Measure title: **Bus Management System in Monza**

City: **Monza** *Project:* **ARCHIMEDES** *Measure number:* **78**

Executive summary

Scope of this measure is the implementation of a software framework to quickly access localisation and monitoring data of the buses for the Public Transport fleet for their subsequent use by measure no. 79 ("Improved Traveller Information in Monza") and measure no. 82 ("Public Transport Priority System in Monza"). This measure doesn't have a direct operational use that is provided by other measures (MNZ79 and MNZ 82), but is a fundamental prerequisite for the use of Public Transport localisation and monitoring data; this is aimed at increasing the service level of Public Transport in Monza. Therefore the impact evaluation of this measure is focused on the collection of localisation and monitoring data rather than on their use. Evaluation will therefore address two issues:

- the quality of localisation and monitoring data (please see indicator 30c)
- the performances of the software suite implemented to access data and to use it (please see indicator 30b)

The research stage of the measure has produced a study focusing on the requirements for interfacing the AVL/AVM ("Automatic Vehicle Localisation/ Automatic Vehicle Monitoring") System implemented on the Public Transport fleet of the urban service in Monza. Such requirements are described in details in the deliverable R78.1 and are independent from the current provider of the AVL/AVM service. Such independence is a fundamental requirement: when the Monza activities were written in the technical description of ARCHIMEDES, the fleet of the urban service of the city of Monza was managed by the Company "Trasporti Pubblici Monzesi (TPM)", but since June 2009 the service has been managed by another Company, "Nord-Est Trasporti" (NET); NET is jointly owned by ATM, the company which manages the Public Transport of the city of Milan, and TPM. Nevertheless, the same requirements coded in the above-mentioned deliverable R78.1 apply.

The implementation stage of the measure has been dedicated to the development of a software platform to access the NET AVL/AVM system and to its use within the operational framework invoving all the vehicles (about 80) of the NET Public Transport Fleet. Each bus was already equipped with an On-Board Unit (OBU), consisting of an Industrial PC with specific devices and sensors:

- a GPS device to determine the vehicle position, coded with Lat-Long coordinate system
- (WGS 84);
- a GPRS communication system to send the information to a Control Centre;

The initial implementation of the AVL-AVM system has been accomplished outside the scope of the ARCHIMEDES project; through ARCHIMEDES, the policy used for data collection (frequency, readiness-to-use) has been changed according to new requirements. Following these new requirements, data concerning vehicle positions ("localisation") and the adherence of the bus to the scheduled service ("monitoring") are sent to the NET Control Centre approximately every minute. Such data are immediately published through a Webservice, whose template has been agreed in the research stage. Data published through the Webservice refer to the stop or the transit of a bus of the fleet at a relevant bus stop. The bus stops selected are the ones belonging to the corridor, as shown in Figure 1.

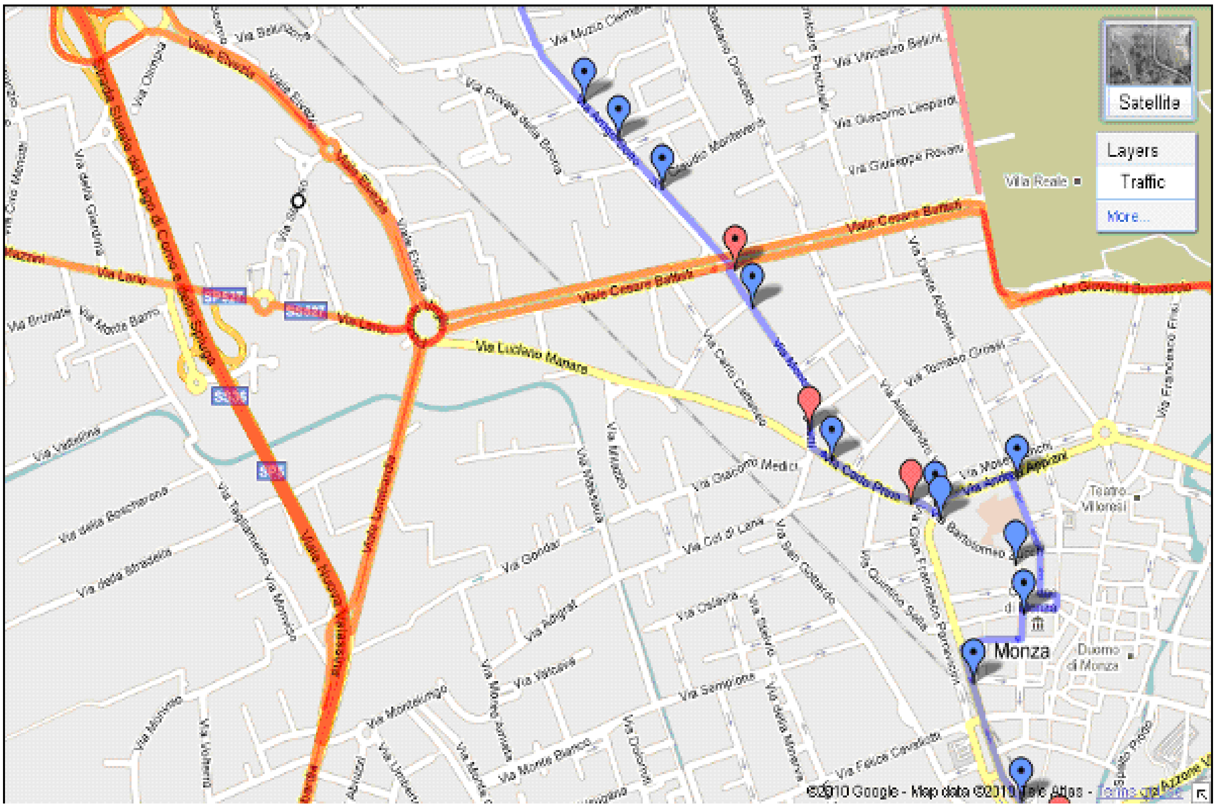

Figure 1- Bus stops where AVL-AVM data are published

Evaluation activities have been aimed at :

- Evaulating quality of data published through the Webservice;
- Evaluating the performances of the data publication, in order to assess typical lead time.

The results achieved have confirmed the complete usability of AVL/AVM data through the access method designed and implemented.

The lessons learned through the accomplishment of this measure mainly concern the awareness of the information that can be extracted from the data collected; this is an added value in addition to the satisfaction of the expected requirements. Furthermore, the approach proposed easily allow to integrate other Public Transport fleets for exploiting the benefits by measure n. 82 (Public Transport Priority).

Measure title: **Bus Management System in Monza**

City: **Monza** *Project:* **ARCHIMEDES** *Measure number:* **78**

A Introduction

A1 Objectives

The measure objectives are:

(A) High level / longer term:

(1) To render Public Transport more effective and appealing for day-by-day use

(2) Positive impact on the number of public transport users

(B) Strategic level:

(1) To improve commercial speed of Public Transport Fleet

(C) Measure level:

(1) To make available to other ITS applications actual data from the Public Transport fleet.

A1.2 Target groups

- Users of public transport
- Owners of public fleets

A2 Description

The use of real time localisation information gathered by the AVL/AVM system is fundamental to increase the Service Level of the Urban Public Transport to be achieved in ARCHIMEDES.

This measure aims at providing the necessary information for measures 79 ("Improved Traveller Information in Monza") and measure no. 82 ("Public Transport Priority System in Monza").

Since November 1st, 2007, the Urban Public Transport Service in Monza has been carrying out under the new asset defined by the European Community, i.e. having won a public tender. As a consequence, the owner of the service at that time, namely TPM, set up an AVL/AVM system to allow the owner of the service to monitor in real-time the service accomplished.

In this context Project Automation, a private company specialised in supplying systems for Mobility management and Environment monitoring defined a software interface to access the AVL/AVM system (details in deliverable R78.1). Positioning data and the status of the bus (On-Time, Delayed, In-Advance) as well as the expected arrival time to relevant points (bus-stops and intersections) have to be made available as soon as they are produced, to be used by the ITS applications which will implement measures 79 and 82, as commented.

From November 2008 the Public Transport branch of TPM Company the service has been merged in another Public Company, NET (Nord-Est Trasporti), subsidiary of ATM (Azienda Trasporti Milanesi) which runs the Public Transport Service for the city of Milan and important surrounding cities (the entire area has about 3 million inh.) . After a necessary timeframe due to the setup of the new service, NET Company decided to switch from the AVL/AVM system inherited by TPM, which was provided by a third-party, to a native AVL/AVM already active on other fleets of the ATM group, however fully satisfying the above-mentioned ARCHIMEDES requirements.

Measure title: **Bus Management System in Monza**

City: **Monza** *Project:* **ARCHIMEDES** *Measure number:* **78**

In Spring 2010 the ARCHIMEDES requirements have been made known to the third-party Company providing the NET AVL/AVM system, through specific meetings with PA.

Since September 2010, AVL/AVM data are regularly collected (see deliverable T78.1) and transferred daily to PA for analyses.

Since January 2011 data is made available in real-time to enable implementation of measures 79 (Improved Traveller Information in Monza) and 82 (Public Transport Priority System in Monza).

The measure covers 2 tasks.

Research Stage: Task 11.8.4 Interface with the AVL/AVM System

Project Automation has carried out a study to define the requirements for interfacing the AVL/AVM System already implemented by NET for the use of localisation and monitoring data by other measures (no. 79 for Bus Traveller Information and no. 82 for Public Transport Priority at Traffic Lights).

Demonstration Stage: Task 8.13 Bus Management System

Implementation by PA of the interface with the Automatic Vehicle Location/Automatic Vehicle Monitoring System (AVL/AVM) covering the entire of Urban Public Transport fleet to make available the position of each bus in Real Time for the applications to be developed within the ARCHIMEDES project.

A3 Person in charge for evaluation of this measure

Name of person	Paolo Giuseppe CONFALONIERI
Name of organisation	Project Automation SpA (PA)
Direct telephone	+39 039 2806283
e-mail	paolo.confalonieri@p-a.it

B Measure implementation

B1 Innovative aspects

The innovative aspects of the measure are:

- **New conceptual approach** – The capability to exploit the information gathered by AVL/AVM system to be used by ITS applications is a new challenge for the city of Monza.
- **Use of new technology/ITS** – The AVL/AVM system is a classical ITS application. It will not be developed in ARCHIMEDES, but it will be interfaced to use its information by other ITS applications (see measures 79 and 82).
- **Targeting specific user groups** – This measure will primarily address the Public Trasport users and the managers of the Public Trasport Company.

B2 Planning of Research and Technology Development Tasks

Task 11.8.4 Interface with the AVL/AVM System:

Project Automation designed a software interface to access the AVL/AVM system used by the Public Transport fleet. This task required the following steps:

(R1.1) Definition of the software requirements, to point out which information is required (functional requirements) and how the gathering of such information has to be achieved (non-functional requirements); these requirements have to be general enough to be implemented by general AVL/AVM systems.

(R1.3) Upgrading of the AVL/AVM system if fundamental functional/no-functional requirements are not basically achieved; this intervention has been done by the AVL/AVM supplier in Summer 2010.

Further activities were carried out in the Demonstration stage of ARCHIMEDES.

B3 Situation before CIVITAS

The AVL/AVL system has been made operational in Monza in Fall 2007 by the owner of the Service at that time, namely TPM, but is has never been interfaced with external applications.

B4 Actual implementation of the measure

Task 8.13 Bus Management System

The demostration stage for this measure has been implemented through the following tasks:

Stage 1: Collection of measurements from the System *(September 2010 – December 2010)* – In this stage a set of activities were carried out:

- (1.1) definition of the interest points in the AVL/AVM system. The system is configured to manage points related to the current service; new points have been defined, especially intersections for which the arrival time has to be forecasted by the system and specific intermediate points to manage situations where bus stops are too far from the relevant intersections of the Corridor;
- (1.2) collection of measurements from the AVL/AVM system;

Stage 2: Analysis and improvement of the performance of the System *(October 2010 to June 2011)* – This stage was devoted to exploratory data analysis to assess the quality of the measurements for their subsequent use in the relevant measures; data and information will be provided to the Evaluation Stage.

B5 Inter-relationships with other measures

The measure is related to other measures as follows:

- **At the site level**: This measure is tightly related to Measure MNZ 79 Improved Traveller Information and MNZ 82 Public Transport Priority System.
- **At the measure level**: The Municipality of Monza will refer to measure DSS 74 ("Bus Management System in Donostia-San Sebastián") and measure IAS 76 ("Bus Management System in Iasi").

C Impact Evaluation Findings

C1 Measurement methodology

C1.1 Impacts and indicators

C1.1.0 Scope of the impact

The indicators chosen in the table below were selected as directly related to the introduction of the measure. It is to be pointed out that this measure is only constituted of software activities to interface an AVL/AVM system for the fleet of Public Transport buses in Monza and it is a fundamental prerequisite for the measures 79 Improved Traveller Information and 82 Public Transport Priority System. The evaluation activities in this result template are limited to the scope of this measure only. Further impacts are considerd in the reports of measures 79 and 82.

The indicators relate to:

- Economy – only capital costs are considered, needed for the software development of the interface module; maintenance costs for the software developed to access the Webservice are negligible. Maintenance costs for the entire AVL/AVM system originating data are only marginally affected by this software component.
- Energy – no indicators of this group are considered due to the kind of this measure
- Environment – no indicators of this group are considered due to the kind of this measure
- Society – no indicators of this group are considered due to the kind of this measure
- Transport – impacts concerning the correctness of forecasts generated by the AVL/AVM system and the performance of the software chain that will developed to make AVL/AVM data available for other measures will be evaluated. Other impacts are not considered.

C1.1.1 Selection of indicators

NO.	EVALUATION CATEGORY	EVALUATION SUB-CATEGORY	IMPACT	INDICATOR	DESCRIPTION	DATA /UNITS
	ECONOMY					
2A			Capital Costs	Capital costs	Costs for design, development and testing of the software interface routine	Euro
	TRANSPORT					
30c			Monitoring of Service	Quality of data	Data are produced by the AVL/AVM system of NET Company and are made available through a Webservice, queried every 10 seconds.	measurements, quantitative
30b			Quality of data access	Protocol performances	Quality of the software protocol developed in ARCHIMEDES; data gathered by the AVL/AVM system promptly have to be made available for the ITS application used for masures 79 and 82.	measurements, quantitative

C1.2 Establishing a Baseline

Before ARCHIMEDES, the collection and the management of data generated by the buses of the Urban Transport Service fleet was planned for the monitoring of the Service; the frequency of collection was 3 minutes.

Within ARCHIMEDES; the data collection has become much more frequent; data are typically refreshed every minute; access time to the Webservice has been fixed to 10 seconds.

C1.3 Building the Business-as-Usual scenario

Without the implementation of the interface to AVL/AVM system, no use outside the system itself can be done in automatic way. Only manual checks or transfer to other systems could be done.

C2 Measure results

C2.1 Economy

In this section, the attention is devoted to costs, as reported in the following table.

Table C2.1: Results

Indicator	Before (date)	B-a-U (date)	After (date)	Difference: After –Before	Difference: After – B-a-U
No. 2A: Capital Cost	N/A	N/A	15,000.00 €	N/A	N/A

C2.2 Energy

Not Applicable.

C2.3 Environment

Not Applicable.

C2.4 Transport

In this section the results achieved are shown. As far as the evaluation of indicators 30c and 30b, a specific Java software application running as Servlet within a Web Server set up for this purpose has been implemented. This application is continuously running, querying between 7am and 8pm the Website where localisation data is published.

Table C2.1: Results

Indicator	Before (date)	B-a-U (date)	After (date)	Difference: After –Before	Difference: After – B-a-U
No. 30c: Quality of Data			94,06% (*)		
No. 30b: Protocol Performances			468 msec (*)		

(*) See details in the sequel of this paragraph

The following diagram shows the application architecture. The arrows direction indicates the data flow.

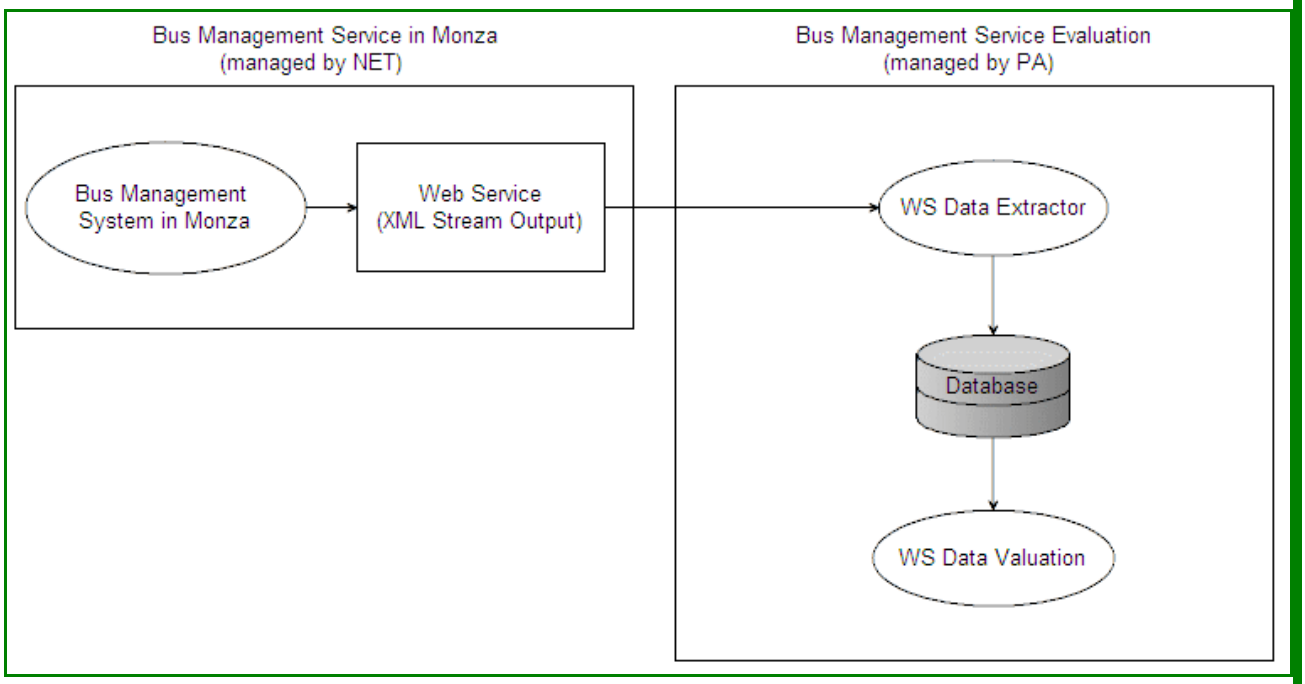

Figure 2 – Architecture of the application to evaluate Measure 78

In the left part of Figure 1 is shown the component made available by NET Company to provide localisation data.

A Web Service (WS) module returns the information about the status of the buses in the last minutes for some relevant points in Monza: they have been chosen according to the intersections to be managed in Measure no. 82 (Bus Priority). In details, the WS provides data in a XML format. An example of this data format is the following:

```
<?xml version="1.0" encoding="UTF-8" ?>
- <root>
  - <fermata id="ATM112">
    - <vehicle name="253">
        <timestamp_unit>8/5/2011 2:47:09 PM</timestamp_unit>
        <lon>9.2715936</lon>
        <lat>45.597544</lat>
        <speed>0</speed>
        <direction>56</direction>
      </vehicle>
      <timestamp_plan>8/5/2011 2:38:32 PM</timestamp_plan>
      <timestamp_real>8/5/2011 2:46:36 PM</timestamp_real>
      <linea>z204</linea>
      <corsa>20180000000020403727</corsa>
    </fermata>
```

Figure 3 – Basic data provided by the Webservice

The meaning of every data tag is:

- "*id_fermata":* the bus stop reference (id_stop);
- "*vehicle":* the vehicle id;
- "*timestamp_unit":* the timestamp indicating the last access at the internal bus system.
- "*lon":* the vehicle longitude;
- "*lat":* the vehicle latitude;
- "*speed":* the vehicle speed;
- "*direction":* the vehicle direction;
- "*timestamp_plan":* the timestamp indicating the planned bus transit time at the stop.
- "*timestamp_real":* the timestamp indicating the actual bus transit time at the stop;
- "*linea"*: the bus line;
- "*corsa"*: the vehicle mission (run). A mission is a planned task that a bus must accomplish. This task consists of:
- a route to be performed in a give time,
- a set of intermediate stops to be served at given time,
- a timestamp for the beginning of the service,
- a timestamp for the completion of the service.

A single set of this data represent a bus *transit* data.

In the right part of Figure 1 the Bus Management System Evaluation is described.

This is a software application specifically designed and developed to access, test and to evaluate the Bus Management System made available by NET for ARCHIMEDES Measure no. 78.

The software system consist of two distinct components:

- **WS Data Extractor module**: the purpose of this component is to extract data, exploiting the Web Service module, from the "Bus Management System in Monza" and store it in a database;
- **WS Data Evaluation module**: the task of this module is to perform simple statistical analyses about data stored in the database. Through this module, at the end of the process, it is possible to analyze the system performance using the following indicator:

The software components used to implement the application are:

- J2SE Development Kit 6 update 24;
- MySQL Server 5.5;
- Eclipse IDE "Helios";
- Apache Tomcat Server 7.0

As far as the "Data Extractor Module" (please see the right parte of Figure 2) The basic task of this module is to query the web service output at fixed rate time and to store the new data found on it. The chosen rate time is 10 seconds.

The information collected, for a single sampling repeated every 10 second, are:

- Every new transit detected,
- Count of the total transits,
- Count of the new transits,
- The WS status, that can be:
  - WS available with data,
  - WS available without data,
  - WS unavailable,
  - WS returns a wrong XML data stream.

This extractor module works between 06.00 am to 08.00 pm. Four time subsets have been defined for a better data organization. This time slots are:

- Peak – Morning (7.00 am to 9.30 am),
- Peak – Afternoon (4.00 pm to 6.30 pm),
- Off-Peak – Weekend (Saturday and Sunday),
- Off-Peak (all others).

The "Web Service Data Evaluation module" handles connection to the database and performs statistical analyses. Therefore, a set of statistics, based on the indicators previously submitted, was defined:

- Protocol performances: Quality of the software protocol developed in ARCHIMEDES. Statistics for this set are:
  - WS Status (see previously section)
  - WS Response time i.e time between sampling start and arrival of stream data at the evaluation module (in milliseconds),
  - WS Data Production time i.e. time between the bus transit (timestamp_real) and arrival of data at the evaluation module (in seconds).

The detail of the results achieved, having considered the timeframe between July 7, 2011 and August 5, 2011, are:

Table 1. WS Status

State 1: WS available with data	94.068 %
State 2: WS available without data	5.927 %

State 3: WS unavailable	0.005 %
State 4: WS returns a wrong XML data stream	0.000%

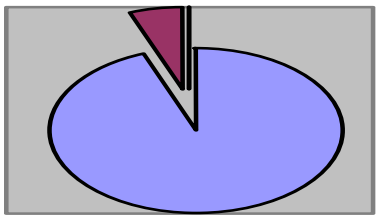

Figure 4 – WS Status pie chart.

Table 2. WS Response time (RT):

Average RT	Standard Deviation RT	Percentile 10	Percentile 25	Percentile 50	Percentile 75	Percentile 90
505.239	615.4803	234.0	265.0	312.0	468.0	969.0

Considering the 75% percentile, the response time of the Webservice is bounded at 468 msec.

Table 3. WS Data Production time (DPT)

Average DPT	Standard Deviation DPT	Percentile 10	Percentile 25	Percentile 50	Percentile 75	Percentile 90
66.7427	51.6893	36.0	47.0	60.0	73.0	87.0

Considering the average, the time needed to get the data of a bus at a given stop is 66 seconds.

C2.5 Society

Not Applicable.

C3 Achievement of quantifiable targets and objectives

Refer to the measure objectives and targets identified in section A1 and in the "Description of Work" and compare the actual achieved results with the envisaged ones. A tabular comparison would be sufficient and a simple indication of the extent to which they have been achieved is suggested in the template (as below) using a star rating scheme. Where the targets/objectives were or were not achieved describe how they differed. Where quantifiable targets have been changed over the course of the project, for example in the Local Evaluation Plans, please indicate these changes.

No.	Target	Rating
30c	Quality of data	**
30b	Protocol performances	**

NA = Not Assessed O = Not Achieved * = Substantially achieved (at least 50%)
**** = Achieved in full *** = Exceeded**

Measure 78 is a fundamental prerequisite to Measures no. 79 Improved Traveller Information and 82 Public Transport Priority System, so only the measure target C1 can be assessed here. At this level, the result has been fully achieved.

C4 Up-scaling of results

To understand the impacts of the measure if it were applied to a larger area or number of services etc. the observed results need to be up-scaled.

What achieved in Measure no. 78 can easily be upscaled, extending the number of relevant points considered. In case of this extension, the performances of the localisation system needs to be reassessed, to know which is the expected time to get data from the Webservice.

As highlighted also in the introduction of this document, functional and non-functional requirements to access to AVL/AVM are general enough to be used with other AVL/AVM systems, should other fleets have to be interfaced in the future. Other Public Transport fleet are operational in Monza so in the future this opportunity could become concrete: such AVL/AVM systems need to be updated to provide data suitable for the other ARCHIMEDES applications.

C5 Appraisal of evaluation approach

The evaluation approach proposed for this measure strongly relies on software tools and techniques to assess data produced by the AVL/AVM system as well as the performances of the Webservice developed as interface.

No other approaches could have been used for this purpose, due to the peculiarity of this measure, so the work accomplished in the evaluation session can be judged a proper one.

C6 Summary of evaluation results

The evaluation results achieved are the following:

- The quality of data concerning localisation and monitoring of the buses are suitable to be used for the other Archimedes measures no. 79 and no.82.
- The performances to access data through the Webservice made available for this purpose are suitable as well

The framework established is therefore robust and ready to be extended to other Public Transport fleet.

The decision to continuously store in a relational database all data concerning evaluation allows to evaluate along time the performances, in order to quickly detect eventual lacks.

C7 Future activities relating to the measure

No specific extensions are foreseen without the scope of the ARCHIMEDES project. The specifications provided by the research study are general enough to ensure that other AVL/AVM systems could provide data to be used for the application developed in measure no. 82 (“Public Transport Priority System in Monza”).

D Process Evaluation Findings

D.0 Focused measure

X	0	No focussed measure
	1	Most important reason
	2	Second most important reason
	3	Third most important reason

D1 Deviations from the original plan

There have been no deviations from the original plan.

D2 Barriers and drivers

For all measures concerning initiatives on Public Transport some starting considerations are needed.

Public Transport in Italy is not in perfect health: for this reason most companies show negative budget sheets. The ticket sale proceeds reach the 18-20 of budget % in the worst cases and the 31-35% in the best ones.

Fuel price is more and more increasing since it is now considered one of the strongest levers for Government to raise incomes. However, latest rises in price of fuel have not been supported by the State or local authority (regions, provinces, cities) through more contractual compensation (in case of call for tenders) or more grants (in case of in house providing) to PT companies: on the contrary, fund transfers from the Central government have been reduced, so it has been necessary, in order to maintain a good standard of the service, to increase fares, whilst rationalizing routes, reducing duplications and reviewing exercise programs in order to focus on more popular routes and timetables.

Such a situation makes it difficult for PT companies to invest on improvements of the service offered to users, even though the only way to encourage people to keep on or to start using Public Transport is to offer them better quality and more personalized services.

This is the most important driver which can help Municipality decisors to fight against barriers caused by the economical crisis.

D.2.1 Barriers

Preparation phase (positively solved)

BP_1. Barrier Field: 2 (institutional) Delay due to merging of TPM with NET – The merging of TPM with NET has delayed many activities and in particular the decision about keeping the the AVL/AVM system implemented by TPM or extending the system already used by ATM fleet to the new acquired fleet.

Implementation phase

BI_1. Barrier Field: 9 (Financial) Financial problems – Because of the financial investment required, NET has taken some time to decide about the installation of the devices.

BI_2. Barrier Field: 4 (Problem related) Technical problems – Once decided to switch to a different AVL/AVM system, additional technical tasks have been carried out to adjust such AVL/AVM system for respecting performances required by the other applications.

Operation phase

BO_1. Barrier Field: 8 (Organisational) PT companies' involvement – The measure at the moment involves only NET fleet, even though Monza is crossed by PT lines managed by several opeators. It is necessary that all the PT operators find a system to interface their AVL/AVM system with the electronic bus stops so to offer a more complete information to travellers.

D2.2 Drivers

Preparation phase

DP_1. Driver field: 1 (Political) Political commitment – Strong political commitment of Mobility Deputy Mayor to implement the measure in order to increase services to make more appealing the Public Transport with the aim of shifting more citizens to sustainable mobility modes.

Implementation phase

DI_1. Driver Field: 4 (Problem related) Technical motivation – Technical staff engaged on the software development was willing to make available a robust component

Operation phase

DO_1. Driver Field: 10 (Technological) Technological opportunity – The availability of this data represents a novelty for Monza; other than the use in ARCHIMEDES, this data is very useful at understanding the traffic status along the Corridor; buses are probes in the traffic that monitor the current status.

D.2.3 Activities

Preparation phase

AP_1. Activity Field: 4 (Problem related) Completion of the study – The research stage has been dedicated to the study of functional and non-functional requirements to be met by software interface to be implemented;

AP_2. Activity Field: 8 (Organisational) Definition of AVL/AVM system to be interfaced – Thorough pressure has been activated on NET Management to decide which AVL/AVM system to use.

Implementation phase

AI_1. Activity Field: 4 (Problem related) Technical tasks - Software development and testing of the module accessing the Webservice through which localisation and monitoring data are published.

Operation phase

AO_1. Activity Field: 4 (Problem related) Activation of the software component developed - The software component developed and described in deliverable T78.1 and in former section of this document has been activated and is continuosuly running; data gathered through the Webservice are stored in the database;

AO_2. Activity Field: 4 (Problem related) Checking the functioning – The functioning of the system is daily checked by Project Automation querying the database.

D3 Participation of stakeholders

D.3.1. Measure Partners

- **Project Automation –** Project Automation, as ARCHIMEDES partner, has defined technical requirements for the implementation of the interface.
- **NET -** "Nord Est Trasporti", as Public Transport operator for the city of Monza, has equipped the buses and implemented the AVL/AVM system enriching its functions to make available the required data

D.3.2 Stakeholders

- **Other PT companies –** Managers of other PT companies are interested in achievements derived from the implementation of the measure, since information about PT service are important for users and could be helpful to attract more people towqrds public transport
- **Comune di Monza –** Mobility and Traffic department can take benefit by the implementation of the measure for side effect, such as real-time traffic monitoring along the Corridor

D.4 Recommendations

D.4.1 Recommendations: measure replication

The scope of this measure is to make enable other applications or agents to exploit data generated by AVL/AVM system, acting as a sort of "device-driver" with respect to the AVL/AVM system(s). This means that the role of this measure is highly-replicable but the specific implementation strongly depends on the systems to be interfaced.

It is therefore quite straightforward to integrate in the ARCHIMEDES software suite developed in Monza throughout the project the management of other Public Transport fleets. To do this, assuming that every fleet is monitored by a different AVL/AVM system, it is sufficient that a Webservice is created by fleet owner accessing the legacy data of every AVL/AVM system respecting the agreed syntax (WSDL file).

Other ARCHIMEDES measures developed in Monza will invoke multiple instances of the Webservice, one fpe each independent fleet.

D.4.2 Recommendations: process

The process resulted by this measure is very general: data gathered by AVL/AVM system provides much information for many uses and the choice of a Webservice as interface mechanism is very general as well.

This means that other Public Transport Companies operating within the City can easily replicate this process to make their AVL/AVM data usable for the use by third parties applications, only adhering to the Webservice structure (WSDL).