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Nancy (F)

Innovation technologique
changements organisationnels
quels enjeux pour la prévention ?



Session 2: New tools for production support

Does technology do it all? Reflections on the design of a tramway cockpit

LAURÈNE ELWERT & ROBIN FOOT, 30 MARS 2017



LATTS

LABORATOIRE TECHNIQUES
TERRITOIRES ET SOCIÉTÉS

Introduction

For more than 15 years, we have been conducting analysis of the driving activity of urban guided transport systems based on a trade union demand (Nancy, Clermont-Ferrand, Lille, Paris, Reims).

We also worked in a network with a consulting firm on the Bordeaux tramway as well as with work health services on the trams of Dijon and Besançon.

Since 2011, we have been cooperating with the Urban Transport branch of the CGT Transport Federation on working conditions and, in particular, the Dead Man.

Lastly, since 2014, we have been working as an assistant to the Project Manager of the Clermont-Ferrand community in a project to redesign the existing cockpit following a major series of recognized occupational diseases (8 in 4 years).

Our presentation is mainly based on a specific case but a number of conclusions have a more general and evident value of the trends in the design of trams.

We start from the technique, considered as a way of doing, to go back to the analysis of technical objects. Taking activity into account serves as an analyzer of these objects.

Then, we will present the way we try to resolve the disagreements between the activity and the technical devices.

Driving a "French-style" tramway, a specific technique

The driving of the tram is different from that of the bus as it is guided by rails. The driver only acts on the speed of the vehicle and must anticipate the movements of pedestrians and cars around.

In France, the tramway lane is sometimes open to other traffic (cars, taxis, bicycles, etc.). This reinforces the need for the driver to see far to anticipate his actions. "Driving at sight" characterizes the driving of the tram. Driving safety is essentially based on this sense of the driver: the sight.

Finally, the role of the tramway in districts is central because it boosts demand and its service ranges from 25% to 60%. This strategic importance imposes a productivity constraint on drivers, which results in increased control over the regularity of schedules and driving speeds.

Besides the information transmitted in the cockpit, signals on the road allow the drivers to anticipate the "going green" of the traffic lights, placing the pressure on the drivers. The technical system of the french style tramway controls and put under stress the activity of the drivers.

Do the cockpit take into account the driving technique?

Despite the importance of driver attention, anticipation and vision in the tramway driving technique, the designers of the cockpit did not really take into account these dimensions of the activity.

Since 1985, the date of reinvention of the tramway in France, new technical objects (computerization of control systems, commands, computer screens, vision systems by cameras ...) arrived in the cockpit and transformed it.

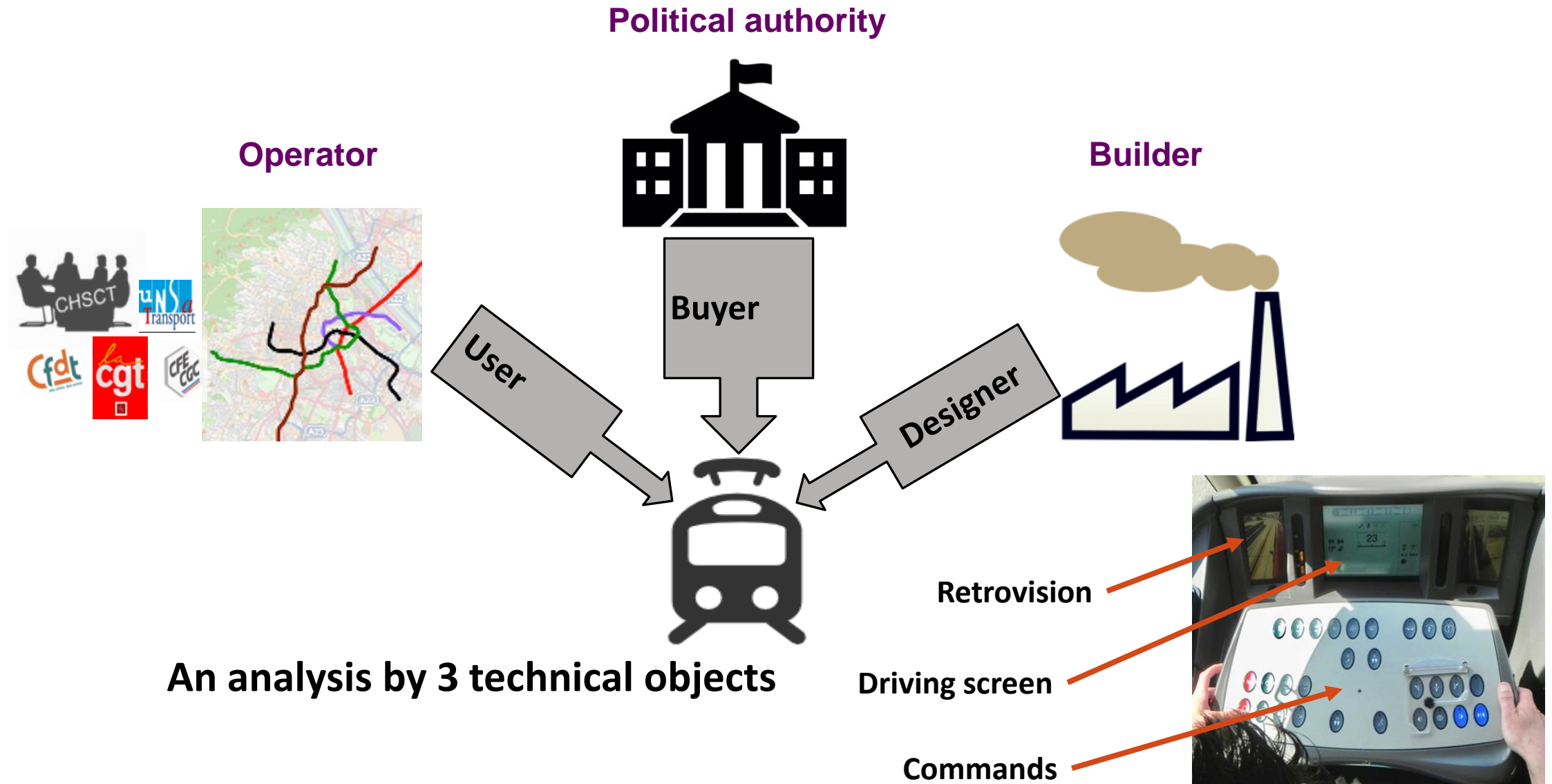
In many cases, these transformations have led to "disarticulating" the driver's activity without the designers measuring this phenomenon.

Misconceptions found by drivers are "misunderstandings".

Through 3 objects, we will try to understand these misunderstandings :

- Misconception about the function: The retrovision, between driving and road.
- Technological misunderstanding: Screens or how to not process information.
- Misunderstanding about the action: The commands, driving position or office station, a formal confusion.

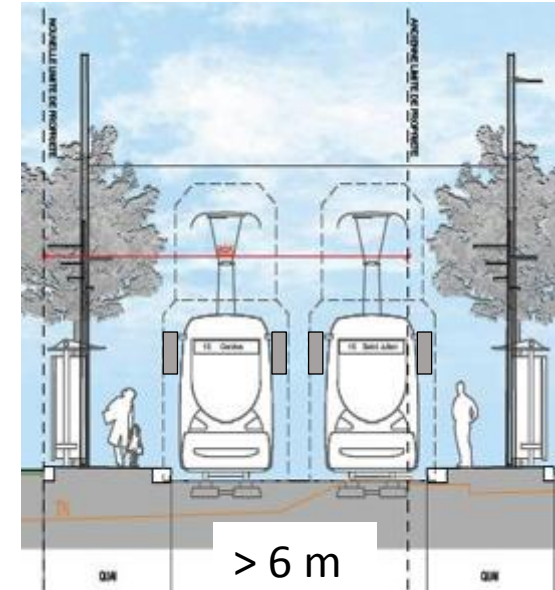
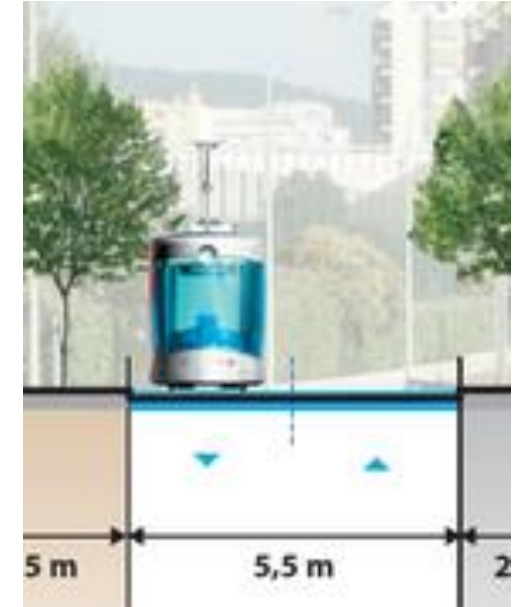
For which actor is the tramway thought?



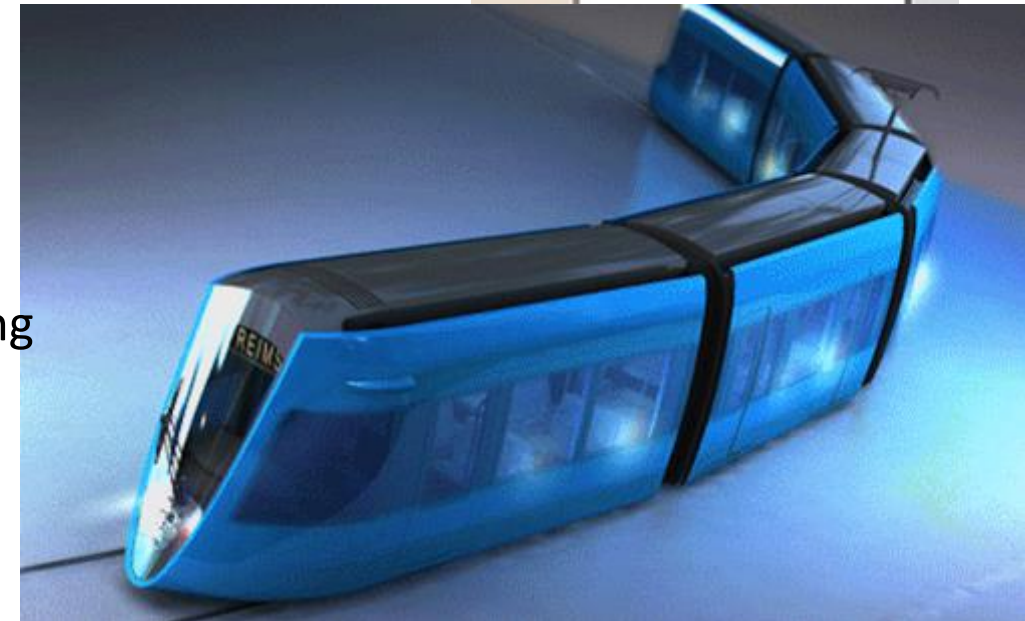
A functional misunderstanding: retrovision, between driving and roads

The transition from the optical mirror to the camera / screen system took place, in France, at the end of the 1990s.

This allowed a reduction in the right-of-way for roads (> 0.5 m) by eliminating the "outgrowths" formed by the optical mirrors. This transformation, facilitated by the reduction of the costs of the cameras and the screens, was compatible with the economic requirements of the manufacturers.



The elimination of the optical mirrors also eliminated any reference to urban road vehicles, promoting the possibility of working "streamlined" and "clean" design.



A functional misunderstanding: retrovision, between driving and roads

The introduction of this camera / screen system, coupled with a "design" strategy, allows the camera to be located behind the driver.

This is not the case with optical mirrors where the information is in front of the driver.

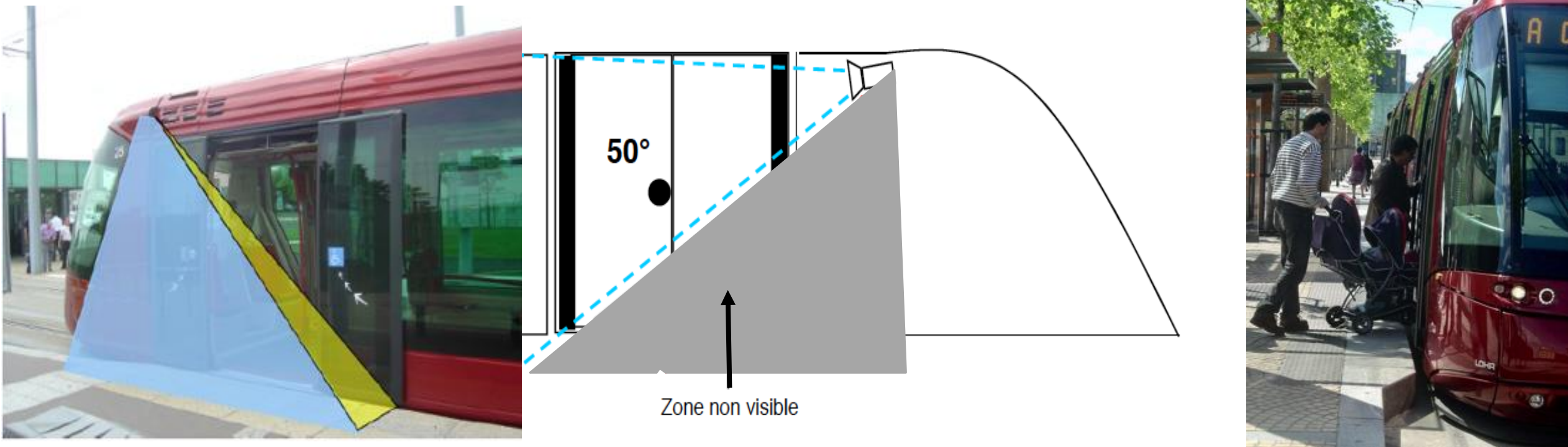


From the apparent mirror to the camera system, the viewpoint backs away.



A functional misunderstanding: retrovision, between driving and roads

This transformation, guided by an esthetic logic, modifies driving activity and visibility. This is particularly important for station service because the driver can't see, for example, a wheelchair passenger or a stroller near this first door, whereas this door is reserved for this category of users. In addition to the fact that the driver can, without seeing him, close the doors in front of a disabled person, he may also not see the fall of a passenger, which creates a permanent tension in the work.



A technological misunderstanding : Screens or how to not process information

The digitization of the information makes it possible to treat in the same way the pictures, the alphanumeric or iconic inscriptions. They can be returned to the same screen types and grouped in a dashboard.

From the point of view of the designers, all information that the driver might need is available. The retrovision screens are located on both sides of the central driving screen, arranged symmetrically.



A technological misunderstanding : Screens or how to not process information

This distribution of the retrovision screens around the driving screen corresponds to a concern for design where symmetry occupies an important place but it does't correspond to a functional concern from the driver's point of view.

The interpretation of the images, which is already complex, is further complicated by the separation of the two screens, which forces the driver to go back and forth between these two screens.

However, from a regulatory point of view, retrovision makes it possible to watch the passenger service.

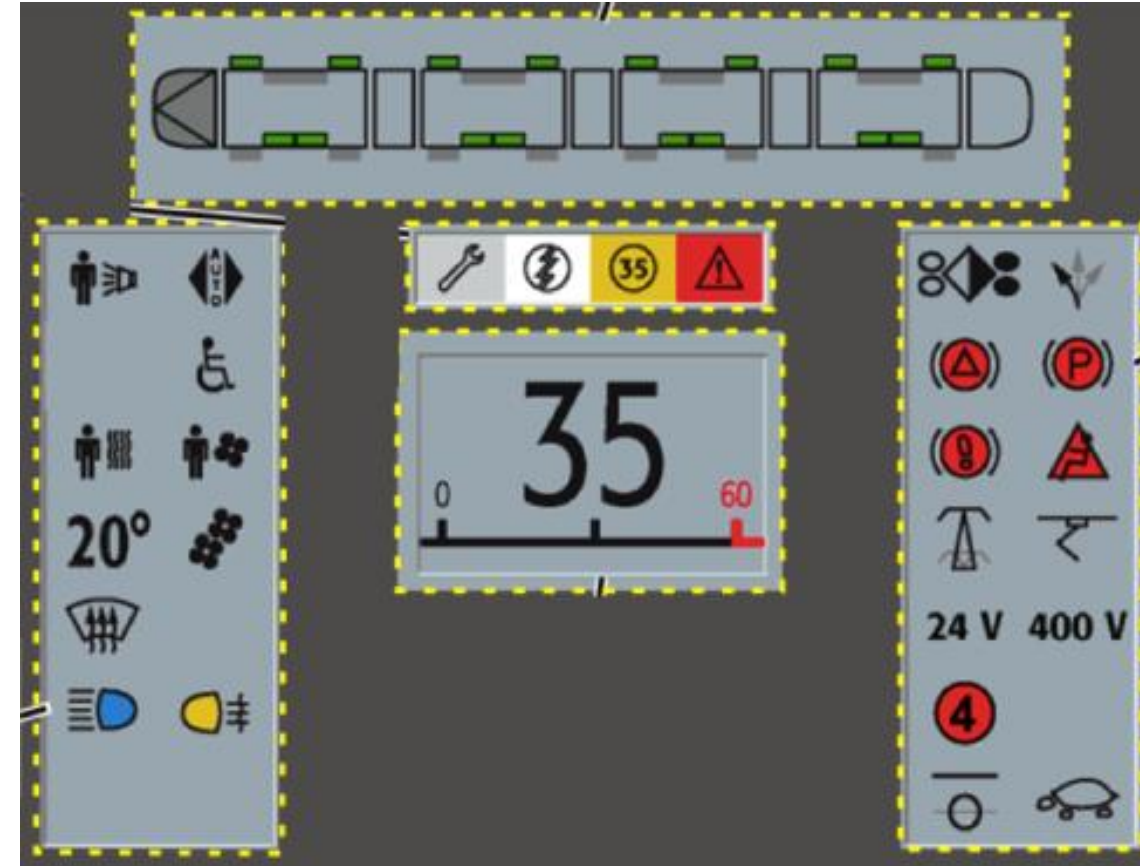


A technological misunderstanding : Screens or how to not process information

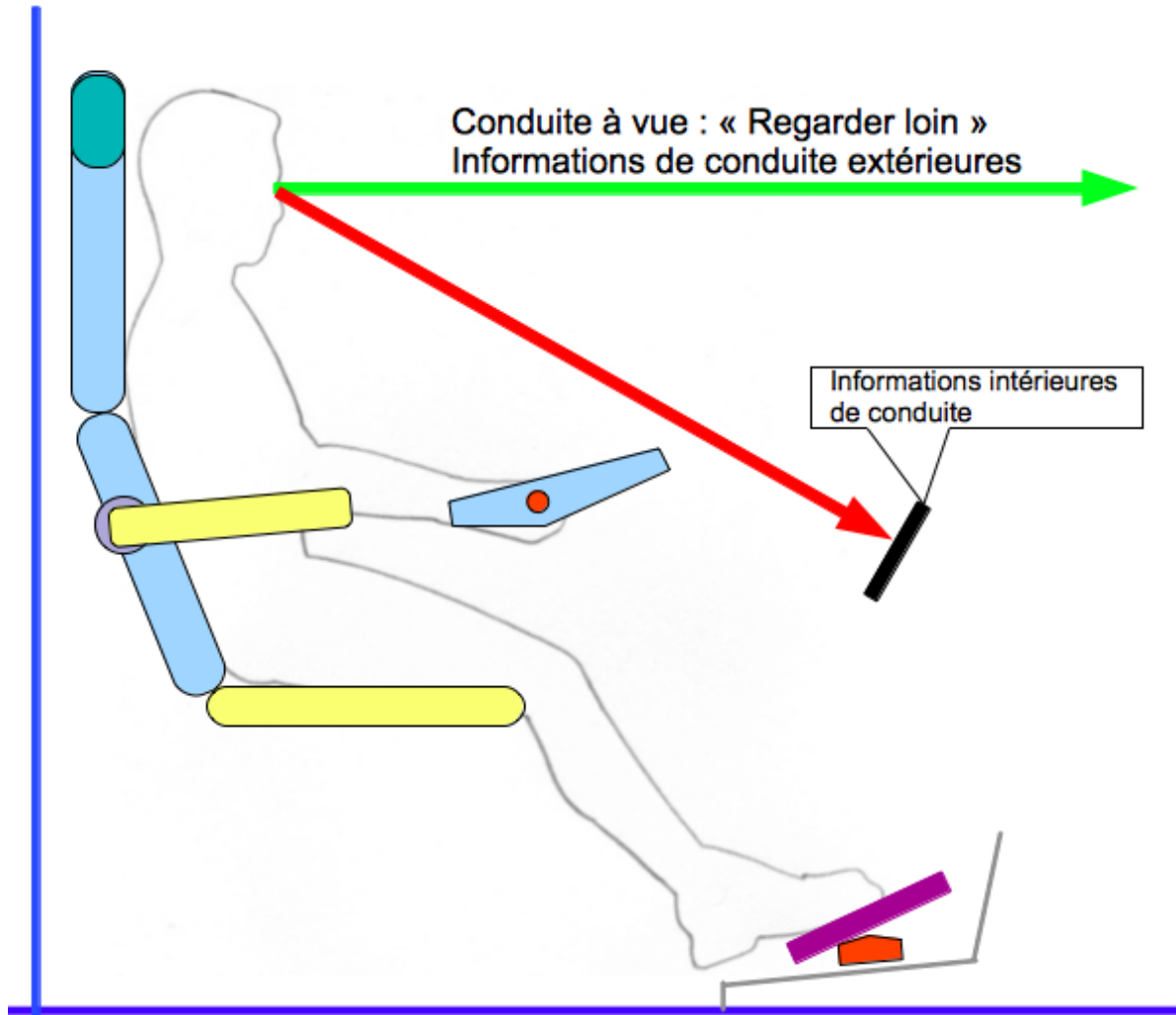
With regard to driving screens, computers can multiply and densify information on a single screen.

This possibility has resulted in a simplification of the designers' thinking.

Rather than analyzing the needs of drivers, they put a set of data on the same level. This makes the identification of information relevant to driving more complex and creates an increased mental load and loss of information.



A technological misunderstanding : Screens or how to not process information



Last but not least, for retrovision or for driving information, there has been no analysis on how this information is processed from the point of view of driving, nor reflection on the implementation of these screens . To capture information from retrovision at a station or to read driving speed, the driver is obliged to "lose sight" of the outside environment.

Misunderstanding about the action: Commands, driving positions or office station

The main control console is similar to an office station with its standard keypad and screens.

The analogy is not only formal.

The reference to an office station was explained during the design of the cockpit. Office standards were then mobilized.



Misunderstanding about the action: Commands, driving positions or office station

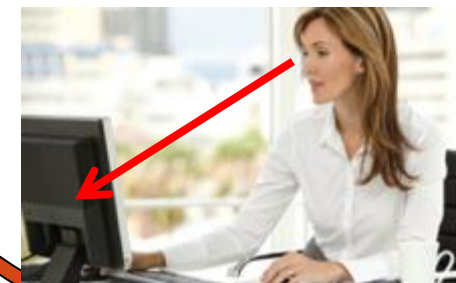
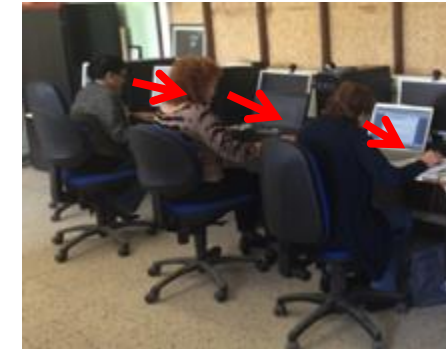
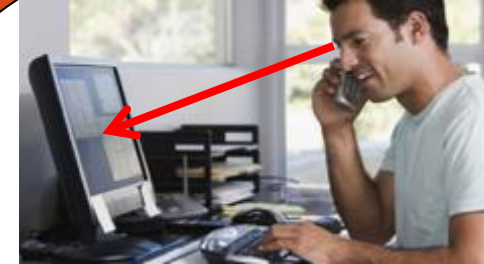
The office reference makes it possible to understand the contradiction between the line of sight necessary for the driving and the line of sight induced by the design of the station

DRIVING



VS

OFFICE STATION

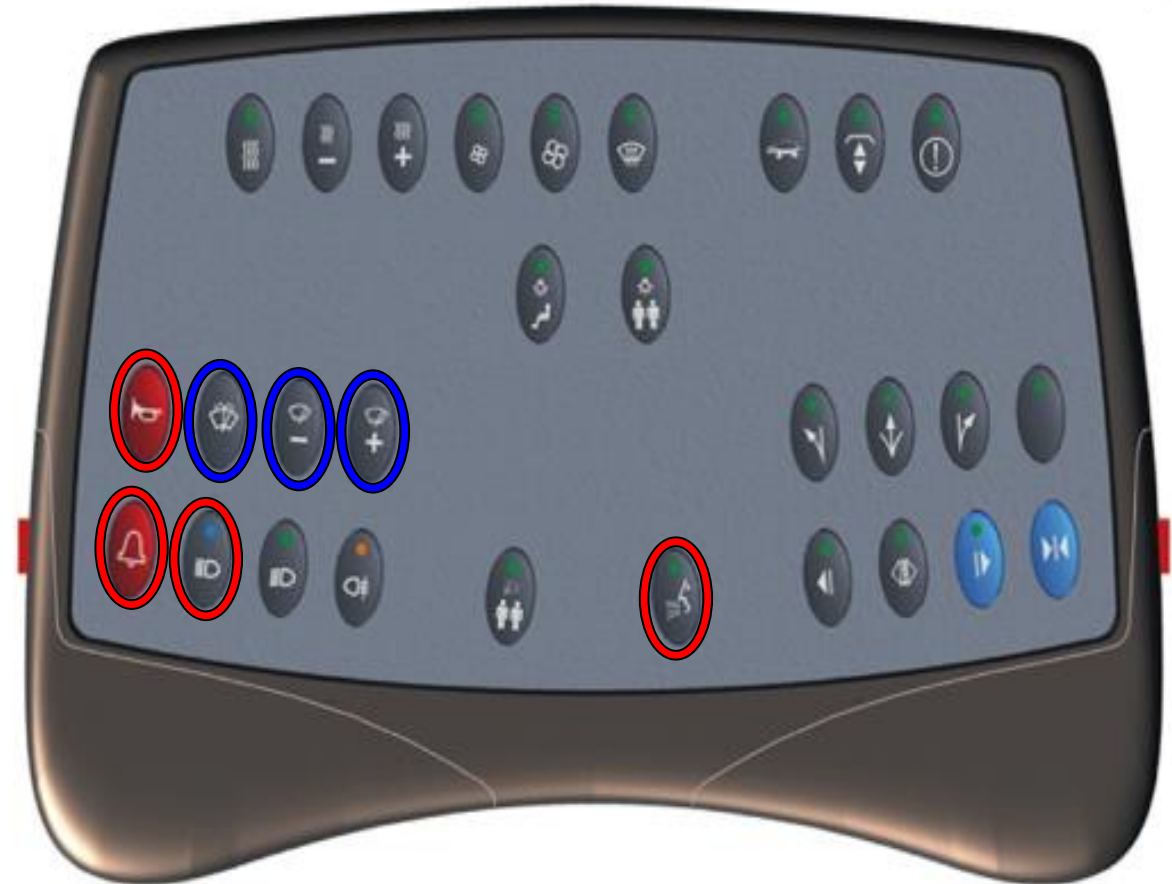


Misunderstanding about the action: Commands, driving positions or office station

Some controls must be operated while driving :

- + either in normal situations (surrounded in blue) mainly in windshield wipers,
- + or in risky situation, passenger alarm, gong or headlights (surrounded in red).

The uniformity of the controls does not allow the driver to distinguish them without leaving the road of the eyes, which is why many of them block their finger on the gong all the way.



Misunderstanding about the action: Commands, driving positions or office station



Thinking objects for driving activity

Since 2009, a first reflection on the design of the cockpit has been carried out, based on a 3-year experience assessment of the tramway operation.

It was not until a major social conflict in 2011 which resulted in the creation of a public authority in 2013 so that in 2014 a project of redesigning the cockpit was launched.

This process, which is still ongoing, should lead to a test in commercial operation with a pre-production tramway at the end of 2017 for a transformation of all 60 cockpit of the network in 2018.

The transformation of existing cockpit is based on consideration of the driving technique, activity. It is on this basis that we have rethought the technical objects that the driver mobilizes and that condition the form of his mobilization.

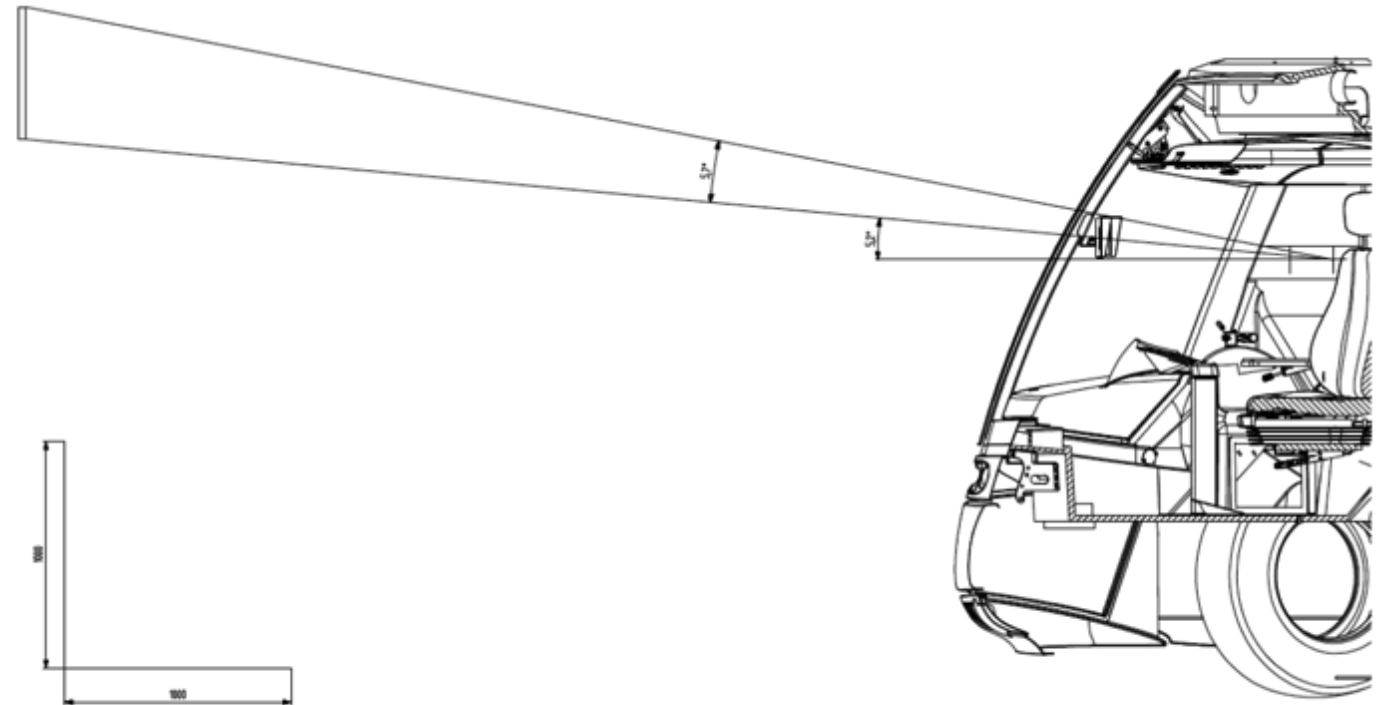
This necessarily partial presentation concerns:

- The retrovision
- Driving data
- The system of controls

Thinking objects for driving activity : the retrovision

Without being able to move the cameras, the solution adopted to remove the blind zones in station was the installation of a mirror on the dock.

The ascent of the retrovision makes it possible for the driver to have in the same field of view the image of the mirror and that of the retrovision screen without losing sight of its immediate environment.



Coupe sagittale avec le miroir de quai du mannequin P5 : angle de vision +10,9° par rapport à ligne de visée horizontale (NTL : D50002376-C-C).

Thinking objects for driving activity : Driving Data

- To re-integrate driving data into the driver's field of vision, the information economy had to be rethought.
- From workgroups with drivers, almost unanimously, it was found that 4 data (+2 in the context of degraded situation), compared with 30 in the current driving screen, were important :
 - *Speed,*
 - *The "PMR" call that tells the driver that a person with reduced mobility wants to get off at the next station,*
 - *The mode of opening the doors,*
 - *And the "orange fault" alarm.*

The astonishment: the discovery of the importance of the traveler for the driver

Representation of the environment (including drivers)

"We go to the tram to avoid having to do with the travelers."

Results of working groups:

The information of the descent of a person with reduced mobility, which conditions the automatic opening of the doors, is the second most important data.

Astonishment

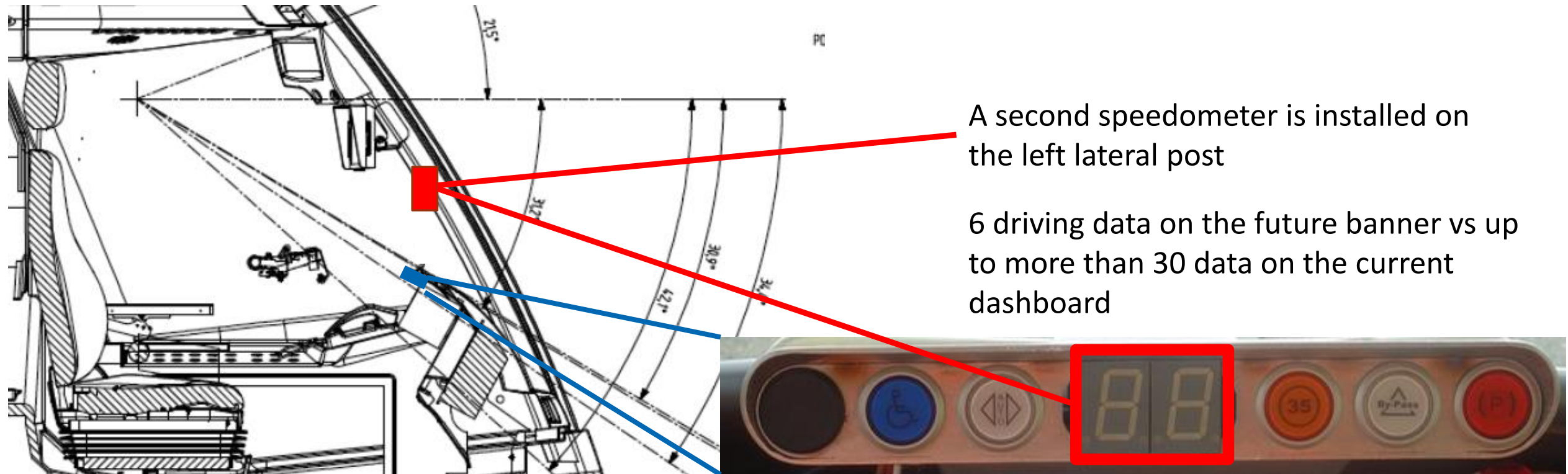
The traveler and the station are at the heart of the tramway driving activity

Thinking objects for driving activity : Driving Data

In order to reintegrate driving data into the driver's field of vision, the information economy had to be rethought

and the information ascend.

For all drivers, all the useful data is now in their field of vision. The central screen (no longer driving) is switched off when the tram runs.



A second speedometer is installed on the left lateral post

6 driving data on the future banner vs up to more than 30 data on the current dashboard

Thinking objects for driving activity : Driving orders

The control desk changes its philosophy

If the controls remain outside the field of vision while driving, those which require a rolling action are intuitively identifiable and can be actuated without risk for the other controls :

- Gong (added a gong pedal)
- Horn and headlights
- Windscreen wipers

The console is simplified, the number of commands decreases from 28 to 15.



Damaging confusion between technology and et technical

In the genesis of the tramway cockpit, it is realized that technological innovation has been achieved through the introduction of "new objects" (driving screens, cameras / screens, electronic controls, etc.) into a cockpit. This introduction was carried out without taking into account the way in which these objects were integrated with the driver's activity, in which they supported his "technique of driving".

In the game of tramway actors neither the operators nor the drivers were able or willing to make their point of view.

From then on, the tramway was defined in a privileged relationship between the local authorities and the builders. This situation has begun to change when security has been questioned by the exclusion from operators and drivers and when trade unions have begun to make their voices heard.

This process of recomposing a cockpit has contributed to the reintegration of the driving activity into the design at the local level but also at the national level. The modalities of this recomposition (new information economy, redesign of the control system, addition of mirror) show that the question of technology, in any case in tram systems, is only secondary in the way in which work recomposes itself.

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