A Introduction

While modifying a public transport network and realizing new major public transport infrastructures, a number of standardizing actions has been taken to increase quality of the service provision. The aim is to create a fully customer-oriented public transport network by developing tools that enable us to identify the need for, standardize and specificity, basic, new and complementary services.

A1 Objectives

The measure objectives are:

- **Objective 1** Create a customer oriented and efficient public transport systems for the entire agglomeration with reliable and high-quality services.
- **Objective 2** Structure the whole urban PT services and network and define the associated level of quality (operating procedure and constraints – information in-board & stops – ticketing facilities - ...).
- **Objective 3** Define benchmark indicators to follow the good application of the PT services.
- **Objective 4** Change the overall image of the PT by using new technologies, providing new types of services (complementary to the transport one) and improving the global level of quality.

A2 Description

Following a number of major network restructuration underway, Tisséo SMTC wants to guarantee and improve the overall quality of service of PT, and to increase the use of PT. Note that during the CIVITAS MOBILIS lifetime, the second metro line was opened (July 2007), the two High Quality Bus Corridors were inaugurated (December 2007 and January 2008) and the bus network was fully restructured.

In addition, the works on the first tramway line (line E) have started and its inauguration will take place in 2010. Please note that an AVL system will also be installed during the year 2010 and that the general management of the quality level of the public transport network (through its measurement system) will evolve from this moment on.

Please also note that since the first of January 2006, the local PT transport operation is directly managed by the authority.

Description of activities

The measure focuses on the definition of an innovative PT network Quality measurement, using a new floating bus system.
The equipment of the 44 buses was realized in August 2007, and the system is operating since September 2007. At the beginning, the buses were used to calibrate the data collection system and secondly to establish a reference state. Then and when the system was completely ready, the certification process was launched, applying the newly defined quality control methodology.

The new methodology of work has been adopted in September 2007, when the data collection system was operational on 44 buses. It is mainly relying on the automatic measurement of indicators linked to the respect of timetables (regularity & punctuality) in respect to the reference quality label EN 13816.

This methodology is based on the following steps:

- Selection of the bus lines to be controlled / to be certified (generally the most important ones in term of traffic);
- Selection of the indicators to be measured in reference to the label EN 13816, completed by the automatic measurement process that should be approved in terms of reliability;
- Measurement campaign (during a few days in a representative period) by using the automatic measurement system on a representative number of commercial services (statistic approach in order to optimize the number of equipped bus to affect on the commercial services and so, to permit some different analysis of commercial services at the same time);
- Analysis of collected data and measurement of selected indicators that will permit a benchmark analysis and that will feed the certification process of the selected bus lines;
- Complement of indicators collection through specific and independent campaigns in order to provide information that could not be automatically collected by the system (final users’ level of information by example);
- Request to the authorized organism (AFNOR in France) for the certification of the concerned bus lines, in application of the label EN 13816, and in the same time definition of the internal action plan to improve the level of service of these bus lines and to correct weak indicators.

The success of this methodology application is mainly relying on two points:

- Availability of the data collection system that will permit the automatic measurement of indicators … (ready for exploitation since the end of 2007);
- Cooperation with the national certification organism (AFNOR) to validate the certification process and to demonstrate the reliability of the automatic indicator collection system ...

Regarding this last point, it has to be noted that other PT networks in France have already established such kind of cooperation with the national certification organism (AFNOR). It’s notably the case in Nantes where the PT operator has partially worked on it within the CIVITAS-VIVALDI project. An exchange has already been done with them in June 2007.

**Expected results and targets**

- Call for tender to select the system to be installed at the level of the Toulouse urban PT network,
- Equipment of 44 buses of the Tisséo fleet with specific sensors (OPTHOR technology selected) and the associated system for the collection of data and their treatment,
• Definition of the new methodology for the bus lane Quality “certification” using indicators automatically collected/computed by the system,
• Campaign of data collection and demonstration of the new Quality level measurement process,
• Definition of an iterative process to follow the Quality level evolution and to define/update an appropriate action plan for the overall improvement of the PT Quality.

B Measure implementation

B1 Innovative aspects

Innovative Aspects:
• New conceptual approach
• Use of new technology/ITS
• New organisational arrangements or relationships

The aim of this measure is develop an innovative process based on the use of floating buses to be used in the same time for:
• Innovative aspect 1 – the update of PT operational characteristics/bus lanes and timetable management;
• Innovative aspect 2 – the measurement of Quality level of bus lanes and the Quality “certification” process;
• Innovative aspect 3 – the definition of dedicated action plan to improve the overall Quality of the PT network.

B2 Situation before CIVITAS

Before CIVITAS, the quality of service was assessed through the use of pollsters who were evaluating the different components of the quality of service (defined in the frame of the Tripartite Committee).

B3 Actual implementation of the measure

The measure was implemented in the following stages:

Stage 1: Call for tender to select the system to be installed on the buses (from January 2007 to July 2007) – The contract in automatic measurement and analysis systems for route times and passenger numbers was awarded to the company TDE Transdata jointly with the company UVT for the Opthor product in order to equip 44 tracer vehicles, representing almost 10% of the fleet.

Stage 2: Equipment of the 44 floating buses (from September 2007 to January 2008) – 44 buses were equipped with the Opthor system in order to realize the measurements during the different campaigns to be organized.
Stage 3: Definition of the new certification methodology and of the associated action plan for the PT quality improvement (January 2008 to November 2008) – In parallel to the realization of the different measurements campaigns, Tisséo (PT Authority and Operator) has defined a new certification methodology integrating the use of the newly installed tool. A dedicated action plan is associated to this new certification methodology.

Stage 4: Realization of the measurement campaigns (from January 2008 on) – The PT operator has started to realize some measurement campaigns from January 2008 on. The campaigns are being realized on several bus lines and in different conditions (peak hours, off-peak hours, holidays, week-end...) in order to get the complete operation data of the different bus lines which are under certification process.

Stage 5: Tripartite Committee (September 2008) – This Committee associated the Public Transport Authority, the Public Transport Operator and the association of public transport users (AFNAUT). The objective of the Tripartite Committee is to approve the commitments in terms of quality of service proposed by the public transport operator as well as to give an opinion about the measurements principles (at least periodicity and observation mode). At this occasion, the Tripartite Committee has validated the use of Opthor as an observation mode to be used in the frame of the certification process.

Stage 6: Certification phase by AFNOR (November 2008) – Several bus lines (plus the two metro lines) have been presented to the AFNOR standardisation authority in order to obtain the associated certification. Results of this certification phase will be known from February 2009 on.

B4 Deviations from the original plan
This measure was forced to be modified due to the reorganization of the contractual relationship between the PT authority and the operator, while, since the 1st of January 2006, the urban PT network is operated within a system of direct management. Due to this reorganization, it was not possible to follow the sequence of planned activities (so to say an up-down approach: general objectives -> implementation -> measurement of the impact). The working group has concluded that this measure should be turned the other way around, in a more pragmatic approach, applying a bottom-up approach: measurement of indicators -> analysis of the quality of service -> inputs for the development of a strategic frame/contracting between operator and authority.

Even if the final goal of this measure remains close to the original one, the content and the methodology/organization of this measure have been in-depth modified. It mainly concerns:
- the description of activity;
- the planning (Milestone chapter) and the Working Document to be produced.

B5 Inter-relationships with other measures
The measure is related to other measures as follows:

<table>
<thead>
<tr>
<th>No.</th>
<th>Measure title</th>
<th>Relation</th>
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<tbody>
<tr>
<td>6.4.T</td>
<td>High-quality bus corridors in Toulouse and development of PT segregated and secured lanes in the city centre.</td>
<td>The development of the HQBC would be integrated in the service quality scheme, especially to establish level of equipment of the different lanes /</td>
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<tr>
<td>Measure number</td>
<td>Measure description</td>
<td>Description</td>
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<tr>
<td>7.1.T</td>
<td>Innovative multimodal PT contracts, services and electronic ticketing in Toulouse.</td>
<td>The development of the new PT ticketing system would be integrated in the service quality scheme, especially to establish level of equipment of the different lanes / infrastructures.</td>
</tr>
<tr>
<td>8.3.T</td>
<td>Improving the accessibility of PT services in Toulouse.</td>
<td>These 2 measures are directly linked: accessibility is considered as an important issue of the quality of service.</td>
</tr>
<tr>
<td>8.7.O</td>
<td>Integration and quality improvements of sustainable modes in Odense.</td>
<td>The share of Experience between these 2 measures would be very interesting for the 2 sides.</td>
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<tr>
<td>12.2.T</td>
<td>Implementation of bus priority scheme in Toulouse.</td>
<td>The development of Bus Priority solutions &amp; systems would be integrated in the service quality scheme, especially to establish level of equipment of the different lanes / infrastructures.</td>
</tr>
<tr>
<td>12.3.T</td>
<td>Development of an integrated multimodal traveler information system in Toulouse.</td>
<td>The development of PT information and associated systems / measures would be integrated in the service quality scheme, especially to establish level of equipment of the different lanes / infrastructures.</td>
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C Evaluation – methodology and results

According to the description of this measure, there are no specific impacts to be presented in this section. The outputs of this measure are much more relevant in terms of process evaluation than in terms of impact evaluation. Actually, the measure only deals with a methodology. A dedicated in-depth process evaluation report (annexed to the project evaluation report). Nevertheless, some process evaluation issues are being addressed in the part D of this measure evaluation results sheet. A synthetic note describing the functioning of the Opthor system has been annexed to this measure evaluation results sheet.

D Lessons learned

D1 Barriers and drivers

D1.1 Barriers

- **Barrier 1** – This delay was mainly caused also due to the postponement of the decision on the PT network restructuring following the opening of the second metro line. This postponement is directly linked to financial decisions (reduction of the financial capacity of the public transport authority) and political debates that resulted in the withdrawal of one of the main members of the SMTC: the County Council of Haute-Garonne (Conseil Général).

D1.2 Drivers

- **Driver 1** – The development of this system is taken under the direct management of the Public Transport Operator, which demonstrates the level of motivation and potential of success.

- **Driver 2** – The success of the methodology application itself relies on two points:
  
  - Availability of the data collection system which permits the automatic measurement of indicators,
  - Cooperation with the national certification organism (AFNOR) to validate the certification process and to demonstrate the reliability of the automatic indicator collection system is being done in the frame of the CIVITAS MOBILIS project and is pursued to improve iteratively the process.

D2 Participation of stakeholders

- **Stakeholder 1** – AFNOR is the entity in charge of certifying the different public transport bus lines. A continuous assessment of the quality level is taking place for the bus lines that are already certified.

- **Stakeholder 2** – Besides the Public Transport Authority and the Public Transport Operator, the Tripartite Quality Committee includes an association of public transport users in order to integrate the public transport users’ point of view in the debate about the quality level of the public transport network.
D3 Recommendations

- **Recommendation 1** – Citizen have often multiple choice to travel from A to B. A high quality of the public transport is essential to increase the use of public transport. An automatic measurement and a certification of public transport services help to bring the public transport quality to the desired and standardized levels.

- **Recommendation 2** – The methodology developed to come from a semi-automatics system to a quality strategy and certification is considered to be an excellent learning practice for other bus operators that want to use the full possibilities of a so-called “floating bus” measurement system.

D4 Future activities relating to the measure

Tisséo-SMTC will continue to take the benefits of having installed the Opthor tool in order to perform in the coming months / years a continuous assessment of the quality level of the different bus lines of the public transport network. This process should enable Tisséo to have more bus lines certified than without the Opthor tool.

It has to be highlighted that the use of this tool will certainly evolve when Tisséo will have its own AVL system (should be operational in 2010).
Opthor in the Tisséo service improvement strategy

Annex to the Measure Evaluation Results Sheet: the functioning of the Opthor system

Tisséo objectives

To improve service quality and in particular consistency and punctuality of buses is a determining factor in making transport systems in the greater Toulouse area attractive.

In order to improve bus punctuality, an effective means of measuring the service provided is required. In addition, an automatic measurement and analysis system for route times and counting passengers should be implemented in order to enable the measurement of punctuality / consistency over all the bus lines.

The use of this system for punctuality measurements in accordance with quality standard EN 13816 for passenger transport is a determining factor: it allows us to achieve the dual objective of on the one hand analysing sources of irregularity in services and on the other hand measuring services on lines in the network for national certification (NF). Service improvement and the certification of network lines provide an obvious synergy, so validating measurements of consistency / punctuality as part of the services national certification strategy (NF) is a deciding factor in improving service quality.

Project objectives

- To improve our route time and passenger load measurements in order to increase the reliability of progress tables and therefore the consistency / punctuality of buses.
- To take part in this service quality objective by enabling us:
  - To make discussion of route times measurements with social partners more objective.
  - To highlight the different causes for lost of time in order to justify roads improvement requests or traffic light programming with the local authorities so as to improve our service.
  - To have a system interfaced with our vehicle traffic plotting / display software (Hastus) and used in addition to the AVL system.
- To perform parallel quality measurements for lines under certification process.

An automatic measurement tool. Why?

Until 2001 we were using the SEREL system with fixed beacons and monitored buses in the fleet were equipped with encoders. Campaigns were planned over 3 to 4 weeks periods. We obtained clusters of data (segments and the whole line) that enabled us to define route times per timetable sections and per segments. This system was damaged by the explosion at the AZF factory in September 2001.

Existing measuring systems in the company are now:
**OPTHOR in the Tisséo service improvement strategy**

- manual counting
- the ticketing system
- the Hastus-Checker application

**The Project**

The system must provide the following measured data:
- Route times
- Passengers (Boarding / Getting off at each stop)
- Time lost (waiting at traffic lights, roundabouts, in a queue, boarding time, etc.)

It must enable us to obtain the following calculated values:
- Route time per timetable section
- Load at stops
- Punctuality / Consistency (compared to theoretical timetable)
- Punctuality / Consistency (as percentage of passengers having a conforming service)
- Distribution of lost time

The chosen system:
The contract in automatic measurement and analysis systems for route times and passenger numbers was awarded to the company TDE Transdata jointly with the company UVT for the OPTHOR product in order to equip 44 tracer vehicles (about 20 in the Atlanta depot and 24 in Great Britain), representing 10% of the current fleet.

**Information provided by the system**

Example: line 24 (studied using OPTHOR as part of the invitation to tender)

**Breakdown analysis of Route Time**
- Time lost = 33%
- Passenger exchange time (Boarding / Alighting) = 15%
- Driving time = 52%

**Analysis of Time Lost (representing 33% of Route Time)**
- Waiting in a queue = 7%
- “Traffic” = 28%
- Waiting at traffic lights = 58%
- Waiting at stops = 7%
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Presentation of results

Comparison with theoretical values
Route time
Data cluster – theoretical timetable – typical journeys

Comparaison avec le théorique

Waiting: in a queue / at traffic lights / at stops / passenger exchange / driving time
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Commercial speed between stops in km/h based on timetable sections on the Leclerc-Rangueil route

Vitesse Commerciale inter arrêt en Km/h selon les tranches horaires sur la course Leclerc - Ranguel

Waiting at traffic lights in seconds based on timetable sections

Attente aux feux en secondes selon les tranches horaires
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Passenger numbers

Counting passenger numbers quantifies the number of people alighting or boarding per stop as well as the journey time. This provides better understanding of critical points and route occupancy.

Number of passengers in the vehicle leaving the stop – Rangueil – Leclerc route
Nombre de Passagers dans le véhicule au départ de l’arrêt concerné

Organisation of quality measurements

Objectives of measurement

- Option to extend to the entire network (the associated cost of pollsters is proportional to the number of lines)
- Thoroughness (all of the route is measured, as well as all the routes of an equipped bus)
- Reliability (automation, an end to “human error” and inaccuracies due to reaction time when making the measurement)
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**Operating conditions**

To guarantee that the services carried out are representative, measurements must be made over:

- All periods (winter, term time, holidays, summer)
- All days of the week (weekdays, weekend)

For each line under certification process, we must therefore carry out:

- 1 summer measurement campaign
- 1 measurement campaign in holiday periods
- 3 campaigns of winter measurements (including Saturdays and Sundays).
  - January / April
  - May / June
  - September / December

Each measurement campaign lasts a minimum of one week (they are planned to be 3 weeks, the final measurement campaign – 3\textsuperscript{rd} winter period – will only be done over 2 weeks).

For other lines on the network, in the first phase:

- 2 measurement campaigns in winter periods

**Calculation of quality results**

**Calculation principle**

Readings are taken over the whole of a bus service but not all the buses of a line are equipped with the Opthor system during the measurement campaign.

As two successive buses will not necessarily be equipped with the measuring system, for a given stopping point on the line some services with therefore be measured and others not. Logistics ensures rotation of the equipped buses and the number of services of each equipped bus is such that the measurements are representative.

**For lines running on a timetable basis:**
For lines running on a timetable basis, the theoretical time ($H_T$) of the service and the actual time ($H_R$) are compared.
To calculate quality results, passage through a stop is considered conforming if:

\[-1 \text{ min} < H_R - H_T < 5 \text{ min}\]

For each service, people affected by the punctuality of passage at this stop (boarded at the stop) are then considered as passengers receiving a conforming or non-conforming service,
Opthor in the Tisséo service improvement strategy

depending on whether or not the time of passage confirmed the condition. Their number is recorded as such.

Over the measurement period, the total number of people receiving a conforming service is compared with the total number of people boarding the bus of the line in order to establish the percentage punctuality conformance for the line over the defined period.

For lines running on a frequency basis:

For lines running on a frequency basis, the fact that two successive buses are not equipped with the measuring system requires an iteration, in order to assess if non-consecutive passages of a bus correspond to a multiple of the published frequency.

In reality, the regulation method for frequency-based buses consists not of meeting the theoretical passage times but the published waiting time between two buses. However, two buses not passing at the theoretical times can therefore be well controlled in terms of quality commitments. Thus, in the example below, the services conform.

Theoretical time T1 T2 T3 T4 T5 T6 T7 T8

Real time of passage P1 P2 P3 P4 P5 P6 P3

Measurement M2 M6

So if F is the published frequency, Mi are the measured values, Ti the theoretical times and fj is a variable value between 0 and + (F-1),

For each value of fj, the following calculation is performed:

- for all measurements, calculate the interval \( \Delta i = Mi - (Ti + fj) \)

- then calculate the absolute value of the sum of the intervals: \(|\Sigma \Delta ij| = \delta j\)

We then define for what value of “j” we get the minimum value of “\(\delta j\)”: minimum of \((\delta j)\)

\[ \text{\rightarrow The new theoretical times for the calculation then become } Ti + j_{\text{mini}} \]

This corresponds to using values recalculated by the theoretical timetable adjuster.

This calculation is then done in the same way as for lines running on a timetable basis.

This iteration is cumbersome and has to be applied for each period of a day, because the timings of a line change during the day. This is why measurements on lines running on a timetable basis are preferred while the use of this calculation is being perfected.
Making quality measurements

Measurement schedules:

Opthor readings began in the last quarter of 2007. Measurements of the load (number of passengers boarding and getting off) were provided in a usable form for the Quality Strategy of the 2nd quarter of 2008.

Measurements were carried out on lines under certification according to the fixed calendar from September 2008.

The principle for measurement and calculation of quality indicators with Opthor was presented in the Tripartite Quality Committee as part of NF 13816 certification of bus lines and ratified by members of the Tripartite Committee in September 2008.

Assessment of results

In order to assess the validity of measurements made using Opthor, a comparison was made for measurements made at a stop by researchers performing the measurements manually.

The results of Opthor measurements and those taken by pollsters were compared over the first quarter of 2008. Only lines having more than 100 Opthor measurements at the relevant stop were taken into consideration. For the six test lines, four showed conformance percentages with less than 2% variance; the other two had a variance of 7 and 8%.

The variance study shows that it is all the more significant given that the results are low: lines having less than 2% conformance variance depending on the measurement method have conformance levels greater than 90%. The greater variance for the other two lines is explained by the fact that the measurements by pollsters were made by sampling over the same month but not on the same days or at the same time as the Opthor measurements. These facts therefore enable consistency between the two measurement methods to be confirmed.

The ability to carry out exhaustive measurements over several days provides greater reliability in the results, in particular for services with a low rate of conformance. This measurement method also enables the causes of non-conformance to be defined in order to remedy them.