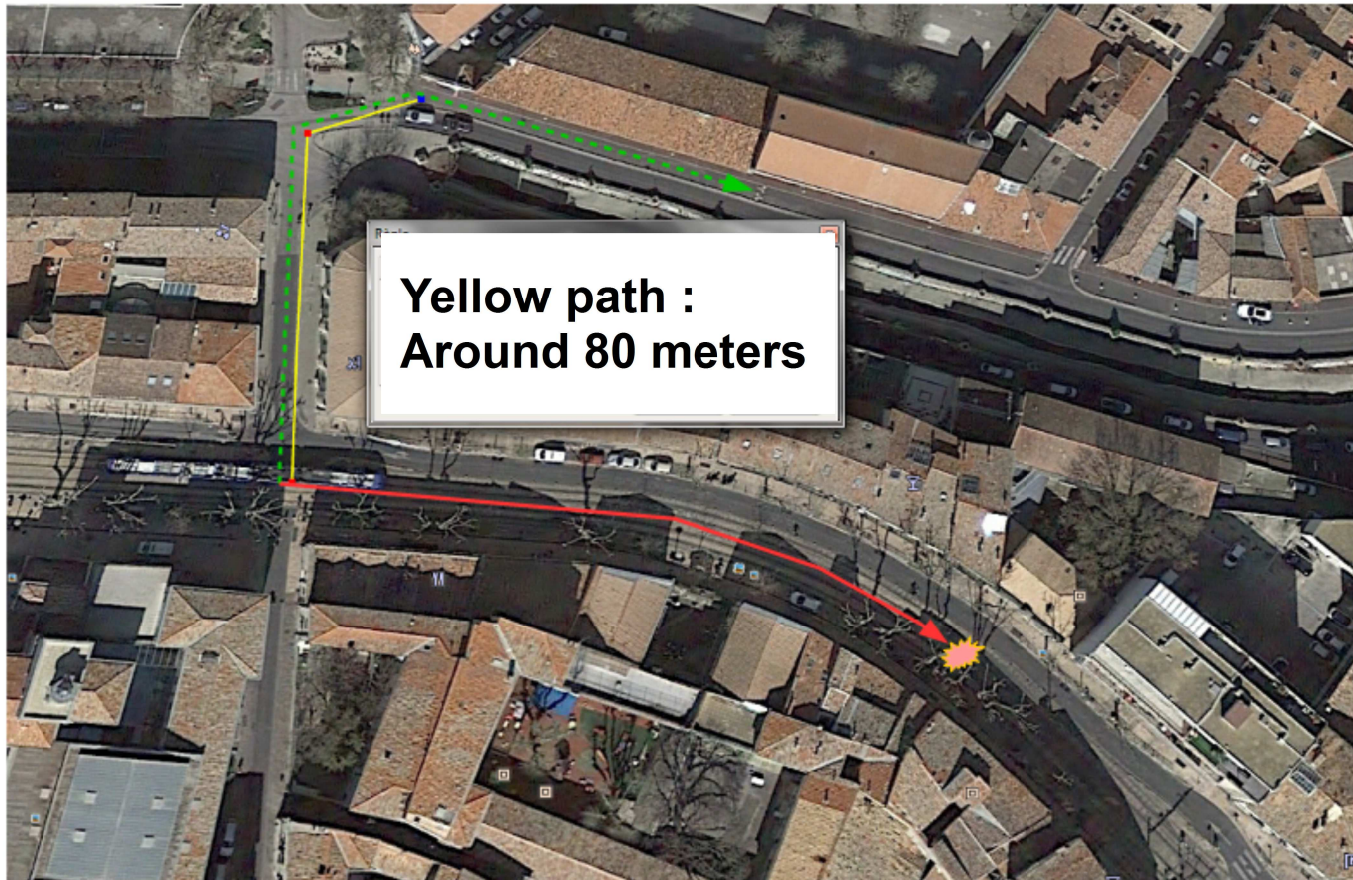
50 km/h speed limit road



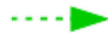


On-street/off-street section

A cyclist goes on the tram track and takes the tram driver by surprise

50 km/h speed limit road



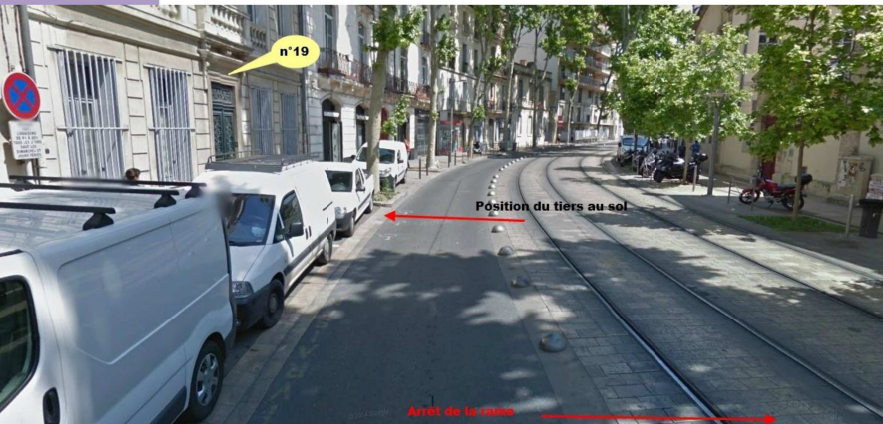
**Yellow path :
Around 80 meters**

-  Itinéraire aménagé
-  Itinéraire réalisé
-  Ecart entre les deux itinéraires

On-street/off-street section

A cyclist goes on the tram track and takes the tram driver by surprise

50 km/h speed limit road



- Human factor(s) possible(s) :
 - Cyclist : not comply with street status, goes in wrong way, excessive or unadapted speed
 - Tram driver : N.A.
- Infra factor(s) possible(s) :
 - Lack of comprehensibility of the cycle route
 - Lack of attractiveness of the cycle route

Synthesis of safety objectives

- Human factors :
 - Make cyclists aware of tram dangerousity, and at its priority
 - Warn cyclists when arriving in front of an interaction
- Infra factors :
 - Ensure continuity of cycle routes at interactions and crossings
 - Make sure other users respect cycle layouts and its use
 - Improve the perception of spaces dedicated for each user
 - Promote co-visibility when approaching crossing for both cyclist and tram
 - For cyclists, improve the perception of a coming tram when crossing
- Infra factors specific to each type of interaction
 - An exemple for p/c crossing :
 - Provide a right angle between tram track and p/c crossing
 - Limitation of the use of p/c crossing only when necessity or need

Next phase of the study

- Methodology isn't stabilized yet, nor the finish of the framework report, but some goals are aiming :
 - Continue the analysis and list layout solutions for each section and their interactions
 - Describe inherent and external parameters for these solutions, new risks that may appear

- Study results to be continued ...

Thank you !

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