

Measure title: **Bus Management System**

City: **Donostia–San Sebastián** *Project:* **ARCHIMEDES** *Measure number:* **74**

Executive Summary

Currently, the public transport company of Donostia-San Sebastian, CTSS-DBUS, operates a fleet of 120 buses over 27 regular routes (plus night and special services). A permanent staff of 346 drivers is required for that (with additional driving staff required often). In this context, planning and management are key elements for an efficient service provision.

Within the CIVITAS project, CTSS-DBUS has introduced a new expert planning and fleet management system that makes use of HSDPA-3G communication technology for the data exchange between the buses and the central information system.

The new expert planning and fleet management system enables the company to respond adequately to the mobility needs of the users by optimizing the number of buses and drivers required in each case, while providing optimal working conditions for drivers.

The measure is aimed at making a more efficient use of the available resources of the public transport company of Donostia-San Sebastian, mainly driver's productive hours. In this regard, an improvement in the ratio between the total amount of working hours of the driving staff as compared to the productive hours (i.e. without considering time losses, mainly due to staff shifts) is pursued. Since drivers' salaries represent a high share of the operational costs this optimization has also an impact on operation costs and the overall costs of the company. As a conclusion, a more efficient use of the available resources makes it possible to dedicate more funds to increase the quality standards of CTSS service provision.

The new management system comprises a significant change in the way that services are scheduled and drivers' hours assigned, which now takes advantage of the innovative developments in communication technologies.

With the new expert planning and fleet management system, the drivers' planning timetables are now more optimized with less time losses during the operation, achieving an Optimization Index of 94,87% regarding the driver's hours in relation to the offered service (1,21 percent points more than the situation before CIVITAS). As a result, the operating costs have been reduced by a 2,5% in relation to the total company costs. As a consequence, the new management system has helped CTSS to save 0,6 million Euros in 2010 and 0,7 million Euros in 2011.

The main changes perceived by the operation staff (drivers and operations management) are the new service schedule and drivers timetable. These changes were widely accepted right after the implementation of the new management system in 2010 (it achieved an acceptance index of 6,5 in the yearly survey among employees). Eventually, the acceptance level has increased once that the new management system has been consolidated and its benefits tested by the operational staff. In 2011 the acceptance level reached an index of 7,0.

A Introduction

A1 Objectives and target groups

A1.1 Objectives

The measure objectives are:

- (A) High level / longer term:
Within the CIVITAS-ARCHIMEDES project in Donostia–San Sebastian, the main objective is to increase all dimensions of quality of public transport in the city.
- (B) Strategic level:
The information collected thanks to this measure will allow providing public transport information in multiple formats that can be adapted to user needs and demand. Public transport employees will also be trained to use the system as part of the training work package (WP13).
- (C) Measure level:
By rationalizing the management of public transport services this measure will contribute to the city level objective of increasing the total number of PT passengers by 5% compared to 2006 figures.

A1.2 Target groups

- The citizens of San Sebastian and visitors that travel by public transport along the city.
- The employees of the Planning and Traffic department of CTSS.

A2 Description

Currently DBUS operates a fleet of 120 buses over 27 regular routes (plus night and special services). A permanent staffs of 346 drivers is required for that (with additional driving staff required often). In this context, planning and management are key elements for an efficient service provision.

Within the CIVITAS project, CTSS-DBUS has introduced a new expert planning and fleet management system that makes use of HSDPA-3G communication technology for the data exchange between the buses and the central information system.

The new expert planning and fleet management system enables the company to respond adequately to the mobility needs of the users by optimizing the number of buses and drivers required in each case, while providing optimal working conditions for drivers. It has been used to define the following service schemes, currently being supplied by CTSS-DBUS on a regular basis:

- Winter weekdays
- Winter Saturdays
- Winter Sundays & Holidays
- School holidays on winter weekdays (Christmas, Easter, last week of June and first week of September)
- July and August weekdays

- July and August Saturdays
- July and August Sundays & Holidays

For each of these service categories, the management system helps calculate the buses' schedule and the drivers' timetable, following the requirements of the CTSS-DBUS Labor Agreement, whose main features are:

- The maximum number of labour hours per day is 7,5h
- A 20 minutes break is mandatory for every driver after every 5 hours in service.

By feeding the system with the characteristics of the different services provided and the detailed information regarding driver's availability, the software is capable of simulating service provision in order to assign drivers to routes and appointing the exact time and place for the required staff shifts, minimizing time loses in this operation.

Real time information exchange helps monitoring the actual performance of the planned service provision, allowing deciding upon changes in the event of incidences, service disruptions, etc.

The expert planning and bus management system is completely integrated with the GPS system.

B Measure implementation

B1 Innovative aspects

The innovative aspects of the measure are:

- **Use of new technology/ ITS, (at international level):** the installation of a new communication system HSDPA-3G to communicate buses and the control centre, and the implementation of a new expert planning and fleet management system. Both systems have no previous experiences in bus companies.

Public transport needs to rationalize its costs to be able to be more competitive compared to the private car.

B2 Research and Technology Development

Not relevant.

B3 Situation before CIVITAS

Before the CIVITAS project the no expert planning system was used for fleet management. Driving staff management and service planning was the sole responsibility of an expert employee who has historically managed the drivers' timetable for each service category. This comprised a wide and difficult task that required a great personal effort to be completed accurately in order to better use the available resources, and well in advance for the optimisation to be put into practice. Although the experience and commitment of the expert employee guaranteed an efficient use of resources, there was no way to guarantee that the decision taken would represent the optimal situation in terms of efficiency. In addition, the lack of a real time information system made it difficult to attend to service incidences. Finally, the fact that only one person had the skills to efficiently undertake this manual planning comprised a risky situation (for example, in the event of sick leave).

These were the main reasons that pushed DBUS to search the market and implement an expert planning and fleet management system that fits the needs of the company.

B4 Actual implementation of the measure

The measure was implemented according to the following process:

Stage 1: Preparation and procurement phase (October 2008 – September 2009)

After a review of the market, in September 2009 CTSS-DBUS purchased a HSDPA-3G communication system for the communication between the buses and the central information system. In the same month, also a new expert planning and fleet management system was purchased.



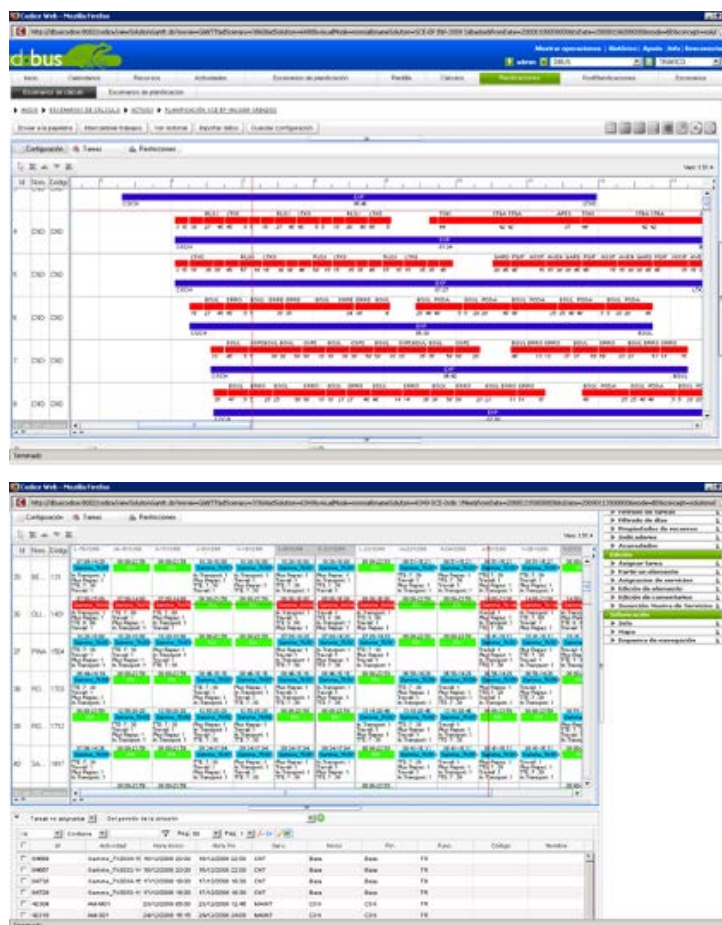
Picture 1: HSDPA-3G communication system

Stage 2: Testing phase (September 2009 – May 2010)

CTSS-DBUS installed the systems and introduced the specific data of the San Sebastian fleet, personnel and PT network. The systems were tested and demonstrated during an 8-month period (in which the tool was tuned), and the operation was monitored to obtain evaluation data.

Stage 3: Operation phase (May 2010 – October 2012)

After an 8-month period in which the system was tested and tuned, the new expert planning and fleet management system was fully operative in May 2010.



Picture 2: New expert planning and fleet management software

Stage 4: Evaluation (October 2008 – October 2012)

Impact and process evaluation has been undertaken according to Measure Level Evaluation Plan guidelines.

B5 Inter-relationships with other measures

- **At the site level:** This measure is closely related to measure 73 on bus travel information. The systems purchased within the two measures will be integrated to be able to provide information for both travellers and fleet management.

This measure can be integrated in the global concern of assessing the impacts and potential improvement of the actions implemented in the measure 16 (High quality transport corridors) and 17 (Business district bus service)

C Planning of Impact evaluation

C1 Measurement methodology

C1.1 Impacts and indicators

C1.1.0 Scope of the impact

This measure is part of a package of measures (measures nº 16, 17, 73 and 74) aiming at increasing the quality offered by the public transport service in the municipality of Donostia-San Sebastián. The development of an optimised and user-friendly environment for public transport modes is contributing to encourage citizens to make a higher use of collective transport, shifting from private cars to public transport.

This particular measure aimed at making a more efficient use of the available resources of the public transport company of Donostia-San Sebastian, mainly driver's productive hours, while providing optimal working conditions for drivers. In this regard, an improvement in the ratio between the total amount of working hours of the driving staff as compared to the productive hours (i.e. without considering time loses, mainly due to staff shifts) is pursued. Since drivers' salaries represent a high share of the operational costs this optimization has also an impact on operation costs and the overall costs of the company. As a conclusion, a more efficient use of the available resources makes it possible to dedicate more funds to increase the quality standards of CTSS service provision.

The measure is part of an overall strategy to reduce the number of cars entering the city and circulating within its neighbourhoods, which is providing benefits in the form of better air quality, less carbon emissions and reduced noise levels, resulting in a better health and quality of life for Donostia-San Sebastian citizens.

Modal shift to public transport modes have an impact on traffic performance, reducing congestion, allowing motorized modes to achieve better travel times, and in the case of public transport services, making it more reliable, thus contributing to increase its attractiveness to users.

Also the increase in the number of users of public transport increases the operating revenues of the public transport company (as well as reduces operation and maintenance costs), making it able to invest in higher quality standards for bus service operation.

Nevertheless, this measure focuses on the internal management side of the public transport service operation. The impacts associated to this isolated measure are moderate and almost not perceived by public transport users. Moreover, impacts are the consequence of the more efficient use of the available resources provided by this measure. Therefore, the evaluation of this measure do not focus on environmental and traffic performance impacts, which are assessed in the corresponding related measures.

C1.1.1 Selection of indicators

NO.	EVALUATION CATEGORY	EVALUATION SUB-CATEGORY	IMPACT	INDICATOR	DESCRIPTION	DATA /UNITS
	ECONOMY					
2b		Costs	Operating Costs	Operating costs	Costs per pkm or vkm	Euros, quantitative, derived or measured
		Quality of Planning	Operation	Driver´s hours in relation to the offered service	Driver´s hours in relation to the offered service	%, quantitative, collected
	SOCIETY					
14		Acceptance	Acceptance	Acceptance level	User acceptance level of the new	Percentage, qualitative, collected survey.

C1.1.2 Methods for evaluation of indicators

No.	INDICATOR	TARGET VALUE	Source of data and methods	Frequency of Data Collection
2b	Drivers Operating costs	50 % of Total costs (14 Million Euros/year in 2008)	Labour costs of the offered service planned as compared to the overall costs of the company.	Once each time that the public transport company implement a change in the offered services
	Driver´s hours in relation to the offered service	Index of 90%	Optimization of the planning of the offered service with the minimum driver hours and drivers.	Once each time that the public transport company implement a change in the offered services
14	Users acceptance level	Improve driver's satisfaction with the management system	A survey was conducted among drivers and operations management staff in order to assess the acceptance level of the new management system. The questionnaire was distributed two times during the project: once, early after the implementation of the system (December 2009); and a second time after 24 months, when the management system was fully operational and well consolidated (December 2011).	Two times during the project.

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C1.1.3 Planning of before and after data collection

EVALUATION TASK	INDICATORS INVOLVED	COMPLETED BY (DATE)	RESPONSIBLE ORGANISATION AND PERSON
Drivers operating costs	2b	Once each time that the public transport company implement a change in the offered services	CTSS / Mr. Javier Vallejo
Driver´s hours in relation to the offered service		Once each time that the public transport company implement a change in the offered services	CTSS / Mr. Javier Vallejo
Users acceptance	14	Months 15-39	CTSS / Mr. Javier Vallejo

C1.2 Establishing a baseline

Although the new management system comprises a significant change in the way that services are scheduled and drivers' hours assigned, which now takes advantage of the innovative developments in communication technologies, the approach for its evaluation is the same. In both cases the main goal is to optimize the resources available in the company, mainly driver's productive hours. Therefore, the main assessment refers to the Optimization Index, which reflects the ratio between the total amount of working hours of the driving staff as compared to the productive hours (i.e. without considering time loses, mainly due to staff shifts).

Since drivers' salaries represent a high share of the operational costs (around 70% of overall operation costs), this optimization has also an impact on operation costs, which are also assessed within the CIVITAS-ARCHIMEDES project. Furthermore, the incidence of operating costs in the overall costs of the company has been assessed, in order to reflect the economical dimension of the improved management system. Nevertheless, it should be noted when analysing these figures that operating costs may also be affected by other CIVITAS measures such as the use of bio-fuels (which are more expensive and causes overconsumption) and the improved service operation (which results in increased efficiency in the use of resources).

Like in the other CIVITAS measures regarding public transport, 2006 is used as a reference year for the evaluation.

C1.3 Business as usual scenario

For the definition of the BaU scenario, it was considered that the former management system had already achieved its maximum quality possible and no further improvements in the use of available resources could have been achieved in the future using this method. Therefore the Optimization Index recorded before the implementation of the measure is considered to stay the same in the future years. A similar approach has been used regarding the operating costs. It has been considered that the same Operating/Total costs ratio as recorded before the implementation of the measure would apply to the future years if the new expert planning and management system were not implemented.

Complementing these issues, the acceptance of the new system by the main affected party i.e. the drivers, has also been considered in the evaluation plan. Nevertheless, it is not possible to estimate a BaU scenario for this indicator, since there is no baseline situation (the indicator refers to the new management system).

C2 Measure results

C2.1 Economy

Table C2.1.1: Costs

Indicator	Before 2006	BaU 2010	After 2010	BaU 2011	After 2011
2b. Operating costs	11,1 million Euros (47,0% of Total Costs)	14,8 million Euros (47,0% of Total Costs)	14,2 million Euros (45,0% of Total Costs)	15,0 million Euros (47,0% of Total Costs)	14,3 million Euros (44,5% of Total Costs)

Indicator	Difference: 2010 –Before	Difference: 2010 – BaU	Difference: 2011 –Before	Difference: 2011 – BaU
2b. Operating costs	3,1 million Euros (-2,0% of Total Costs)	-0,6 million Euros (-2,0% of Total Costs)	3,2 million Euros (-2,5% of Total Costs)	-0,7 million Euros (-2,5% of Total Costs)

With the new expert planning and fleet management system, the operating costs have been reduced by a 2,5% in relation to the total costs. That is because the drivers' planning timetables are now more optimized with less time losses following the labour agreement. As a result, it can be inferred that the new management system has helped CTSS saving 0,6 million Euros in 2010 and 0,7 million Euros in 2011.

Table C2.1.2: Quality of Planning

Indicator	Before 2006	BaU 2010	After 2010	BaU 2011	After 2011
Driver´s hours in relation to the offered service	93,66%	93,66%	94,87%	93,66%	94,87%

Indicator	Difference: 2010 –Before	Difference: 2010 – BaU	Difference: 2011 –Before	Difference: 2011 – BaU
Driver´s hours in relation to the offered service	1,21%	1,21%	1,21%	1,21%

As mentioned above, the drivers' planning timetable is now more optimized. A 19% less time losses following the labour agreement, achieving an Optimization Index of 94,87% (1,21% more than before CIVITAS). This situation has remained stable during 2011 (no changes in the public transport offer occur in 2011).

C2.2 Society

Table C2.2.1: Acceptance

Indicator	Before 2006	BaU 2010	After Dec. 2009	BaU 2011	After Dec. 2011
14. Acceptance level	NOT AVAILABLE	NOT AVAILABLE	6,5	NOT AVAILABLE	7,0

For the assessment of the acceptance level towards the new management system, a survey was conducted among drivers and operations management staff. The questionnaire was distributed before (December 2009) and after the implementation of the system (December 2011), with 66 and 59 employees filling in the questionnaire each year, respectively.

The main changes perceived by the operational staff (drivers and operations management) are the new service schedule and drivers' timetable. These changes were widely accepted right after the implementation of the new management system by the end of year 2009 (it achieved an acceptance index of 6,5 in the yearly survey to employees). Eventually, acceptance level has increased once that the new management system has been consolidated and its benefits tested by the operation staff. In 2011 the acceptance level reached an index of 7,0.

Last but not least, as stated in the Objectives section, the measure is aimed at, in combination with other CIVITAS measures, contributing to a 5% increase in the number of passengers by the end of the CIVITAS project. In this regard it should be noted that between 2006 and 2011, there was an increase of 2,55 million extra travellers in CTSS's public transport system, which represents a 9,6% increase in the number of users. Although this increase in the number of users didn't have a significant impact in terms of modal share, with public transport substantially maintaining its patronage while a 0,4% reduction in car use is accounted as compared to the BaU situation, it should be highlighted that this achievement is made in a context of a steady increase in car travel, thus it can be considered a positive result.

C3 Achievement of quantifiable targets and objectives

No.	Target	Rating
1	Contribute to the city level objective of increasing the total number of PT passengers by 5% compared to 2006 figures.	***
2	Drivers Operating costs: lower 50 % of total costs	***
3	Optimization Index (Driver's hours in relation to the offered service): 90%	***
4	Improve driver's satisfaction with the management system	**
5		
6		
NA = Not Assessed O = Not Achieved * = Substantially achieved (at least 50%) ** = Achieved in full *** = Exceeded		

C4 Upscaling of results

This measure is already implemented to the whole public transport system in Donostia-San Sebastian.

C5 Appraisal of evaluation approach

Overall, it is considered that the evaluation approach is in concordance with the measure objectives, and data collection procedures adequate.

C6 Summary of evaluation results

The new management system comprises a significant change in the way that services are scheduled and drivers' hours assigned, which now takes advantage of the innovative developments in communication technologies.

With the new expert planning and fleet management system, the drivers' planning timetables are now more optimized with less time losses during the operation, achieving an Optimization Index of 94,87% regarding the driver's hours in relation to the offered service (1,21% more than the situation before CIVITAS). As a result, the operating costs have been reduced by 2,5% in relation to the total costs of the company. As a consequence, the new management system has helped CTSS saving 0,6 million Euros in 2010 and 0,7 million Euros in 2011.

The main changes perceived by the operational staff (drivers and operations management) are the new service schedule and drivers' timetable. These changes were widely accepted right after the implementation of the new management system in 2010 (it achieved an acceptance index of 6,5 in the yearly survey to employees). Eventually, acceptance level has increased once that the new management system has been consolidated and its benefits tested by the operation staff. In 2011 the acceptance level reached an index of 7,0.

C7 Future activities relating to the measure

There are no future plans related to this measure, which is already implemented to the whole public transport system in Donostia-San Sebastian.

D Process Evaluation Findings

D0 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

The deviations from the original plan comprised:

- **Operation Costs Units** – There has been a change in the units used for the assessment of Operation Costs. While in the MLEP it was “€/pk-m”, it is now considered that the use of this unit does not reflect the efficiency of the new Bus Management System to its all extent, where limited thresholds regarding journey times are assigned in each route, and arriving with some time in advance, although forcing the buses to wait for small time lapses at route terminals to observe the scheduled timetable (therefore not covering any mileage), should be considered a success in terms of fleet management. The use of the “passenger-km” factor may hide this effect, while the analysis of the share of operation costs in the overall costs of the company is more precise.

D2 Barriers and drivers

D2.1 Barriers

The main barriers encountered for the development of measure 74 are:

Preparation phase

- **Technological:** HDSPA-3G communication systems are not commonly being used by bus companies. CTSS-DBUS has been one of the first companies in Spain to use this communication system. Therefore, there was no past experience to relay on in the preparation phase of the measure.
- **Financial:** HDSPA-3G communication systems are very expensive.

Implementation phase

- **Organizational:** The measure involves training of staff members on a new and very sensitive task.

Operation phase

- **Technological:** Some difficulties appeared in order to include the actual labour restrictions within the specifications framework definition available for the expert planning system.

D2.2 Drivers

As for the drivers, the main ones affecting the measure are:

Preparation phase

- **Positional:** The measure is part of an overall strategy to improve public transport quality and promote modal shift. Also there are interactions and synergies with other measures making use of shared technology.

Implementation phase

- **Financial:** The availability of CIVITAS funding has been a significant opportunity to develop these measures.

Operation phase

- **Technological:** The measure makes use of the latest technology available in the field of fleet management. Previously it was more complicated and expensive to achieve this kind of developments.

D2.3 Activities

In order to handle the above-referred barriers and/or to make use of the drivers, the following activities were taken during the implementation of the measure:

Preparation phase

- **Technological:** An in-depth review of best practise regarding bus management systems and communication technologies has been developed, in order to apply the findings in the definition and implementation of the measure.

Implementation phase

- **Involvement/Communication:** Labour restrictions related difficulties have been solved through the involvement of the existing CTSS-DBUS planning employees in the process.
- **Organizational:** New employees have been involved in tasks with increased responsibility, increasing their motivation and involvement levels.

- **Operation phase**

- **Involvement/Communication:** A close cooperation with the communications technology supplier (EUSKALTEL) was established in order to minimize risks related to insufficient HSDPA-3G coverage

D3 Participation

D.3.1 Measure partners

Following there is a brief description of all project partners and its level of involvement with the measure:

- **CTSS' Traffic and Planning Department** - Test and implementation of the HSDPA-3G communication system and the expert planning and fleet management system. Leading role.

D.3.2 Stakeholders

The main stakeholders involved in the measure are:

- **DBUS driving staff** – the new expert planning and fleet management system guarantees that labour conditions are efficiently observed while enhancing service operation. Also, the new system allows defining staff needs, working shifts and scheduling well in advance, which benefit staff in regards of their personal and family planning (spare time, familiar commitments, etc).
- **PROINTEC/INDRA** - Development of a HSDPA-3G communication system that meets CTSS' necessities.
- **CODICE TECHNOLOGIES** - Development of an expert planning and fleet management system that meets CTSS' necessities.
- **EUSKALTEL** - Communications technology supplier

D4 Recommendations

D.4.1 Recommendations: measure replication

- **System approach:** Before deciding upon whether to implement an expert planning and management system or not, it is necessary to undertake an in-depth analysis of the current service provision and the desired future scenario, management procedure and especially labour conditions, more particularly the existence of restrictions affecting driving staff. Expert planning and management systems are best suited for companies where labour conditions entail frequent driving staff breaks, but it is desired that this situation may affect service provision to a minimum extent (i.e. adapting staff management to the optimum service provision, while complying with labour conditions, instead of altering service provision during certain time windows to ease the observance of driving staff requirements).
- **Technology:** Search the market in order to find the technology that best fits the migration from the situation to the foreseen scenario.
- **GPS compatibility:** in order to take full advantage of the planning capabilities of the expert system it should be checked that the system is fully compatible with GPS data outputs, allowing these to be directly fed into the planning software.
- **Video capability:** If the communication system is intended to exchange video information, like is the case of CTSS-DBUS' system, HSDPA-3G (or beyond) technology is required in order to do so efficiently. GPRS based communication systems would have troubles transferring video.
- **Interoperability:** It is highly recommended that the expert planning and management system is installed on a server, making it able to be used from any computer, instead of installing the system in one particular computer. This allows operating the system from every computer in the planning and operations department, as well as from an

employee's computer at home or from a laptop while staying out of the office, if necessary.

D.4.2 Recommendations: process

- **Staff involvement:** Since the measure requires the involvement of staff members on a new and very sensitive task it is important to provide them with training and incentives in the early stages of the preparation and implementation phases, in order to motivate them and gain their confidence, thus contributing to a successful definition and operation.
 - **On-going communication:** The use of innovative technology requires that an on-going communication framework with technology suppliers be established not only throughout the preparation and implementation phases, but also during the beginning stages of the operation.
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E Summary time schedule

Task No.	Task name	YEAR 1											YEAR 2												YEAR 3												YEAR 4																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48											
8.9	Bus Management System	Red							Yellow				PXE1	Blue																																														
Evaluation tasks																																																												
	Process evaluation report																			X																			X												X									
Deliverables																																																												
	M12.1 Draft MLEP							X																																																				
	D12.1 Final MLEP																											X																																
	D12.2 Baseline and first results Temp																																X																											
	D12.3 Draft results Temp																																													X														
	D12.4 Final result temp																																																X											