ANNEX 3 – CRAIOVA MERTS

M01.02 – Executive summary

Replacing fossil fuels with biodiesel offers a solution against global warming without loss of engine performance and without major engine changes. For this reason, Craiova intended to offer its citizens a better life by using alternative fuels.

In recent years, the necessity of having a clean air in cities has been at the center of attention of many public authorities, research institutions and business companies. The city of Craiova is well aware of this need and is currently working to achieve this goal by different interventions. This measure is such an intervention and its objective consisted in promoting the use of biofuels to replace conventional diesel in the public transport system.

The measure introduced for demonstration 10 buses (Roman UDM type) belonging to the Public Transport Company (RAT), which were slightly modified with additional filters to run with biodiesel up to 20% concentration.

First tests were made on 2 buses fuelled with mixtures of 5 (this is the standard fuel which is supplied at filling stations), 10, 15 and 20% biodiesel in conventional diesel. The physical properties of different biodiesel mixtures and the emissions of buses using biodiesel mixtures were measured and analysed within the University of Craiova in dedicated laboratories. Based on these tests it was decided that for operation to be used a blend of 20% biodiesel and the 10 buses for demonstration were included in the operation program and run in the city.

For the evaluation of the measure's impact, were defined indicators from three categories: economy (costs), energy (efficiency) and environment (specific emissions). Different alternatives, scenarios and situations were characterized based on these indicators. These cases were compared with the CIVITAS intervention and highlighted in a realistic way the effect of the measure, its efficiency and the impact produced.

The evaluation's results demonstrated a real benefit for RAT in terms of operational costs (reduction of operational costs of 1.32%) and for the quality of life in the city, due to the emissions' reduction equal to 8.91% of CO2 emissions for the buses running with biodiesel B20 compared with 2% reduction that is the measure's target assumed for the emissions. It should be mentioned that the demonstration period was short and the results should be considered only a first assessment of the new fuel and an encouraging reason to repeat the trials for a longer period of time.

During the implementation it has been found that there is a large deficiency in terms of legislative framework to encourage biodiesel production and to support its widespread use as fuel. In addition, the global economic situation steadily worsened since 2008 led to the withdrawal from the market of many producers of biodiesel. To overcome these barriers we have been forced to reduce the demonstration group of buses from 88 to 10 and to change the original timetable when needed, without causing problems in the timely completion of the measure.

The introduction of biodiesel in the public transport is no longer a pioneering action. There are cities/transport companies already using for a long time this fuel without any problems. The result of the evaluation in our case is a positive one but the economic context, biodiesel market trends, and national legislative context represent strong criteria in the decision to introduce biodiesel as usual practice in the public transport future operation.

Based on the results of evaluation, on the experience of other cities and considering the technical state of the RAT's buses, the introduction of B20 as current fuel in parallel with a careful monitoring of buses could lead to real benefits.

We believe also that the wide application of this fuel depends actually only on political and economic reasons that are being found from global, down to local level. There are regulations/general recommendations and there are particular initiatives at cities level but to accelerate the adoption of biodiesel is needed to stimulate both producers and users, to develop a legislative framework focused on this area and to make much lobbying so that to overcome the operators' inertia.

A. Introduction

A1 Objectives

The measure objectives are:

(A) High level / longer term:

- To reduce emissions in the city

(B) Strategic level:

- To implement alternative fuel in PT

(C) Measure level:

- To use a fuel mixture with up to 20% biodiesel
- To test this mix on a batch of 10 buses belonging to RAT
- To decrease emissions level up to 2% for buses operating with mix of biodiesel in conventional diesel fuel.

A2 Description

Transportation activities release in the atmosphere around 33% of CO2 as result of fossil fuel combustion. Replacing fossil fuels with biodiesel offers a solution against global warming without loss of engine performance and without engine changes.

Numerous studies and scientific researches demonstrate that climatic changes from the last decades are the effect of the carbon dioxide increasing level, with transportation system being one of the main reasons. Replacing fossil fuels with alternative ones is now getting more and more a widespread solution to tackle climate change, with mature technologies offering an attractive and efficient alternative.

Following the experience of other CIVITAS cities, Craiova city aims to start a set of actions targeting a partial replacement in the public transport system of fossil fuels with biodiesel.

Initially, the Public Transport Company of Craiova – RAT – planned to introduce the biodiesel in two stages: firstly on a limited number of buses (10 buses) and then extending the intervention to 88 buses.

Unfortunately, the economic context induced by the global economic crisis and the poor national legislation in the field of regulations on biodiesel usage led to some changes in terms of the sample size of buses to be used for the pilot tests from 88 to 10 vehicles.

Hence, in the implementation stage 10 buses have been endowed with additional filters to be able to run with biodiesel. During the technical work on buses the drivers and the maintenance technicians have been trained to learn working with the new fuel, under a program supported by the company responsible for the buses adaptations.

Two out of the 10 buses have been set in a testing program for a period of 4 weeks. The two buses have been fuelled by different blends, namely 5% (which is the standard fuel according to the national regulation), 10%, 15% and 20% biodiesel. For each mixture were measured the density, power content and viscosity. Emissions corresponding to each mixture were determined for different engine speeds. The data collected have then been analysed and it was decided to select the B20 (i.e. 20% biodiesel) as the blend for the demonstration stage to be performed with 10 buses.

The 10 buses running with 20% biodiesel demonstrated a reduction of 8.93% of the emissions which is a good and encouraging result for the city environment and also a small reduction of operational costs which could be a good and promising reason for extending the measure to a larger number of buses.

B. Measure implementation

B1 Innovative aspects

- **Use of new technology/ITS**

Use of non-conventional fuel – in our case biodiesel – in the public transport of Craiova represents a technical novelty for our city and also a solution for the limitation of GHG in the city. The alternative fuels are getting used for the first time in the public transport of Craiova.

This is a new technology which will be applied at DEMO scale on a batch of 10 buses supporting the general efforts to meet the principles of sustainable public transport.

The mix of conventional diesel fuel and biodiesel leads to a lower level of emissions and does not change the engine performance..

Research and Technology Development

State of the art in the use of bio-fuels

During the research and technology activities the state of the art in the use of bio-fuels and the bio-fuels market have been examined by using literature and online sources. Besides this usual desk work, a research about good practices and supporting policies adopted by other countries regarding the use of biodiesel has been performed. The analysis has been made by studying policies and regulations of neighbour countries (i.e. Bulgaria, Serbia, Ukraine and Hungary), other European countries and worldwide (United States, Canada, Japan, China, South America and South-East Asia).

From the research work it was noted that many countries have introduced various regulations on the introduction of biodiesel. These policies are generally aligned to a common global policy focused on two directions: to reduce GHG and decrease fossil fuels dependence.

The Graz city (AT) was presented as good practice concerning the research and observations made during the 3-years field tests which were carried out in co-operation with the Institute of Internal Combustion Engines and Thermodynamics (Graz University of Technology), the Institute of Organic Chemistry (University of Graz) and the Austrian Biodiesel Institute. The city buses were regularly

checked by these institutes, monitoring the exhaust gas emissions, the driver abilities, the effects on engine power and fuel consumption, any changes in the quality of the motor oil, and the wear and deposit in the engine. After a total mileage of 270'000 km with biodiesel, no additional, abnormal wear in comparison to the use of mineral oil diesel was found. The positive results of field tests encouraged Graz to extend the use of biodiesel to a large number of buses leading to remarkable results of city air quality. The Graz case could encourage also other cities in the use of biodiesel in the urban transport.

The technical and market aspects of using biodiesel in on buses have been analysed in details by also correlating them with local conditions. Additionally, the technical and economic conditions affecting the use of biodiesel have been investigated.

According to the European Biodiesel Board, the Romanian production of biodiesel reached in 2010 approximately 70'000 tons that is the 0.73% of the total production with respect to the 9,570,000 tons at EU27 level[1].

In the recent years more than in the past, due to the macroeconomic context affected by the global recession, the investments in biodiesel industry were reduced and the production declined dramatically.

Beside the production issues, the quality of biodiesel is variable and it can often be contaminated mainly by glycerine, it can face problems because of its gel point, and there can be some water. Glycerine, in fact, creates problems causing deposits with negative effects on combustion chamber. The gel point, instead, comes out to be a problem in two cases: when using the biodiesel over 25% and in zones with temperate climate like Romania, where 4-6 months per year the temperature drops below zero making biodiesel unusable. Water presence could induce problems in the injection process and during engine operation.

All these inconveniences were solved by installing in the 10 tested buses specific filters before the fuel injection in the combustion chamber.

For harmonizing Romanian legislation with the EU one and for completing the legislative framework in the energy field, it was adopted the Government Decision nr.1844/2005 on the promotion of biofuels and other renewable fuels in transport by transposing the European Directive 2003/30/CE. According to this decision a minimum percentage of biofuels or other renewable fuels placed on the market has been gradually introduced in the fossil fuel, as follows:

- 2% from 2007
- Minimum of 5.75% by 31 December 2010

Currently the Romanian legislation is in line with EU requirements and introduced gradually biodiesel in the fossil diesel. As a consequence, the standard diesel at the fuelling station now contains 5% biodiesel. The blends can be legally made only by licenced companies and supplied to users (transport companies, fuelling stations).

[1] http://www.ebb-eu.org/stats.php

According to the *Government Ordinance 456* of 2007 the mandatory blending percentages for fuel used in transport were set out as follows:

- From 1 July 2007 a minimum content of 2% of biodiesel
- From 1 January 2008 a minimum content of 3% of biodiesel
- From 1 July 2008 a minimum content of 4% of biodiesel
- From 1 January 2010 a minimum content of 5% of biodiesel

Unfortunately Romania does not benefit of a very well developed program in terms of "green" fuel production. In addition, the promotion and supporting initiatives of biodiesel production were quite poor in the last years. Romanian producers complain that biodiesel is proving an unprofitable business in Romania. They say that big oil producers prefer to import biodiesel rather than buy it from local producers. This situation has led many producers to leave the production of biodiesel.

Studies result about diesel engine modifications for using more than 20% bio-diesel

Another part of RTD studies analysed the engine modifications required by considering two possible alternatives: fuel mix up to 20% of biodiesel and over 20% – considered this limit being critical for engines working without major modifications.

The use of biodiesel over 20% needs major changes of the engine and so they require a homologation (approval) according to the national regulations. In addition, the climate zone where Craiova is located does not allow the use of biodiesel in the cold season, approximately 4-6 months per year when its viscosity is high.

Following the study findings, the biodiesel content was limited to 20% and the measure was redesigned taking into account the technical implications knowing that RAT buses fleet is quite old and could not have supported a change of fuel used because of potential consequences on the engine operation.

Considering the physical and chemical properties of biodiesel and all the consideration outlined in the RTD studies, the following conclusions to use biodiesel with B20 blend have been drawn up:

1. The engines require minimal technical modifications;
2. The costs for these modifications are minimal;
3. No approval is necessary for the modified engines;
4. No approval is necessary for the vehicles running with the modified engines;
5. No approval is necessary for the feed pumps of fuel stations;
6. No approval is necessary for the fuel supply tanks.

The technical modifications to the buses working with biodiesel B20 have been made in order to provide quality assurance for elastic and plastic components on the alimentation route in case of using biodiesel. The main element installed to protect the engine supply route against the acid corrosion of biodiesel fuel, consisted in a special filter as shown in the figure below:

Figure 1 – Biodiesel filter

The normal bus filters have then be replaced with the new ones. The inlet and outlet couplings on the engine supply circuit have been fixed and sealed on the new filter.

B2 Situation before CIVITAS

Craiova surface is around 100 km^2, being divided by 17 buses routes. The Public Transport Company has a fleet of 176 buses most of them being older than 10 years. In November 2008 RAT purchased 17 new buses MAN Lion's City because buses older than 10 years were depreciated and did not comply with the requirements of the Environmental Protection Agency. Currently the RAT fleet is predominantly old and should be enforced by new buses or by adoption of new solutions to limit the pollution level.

According to the targets defined by the EC about the use of biofuels, Member States should introduce progressively biofuels in their transport fuel mix, reducing the dependence from fossil fuel. The existing legislation recommended a limit of 4% biofuel in 2008 and a target of 5.75% for 2010. The limits for 2020 were initially foreseen equal to 10% but it seems that this standard is too high for a relatively short period and therefore, according to the latest analysis performed by the DG-TREN, it is expected a substitution of only 6.9% in 2020.

The European standards have been applied in Romania according to the stipulated terms and diesel fuel at the pump contains now 5% biodiesel. The use of biodiesel as alternative fuel came to the attention of the Municipality as a result of the experience of other cities in Romania (Constanta, Cluj, Alba Iulia) which have introduced this fuel in different research programs and obtained successful results. The existing and numerous research papers, the published results on the use of biodiesel, the European policies to promote the use of alternative fuels, the targets that the EU has stipulated in this direction, all these have motivated the decision to implement the measure in Craiova.

B3 Actual implementation of the measure

- **Stage 1**: **Planning and design of the measure**

In order to determine how the measure can be applied and integrated into the development strategy of the Public Transport Company (RAT), several meetings with the technical team from Craiova and politicians from the Municipality were organized prior to the starting of the RTD work in fact but also during the development of this initial task.

Through the RTD analyses and studies described in paragraph B.2, it was found out that there was a reduced possibility of obtaining alternative fuel in the quantity required to test 88 buses due to several economic barriers which became more pronounced in 2009 when the economic crisis became evident. As a consequence the number of buses used for tests was reduced to 10 instead of the 88 initially foreseen.

The work undertaken in this stage contributed to the decision of introducing the above changes in the original shape of the measure and to design accordingly the measure.

- **Stage 2: Training for involved technicians**

The following activities have been carried out:

- definition of the participants, the trainers and the training program
- development of the training by the company which made the up-grade of the buses

The training program was held in 3 sections:

1. <u>Technical staff training – 4 engineers</u>

   The company that installed the biodiesel filters organized a training session for 4 engineers from RAT. The training program was divided into theoretical and practical notions and lasted one day. Moreover, the four engineers assisted at the filters installation and had the opportunity to know in details how they operate. The training program was further organized and held by the 4 technicians.

2. <u>Training of maintenance mechanics – 12 mechanics</u>

   12 mechanics were trained about the installation and use of devices for use of biodiesel fuel. The course lasted 3 hours for each group of 4 mechanics and was divided into theoretical and practical notions. Finally, the mechanics received written instructions on the operation and maintenance of the filters.

3. <u>Training of buses drivers – 10 drivers</u>

   The training program was held for 10 drivers. The course content was the same as for mechanics. Biodiesel filters do not involve special issues for drivers but considering that it is a new fuel it has been considered necessary drivers to be aware of changes made.

- **Stage 3: Modification of buses to run with biodiesel up to 20%**

The buses for trials with biodiesel mixtures were selected and prepared to run with biodiesel by endowing them with filtering devices to avoid the fuel entering in the lubrication system. Biodiesel filters were installed on 10 buses belonging to RAT fleet as follows: 7 ROMAN 112 UDM, 1 Mercedes, 1 MAN SL, 1 Bredabus.

Figure 2 – Modifications on buses

Stage 4: Test with bio-diesel up to 20% (January – April 2012)

In recent years most of the regional biodiesel producers closed their activity due to a lot of reasons among which the lack of raw material, increasing of fees, general recession process. As a consequence, the use of biodiesel has been limited to 10 buses. The tests were made on 2 buses fuelled gradually with mixtures of 5% (standard fuel of fuelling station), 10%, 15% and 20% biodiesel in conventional diesel.

A testing plan was developed including the detailed working methodology. Basically the tests consisted in preparing controlled mixtures of biodiesel, fuelling the 2 assigned buses and examine them within dedicated laboratories of the Craiova University according to an agreed protocol. The initial testing plan provided in the deliverable developed in this stage was changed and adapted to the available conditions. The methodology for the tests followed a certain number of steps, namely:

1. Preparation of mixtures of diesel – biodiesel by the fleet operator (RAT) under controlled conditions of the concentration; 4 blends were analysed in laboratory: 5% (standard diesel fuel), 10%, 15% and 20% biodiesel mixtures. The measured parameters have been: calorific power, viscosity, and density.
2. Analysis of the emissions in engine gas exhaust pipe (NO_x, SO2, CO, CO_2, and O_2) produced by using the above mentioned biodiesel blends performed on 2 ROMAN 112 UDM buses.
3. Each bus was tested 2 consecutive days by using each of the 4 biodiesel blends. The testing program was:
    - 8 and 9 March 2012, for standard diesel (i.e. 5% biodiesel in volume, B5)
    - 15 and 16 March 2012, with fuel containing 10% biodiesel in volume (B10)
    - 22 and 23 March 2012, with fuel containing 15% biodiesel in volume (B15)

- 29 and 30 March 2012, with fuel containing 20% biodiesel in volume (B20)

The pollutant emissions level analysis in engine gas exhaust pipe (NOx, SO2, CO, CO2, and O2) was determined for each bus working in 3 representative consecutive rotational speeds ranges (recommended by the buses owner/operator): 550 ÷ 600 RPM, 850 ÷ 900 RPM and 1150 ÷ 1200 RPM.

The data referring to the physical parameters have been presented by the University of Craiova in the study performed and the database with emissions were attached to the study in two excel files, one for each bus. (The raw data of emissions are presented in Annex 1).

The different biodiesel mixture and the buses emissions were analysed and the tests results led to the decision on the optimal content of biodiesel for the operation of 10 buses.

Figure 3 – Equipment for the emissions' measurements

Figure 4 – Measurement of emissions at tailpipe

- **Stage 5: System running**

The 10 buses started to run with biodiesel blend B20 for two weeks in the first half of October 2012 and were carefully monitored to promptly intervene in case of technical malfunctions.

In last five years most of the regional biodiesel producers closed their activity due to a lot of reasons: lack of raw material, increasing of fees, general recession process. Moreover, the national regulations do not allow to blend fuels than in licenced warehouses. According to the current legislation, the mixture of 20% (B20) is not standardized and therefore cannot be used except for limited test actions. Purchase of biodiesel for 10 buses and finding a legal solution for mixing it with diesel fuel inside RAT has been a major issue that led to delays of the demonstration phase and limited the operating period to only 2 weeks (first half of October 2012).

Due to the fact that the 10 buses have run in the city only a short period of time, this period has been considered as a pilot test extended to a larger number of buses (from 2 to 10) and not a fully operational stage.

RAT usually keeps a record of every bus daily activity and centralizes these data monthly and annually. To monitor the 10 buses that worked with biodiesel the same type of evidence sheets have been used. Hence, the main data monitored and information recorded have been:

- Name of bus driver;
- Mileage at the beginning of the month and cumulative mileage at the end of each day;
- The effective time of the trip;
- The fuel consumption.

In evaluating the indicators aggregated data have been used for the mileage and the actual consumption recorded by the 10 buses during the 2 testing weeks.

At the end of each day, the drivers had the duty to mention the technical failures occurred to the monitored buses or the important issues related to the engine operation. During the demonstration there were no failures or engine malfunctions that could be caused by fuel switching, but drivers noted that buses had not enough power when they were fully loaded and passengers have noticed a distinct smell when traveling.

The monitoring sheets for buses running with biodiesel and the cumulative data sheet are reported in Annex 2**.**

Figure 5 – Fuelling station of RAT buses

B4 Inter-relationships with other measures

M01.02 Alternative Fuels in Craiova and M01.07 Transition towards Clean Fleets in Craiova aim both to reduce the emissions coming from public transport. The measure M01.07, in fact, foresaw to find an appropriate grant to replace the fleet of old buses running daily in Craiova with low polluting vehicles and an option was also the acquisition of buses that can run with B20.

C. Impact Evaluation Findings

C1 Measurement methodology

C1.1 Impacts and Indicators

Table C1.1: Indicators

No.	Impact	Indicator	Data used	Comments
1	**Economy**	Average Operating costs	– Km travelled /month – Fuel consumption /month	For the 10 buses targeted: – 7 ROMAN 112 UDM, – 1 Mercedes, – 1 MAN SL, – 1 Bredabus
2	**Energy**	Vehicle Fuel Efficiency	– Fuel consumption /month for 10 buses operating with biodiesel – Km travelled/month for 10 buses operating with biodiesel	
3	**Environment**	CO_2, CO, NO_x emissions	– Emissions measured on the testing bench (ppm or %) – Fuel consumption /month for 10 buses operating with biodiesel – Km travelled/month for 10 buses operating with biodiesel – Average vehicle speed in urban area	

Detailed description of the indicator methodologies

The following elements should be considered in the context of indicators calculation:

- The 10 buses operated with biodiesel two weeks in the first half of October 2012.
- The indicators calculation and their analysis were done for a month (October 2011) for the ex-ante, and October 2012 for ex-post analysis. Therefore data from the same period of the year have been collected for both the ex-ante and ex-post periods in order to have similar operating conditions in terms of traffic, occupancy, air temperature, and so to reduce the number of variables that could influence the buses operative conditions and avoid as much as possible any misinterpretations.
- The hypothesis to extrapolate data for the whole year does not make sense because it would be applied a linear variation which would lead to the same results.

- **Indicator 2 (*Average Operating costs*)** - Ratio of total operating costs incurred by the 10 monitored buses divided by the total vehicle-km travelled in the period considered. All data are related to the 10 monitored buses.

A = B / C, where:

A = Average operational costs for the service (€/vKm)

B = Total operational costs for the service (€), limited to the fuel cost, this being the only cost element that changes. It has been assumed that all the other cost categories (personnel, maintenance, spare parts, etc.) are similar for the buses running with conventional diesel as for those running with biodiesel mixture of 20%.

C = Total vehicle- Km

Argumentation for operational costs: Sources of literature specify that B20 does not affect the engine life differently than conventional diesel. Moreover, due to its higher lubrication this fuel can improve the engine life. For instance in a study called "Biodiesel"[2] it is specified that the use of B20 for covering 2.25 x 10^6 km did not produce any problems. Also, in a study of the European Biodiesel Board it is specified that the tests performed for long periods of time (i.e. 12 years) by using a B50 blend (50% biodiesel) – which means more that the blend used for testing the 10 buses – have shown that the functional components of a vehicle do not wear down in a different way than in the case with only conventional diesel[3]. Similar considerations have been found by the city of Graz (AT).

The data used in the indicator calculation were provided by RAT and are characteristic to the first 2 weeks of October 2012.

RAT usually keeps a record of every bus daily activity and centralizes these data monthly and yearly per total fleet and type of buses. Depending on the case we asked the appropriate data.

- **Indicator 3** ***(Vehicle Fuel Efficiency)*** Energy consumption of 10 buses adapted to run with biodiesel per unit of transport activity.

A = B / C, where:

A = Average vehicle energy efficiency (MJ/vkm)

B = Total energy consumed for the 10 vehicles considered (MJ)

The energy content of fuel (MJ/kg) was determined in laboratory during the testing period for various blends of biodiesel together with other physical properties of mixtures, like density, and viscosity. The values of these parameters have been calculated by the University of Craiova[4].

[2] Biodiesel, Andreea Cretu, http://www.scribd.com/doc/94699012/Biodieselul
[3]European Biodiesel Board: : http://www.ebb-eu.org/studies.php
[4] Research concerning level analysis of pollutant emissions produced by buses operating with biodiesel fuel in Craiova city / contract no. 5C/27.02.2012.

Figure 6 – Equipment for the energy content measurement

Figure 7 – Equipment for viscosity determination

B = Total energy consumed for the 10 vehicles considered (MJ) was calculated with the formula:

$\mathbf{B = P_{cal} \times \rho \times M}$, where

P_{cal} = Energy content of fuel ((MJ/kg)

ρ = Fuel density determined in laboratory (kg/m3) and converted in kg/litre

M = Quantity of fuel consumed by 10 buses, resulted from data provided by RAT (litres)

C = Total amount of vehicle-kilometres completed by the 10 monitored vehicles, unit: (vkm)

*** It should be noted that RAT provided for the ex-ante indicators calculation the monthly record of mileage and fuel consumption by type of buses so the mileage/fuel consumed by 10 buses have been proportionally calculated from the data corresponding to all buses of the same type that have operated in the considered period.

- **Environment indicators*(CO_2, CO, NO_x)***

Emissions measurement was a subcontracted work with the University of Craiova.

The testing program, measurement methodology and equipment used have been detailed in the developed study. Measurements were made both on the buses running with conventional diesel and on B20 (20% biodiesel).

Figure 8 – Measurements of emissions at tailpipe

The environmental indicators considered in the measure's evaluation have been:

- **Indicator n. 8 (CO2)**
- **Indicator n. 9 (CO)**
- **Indicator n. 10 (NO_x)**

O2 emissions were additionally measured even if they are not listed as indicator but allowed us to convert the ppm in g/unit of activity for the measured emissions.

Emissions were measured in ppm or % and then converted in g/vkm using a simplified methodology adopted.

Measurements were made for different engine speeds from 500 to 1200 rpm. The normal operating speed of an engine in urban conditions is of 1200 rpm/minute so we extracted from emissions only the data corresponding to the rotational speed of 1200 rpm/minute.

The COPERT methodology does not have options for a fuel mixture as in the case of this measure. Therefore to calculate the environmental indicators a simplified method based on Core Inventory of Air Emissions - EMEP/CORINAIRE of the European Environment Agency has been used. The method was developed and used by IPA in FP6/CREATING project and it has been adapted for the evaluation of this measure.

The calculation methodology we adopted is further presented.

<u>Step1: Calculation of the exhaust gas flow</u>

The exhaust gas based on the fuel flow and air to fuel ratio is as follows:

$\mathbf{G_{EXHW} = G_{FUEL} \times (1 + \lambda \times A/F_{st})}$ where:

G_{EXHW}= exhaust gas mass flow rate (kg/h)

G_{FUEL}= fuel mass consumption (kg/h)

λ = air to fuel ratio

Lambda was calculated by using EC regulations for internal combustion engines (EC Directive 26/2004):

$$\lambda = \frac{\left(100 - \frac{conc_{CO} \times 10^{-4}}{2} - conc_{HC} \times 10^{-4}\right) + \left(0.45 \times \frac{1 - \frac{2 \times conc_{CO} \times 10^{-4}}{3.5 \times conc_{CO_2}}}{1 + \frac{conc_{CO} \times 10^{-4}}{3.5 \times conc_{CO_2}}}\right) \times \left(conc_{CO_2} + conc_{CO} \times 10^{-4}\right)}{6.9078 \times \left(conc_{CO_2} + conc_{CO} \times 10^{-4} + conc_{HC} \times 10^{-4}\right)}$$

where:

$conc_{CO}$ = concentration of CO (ppm)

$conc_{CO_2}$= concentration of CO2 (%)

$conc_{HC}$= concentration of hydrocarbons (ppm)

The HC (hydrocarbons emissions) were not measured but generally in a well done burning process they have values under 100 ppm and their influence on the lambda value is insignificant. So we might consider them zero.

A/F_{st} = stoichiometric air to fuel ratio

Different sources provide different reports for A/Fst both for conventional diesel fuel and biodiesel depending on the raw materials in the biodiesel case. Using constantly the same A/Fst values the calculation error which could occur is the same and will not produce errors in the interpretation of data.

In the calculation methodology the following values for A/Fst have been used (Stoichiometric air/fuel ratio) [kg air/kg fuel]:

- Fossil diesel: 14.53
- Biodiesel 100% (B100): 12.3

[Source: An overview of biofuel technologies, market and policies in Europe**,** E. van Thuijl, C.J. Roos, L.W.M. Beurskens/Energy research Centre of the Netherlands (ECN)[5].

For the fuels used in the measure we calculated the following values for the A/Fst:

- B5 (biodiesel 5% which is assimilated with diesel because the current diesel fuel at fuel stations have already a content of 5% biodiesel according to the national regulations): A/Fst= 14.42
- B20: A/Fst =14.09

The A/Fst calculated are presented in the table below:

Stoichiometric ratio air/fuel (A/Fst) **for different fuels**	
Diesel oil	14,530
Biodiesel fuels	12,300

		Biodiesel	**Diesel oil**	**Biodiesel 5% (B5)**
Quantity used for fuels mixture	[litres]	5	95	100
density	[kg/l]	0,819	0,84	
Quantity used for fuels mixture	[kg]	4,095	79,8	83,895
air for combustion	[kg]	50,3685	1159,494	1209,8625
A/Fst for B5				**14,42**

		Biodiesel	**Diesel oil**	**Biodiesel 20% (B20)**

[5] http://www.ssc.it/pdf/2005/biofuel_UE2005.pdf

Quantity used for fuels mixture	[litres]	20,00	80,00	100
density	[kg/l]	0,819	0,84	
Quantity used for fuels mixture	[kg]	16,38	67,2	83,58
air for combustion	[kg]	201,474	976,416	1177,89
A/Fst for B20				**14,09**

Step 2 - Calculation of emissions mass flow rates

The emissions mass flow rates is calculated as follows:

$\mathbf{Gas(i)_{mass} = conc(i) \times \rho(i) \times G_{EXHW} \times 10^{-6}}$ **(kg/h)** where:

$Gas(i)_{mass}$ = instantaneous flow of gas i in exhaust gases, calculated above (kg/h)

conc(i) = concentration of gas i in exhaust gases, measured (ppm)

ρ(i) = density of exhaust component, kg/ m^3, (we assume that the density of exhaust gases is around 1 kg/m^3)

The ρ(i) calculated for each exhaust gas is given in the table below:

Gas	Molar weight / molar volume	Density (kg/m3)	Comments
CO2	44 / 22.4	**1,96**	
CO	28 / 22,4	**1,25**	
O2	32 / 22,4	**1,43**	
HC ($H_{1.85}C_1$)	(1,85+1*12)/22,4	**0,62**	average carbon to hydrogen ratio: 1: 1.85 in case of diesel fuel
NO_x(x=1.8)	(14+1,8*16)/22.4	**1,91**	considered as a mixture of equal parts of NO, NO2, NO3 si N2O3 (supposition)

Step 3 - Calculation of the specific emissions

The Specific emission (g/vehicle-km) shall be calculated for each individual component in the following way:

$$Specific\ emissions = \frac{Gas(i)_{mass} \times 10^{-3}}{fuel_{cons} \times vehicle\ speed} \times average\ fuel\ cons$$ where,

Specific emissions = emissions per unit of transport activity (g/vehicle-km)
$Gas(i)_{mass}$ = instantaneous flow of gas i in exhaust gases (kg/h)
$Fuel_{cons}$ = fuel consumption (litres/km)

For buses running with conventional diesel we used monthly data provided by RAT. For the 10 buses running with biodiesel blend we used the data recorded by drivers during the demonstration period.

- vehicle speed = average speed of buses in the city (km/h)
  The vehicle speed value is an average one provided by RAT based on daily activity sheets where the arrival and departure time are recorded. The route length is known and the speed of buses is periodically calculated. An average speed is calculated every year and used in statistics. For the 10 buses running with B20 the vehicles speed was calculated based on mileage and time recorded by drivers demonstration sheets
- average fuel consumption = fuel consumption per unit of transport activity(litres/vehicle-km)

The calculus methodology was applied to indicators number 8,9 and 10.

C1.2 Establishing a Baseline

The economic developments during the period 2008-2011 caused significant market disturbances affecting the fuel unit costs. Also other cost elements have been modified (maintenance, staff salaries) in an unpredictable way. All these fluctuations caused by economic crisis would certainly induce discrepancies between the results when we tried to evaluate the situation during this period. To remove these random perturbations we decided that the reference year be 2011, year when it was felt some economic stability which had allowed us a comparative analysis with the year when the project MODERN acted.

The analysis of the reference year was based on data from RAT, the phisical parameters and environmental data obtained by measurements and included in the study of the University of Craiova.

The results we obtained in the baseline year are:

Baseline (ex-ante) Year 2011			
Indicator number / name		**Unit**	**Results**
Indicator 2	***Average Operating costs***	EURO/vkm	0.4012
Indicator 3	***Vehicle Fuel Efficiency***	MJ/vkm	15.61
Indicator 8	***CO2 emissions***	g/vkm	1’345.27
Indicator 9	***CO emissions***	g/vkm	46.72
Indicator 10	***NOx emissions***	g/vkm	6.20

The calculation sheets for each baseline (ex-ante) indicator, year 2011, are in **annex 3** and the data used in the indicators calculation are presented in the tables bellow:

Indicator 2 - ***Average operating costs ex-ante (EURO/vkm)***

Operational costs for 10 buses (EURO)	11’823

Total vehicle- km (mileage) for 10 buses (km)	29'469
Price (EURO/litre)	0.99
Fuel consumption per unit of activity (l/vkm)	0.4044
Average Operating costs – ex-ante (EURO/vkm)	**0.4012**

Indicator 3 ***Vehicle Fuel Efficiency ex-ante (MJ/vkm)***

Energy content of fuel (MJ/kg)	45.862
Fuel density (kg/l)	0.8415
Fuel consumption for 10 buses (litres)	11'918
Total vehicle- km (mileage) for 10 buses (km)	29'469
Energy content of fuel consumed by 10 buses (MJ)	459'947
Vehicle Fuel Efficiency (MJ/vkm)	15.61

Indicators 8,9,10 Emissions ex-ante (g/vkm)

Emissions measured at the tailpipe depend on the fuel type and the engine working parameters when the measurements are being made. The emissions measured for buses running with diesel fuel and calculations data are further presented:

Average values of emissions measured for buses running with standard diesel oil (B5)	***CO (ppm)***	***CO2 (%)***	***NO_x (ppm)***
	970.64	1.78	84.30

Engine speed (rot/min)	1'200
A/Fst (Stoichiometric ratio air)	14.42
Fuel consumption per unit of activity (l/vkm)	0.404
CO - Specific emissions ex-ante g/vkm	***46.72***
CO2 - Specific emissions ex-ante g/vkm	***1'345.27***
NO_x- Specific emissions ex-ante g/vkm	***6.20***

C1.3 Building the Business-as-Usual scenario

The introduction of biodiesel seemed an appropriate measure for Craiova and in full compliance with European policies on renewable energy orientation at the time of project proposal preparation. During the project implementation, as a result of adaptation to the economic conditions of the moment, this measure has undergone some changes by reducing the sample size demonstration.

If in 2007 the idea of introducing biodiesel to the entire fleet of buses through MODERN project or even on their own initiative seemed a realistic one, the year 2009 brought major changes regarding this type of intervention: reducing the biodiesel market and the number of producers, the lack of a steady offer of biodiesel.

Looking at the overall economic and financial context created by the global crisis we can say that without the MODERN project (Business-as-Usual scenario), RAT and Craiova Municipality would not have been introduced biodiesel as an alternative to the fossil fuels currently used. So BAU scenario is equal to the "nothing to do" scenario.

Business-as-Usual scenario has the start situation in 2011 (reference year) and configures the evolution of indicators for 2012 in case of not introducing biodiesel.

The indicators value for the BAU scenario are the following:

Indicator name	**Unit**	**BAU Results**	
		2011	**2012**
Indicator 2 / *Average Operating costs*	EURO/vkm	0.4012	0.4022
Indicator 3 / *Vehicle Fuel Efficiency*	MJ/vkm	15.61	15.05
Indicator 8 / *CO2 emissions*	g/vkm	1'345.27	1'296.96
Indicator 9 / *CO emissions*	g/vkm	46.72	45.04
Indicator 10 / *NO_x emissions*	g/vkm	6.20	5.98

The calculation sheets for each BAU indicator related to the BAU for the years 2011 and 2012 are reported in Annex 4 while the data used for the indicators calculation are presented in the tables below:

Indicator 2/*Average Operating costs – BAU*

	2011	**2012**
Operational costs for 10 buses (EURO)	11'823	11'553
Total vehicle - km (mileage) for 10 buses (km)	29'469	28'726
Price (EURO/litre)	0.99	1.03
Fuel consumption per unit of activity (l/vkm)	0.404	0.390
Average Operating costs – BAU (EURO/vkm)	0.4012	0.4022

During the analysis, the price of fuel and the exchange rate RON / EURO have suffered frequent changes following specific markets trends. In any case, we can say that the values obtained allow us to draw conclusions and predictions for the following period. In a period of economic stability when the elements of the operation cost are constant, the element which must be controlled and produces changes in this indicator is the fuel consumption per unit of activity. The indicator does not differ too much in the two years, what is normal considering that the diesel fuel prices were very close in the two

years (0,99 and 1,03 Euro/liter) and the fuel consumptions per unit of activity have had almost the same value in both years of 0,04 liter/vkm).

Indicator 3 / *Vehicle Fuel Efficiency – BAU*

	2011	**2012**
Energy content of fuel (MJ/kg)	45.862	45.862
Fuel density (kg/l)	0.8415	0.8415
Fuel consumption for 10 buses (litres)	11'918	11'200
Total vehicle- km (mileage) for 10 buses (km)	29'469	28'726
Energy content of fuel consumed by 10 buses (MJ)	459'947	432'248
Vehicle Fuel Efficiency (MJ/vkm)	15.61	15.05

This indicator, as it is defined, represents the energy consumption per unit of activity which means that we get efficiency if this indicator is less, i.e. we have lower fuel consumption per unit of activity or use a lower amount of energy to perform the same activity. Efficiency means energy saving or, in our case, fuel saving.

In our BAU scenario the differences between the fuel efficiency per vkm in 2011 and 2012 are insignificant and show a stable situation which is expected in the case of the constant activity that takes place under the same conditions.

Indicators 8,9,10 Emissions -BAU

Average values of emissions measured for buses running with standard diesel oil (B5)	***CO (ppm)***	***CO2 (%)***	***NO_x(ppm)***
	970.64	1.78	84.30

	2011	**2012**
Engine speed (rot/min)	1200	1200
A/Fst (Stoichiometric ratio air)	14.42	14.42
Fuel consumption per unit of activity (l/vkm	0.404	0.390
CO - Specific emissions ex-ante g/vkm	46.72	45.04
CO2 - Specific emissions ex-ante g/vkm	1'345.27	1'296.96
NO_x- Specific emissions ex-ante g/vkm	6.20	5.98

<u>General comments on the emissions indicators:</u>

Emissions have a slight downward trend and this is normally given that the amount of fuel per unit of activity decreased slightly in 2012 compared with 2011. Without any intervention on fuel quality, fuel type, adoption of retrofitting technologies or new buses, the emissions will be more or less dictated by the amount of fuel consumed (they are a result of the quantity of the fuel burned) and will follow only the fuel consumed trend.

C2 Measure results

This measure was demonstrated in 2012 for a short period of time (2 weeks) due to the dificulties in acquiring the biodiesel needed for running of 10 buses for a long period of time.

During this period the 10 buses prepared with specific filters operated with biodiesel blend B20 (20%). They were carefully monitored and all the data refering to their activity were recorded for each bus under observation.

The ex-post evaluation ("after") provide data referring only to this period.

The values of ex-post indicators are listed in the table below:

Indicator number	***Indicator name***	***Unit of measurement***	***Indicator value***
Indicator 2	*Average Operating costs*	EURO/vkm	0.396
Indicator 3	*Vehicle Fuel Efficiency*	MJ/vkm	14.34
Indicator 8	*CO2 emissions*	g/vkm	1'225.38
Indicator 9	*CO emissions*	g/vkm	40.76
Indicator 10	NO_x *emissions*	g/vkm	7.17

The calculation sheets for ex-post indicators are reported in Annex 5 while the data used for calculating the indicators are presented in the tables bellow:

Indicator 2 - ***Average operating costs ex-post (EURO/vkm)***

Operational costs for 10 buses (EURO)	3'783
Total vehicle- km (mileage) for 10 buses (km)	9'555
Price (EURO/litre)	1.02
Fuel consumption per unit of activity (l/vkm)	0.387
Average Operating costs – ex-post (EURO/vkm)	**0.396**

Indicator 3 ***Vehicle Fuel Efficiency ex-post (MJ/vkm)***

Energy content of fuel (MJ/kg)	45'245
Fuel density (kg/l)	0.819

Fuel consumption for 10 buses (litres)	3'697
Total vehicle- km (mileage) for 10 buses (km)	9'555
Energy content of fuel consumed by 10 buses (MJ)	136'995
Vehicle Fuel Efficiency (MJ/vkm)	**14.34**

Indicators 8,9,10 Emissions ex-post (g/vkm)

Emissions measured at the tailpipe depend on the fuel type and the engine working parameters when the measurements are made.

Average values of emissions measured for buses running with biodiesel fuel B20	***CO (ppm)***	***CO2 (%)***	***NO_x(ppm)***
	852.76	**1.63**	**98.23**

Engine speed (rot/min)	1'200
A/Fst (Stoichiometric ratio air)	14.09
Fuel consumption per unit of activity (l/vkm	0.387
CO - Specific emissions ex-ante g/vkm	40.76
CO2 - Specific emissions ex-ante g/vkm	1'225.38
NO_x- Specific emissions ex-ante g/vkm	7.17

C2.1 Economy

Table C2.1.1 – Economic Indicators values

Indicator	**Before (date)**	**B-a-U (date)**	**After (date)**	**Difference: After –Before**	**Difference: After – B-a-U**
Indicator 2 / *Average Operating costs (€/vkm)*	0.401 (2011)	0.401 (2011)			
		0.402 (2012)	0.396 (2012)	-0.005	-0.006
Differences (%)				-1.32%	-1.56%

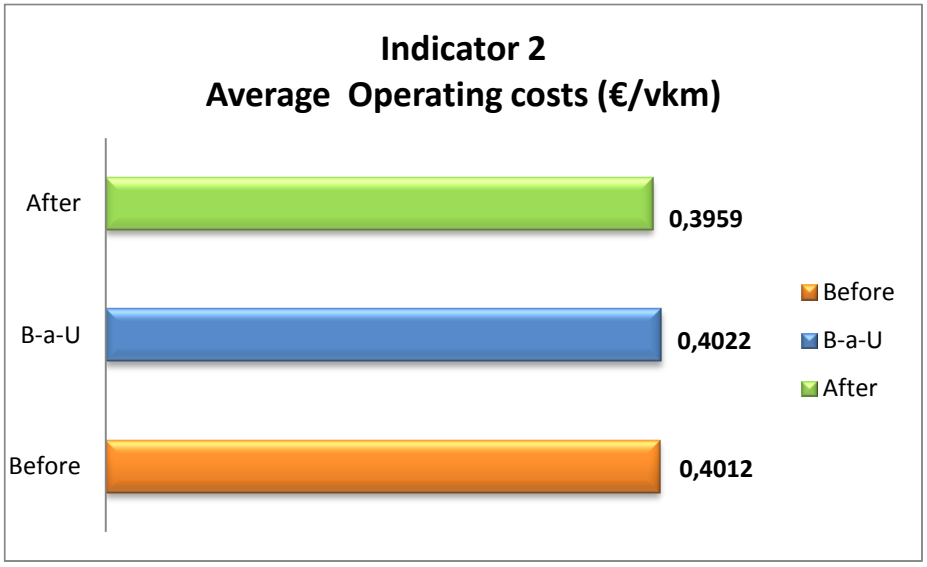


Figure 9 – Average operating costs indicator values

As expected the total costs of the new technology based on biodiesel B20 reported to the unit of activity is lower (0.396 EURO/vkm) than the current technology based on the use of traditional diesel (0.402 EURO/vkm), even if the difference is not so huge. This indicator shows therefore a positive result with respect to the idea of introducing biodiesel in the public transport fleet.

The PT Company RAT expressed its aim to continue the experimentation on a large basis in order to fully evaluate the possibility to use this fuel almost for the oldest part of the fleet. Then, for the new buses they are going to impose in the purchase specifications the use of this fuel.

C2.2 Energy

Table C2.2.1 – Energy Indicators values

Indicator	Before (date)	B-a-U (date)	After (date)	Difference: After –Before	Difference: After – B-a-U
Indicator 3 /*Vehicle Fuel Efficiency (MJ/vkm)*	15.61 (2011)	15.61 (2011)			
		15.05 (2012)	14.43 (2012)	-1.27	-0.71
Differences (%)				-8.14%	-4.72%

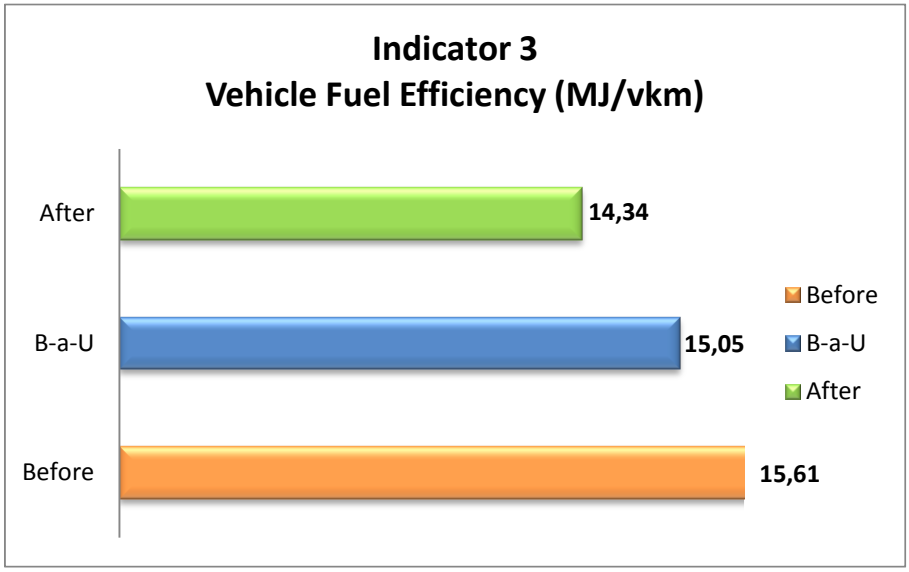


Figure 10 – Vehicle Fuel Efficiency indicator values

Concerning the vehicle fuel efficiency – given the lower energy content of B20 than diesel fuel – it was expected that by using biodiesel B20, this indicator would have had higher values and so been less efficient than the ex-ante situation or BAU situation in 2012. Consequently, it would have expected to face a higher fuel consumption in respect to the same level of service provided.

Contrary to expectations, during the demonstration with B20 on 10 buses the energy efficiency was better than the case of using diesel fuel on the same buses. This "anomaly" could be explained by the fact that the monitoring period was very short and not all the circumstances normally occurring during an annual activity have been encountered.

C2.3 Environment

Table C2.3.1 – Environmental Indicators values

Indicator	Before (date)	B-a-U (date)	After (date)	Difference: After –Before	Difference: After – B-a-U
Indicator 8 / *CO2 emissions /vkm)*	1345.27 (2011)	1345.27 (2011)			
		1296.96 (2012)	1225,38 (2012)	-119.89	-71.58
Differences (%)				-8.91%	-5.52%
Indicator 9 / *CO emissions*	46.72	46.72			

(g/vkm)	(2011)	(2011)			
		45.04 (2012)	40.76 (2012)	-5.96	-4.28
Differences (%)				-12.76%	-9.51%
Indicator 10 / *NO_x emissions (g/vkm)*	6.20 (2011)	6.20 (2011)			
		5.98 (2012)	7.17 (2012)	0.97	1.20
Differences (%)				15.71%	20.02%

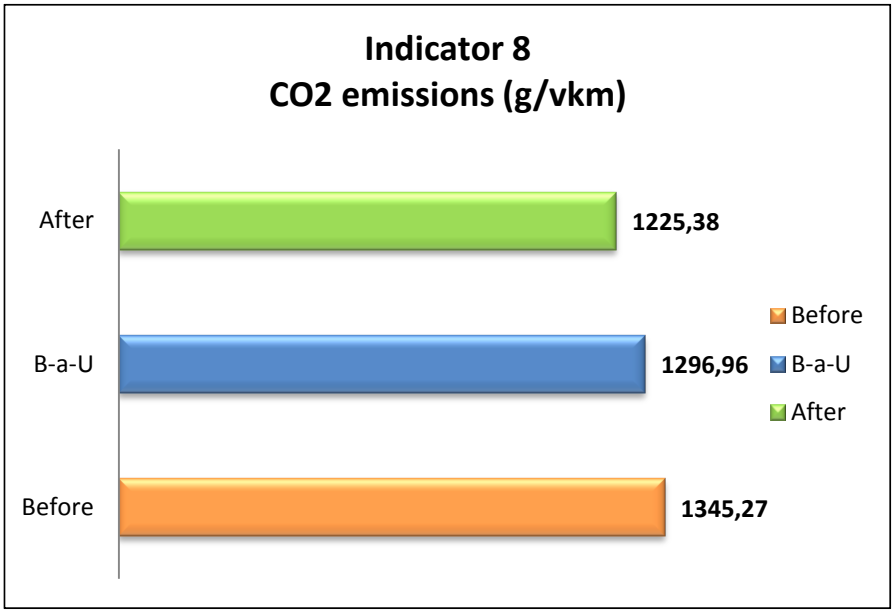


Figure 11 – CO2 Emissions indicator values

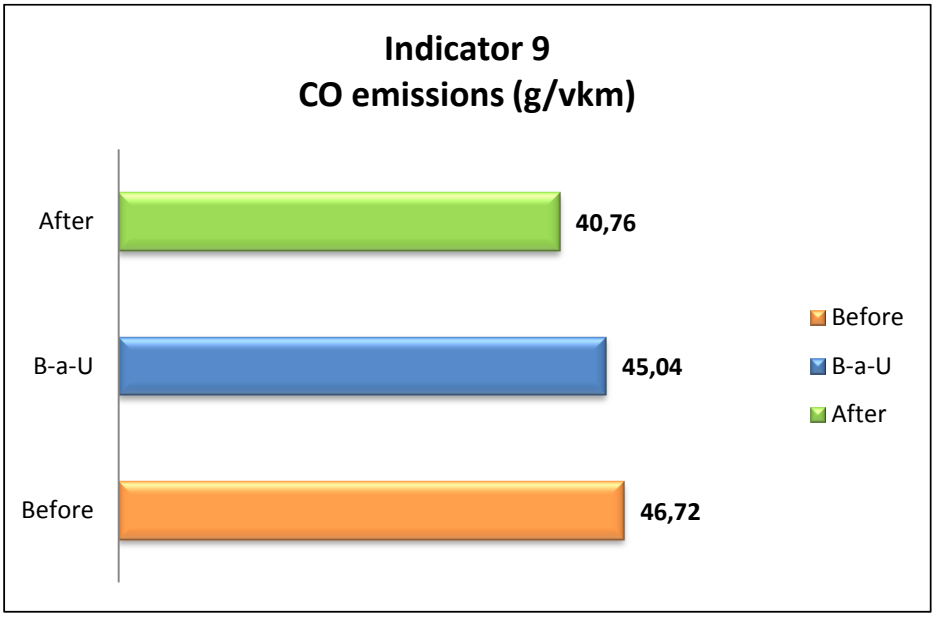


Figure 12 – CO Emissions indicator values

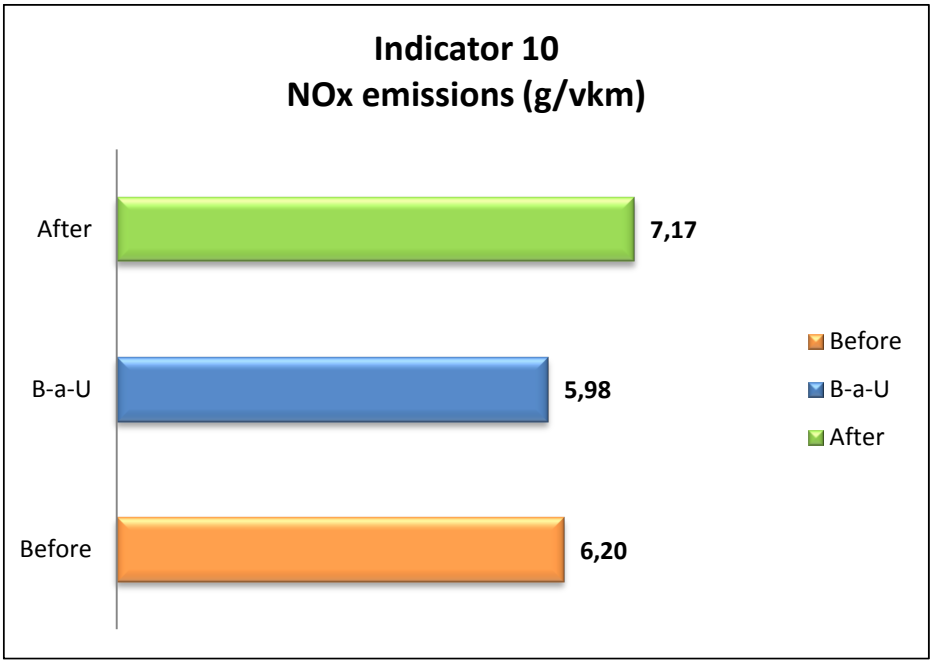


Figure 13 – NOx Emissions Indicators values

As it was expected, the CO_2 emissions decreased; that's because B20 has a lower carbon content. Biodiesel also contains in its composition (formula) oxygen which contributes to a better combustion, so less CO.

In terms of NO_x emissions, different sources have been consulted to understand whether or not it is normally to have a growth when using B20. Several studies on this topic produced different outcomes. For example, EPA and the National Renewable Energy Laboratory (NREL) in a study of 2006 stated that B20 has no net impact on NO_x[6]. Other sources state that NO_x emissions are higher for biodiesel but can be significantly reduced depending on engine operating conditions (e.g. injection time, engine temperature)[7].

There is, however, a general consensus regarding the fact that biodiesel increases NO_x emissions depending on engine type, age, concentration, and combustion conditions (temperature, time of injection).

Through MODERN project it has been demonstrated that the introduction of biodiesel fuel leads to the reduction of emissions with 2%, target that was achieved.

C3 Achievement of quantifiable targets and objectives

No.	Target	Rating
1	To introduce in the demonstration program 10 buses belonging to the Public Transport Company; buses were **updated with special devices in order to be able to use biodiesel fuel up to 20%**. Based on the tests conducted it has been decided that the 10 buses will run with 20% biodiesel blend.	**
2	**Decreasing of the emissions level up to 2%** for buses operating with mixture of biodiesel in conventional diesel fuel. The target was exceeded and a reduction of 8.93% has been achieved.	***
NA = Not Assessed	**O = Not Achieved * = Substantially achieved (at least 50%)**	
**** = Achieved in full**	**** = Exceeded**	

C4 Up-scaling of results

Since the results achieved seem to be very promising, RAT is going to take into consideration the hypothesis to introduce the 20% blend to the all fleet. This would also allow to have a decrease in fuel thefts that now happen in the company depots.

[6] http://www.seco.cpa.state.tx.us/re_biodiesel-air.htm

[7] University of Illinois, Combustion and Emissions Characteristics of Biodiesel Fuel, Alan C. Hansen, Department of Agricultural and Biological Engineering, University of Illinois, CABER Seminar May 5, 2008, http://bioenergy.illinois.edu/education/08seminars/080505_hansen.pdf

C5 Appraisal of evaluation approach

The evaluation process of the measure followed the POINTER guideline with some specific approaches when no recommended tools for evaluation were available. For the measure impact assessment a set of indicators were included in the evaluation plan at the beginning of the project.

These indicators were modified as we understood better which elements highlight the best the socio-economic impact of the measure.

The evaluation activity was generally a difficult one for at least two reasons:

- Technical obstacles (old/used buses) and the lack of suppliers of biodiesel on the market have led to changing of the measure objectives and caused delays in implementation and evaluation involved in
- Difficulties in terms of obtaining in due time data to calculate indicators (especially emissions data)

Generally, the problems in the measure evaluation ranged from the data provision, methods for measurement or data processing to the large number of variables that influence the impact and that cannot be controlled. The last it seems to be maybe the most misleading in terms of accuracy of impact assessment considering the global economic recession which affected a lot of activities and a lot of market elements (prices, production, exchange rate, etc.).

An example is the fuel prices: be it diesel or biodiesel this is determined by economic policies and is not related to the actual cost of the production. Although the price of biodiesel production is lower than that of fossil fuels, the current market price is very close to that of diesel fuel making it unprofitable for a transport company if we put it in balance the deficits which means more fuel consumption in case of biodiesel (theoretically speaking).

Another example is the CO2 emissions that are undoubtedly lower for biodiesel but recent research works have shown that production of biodiesel implies higher CO2 emissions than for oil refining. By using biodiesel the air quality is considerably improving in cities but at the global level it might be affected in the negative way.

The emissions measurement for on road vehicles is not a simple one and is based on a lot of standards. The continuous measurement of emissions during the operation of the vehicles (on road vehicles) is not an usual one and is practiced only for specific reasons or for researches.

The fact that we were able to measure these emissions and use a calculation method to obtain emissions per unit of activity is a plus for the measure evaluation and certainly it should not be changed. What should be improved is the data collection process: emissions measured in different conditions of temperature and on different types of buses as age and as brand.

What should be changed: the communication between partners, with measure leader and the most important the communication with the top management of the local partners so that to involve them both in the implementation and evaluation activities.

Another weakness in the evaluation process was the activity of data collection within RAT (public transport company). This collection system was improved in the last years but is still slow and not able to provide quickly the requested data or specific reports.

C6 Summary of evaluation results

The key results are as follows:

- **Key result 1 – Average operating costs** –as it was expected, given that the cost of the biodiesel is lower than the one of the fossil fuel, the operating costs decreased with 1.32% after the implementation of the measure. It must be stated that in the operating costs' structure, several elements are included, but the element that contributes mostly to the operating costs' variation is the price of fuels; the fuel consumption per unit of activity in case of diesel oil and B20 are very closed. The replacement of a part of traditional fuel with biodiesel, in our case 20%, produces modifications over this indicator as a consequence of different costs of fuels. Because the cost of fuels is determined by the economic policies, this indicator might be favourable or unfavourable to the CIVITAS intervention. Given a stable market, maturity and fluency in using biodiesel fuels sustained and encouraged by the national policies, this indicator is definitely favourable to CIVITAS intervention.
- **Key result 2 – Vehicle fuel efficiency** – It is well-known the fact that biodiesel has a lower energy content compared to the traditional fuel and this deficiency is compensated by a larger consumption of fuel. Contrary to expectations and theoretical considerations, the ex-post results showed a better energy efficiency when using B20 (14.43 MJ /vkm) than with regular diesel fuel (15.61 MJ/vkm). This result reflects actually a situation limited to a short period of data collection therefore, to substantiate the results these should be based on a longer period of monitoring. In the analysis of this indicator it is also important to have a balance between this indicator and the one regarding the costs.
- **Key result 3 – CO emissions** – the results of the evaluation of this indicator show a reduction of its level of 12.76% through the implementation of the measure, thing that indicates a better fuel combustion.
- **Key result 4 – CO2 emissions** – it is remarkable the fact that by using a mix fuel with 20% biodiesel, the CO2 emissions become reduced with 8.91%.
- **Key result 5 – NO_x emissions** – by using the biodiesel, the NO_x emissions register a substantial increase of 15.71%. It is known and accepted the fact that the NO_x emissions rise in this case, but the modern technologies offer solutions for the reduction of these emissions; the most used are the ones that use different additives to reduce NO_x emissions in biodiesel blends.

C7 Future activities relating to the measure

The wide application of the biodiesel depends actually only on political and economic reasons that are being found from global, down to local level. There are regulations / general recommendations and there are particular initiatives at cities level but to accelerate the adoption of biodiesel is needed to stimulate both producers and users, to develop a legislative framework focused on this area and to make much lobbying so that to overcome the operators' inertia.

The Municipality is a complex mechanism which can produce major changes in the quality of urban life under an effective management and coordination. As a lesson learned, for the future we need to do more for the city because the people are working with us and not against us.

The results of the evaluation are encouraging and should be widely disseminated and promoted as a starting point for future possible decisions in Craiova or in other cities. During the entire project we had some TV shows on local TVs in which we talked about the use of alternative biodiesels and the demonstrative results, together with other measures in CIVITAS MODERN.

Figure 14 – Capture from the video material related to the alternative fuels in Craiova

D. Process Evaluation Findings

D.0 Focused measure

x	0	No focused measure
	1	Most important reason
	2	Second most important reason
	3	Third most important reason

D.1 Deviations from the original plan

The deviations from the original plan comprised:

- **Deviation 1** – The shape of the measure by performing technological tests over a lower number of buses (10) instead of 88 and enlarging the use of biodiesel on 88 buses after the testing results. The measure's objectives and the technical content were not changed, only the budget was reduced because RAT requested budget only for the testing of 10 buses. The

upgrade of the results to the overall fleet in case of a successful experimental phase would be financed by own sources.

- **Deviation 2** – Testing 10 buses with biodiesel mixture up to 20% instead of up to 100% ; first tests were performed on 2 buses with different biodiesel mixtures up to 20%. The demonstration of the measure was limited to 10 buses without additional enlargement to other buses due to economic reasons (the forecasts for the following years in the biodiesel national market) and because the biodiesel needed for running the tests became available only on October 2012.

D.2 Barriers and drivers

D.2.1 Barriers

Preparation phase

- **Barrier 1– Institutional barrier:** In 2009 the top management of RAT (Public Transport Company of Craiova)was changed; this led to some disruptions in the decision-making process.
- **Barrier 2 – Technological barrier:** The bio-diesel availability depends on the market evolution and on the producers' policy in the circumstances of global economic crisis. Practically the biodiesel production is limited by market demand. Large-scale use of biodiesel mixtures should be supported by national policy and by an adequate infrastructure to feed a large number of vehicles.

Implementation phase

- **Barrier 1 – Institutional barrier:** Romanian government introduced taxes for bio diesel producers making unprofitable the commercialization activity
- **Barrier 2 –Institutional barrier:** Most of the regional biodiesel producers closed their activity due to a lot of reasons: lack of raw material, increasing of taxes, general economic crisis.
- **Barrier 3 –Problem related barrier:** The producers cannot ensure the quantity of fuel needed to constantly feed the public transport fleet so that the use of biofuel is limited to 10 buses.

Operation phase

- **Barrier 1 – Institutional barrier:** the decision of adopting biodiesel mixture for 10 buses was a difficult one and still produces concern since RAT fleet are old and any change in the operational procedures could lead to the removal of buses from the operational fleet with the consequent reduction of the transport capacity.

D.2.2 Drivers

Preparation phase

- **Driver 1 -** Not applicable

Implementation phase

- **Driver 1 –Institutional driver:** Support from the University of Craiova and Environment Agency (with equipment and experience) to perform the emissions measurements of buses working with biodiesel.

Operation phase

- **Driver 1** – Not applicable

D.2.3 Activities

Preparation phase

- **Activities 1– Institutional activity:** Measure leader, site coordinator and the manager of the project discussed with RAT's administration concerning to the importance of the measure's implementation offering examples of other European cities
- **Activities 2 –Involvement, communication activity:** The measure leader organized round tables with key stakeholders sharing different viewpoints. The measure's leader and the team organize face-to face interviews with potential providers of alternative fuel

- **Activities 3 –Organizational activity:** The implementation team learnt about alternative fuels by extra measure meeting or deep documentation and up-dated the knowledge about alternative fuels.
- **Activities 4 – Technological activity :** The measure leader and research team involved experts on alternative fuels to highlight its benefits

Implementation phase

- **Activities 1 – Planning activity:** Reducing the number of buses to the minimum necessary for testing so that the conclusion of the tests be relevant and at the same time the limitation of the biodiesel content at 20%
- **Activities 2 – Planning activity:** The market analyses on the availability of biodiesel fuel

Operation phase

- **Activities 1 – Involvement, communication activity:** To overcome the concerns about the introduction of biodiesel as alternative fuel on 10 demonstration buses, the tests' results and examples of other cities already using this alternative were presented within several meetings with management team of RAT.

D.3 Participation

D.3.1. Measure Partners

- **Measure partner 1 –IPA SA Craiova Subsidiary- leading partner** is a 47 year-old Romanian industrial R&D company and it is the Romanian national institute for research and development, engineering in energy, automation and IT, with a large experience in European projects in technology transfer and in information dissemination.

- **Measure partner 2 – RAT – Craiova Public Transport Company- principle participant** is the main public transport operator in the whole Oltenia region. In Craiova (320,000 inhabitants) it provides transport by trams, buses and micro-buses of their own (250 vehicles), transporting 65 million travellers every year.
- **Measure partner 3 – LCM – The Local Council of Craiova Municipality- occasional participant** (Primaria Municipiului Craiova) was organized and functions according to Law No. 215/2001 regarding the Local Public Administration with the subsequent modification and completion.

D.3.2 Stakeholders

- **Faculty of Electrical Engineering of Craiova–**tests of the buses running with bio-diesel in different percentages blended (5%,10%,15%,20%) and for three different engine RPM for emissions of CO, CO2, SO2, NO_x are performed in the laboratory of this faculty.
- **Craiova Environment Agency** – process of the data provided following the tests.
- **Orfescu SRL Company** – supplier of equipment needed for the buses in order to run with bio-diesel.
- **Romanian Auto Registry** ─ checking technical condition of the buses in order to run with the bio-diesel in safety conditions.
- **Bio-diesel suppliers from the region.**

D.4Recommendations

D.4.1 Recommendations: measure replication

- **Recommendation 1 –Legal framework**

Currently the public transport operators have difficulties in getting biofuel in a certain concentration from recognized suppliers (those who respect and certify the quality of the fuel according to the current standards) at a competitive price. Based on these reasons it is important that biodiesel fuel use be more in the government attention. Incentive legislation should be developed in order to speed up the introduction of biodiesel based fuels as a clean solution to the pollution in the city. The national legislation should be enforced both on the production direction and on the use direction.

- **Recommendation 2 –Biodiesel supply network**

Having a feeding network of biodiesel fuel in various concentrations with specific additives to control viscosity and the NO_x emissions, is a prerequisite for widespread biodiesel introducing in the public transportation.

D.4.2 Recommendations: process (related to barrier-, driver- and action fields)

Recommendation 1 –Biodiesel a solution for public transport

The measure has demonstrated a real benefit for RAT in terms of operational costs and for the quality of life in the city due to the emissions' reduction. It should add also that there are cities that applied B20 at buses for over 10 years and after this long-running period they found no operational problems associated with biodiesel and, even more the injector life increased and decreased the need for maintenance in this period[8].

Based on the results of evaluation, on the experience of other cities and considering the technical state of the RAT's buses we would recommend the introduction of B20 as current fuel in parallel with a careful monitoring of buses.

Recommendation 2 –Shift fuels

Even if the biodiesel market is not constant in terms of supply (not provide enough biodiesel), B20 and diesel fuel can be used alternatively without any technical intervention or investment. B20 becomes ineffective only if its price leads to the increasing of the company's operating costs.

[8] http://www.rimlifegreentech.com/biodiesel_current_usage.htm

Annexes

Annex 1 – Emissions measurements

Annex 2 – Biodiesel data sheets

Annex 3 – Calculation sheets for ex-ante evaluation

Annex 4 – Calculation sheets for BAU evaluation

Annex 5 – Calculation sheets for ex-post evaluation

Annex 1: Emissions measurements

Engine speed: 1150-1200 rot/min

Standard diesel fuel (B5)							
	Bus 1- DJ-03ROA				***Bus 2 - DJ-03NTL***		
	CO	*CO2*	*NOx*		*CO*	*CO2*	*NOx*
	ppm	*%*	*ppm*		*ppm*	*%*	*ppm*
1	1006.33	1.95	99.10		899.33	1.50	70.00
2	1010.00	1.95	100.50		893.67	1.51	69.00
3	999.33	1.94	100.50		901.00	1.66	70.67
4	1126.33	1.92	100.33		890.33	1.72	73.33
5	1147.33	1.95	99.00		852.00	1.56	68.00
6	1135.33	1.95	98.33		865.33	1.55	68.00
7	1122.00	1.98	98.00		885.67	1.68	68.33
8	1112.00	1.98	98.33		877.67	1.62	65.33
9	1107.33	1.99	99.33		865.33	1.65	66.67
10	1086.67	2.00	99.33		877.00	1.66	68.33
11	1091.67	2.00	99.33		849.33	1.61	66.67
12	1084.67	2.00	100.00		841.67	1.57	66.67
13	1074.00	1.93	100.33		874.00	1.68	69.00
14	1068.67	1.94	101.00		882.33	1.74	70.67
15	1074.33	1.93	100.33		849.00	1.69	71.67
16	1065.33	1.92	100.67		838.33	1.64	71.33
17	1060.67	1.92	101.00		827.67	1.56	67.67
18	1059.00	1.91	101.33		824.33	1.56	67.33
19	1056.67	1.91	101.00		822.67	1.44	65.67
20	1057.00	1.89	100.00		864.33	1.61	70.00
Average values	**1077.23**	**1.95**	**99.89**		**864.05**	**1.61**	**68.72**

Standard diesel fuel B5			
Engine speed 1200 rot/min	*CO*	*CO2*	*NOx*
	ppm	*%*	*ppm*
Average values bus 1	1077.23	1.95	99.89
Average values bus 2	864.05	1.61	68.72
Average values	**970.64**	**1.78**	**84.30**
	ppm	*ppm*	*ppm*
Average values (ppm)	**970.64**	**17787.33**	**84.30**

Measure title: **Alternative fuels in Craiova**

City: **Craiova** *Project:* **MODERN** *Measure number:* **01.02**

Emissions measurements

Engine speed: 1150-1200 rot/min

Biodiesel fuel (B20)

	Bus 1- DJ-03ROA			*Bus 2 - DJ-03NTL*		
	CO	*CO2*	*NOx*	*CO*	*CO2*	*NOx*
	ppm	*%*	*ppm*	*ppm*	*%*	*ppm*
1	880.00	1.64	105.00	812.00	1.43	80.67
2	974.00	1.84	105.20	791.00	1.42	82.00
3	868.00	1.74	105.10	787.00	1.41	80.00
4	835.00	1.79	105.40	783.00	1.45	80.67
5	853.00	1.81	105.80	831.33	1.43	81.00
6	947.00	1.88	107.60	826.00	1.39	81.00
7	954.00	1.90	114.30	788.00	1.40	81.33
8	955.00	1.91	114.30	785.00	1.41	81.00
9	905.00	1.82	114.10	783.00	1.41	81.00
10	910.00	1.91	117.10	777.00	1.41	81.33
11	910.00	1.91	117.10	780.00	1.40	83.33
12	917.00	1.88	116.60	774.00	1.40	82.00
13	913.00	1.89	117.60	779.00	1.43	82.00
14	954.00	1.88	117.60	777.00	1.41	82.00
15	960.00	1.86	117.40	772.00	1.44	82.67
16	929.00	1.87	120.00	776.00	1.43	82.33
17	948.00	1.87	123.60	763.00	1.40	83.00
18	940.00	1.86	123.80	769.00	1.41	82.00
19	944.00	1.87	123.20	761.00	1.41	82.67
20	935.00	1.83	123.70	765.00	1.43	82.67
Average values	**921.55**	**1.85**	**114.73**	**783.97**	**1.42**	**81.73**

Biodiesel fuel B20

Engine speed	*CO*	*CO2*	*NOx*
1200 rot/min	*ppm*	*%*	*ppm*
Average values bus 1	921.55	1.85	114.73
Average values bus 2	783.97	1.42	81.73
Average values	**852.76**	**1.63**	**98.23**
	ppm	*ppm*	*ppm*
Average values (ppm)	**852.76**	**16315.75**	**98.23**

Measure title: **Alternative fuels in Craiova**

City: **Craiova** *Project:* **MODERN** *Measure number:* **01.02**

Annex 2: Biodiesel data sheets

Annex 2

Biodiesel data sheets

Unitatea RAT CRAIOVA
Autocoloana Sectia 1
– BIODIESEL –

CENTRALIZATORUL
realizărilor de consum extrase din F.A.Z.
Pe luna 04.10.2012 – 15.10.2012

Nr. crt.	Numele şi prenumele şoferului	Marca şi tipul autovehi	Nr. înmatriculare	Parcursul realizat (km) Efectiv	Echivalent	Consumul de combustibil (litri) Rest rezervor Inceput de lunii	Alimentat lichid	Consum efectiv B.C.F.	Restituit lichid	Rest rezervor sfârşit de lunii	Consum efectiv	Consum normat	Diferenţe ec. (-) dep. (+)	Consum de uleiuri (litri) Efectiv	Normat	Diferenţe ec. (-) dep. (+)
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	DUMITRU MIRCEA	31,25% MAN NL 202	[illegible]	302,4	334,1	230	126	=	=	215	141	122	+19			
2	BARBUCEANU VALI	34% BREDA BUS	[illegible]	752,3	943,1	266	341	=	=	215	326	328	-2			
3	BUZARU ION	33,3% MERCEDES	1054	931,9	1141,5	212	445	=	=	234	426	425	-1			
4	CEICELARU FLORIN	31% UDM R 112	400	1284,7	1667,6	176	576	=	=	220	531	532	+1			
5	UNCHES VALENTIN	31% UDM R 112	403	1402	1648	171	534	=	=	215	493	529	+36			
6	BADULESCU ILIE	31% UDM R 112	410	1566	1875	180	559	=	=	220	559	591	-32			
7	MITEA GABRIEL	31% UDM R 112	413	1435	1729	220	405	=	=	220	405	418	-13			
8	TOMA DUMITRU	31% UDM R 112	415	891	1009	180	383	=	=	220	343	320	+23			
9	CEPRA FLORIAN	31% UDM R 112	416	571	685	138	258	=	=	200	216	216	✓			
10	GHITA IONUT	31% UDM R 112	417	665	798	176	347	=	=	220	263	253	+10			
				9558							3647					

TEHNICIANU
BADIU VASILICA
MARIA

FISA ACTIVITATII ZILNICE PENTRU MÁSINA BREDA BUS cu numarul de inventar 458, sectia: 1 in perioada 05.10.2012 - 15.10.2012

Pag. 1

Ziua	Nr.foale	Sofer	KM Efectivi	KM Echiv.	Timp efectiv Circul.	Timp efectiv Station.	Timp efectiv Total	Timp normat Circul.	Timp normat Station.	Timp normat Total	Trafic aglom.	Porniri motor	Combustibil Alim.	Combustibil Restit	Combustibil Consum normat
5	41758	1.BARBUCEANU VALENTIN	52.40	65.52	02:50	00:20	03:10	02:35		02:35			0		22.70
5	41758	2.BARBUCEANU VALENTIN	34.90	43.64	03:35	00:05	03:40	01:40		01:40		266	54		15.26
6	42411	1.BARBUCEANU VALENTIN	125.00	156.26	07:30	00:15	07:45	13:30		13:30			0		53.98
7	42459	1.BARBUCEANU VALENTIN	161.40	201.80	08:20	02:00	10:20	08:50		08:50			0		69.46
8	41777	2.BARBUCEANU VALENTIN	95.90	119.91	06:35	00:35	07:10	05:00		05:00	00: 5		135		41.95
9	42276	2.BARBUCEANU VALENTIN	98.70	123.41	06:45	00:40	07:25	05:05		05:05			42		42.81
10	42755	1.BARBUCEANU VALENTIN	22.40	28.01	02:40	00:00	02:40	01:05		01:05			59		9.95
10	42755	2.BARBUCEANU VALENTIN	35.80	44.76	03:25	00:15	03:40	01:40		01:40			0		15.64
TOTAL DECADA 1			626.50	783.31	41:40	04:10	45:50	39:25		39:25	00: 5		290		271.75
11	42773	1.BARBUCEANU VALENTIN	43.40	54.27	02:20	00:40	03:00	02:05		02:05			0		18.88
11	42773	2.BARBUCEANU VALENTIN	35.80	44.76	03:25	00:15	03:40	01:40		01:40			0		15.64
12	42103	1.BARBUCEANU VALENTIN	22.00	27.51	02:30	00:00	02:30	01:00		01:00			55		9.78
12	42103	2.BARBUCEANU VALENTIN	35.80	44.76	03:45	00:15	04:00	01:40		01:40			0		15.64
13		*LIBER			00:00	00:00	00:00	00:00		00:00			0		0.00
14		*LIBER			00:00	00:00	00:00	00:00		00:00			0		0.00
15	42114	1.BARBUCEANU MARIN	43.20	54.02	02:20	00:55	03:15	02:20		02:20			0		18.79
15	42114	2.BARBUCEANU MARIN	36.60	45.76	03:35	00:05	03:40	01:45		01:45			35		15.98
TOTAL DECADA 2			216.80	271.08	17:55	02:10	20:05	10:30		10:30			90		94.71
TOTAL PERIOADA			843.30	1054.39	59:35	06:20	65:55	49:55		49:55	00: 5		380		366.46

CONSUM COMBUSTIBIL

RRi	Alimentat	Normat	Restituit	Rest calculat	RRf	Dif	Consum efectiv
286.00	380	366.46	0.000	299.54	0	299.54	666.00
	BCF						
	0						

843,3
943,11

Zile lunii	Zile efective	Lipsa plese	Lipsa mater	Lipsa anvel	Rep. curente	Rep. tehn2	Rep. capitale	Rodaj	Libere	Nemot	CO	CM	CFS	Altele
15	13	0	0	0	0	0	0	0	2					0

Numar de zile si imobilizari pe cauze

	Parcurs realizat (km) de la introducerea in exploatare: KM efectivi	KM echivalenti	KM. ECHIVALENTI: rt1	rt2	rc	rk	anv	ulei	motor
Inceput luna	117571.20	146841.89							
Luna curenta	843.30	1054.39							
Total	118414.50	147896.28							

BABOLEA DANIELA-FLORENTINA

Measure title: **Alternative fuels in Craiova**

City: **Craiova** *Project:* **MODERN** *Measure number:* **01.02**

FISA ACTIVITATII ZILNICE PENTRU MASINA MERCEDES cu numarul de inventar 507, sectia: 1 in perioada 04.10.2012 - 15.10.2012

Pag. 1

Ziua	Nr.foale	Sofer	KM Efectivi	KM Echiv.	Timp efectiv Circul.	Timp efectiv Station.	Timp efectiv Total	Timp normat Circul.	Timp normat Station.	Timp normat Total	Trafic aglom.	Porniri motor	Combustibil Alim.	Combustibil Restit	Combustibil Consum normat
4	42210	1.ZAMFIR TITI - LUCIAN	62.90	78.65	07:05	00:55	08:00	03:25		03:25			65		28.26
4	42210	2.BUZATU ION	62.30	77.90	04:17	00:48	05:05	03:10		03:10	00:27		53		29.82
5	42310	1.ZAMFIR TITI - LUCIAN	43.20	54.02	02:15	00:35	02:50	02:20		02:20			50		19.57
5	42310	2.BUZATU ION	175.90	219.91	05:40	01:40	07:20	06:30		06:30			10		78.29
6		*LIBER			00:00	00:00	00:00	00:00		00:00			0		0.00
7		*LIBER			00:00	00:00	00:00	00:00		00:00			0		0.00
8	42809	1.BUZATU ION	62.90	78.65	03:26	01:14	04:40	03:25		03:25			12		28.28
8	42809	2.ZAMFIR TITI - LUCIAN	62.90	78.65	03:25	00:50	04:15	03:25		03:25	00:5		64		28.62
9	42929	1.BUZATU ION	82.60	103.28	04:46	01:14	06:00	04:30		04:30			10		37.00
9	42929	2.ZAMFIR TITI - LUCIAN	23.70	29.63	07:15	00:45	08:00	01:05		01:05			56		10.93
10	42706	1.BUZATU ION	82.60	103.28	04:22	01:43	06:05	04:30		04:30			8		37.00
10	42706	2.ZAMFIR TITI - LUCIAN	82.60	103.28	04:34	00:51	05:25	04:30		04:30	00:6		45		37.40
TOTAL DECADA 1			741.60	927.25	47:05	10:35	57:40	36:50		36:50	00:38		373		335.19
11	42610	1.BUZATU ION	82.60	103.28	04:31	00:59	05:30	04:30		04:30			11		37.00
11	42610	2.ZAMFIR TITI - LUCIAN	42.10	52.64	02:10	01:25	03:35	02:05		02:05			66		19.08
12	42509	1.BUZATU ION	82.60	103.28	04:15	01:20	05:35	04:30		04:30			9		37.45
13	42139	1.BUZATU ION	26.60	33.26	02:05	00:00	02:05	01:13		01:13			0		12.22
13	42139	2.BUZATU ION	26.80	33.50	01:15	00:25	01:40	01:15		01:15			0		12.30
14		*LIBER			00:00	00:00	00:00	00:00		00:00			0		0.00
15	42010	2.BUZATU ION	102.30	127.91	05:50	00:45	06:35	05:35		05:35	00:15		8		47.17
TOTAL DECADA 2			363.00	453.87	20:06	04:54	25:00	19:08		19:08	00:15		68		165.22
TOTAL PERIOADA			1104.60	1381.12	67:11	15:29	82:40	55:58		55:58	00:53		441		500.41

CONSUM COMBUSTIBIL

RRi	Alimentat	Normat	Restituit	Rest calculat	RRf	Dif	Consum efectiv
170.00	468	500.41	25.000	112.59	0	112.59	613.00
	BCF 0						

Numar de zile si imobilizari pe cauze

Zile luna	Zile efective	Lipsa plese	Lipsa mater	Lipsa anvel	Rep. curente	Rep.tehn2	Rep. capitale	Rodaj	Libere	Nemot.	CO	CM	CFS	Altele
15	12	0	0	0	0	0	0	0	3					0

	Parcurs realizat (km) de la introducerea in exploatare: KM efectivi	KM echivalenti	KM. ECHIVALENTI: rt1	rt2	ro	rk	anv	utel	motor
Inceput luna	896480.40	1118955.3							
Luna curenta	1104.60	1381.12							
Total	897585.00	1120336.4							

BABOLEA DANIELA-FLORENTINA

FISA ACTIVITATII ZILNICE PENTRU MASINA ROMAN UDM 112 cu numarul de inventar 400, sectia: 1 in perioada 04.10.2012 - 15.10.2012

Pag. 1

Ziua	Nr.foale	Sofer	KM Efectivi	KM Echiv.	Timp efectiv Circul.	Timp efectiv Station.	Timp efectiv Total	Timp normat Circul.	Timp normat Station.	Timp normat Total	Trafic aglom.	Porniri motor	Combustibil Alim.	Combustibil Restit	Combustibil Consum normat
4	42232	1.CERCELARU FLORIAN	86.70	104.04	07:18	00:32	07:50	07:15		07:15			60		32.64
4	42232	2.JEGA MARIN	87.30	104.76	06:48	01:07	07:55	06:45		06:45			44		32.66
5	42333	1.CERCELARU FLORIAN	92.90	111.48	07:24	00:42	08:06	07:15		07:15			0		34.95
5	42333	2.CERCELARU FLORIAN	68.70	82.44	05:10	00:44	05:54	04:45		04:45			61		25.94
6	42435	1.CERCELARU FLORIAN	87.70	105.24	07:05	00:25	07:30	07:15		07:15			0		33.01
6	42435	2.JEGA MARIN	114.90	137.88	08:45	00:00	08:45	09:15		09:15			0		43.13
7	42483	1.JEGA MARIN	102.10	122.52	07:45	00:15	08:00	08:15		08:15			0		38.37
7	42483	2.CERCELARU FLORIAN	76.50	91.80	05:45	00:00	05:45	06:15		06:15			0		28.85
8	42940	2.CERCELARU FLORIAN	62.30	74.76	03:45	00:40	04:25	03:10		03:10	00:35		169		26.28
9	42952	1.JEGA MARIN	74.20	89.04	06:05	00:25	06:30	05:30		05:30			58		27.99
9	42952	2.CERCELARU FLORIAN	99.00	118.80	08:35	00:45	09:20	07:30		07:30			0		37.22
10	42731	1.JEGA MARIN	74.60	89.52	06:13	00:32	06:45	05:30		05:30			64		28.14
10	42731	2.CERCELARU FLORIAN	62.30	74.76	03:37	00:28	04:05	03:10		03:10	00:22		0		25.03
TOTAL DECADA 1			1089.20	1307.04	84:15	06:35	90:50	81:50		81:50	00:57		456		414.41
11	42632	1.JEGA MARIN	37.00	44.40	02:35	00:25	03:00	02:30		02:30			0		14.15
11	42632	2.CERCELARU FLORIAN	86.60	103.92	06:50	00:30	07:20	06:30		06:30			0		32.60
12	42538	1.JEGA MARIN	84.20	101.04	05:53	01:07	07:00	05:30		05:30			110		31.71
12	42538	2.CERCELARU FLORIAN	99.40	119.28	08:27	00:28	08:55	07:30		07:30			0		37.36
13		*LIBER			00:00	00:00	00:00	00:00		00:00			0		0.00
14		*LIBER			00:00	00:00	00:00	00:00		00:00			0		0.00
15	42046	1.CERCELARU FLORIAN	78.30	93.96	05:43	01:17	08:00	05:45		05:45			69		29.90
TOTAL DECADA 2			385.50	462.60	30:28	03:47	34:15	27:45		27:45			179		145.72
TOTAL PERIOADA			1474.70	1769.64	114:43	10:22	125:05	109:35		109:35	00:57		635		560.13

CONSUM COMBUSTIBIL

RRi	Alimentat	Normat	Restituit	Rest calculat	RRf	Dif	Consum efectiv
187.00	635	560.13	0.000	261.87	0	261.87	822.00
	BCF 0						

Numar de zile si imobilizari pe cauze

Zile luna	Zile efective	Lipsa plese	Lipsa mater	Lipsa anvel	Rep. curente	Rep.tehn2	Rep. capitale	Rodaj	Libere	Nemot.	CO	CM	CFS	Altele
15	13	0	0	0	0	0	0	0	2					0

	Parcurs realizat (km) de la introducerea in exploatare: KM efectivi	KM echivalenti	KM. ECHIVALENTI: rt1	rt2	ro	rk	anv	utel	motor
Inceput luna	659930.00	741386.00							
Luna curenta	1474.70	1769.64							
Total	660504.70	743155.64							

BABOLEA DANIELA-FLORENTINA

Measure title: **Alternative fuels in Craiova**

City: **Craiova** *Project:* **MODERN** *Measure number:* **01.02**

FISA ACTIVITATII ZILNICE PENTRU MASINA MAN NL 202 cu numarul de inventar 428, sectia: 1 in perioada 04.10.2012 - 15.10.2012

Pag. 1

Ziua	Nr.foaie	Sofer	KM Efectivi	KM Echiv.	Timp efectiv Circul.	Timp efectiv Station.	Timp efectiv Total	Timp normat Circul.	Timp normat Station.	Timp normat Total	Trafic aglom.	Porniri motor	Combustibil Alim.	Combustibil Restit	Combustibil Consum normat
4	42204	1.CIOBANU ILIUTA - VIOREL	43.20	54.02	07:40	02:35	10:15	02:20		02:20	00: 5		32		17.61
4	42204	2.DUMITRU AUREL	43.20	54.02	03:33	01:25	04:58	02:20		02:20		230	20		17.27
5	42304	1.DUMITRU AUREL	43.20	54.02	07:15	00:45	08:00	02:20		02:20			24		17.27
5	42304	2.DUMITRU AUREL	43.20	54.02	02:43	00:37	03:20	02:20		02:20			14		17.27
6		*LIBER			00:00	00:00	00:00	00:00		00:00			0		0.00
7		I:Alte cauze			00:00	00:00	00:00	00:00		00:00			0		0.00
8		*LIBER			00:00	00:00	00:00	00:00		00:00			0		0.00
9	42923	1.DUMITRU AUREL	43.20	54.02	07:23	00:37	08:00	02:20		02:20			46		17.66
10	42703	1.DUMITRU AUREL	43.20	54.02	02:24	00:46	03:10	02:20		02:20			2		17.27
10	42703	2.ZANOAGA STANCU	62.90	78.65	03:42	01:03	04:45	03:25		03:25	00: 7		20		25.44
TOTAL DECADA 1			322.10	402.77	34:40	07:48	42:28	17:25		17:25	00:12		158		129.79
11	42604	1.DUMITRU AUREL	23.50	29.39	07:03	00:57	08:00	01:15		01:15			0		9.58
11	42604	2.ZANOAGA STANCU			08:00	00:00	08:00	00:00		00:00			0		0.00
12		I:Alte cauze			00:00	00:00	00:00	00:00		00:00			0		0.00
13		*LIBER			00:00	00:00	00:00	00:00		00:00			0		0.00
14		I:Alte cauze			00:00	00:00	00:00	00:00		00:00			0		0.00
15		*LIBER			00:00	00:00	00:00	00:00		00:00			0		0.00
TOTAL DECADA 2			23.50	29.39	15:03	00:57	16:00	01:15		01:15			0		9.97
TOTAL PERIOADA			345.60	432.16	49:43	08:45	58:28	18:40		18:40	00:12		158		139.76

CONSUM COMBUSTBIL							
RRi	Alimentat	Normat	Restituit	Rest calculat	RRf	Dif	Consum efectiv
174.00	158	139.76	0.000	192.24	0	192.24	332.00
	BCF 0						

Numar de zile si imobilizari pe cauze														
Zile luna	Zile efective	Lipsa piese	Lipsa mater	Lipsa anvel	Rep. curente	Rep.tehn2	Rep. capitale	Rodaj	Libere	Nemot.	CO	CM	CFS	Altele
15	8	0	0	0	0	0	0	0	4					3

	Parcurs realizat (km) de la introducerea in exploatare		KM. ECHIVALENTI						
	KM efectivi	KM echivalenti	rt1	rt2	rc	rk	anv	ulei	motor
Inceput luna	918460.75	1143755.1							
Luna curenta	345.60	432.16							
Total	918806.35	1144187.2							

BABOLEA DANIELA-FLORENTINA

FISA ACTIVITATII ZILNICE PENTRU MASINA ROMAN UDM 112 cu numarul de inventar 410, sectia: 1 in perioada 04.10.2012 - 15.10.2012

Pag. 1

Ziua	Nr.foaie	Sofer	KM Efectivi	KM Echiv.	Timp efectiv Circul.	Timp efectiv Station.	Timp efectiv Total	Timp normat Circul.	Timp normat Station.	Timp normat Total	Trafic aglom.	Porniri motor	Combustibil Alim.	Combustibil Restit	Combustibil Consum normat
4	42234	1.BADULESCU ILIE	86.70	104.04	07:18	00:32	07:50	07:15		07:15			51		32.64
4	42234	2.STINGA IONUT	61.70	74.04	04:55	00:10	05:05	04:45		04:45			40		23.34
5	42335	1.BADULESCU ILIE	49.40	59.28	03:44	00:26	04:10	03:30		03:30			0		18.76
5	42335	2.STINGA IONUT	61.80	74.16	05:05	00:10	05:15	04:30		04:30			34		23.38
6	42382	1.BADULESCU ILIE	115.70	138.84	08:35	00:30	09:05	07:45		07:45			0		43.82
7	42916	2.BADULESCU ILIE	111.40	133.68	08:40	00:30	09:10	08:30		08:30			0		42.22
8	42841	1.STINGA IONUT	87.00	104.40	07:10	00:15	07:25	06:30		06:30			0		32.75
8	42841	2.BADULESCU ILIE	108.60	130.32	08:04	00:39	08:43	07:00		07:00			140		40.79
9	42953	1.STINGA IONUT	92.70	111.24	07:25	00:05	07:30	06:45		06:45			59		34.87
9	42953	2.BADULESCU ILIE	91.60	109.92	06:42	01:03	07:45	06:00		06:00			0		34.46
10	42733	1.STINGA IONUT	35.70	42.84	02:15	00:45	03:00	02:15		02:15			51		13.67
10	42733	2.BADULESCU ILIE	88.90	106.68	06:30	00:15	06:45	05:45		05:45			0		33.46
TOTAL DECADA 1			991.20	1189.44	76:23	05:20	81:43	70:30		70:30			375		374.16
11	42634	1.STINGA IONUT	81.70	98.04	07:30	00:20	07:50	06:15		06:15			0		30.78
11	42634	2.BADULESCU ILIE	114.10	136.92	08:50	00:35	09:25	07:45		07:45			0		42.83
12	42540	1.STINGA IONUT	86.50	103.80	07:15	00:30	07:45	06:45		06:45			90		32.57
12	42540	2.BADULESCU ILIE	96.60	115.92	07:16	00:29	07:45	07:00		07:00			0		36.32
13	42684	2.STINGA IONUT	111.40	133.68	08:35	00:00	08:35	08:30		08:30			0		42.22
14	42184	1.STINGA IONUT	86.60	103.92	06:20	00:10	06:30	06:30		06:30			0		32.99
15	42040	1.BADULESCU ILIE	84.70	101.64	05:45	02:05	07:50	05:20		05:20			185		31.90
15	42040	2.STINGA IONUT	90.80	108.96	07:30	01:05	08:35	06:00		06:00			0		34.17
TOTAL DECADA 2			752.40	902.88	59:01	05:14	64:15	54:05		54:05			275		283.78
TOTAL PERIOADA			1743.60	2092.32	135:24	10:34	145:58	124:35		124:35			650		657.94

CONSUM COMBUSTBIL							
RRi	Alimentat	Normat	Restituit	Rest calculat	RRf	Dif	Consum efectiv
165.00	650	657.94	0.000	157.06	0	157.06	815.00
	BCF 0						

Numar de zile si imobilizari pe cauze														
Zile luna	Zile efective	Lipsa piese	Lipsa mater	Lipsa anvel	Rep. curente	Rep.tehn2	Rep. capitale	Rodaj	Libere	Nemot.	CO	CM	CFS	Altele
15	15	0	0	0	0	0	0	0	0					

	Parcurs realizat (km) de la introducerea in exploatare		KM. ECHIVALENTI						
	KM efectivi	KM echivalenti	rt1	rt2	rc	rk	anv	ulei	motor
Inceput luna	483430.35	547493.81							
Luna curenta	1743.60	2092.32							
Total	485173.95	549586.13							

BABOLEA DANIELA-FLORENTINA

Measure title: **Alternative fuels in Craiova**

City: **Craiova** *Project:* **MODERN** *Measure number:* **01.02**

FISA ACTIVITATII ZILNICE PENTRU MASINA ROMAN UDM 112 cu numarul de inventar 403, sectia: 1 in perioada 04.10.2012 - 15.10.2012

Pag. 1

Ziua	Nr.foaie	Sofer	KM Efectivi	KM Echiv.	Timp efectiv Circul.	Timp efectiv Station.	Timp efectiv Total	Timp normat Circul.	Timp normat Station.	Timp normat Total	Trafic aglom.	Porniri motor	Combustibil Alim.	Combustibil Restit	Combustibil Consum normat
4	42233	1.URDES VALENTIN	93.30	111.96	07:19	00:36	07:55	07:15		07:15			66		35.10
4	42233	2.URDES MARIN-MARINEL	93.50	112.20	07:00	01:35	08:35	06:45		06:45			44		35.17
5	42334	1.URDES VALENTIN	43.90	52.68	02:58	00:17	03:15	03:05		03:05			35		16.72
5	42334	2.URDES MARIN-MARINEL	99.80	119.76	07:36	01:24	09:00	07:30		07:30			10		37.51
6		*LIBER			00:00	00:00	00:00	00:00		00:00			0		0.00
7		*LIBER			00:00	00:00	00:00	00:00		00:00			0		0.00
8	42875	2.URDES VALENTIN	99.00	118.80	07:43	00:40	08:23	07:30		07:30			39		37.60
9	42792	1.URDES VALENTIN	50.60	60.72	03:30	00:15	03:45	03:30		03:30			55		19.21
9	42792	2.NITOI DANIEL	61.00	73.20	04:32	00:20	04:52	04:30		04:30			0		23.08
10	42732	1.URDES VALENTIN	87.00	104.40	06:38	00:42	07:20	06:30		06:30			53		32.75
10	42732	2.NITOI DANIEL	99.80	119.76	08:25	00:15	08:40	07:30		07:30			0		37.51
TOTAL DECADA 1			727.90	873.48	55:41	06:04	61:45	54:05		54:05			302		274.65
11	42633	1.URDES VALENTIN	49.50	59.40	03:25	00:30	03:55	03:45		03:45			46		18.80
11	42633	2.NITOI DANIEL	99.70	119.64	08:25	00:00	08:25	08:15		08:15			0		37.48
12	42539	1.URDES VALENTIN	81.90	98.28	06:02	01:58	08:00	05:45		05:45			62		30.85
12	42539	2.NITOI DANIEL	92.90	111.48	08:02	00:03	08:05	07:15		07:15			0		34.95
13	42688	1.NITOI DANIEL	37.00	44.40	02:30	00:00	02:30	02:30		02:30			0		14.15
13	42688	2.URDES VALENTIN	127.40	152.88	09:30	00:10	09:40	09:30		09:30			0		47.78
14	42179	1.URDES VALENTIN	80.50	96.60	06:15	00:25	06:40	06:15		06:15			0		30.33
14	42179	2.NITOI DANIEL	105.30	126.36	08:25	00:00	08:25	08:15		08:15			0		39.56
15	42039	1.URDES VALENTIN	93.10	111.72	06:46	00:59	07:45	06:45		06:45			193		35.02
15	42039	2.NITOI DANIEL	93.70	112.44	07:30	01:30	09:00	07:15		07:15			0		35.24
TOTAL DECADA 2			861.00	1033.20	66:50	05:35	72:25	65:30		65:30			301		324.16
TOTAL PERIOADA			1588.90	1906.68	122:31	11:39	134:10	119:35		119:35			603		598.81

CONSUM COMBUSTIBIL

RRI	Alimentat	Normat	Restituit	Rest calculat	RRF	Dif	Consum efectiv
138.00	603	598.81	0.000	142.19	0	142.19	741.00
	BCF						
	0						

Numar de zile si imobilizari pe cauze

Zile luna	Zile efective	Lipsa plese	Lipsa mater	Lipsa anvel	Rep. curente	Rep.tehn2	Rep. capitale	Rodaj	Libere	Nemot.	CO	CM	CFS	Altele
15	13	0	0	0	0	0	0	0	2					0

	Parcurs realizat (km) de la introducerea in exploatare: KM efectivi	KM echivalenti	KM. ECHIVALENTI: rt1	rt2	rc	rk	anv	ulei	motor
Inceput luna	634898.10	735226.12							
Luna curenta	1588.90	1906.68							
Total	636487.00	737132.80							

BABOLEA DANIELA-FLORENTINA

FROM :RAT CRAIOVA FAX NO. :0251506877 24 Oct. 2012 13:41 P9

FISA ACTIVITATII ZILNICE PENTRU MASINA ROMAN UDM 112 cu numarul de inventar 415, sectia: 1 in perioada 04.10.2012 - 15.10.2012

Pag. 1

Ziua	Nr.foaie	Sofer	KM Efectivi	KM Echiv.	Timp efectiv Circul.	Timp efectiv Station.	Timp efectiv Total	Timp normat Circul.	Timp normat Station.	Timp normat Total	Trafic aglom.	Porniri motor	Combustibil Alim.	Combustibil Restit	Combustibil Consum normat
4	42238	2.TOMA DUMITRU	87.00	104.40	06:05	01:55	08:00	06:30		06:30			40		33.14
5	42337	2.TOMA DUMITRU	99.60	119.52	06:00	02:25	08:25	07:30		07:30			35		37.83
6	42437	2.TOMA DUMITRU	123.80	148.56	07:30	01:55	09:25	09:30		09:30			0		46.63
7	42484	1.TOMA DUMITRU	99.00	118.80	06:20	01:05	07:25	07:30		07:30			0		37.60
8	42863	1.TOMA DUMITRU	49.40	59.28	03:06	00:24	03:30	03:30		03:30			152		18.76
8	42863	2.TOMA DUMITRU	49.60	59.52	03:00	00:55	03:55	03:30		03:30			0		18.84
9	42956	1.TOMA DUMITRU	86.80	104.16	05:30	02:10	07:40	06:30		06:30			54		33.06
10	42735	1.TOMA DUMITRU	87.00	104.40	05:30	01:45	07:15	06:30		06:30			37		33.14
TOTAL DECADA 1			682.20	818.64	43:01	12:34	55:35	51:00		51:00			318		259.20
11	42637	1.TOMA DUMITRU	87.00	104.40	05:30	01:40	07:10	06:30		06:30			0		33.14
12	42545	1.TOMA DUMITRU	71.60	85.92	04:22	01:38	06:00	05:00		05:00			65		27.41
13		*LIBER			00:00	00:00	00:00	00:00		00:00			0		0.00
14		*LIBER			00:00	00:00	00:00	00:00		00:00			0		0.00
15	42169	1.GALUTA FLORIN	24.60	29.52	01:23	00:22	01:45	01:30		01:30			0		9.93
TOTAL DECADA 2			183.20	219.84	11:15	03:40	14:55	13:00		13:00			65		70.48
TOTAL PERIOADA			865.40	1038.48	54:16	16:14	70:30	64:00		64:00			383		329.68

CONSUM COMBUSTIBIL

RRI	Alimentat	Normat	Restituit	Rest calculat	RRF	Dif	Consum efectiv
129.00	383	329.68	0.000	182.32	0	182.32	512.00
	BCF						
	0						

Numar de zile si imobilizari pe cauze

Zile luna	Zile efective	Lipsa plese	Lipsa mater	Lipsa anvel	Rep. curente	Rep.tehn2	Rep. capitale	Rodaj	Libere	Nemot.	CO	CM	CFS	Altele
15	13	0	0	0	0	0	0	0	2					0

	Parcurs realizat (km) de la introducerea in exploatare: KM efectivi	KM echivalenti	KM. ECHIVALENTI: rt1	rt2	rc	rk	anv	ulei	motor
Inceput luna	560017.70	632299.44							
Luna curenta	865.40	1038.48							
Total	560883.10	633337.92							

BABOLEA DANIELA-FLORENTINA

FROM :RAT CRAIOVA FAX NO. :0251506877 24 Oct. 2012 13:42 P10

Measure title: **Alternative fuels in Craiova**

City: **Craiova** *Project:* **MODERN** *Measure number:* **01.02**

FISA ACTIVITATII ZILNICE PENTRU MASINA ROMAN UDM 112 cu numarul de inventar 413, sectia: 1 in perioada 08.10.2012 - 15.10.2012

Pag. 1

Ziua	Nr.foaie	Sofer	KM Efectivi	KM Echiv.	Timp efectiv Circul.	Timp efectiv Station.	Timp efectiv Total	Timp normat Circul.	Timp normat Station.	Timp normat Total	Trafic aglom.	PornirI motor	Combustibil Alim.	Combustibil Restit	Combustibil Consum normat
8	42843	1.FOTA FLORIN	74.60	89.52	05:40	01:20	07:00	05:30		05:30			115		28.14
8	42843	2.MITEA GABRIEL	86.60	103.92	06:55	00:30	07:25	06:30		06:30			0		32.60
9	42955	1.FOTA FLORIN	87.00	104.40	06:45	00:30	07:15	06:30		06:30			0		32.75
9	42955	2.MITEA GABRIEL	87.00	104.40	08:20	00:00	08:20	06:30		06:30			65*		32.75
10	42734	1.FOTA FLORIN	43.10	51.72	03:00	00:40	03:40	02:45		02:45			50		16.42
10	42734	2.MITEA GABRIEL	82.40	98.88	08:15	00:00	08:15	06:20		06:20			0		31.04
TOTAL DECADA 1			460.70	552.84	38:55	03:00	41:55	34:05		34:05			230		173.70
11	42636	1.FOTA FLORIN	80.70	96.84	06:10	01:50	08:00	05:45		05:45			64		30.41
11	42636	2.MITEA GABRIEL	68.50	82.20	06:00	00:00	06:00	05:15		05:15			0		25.87
12	42542	1.FOTA FLORIN	49.80	59.76	03:30	00:40	04:10	03:30		03:30			56		18.91
12	42542	2.MITEA GABRIEL	113.40	136.08	08:55	00:00	08:55	08:30		08:30			0		42.57
13	42687	1.FOTA FLORIN	92.90	111.48	07:15	00:25	07:40	07:15		07:15			0		34.95
13	42687	2.MITEA GABRIEL	68.10	81.72	05:20	00:00	05:20	05:15		05:15			0		25.72
14	42183	1.MITEA GABRIEL	92.90	111.48	07:10	00:35	07:45	07:15		07:15			0		34.95
14	42183	2.FOTA FLORIN	68.10	81.72	05:15	00:00	05:15	05:15		05:15			0		25.72
15	42042	1.MITEA GABRIEL	87.10	104.52	07:20	00:40	08:00	06:45		06:45			170		32.79
15	42042	2.FOTA FLORIN	74.50	89.40	05:45	01:45	07:30	06:15		06:15			0		28.10
TOTAL DECADA 2			796.00	955.20	62:40	05:55	68:35	61:00		61:00			290		299.99
TOTAL PERIOADA			1256.70	1508.04	101:35	08:55	110:30	95:05		95:05			520		473.69

CONSUM COMBUSTBIL

RRi	Alimentat	Normat	Restituit	Rest calculat	RRf	Dif	Consum efectiv
160.00	520	473.69	0.000	206.31	0	206.31	680.00
	BCF 0						

Numar de zile si imobilizari pe cauze

Zile luna	Zile efective	Lipsa piese	Lipsa mater	Lipsa anvel	Rep. curente	Rep.tehn2	Rep. capitale	Rodaj	Libere	Nemot.	CO	CM	CFS	Altele
15	15	0	0	0	0	0	0	0	0					0

	Parcurs realizat (km) de la introducerea in exploatare: KM efectivi	KM echivalenti	KM. ECHIVALENTI: rt1	rt2	rc	rk	anv	ulei	motor
Inceput luna	531963.00	620610.60							
Luna curenta	1256.70	1508.04							
Total	533219.70	622118.64							

BABOLEA DANIELA-FLORENTINA

FROM :RAT CRAIOVA FAX NO. :0251506077 24 Oct. 2012 13:42 P11

FISA ACTIVITATII ZILNICE PENTRU MASINA ROMAN UDM 112 cu numarul de inventar 416, sectia: 1 in perioada 05.10.2012 - 15.10.2012

Pag. 1

Ziua	Nr.foaie	Sofer	KM Efectivi	KM Echiv.	Timp efectiv Circul.	Timp efectiv Station.	Timp efectiv Total	Timp normat Circul.	Timp normat Station.	Timp normat Total	Trafic aglom.	Pornirl motor	Combustibil Alim.	Combustibil Restit	Combustibil Consum normat
5	42338	1.CAPRA SILVIAN	50.40	60.48	03:41	00:09	03:50	03:30		03:30			44		19.14
5	42338	2.CAPRA SILVIAN	49.40	59.28	03:53	00:35	04:28	03:30		03:30			18		18.76
6		*LIBER			00:00	00:00	00:00	00:00		00:00			0		0.00
7		*LIBER			00:00	00:00	00:00	00:00		00:00			0		0.00
8	42844	1.CAPRA SILVIAN	50.60	60.72	03:45	00:05	03:50	03:30		03:30			36		19.21
8	42844	2.CAPRA SILVIAN	62.20	74.64	05:15	00:20	05:35	04:30		04:30			0		23.53
9	42957	1.CAPRA SILVIAN	37.00	44.40	02:43	00:31	03:14	02:30		02:30			36		14.15
9	42957	2.CAPRA SILVIAN	61.80	74.16	05:10	00:10	05:20	04:30		04:30			0		23.38
10	42736	1.CAPRA SILVIAN	37.00	44.40	02:40	00:20	03:00	02:30		02:30			37		14.15
10	42736	2.CAPRA SILVIAN	74.60	89.52	06:05	00:30	06:35	05:30		05:30			0		28.14
TOTAL DECADA 1			423.00	507.60	33:12	02:40	35:52	30:00		30:00			171		160.46
11	42638	1.CAPRA SILVIAN	37.00	44.40	02:43	00:27	03:10	02:30		02:30			49		14.15
11	42638	2.CAPRA SILVIAN	62.20	74.64	04:55	00:25	05:20	04:30		04:30			0		23.53
12	42543	1.CAPRA SILVIAN	37.00	44.40	02:40	00:20	03:00	02:30		02:30			38		14.15
12	42543	2.CAPRA SILVIAN	61.80	74.16	05:12	00:13	05:25	04:30		04:30			0		23.38
13		*LIBER			00:00	00:00	00:00	00:00		00:00			0		0.00
14		*LIBER			00:00	00:00	00:00	00:00		00:00			0		0.00
15		I:Alte cauze			00:00	00:00	00:00	00:00		00:00			0		0.00
TOTAL DECADA 2			198.00	237.60	15:30	01:25	16:55	14:00		14:00			87		75.21
TOTAL PERIOADA			621.00	745.20	48:42	04:05	52:47	44:00		44:00			258		235.67

CONSUM COMBUSTBIL

RRi	Alimentat	Normat	Restituit	Rest calculat	RRf	Dif	Consum efectiv
183.00	258	235.67	0.000	205.33	0	205.33	441.00
	BCF 0						

Numar de zile si imobilizari pe cauze

Zile luna	Zile efective	Lipsa piese	Lipsa mater	Lipsa anvel	Rep. curente	Rep.tehn2	Rep. capitale	Rodaj	Libere	Nemot.	CO	CM	CFS	Altele
15	10	0	0	0	0	0	0	0	4					1

	Parcurs realizat (km) de la introducerea in exploatare: KM efectivi	KM echivalenti	KM. ECHIVALENTI: rt1	rt2	rc	rk	anv	ulei	motor
Inceput luna	631646.80	730630.76							
Luna curenta	621.00	745.20							
Total	632267.80	731375.96							

BABOLEA DANIELA-FLORENTINA

FROM :RAT CRAIOVA FAX NO. :0251506077 24 Oct. 2012 13:43 P12

Measure title: **Alternative fuels in Craiova**

City: **Craiova** *Project:* **MODERN** *Measure number:* **01.02**

FROM :RAT CRAIOVA FAX NO. :0251506077 24 Oct. 2012 13:44 P13

FISA ACTIVITATII ZILNICE PENTRU MASINA ROMAN UDM 112 cu numarul de inventar 417, sectia: 1 in perioada 05.10.2012 - 15.10.2012

Pag. 1

Ziua	Nr.foale	Sofer	KM Efectivi	KM Echiv.	Timp efectiv Circul.	Timp efectiv Station.	Timp efectiv Total	Timp normat Circul.	Timp normat Station.	Timp normat Total	Trafic aglom.	Pornit motor	Combustibil Alim.	Combustibil Restit	Combustibil Consum normat
5	42339	1.GHITA FLORICA-IONUT	49.40	59.28	03:36	00:09	03:45	03:30		03:30			43		18.76
5	42339	2.GHITA FLORICA-IONUT	62.20	74.64	04:50	00:25	05:15	04:30		04:30			44		23.53
6		*LIBER			00:00	00:00	00:00	00:00		00:00			0		0.00
7		*LIBER			00:00	00:00	00:00	00:00		00:00			0		0.00
8		I:Alte cauze			00:00	00:00	00:00	00:00		00:00			0		0.00
9		I:Alte cauze			00:00	00:00	00:00	00:00		00:00			0		0.00
10	42737	1.GHITA FLORICA-IONUT	49.40	59.28	03:35	00:00	03:35	03:30		03:30			50		18.76
10	42737	2.GHITA FLORICA-IONUT	62.20	74.64	05:00	00:45	05:45	04:30		04:30			0		23.53
TOTAL DECADA 1			223.20	267.84	17:01	01:19	18:20	16:00		16:00			137		84.58
11	42639	1.GHITA FLORICA-IONUT	49.40	59.28	03:27	00:11	03:38	03:30		03:30			50		18.76
11	42639	2.GHITA FLORICA-IONUT	61.80	74.16	04:50	00:55	05:45	04:30		04:30			0		23.38
12	42544	1.GHITA FLORICA-IONUT	49.40	59.28	03:29	00:01	03:30	03:30		03:30			45		18.76
12	42544	2.GHITA FLORICA-IONUT	62.20	74.64	05:10	00:35	05:45	04:30		04:30			0		23.53
13	42689	2.GHITA FLORICA-IONUT	111.40	133.68	08:40	00:00	08:40	08:30		08:30			0		42.22
14	42181	1.GHITA FLORICA-IONUT	114.60	137.52	08:30	00:00	08:30	08:30		08:30			0		43.41
15	42043	1.GHITA FLORICA-IONUT	41.80	50.16	03:05	00:00	03:05	03:00		03:00			118		15.94
15	42043	2.GHITA FLORICA-IONUT	29.40	35.28	02:15	00:00	02:15	02:00		02:00			0		11.32
TOTAL DECADA 2			520.00	624.00	39:26	01:42	41:08	38:00		38:00			213		197.32
TOTAL PERIOADA			743.20	891.84	56:27	03:01	59:28	54:00		54:00			350		281.90

CONSUM COMBUSTIBIL

RRi	Alimentat	Normat	Restituit	Rest calculat	RRf	Dif	Consum efectiv
155.00	350	281.90	25.000	198.10	0	198.10	480.00
	BCF						
	0						

Numar de zile si imobilizari pe cauze

Zile luna	Zile efective	Lipsa plese	Lipsa mater	Lipsa anvel	Rep. curente	Rep.tehn2	Rep. capitale	Rodaj	Libere	Nemot.	CO	CM	CFS	Altele
15	11	0	0	0	0	0	0	0	2					2

	Parcurs realizat (km) de la introducerea in exploatare: KM efectivi	KM echivalenti	KM. ECHIVALENTI: rt1	rt2	rc	rk	anv	ulei	motor
Inceput luna	507371.70	597296.64							
Luna curenta	743.20	891.84							
Total	508114.90	598188.48							

BABOLEA DANIELA-FLORENTINA

Annex 3: Calculation sheets for ex-ante evaluation

Fuel type: diesel oil

Data provided by RAT

2011 / monthly data			
Buses type	**Number of buses in operation**	**Total fuel consumption (liters)**	**Total mileage (km)**
Roman UDM (section 1)	17	16677	41502
Roman UDM (section 2)	17	18619	50210
Mercedes	12	19243	36407
MAN	8	15083	38719
Bredabus (section 1)	23	26517	61774
Bredabus (section 2)	4	4861	11486

Total

Roman UDM	34	35296	91712
Mercedes	12	19243	36407
MAN	8	15083	38719
Bredabus	27	31378	73260

Diesel oil price

Fuel type	**Acquisition date**	**Quantity (tons)**	**Price (RON/ ton)**	**Costs (RON)**	**Density (kg/liter)**	**Quantity (liters)**	**Price (RON/ liter)**	**Currency (RON/ EURO)**	**Price (EURO/ liter)**
Diesel oil	Apr-11	7.311	4847.55	35440	0.8415	8688	4.08	4.1120	**0.99**
Diesel fuel price according to the RAT invoices									
Source of currency: http://cursvalutar.dailybusiness.ro/curs-valutar-mediu-lunar									

Measure title: **Alternative fuels in Craiova**

City: **Craiova** *Project:* **MODERN** *Measure number:* **01.02**

Data provided by RAT						Data calculated for 10 buses				
Buses type	Number of buses in operation	Total fuel consumption per month (liters)	Total mileage per month (km)	Number of buses with biodiesel filters for demonstration	Average speed of buses in the city (km/h)	Fuel consumed by demonstration buses (liters)	Mileage for demonstration buses (km)	Fuel consumption per unit of activity (l/vkm)	Specific consumption (liters/h)	Specific consumption (kg/h)
0	1	2	3	4	5	6=2x7/1	7=3x7/1	8=6/7	9=8x5	10=9x fuel density
Roman UDM	34	35296	91712	7	18	7267	18882	0.38	6.93	5.83
Mercedes	12	19243	36407	1	18	1604	3034	0.53	9.51	8.01
MAN	8	15083	38719	1	18	1885	4840	0.39	7.01	5.90
Bredabus	27	31378	73260	1	18	1162	2713	0.43	7.71	6.49
Total				**10**	**18**	**11918**	**29469**	**0.404**	**7.28**	**6.13**

Average operating costs

Average operating costs					Data calculated		
Buses type **Source: RAT**	**Number of buses for demonstration** **Source: RAT**	**Price (EURO/liter)** **Source: RAT**	**Fuel consumed by demonstration buses (liters)** **Source: RAT**	**Mileage for demonstration buses (km)** **Source: RAT**	**Total fuel price (EURO)**	**Operational costs for the demonstration buses (EURO)***	***Average Operating costs (EURO/vkm)***
0	1	2	3	4	5=3x2	6=5	7=6/4
Roman UDM	7	0.99	7267	18882	7209	7209	
Mercedes	1	0.99	1604	3034	1591	1591	
MAN	1	0.99	1885	4840	1870	1870	
Bredabus	1	0.99	1162	2713	1153	1153	
TOTAL	**10**		**11918**	**29469**	**11823**	**11823**	**0.4012**

* The operational costs were limited to the fuel cost, this being the only cost element that changes; detailed explanation in the chapter C1.1

Vehicle Fuel Efficiency (MJ/vkm)

Fuel Type	***Energy content of fuel (MJ/kg)****	***Fuel density (kg/l)*****	***Energy content of fuel, calculated (MJ/l)****	**Number of buses for demonstration** **Source: RAT**	**Fuel consumed by demonstration buses (liters)** **(calculated table above)**	**Mileage for demonstration buses (km)** **(calculated table above)**	***Energy content of fuel consumed by 10 buses (MJ)***	***Vehicle Fuel Efficiency (MJ/vkm)***
0	1	2	3=1x2	4	5	6	7=5x3	8=7/6
Diesel fuel	**45.862**	**0.84**	**38.59**	**10**	**11918**	**29469**	**459947**	**15.61**

* Data from the study: Researches concerning the analysis of pollutant emissions level produced by buses operating with biodiesel fuel in Craiova / agreement no. 5C/27.02.2012

** According to the fuel supplier specified on the invoice

Emissions calculation

(to transform the emissions concentration measured in the exhaust gases in quantity of emissions per unit of activity)

The method of calculation is presented in the chapter C1.1

	CO	**CO2**	**CO2**	**NOx**	Air to fuel ratio lambda calculated *	Exhaust gas mass flow rate Gexhw kg/h ** calculated
Emissions in the exhaust gases measured	Concentration of CO (ppm) measured	Concentration of CO2 (%) measured	Concentration of CO2 (ppm) calculated	Concentration of NOx (ppm) measured		
	970.64	1.78	17787	84.30	7.776	693
Instantaneous flow of gas i in exhaust gases Gas $(i)_{mass}$ (kg/h) calculated	0.8409		24.21	0.112		
Specific emissions g/l fuel	115.51		3,326.39	15.330		

calculated						
Specific emissions g/vkm calculated	46.7		1345.3	6.2		

*lambda was calculated with formula from chapter C1.1

**Gexhw (kg/h) was calculated with lambda calculated

Table of data for emissions density calculation

Gas	**Molar weight / molar volume**	**Density (kg/m3)**	**Comments**
CO2	44 / 22.4	1.96	
CO	28 / 22,4	1.25	
O2	32 / 22,4	1.43	
HC ($H_{1.85}C_1$)	(1,85+1*12)/22,4	0.62	average carbon to hydrogen ratio: 1: 1.85 (EC Directive 26/2004)
NOx (x=1.8)	(14+1,8*16)/22.4	1.91	considered as a mixture of equal parts of NO, NO2, NO3 si N2O3 (supposition)

Calculation of stoichiometric ratio air / fuel (A/Fst) for standard diesel fuel which is a blend of 5% biodiesel in diesel oil

Stoichiometric ratio air / fuel (A/Fst) **for different fuels**	
Diesel oil	***14,530***
Biodiesel fuels	***12,300***

		Biodiesel	Diesel oil	Biodiesel 5% (B5)
Quantity used for fuels mixture	[liters]	5	95	100
density	[kg/l]	0,819	0,84	
Quantity used for fuels mixture	[kg]	4,095	79,8	83,895
air for combustion	[kg]	50,3685	1159,494	1209,8625
A/Fst for B5				**14,42**

Annex 4: Calculation sheets for BAU evaluation

Fuel type: diesel oil

Data provided by RAT

2011 / monthly data			
Buses type	**Number of buses in operation**	**Total fuel consumption (liters)**	**Total mileage (km)**
Roman UDM (section 1)	17	16677	41502
Roman UDM (section 2)	17	18619	50210
Mercedes	12	19243	36407
MAN	8	15083	38719
Bredabus (section 1)	23	26517	61774
Bredabus (section 2)	4	4861	11486

Total

Roman UDM	34	35296	91712
Mercedes	12	19243	36407
MAN	8	15083	38719
Bredabus	27	31378	73260

2012 / monthly data			
Buses type	**Number of buses in operation**	**Total fuel consumption (liters)**	**Total mileage (km)**
Roman UDM (section 1)	14	14432	38102
Roman UDM (section 2)	15	14570	39487
Mercedes	12	17399	37874
MAN	11	16709	43401
Bredabus (section 1)	4	7386	17182
Bredabus (section 2)	7	7793	18020
Bredabus (section 2)	16	18053	42987

Total

Roman UDM	29	29002	77589
Mercedes	12	17399	37874
MAN	11	16709	43401
Bredabus	27	33232	78189

Measure title: **Alternative fuels in Craiova**

City: **Craiova** *Project:* **MODERN** *Measure number:* **01.02**

Fuel type	Acquisition date	Quantity (tons)	Price (RON/ ton)	Costs (RON)	Density (kg/litre)	Quantity (litres)	Price (RON/ litre)	Currency (RON/ EURO)	Price (EURO/ litre)
Diesel oil	Apr-11	7.311	4847.55	35440	0.8415	8688	4.08	4.1120	**0.99**
Diesel oil	Sep-12	7.197	5668.41	40796	0.819	8788	4.64	4.5007	**1.03**
Diesel fuel prices according to the RAT invoices									
Source of currency: http://cursvalutar.dailybusiness.ro/curs-valutar-mediu-lunar									

Data provided by RAT for 2011						Data calculated for 10 buses				
Buses type	Number of buses in operation	Total fuel consumption per month (liters)	Total mileage per month (km)	Number of buses with biodiesel filters for demonstration	Average speed of buses in the city (km/h)	Fuel consumed by demonstration buses (liters)	Mileage for demonstration buses (km)	Fuel consumption per unit of activity (l/vkm)	Specific consumption (liters/h)	Specific consumption (kg/h)
0	1	2	3	4	5	6=2x7/1	7=3x7/1	8=6/7	9=8x5	10=9x fuel density
Roman UDM	34	35296	91712	7	18	7267	18882	0.38	6.93	5.83
Mercedes	12	19243	36407	1	18	1604	3034	0.53	9.51	8.01
MAN	8	15083	38719	1	18	1885	4840	0.39	7.01	5.90
Bredabus	27	31378	73260	1	18	1162	2713	0.43	7.71	6.49
Total				**10**	**18**	**11918**	**29469**	**0.404**	**7.28**	**6.13**

Data provided by RAT for 2012						Data calculated for 10 buses				
Buses type	Number of buses in operation	Total fuel consumption per month (liters)	Total mileage per month (km)	Number of buses with biodiesel filters for demonstration	Average speed of buses in the city (km/h)	Fuel consumed by demonstration buses (liters)	Mileage for demonstration buses (km)	Fuel consumption per unit of activity (l/vkm)	Specific consumption (liters/h)	Specific consumption (kg/h)
0	1	2	3	4	5	6=2x7/1	7=3x7/1	8=6/7	9=8x5	10=9x fuel

Measure title: **Alternative fuels in Craiova**

City: **Craiova** *Project:* **MODERN** *Measure number:* **01.02**

Data provided by RAT for 2012						Data calculated for 10 buses				
Buses type	Number of buses in operation	Total fuel consumption per month (liters)	Total mileage per month (km)	Number of buses with biodiesel filters for demonstration	Average speed of buses in the city (km/h)	Fuel consumed by demonstration buses (liters)	Mileage for demonstration buses (km)	Fuel consumption per unit of activity (l/vkm)	Specific consumption (liters/h)	Specific consumption (kg/h)
										density
Roman UDM	29	29002	77589	7	18	7000	18728	0.37	6.73	5.66
Mercedes	12	17399	37874	1	18	1450	3156	0.46	8.27	6.96
MAN	11	16709	43401	1	18	1519	3946	0.38	6.93	5.83
Bredabus	27	33232	78189	1	18	1231	2896	0.43	7.65	6.44
Total				**10**	**18**	**11200**	**28726**	**0.390**	**7.02**	**5.91**

Average operating costs

Average operating costs 2011					Data calculated		
Buses type **Source: RAT**	**Number of buses for demonstration** **Source: RAT**	**Price (EURO/liter)** **Source: RAT**	**Fuel consumed by demonstration buses (liters)** **Source: RAT**	**Mileage for demonstration buses (km)** **Source: RAT**	**Total fuel price (EURO)**	**Operational costs for the demonstration buses (EURO)***	***Average Operating costs (EURO/vkm)***
0	1	2	3	4	5=3x2	6=5	7=6/4
Roman UDM	7	0.99	7267	18882	7209	7209	
Mercedes	1	0.99	1604	3034	1591	1591	
MAN	1	0.99	1885	4840	1870	1870	
Bredabus	1	0.99	1162	2713	1153	1153	
TOTAL	**10**		**11918**	**29469**	**11823**	**11823**	**0.4012**

Measure title: **Alternative fuels in Craiova**

City: **Craiova** *Project:* **MODERN** *Measure number:* **01.02**

Average operating costs 2011					**Data calculated**		
Buses type **Source: RAT**	**Number of buses for demonstration** **Source: RAT**	**Price (EURO/liter)** **Source: RAT**	**Fuel consumed by demonstration buses (liters)** **Source: RAT**	**Mileage for demonstration buses (km)** **Source: RAT**	**Total fuel price (EURO)**	**Operational costs for the demonstration buses (EURO)***	***Average Operating costs (EURO/vkm)***
0	1	2	3	4	5=3x2	6=5	7=6/4
Roman UDM	7	1.03	7000	18728	7221	7221	
Mercedes	1	1.03	1450	3156	1496	1496	
MAN	1	1.03	1519	3946	1567	1567	
Bredabus	1	1.03	1231	2896	1270	1270	
TOTAL	**10**		**11200**	**28726**	**11553**	**11553**	**0.4022**

* The operational costs were limited to the fuel cost, this being the only cost element that changes; detailed explanation in the chapter C1.1

Vehicle Fuel Efficiency (MJ/vkm)

Data for 2011

Fuel Type	***Energy content of fuel (MJ/kg)****	***Fuel density (kg/l)*****	***Energy content of fuel, calculated (MJ/l)****	**Number of buses for demonstration** **Source: RAT**	**Fuel consumed by demonstration buses (liters)** **(calculated table above)**	**Mileage for demonstration buses (km)** **(calculated table above)**	***Energy content of fuel consumed by 10 buses (MJ)***	***Vehicle Fuel Efficiency (MJ/vkm)***
0	1	2	3=1x2	4	5	6	7=5x3	8=7/6
Diesel fuel	**45.862**	**0.84**	**38.59**	**10**	**11918**	**29469**	**459947**	**15.61**

Data for 2012

Measure title: **Alternative fuels in Craiova**

City: **Craiova** *Project:* **MODERN** *Measure number:* **01.02**

Fuel Type	*Energy content of fuel (MJ/kg) **	*Fuel density (kg/l)** **	*Energy content of fuel, calculated (MJ/l)**	**Number of buses for demonstration Source: RAT**	**Fuel consumed by demonstration buses (liters) (calculated table above)**	**Mileage for demonstration buses (km) (calculated table above)**	*Energy content of fuel consumed by 10 buses (MJ)*	*Vehicle Fuel Efficiency (MJ/vkm)*
0	1	2	3=1x2	4	5	6	7=5x3	8=7/6
Diesel fuel	**45.862**	**0.84**	**38.59**	**10**	**11200**	**28726**	**432248**	**15.05**

* Data from the study: Researches concerning the analysis of pollutant emissions level produced by buses operating with biodiesel fuel in Craiova / agreement no. 5C/27.02.2012

** According to the fuel supplier; specified on the invoice

Emissions calculation

(to transform the emissions concentration measured in the exhaust gases in quantity of emissions per unit of activity). The method of calculation is presented in the chapter C1.1

Data for 2011	**CO**	**CO2**	**CO2**	**NOx**	Air to fuel ratio lambda calculated *	Exhaust gas mass flow rate Gexhw kg/h ** calculated
Emissions in the exhaust gases measured	Concentration of CO (ppm) measured	Concentration of CO2 (%) measured	Concentration of CO2 (ppm) calculated	Concentration of NOx (ppm) measured		
	970.64	1.78	17787	84.30	7.776	693
Instantaneous flow of gas i in exhaust gases Gas $(i)_{mass}$ (kg/h) calculated	0.8409		24.21	0.112		
Specific emissions g/l fuel calculated	115.51		3,326.39	15.330		
Specific emissions	***46.7***		***1345.3***	***6.2***		

g/vkm calculated						
Data for 2012	**CO**	**CO2**	**CO2**	**NOx**	Air to fuel ratio lambda calculated *	Exhaust gas mass flow rate Gexhw kg/h ** calculated
Emissions in the exhaust gases measured	Concentration of CO (ppm) measured	Concentration of CO2 (%) measured	Concentration of CO2 (ppm) calculated	Concentration of NOx (ppm) measured		
	970.64	1.78	17787	84.30	7.776	668
Instantaneous flow of gas i in exhaust gases Gas $(i)_{mass}$ (kg/h) calculated	0.8107		23.35	0.108		
Specific emissions g/l fuel calculated	115.51		3,326.39	15.33		
Specific emissions g/vkm calculated	***45.04***		***1296.96***	***5.98***		

*lambda was calculated with formula from chapter C1.1

**Gexhw (kg/h) was calculated with lambda calculated

Table of data for emissions density calculation

Gas	**Molar weight / molar volume**	**Density (kg/m3)**	**Comments**
CO2	44 / 22.4	1.96	
CO	28 / 22,4	1.25	
O2	32 / 22,4	1.43	
HC ($H_{1.85}C_1$)	(1,85+1*12)/22,4	0.62	average carbon to hydrogen ratio: 1: 1.85 (EC Directive 26/2004)
NOx (x=1.8)	(14+1,8*16)/22.4	1.91	considered as a mixture of equal parts of NO, NO2, NO3 si N2O3 (supposition)

Calculation of stoichiometric ratio air / fuel (A/Fst) for standard diesel fuel which is a blend of 5% biodiesel in diesel oil

Stoichiometric ratio air / fuel (A/Fst) **for different fuels**	
Diesel oil	***14,530***
Biodiesel fuels	***12,300***

		Biodiesel	Diesel oil	Biodiesel 5% (B5)
Quantity used for fuels mixture	[liters]	5	95	100
density	[kg/l]	0,819	0,84	
Quantity used for fuels mixture	[kg]	4,095	79,8	83,895
air for combustion	[kg]	50,3685	1159,494	1209,8625
A/Fst for B5				**14,42**

Annex 5: Calculation sheets for ex-post evaluation

Fuel type: biodiesel 20% (B20)

Demonstration period: 04 – 15.10.2012

Data provided by RAT

2012 / demonstration period				
Buses type	**Number of buses in operation**	**Total fuel consumption (liters)**	**Total mileage (km)**	**Average buses speed (km/h)***
Roman UDM	7	2810	7569	13.28
Mercedes	1	420	930	16.45
MAN	1	141	302	6.96
Bredabus	1	326	754	14.17
TOTAL	**10**	**3697**	**9555**	**13**

* vehicle speed resulted from buses activity records during the demonstration with biodiesel B20

Diesel oil price

Fuel type	**Acquisition date**	**Quantity (tons)**	**Price (RON/ ton)**	**Costs (RON)**	**Density (kg/liter)**	**Quantity (liters)**	**Price (RON/ liter)**	**Currency (RON/ EURO)**	**Price (EURO/ liter)**
Diesel oil	Sep-12	7.197	5668.41	40796	0.819	8788	4.64	4.5007	**1.03**
Diesel fuel price according to the RAT invoices									
Source of currency: http://cursvalutar.dailybusiness.ro/curs-valutar-mediu-lunar									

Biodiesel price

Fuel type	**Acquisition date**	**Costs (RON)**	**Density (kg/ liter)**	**Quantity (liters)**	**Price (RON/ liter)**	**Currency (RON/ EURO)**	**Price (EURO/liter)**
Biodiesel	02.10.2012	2400		600	4.00	4.5583	**0.88**
Biodiesel	10.10.2012	800		200	4.00	4.5583	**0.88**

Biodiesel fuel price / October 2012 according to the RAT invoices

Measure title: **Alternative fuels in Craiova**

City: **Craiova** *Project:* **MODERN** *Measure number:* **01.02**

Source of currency: http://cursvalutar.dailybusiness.ro/curs-valutar-mediu-lunar

Calculation of the B20 price

	Price (EURO/liter)
Diesel fuel price / September 2012	1.03
Biodiesel price / October 2012	0.88
B20 (20% biodiesel mixture) price calculation	1.02

Note: The current diesel fuel is a mixture with 5% biodiesel. To prepare a mixture of 20% biodiesel it should be added 18.75 liters of biodiesel to 100 liters of diesel B5

The B20 price is calculated with the following formula:

*B20 price = (100*diesel B5 price+18.75*biodiesel price)/118.75*

Measure title: **Alternative fuels in Craiova**

City: **Craiova** *Project:* **MODERN** *Measure number:* **01.02**

Data provided by RAT					**Data calculated for 10 buses**		
Buses type	Number of buses in operation	Fuel consumed by demonstration buses (liters)	Mileage for demonstration buses (km)	Average speed of buses in the city (km/h)	Fuel consumption per unit of activity (l/vkm)	Specific consumption (liters/h)	Specific consumption (kg/h)
0	1	2	3	4	5=2/3	6=5x4	7=6x fuel density
Roman UDM	7	2810	7569	13.28	0.37	4.93	4.04
Mercedes	1	420	930	16.45	0.45	7.43	6.08
MAN	1	141	302	6.96	0.47	3.25	2.66
Bredabus	1	326	754	14.17	0.43	6.13	5.02
Total	**10**	**3697**	**9555**	**13**	**0.387**	**4.92**	**4.03**

Average operating costs

Average operating costs					**Data calculated**		
Buses type **Source: RAT**	**Number of buses for demonstration** **Source: RAT**	**Price (EURO/liter)** **Calculated**	**Fuel consumed by demonstration buses (liters)** **Source: RAT**	**Mileage for demonstration buses (km)** **Source: RAT**	**Total fuel price (EURO)**	**Operational costs for the demonstration buses (EURO)***	***Average Operating costs (EURO/vkm)***
0	1	2	3	4	5=3x2	6=5	7=6/4

Measure title: **Alternative fuels in Craiova**

City: **Craiova** *Project:* **MODERN** *Measure number:* **01.02**

Average operating costs					Data calculated		
Buses type **Source: RAT**	**Number of buses for demonstration** **Source: RAT**	**Price (EURO/liter)** **Calculated**	**Fuel consumed by demonstration buses (liters)** **Source: RAT**	**Mileage for demonstration buses (km)** **Source: RAT**	**Total fuel price (EURO)**	**Operational costs for the demonstration buses (EURO)***	***Average Operating costs (EURO/vkm)***
Roman UDM	7	1.02	2810	7569	2875	2875	
Mercedes	1	1.02	420	930	430	430	
MAN	1	1.02	141	302	144	144	
Bredabus	1	1.02	326	754	334	334	
TOTAL	**10**	**1.02**	**3697**	**9555**	**3783**	**3783**	**0.396**

* The operational costs were limited to the fuel cost, this being the only cost element that changes; detailed explanation in the chapter C1.1

Vehicle Fuel Efficiency (MJ/vkm)

Fuel Type	***Energy content of fuel (MJ/kg)****	***Fuel density (kg/l)***	***Energy content of fuel, calculated (MJ/l)****	**Number of buses for demonstration** **Source: RAT**	**Fuel consumed by demonstration buses (liters)** **(calculated table above)**	**Mileage for demonstration buses (km)** **(calculated table above)**	***Energy content of fuel consumed by 10 buses (MJ)***	***Vehicle Fuel Efficiency (MJ/vkm)***
0	1	2	3=1x2	4	5	6	7=5x3	8=7/6
B20	**45.245**	**0.819**	**37.06**	**10**	**3697**	**9555**	**136995**	**14.34**

Measure title: **Alternative fuels in Craiova**

City: **Craiova** *Project:* **MODERN** *Measure number:* **01.02**

* Data from the study: Researches concerning the analysis of pollutant emissions level produced by buses operating with biodiesel fuel in Craiova / agreement no. 5C/27.02.2012

Emissions calculation

(to transform the emissions concentration measured in the exhaust gases in quantity of emissions per unit of activity)

The method of calculation is presented in the chapter C1.1

	CO	**CO2**	**CO2**	**NOx**	Air to fuel ratio lambda calculated *	Exhaust gas mass flow rate Gexhw kg/h ** calculated
Emissions in the exhaust gases measured	Concentration of CO (ppm) measured	Concentration of CO2 (%) measured	Concentration of CO2 (ppm) calculated	Concentration of NOx (ppm) measured		
	852.76	1.63	16316	98.23	8.491	486
Instantaneous flow of gas i in exhaust gases Gas $(i)_{mass}$ (kg/h) calculated	0.5182		15.58	0.091		
Specific emissions g/l fuel calculated	105.34		3,167.03	18.540		
Specific emissions g/vkm ***calculated***	***40.76***		***1225.38***	***7.17***		

*lambda was calculated with formula from chapter C1.1

**Gexhw (kg/h) was calculated with lambda calculated

Measure title: **Alternative fuels in Craiova**

City: **Craiova** *Project:* **MODERN** *Measure number:* **01.02**

Table of data for emissions density calculation

Gas	**Molar weight / molar volume**	**Density (kg/m3)**	**Comments**
CO2	44 / 22.4	1.96	
CO	28 / 22,4	1.25	
O2	32 / 22,4	1.43	
HC ($H_{1.85}C_1$)	(1,85+1*12)/22,4	0.62	average carbon to hydrogen ratio: 1: 1.85 (EC Directive 26/2004)
NOx (x=1.8)	(14+1,8*16)/22.4	1.91	considered as a mixture of equal parts of NO, NO2, NO3 si N2O3 (supposition)

Calculation of stoichiometric ratio air / fuel (A/Fst) for standard diesel fuel which is a blend of 5% biodiesel in diesel oil

Stoichiometric ratio air / fuel (A/Fst) **for different fuels**	
Diesel oil	***14,530***
Biodiesel fuels	***12,300***

		Biodiesel	Diesel oil	Biodiesel 5% (B5)
Quantity used for fuels mixture	[liters]	20,00	80,00	100
density	[kg/l]	0,819	0,84	
Quantity used for fuels mixture	[kg]	16,38	67,2	83,58
air for combustion	[kg]	201,474	976,416	1177,89
A/Fst for B5				**14,09**

M01.07 – Executive summary

The measure aims to find an appropriate grant in order to replace the old buses fleet running daily in Craiova with a new low pollution one. The strategy of the Municipality and RAT Craiova to replace old buses with clean buses has begun in November 2008 with the purchasing of 17 new buses, MAN Lion's City Euro 4, using the Municipality own financial resources. Within the measure, the Municipality wanted to continue replacing old buses with new ones that could be purchased with grant funds available. Either open calls could not be accessed by RAT for various reasons.

The project team carried out an analysis of the public transport needs in Craiova and an environmental impact evaluation o understand the importance of the fleet renewal. The conclusion was that the buses fleet in Craiova is old and polluting because it consists of NON EURO, EURO 2 and EURO 3 buses and should be replaced with new ones more comfortable and cleaner. Technical documentation and requirements have been developed in order to purchase new buses and the open calls analysis was performed as well.

Unfortunately, either open calls could not be accessed and the only appropriate solution found for renewing the buses fleet was based on the budget of the Municipality that reserved money for buses purchasing.

In 2010 the Mayor of Craiova was suspended from his position and the Deputy Mayor replaced him. For 2011 the Deputy Mayor included in the budget of the Municipality the amount of money needed to purchase 20 new buses. At the end of 2011 the Mayor has returned into the position and reconsidered the Municipality budget, cancelling the acquisition of 20 new buses in favour of other priorities considered at that time more important for the city.

Regarding the evaluation activity, we assessed the impact of the 17 buses purchased by the Municipality with its own budget on environment and public transport users. In this sense it has been estimated, with the help of the COPERT IV program, the annual emissions of 17 old buses from the NON EURO category which were replaced with those new 17 from the EURO IV category and we observed a clear difference of the emissions produced by those two bus categories. The emissions' estimation in COPERT was made taking into account the Km run and the fuel quantity used by those two bus categories. We also estimated the annual emissions of the entire fleet of old buses and the emissions produced by the entire fleet in which 17 old buses were replaced with new ones. We observed a slight decrease of the annual emissions made by the fleet, thing which demonstrates a positive impact over the environment. Under these conditions, it is obvious that the replacement of the entire old bus fleet with a new ecologic one will lead to a significant decrease of emissions in this city.

After the results obtained by comparing the emissions coming from 17 NON EURO buses versus 17 EURO IV buses and taking into consideration the opinion of the public transport users after the replacement of the 17 old buses, the Municipality decided to continue the replacement of old buses starting with the taking out of circulation of NON EURO buses.

The Municipality is willing to renew in the near future all the bus fleet of Craiova and that is why it decided at the end of 2012 to allocate in the budget funds for buying of 50 ecologic buses. For this reason, at evaluation purposes, a scenario considering the availability of a completely new fleet has been developed.

Following the COPERT estimation, the emissions from the 17 NON EURO buses decreased comparing with emissions from the 17 EURO IV buses, as follows:

- CO2(g/vKm) decreased with 1%
- CO(g/vKm) decreased with 76%
- NOx(g/vKm) decreased with 36%
- Pm exhaust(g/vKm) decreased with 96%

In order to evaluate the impact over the public transport users, a survey was conducted asking the interviewed people to state their opinion regarding the quality of services brought by the public transport.

The conclusion of the survey was that the population appreciated the new clean and comfortable buses traveling in Craiova. An improvement of the quality of the service was perceived, and an higher level of comfort and safety was emphasized. The result of the survey will be used as part of the documentation that the Municipality will produce in order to prepare the public tender for the acquisition of 50 new buses foreseen for 2013.

A. Introduction

A1 Objectives

The measure objectives are:

(A) High level / longer term:
- To reduce emissions in the city.
- To modify the modal share.

(B) Strategic level:
- To increase the service quality of PT.

(C) Measure level:
(1) To identify the typology of buses suitable for decreasing the emissions by 5 %.
(2) To identify a proper granting program for eco-buses acquisition.

A2 Description

The huge number of circulating vehicles represents one of the major pollution sources in urban areas. A clean public transport system is thus needed in cities to reduce the pollution level and the new technologies for buses offer a viable solution.

This measure wants to bring a contribution to the improvement of the quality of life by decreasing the pollution level, increasing the travellers comfort and, generally, the image of the city by defining a realistic funding scheme to renew Craiova's public transport fleet with 100 new ecological buses.

The transport of passengers by bus in Craiova was not an environmental friendly transportation mode and did not offer attractive travel conditions for passengers. Craiova public transport fleet consisted in old buses, NON EURO, EURO 2, EURO 3, and most of them were older than 10 years. Due to practical reasons of material type and the general bad financial conditions generated by the financial crisis an important percentage from the Romanian Public Transport Companies fleet is composed of vehicles in a bad condition, either because of the long exploitation, or because they were bought second-hand. This fact leads progressively to the degradation of the quality and image of the urban public transport, proving imperative to reform the system of public transport, by acquiring vehicles with an increased capacity and more efficient from the point of view of fuel consumption and transport quality.

The strategy of the Municipality and RAT Craiova to replace old buses with clean buses has begun in November 2008 with the purchasing of 17 new buses, MAN Lion's City Euro 4, using the Municipality own financial resources.

Within the measure, a specific analysis was carried out in order to find out how to use in an optimal way and according with the urban necessities, different funding sources including the Structural Funds (European Regional Development Fund – Transport Operational Regional Programme 2007-2013), funds from the European Bank of Investments (BEI), COMPRO for purchasing eco buses and ELENA programme. The activities developed within the measure consisted in appraising the funding programs

mentioned above in order to decide in accordance with the financial possibilities of Public Transportation Company and Municipality.

On one hand, some of the Funding programmes analysed do not finance acquisition of clean buses, being these programmes focused on financing the transport infrastructures only, on the other hand, others are not suitable for the current economical context because they would increase too much the indebtedness of the Municipality. In fact Romania is living a severe economic restriction period, which affected the capability of the municipality to finance own investments.

As a result, the funding programmes analysed within the measure, cannot be used in order to purchase the new clean buses. This means that Craiova Municipality has to consider funding the acquisition of the new buses with its own financial resources, or national financial resources.

The 17 new buses were bought according to the 2008 investment plan of the Municipality. RAT Craiova and the Municipality acquired these buses based on the analysis of appropriate buses typology, in terms of pollutant emissions and passengers comfort. The 17 new buses were included in the 100 active buses that are running daily in the city, provide travel comfort with low pollution.

RAT Company estimated emissions for these 17 new buses, using COPERT IV program, and made demo activities to prove the high quality of the services provided by these buses in order to decide if the typology MAN Lion's City is the best solution for Craiova if the entire fleet of buses could be renewed.

All this 17 new buses were included in the e-ticketing integrated system and the fleet mobility network.

B. Measure implementation

B1 Innovative aspects

The innovative aspects of the measure are:

- **New conceptual approach –** Acquisition of 100 new buses for the Craiova fleet by accessing different grants and programs is a new conceptual approach and a solution to reduce emissions in the city of Craiova

B2 Research and Technology Development

- **Analyzing the necessity of a sustainable transport network and its impact on the environment**

Research activity started with meetings with Municipality representatives and general considerations regarding the measure design.

The public transport needs and environmental impact of bus travel in Craiova was assessed when considering bus replacement. This analysis considered the public transport network (Fig. B2.1), population and the bus fleet status in Craiova

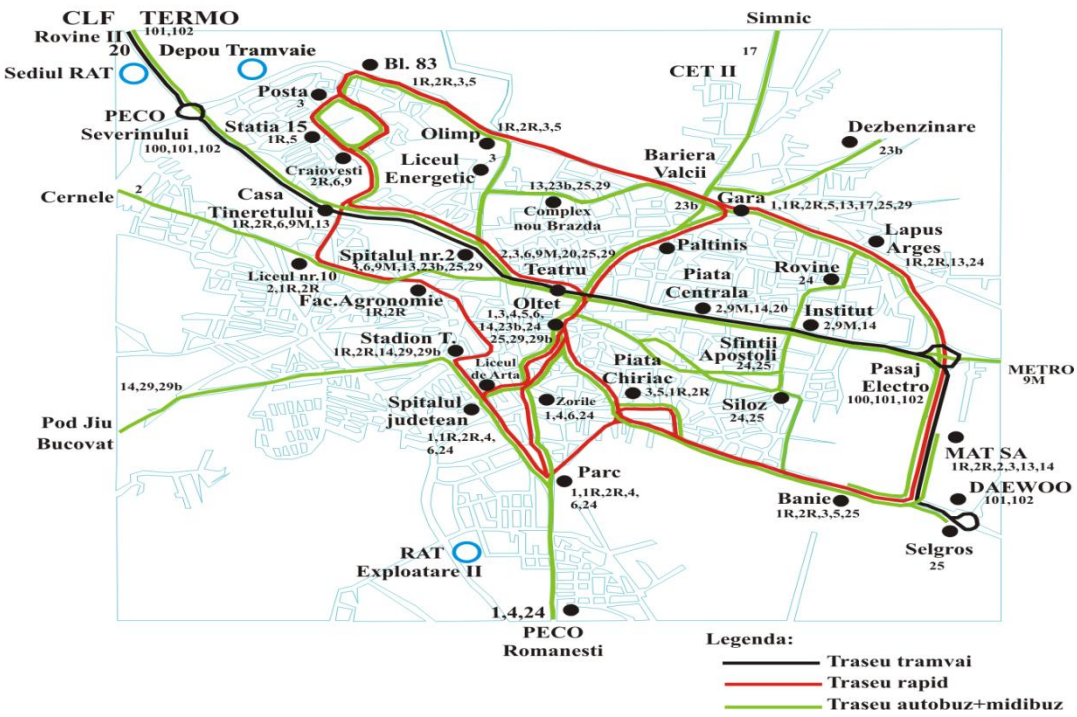


Figure B2.1 – Craiova PT network

A study was carried out on the requirements of the capacity of the Craiova public transportation. The study covered the features of the Craiova metropolitan area and the public transportation network. The

final part of the study included the analysis of air quality in Craiova and environmental impact of bus fleet renewal

In the study, the environmental data were provided by the Agency for Environmental Protection Dolj County that collected them from automatic monitoring system which includes 5 automatic stations. The pollutants monitored are those regulated by the national legislation (ORDIN 592/2002) that calculates the limit values, threshold values, criteria and the evaluation methods of SO2, NO2, NOx, CO and PM10.

The air monitoring stations from Craiova are placed in key locations for air quality so that they collect data from various pollution sources. The structure of the monitoring network is the following:

1. Calea Bucuresti Station (DJ1) – traffic station. This location is the most crowded point from the traffic in Craiova.
2. Primarie Station (Town Hall) (DJ2) –urban station, situated in urban area, near the city centre.
3. Billa Station (DJ3) - mixed station – industrial and traffic station, found under the influence of both thermal plants, of the Chemical Plant and of the heavy traffic network from the west part of the city
4. Isalnita Station (DJ4) - industrial station, situated in the suburban area, found under the influence of the Chemical Plant and of the thermal plant in the area.
5. Breasta Station (DJ5) - regional station, situated at a distance to all major pollution and agglomeration sources.

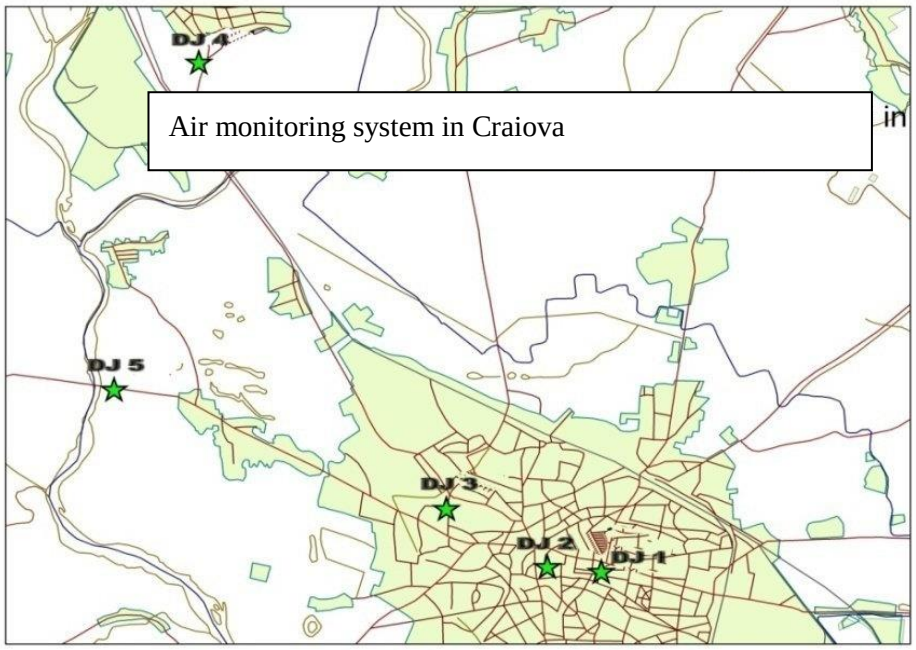


Figure B2.2- Craiova map presenting the air quality monitoring stations

The monitoring stations are situated in the urban area and in the industrial area. Two of these stations are important for the transport pollutant emissions. The emissions registered by the Calea Bucuresti station (DJ1) result from the urban transport, the station being placed in one of the most crowded intersections from the area. Billa station (DJ3) is placed near the western industrial area of Craiova and in a crossroads with intense traffic. From the 2009 report regarding air quality in Craiova, made

by the Agency for Environmental Protection Dolj we took over the data monitored in those 5 stations. The data related to 2008 and 2009 are shown in the following table:

MONITORING STATIONS			Concentration - Annual average (µg/m³)	
Monitoring station	Pollution source	Pollutant type	year	
			2008	2009
DJ1 Calea Bucuresti	traffic	SO2	21	17
		NO2	33.7	32
		NOx	55	57
		CO	0.40	0.36
		PM10	47	38
DJ2 City Hall	urban background	SO2	19	15
		NO2	35	24
		NOx	58	41
		CO	0.32	0.35
		PM10	50	38
DJ3 Billa	traffic and industry	SO2	21	16
		NO2	30	34
		NOx	60	75
Station has no CO sensor		X	X	X
		PM10	60	40
DJ4 Isalnita	industry	SO2	23	18
		NO2	17	16
		NOx	29	25
Station has no CO sensor		X	X	X
Station has no Pm sensor		X	X	X
DJ5 Breasta	regional background	SO2	17	18
		NO2	16	16
		NOx	25	24
		CO	0.30	X
		PM10	34	X

The data from the table shown that the stations DJ1 and DJ3 registered high values of nitrogen oxides (NOx) and material particles (Pm). These pollutants are specific to transport activities.

The nitrogen oxides values registered in 2009 are a little bit higher than those of 2008 thing that is explicable through the fact that the number of cars increased and the traffic is more intense.

The conclusions of the study were the following:

- Craiova city has a network of public transportation with a developed infrastructure that covers the entire surface of the city and makes the connections between the industrial areas and the general interest areas in conditions of average comfort for the passengers.
- Because of the objective conditions of material type, the quality of public transportation has degraded gradually in the last 15 years. This is hard to accept by the citizens. More than that, the bad state of some means of transportation, led to an irregular traffic, with low speed for these means of transport.
- It is necessary a renewal of the buses park with new ecologic buses.
- It is necessary to change of the attitude to use low capacity buses, by using this type of auto vehicles only on the transport routes with a low number of passengers, and adopting high capacity buses on the more important lines.
- Because of the bad state of many of the vehicles from the PTC Craiova, the use coefficient of the bus and microbus fleet is of only 75%.

The operation of the public transportation network under the actual conditions lead to economic losses for the operator PTC Craiova, low comfort for passengers and also increase the level of pollutants that are released in the atmosphere. Public transportation must be made in correlation with the organization of the urban general traffic for assuring an optimum service and a fluent traffic, in safety conditions and with a favourable impact over the protection of the environment.

The result of this activity was the deliverable 01.07.02 –"Analysis of necessity and environmental impact"

- **Renewal fleet**

Technical specification for the purchase of clean buses was produced. The technical requirements for the new buses were compliant with the norms EURO 4 as minimum and contained all the technical, functional, constructive and qualitative specifications as well as the environmental impact

The result of this activity was the technical requirements for purchasing clean buses which will be used as a part of public tender documentation that the Municipality of Craiova intends to launch in 2013 for the tender for acquisition of 50 new clean buses.

- **Finding of available financial support**

There were analysed various open calls for access, available for purchasing new clean buses

The following open calls and opportunities were found:

- Transport Regional Program(ERDF- European Regional Development Fund, Structural Funds- 2007-2013)
- ELENA Program – support the cities in acquisition of ecological buses.
- COMPRO project

- Own financial resources(money coming from the Municipality)

After analysing these available funding opportunities, solution for renewing the fleet of buses was to use the available budget of the Municipality, according to the deliverable 01.07.08- "Report on funding scheme plan".

B3 Situation before CIVITAS

Before the CIVITAS project, Craiova's public transport fleet consisted in old buses and a considerable part of them were older than 10 years, according to the table below (Table B3.1) that shows the fleet structure, in 2008. There were 100 buses used in daily operations leading to a not so attractive public transport for passengers.

Table B3.1 – Fleet composition in 2008

Number of buses in inventory	Year of fabrication	EURO Classification
64	1995	Non EURO
63	1997	2
16	2000	2
2	2002	3
19	2002	2
10	2003	2
12	2004	3

The vehicles mentioned above suffered a bad technical condition because of long exploitation.

Taking into account the endowment of the public transport in Craiova, the purchasing of new vehicles that could give a cleaner and ecological public transport in the city would be needed.

B4 Actual implementation of the measure

The measure was implemented in the following stages:

Stage 1: Planning and design of the measure (Sept 2009 – March 2010)

This activity was R&D one and it was described in detail within the chapter "Research and Technology Development".

An analysis of the public transport needs in Craiova was carried out and an environmental impact assessment was completed.

The analysis included the characteristics of the Craiova metropolitan area, description of the public transport network and the needs of the public transport. The analysis shown that the quality of public transportation has degraded gradually in the last 15 years and the bad state of some means of transportation, led to an irregular traffic, with low speed for these means of transportation.

The analysis of air quality shown that the stations DJ1 and DJ3 which are directly affected by traffic, registered high values of nitrogen oxides (NOx) and material particles (Pm), specific to transportation activities.

The conclusion of the analysis was, on the one hand, to renew the buses park with new ecologic buses, and, on the other hand, to use low capacity buses only on the transport routes with a low number of passengers, and adopt high capacity buses on the more important lines

Stage 2: Plan for renewal fleet (April 2010 – March 2011)

Technical specification for the purchase of 20 clean buses was produced. The technical requirements for the new buses were compliant with the norms EURO 4 as minimum and contained all the technical, functional, constructive and qualitative specifications as well as the environmental impact. The result of this activity was the technical requirements for purchasing clean buses, which will be used as a part of public tender documentation that the Municipality of Craiova intends to launch in 2013 for the tender for acquisition of 50 new clean buses.

TECHNICAL SPECIFICATION

1. GENERALITIES

1.1. Object and domain of application

The acquisition of products packages made out of:

''Bus for public transport"

a. **number of units: 20;** ± 20%
b. **motoring: minimum EURO 5 without AdBlue;**
c. **Lot: 2010.**

All those 20 buses will be manufactured by the same producer:

CPV Code: 34121100 – 2 –public bus.

The Job specification refers to the technical and quality conditions that the buses must meet. The buses will have RAR (Romanian Automobile Register) approval or an equivalent for the ones coming from the C.E. member states. The buses must have identity cards issued by RAR, for obtaining the registration certificate. The approval given by RAR or its equivalent must be presented at the moment of the bid.

The bidder has to present to the buyer's commission, for viewing and evaluation, an urban bus, found under serial production for at least two years, which would satisfy the requirements of the present job specification. The bidders can present to the evaluation commission a bus with materials and technical equivalent solutions, with the condition that it would meet the minimal performance requirements, anti-corrosive protection, warranty and long life, imposed by the present job specification.

1.2. TECHNICAL CONDITIONS

1.2.1. Requirements for the environment

The bus is destined for the exploitation in areas with temperate climate **N** and that is:

a) ambient temperature: -33°C up to +50°C;
b) maximum relative humidity (to + 20°C): 80 %;
c) maximum altitude: 1200 m;
d) exterior agents: powder, rain, fog, mud, snow, frost, ice, salt water, petrochemical products.

1.2.2. Mechanical conditions

Noise level: according to the European bus norms (CEE ONU R 51)

1.3. General constructive description of the bus

a) Buses must fulfil the special conditions of viability, security, comfort, ambient protection at the level of the European norms and must assure a low maintenance and easy accessibility to aggregates. Buses will have low floor for the entire length or at least at two doors they will respect the CE 2001/85 norms.
b) The exterior design and the design of the elements inside the bus must be modern and must offer corresponding comfort to passengers.
c) The bus will have a transport capacity of app. 100 people out of which 25 - 35 seated.
d) The body will be self-supporting modular type, on the whole available surface for the standing passengers. The body will have a warranty to corrosion for at least 12 years. It will have 3 access doors for passengers, on the right side.
e) The position of the doors, the configuration of the passengers' room and of the climbing platform will assure a good circulation of passengers with a corresponding load of the axles.
f) The driving room will have a modern design, separated from the passengers' room. (cabin).
g) The direction will be of „servo-assisted" type and it is preferred the hydraulic variant.
h) The suspension will be fully pneumatic, with a "kneeling" system controlled electronically. The failure of suspension will be signalled on board.
i) The bus will be endowed with secondary break with compressed air with 2 independent circuits.
j) The front axle will be of rigid type, and the back axle compact, with crown and hypoid pinion teeth attack. The back axle can be equipped with two-stage reducer.

1.4. Documentation

The offer will comprise:

- design presenting the view (frontal, back, lateral, up) of the bus. The designs contain the indication of main dimensions.
- designs that will indicate the position of chairs, doors, stop buttons, windows, and safety exits.
- the scheme of the electric circuit and the cable plan.
- the arrangement of the driver's seat and the board panel, in detail.
- the scheme of the pneumatic circuits with the value of the pressures in the circuits and the mounting plan.

- the scheme of the oiling installation.

2. Technical quality conditions

2.1. Constructive specifications

a) All the buses that are the object of the present job specification must present a unitary solution, verified in practice for at least two years on a series product approved and delivered to at least 3 municipalities from CE countries. There will be presented testimonials, in original, from users.
b) All the sub-ensembles and the component parts must be of series type, interchangeable to the entire delivered lot.
c) The origin of the sub-ensembles, aggregates and equipment from these buses will be kept for the entire delivered lot.

2.1.1. Materials

The important sub-ensembles (engine, gearbox, front, motor axle), as well as the body, will be given warranty from the bidder of the bus, through warranty certificates accompanied by conformity certificates from the producers of the sub-ensembles, respectively of the bus, regarding an increased reliability, low maintenance, assuring a good accessibility for the execution of maintenance operations.

In the stage of bid, the bidder will present a model of the warranty certificate, accompanied by conformity certificates from the producers of the sub-ensembles mentioned above.

Stage 3: Funding scheme study (March 2011- Jun 2011)

Finding available financial support

Various calls and funding programs were analysed, for purchasing new clean buses. The following open calls and opportunities were analysed:

- Transport Regional Program (ERDF- European Regional Development Fund, Structural Funds- 2007-2013)
- ELENA Program –support the cities in order to facilitate the access to financing from European Investment Bank in acquisition of ecological buses.
- COMPRO project.
- Own financial resources(money coming from the Municipality), through the investment budget, without using any external financial resources.
- European Investment Bank – facilities to access to financing in acquisition of ecological buses.

After analysing these available funding opportunities, solution for renewing the fleet of buses was to use the available budget of the Municipality, as reported in the deliverable 01.07.08- “Report on funding scheme plan”. This for the following reasons:

STRUCTURAL FUNDS

In the framework of Structural Funds- 2007-2013 of the Europe Union, the acquisition of buses and trams are not considered as eligible costs, so this financial opportunity cannot be used for the purpose of the measure. In order to find a possible financial source for the acquisition of new buses, the Municipality of Craiova sent a request related to this subject to the Ministry of Transport which is the management authority for the **Structural Funds** devoted to the transport domain which could provide support for the acquisition of clean buses. Unfortunately, the response of the Ministry was negative and we were informed by a formal letter that in the current programming period for the structural funds, the public transport topics cannot be addressed not only to Romania, but to all European states.

MINISTERUL TRANSPORTURILOR
ŞI INFRASTRUCTURII

AUTORITATEA DE MANAGEMENT POS TRANSPORT

DIRECŢIA GENERALĂ RELAŢII FINANCIARE EXTERNE

București 15 / 03 / 2019

Nr.40/DP/CC/ 100.195

Domnului Ciprian Predescu, SC IPA CIFATT Craiova

Ref: Răspuns la solicitarea de informații

La solicitarea cumneavoastră privind posibilitatea achiziționării de autobuze urbane prin POST, vă informăm că această acțiune nu este eligibilă în cadrul programului pe care îl gestionăm.

Programul Operațional Sectorial Transport finanțează în principal proiecte de construcție, reabilitare sau modernizare a infrastructurii naționale de transport.

Investițiile aferente DMI 3.3 se adresează minimizării efectelor asupra mediului pentru infrastructura națională de transport (drumuri naționale, autostrăzi, căi ferate, Dunărea etc.).

Cu stimă,

DIRECTOR GENERAL
ŞERBAN ALEXANDRU CUCU

București, B-dul Dinicu Golescu, nr. 38, Sector 1
tel.: 0750.032.291; fax: 319.61.78; e-mail: dgrfe5@mt.ro

Figure B4.1 – Ministry of Transport reply to Craiova request

ELENA PROGRAM

Another analysed financing source was the ELENA program devoted to cities for the acquisition of ecological buses. The ELENA project comes to support the applicants with the preparation of technical and economic assistance without any financial participation, but the buses acquisition must be acquired through a bank loan. The applicant should submit a description of the planned investments for the project, the foreseen cost and the development plan.

THE INSTRUMENT OF TECHNICAL ASSISTANCE FOR THE ENERGETIC EFFICIENCY –ELENA (EUROPEAN LOCAL ENERGY ASSISTANCE).

The budget of the program is of 15 million euro, The financier of the program is the European Investment Bank, The purpose of the program is the support of the local and regional innovative investments in the domain of renewable energies and energetic efficiency, mainly for constructions and transports.

Approximate financing domains

- The development of eco-efficient energetic systems
- The integration of renewable energy systems at the level of building: solar panels, photo-voltaic panels, etc.
- The development of a public clean and efficient transport system from the energetic point of view.

THE DESCRIPTION OF THE ELENA PROGRAM

In order to facilitate the mobilization of funds for investments in sustainable energy at the local level, The European Commission and the European Investment Bank came up with the ELENA technical

assistance mechanism (European local energy assistance), financed through the Intelligent Energy-Europe program.

ELENA covers a part of the cost for the technical support that is necessary to train, and to put into practice the financing of the investment program, such as *feasibility and market studies, the programs structuring, business plans, energetic audits, preparation for tender procedures* – in short, all that is necessary to make the cities and regions "sustainable energetic projects" ready for EIB finance.

INVESTMENT PROGRAMS THAT CAN BE SUPPORTED BY ELENA

Many cities and regions from the EU started recently to prepare projects for the energetic efficiency and project proposals for renewable energy, in order to approach challenges connected to climate changes. Nevertheless, most of them are still in the stage of project and their putting into practice proves difficult, because most regions and cities, especially average and small, do not have the technical capacity to develop large programs in this domain.

ELENA helps the public authorities solve such problems by offering specific support for the application of investment programs and projects, such as the renovation of public and private buildings, sustainable constructions, low energy consumption for heating and cooling, of ecologic transport, etc. The urban areas represent approximately 70% from the energy consumption from the EU.

Several studies show that there is a high potential for improving the energetic efficiency and for developing energy from renewable sources in cities and regions for urban transport. As a consequence, cities and regions will play an important role in attaining the energetic need of the EU and for climate changes through the clean, ecologic urban transport. In order to attain these objectives large investments that can be made through projects with European finance are necessary.

EIB CONTACTING

ELENA Program can facilitate the access to financing from European Investment Bank or to the financing from another bank. The ELENA program is managed by EIB.

The contacts with EIB can be under any form:

- by phone, by fax, by e-mail or letter (the preferred method is the e-mail at elena@eib.org).

For a first contact, it is needed a short description to comprise all the planned investments (for example, type of investments, approach of putting into practice), the cost of investments foreseen and the calendar for program, plus the sum of the project and the application domain. The European Union (EU) made from the global fight against climate changes a top priority, and the local authorities will play a significant role in attaining this objective.

ELENA Program offers technical assistance to facilitate the grant awarding for preparing investment programs in this domain. The local authority has an important role for the realization of the strategic objectives of the EU connected to the energetic politics and especially for the efficiency that they represent as significant investments. The realization of these objectives at a local level brings benefits to the local economy, the improvement of life quality for the citizens and the attenuation of climate changes.

EXAMPLES OF INVESTMENT PROGRAMS THAT CAN BE SUPPORTED BY ELENA:

- Energetic efficiency in public buildings,
- Development of solar energy in public buildings,
- Public transport in clean and energy efficient cities.

PUBLIC TRANSPORT IN CLEAN AND ENERGY EFFICIENT CITIES

The transport authorities see for the improvement of services through the renewal of its public bus fleet. The new fleet must be characterized through a high environment performance, superior to the one already existent and also, up to date with the standards imposed by the EU regulations.

Different technological options were taken into consideration (hybrid engines, etc), considering to be the best available solution on the market. Nevertheless, the costs connected to the acquisition and to the function of the new fleet can be larger than the conventional technologies and it is needed corresponding financing, including the potential participation of the private sector. The ELENA assistance is required for building a business plan, including the preparation of reference terms for bus offer request.

THE TECHNICAL FACILITY OF ELENA ASSISTANCE

The European Commission and the EIB launched the ELENA facility, with a fund of 15 million EUR managed by EIB, to improve the quality training of projects in the domain of energetic efficiency and of renewable energy sources. This facility has as objective the preparation of investment programs in cities that can be afterwards replicated in other cities or regions. This subvention/ support are offered inside the EIE II program.

The public organisms prepare the investment program in the sectors mentioned above and can apply for direct assistance from EIB. There will be no request for proposals, the assistance will be granted based on the principle "first come, first served" in the limits of the budget. The applicants must present the EIB investment project and to indicate the technical assistance necessity inside the facility.

In order to start the discussion for ELENA assistance, at least the following information must be presented at EIB:

- Short description of planned investments inside the project, including the type of investments for the putting into practice and approach of the program;
- The cost of foreseen investments and the development plan for the program;
- The sum, the application domain and the main needs that must be approached by the required AT.

Based on this information, EIB will see if the proposal fulfils the selection criteria and will evaluate the technical assistance necessity (AT) of the specific investment program.

After receiving a positive result for this evaluation, an assistance request can be prepared and EIB will present the proposal to the European Commission for approval. The selection criteria and the eligible costs are detailed below.

EIB will select the investment programs that are to be supported inside the facility based on the following criteria:

- The eligibility of the applicant;
- Considering the eligibility of the investment programs (type of program, location in an eligible country);
- Financial and technical capacity of the applicant for putting into practice and the finalization of the investment program;
- The verification of the fact that the financial assistance inside this mechanism should not be used for investment programs that can be better supported by other similar facilities from the European Union, including the cohesion and the Structural Funds. In the case in which the funds can be obtained from other facilities, the applicant should justify why the use of this mechanism is more appropriate;

ELIGIBLE COSTS

Technical assistance can be given for the development of feasibility and market studies, programs' structuring, business plans, energetic audits, the elaboration of bid procedures for the units that implement the programs and which include any other type of assistance necessary for the development of investment programs. Nevertheless, the hardware costs, such as measurement equipment, computers or office spaces, are excluded.

The required technical assistance must be for the realization of the investment programs and must respect the principles of a good financial management, for money and for cost efficiency. The auxiliary personal cost allocated for the application of a TA is an eligible cost. The staff costs must correspond to the effective salaries plus the taxes with social security and other costs connected to payment. The EU contribution can cover up to 90% from the eligible costs.

The financial aid for technical assistance inside this mechanism cannot be given retrospectively. The financial assistance must not have as purpose or as effect the providing of a profit for the beneficiary.

COMPRO PROGRAM FOR THE ACQUISITION OF ECOLOGIC BUSES

Based on criteria as eligibility of the applicant, eligibility of the investment, financial and technical capacity of the applicant to put into practice the investment, the technical assistance from European Investment Bank makes an evaluation followed by a proposal to the European Commission in order to be approved.

This program unfortunately does not represent a solution for the actual economic context because it would raise the degree of debt of the Municipality which is already involved in a package of large investment projects for whose implementation the Municipality must partially participate with its own resources. Additionally, due to the economic situation, the Municipality has not now the possibility to access new loans.

So, the appropriate (and remaining) solution for renewing the buses fleet was the budget of Municipality that reserved money for buses purchasing. Unfortunately, after the budget analysis made as usually in June 2011, the Municipality was forced to redirect the budget for buses purchasing to other investments that were considered of major importance for the year 2011. In these conditions, the Municipality transferred the buses acquisition initiative at the beginning of 2013. The current difficult economic situation generated by the general economic crisis is not favourable for investment and any investment is being made with caution and is very well weighed before the final decision. Often the decisions and priorities are changing according to the economic context and more, according to the forecasts in the global economy.

The Municipality of Craiova, although has a large number of projects in its local strategy, was forced to establish some priorities concerning the local budget allocation and its targeting to different projects. In the local strategy of the Craiova Municipality, the buses acquisition was a priority but the difficult economic circumstances, which have begun to be perceived in 2009, allowed the purchase of only 17 clean buses.

Stage 4: Operation with new buses (Nov 2011-Sept 2012)

Emissions estimation was made by COPERT IV software, to evaluate the reduction of pollutant emissions by renewing the fleet. The emissions coming from the 17 new buses – Lion's city type – were estimated and compared with the emissions coming from NON Euro buses which were scrapped.

A survey was done on public transport users in order to see the passengers' opinion regarding to the buses fleet which was a little upgraded by replacing of 17 NON Euro buses with 17 Euro IV type buses.

Stage 5: Plan for renewal fleet (September 2012 –December 2013)

As a result of this measure outcomes, the Municipality of Craiova City decided to consider a priority the acquisition of new clean buses. In this regard it was decided for 2013 to purchase 50 new clean buses, this acquisition being included in the investment list. The acquisition will take place on the basis of the technical specification and the tender documentation developed within this measure and described above, in the stage 2 of measure implementation.

B5 Inter-relationships with other measures

The measure is related to other measures as follows:

- **M 01.02** Alternative Fuels in Craiova aims to decrease the emissions in the city by introducing alternative fuel.

C. Impact Evaluation Findings

C1 Measurement methodology

C1.1 Impacts and Indicators

Table C1.1: Indicators. Insert your own table where available, use landscape layout as necessary

No.	Impact	Indicator	Data used	Comments
8-11	Environment	CO2 emissions	-Km travelled/year for the 100 active buses -Annual fuel consumption for the 100 active buses	Modelling using COPERT IV model for daily active fleet consisting in 100 buses.
		CO emissions		
		NOx emissions		
		Particulate emissions		
19	Transport	Quality of service	Index %, qualitative	Face to face surveys Perception of quality of service of the buses fleet (From survey)

Detailed description of the indicator methodologies:

- **Indicator 8 -11(CO2, CO, NOx, PM exhaust)**

The emissions (CO, NOx, PM, CO2,) are estimated with COPERT IV program, version 7.1, using the input data provided by Transport Company.

The steps followed for calculating the emissions have been:

- Step 1: Install COPERT IV version 7.1 program
- Step 2: Create a file: .mdb extension

- Step 3: Input data entry and obtaining report:

Table C1.1.1

RAW DATA INPUT				REPORTS	
Country data:	**Fuel info:**	**Fleet configuration**	**Activity data**	**Emissions factor**	**Total emissions**
- min temperature - max temperature atmospheric pressure - length trip(Km) - time trip(h) - Comments: First of all, set the year for emissions determination then input min and max. temperatures and atmospheric pressure for each months of the reference year . There are set the trip length and the time /trip	- fuel type - annual consumption (tones) Comments: Input the fuel type consumption(tonnes) coming from the buses for which calculate the emissions	- Select the sector: buses - Select the subsector: Urban buses midi,<=15 t - Select Legislation standard: Euro 1, 2, 3, 4 or Conventional	-input the number of buses for which calculate the emissions - input km travelled annual by the buses for which calculate emissions - input the average speed-(km/h) of buses for which calculate the emissions - input the travel area: urban only	CO, CO2, NOx, Pm Emissions factors(g/Km) Comments: The emissions factors are calculated automatically based on the raw input data	-All emissions (t/year): CO2, CO, NOx, Pm (exhaust) Comments: The emissions are calculated based on raw input data and emissions factors

- **Indicator 19 (Quality of Service)** - Survey based perception of quality of service

The survey was made to see the impact on PT users of the 17 clean buses purchased by RAT and the impact of the all fleet renewing 160 questionnaires were circulated to evaluate the 17 clean buses purchased by RAT and the same number of questionnaires to evaluate the impact of all buses fleet that could be new one.

The feedback for evaluation of the 17 buses (BAU situation) was 120 filled questionnaires and the feedback for the ex-post evaluation of the all fleet consisting of new buses were 110 filled

questionnaires. The questionnaires for BAU situation were disseminated to public transport users in stations, inside buses and during workshops organized by MODERN project team.

The workshops were organized during the Communication Campaign and seminar presentation that took place between 3 - 5 May 2010), 6-7 hours per day in the street in a pavilion located in the prefecture market (in the downtown) In agreement with the target group it was kept e-mail and phone to be contacted for ex-post evaluation period, too. The feedback of 120 and 110 questionnaires are satisfied for a population of 300'000 people in Craiova.

To be sure of obtaining such a sample we launched a number of questionnaires-160 The questionnaires were structured in 2 sections:

- General information about citizens (job, edge, gender, education level, contact data)
- Questions referring to the measure. The most important questions were:
    - "How do you estimate the quality of public transport in your city?" (satisfaction scale: 1-3)
    - "Do you consider that the quality of services in PT have been improved lately?"(Yes/No)

The sample size was estimated according to GUARD guideline – Annex G- " Sample size estimation formulae" (see Annex 3)

C1.2 Establishing a Baseline

In October 2008, in Craiova, RAT Craiova had 186 buses in inventory, structured as follows:

- 64 buses non-Euro,
- 108 buses Euro II,
- 14 buses Euro III

Public Transport Company in Craiova was operating, daily, with about 100 buses, according to existing requirements. The 100 buses in operation were polluting and didn't offer a good comfort for passengers because they are worn and old. Also, the image of the old buses was contrasting with the image of Craiova city which was under the modernization process. For this reason, Craiova Municipality decided to find a solution for renewing the buses fleet to improve the comfort of public transport.

This measure involves finding available funds for purchasing clean buses in order to replace the old buses that currently travel in Craiova. Therefore, evaluation compares the quality of service and pollution of old buses travelling in the city with new clean buses that could replace them.

The starting point is to calculate the emissions coming from the 100 old buses that were running in the city between (January – October) 2008, using the program COPERT IV, version 7.1. The 100 daily running buses included 60 Euro II buses, 30 Non euro buses and 10 EIII buses.

COPERT IV programme needs input data referring to country, length and time of trip, number of buses, fuel consumption and Kms travelled by fleet taking into consideration the EURO category

In the Table C1.2.1 are calculated emissions from entire fleet consisted of 100 old buses (NON EURO, EURO II and EURO III) :

Table C1.2.1 – emissions calculation

Name of raw data input	**Values of ex-ante raw data**
Country	Romania
Year	2008
length of trip in Craiova city Provided by RAT	20 Km
Time trip Provided by RAT	1 h
Country info – refers to the min. and max. temperatures and pressure recorded each month , from January to December 2008, in Romania Statistic data	

Month	Temp min(^{0}C)	Temp max(^{0}C)	RVP(kP)	calculate Beta
Jan	-20	8	100	0.15064
Feb	-15	9	100	0.14452
Mar	-12	2	100	0.12820
Apr	6	15	100	0.11698
May	12	25	100	0.10066
Jun	17	27	100	0.09352
Jul	20	38	100	0.07924
Aug	18	34	100	0.08536
Sep	14	27	100	0.09658
Oct	8	17	100	0.11290
Nov	5	10	100	0.12310
Dec	-10	6	100	0.14248

Annual fuel consumption (tones of diesel)- refers to fuel consumed by the old fleet in 2008 by type RAT provided the data relating to 2008	**1064 tones for 60 Euro II buses**
	368 tones for 30 Non Euro buses
	139 tones for 10 Euro III buses
Fleet configuration- refers to the buses size Provided by RAT	HD Urban buses midi <=15 tones
Fleet data – refers to number of buses traveling in the city and the respective mileage by Euro category RAT provided the data relating to 2008	**Population**: no of buses by Euro category(EII, EIII and NON Euro) - 60 Euro II - 30 NON EURO - 10 Euro III
	Mileage: - 4400907 Km travelled by 60 Euro II buses - 1185229 Km travelled by 30 NON Euro buses - 605143 Km travelled by 10 Euro III buses
Circulation data referring to the buses speed in the city Provided by RAT	Speed(Km/h): about 17Km/h in urban

Names of indicators calculated automatically	Values of indicators calculated automatically by the software (t/year)	Values of indicators (g/vKm)
CO2 exhausted by 60 Euro II buses	232’400	880.1216052
CO2 exhausted by 30 NON EURO buses	42’430	1193.299635
CO2 exhausted by10 Euro III buses	5’660	935.3161154
Total quantity CO2 exhausted by 100 old buses	**280’490**	
CO exhausted by 60 Euro II buses	602	2.279833074
CO exhausted by 30 NON EURO buses	258	7.255981755
CO exhausted by10 Euro III buses	15	2.478752956
Total quantity CO exhausted by 100 old buses	**875**	
NOx exhausted by 60 Euro II buses	2736	10.36150048
NOx exhausted by 30 NON EURO buses	446	12.54328629
NOx exhausted by10 Euro III buses	60	9.915011824
Total quantity NOx exhausted by 100 old buses	**3’242**	
Small particulate emissions exhausted by 60 Euro II buses	48	0.18178071
Small particulate emissions exhausted by 30 NON EURO buses	43	1.209330293
Small particulate emissions exhausted by10 Euro III buses	1.15	0.190037727
Total quantity Small particulate emissions exhausted by 100 old buses	**92.15**	

In order to have a clear picture of how emissions decreased by replacing of NON EURO category buses with new buses EURO IV category, we can calculate emissions from the 17 NON EURO buses versus 17 EURO IV clean buses.

Considering 17 NON EURO buses ROMAN UMD type that were proposed for scrapping can estimate annual quantity of emissions function of Km travelled and fuel consumption. The results for the 17 buses that are proposed for scrapping are shown in the table below.

Name of raw data input	Values of Ex-Ante raw data referring to 17 buses to be replaced

Measure title: Transition Towards Clean Fleets

City: Craiova Project: MODERN Measure number: 01.07

Country	Romania				
Year	2008				
length of trip in Craiova city	20 Km				
Time trip	1 h				
Country info – refers to the min. and max. temperatures and pressure recorded each month , from January to December 2008, in Romania Statistic data	Month	Temp min(^{0}C)	Temp max(^{0}C)	RVP(kP)	calculate Beta
	Jan	-20	8	100	0.15064
	Feb	-15	9	100	0.14452
	Mar	-12	2	100	0.12820
	Apr	6	15	100	0.11698
	May	12	25	100	0.10066
	Jun	17	27	100	0.09352
	Jul	20	38	100	0.07924
	Aug	18	34	100	0.08536
	Sep	14	27	100	0.09658
	Oct	8	17	100	0.11290
	Nov	5	10	100	0.12310
	Dec	-10	6	100	0.14248
Annual fuel consumption (tons of diesel) for the 17 buses proposed for scrapping- ROMAN UDM type RAT provided the data relating to 2008	174,15 tons for 17 NON EURO buses, ROMAN UDM type				
Fleet configuration - refers to the buses	HD Urban buses midi <=15 tones				
Number and mileage of buses - refers to number of buses and the respective mileage related to the 17 buses proposed for scrapping RAT provided the data relating to 2008	Population: no of buses 17 NON EURO buses, ROMAN UDM type				
	Mileage: 561784 Km travelled by 17 NON Euro buses, ROMAN UDM type				
Average speed of buses in urban area Provided by RAT	Speed(Km/h): 17 Km/h in urban				

Name of indicators calculated automatically	**Values of indicators calculated automatically (t/year)**	**Values of indicators (g/vKm)**
CO2 exhausted by 17 NON EURO buses	11400	1193.67628
CO exhausted by 17 NON EURO buses	69.23	7.24896569
NOx exhausted by 17 NON EURO buses	119.9	12.55454263

Small particulate emissions exhausted by 17 NON EURO buses	11.64	1.218806307

The results are included in the Annex 1 as screen-shots of COPERT IV reports.

C1.3 Building the Business-as-Usual scenario

Without CIVITAS project, the Municipality started the renewing the buses fleet by purchasing of 17 clean buses, in the end of 2008. So, 17 old buses were scrapped and replaced with the new ones. The Public Transport Company included the 17 new clean buses (Euro IV- MAN Lion's City) in the 100 buses that were operating daily in Craiova, therefore, canceling 17 old buses NON EURO category from their daily routine. The investment of the 17 buses was made with private resources, in the first month of the project, October 2008. Therefore, in 2009 the active buses fleet included the buses type as follows:

- 60 EuroII
- 13 NON EURO
- 10 EuroIII
- 17 Euro IV- MAN Lion's City

For these 100 active buses, that include 17 clean buses, the emissions were calculated using the same methodology COPERT software The input data and results are shown in the tables below:

Name of raw data	**Values of row data in BAU**				
Country	Romania				
Year	2009				
length of trip in Craiova city Provided by RAT	20 Km				
Time trip Provided by RAT	1 h				
Country info – refers to the min. and max. temperatures and pressure recorded each month , from January to December 2009, in Romania Statistic data	Month	Temp min(^{0}C)	Temp max(^{0}C)	RVP(kP)	calculate Beta
	Jan	-20	8	100	0.15064
	Feb	-15	9	100	0.14452
	Mar	-12	2	100	0.12820
	Apr	6	15	100	0.11698
	May	12	25	100	0.10066
	Jun	17	27	100	0.09352
	Jul	20	38	100	0.07924
	Aug	18	34	100	0.08536
	Sep	14	27	100	0.09658
	Oct	8	17	100	0.11290
	Nov	5	10	100	0.12310
	Dec	-10	6	100	0.14248
Annual fuel consumption (tons of diesel) of the fleet consisting in 83 old buses and 17 *MAN Lion's city* new buses.	1054 tones for 60 Euro II buses				
	335 tones for 13 NON Euro buses				

Measure title: Transition Towards Clean Fleets

City: Craiova Project: MODERN Measure number: 01.07

Name of raw data	**Values of row data in BAU**
The data were provided by RAT relating to 2009	137 tones for 10 Euro III buses
	256.26 tones for 17 *MAN Lion's city* new buses
Fleet configuration – buses size Provided by RAT	HD Urban buses midi <=15 tones
Number of buses and mileage - refers to number of buses and the respective mileage related to 83 old buses and 17 *MAN Lion's city* new buses The data were provided by RAT relating to 2009	Population: no of buses by Euro standard - 60 Euro II - 13 NON EURO - 10 Euro III - 17 Euro IV *MAN Lion's city type*
	Mileage: - 3119295 Km travelled by 60 Euro II buses - 1080229 Km travelled by 13 NON Euro buses - 595154 Km travelled by 10 Euro III buses - 732190 Km travelled by 17 Euro IV new buses MAN Lion's city type
Average speed of buses in urban area Provided by RAT	Speed(Km/h): 17Km/h in urban

Name of indicators calculated automatically	**Values of indicators calculated automatically(t/year)**	**Values of indicators (g/vKm)**
CO2 exhausted by 60 Euro II buses	164700	880.0065399
CO2 exhausted by 13 NON EURO buses	16760	1193.479132
CO2 exhausted by 10 Euro III buses	5567	935.3881516
CO2 exhausted by 17 Euro IV buses *MAN Lion's city type*	14750	1185.002607
Total quantity CO2 exhausted by 100 buses which consist in 83 old buses and 17 new buses	**201777**	
CO exhausted by 60 Euro II buses	426.8	2.280429819
CO exhausted by 13 NON EURO buses	101.8	7.249175157
CO exhausted by 10 Euro III buses	14.81	2.488431566
CO exhausted by 17 Euro IV buses *MAN Lion's city type*	22.49	1.767461516

Name of indicators calculated automatically	**Values of indicators calculated automatically(t/year)**	**Values of indicators (g/vKm)**
Total quantity CO exhausted by 100 buses which consist in 83 old buses and 17 new buses	**565.41**	
NOx exhausted by 60 Euro II buses	1939	10.360247
NOx exhausted by 13 NON EURO buses	176.2	12.54719708
NOx exhausted by 10 Euro III buses	59.41	9.982290298
NOx exhausted by 17 Euro IV buses *MAN Lion's city type*	100	8.03391598
Total quantity NOx exhausted by 100 buses which consist in 83 old buses and 17 new buses	**2274.61**	
Small particulate emissions exhausted by 60 Euro II buses	33.88	0.18102381
Small particulate emissions exhausted by 13 non-euro buses	17.12	1.219114722
Small particulate emissions exhausted by 10 Euro III buses	1	0.168023738
Small particulate emissions exhausted by 17 Euro IV buses *MAN Lion's city type*	0.78	0.062664545
Total quantity Small particula emissions exhausted by 100 bus which consist in 83 old buses and clean buses(Euro IV category)	**52.78**	

To have a clear picture of decreasing emissions by replacing the old buses NON EURO category with clean buses EURO IV category, estimate the emissions of the 17 EURO IV *MAN Lion's city type* , travelled in 2009. The results are shown in the table below:

Name of raw data	**Values of row data in BAU**				
Country	Romania				
Year	2009				
length of trip in Craiova city Provided by RAT	20 Km				
Time trip Provided by RAT	1 h				
Country info – refers to the min. and max. temperatures and pressure recorded	Month	Temp min(^{0}C)	Temp max(^{0}C)	RVP(kP)	calculate Beta
	Jan	-20	8	100	0.15064

each month , from January to December 2009, in Romania Statistic data	Feb	-15	9	100	0.14452
	Mar	-12	2	100	0.12820
	Apr	6	15	100	0.11698
	May	12	25	100	0.10066
	Jun	17	27	100	0.09352
	Jul	20	38	100	0.07924
	Aug	18	34	100	0.08536
	Sep	14	27	100	0.09658
	Oct	8	17	100	0.11290
	Nov	5	10	100	0.12310
	Dec	-10	6	100	0.14248
Annual fuel consumption for the 17 MAN Lion's city type replacing 17 NON Euro buses	256.26 tones for 17 clean buses				
Fleet configuration Provided by RAT	HD Urban buses midi <=15 tones				
Number and mileage of 17 MAN Lion's city buses The data were provided by RAT relating to 2009	**Population**: 17 EURO IV buses				
	Mileage: 732190 Km travelled by 17 EURO IV buses				
Input the average speed of buses in urban area Provided by RAT	Speed(Km/h): 17Km/h in urban				

Name of indicators calculated automatically	**Values of indicators calculated automatically(t/year)**	**Values .of indicators (g/vKm)**
CO2 exhausted by 17 EURO IV buses	**14'750**	1'185.002607
CO exhausted by 17 EURO IV buses	**22.49**	1.767461516
NOx exhausted by 17 EURO IV buses	**100**	8.03391598
Small particulate emissions exhausted by 17 EURO IV buses	**0.78**	0.062664545

The tables below, show emissions from 17 NON EURO buses versus 17 EURO IV buses expressed in t/year and g/vKm.

Measure title: Transition Towards Clean Fleets

City: Craiova Project: MODERN Measure number: 01.07

Indicators	Ex-ante values NON-EURO category (t/year)	Mileage(Km travelled in 2008) Related to 17 NON-EURO buses	BAU values EURO IV category (t/year)	Mileage(Km travelled in 2009) Related to 17 EURO IV buses Lion's city type
CO2	11'400	561784	14'750	732'190
CO	69.23		22.49	
NOx	119.9		100	
Small particulate emissions (PM)	11.64		0.78	

Indicators	Ex-ante values NON EURO category(g/vKm)	BAU values EURO IV category(g/vKm)
CO2	1'193.67628	1'185.002607
CO	7.24896569	1.767461516
NOx	12.55454263	8.03391598
Small particulate emissions (PM)	1.218806307	0.062664545

Fig C1.3.5 – CO2 emissions

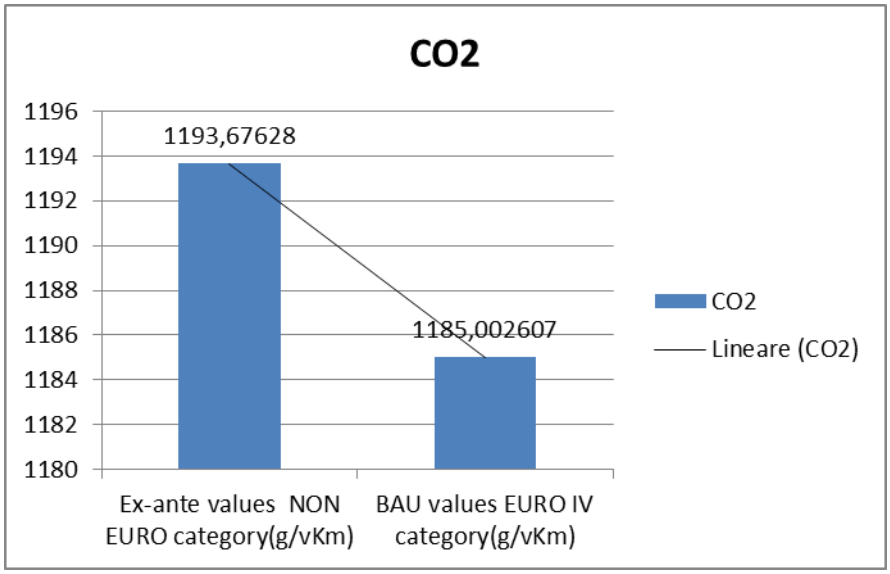


Fig C1.3.6 – CO emissions

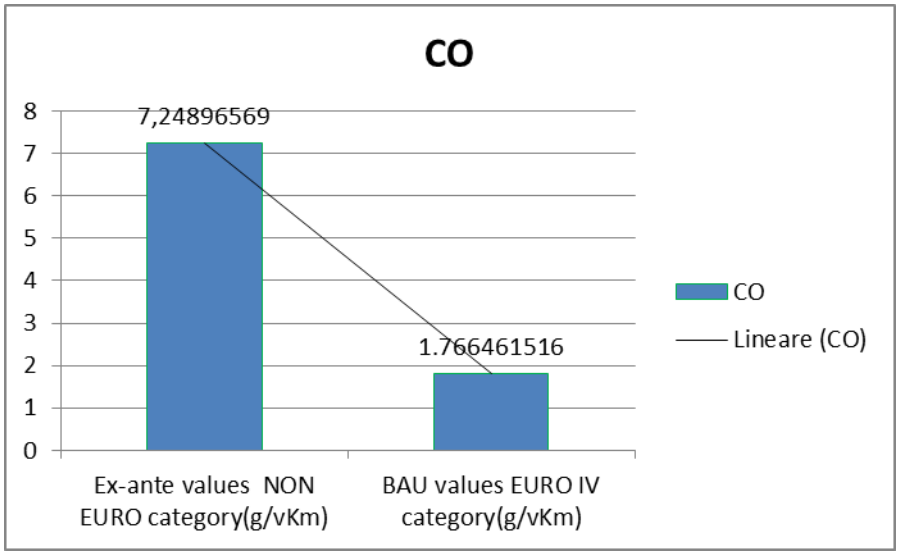


Fig C1.3.7 – NOx emissions

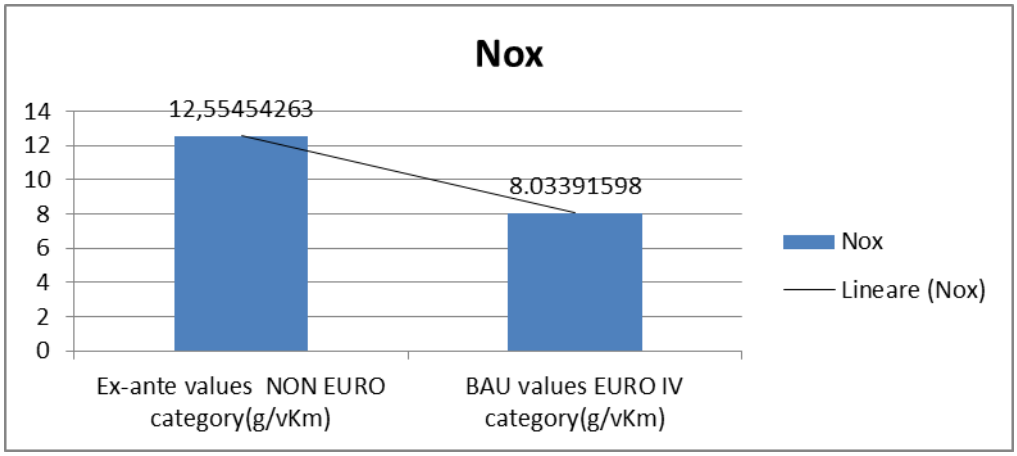
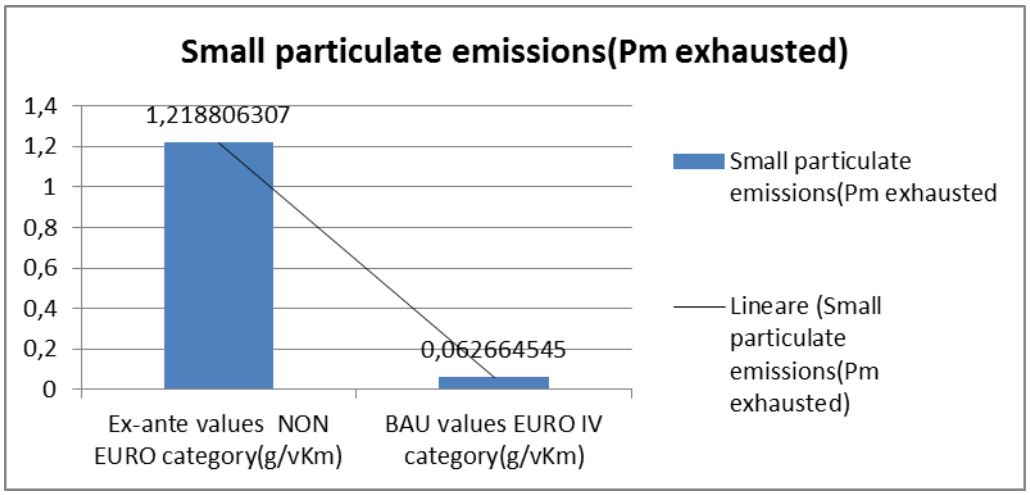


Fig C1.3.8 – Small particulate emissions



The quality of services given by the buses fleet including the new 17 buses purchased by RAT, has been shown through a survey on Public Transport users

160 questionnaires were circulated and 120 feedbacks were received. The people expressed their opinion about the fleet buses and they commented the emergence of new 17 buses as a commendable initiative of Municipality.

Table C1.3.9-a

Quality of Service	**BAU**
dissatisfied	22%
somewhat dissatisfied	39%
Satisfied	38%
don't know	1%

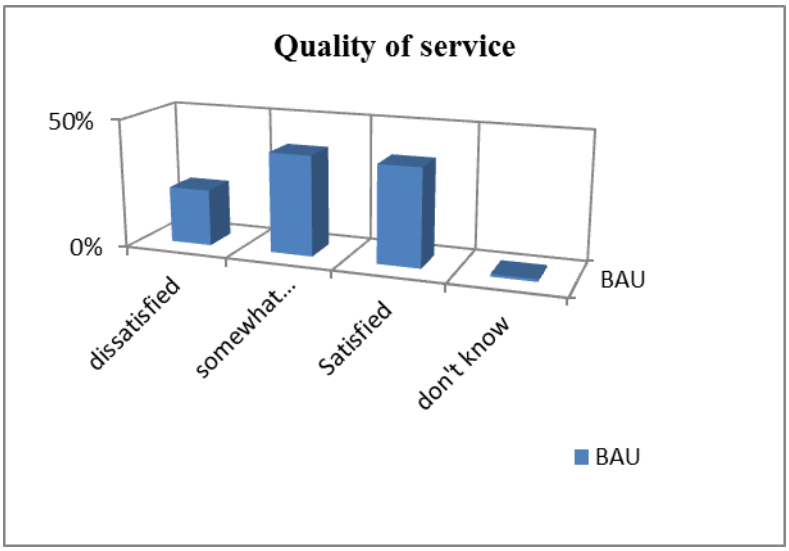


Figure C1.3.9-b – Quality of service results for BAU scenario – question n.1

Table C1.3.10-a

Quality of Service	BAU
uncomfortable	24%
somewhat comfortable	40%
comfortable	35%
don't know	1%

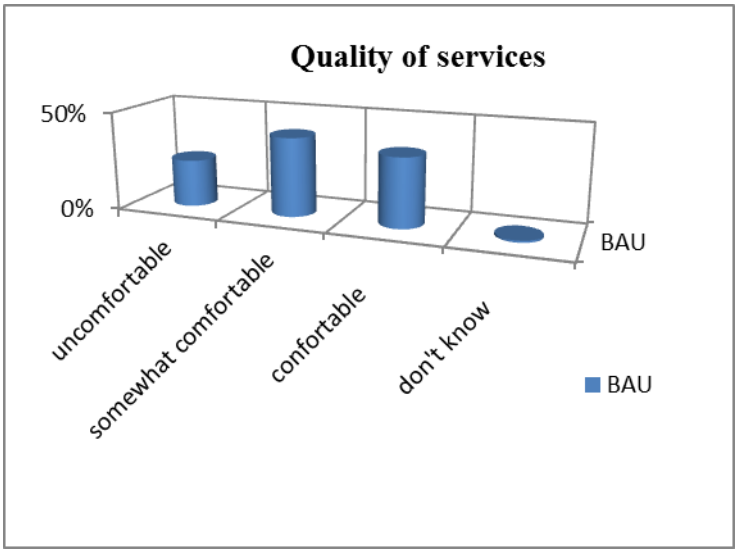


Figure C1.3.10-b – Quality of service results for BAU scenario – question n.2

C2 Measure results

The results are presented under sub headings corresponding to the areas used for indicators – i.e. economy, energy, environment, society and transport.

C2.3 Environment

Ex-post measurements based on the assumption that all active 100 buses are new buses, if RAT would have found a convenient source of financing for purchasing the buses

The emissions are calculated by COPERT software using the same raw data provided by RAT

Table C2.3.1

<table>
<tr><th>Name of raw data input</th><th>Values of Ex-post raw data</th></tr>
<tr><td>Country</td><td>Romania</td></tr>
<tr><td>Year</td><td>2009</td></tr>
<tr><td>length of trip in Craiova city
Provided by RAT</td><td>20 Km</td></tr>
<tr><td>Time trip
Provided by RAT</td><td>1 h</td></tr>
<tr><td>Country info – refers to the min. and max. temperatures and pressure recorded each month , from January to December 2009, in Romania
Statistic data</td><td>
<table>
<tr><th>Month</th><th>Temp min(^{0}C)</th><th>Temp max(^{0}C)</th><th>RVP(kP)</th><th>calculate Beta</th></tr>
<tr><td>Jan</td><td>-20</td><td>8</td><td>100</td><td>0.15064</td></tr>
<tr><td>Feb</td><td>-15</td><td>9</td><td>100</td><td>0.14452</td></tr>
<tr><td>Mar</td><td>-12</td><td>2</td><td>100</td><td>0.12820</td></tr>
<tr><td>Apr</td><td>6</td><td>15</td><td>100</td><td>0.11698</td></tr>
<tr><td>May</td><td>12</td><td>25</td><td>100</td><td>0.10066</td></tr>
<tr><td>Jun</td><td>17</td><td>27</td><td>100</td><td>0.09352</td></tr>
<tr><td>Jul</td><td>20</td><td>38</td><td>100</td><td>0.07924</td></tr>
<tr><td>Aug</td><td>18</td><td>34</td><td>100</td><td>0.08536</td></tr>
<tr><td>Sep</td><td>14</td><td>27</td><td>100</td><td>0.09658</td></tr>
<tr><td>Oct</td><td>8</td><td>17</td><td>100</td><td>0.11290</td></tr>
<tr><td>Nov</td><td>5</td><td>10</td><td>100</td><td>0.12310</td></tr>
<tr><td>Dec</td><td>-10</td><td>6</td><td>100</td><td>0.14248</td></tr>
</table>
</td></tr>
<tr><td rowspan="4">Annual fuel consumption- assumed for 100 buses fleet consisting in MAN Lion’s city Euro IV type</td><td>1054 tones for 60 buses MAN Lion’s city Euro IV type</td></tr>
<tr><td>335 tones for 13 buses MAN Lion’s city Euro IV type</td></tr>
<tr><td>137 tones for 10 buses MAN Lion’s city Euro IV type</td></tr>
<tr><td>256.26 tones for 17 buses MAN Lion’s city Euro IV type</td></tr>
<tr><td>Fleet data- assuming that</td><td>Population:</td></tr>
</table>

all active fleet of 100 buses fleet consisting in MAN Lion's city Euro IV type Consider the real mileage of the fleet- in 2009	100 MAN Lion's City buses – Euro IV type Mileage: **3119295** Km travelled by 60 buses MAN Lion's city Euro IV type **1080229** Km travelled by 13 buses MAN Lion's city Euro IV type **595154** Km travelled by 10 buses MAN Lion's city Euro IV type **732190** Km travelled by 17 buses MAN Lion's city Euro IV type
Name of indicators calculated automatically	Values of indicators calculated automatically(t/year)
CO2 exhausted by 60 Euro IV LC buses	153'800
CO2 exhausted by 13 Euro IV LC buses	11'540
CO2 exhausted by 10 Euro IV LC buses	4'891
CO2 exhausted by 17 Euro IV LC buses	14'750
Total quantity CO2 exhausted by 100 Euro IV LC buses	184'981
CO exhausted by 60 Euro IV LC buses	234.6
CO exhausted by 13 Euro IV LC buses	17.6
CO exhausted by 10 Euro IV LC buses	7.46
CO exhausted by 17 EIV buses	22
Total quantity CO exhausted by 100 Euro IV LC buses	281.66
NOx exhausted by 60 Euro IV LC buses	1'046
NOx exhausted by 13 Euro IV LC buses	78.47
NOx exhausted by 10 Euro IV LC buses	33.26
NOx exhausted by 17 Euro IV LC buses	100
Total quantity NOx exhausted by 100 Euro IV LC buses	1'257.73
Small particulate emissions exhausted by 60 Euro IV LC buses	8.206
Small particulate emissions exhausted by 13 Euro IV LC buses	0.61
Small particulate emissions exhausted by	0.26

10 Euro IV LC buses	
Small particulate emissions exhausted by 17 Euro IV LC buses	0.78
Total quantity Small particulate emissions exhausted by 100 Euro IV LC buses	9.856

As shown above, emissions could decrease significantly if all 100 old buses would be replaced with new buses MAN Lion's city Euro IV type.

The table below (Table C2.3.2) presents the comparison between Ex-ante, BAU and Ex-post values of emissions expressed in t/year**,** considering the emissions from the entire active fleet of 100 buses.

Table C2.3.2 – emissions results

Indicators	**Ex-ante values (t/year)**	**BAU values (t/year)**	**Ex-post values all fleet consisting of EURO IV category (t/year)**
CO2	280'490	201'777	184'981
CO	875	565.41	281.66
NOx	3'242	2'274.61	1'257.73
Small particulate emissions	92.15	52.78	9.856

See annex 1- ex-ante, BAU and ex-post emissions calculation and emissions print screens

As shown in the table, the entire fleet emissions decrease slightly by replacing the 17 buses but a significant decrease could be recorded if the whole active fleet would be replaced with clean buses- MAN Lion's city Euro IV type.

Fig. C2.3.3 Graphic presentation of CO2 emissions from all active fleet travelling in Craiova

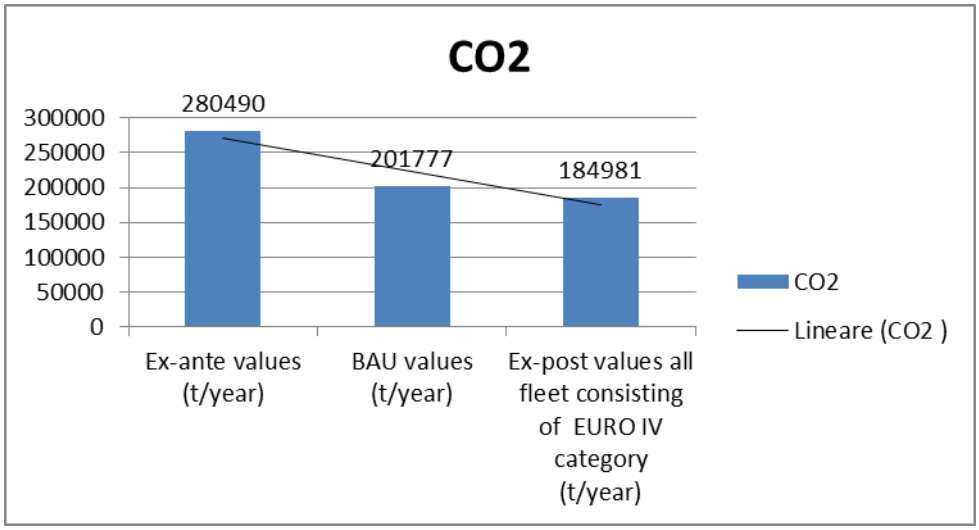


Fig. C2.3.4 Graphical presentation of CO emissions from all active fleet travelling in Craiova

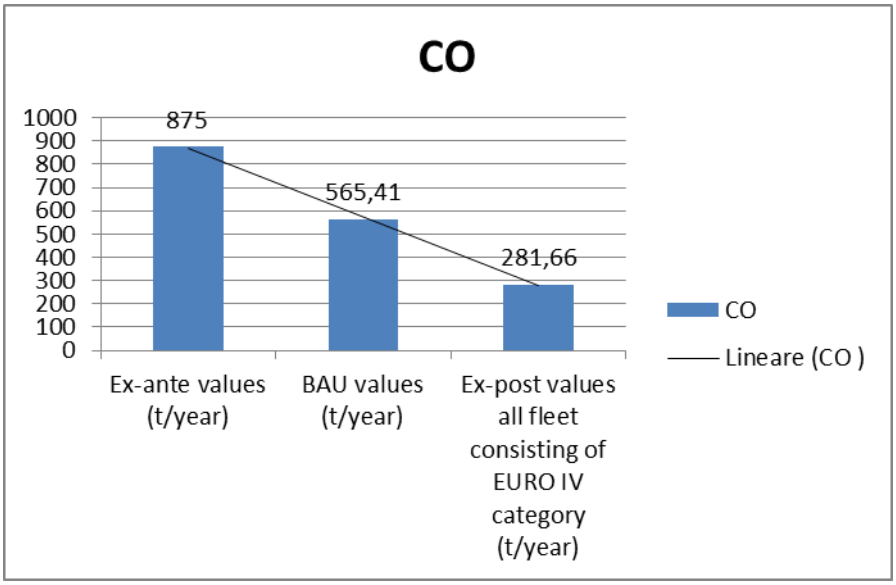


Fig. C2.3.5 Graphical presentation of NOx emissions from all active fleet travelling in Craiova

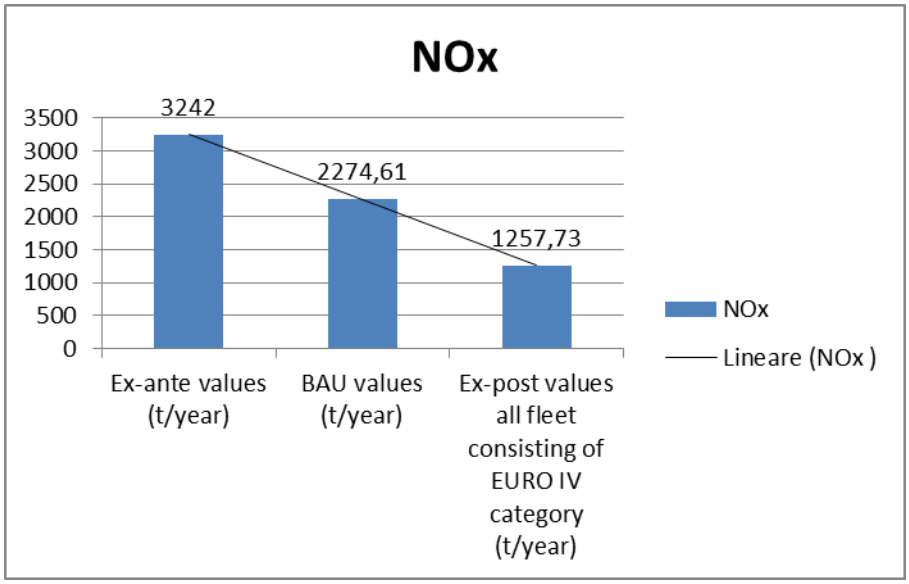
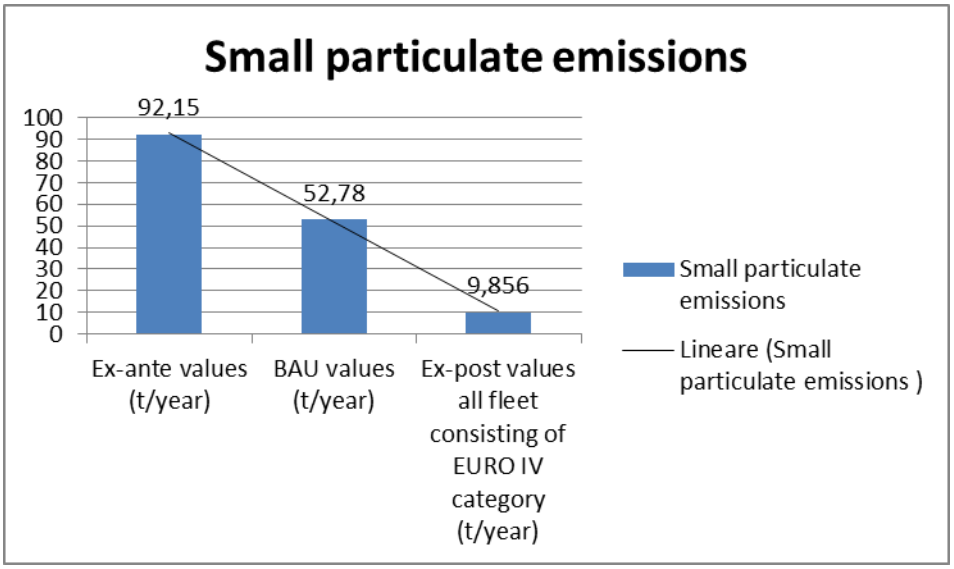


Fig. C2.3.6 Graphical presentation of small particulate emissions from all active fleet travelling in Craiova



By comparing total emissions from the entire fleet of old buses ("before case") with total emissions from the entire fleet, in which 17 NON Euro old buses were replaced with 17 Euro IV new buses we found that CO2 emissions decreased by 34%, CO emissions decreased by 67%, NOx emissions decreased by 61% and PM emissions decreased by 89%.

If considering the entire fleet to be replaced with new one ("after case"), there could be a decrease of CO2 emissions by 8%, CO emissions by 50% , NOx emissions by 44% and Pm emissions by 81% compared with "BAU case", in which 17 buses MAN LC type, only, replaced 17 NON Euro buses of entire fleet.

Table C2.3.1 – emissions from the whole fleet (100 buses)

Indicator	Before	B-a-U	After	Difference: After – Before	Difference: After – B-a-U
Indicator 8 CO2	280'490 t/year (2008)	201'777 t/year (2009)	184'981 t/y (2009)	-95'509	-16'796
Indicator9 (CO)	875 t/year (2008)	565.41 t/year (2009)	281.66 t/year (2009)	-593.34	-283.75
Indicator 10 (NOx)	3242 t/year (2008)	2'274.61 t/year (2009)	1'257.73 t/year (2009)	-1984.27	-1'016.88
Indicator 11 (Small particulate emissions)	92.15 t/year (2008)	52.78 t/year (2009)	9.856 t/year (2009)	-82.294	-42.924

C2.4 Transport

Table C2.4.1:

The surveys show that the satisfaction level increases and comfort will be improved if the buses old fleet would be replaced with new ones. To evaluate the passengers perception referring to whole bus fleet renewal scenario, 160 questioners were circulated and received 110 feedbacks .

Indicator	Before	B-a-U	After	After –Before	After – BAU
Indicator 19 (Quality of Service)	None applicable (2008)	22 % dissatisfied 39 % somewhat dissatisfied; 38% Satisfied 1 % don't know	10% dissatisfied 19 % somewhat dissatisfied; 70% Satisfied 1 % don't know	Not applicable	-12% -20% 32 %
		24 % uncomfortable 40% somewhat comfortable 35%confortable 1 % don't know **(2009)**	11 % uncomfortable 46 % somewhat comfortable 42%confortable 1 % don't know **(2009)**		-13 % 6 % 7%

Fig. C 2.4.2 Graphic representation of perception on quality of service(satisfaction level)

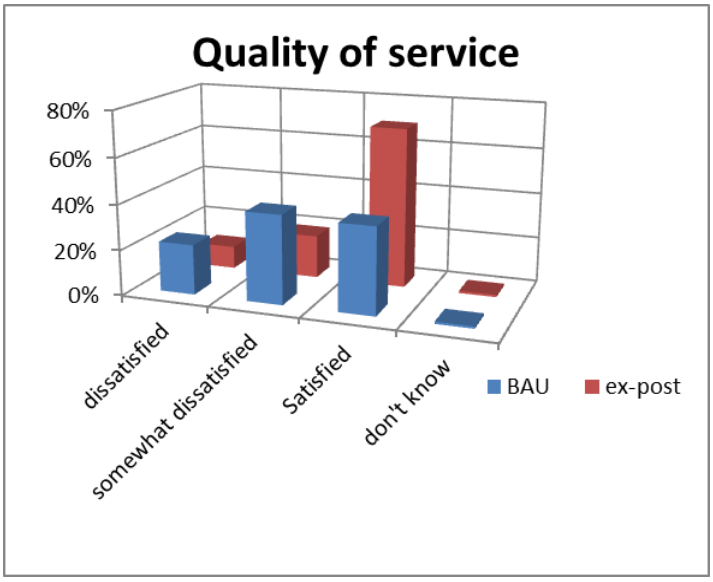
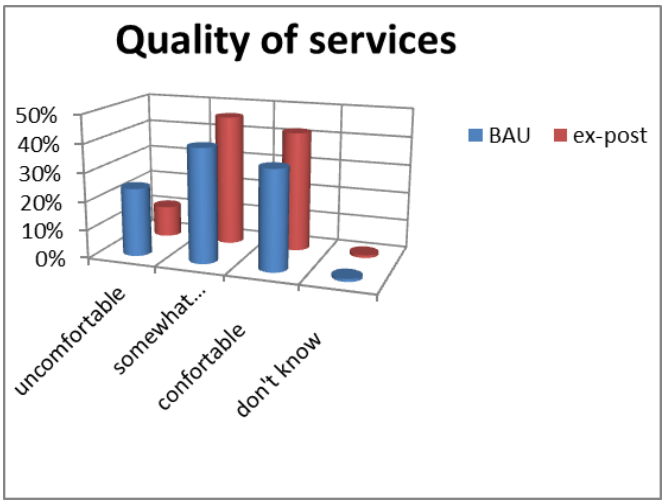


Fig. C 2.4.3 Graphic representation of perception on quality of service(comfortable)



C3 Achievement of quantifiable targets and objectives

No.	Target	Rating
1	To identify the typology of buses suitable for decreasing the emissions by 5%. Following the COPERT estimation, the emissions from the 17 NON EURO buses decreased comparing with emissions from the 17 EURO IV buses, as follows: • CO2(g/vKm) decreased with 1% • CO(g/vKm) decreased with 76% • NOx(g/vKm) decreased with 36% • Pm exhaust(g/vKm) decreased with 96%	★★★
2	To identify a good granting program for eco-buses acquisition.	O = Not Achieved
NA = Not Assessed O = Not Achieved ★ = Substantially achieved (at least 50%) ★★ = Achieved in full ★★★ = Exceeded		

C4 Up-scaling of results

After the results obtained by comparing the emissions coming from 17 NON EURO buses versus 17 EURO IV buses and taking into consideration the opinion of the public transport users after the replacement of the 17 old buses, the Municipality decided to continue the replacement of old buses starting with the taking out of circulation of NON EURO buses.

The Municipality is willing to renew in the near future all the bus fleet of Craiova and that is why it decided at the end of 2012 to allocate in the budget funds for buying of 50 ecologic buses. For this reason, at evaluation purposes, a scenario considering the availability of a completely new fleet has been developed.

C5 Appraisal of evaluation approach

In the evaluation activity we assessed the impact of the 17 buses that Municipality purchased by own budget on the environment and public transport users. In this sense we estimated with the help of the COPERT IV program, the annual emissions of 17 old buses from the NON EURO category which were replaced with new 17 EURO IV category and we observed a clear difference of the emissions produced by those two bus categories mentioned above. The emissions' estimation in COPERT was made taking into account the mileage and the fuel consumed by NON EURO buses and EURO IV buses.

To have a general picture of pollution from all buses fleet we also estimated the annual emissions of the entire fleet of old buses and the emissions produced by the entire fleet in which 17 old buses were replaced with new ones. We observed a slight decrease of the annual emissions made by the fleet, thing which demonstrates a positive impact over the environment. Under these conditions, it is obvious that the replacement of the entire old bus fleet with new ecologic ones will lead to a significant decrease of emissions in this city. That is why we have put together a scenario where we supposed that if an available financing source will be found, the municipality would be able to replace all old and polluting buses with ecological ones.

In order to assess the impact on public transport users, a survey was conducted and the interviewed people were stating their opinion regarding the quality of services brought by the public transport. The conclusion of the survey was that the population noticed the new clean and comfortable buses traveling in Craiova but they would feel more comfortable if all buses would be replaced with new ones.

C6 Summary of evaluation results

The key results are as follows:

- **Key result 1** – Following the COPERT estimation, the emissions from the NON EURO buses decreased comparing with emissions from EURO IV-MAN LC(Lion's city) type buses, as follows:
    - CO2(g/vKm) decreased with 1%
    - CO(g/vKm) decreased with 76 %
    - NOx(g/vKm) decreased with %
    - Pm exhaust(g/vKm) decreased with 96%

If entire fleet would be replaced by new buses Euro IV MAN Lions city type, city of Craiova would record a decreasing of emissions coming from entire fleet, compared with the situation in which 17 buses MAN LC type, only, replaced 17 NON Euro buses of entire fleet:

- CO_2 emissions decrease by 8%,
- CO emissions decrease by 50% ,
- NOx emissions decrease by 44%
- Pm emissions decrease by 81%

- **Key results 2** – Quality of services: The result of survey was the people that use public transport vehicles would be more satisfied and feel more comfortable if all old buses travelling in the city would be replaced with new ones

C7 Future activities relating to the measure

The Municipality of Craiova City decided to consider a priority the acquisition of new clean buses, as a result of these measure outcomes. In this regard it was decided for 2013 to purchase 50 new clean buses, this acquisition being included in the investment list. The acquisition will take place on the basis of the technical specification and the tender documentation developed within this measure and described in the second stage of implementation

D. Process Evaluation Findings

D.0 Focused measure

Question in Focussed Measure Process Evaluation Form

B4.

In the checklist below you will find a number of possible reasons for selecting this measure as a focused measure

Checklist of possible reasons

1	The measure fits into the EU policy towards clean urban transport (five pillars of the EU Green Paper)
2	The measure fits into the city policy towards sustainable urban transport and / or towards sustainability in general
3	The expected impact on the transport system, environment, economy and/ or society / people is very high
4	The high level of innovativeness of the measure with respect to technique, consortium, process, learning etc
5	The measure is typical for a group of measures or a specific context
6	The possibility of carrying out a good Cost Benefit Analysis
7	Participation of a range of different actors
8	The high degree of complexity of managing the measure
9	The measure is regarded as an example measure
10	Other, *please describe????*

Which are the three most important reasons for selecting this measure as a focused measure?

- *Please fill in the number of the reason from the checklist above in the open box according to importance.*
- *If it is not clear what the reason(s) is (are), please check this with your Local Evaluation Manager and / or your Project Evaluation Manager.*

3	1	Most important reason
1	2	Second most important reason
2	3	Third most important reason

x	0	No focused measure
-	1	Most important reason
-	2	Second most important reason
-	3	Third most important reason

D.1Deviations from the original plan

The deviations from the original plan comprised:

- **Deviation 1**– *Change the decision of Craiova Municipality to acquire 100 buses by own financial sources and grants.* The initial measure description form focused on searching available grant to acquire 100 new buses. In Romania, in the period 2007-2013. The buses acquisition costs are not eligible within the Structural Funds Program, so the Municipality could not use any support from this program. Although other funding programmes such as ELENA and COMPRO were available, the Municipality could not supported the financial conditions imposed by those programs, as it cannot access to new bank loans.

D.2Barriers and drivers

D.2.1 Barriers

Preparation phase: No barriers

Implementation phase

- **Barrier 1**: **Institutional –** The SW Oltenia Region did not include in its Operational Regional Program up to 2013 any budget (coming from European Structural Funds) for PT buses. So there are no available funding programmes to finance the acquisition of clean buses, the Operational Regional Program being focused on financing the transport infrastructures. There are no funding programmes opened for accession to finance acquisition of clean buses, these programmes being focused on financing the transport infrastructures, only, on the other hand, others are not suitable for the actual economical context because they would increase the indebtedness of the Municipality.
- **Barrier 2: Financial –** The global economic recession make that the Craiova City Hall changed its priorities in expenditures cutting funds for PT vehicles acquisition, with the perception that the same will come for the next 2- 3 years. Due to the dependency on public funds, RAT cannot achieve the target to improve the PT fleet. The Public Transportation Company depends on public fund, if the expenditures are approved by the City Hall. As a result of the global economic recession the City Hall cut the funds for the acquisition of PT vehicles.

Operation phase

- **Barrier 1: Financial** – Due to the economical context the Municipality was forced to make changes in the budget allocation and to direct the budget for the 20 buses foreseen for investment in 2011, toward other priorities (tramline rehabilitation).

D.2.2 Drivers

Preparation phase

- **Driver 1: Involvement, communication** – It was a good communication between partners. IPA start searching opened calls for applications in order to attract European money for transport infrastructure

Implementation phase

- **Driver 1: Involvement, communication –** The partners established a good communication relationship. IPA started to identify the funding programmes open for accession concerning the financing of clean buses acquisition for RAT.

Operation phase

- **Driver 1 Political / strategic** – The Municipality included in the investment plan for 2011 the necessary budget for 20 buses beside the 17 clean buses already achieved in the first year of the project as an additional initiative which represents an expected finality of this measure not necessary during the project implementation but as future investment plans.

D.2.3 Activities

Preparation phase: No activities

Implementation phase

- **Activities 1 Financial** – Analysis of other than Structural Funds. Partner IPA tried to identify other financing programmes for acquisition of new clean buses than the Structural Funds.
- **Activities 2 Financial** – Craiova participated to the cities working group under COMPRO project to explore the possibility of joint procurement of buses. This project intended to establish the general condition for a common acquisition. But there were no funds foreseen for the acquisition for new buses. Also, the ELENA instrument of the European Investments Bank has been identified as a potential source of loans to be deeply analyzed. But the City hall could not fulfil the financial conditions required by this program due to the actual economical context and the fact that it would increase the indebtedness of the Municipality.

Operation phase

- **Activities 1 Planning** – Evaluation according to the proposed indicators of the 17 buses purchased in the first year of the project and considered as "Business as Usual" scenario.

D.3 Participation

D.3.1. Measure Partners

- **Measure partner 1** – IPA Leading role

  IPA SA is a 47 years old Romanian industrial R & D company and is the Romanian national institute for research and development, engineering in energy, automation and IT, with a large experience in European projects in technology transfer and in information dissemination.
  IPA was responsible for the dissemination activities and carrying out the research activity and technical study in the MODERN project of Craiova.

- **Measure partner 2** – RAT Principle participant

  RAT Craiova is the main Public Transportation Company in Oltenia region. RAT Craiova provides citizen transportation by trams, buses and micro-buses.

  In the measure, RAT provided the mileage and fuel consumption of buses assessed. The buses drivers from RAT helped the evaluation team to disseminate questionnaires to PT users in order to assesses the quality of services from new buses.

- **Measure partner 3** – LCM – Occasional participant

  The Local Council of Craiova Municipality was established according to Law No. 215/2001 regarding Local Public Administration with the subsequent modification and completion.

  Municipality as local government institution has, under the conditions imposed by the public administration law, the decisional right in all matters of local interest: political, social, cultural,

educational and technical. Through their structures, the municipality is a complex mechanism which can produce major changes in the quality of urban life under an effective management and coordination.

The competencies of these bodies related to the project covers both the services provided to the local community (i.e. Public transport service in various forms) and the technical interventions (the urban infrastructure, constructions) that together change the image of the city and bring added value to the quality of life in the areas where they act.

D.3.2 Stakeholders

- **Stakeholder 1 – Regional Development Agency South-West Oltenia** – In Romania there are eight this kind of regional development agencies. Their purpose is to implement the economic and social cohesion policies at the level of the regions and promote the implementation of development programs and provide the services necessary to community and investors to maximize the economic and social benefits at the level of the region. The agencies coordinate all projects using Structural Funds from the European Commission at the region level. Together we try to find a solution for clean bus acquisition.
- **Stakeholder 2 – Romanian Ministry of Transport -** Trying to find a solution for clean bus acquisition through a scheme using European funds or advantageous bank loan.

D.4Recommendations

Managing financial resources of the city is a strong element in decisions regarding city development but is the strongest barrier that keeps policy options derived from the vision of the Municipality. Every public administration has its own policy priorities and often political change brings changes in the city's development priorities. Own financial Municipal resources, even if included in their budget, could be changed according to the financial situation and political factors leading to reconsider the priorities list of the cities.

A vision regarding the Mobility Plan, integrated with local and sustainable development measures is absolutely necessary in the medium size cities. When we analyze the mobility, to cut CO2 emissions, we must discuss others options:

- Development of new and clean fleet supported by the green procurement.
- Traffic restrictions and green zones (pedestrian areas, restricted access zones, speed limits, urban charging, etc.).
- Intelligent Transport Systems (ITS), urban traffic management and control.
- Innovative solutions for high quality collective transport, inter-modal terminals for collective transport, and good links between suburban and urban transport networks.
- Education, training and awareness raising activities have an important role to play, as well as development of new knowledge, collection of data and monitoring of trends.

Municipality, as local government institution has, under the conditions imposed by the public administration laws, the decisional right in all matters of local interest: political, social, cultural, educational and technical. Through their structures, the Municipality is a complex mechanism which can produce major changes in the quality of urban life under an effective management and coordination.

Moreover, other important lessons learnt are:

- The objective to cut CO2 emissions, to develop more sustainable urban transport systems are linked with a program of training, especially for drivers of the buses (eco-driving training).
- Great achievements are made in small steps. We learn that changes do not occur overnight and they are the results of a lot of effort and resources.

D.4.1 Recommendations: measure replication

- **Recommendation 1 –** For the cities that are in the conditions to use structural funds for urban PT, that would be the most convenient solution. In all other situation, the BEI through ELENA program give good financial conditions.

D.4.2 Recommendations: process (related to barrier-, driver- and action fields)

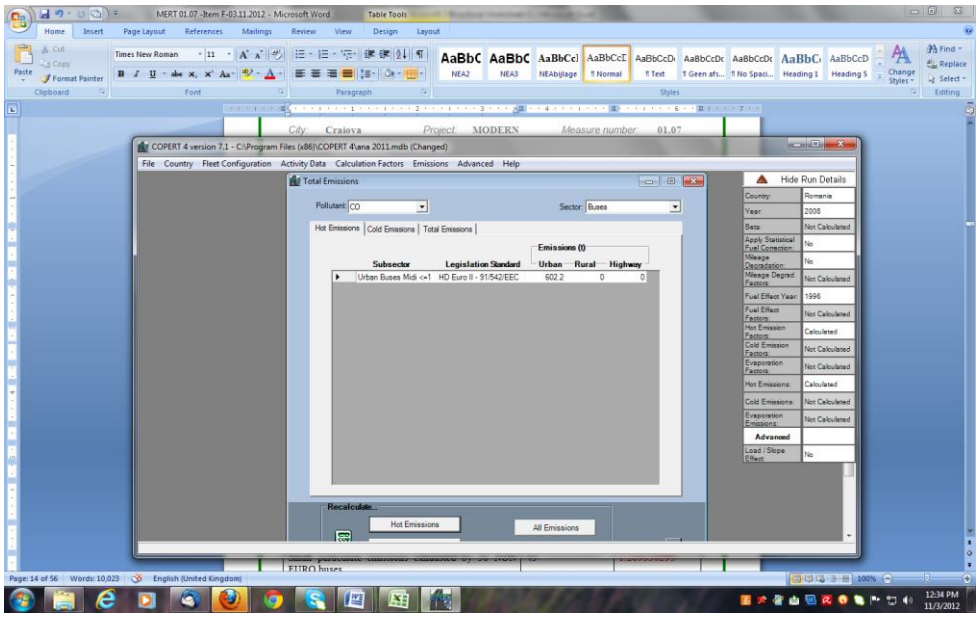
- **Recommendation 1 –** Before undertake a task like improving most of the public transport fleet, in order to make the public transport more utilized we must take into account that a budgets and the financial programs can change from when the feasibility study was made to when the buses will be bought.

Annex 1: Emissions calculation

Total emissions coming from all fleet in 2008 , consisting in 100 old buses:

- 60 buses Euro II
- 30 buses NON Euro
- 10 buses Euro III

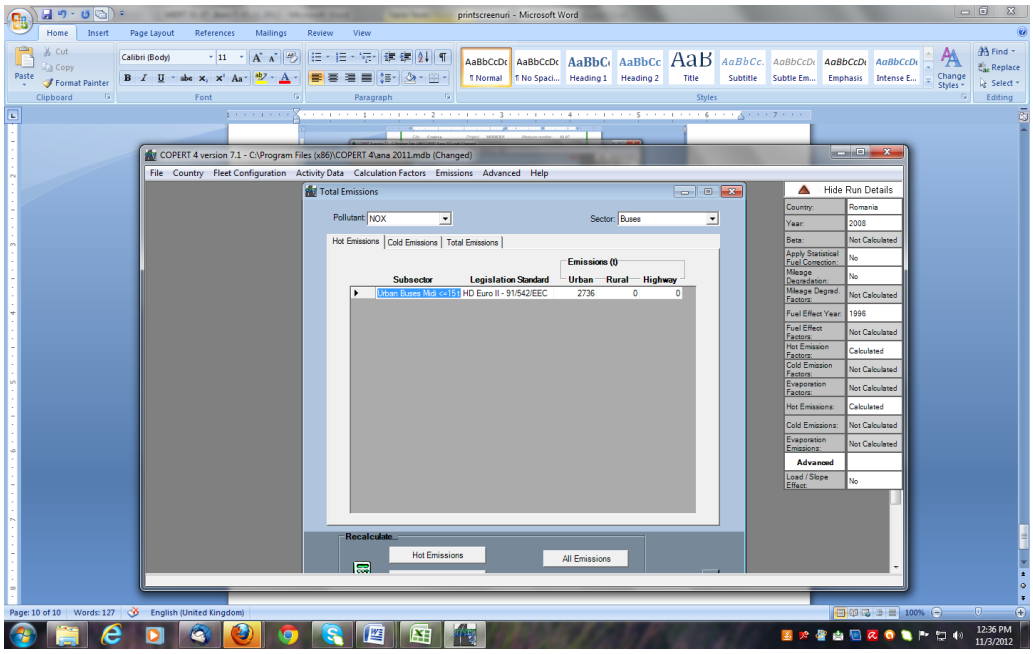
Total emissions CO- 60 buses Euro II in 2008



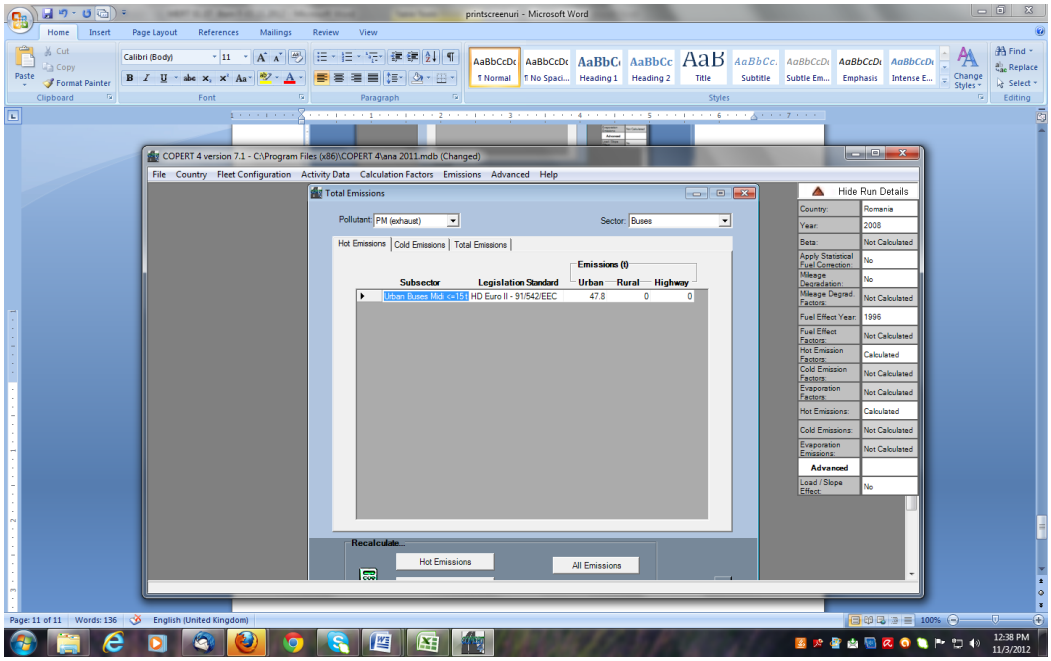
Total emissions NOx- 60 buses Euro II in 2008

Measure title: Transition Towards Clean Fleets

City: Craiova Project: MODERN Measure number: 01.07



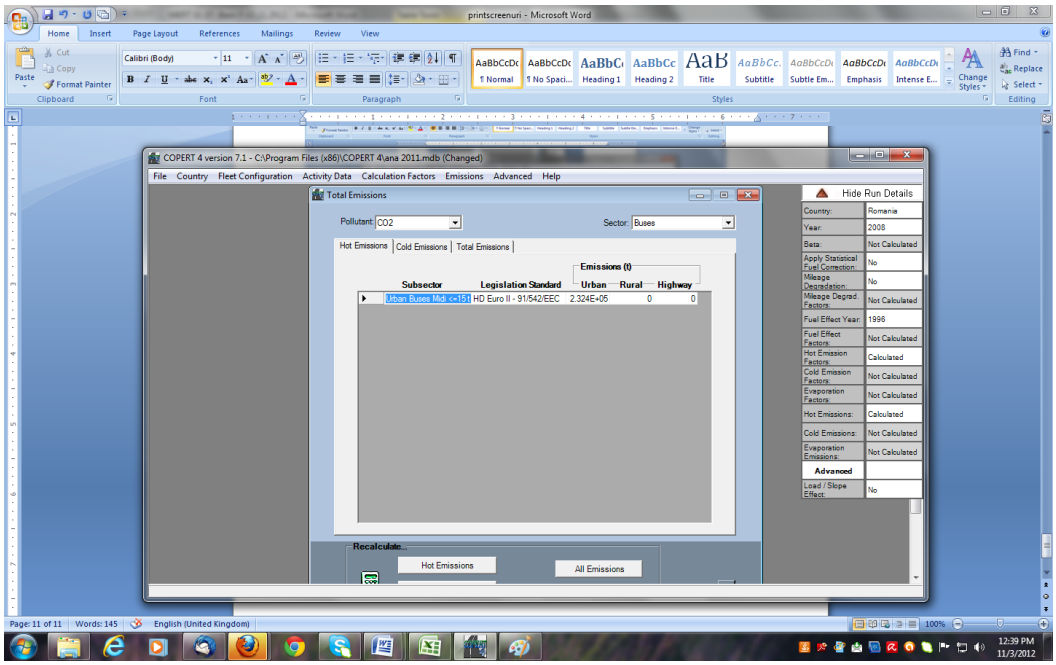
Total emissions Pm- -60 buses Euro II in 2008



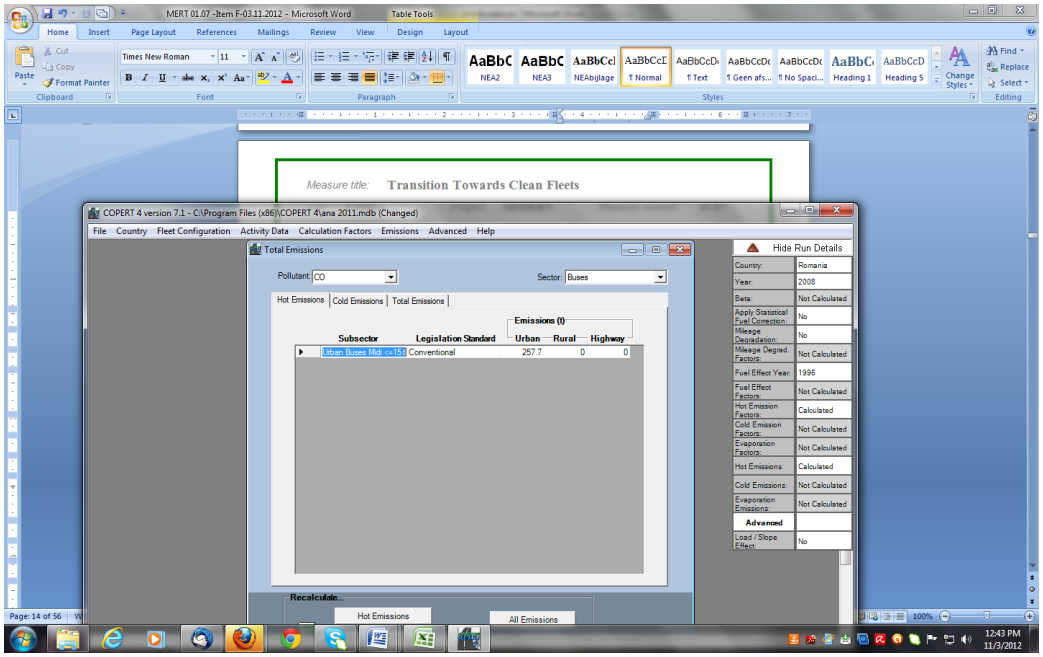
Total emissions CO2- 60 buses Euro II in 2008

Measure title: Transition Towards Clean Fleets

City: Craiova Project: MODERN Measure number: 01.07



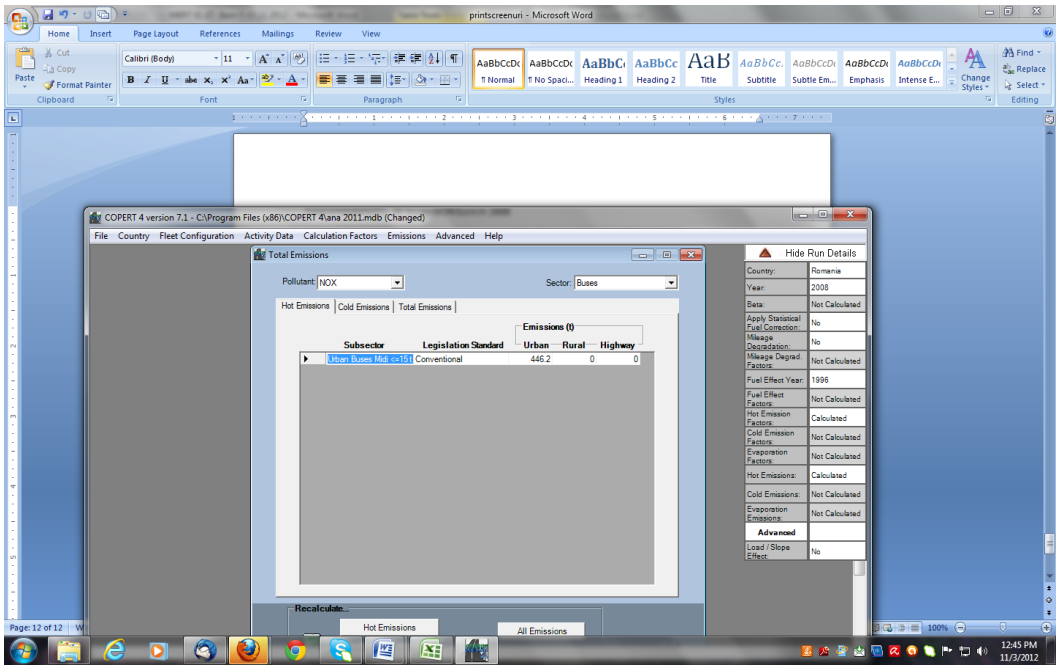
Total emissions CO- 30 buses NON Euro in 2008



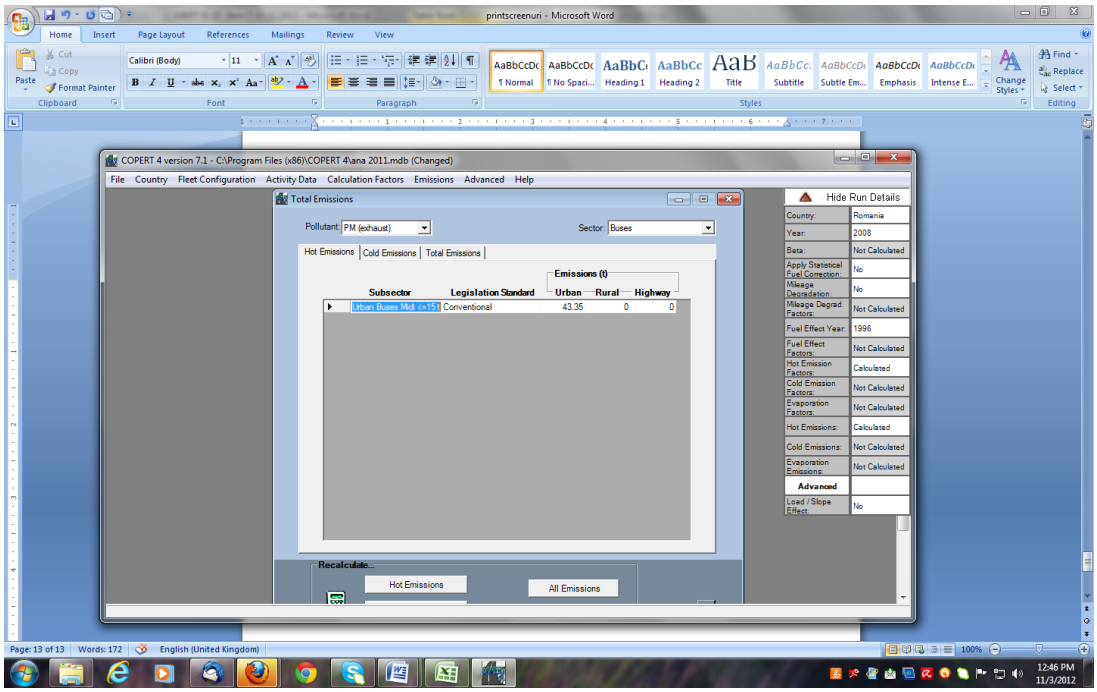
Total emissions NOx- 30 buses NON Euro in 2008

Measure title: Transition Towards Clean Fleets

City: Craiova Project: MODERN Measure number: 01.07



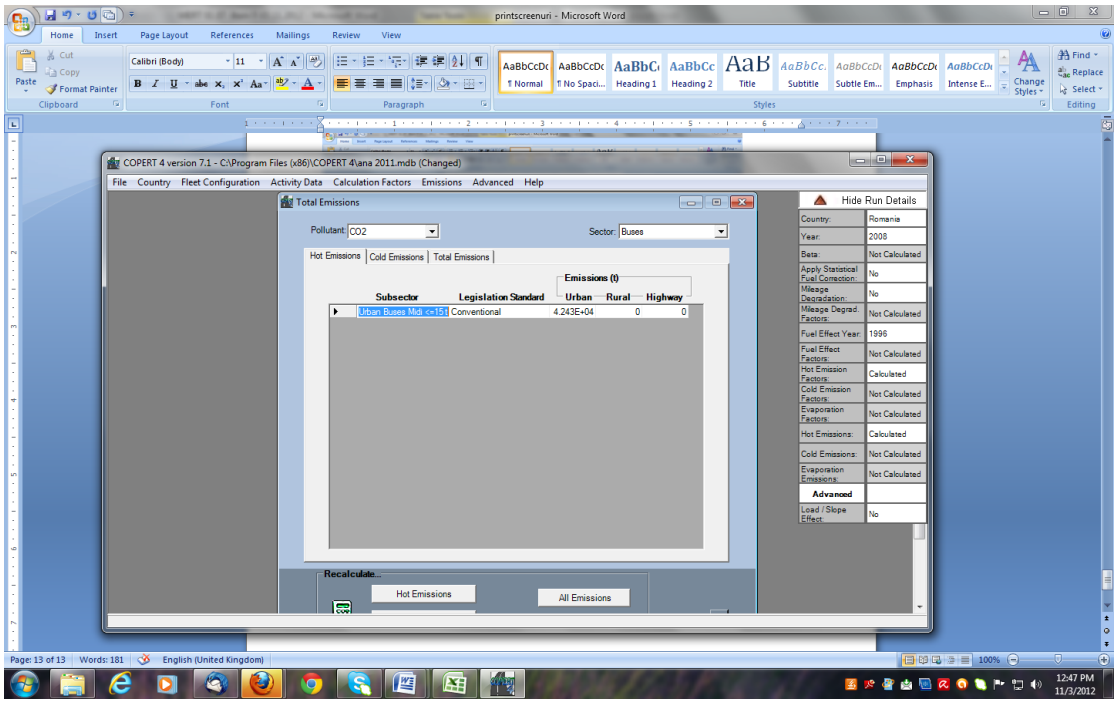
Total emissions Pm- 30 buses NON Euro in 2008



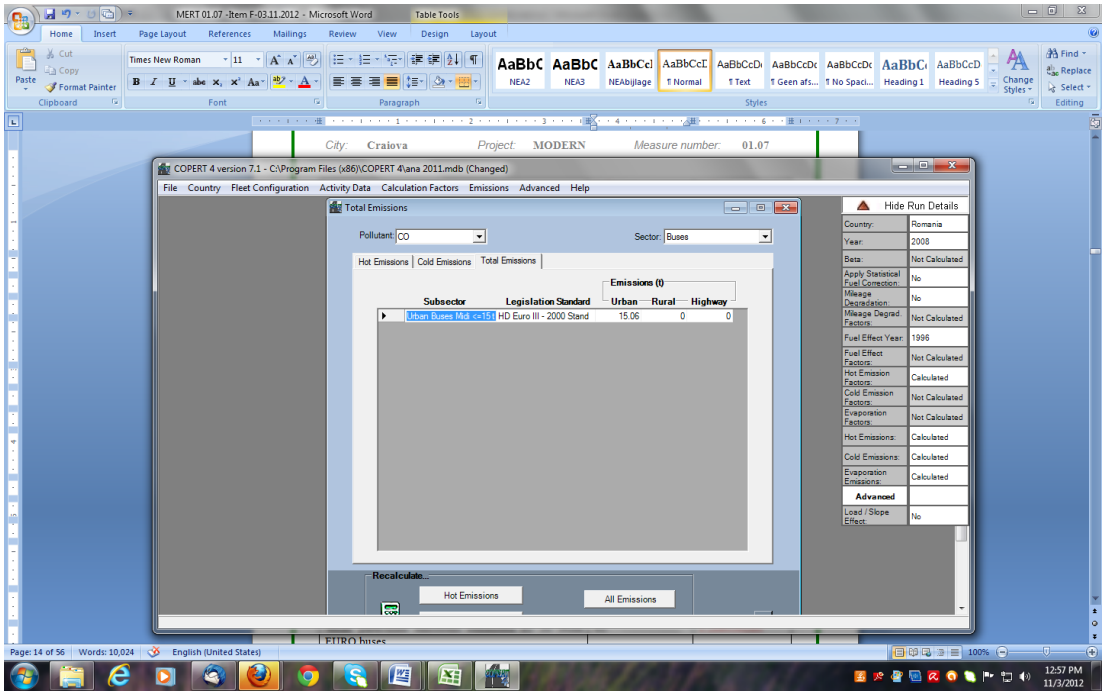
Total emissions CO2- 30 buses NON Euro in 2008

Measure title: Transition Towards Clean Fleets

City: Craiova Project: MODERN Measure number: 01.07



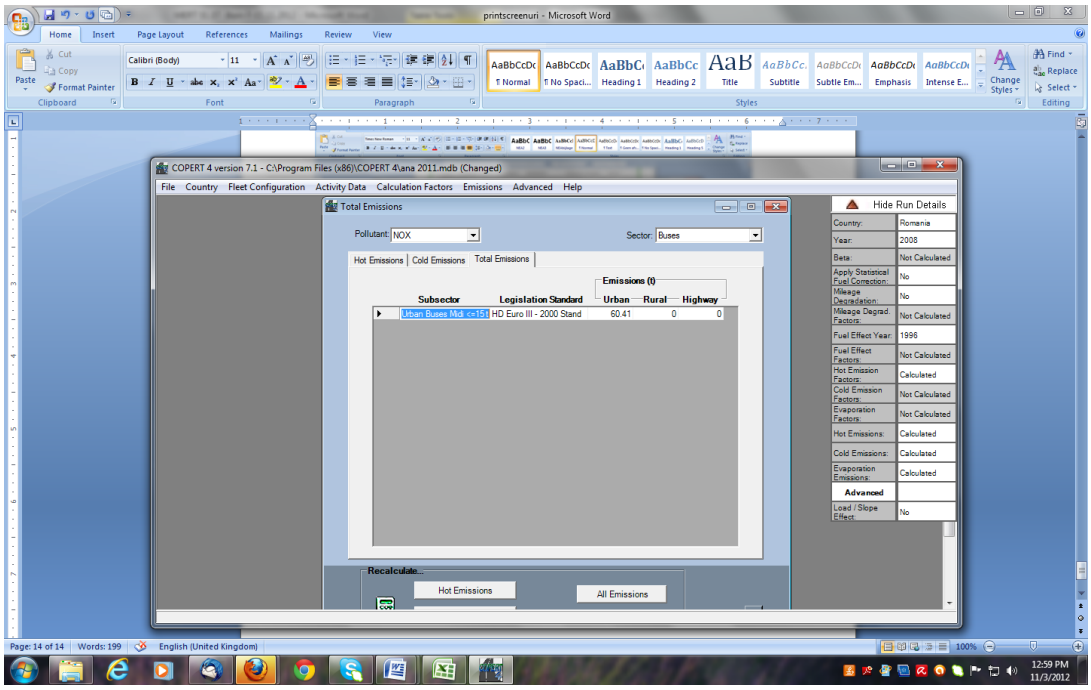
Total emissions CO- 10 buses Euro III in 2008



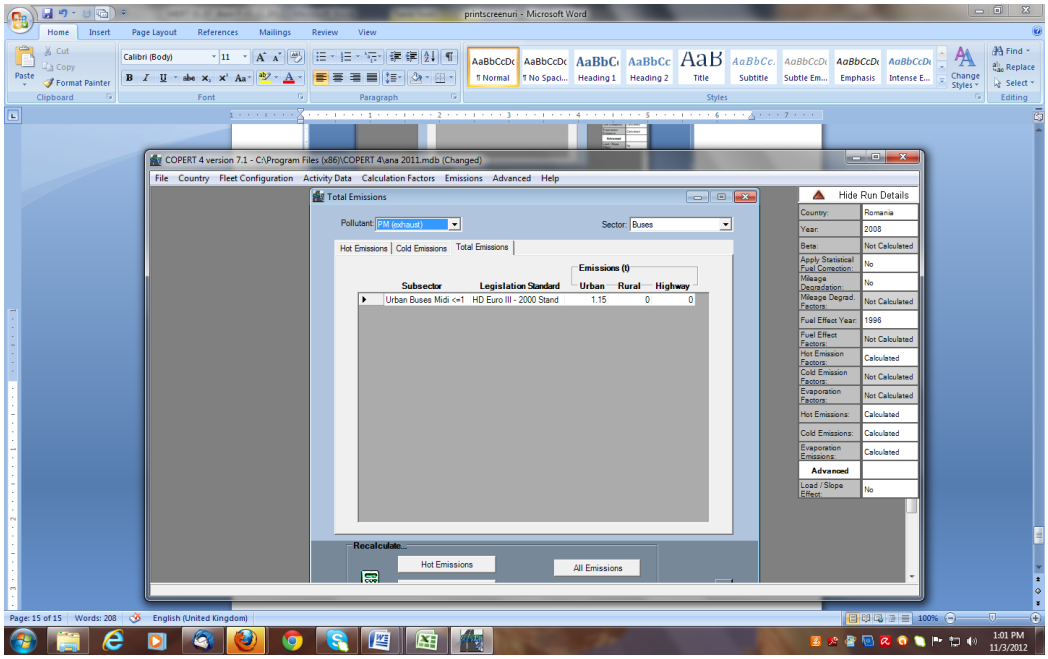
Total emissions NOx- 10 buses Euro III in 2008

Measure title: Transition Towards Clean Fleets

City: Craiova Project: MODERN Measure number: 01.07



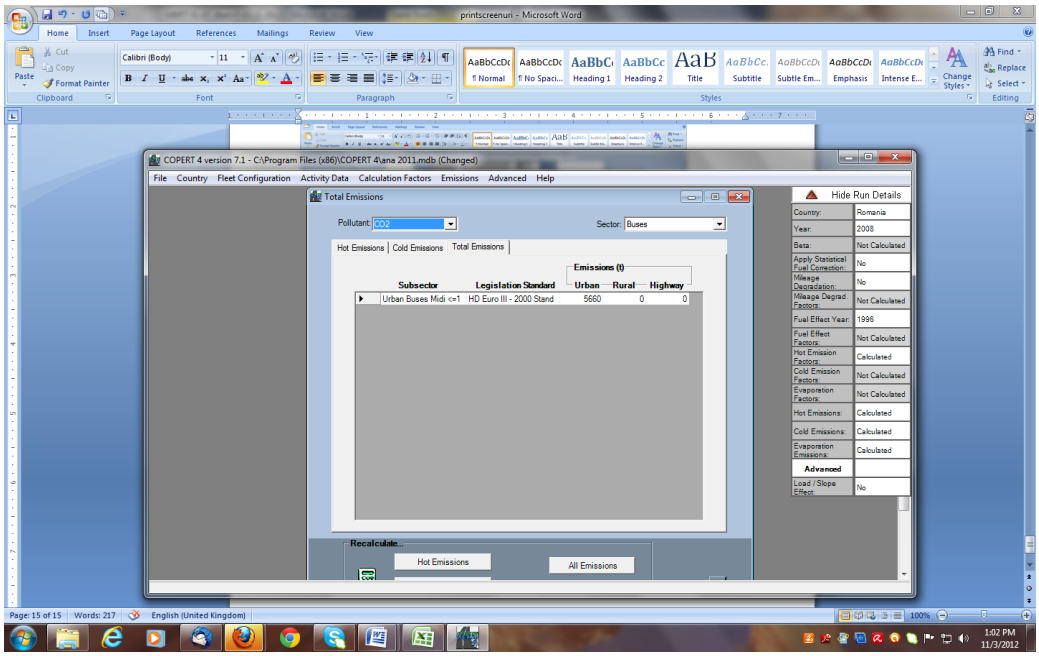
Total emissions Pm- 10 buses Euro III in 2008



Total emissions CO2- 10 buses Euro III in 2008

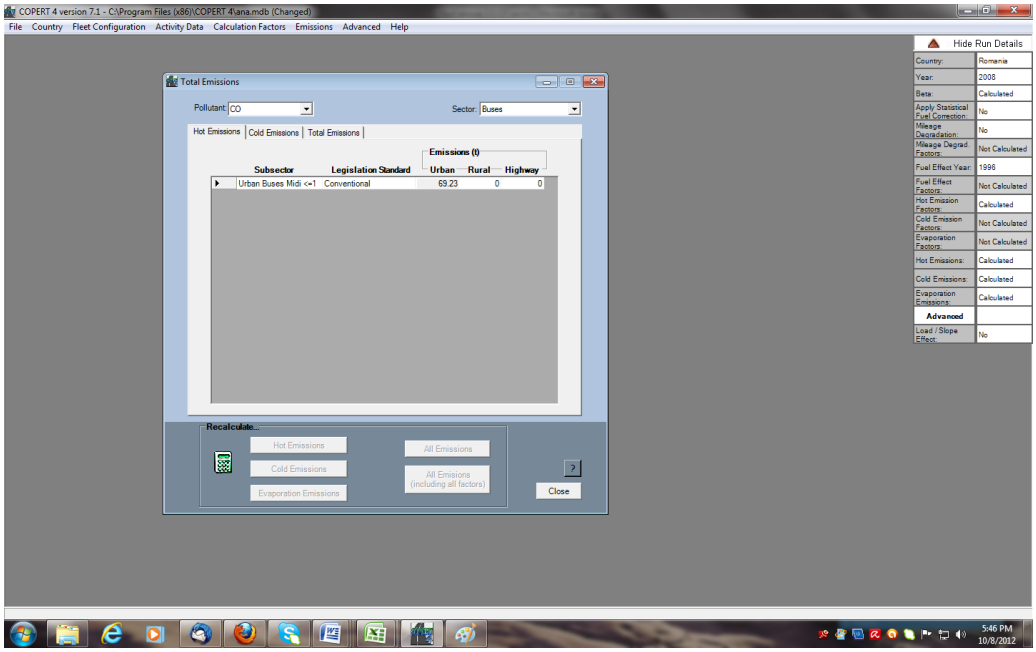
Measure title: Transition Towards Clean Fleets

City: Craiova Project: MODERN Measure number: 01.07



In order to emphasis the emissions coming from 17 envisaged buses proposed for scrapping we select 17 buses ROMAN UDM type and calculate emissions taking into consideration fuel consumption and respective mileage.

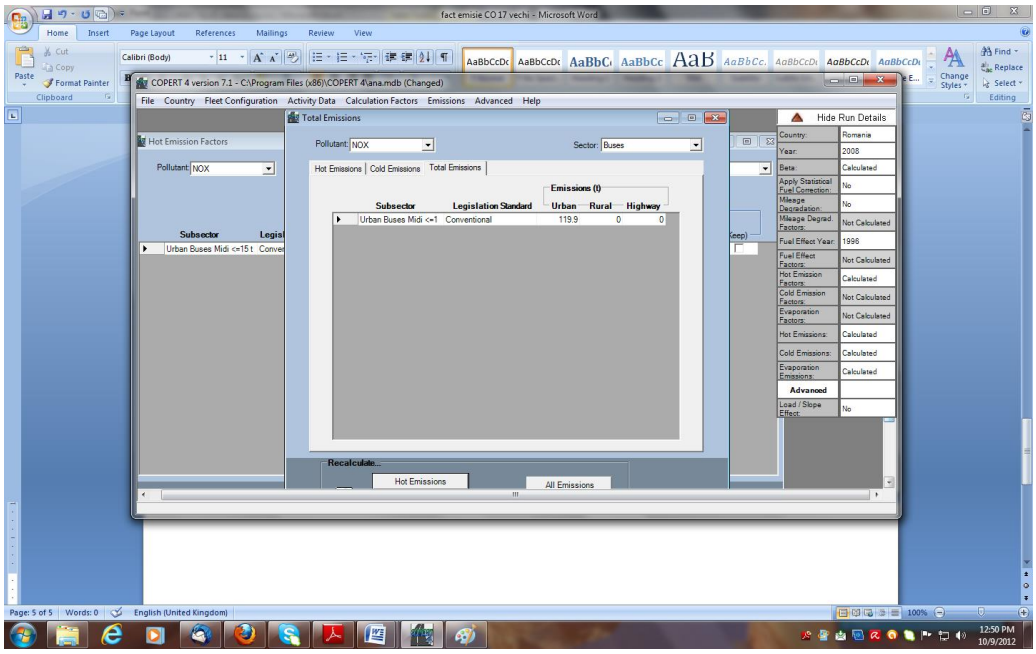
Total emissions CO- 17 buses(NON EURO category) in 2008



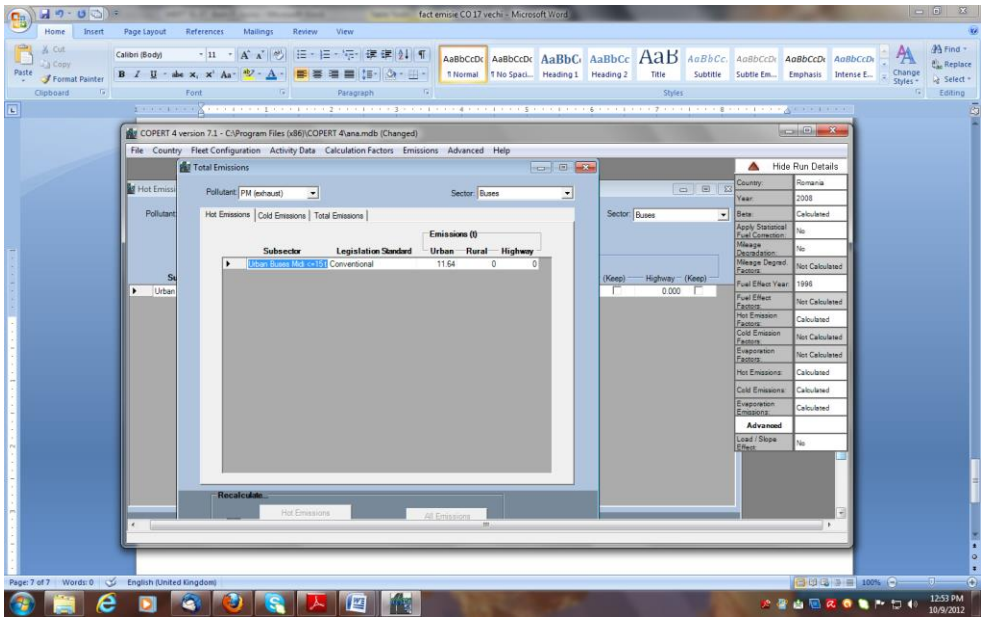
Total emissions NOx-17 buses(NON EURO category) in 2008

Measure title: Transition Towards Clean Fleets

City: Craiova Project: MODERN Measure number: 01.07



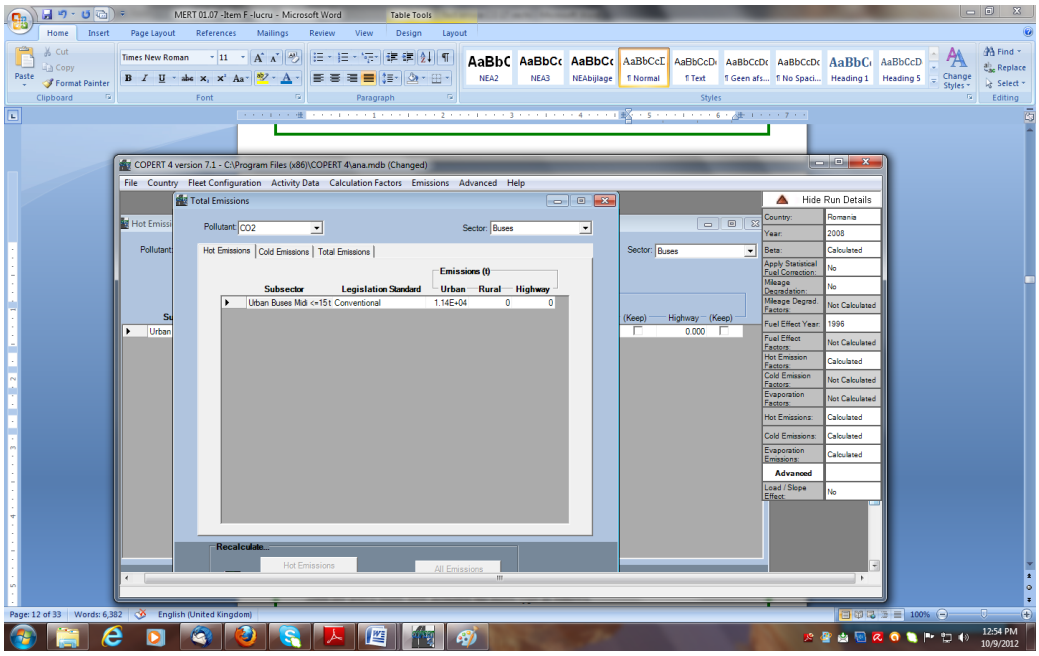
Total emissions Pm-17 buses(NON EURO category) in 2008



Total emissions CO2-17 buses(NON EURO category) in 2008

Measure title: Transition Towards Clean Fleets

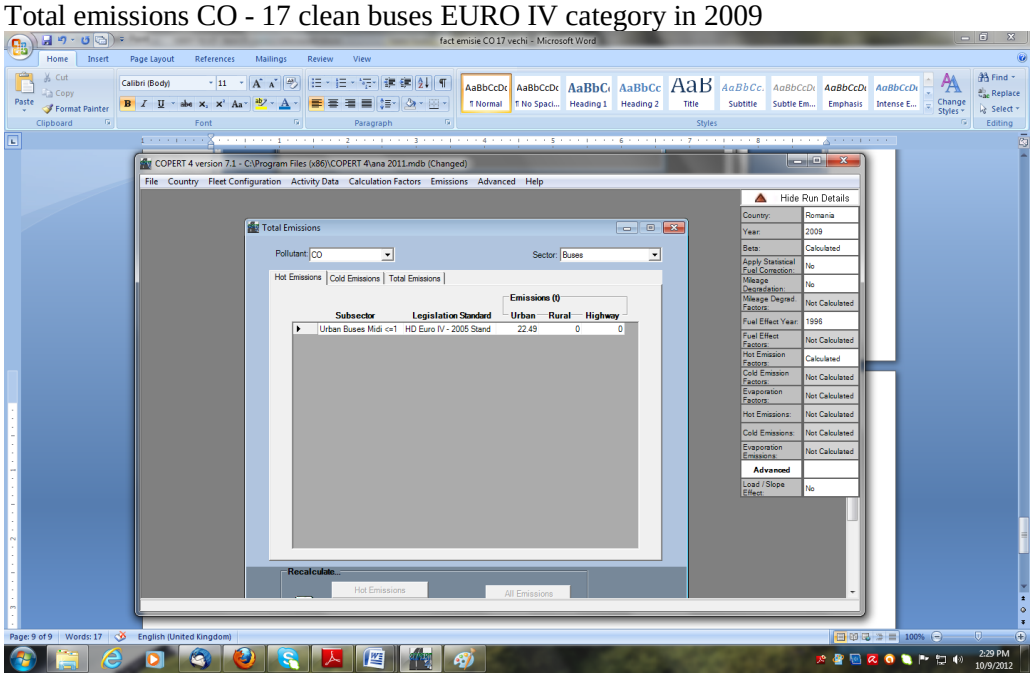
City: Craiova Project: MODERN Measure number: 01.07



Emissions coming from all buses fleet in 2009, consisting in 100 buses :

- 60 buses Euro II
- 13 buses NON Euro(17 NON Euro buses were replaced with clean buses Euro IV- MAN Lions city type)
- 10 buses Euro II
- 17 buses Euro IV- MAN Lions city type

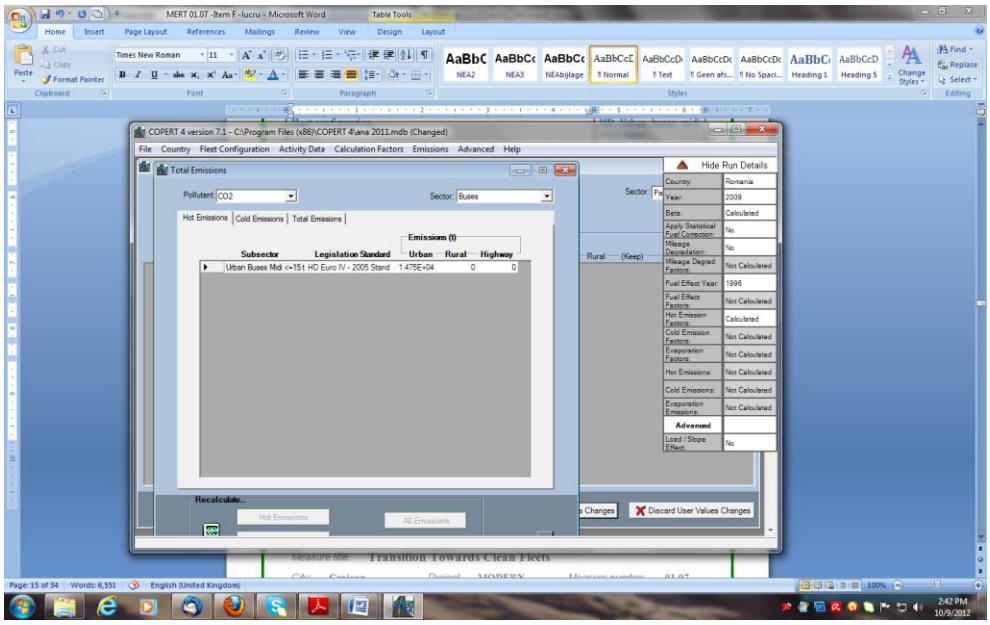
Total emissions CO - 17 clean buses EURO IV category in 2009



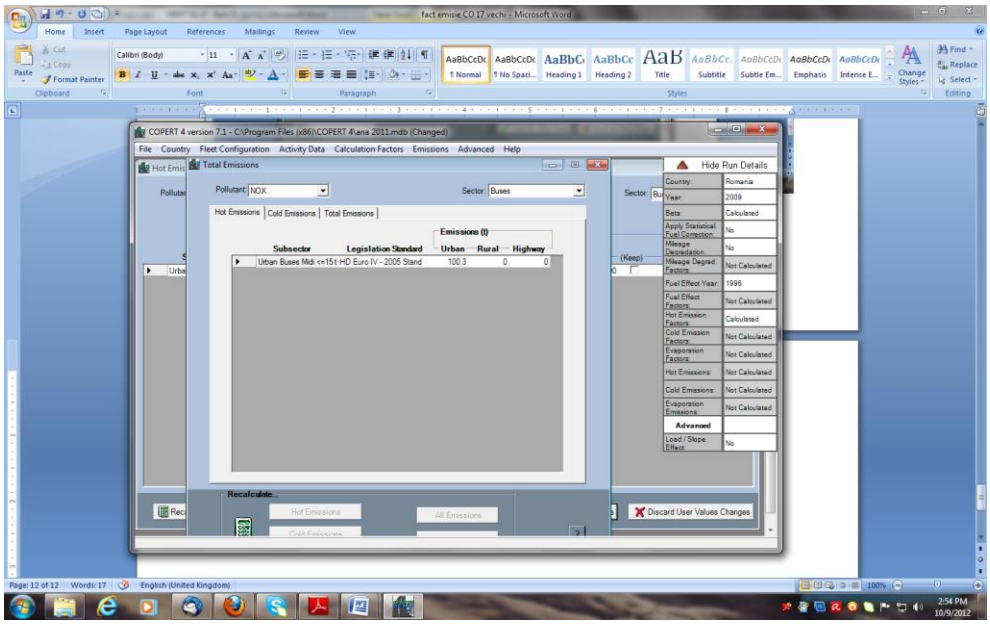
Total emissions CO2- 17 clean buses EURO IV category in 2009

Measure title: Transition Towards Clean Fleets

City: Craiova Project: MODERN Measure number: 01.07



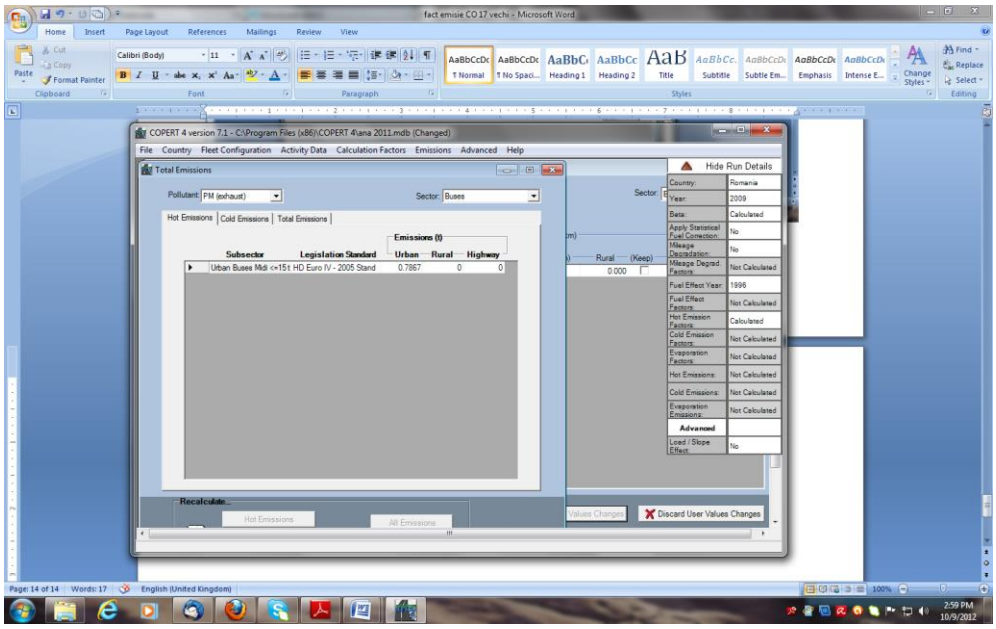
Total emissions NOx- 17 clean buses EURO IV category in 2009



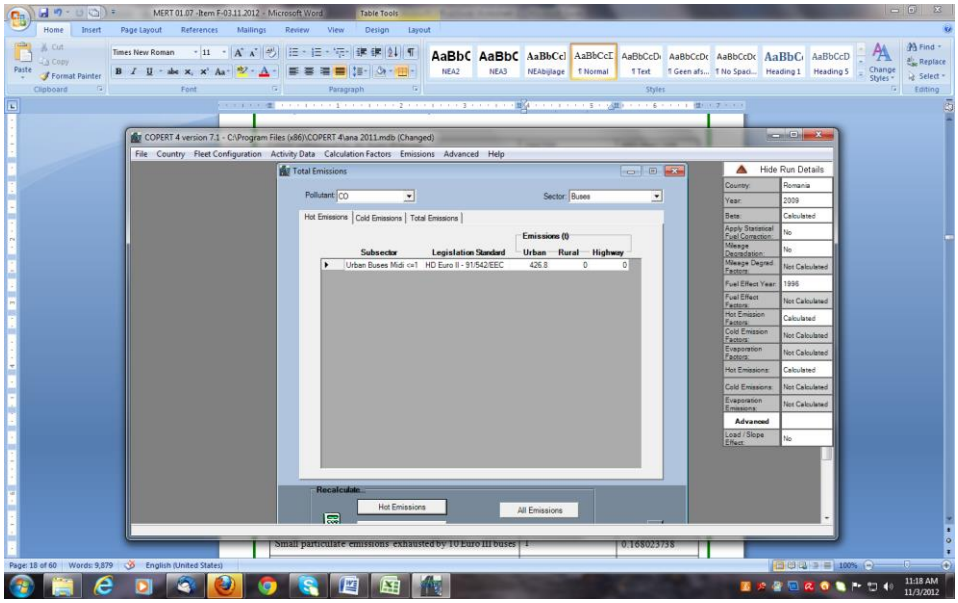
Total emissions Pm- 17 clean buses EURO IV category in 2009

Measure title: Transition Towards Clean Fleets

City: Craiova Project: MODERN Measure number: 01.07



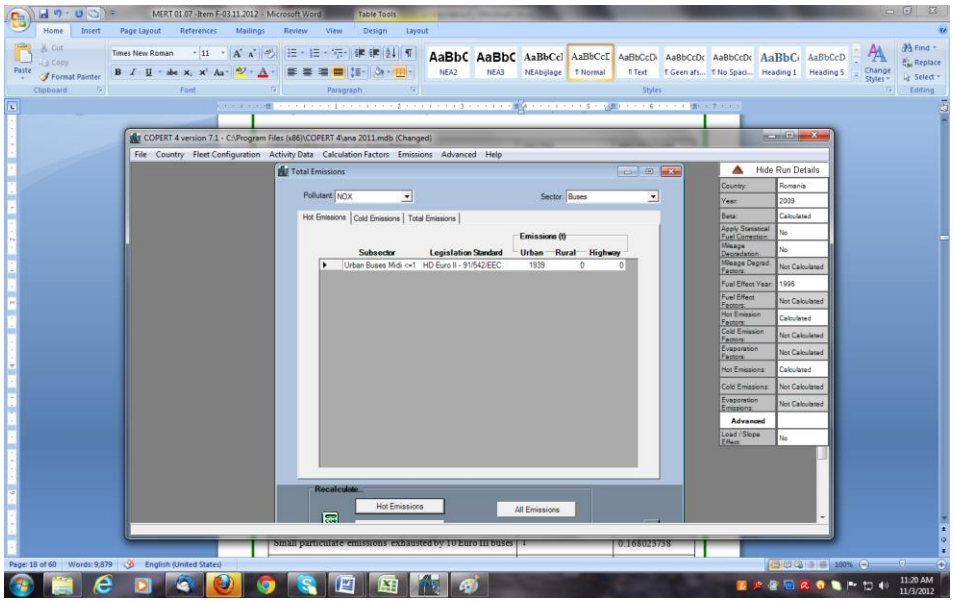
Total emissions CO- 60 buses Euro II in 2009



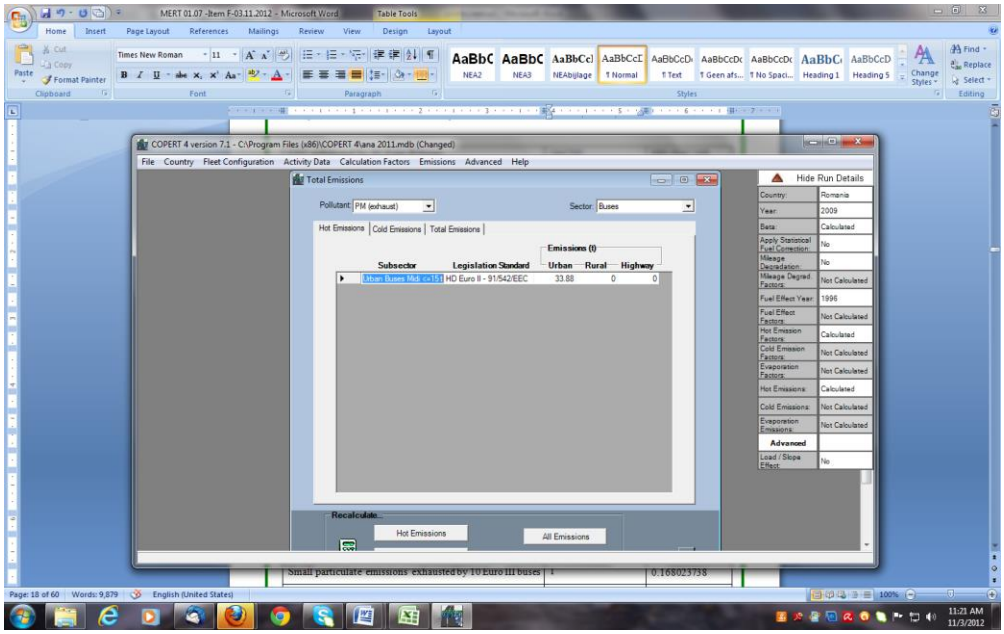
Total emissions NOx- 60 buses Euro II in 2009

Measure title: Transition Towards Clean Fleets

City: Craiova Project: MODERN Measure number: 01.07



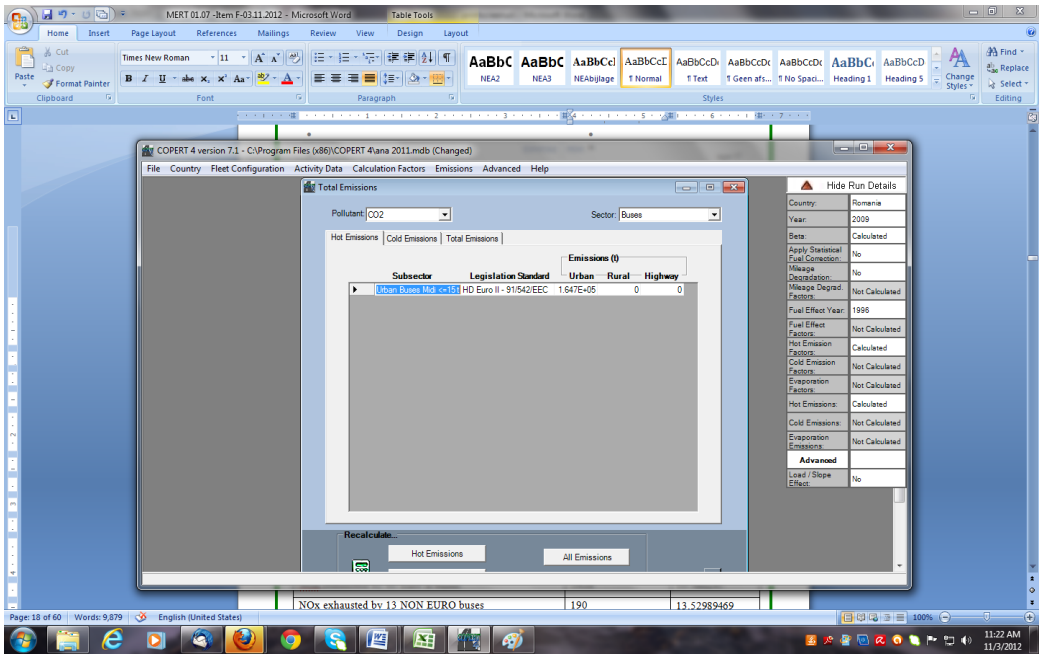
Total emissions Pm- 60 buses Euro II in 2009



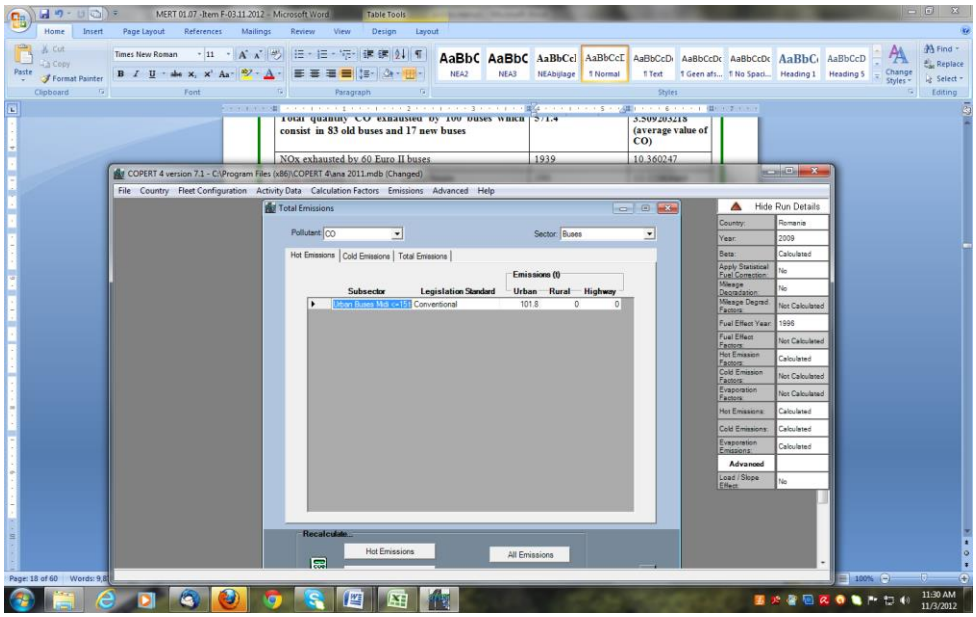
Total emissions CO2- 60 buses Euro II in 2009

Measure title: Transition Towards Clean Fleets

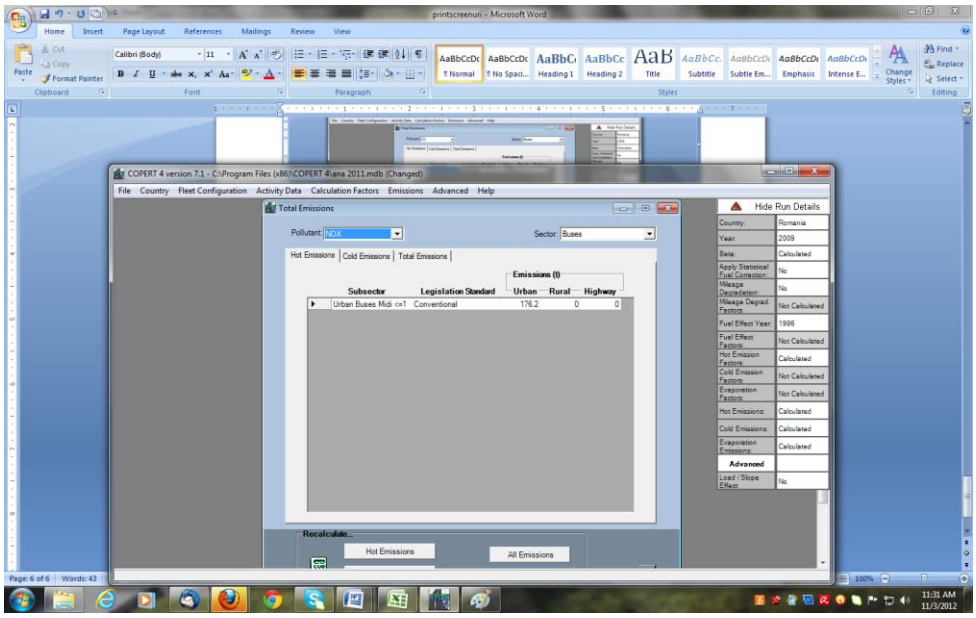
City: Craiova Project: MODERN Measure number: 01.07



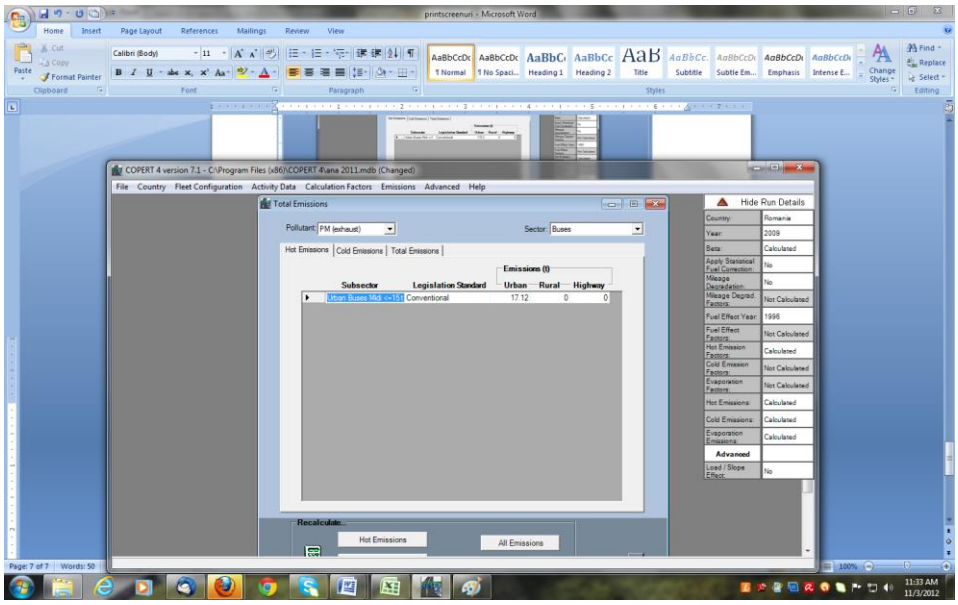
Total emissions CO – 13 buses NON Euro in 2009



Total emissions NOx – 13 buses NON Euro in 2009



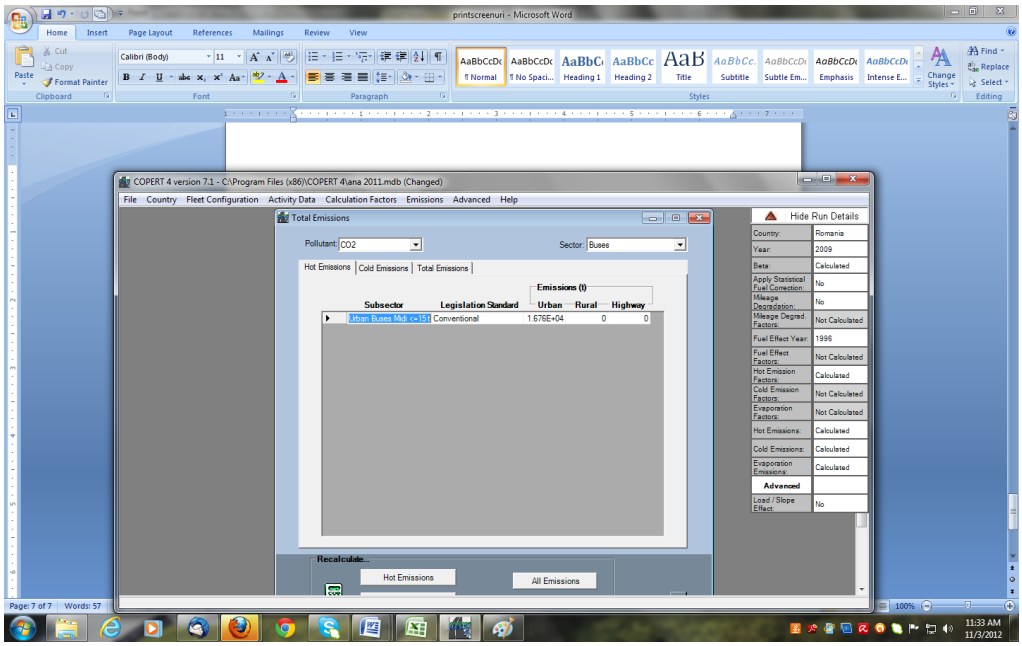
Total emissions Pm- 13 buses NON Euro in 2009



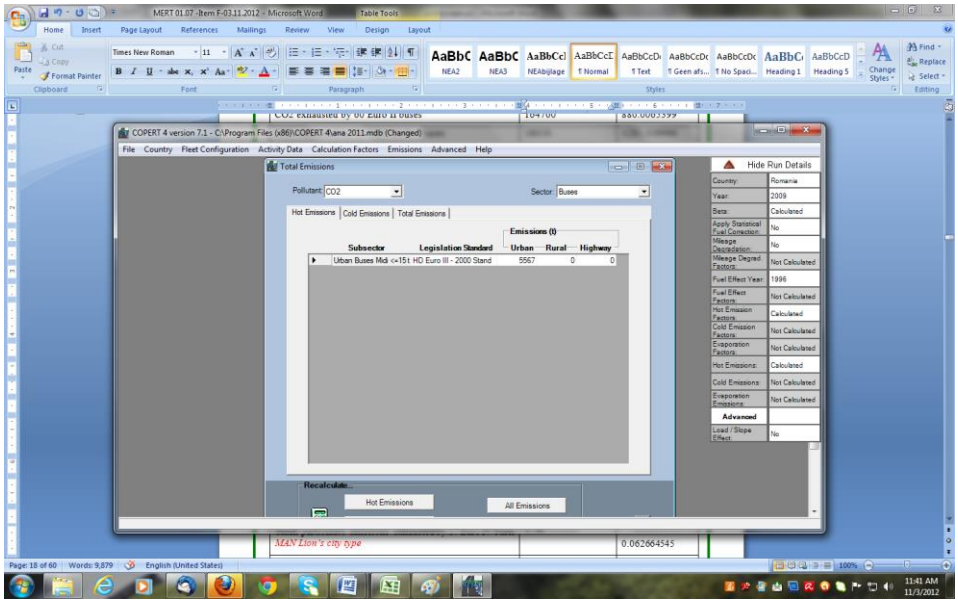
Total emissions CO2- 13 buses NON Euro in 2009

Measure title: Transition Towards Clean Fleets

City: Craiova Project: MODERN Measure number: 01.07



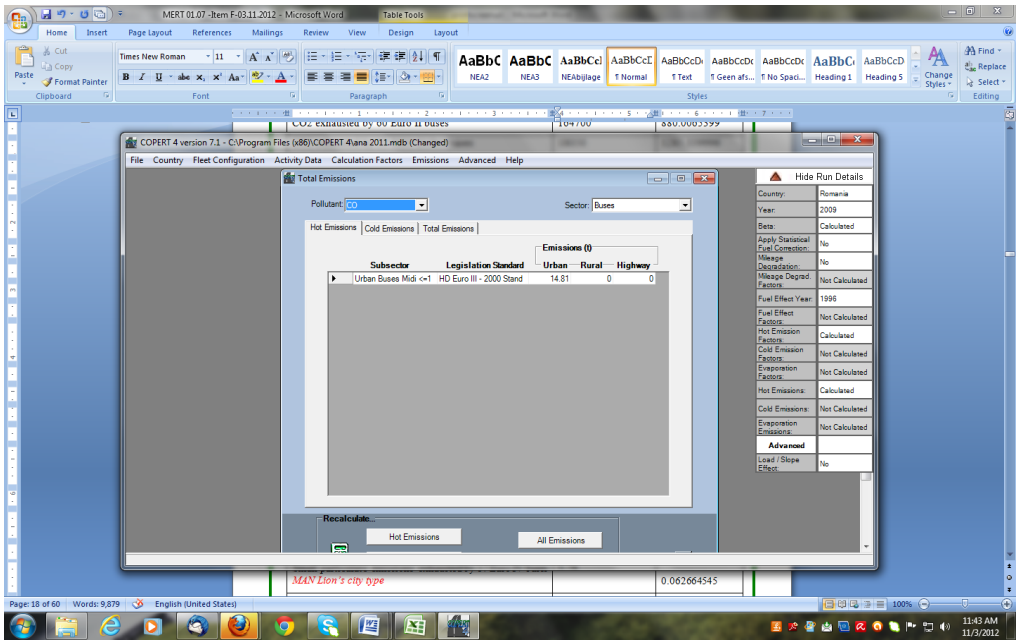
Total emissions CO2- 10 buses Euro III - 2009



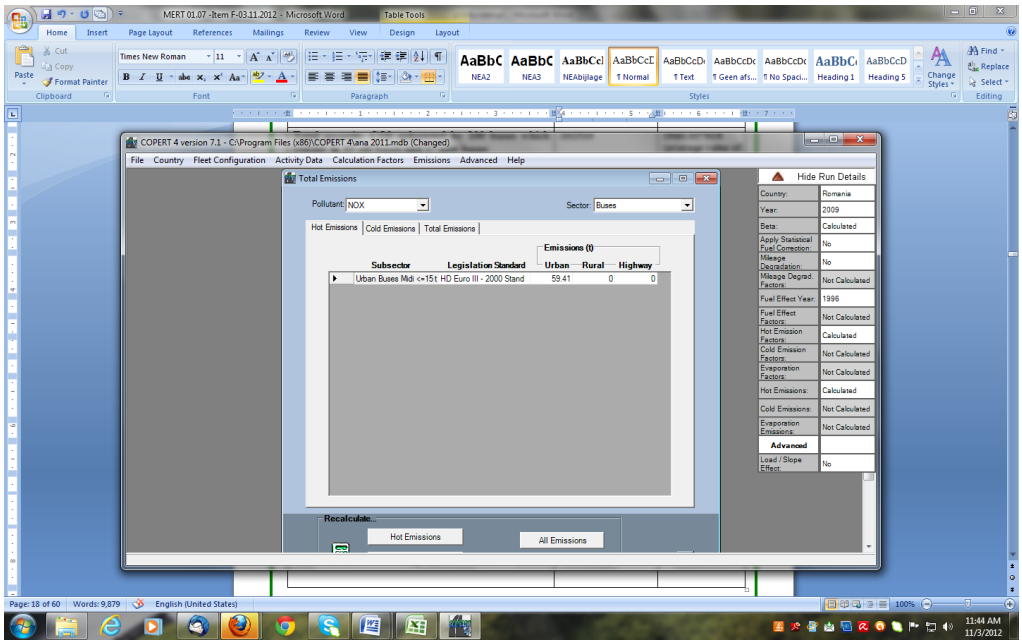
Total emissions CO- 10 buses Euro III in 2009

Measure title: Transition Towards Clean Fleets

City: Craiova Project: MODERN Measure number: 01.07



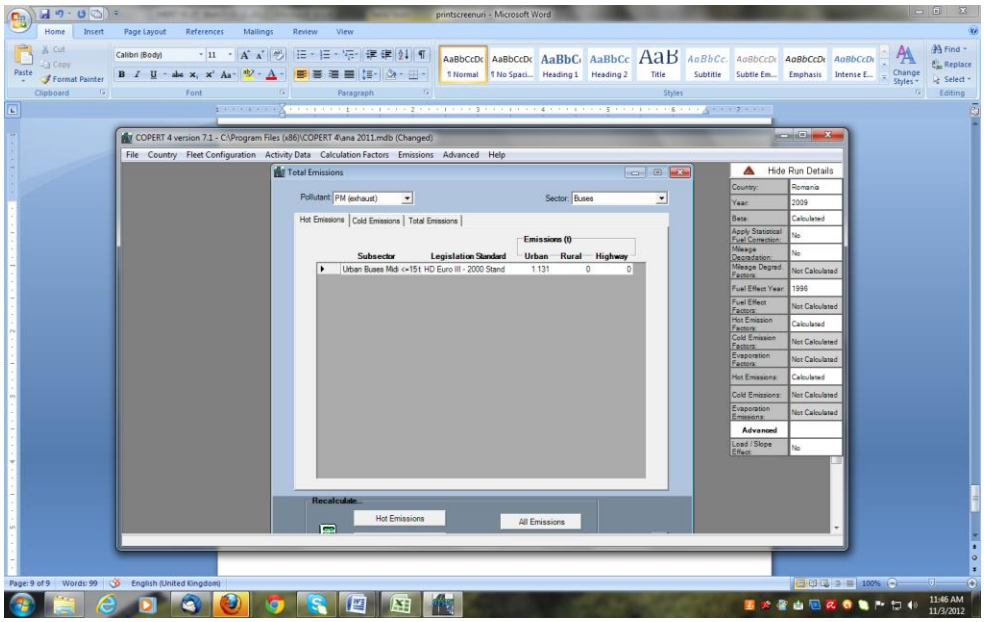
Total emissions NOx- 10 buses Euro III in 2009



Total emissions Pm- 10 buses Euro III in 2009

Measure title: Transition Towards Clean Fleets

City: Craiova Project: MODERN Measure number: 01.07



Ex-ante emissions calculation

Name of indicators calculated automatically	Values of indicators calculated automatically by the software(t/year)	grams /year	No of buses	Product of the number of vehicles and Km travelled by the vehicles	Values of indicators (g/vKm)	Km travelled by the vehicles in 2008
1	2	3 Data from column 2 multiplied by 10^6	4	5 Data from column 4 multiplied by data from column 7	6 Data from column 3 divided by data from column 5	7
CO2 exhausted by 60 EII buses	232400	2.324E+11	60	264054420	880.1216052	4,400,907
CO2 exhausted by 30 NON EURO buses	42430	42430000000	30	35556870	1193.299635	1,185,229
CO2 exhausted by10 EIII buses	5660	5660000000	10	6051430	935.3161154	605,143
Total quantity CO2 exhausted by 100 old buses	280490	2.8049E+11	100			
CO exhausted by 60 EII buses	602	602000000	60	264054420	2.279833074	4,400,907
CO exhausted by 30 NON	258	258000000	30	35556870	7.255981755	1,185,229

Measure title: Transition Towards Clean Fleets

City: Craiova Project: MODERN Measure number: 01.07

Name of indicators calculated automatically	Values of indicators calculated automatically by the software(t/year)	grams /year	No of buses	Product of the number of vehicles and Km travelled by the vehicles	Values of indicators (g/vKm)	Km travelled by the vehicles in 2008
EURO buses						
CO exhausted by10 EIII buses	15	15000000	10	6051430	2.478752956	605,143
Total quantity CO exhausted by 100 old buses	875	875000000	100			
NOx exhausted by 60 EII buses	2736	2736000000	60	264054420	10.36150048	4,400,907
NOx exhausted by 30 NON EURO buses	446	446000000	30	35556870	12.54328629	1,185,229
NOx exhausted by10 EIII buses	60	60000000	10	6051430	9.915011824	605,143
Total quantity NOx exhausted by 100 old buses	3242	3242000000	100			
Small particulate emissions exhausted by 60 EII buses	48	48000000	60	264054420	0.18178071	4,400,907
Small particulate emissions exhausted by 30 NON EURO buses	43	43000000	30	35556870	1.209330293	1,185,229
Small particulate emissions exhausted by10 EIII buses	1.15	1150000	10	6051430	0.190037727	605,143
Total quantity Small particulate emissions exhausted by 100 old buses	92.15	92150000	100			

Measure title: Transition Towards Clean Fleets

City: Craiova Project: MODERN Measure number: 01.07

BAU emissions calculation

Name of indicator calculated automatically	**Values of indicators calculated automatically by the software(t/year)**	**grams /year**	**No of buses**	**Product of the number of vehicles and Km travelled by the vehicles**	**Values of indicators (g/vKm)**	**Km travelled in 2009 by euro type**
1	2	3 Data from column 2 multiplied by 10^6	4	5 Data from column 4 multiplied by data from column 7	6 Data from column 3 divided by data from column 5	7
CO2 exhausted by 60 EII buses	164700	1.647E+11	60	187157700	880.0065399	3119295
CO2 exhausted by 13 NON EURO buses	16760	16760000000	13	14042977	1193.479132	1080229
CO2 exhausted by 10 EIII buses	5567	5567000000	10	5951540	935.3881516	595154
CO2 exhausted by 17 EIV buses	14750	1475000000	17	12447230	1185.002607	732190
Total quantity CO2 exhausted by 100 buses which consist in 83 old buses and 17 new buses	201777	2.01777E+11	100			5526868

Name of indicator calculated automatically	Values of indicators calculated automatically by the software(t/year)	grams /year	No of buses	Product of the number of vehicles and Km travelled by the vehicles	Values of indicators (g/vKm)	Km travelled in 2009 by euro type
CO exhausted by 60 EII buses	426.8	426800000	60	187157700	2.280429819	3119295
CO exhausted by 13 NON EURO buses	101.8	101800000	13	14042977	7.249175157	1080229
CO exhausted by 10 EIII buses	14.81	14810000	10	5951540	2.488431566	595154
CO exhausted by 17 EIV buses	22	22000000	17	12447230	1.767461516	732190
Total quantity CO exhausted by 100 buses which consist in 83 old buses and 17 new buses	565.41	565410000	100			5526868
NOx exhausted by 60 EII buses	1939	1939000000	60	187157700	10.360247	3119295
NOx exhausted by 13 NON EURO	176.2	176200000	13	14042977	12.54719708	1080229

Name of indicator calculated automatically	Values of indicators calculated automatically by the software(t/year)	grams /year	No of buses	Product of the number of vehicles and Km travelled by the vehicles	Values of indicators (g/vKm)	Km travelled in 2009 by euro type
buses						
NOx exhausted by 10 EIII buses	59.41	59410000	10	5951540	9.982290298	595154
NOx exhausted by 17 EIV buses	100	100000000	17	12447230	8.03391598	732190
Total quantity NOx exhausted by 100 buses which consist in 83 old buses and 17 new buses	2274.61	2274610000	100			5526868
Small particulate emissions exhausted by 60 EII buses	33.88	33880000	60	187157700	0.18102381	3119295
Small particulate emissions exhausted by 13 NON EURO buses	17.12	17120000	13	14042977	1.219114722	1080229
Small particulate emissions exhausted	1	1000000	10	5951540	0.168023738	595154

Measure title: Transition Towards Clean Fleets

City: Craiova Project: MODERN Measure number: 01.07

Name of indicator calculated automatically	Values of indicators calculated automatically by the software(t/year)	grams /year	No of buses	Product of the number of vehicles and Km travelled by the vehicles	Values of indicators (g/vKm)	Km travelled in 2009 by euro type
by 10 EIII buses						
Small particulate emissions exhausted by 17 EIV buses	0.78	780000	17	12447230	0.062664545	732190
Total quantity Small particulate emissions exhausted by 100 buses which consist in 83 old buses and 17 clean buses(Euro IV category)	52.78	52780000	100			5526868

Ex-post emissions calculation

Name of indicators calculated automatically	Values of indicators calculated automatically by the software(t/year)	grams /year	No of buses	Product of the number of vehicles and Km travelled by the vehicles	Values of indicators (g/vKm)	Km travelled in 2009
1	2	3 Data from column 2 multiplied by 10^6	4	5 Data from column 4 multiplied by data from column 7	6 Data from column 3 divided by data from column 5	7

Measure title: Transition Towards Clean Fleets

City: Craiova Project: MODERN Measure number: 01.07

Name of indicators calculated automatically	Values of indicators calculated automatically by the software(t/year)	grams /year	No of buses	Product of the number of vehicles and Km travelled by the vehicles	Values of indicators (g/vKm)	Km travelled in 2009
CO2 exhausted by 60 Euro IV LC buses	153800	1.538E+11	60 Euro IV LC buses	187157700	821.7668843	3119295
CO2 exhausted by 13 Euro IV LC buses	11540	11540000000	13 Euro IV LC buses	14042977	821.7630777	1080229
CO2 exhausted by 10 Euro IV LC buses	4891	4891000000	10 Euro IV LC buses	5951540	821.8041045	595154
CO2 exhausted by 17 Euro IV LC buses	14750	14750000000	17 Euro IV LC buses	12447230	1185.002607	732190
Total quantity CO2 exhausted by 100 Euro IV LC buses	184981	1.84981E+11	100	552686800	334.6940799	5526868
CO exhausted by 60 Euro IV LC buses	234.6	234600000	60 Euro IV LC buses	187157700	1.253488368	3119295
CO exhausted by 13 Euro IV LC buses	17.6	17600000	13 Euro IV LC buses	14042977	1.253295508	1080229
CO exhausted by 10 Euro IV LC buses	7.46	7460000	10 Euro IV LC buses	5951540	1.253457088	595154
CO exhausted	22	22000000	17 Euro IV LC	12447230	1.767461516	732190

Name of indicators calculated automatically	Values of indicators calculated automatically by the software(t/year)	grams /year	No of buses	Product of the number of vehicles and Km travelled by the vehicles	Values of indicators (g/vKm)	Km travelled in 2009
by 17 EIV buses			buses			
Total quantity CO exhausted by 100 Euro IV LC buses	281.66	281660000	100	552686800	0.509619553	5526868
NOx exhausted by 60 Euro IV LC buses	1046	1046000000	60 Euro IV LC buses	187157700	5.588869707	3119295
NOx exhausted by 13 Euro IV LC buses	78.47	78470000	13 Euro IV LC buses	14042977	5.587846509	1080229
NOx exhausted by 10 Euro IV LC buses	33.26	33260000	10 Euro IV LC buses	5951540	5.588469539	595154
NOx exhausted by 17 Euro IV LC buses	100	100000000	17 Euro IV LC buses	12447230	8.03391598	732190
Total quantity NOx exhausted by 100 Euro IV LC buses	1257.73	1257730000	100	552686800	2.275664988	5526868
Small particulate emissions exhausted by 60	8.206	8206000	60 Euro IV LC buses	187157700	0.043845377	3119295

Name of indicators calculated automatically	Values of indicators calculated automatically by the software(t/year)	grams /year	No of buses	Product of the number of vehicles and Km travelled by the vehicles	Values of indicators (g/vKm)	Km travelled in 2009
Euro IV LC buses						
Small particulate emissions exhausted by 13 Euro IV LC buses	0.61	610000	13 Euro IV LC buses	14042977	0.043438083	1080229
Small particulate emissions exhausted by 10 Euro IV LC buses	0.26	260000	10 Euro IV LC buses	5951540	0.043686172	595154
Small particulate emissions exhausted by 17 Euro IV LC buses	0.78	780000	17 Euro IV LC buses	12447230	0.062664545	732190
Total quantity Small particulate emissions exhausted by 100 Euro IV LC buses	9.856	9856000	100	552686800	0.017832885	5526868

Annex 2: Questionnaire

Instructions

This survey is part of a FP7 European project- called MODERN (Mobility, Development and Energy Reduction) and aims to collect your experiences in traveling by bus. The objectives of the measure are:

- *To identify the typology of buses suitable for decreasing the emissions*
- *To identify a proper granting program for eco-buses acquisition*

Your answers will be treated confidentially.

Thank you for your participation!

BAU questionnaire- disseminated to people to see their opinion on buses fleet which includes 17 new buses

MEASURE 01.07: Transition Towards Clean Fleets

1. Gender: F 45% ☐ M 55% ☐

2. Age:

Up to 15	15-24	25-45	45-54	55-65	over 65
5%	5%	26%	31%	23%	10%

3. Background (last graduate institution):

· faculty	· secondary school	· primary school
35%	60%	5%

4. **Labour market status**:

employed	unemployed	students
60%	25%	15%

5. Public transport user

daily 80 % ☐ occasionally 20% ☐

Quality of service

6. How would you rate the quality of public transport service in Craiova, currently, before implementing measure**?**

dissatisfied	Somewhat dissatisfied	Satisfied	Don't know
22%	39%	38%	1%

7. How do you perceive buses journey now**?**

uncomfortable	Somewhat Comfortable	Comfortable	Don't know
24%	40%	35%	1%

8. Have you ever responded to questionnaires on MODERN project**?**

☐1	Yes 60%
☐2	No 40%

Measure title: Transition Towards Clean Fleets

City: Craiova Project: MODERN Measure number: 01.07

Instructions

This survey is part of a FP7 European project- called MODERN (Mobility, Development and Energy Reduction) and aims to collect your experiences in traveling by bus. The objectives of the measure are:

- *To identify the typology of buses suitable for decreasing the emissions*
- *To identify a proper granting program for eco-buses acquisition*

Your answers will be treated confidentially.

Thank you for your participation!

Ex-post questionnaire

MEASURE 01.07: Transition Towards Clean Fleets

1. Gender: F 38% ☐ M 62% ☐

2. Age:

Up to 15	15-24	25-45	45-54	55-65	over 65
3%	7%	26%	31%	20%	13%

3. Background (last graduate institution):

· faculty	· secondary school	· primary school
38%	60%	2%

4. **Labour market status**:

employed	unemployed	student
55	20	25

5. Public transport user

daily 82 occasionally 18%

Quality of service

6. H**ow would you assess the quality of service if all the buses would be new**?

dissatisfied	Somewhat dissatisfied	Satisfied	Don't know
10%	19%	70%	1%

7. **How would you perceive buses journey if all the buses would be new**?

uncomfortable	Somewhat Comfortable	Comfortable	Don't know
11%	46%	42%	1%

8. Have you ever responded to questionnaires on MODERN project?

☐1	Yes 100%
☐2	no

Annex 3: Estimation of sample size

Variables name and explanations		Variables values
		01.07
n	The sample size	119
t	z-score: the abscissa of the Normal distribution for probability α (consisted of 1.5+0.03 from the table-standard normal probabilities)	1.53
α	**confidence level**, is a percentage and represents how often the true percentage of the population who would pick an answer lies within the **confidence interval** (margin of error).	87.50%
P	percentage of your sample that picks a particular answer. We considered that majority of people will be satisfied if the buses fleet will be replaced with new one	0.85
Q	(1-P)	0.15
d	**confidence interval** (also called margin of error)	0.05
N	population total (if N is enough large the term in the denominator tends to 1 and the formula is reduced to the numerator)	300000

Sample size

$n = [t^2PQ/d^2] / [1 + (t^2PQ/d^2 - 1)/N]$ (1)

where: t = the abscissa of the Normal distribution for probability α

P = expected population value of the proportion

Q = (1-P)

d = margin of error

N = population total

α - in mod obisnuit se foloseste 95%

A preliminary estimate of P (called p) is made from prior information or as an informed guess; so then q = 1-p.

If N is large, a first approximation of *n* is given by:

$n_o = t^2pq/d^2$ (2)

or $n_o = pq/V$ (3)

where $V = d^2/t^2$ is the desired variance of the sample proportion

In practice, n_o is calculated first and so long as n_o/N is quite small, n_o provides a satisfactory estimate of *n*. If not, then from equations (1) and (2) above:

$n = n_o / [1 + (n_o - 1)/N]$

Source: http://people.richland.edu/james/lecture/m170/tbl-norm.html

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974

2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990

Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

M01.09 – Executive summary

Trams with a high capacity transport and minimal environmental impact are an efficient mean for mass transport in cities like Craiova. The trams fleet from Craiova consists in 34 trams and the rolling tracks are 36 kms long. Of the 34 trams, 27 trams are available for passenger's transportation, from East to West in the city. The electric network supplying power for trams and the rolling tracks of trams are 30 years old.

Most trams belonging to RAT Craiova (Public Transport Company) have huge energy consumptions and high maintenance costs due to the old contactors driving system. Thus, Craiova decided to implement this measure by which 9 old trams with contactors driving system have been equipped with chopper driving systems, in order to reduce the energy consumption and maintenance costs. At the same time, by the new tram driving system, passenger comfort was expected to be increased due to smoother starts and stops. The innovative aspects of this measure- new driving technology with low energy consumption and maintenance costs – is relevant for Transport Company in Craiova that records lower energy consumptions and maintenance costs coming from the trams endowed with chopper driving system.

The research team found the optimal implementation solution through a chopper driving system that fits the technical features of the 9 old trams to be upgraded. In this respect, the implementation team produced a technical papers specifying the technical features that the chopper systems to be purchased must meet. The 9 chopper driving systems which were tested in University's laboratories, in terms of vibrations, noise and different loads, were purchased and later they were installed on the 9 old trams, tested and evaluated. In order to highlight the impact of the measure both the energy consumptions and maintenance costs arising from the trams with contactors driving system and the ones c arising from the trams endowed with chopper driving system were compared. The results proved that the chopper driving system leaded to low operating costs (due to energy saving) and cheaper maintenance.

In order to assess the impact of the measure on the public transport users, a survey was performed and the interviewed people stated their opinion regarding the quality of services brought by the implementation of the new driving system on the trams and in the same time, they expressed their point of view on the usefulness of the measure.

As a focused measure, Cost-Benefit Analysis (CBA) was conducted to assess the cumulated cash flow brought by the measure operation in a period of 10 years.

The key results are the following:

- Average Operating Cost shows the effectiveness of the chopper driving system due to the lower energy and maintenance cost;
- Vehicle Fuel Efficiency - The energy consumption is noticeably lower for the trams upgraded with the new chopper driving system (35% less per tram)
- Quality of service - The results of the surveys in the evaluation period shows a change of users perception on quality of service; they feel more comfortable when travelling by trams endowed with chopper driving system due to smoother start and stop (+1% service quality perceived).

As a conclusion, based on the results obtained from assessing the measure's indicators and the success of promotional campaigns, we can conclude that the measure was successfully implemented.

Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

A Introduction

A1 Objectives

(D) High level / longer term:

- To reduce emissions in the city, through the reduction of energy consumption.
- To modify the transport attractiveness.

(E) Strategic level:

- To increase the total fleet capacity and reduce energy consumption of the trams in use.

(F) Measure level:

- To put back into service 9 trams in order to reduce the energy consumption of the used trams.
- To install the chopper driving system on the 9 trams in order to decrease up to 40% the electrical consumption of each tram.
- Increasing of PT users comfort by implementing the new tram driving system which gives smoother start and stop.

A2 Description

In circumstances of traffic congestion and pollution are the real problems of the city, to use trams with a high capacity transport and minimal environmental impact is a viable alternative for daily commuting.

The trams fleet from Craiova consists in 37 trams and the rolling tracks are 36 km long. Of the 37 trams, 27 trams are available for passenger's transportation, from East to West in the city. The electric network supplying power for trams and the rolling tracks of trams are 30 years old. So the electric public transportation of Craiova needs a lot of improvements and the target, is to reduce the operation costs, increasing at the same time the passengers' safety and comfort.

Figure A2.15 – trams in Craiova

Within this measure, the old driving systems of 9 trams (Figure A2.1) have been replaced by modern driving systems with low power consumption. The 9 old trams, upgraded with CIVITAS measure, were not in use because of high energy consumption driving systems, and they were proposed for scrapping. In order to up-grade the trams, high power transistors technology was needed, to keep the original electric engine of the trams. The new driving system, called chopper, is easier to use because it provides a better electronic control and allows an energy saving up 40%. The chopper system is assisted by software which store and processes the data from the entire running system. The software allows the online visualization and management of 4 defined electric parameters - network current, engine current, network voltage, and filter voltage.

Modernization of the power supply systems for tram motors, using choppers, included several changes to the whole power system. In addition, it was necessary to modify the electric wiring of the trams.

Moreover these modifications were needed for an easy maintenance after implementation. Another important aspect is the fact that, the trams proposed for upgrading by RAT, have different construction features (there are 2 different types of trams from 2 different manufacturers).

These different construction features require additional working regarding the placement of the choppers and, obviously, their adjustment to the required power.

All these issues resulted in need to develop a prototype of chopper.

The measure implementation implied research activities aimed to find a good technical solution for the chopper fitting to old trams' features.

A chopper prototype was developed, as a result of technological transfer (TT) between IPA (as measure leader) and SC INDA ELTRAC SA Craiova that is an industrial company specialized in development of automatic driving system. The TT agreement between the two parties consisted of: brake recovery energy, anti-skidding of the driving wheels solution and solution for on-board computer. The prototype of chopper system was tested in terms of power connections, vibration and noise, both in IPA's and University's laboratory.

Starting from the prototype, technical requirements documentation was carried out for purchasing the chopper driving systems for the 9 old trams.

In addition, IPA Craiova manufactured specific devices for reading and storing the energy consumption and installed them on the 9 trams endowed with chopper system. In this way, the energy consumed by each tram with chopper driving system can be monitored more precisely. The system allowed a breakdown of energy use on different sections of track via monitoring equipment connected to different power supply stations. This gave a detailed picture of not only drivers' performance, but each individual's energy profile along different parts of the network.

Main characteristics of the chopper system are:

- Energy saving up to 40%,
- Decrease of maintenance cost and time
- Increase the safety and comfort of the passengers
- Provides power supply for the driving motors corresponding to the run-brake regime;
- The chopper has an unitary construction, mono-block;
- Communication of CAN open type with the board computer for receiving the commands and the permanent monitoring of the tramway's state;
- The chopper runs in a fault regime if the board computer is damaged or communication is lost; this regime is useful to drive the vehicle to the depot for troubleshooting;
- The command module of the chopper is able to store information that can easily be used for the maintenance of the vehicle (function hours, mileages, maximum speed, minor faults or critical faults, etc.).

Another advantage of chopper driving system implementation is the smooth starting and stopping of the trams, which led to increasing the comfort and safety.

Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

Fig. A2.2 – the chopper

Fig. A2.3 – the board computer

Fig A2.4 – a tram with chopper

B Measure implementation

B1 Innovative aspects

The innovative aspects of the measure are:

- **Use of new technology/ITS** – The chopper system is a new driving technology with low energy consumption. The monitoring software is a Windows application that works independently of equipment and has the role to store and process all data from the entire working system.
- **Up to 40% energy reduction** – If two or more trams with chopper installed are driving on the same electrical powered section the energy reduction can go up to 40%, because of the energy saving from braking and other subsystems, that injects energy into the that specific section so that other trams can use it.
- **Increasing the braking safety** – The chopper system makes the tram to brake in a safer manner, meaning that the start and the stop of the tram are more secured and comfortable.
- **Online management** – The software allows the online visualization and management of 4 defined electric measures - line current, engine current, line voltage, and filter voltage.

B2 Research and Technology Development

The purpose of the Research and Technology Development for this measure was to ensure the quality and the function into the parameters of the chopper system.

- **Planning and design of the measure**

Similar systems were studied, implemented both by Public Transport operators in Romania and from other European cities. The research team found the optimum solution of a chopper system that match to old trams' structure as described above.

During the RD activity the team developed an innovative specific technical solution for anti-skidding (anti skating in order to avoid tram derailment) of the driving wheels. This innovation developed by IPA and has been proposed as a patent to OSIM (State Office for Inventions and Trademarks).

To ensure the industrial perspective of this product, a technological transfer (TT) to an industrial company has been carried out. This transfer occurred from IPA (as measure leader) toward SC INDA Eltrac SA Craiova, an industrial company specialized in this field of activity, has been carried out. This technological transfer was made on the agreement basis between IPA and SC INDA Eltrac SA Craiova.

The Technology Offer for chopper solution is registered in the Technological Transfer Database of the Enterprise Europe Network and can be requested by anyone. For the technological transfer under EEN rules there is not about a selection process.

The transfer was focused on:

- brake recovery energy
- anti-skidding (anti skating in order to avoid tram derailment) of the driving wheels solution
- solution for on-board computer

Thus, IPA and RAT technicians designed the whole wiring, data communication system between choppers and the location of all the different devices of the chopper.

- **Project of electronic chopper system for trams**

Starting from the technology transfer, an optimal technology for chopper system implementation was agreed, in compliance with the best balance between quality and price. In the same time, a lot of devices for chopper system were designed and software programs (Figure B2.1 and B2.2) were developed needed for chopper operation. The chopper system was tested (Figure B2.3) in terms of power connections vibration and noise, both in IPA laboratory and in University's laboratory by the help of professors and technicians.

The chopper driving system allows to the motor using continuous current to pass in a generator regime, especially when it brakes. So, the kinetic energy of the tramway is transformed in electric energy that is recovered in the power line. This energy is consumed by the other vehicles that are powered from the same line. In the case in which there are no other consumers, the braking energy will be dissipated in the line.

There were defined technical specifications needed for public tender procedure regarding the acquisition of chopper systems for trams.

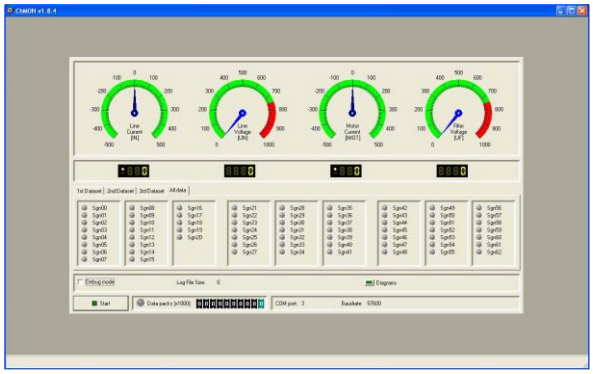


Figure B 2.1 Main window of the program

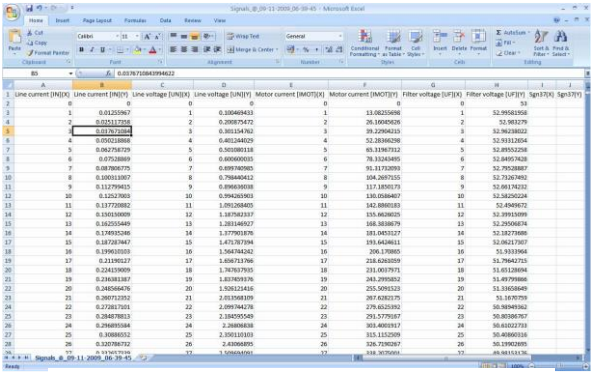
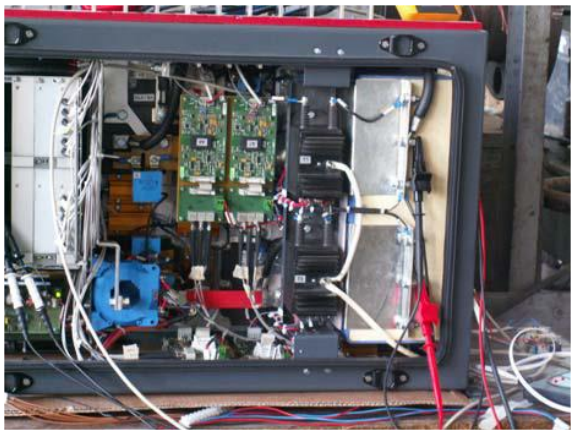


Figure B2.2 File visualized with Microsoft



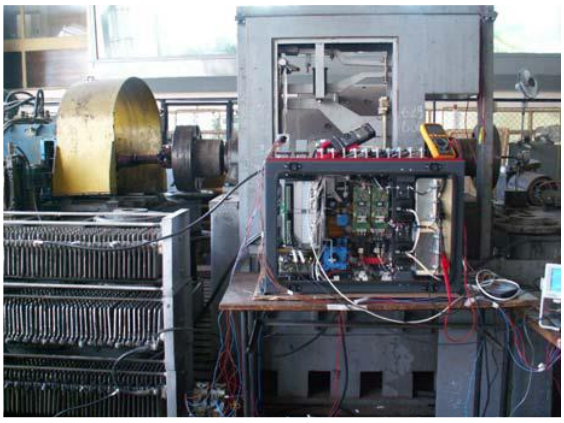


Figure B2.3 Testing of the chopper

Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

- **Designing and prototype carrying -out of device for** reading and storing data related to the energy consumption from trams

This activity has been necessary to monitor in a more accurate way the energy consumption on each upgraded tram. In principle the following components contribute to the energy consumption:

- Electrical engine
- Air conditioner
- Lighting system
- Safety equipment
- Braking system

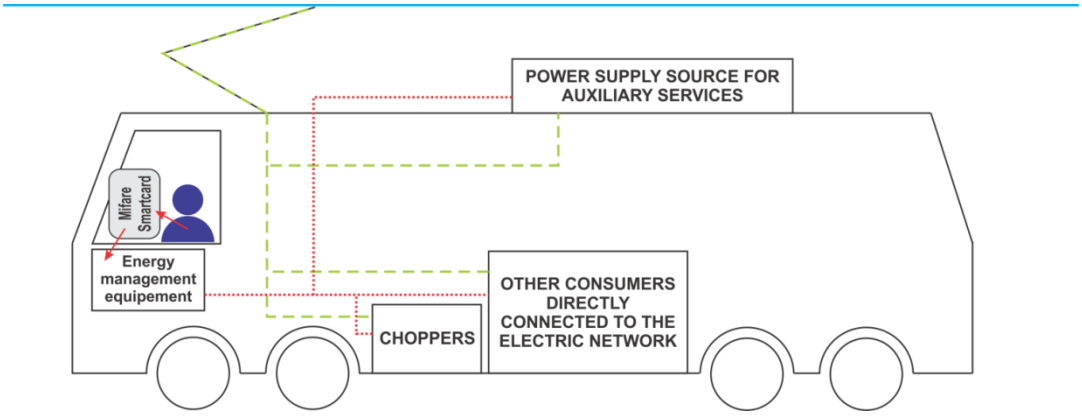


Figure B2.4 Position of the storage device (with Smartcard) for total energy consumption

The carrying -out of the device for reading and storing electrical data included the following steps

- Definition of the device's technical features
- Designing of the device and the PCB (Printed Circuit Board- Fig. B 2.5)

Figure B2.5

- Definition of the technical features of the firmware (a special program which assures the control of the device)
- Definition of the data recording both in the equipment memory and Mifare identification cards of the tram drivers Designing of the software routines interfacing the specific device software package started

Testing of the communication between the main device (made with Microchip signal processor), computer card reader and chopper

Energy consumption values have been determined reading electrical data from 2 devices, at the same time:

- On-board computer (BC) providing energy consumption only from traction part (ETractiune);
- Voltage and current acquisition devices (placed next the power supply line of the trams) by reading the records from the Smartcards, in that way we obtain the entire tram energy consumption value (ET_{otal}).

Difference between the two values (E_{Totala} - $E_{Tractiune}$) represents the consumption of auxiliary services of the tram (breaking system, air conditioning system, heating, and lightning).

B3 Situation before CIVITAS

In 2008 in Craiova, at the start of the project, the trams fleet was of 37 trams. Daily, about 27 trams ran from East to West of the city. 24 trams out of 37 had old electric driving system and 13 trams had chopper driving systems by construction. 9 trams out of 24 old driving system trams were out of service because of high energy consumption.

Of the 27 trams that ran every day, 13 trams are equipped with chopper driving systems and 14 trams are equipped with old driving systems based on contactors and braking rheostats with a high consumption of energy. Of the 14 trams old driving systems trams that were running in 2009, in Craiova, some of them (Mm5 type) had a rigid construction (belonging of the year 1945) which has seriously damaged the runway and could lead to the derailment.

This is the reason for that the trams Mm5 type were not chosen to be equipped with the chopper system. RAT intention is to disable them and retire from exercise in the next future. Besides, in 2010 RAT Company decided to scrap 3 trams KT4D because they were very damaged and not good for upgrading.

Given that the trams public transport is a viable alternative for daily commuting, RAT Craiova decided to upgrade the 9 old trams (6 trams KT4D type and 3 trams GT type) and put them back into service.

So, through MODERN project, RAT Craiova decided to replace the high energy consumption driving system of the 9 trams with low energy consumption driving system (chopper system), noting that the 9 trams does not add to the fleet that run daily but they replace other old trams with high energy consumption (see the Table B3.1)

Table B3.1 – Status of Craiova tram fleet

Trams type	Average number of trams in operation	Total no of trams	Trams type of whole fleet (%)	Comments
KT4D	1- equipped with contactors old driving system	10- equipped with contactors old driving system	25%	6 of these trams upgraded through MODERN project, measure 01.09
GT6	9- equipped with contactors old driving system	9- equipped with old driving system	25%	3 of these trams upgraded through MODERN project, measure 01.09
Mm5	4- equipped with contactors old driving	5 - equipped with old	14%	

	system	driving system		
T4DMTTB	13- with different chopper systems by construction	13- with different chopper systems by construction	36%	
Total	27	37	100%	

The trams fleet structure in 2008 is shown in the figure B3.2

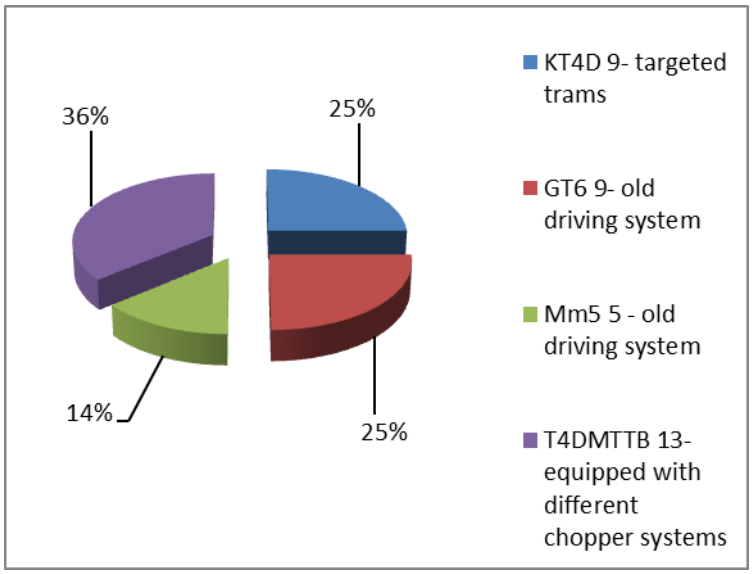


Figure B 3.2 – share of tram types operating in Craiova

B4 Actual implementation of the measure

Stage 1: Planning and design of the measure (October 2008-January 2009)

There were studied similar systems implemented both the Public Transport operators from Romania and the Public Transport operators from other European cities. The research team found optimum solution of chopper system that match to old trams' features.

A technical solution for anti-skidding of the driving wheels was developed by IPA and proposed as a patent at OSIM (State Office for Inventions and Trademarks). The registration document at OSIM (notification) nr. A/00931 – in Romanian - was attached to the MERT(annex 3) . The technological transfer (TT) from IPA (as measure leader) toward SC INDA ELTRAC SA Craiova which is an industrial company focused on controlling systems production, has been carried out. The TT agreement between the two parties is attached to the MERT(annex 3). The technological transfer consisted of:

- brake recovery energy
- anti-skidding of the driving wheels solution
- solution for on-board computer

Thus, IPA and RAT technicians designed all type of electric cables, data communication system between chopper and found the location of the different devices of the chopper.

Stage 2: Development and testing of the chopper prototype (January 2009- May 2009)

In this stage, the chopper system was developed and every subsystem was tested and calibrated for the purpose of implementing a prototype on the tram (Fig. 6).

Starting from the technical conditions and requirements there were agreed the optimal technologies for the chopper system implementation taking into consideration the best balance between quality and price. In the same time, a lot of devices for chopper system were designed and software programs needed for the operation of the chopper (Figure 1 and 2) were developed.

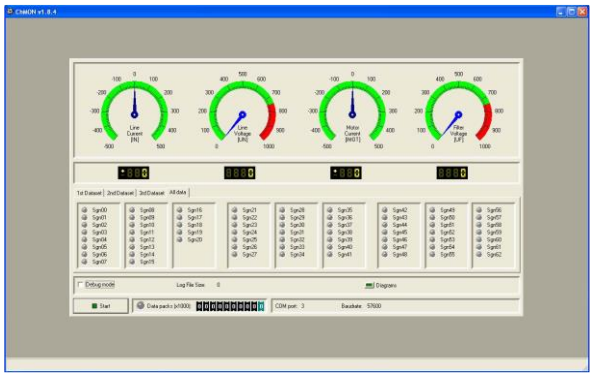
The chopper system was tested (Figure 3) in terms of power connections vibration and noise, both in IPA laboratory and in University's laboratory by professors and technicians.

The chopper driving system allows to the engine using continuous current to pass in a generator regime, especially when it brakes. So, the kinetic energy of the tramway is transformed in electric energy that is recovered in the power line. This energy is consumed by the other vehicles that are powered from the same line. In the case in which there are no other consumers, the braking energy will be dissipated on the line.

The chopper prototype was installed and tested on a tram. The final version of the equipment specification was defined.

Several tests on shape and size, installation, control and power connections, insulation resistance and endurance of both devices were made.

The equipment met all the requirements.



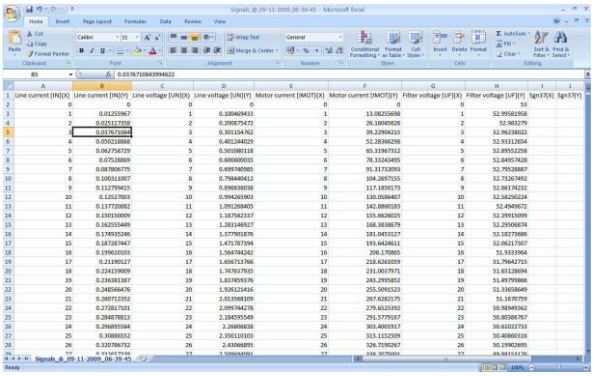
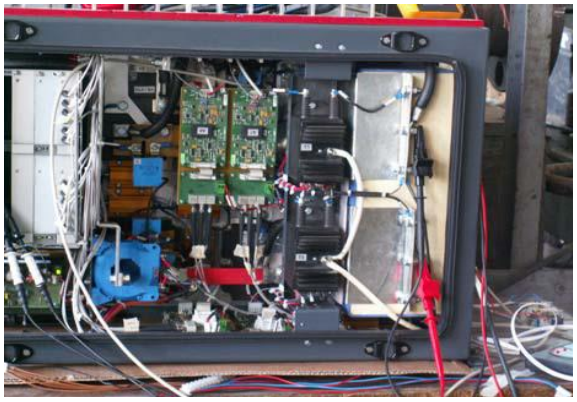


Figure 1 Main window of the program
Figure 2 File visualized with Microsoft



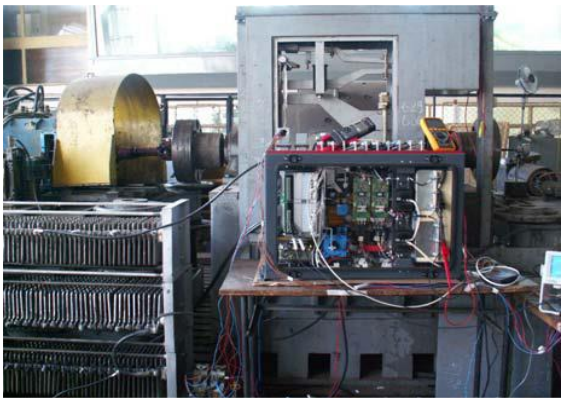


Figure 3 Prototype unit *Figure 4* Testing of the chopper

Figure 5 Energy saving on tramline

Stage 3: Subcontracting company for chopper production and installation (June 2009 - March 2011)

- **Procurement procedure carrying out (June 2009- Jan. 2010)**

Because the investment cost is high, RAT was obliged, by Romanian procurement low (34/19.04.2006 regulations,) to organize public auction to purchase 9 choppers systems.

Tender documentation was based on up-dating of electrical driving systems, according to current legislation, and following some solutions adopted by other transport operators.

The tender book contains the technical features of the equipment, the general implementation plan, the needed qualifications of the contractor etc.

Procurement procedure ended in January 2010 and the choppers delivery contract between RAT and provider, was signed.

- **Choppers delivery and installing (Feb. 2010-March 2011)**

The provider delivered the choppers in 3 steps, as following:

No. crt	Delivering date	Quantity
1	01.02.2010	3
2	15.04.2010	3
3	30.07.2010	3

Figure 7 A trams prepared for the chopper system installation process

In accordance with the delivery, the choppers were installed on trams.

In the figure 7, a tram prepared for the chopper system installation process is shown.

Stage 4: Technicians training (Sept 2009- March 2010)

The training program for drivers consisted of theoretical and practical notions about the new equipment installed on the trams, and a test drive together with the trainer.

From driving point of view, the differences between trams are not high, but the board of trams with chopper equipment is changed and provides more information and functions to the drivers and this must be known.

Stage 5: Chopper system operating (April 2011-Sept 2012)

In this stage, all 9 trams endowed with chopper systems operated in Craiova.

The upgraded 9 trams didn't record technical problems in circulation during operation in normal working hours. The trams were under continuous monitoring from the technical point of view.

This stage flags the beginning of the measurements needed in the ex-post evaluation.

Stage 6: Design and prototype for reading and storing data device, referring to the energy consumption on trams (Jul 2011-Jan 2012)

This activity was developed in addition to the initial set at the beginning of the project because an accurately monitoring of the energy consumption on each upgraded tram was necessary.

IPA Craiova manufactured specific devices for reading and storing the energy consumption and installed them on the 9 trams endowed with chopper system.

These were necessary to monitor in a more accurate way the energy consumption on each upgraded tram. In principle the following devices contribute to the energy consumption

- the converters (choppers) devoted to supply power to the traction motors
- the ancillary services supplied with energy by the source for auxiliary services
- The ancillary services directly coupled to the tram's power network (600V line).

Specific devices (Fig 4) were manufactured for reading and storing the energy consumption of trams endowed with chopper system.

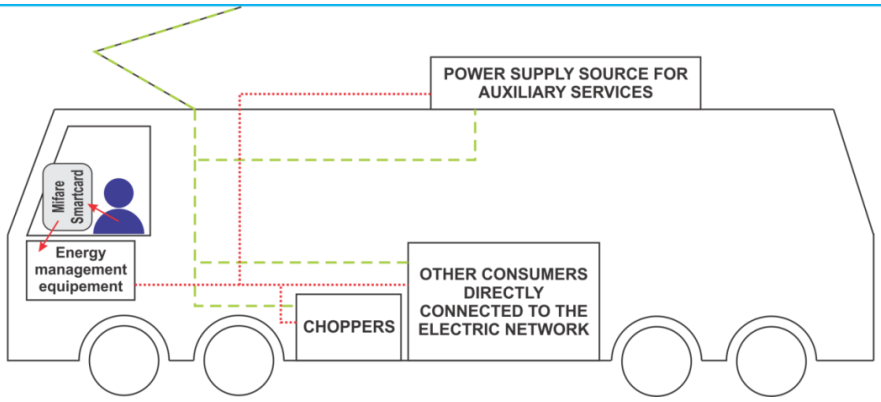


Figure 4 Specific devices for the tram

After the installation of the choppers on trams it was observed a different consumption according to the driver. The different consumption is due to the different behaviour of each driver in traffic, and to the use of ancillary services in a different ways.

Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

To realize a more detailed analysis of different modes of use of the vehicles with electric traction (trams in our case) by human operators, it was necessary to analyse the energy consumption for each driver separately. This is the main function of the devices which provide more realistic information about the energy consumption of trams.

Thus, on the driver board a specific device was installed, capable of reading/writing Mifare cards type and of communicating with the tram driver on one side, and on the other side with the other on-board equipment, responsible for acquiring the electrical parameters necessary to evaluate the energy consumption.

Figure 5 Printed Circuit Board

The communication with the on-board computer (which is connected with the chopper equipment) is ensured by a serial port CAN, in a CANOpen protocol and by RS232 and / or RS485 port, with the Mifare card reader which selects the tram driver.

All the nine upgraded trams were equipped with these devices for reading and storing information related to energy consumption, also related to drivers' behaviour. The system is activated by each driver, using the chip card, at the beginning of his service.

Data are stored and processed for each tram but also for each driver and are used to make management decisions on the trams fleet.

The devices were installed on the on-board computers of the 9 trams already upgraded within the project.

- the technical features of the equipment have been defined
- the design of the device to acquire information about energy consumption by tram and by tram driver.
- the PCB (Printed Circuit Board - Fig. 5) for the energy consumption devices was designed in order to provide the needed functions and the electronic components were positioned
- the functional characteristics of the firmware (a special program which assures the command and control of the device) have been specified
- the data which will be recorded both in the equipment memory and in the Mifare identification cards of the tram drivers have been defined
- the design of the software routines interfacing the specific device software package started
- some tests on the communication between the main equipment (made with Microchip signal processor) and related equipment (computer card reader and choppers) have been performed.

All the 9 upgraded trams were equipped with devices for reading and storing information related to energy consumption.

Stage 7: Design and development of a pilot qualitative evaluation system of electricity, from trams distribution stations, in order to optimize energy distribution (Jan 2012- May 2012)

To measure the overall energy consumption of trams, in 3 distribution stations were made acquisition systems for voltage and current in order to calculate the electric power absorbed from each station. These devices are built with 8-bit microcontrollers.

The development of these devices and their installation in distribution stations was necessary for the following reasons:

- RAT uses in the same time both modernized trams equipped with chopper, and modernized trams. In this situation, having both entire energy consumption (in substations) and energy consumption of each modernized tram they can determine the total energy consumption of un-modernized trams;

- Having an evolution for voltage and current in each distribution station separately, they can take some decisions mainly about the distribution of the trams on different route sections in order to have a maximum use of recovered energy given by modernized trams.

To measure current flow LEM transducers and signal adjustment circuits were used. Current acquisition was performed using the current shunt from each measuring circuit which is present in each distribution station.

Finally, the on time data acquisition is made through systems with PIC18F8722 microcontroller. To avoid any perturbations the current or voltage are transformed into unified signal (4 - 20mA).

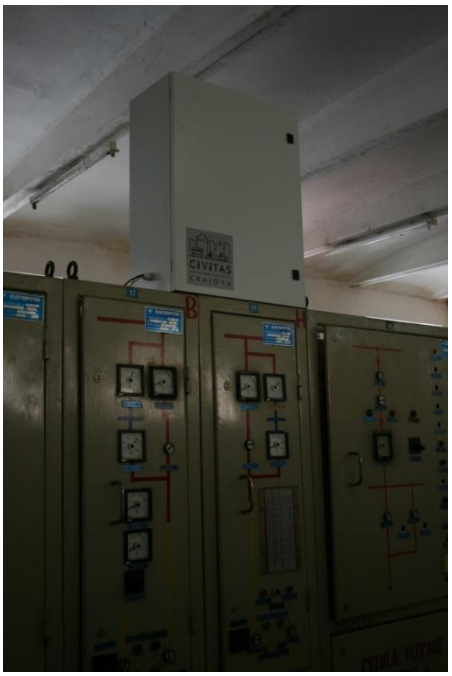
Due to this type of signal, the analogue inputs of the microcontrollers required adjustments, namely transforming current signal (20mA maximum) in voltage signal (5V max).

To view analogue measurements acquired by the microcontroller systems, in each distribution stations were made RS232 - Ethernet converters allowing serial data transmission from microcontroller systems via Ethernet network.

Data visualization can be made using virtual oscilloscope software installed on a personal computer.

Activities for the development of these systems were:

- Definition of the technical characteristics of the acquisition system.
- Establishing how to make the interconnections of the system in the existing measurement circuit of each distribution station.
- Design of the electronic circuits and printed circuit boards (PCBs).
- Physical implementation of each device.
- Development of the firmware.
- Manufacturing of the metal cabinets containing the acquisition system.
- Installation of the data acquisition system.
- Test of the data acquisition system.



Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

Metal cabinet with acquisition system *Data acquisition system from distribution stations*

B5 Inter-relationships with other measures

The measure is related to other measures as follows:

- **M 08.06** Priority traffic light regulation for PT in Craiova is implemented on the same vehicles- the 9 old trams

Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

C Impact Evaluation Findings

C1 Measurement methodology

C1.1 Impacts and Indicators

The key indicators assessed within this measure are:

- electric energy consumption (%)
- quality of service
- exploitation costs

The evaluation process was supported by the availability of special purpose software which allows the online visualization and management of - network current, engine current, network voltage, and filter voltage. The following table reports the whole set of data used for the evaluation:

Table C1.1: Indicators.

No.	Impact	Indicator	Data used	Comments
2	Economy	Average Operating costs	Annual operating costs: Energy, Spare parts and maintenance	Shows the effectiveness of the chopper driving system due to the lower energy and maintenance cost
2’		Capital cost	Investments costs	The investments cost can be recuperated due to the energy saving
3	Energy	Vehicle Fuel Efficiency Energy consumption	Tram Energy consumption Number of Km travelled RAT Craiova records	The energy consumption is noticeably lower for the trams upgraded having chopper driving system
13	Society	Awareness level	Face to face and phone surveys	Perception of the increase of the awareness level for the transport with trams
19	Transport	Quality of Service	Perception of the quality of service of public transport (trams). Face to face and phone surveys	The results of the surveys in the evaluation period shows a change of users perception on quality of service; they feel more comfortable when travelling by trams equipped with chopper driving system due

				to smoother start and stop

Detailed description of the indicator methodologies:

Indicator 2 (Average Operating costs) - Ratio of total operating costs, such as energy, spare parts and maintenance costs, divided by the total vehicle-km completed by the 9 trams in service per year.

A = B / C

where: A = Average operational costs for the service (€/vKm)

B = Total operational costs coming from the 9 trams, (€)

C = Total vehicle- Km traveled by the 9 envisaged trams.

RAT provided only operating costs related to the 9 trams referring to energy consumption, spare parts and maintenance.

Indicator 2' (Capital cost) - Investment cost for the 9 chopper driving systems

The capital cost is according to the contract between the provider and RAT

Indicator 3 (Vehicle Fuel Efficiency)- The energy consumption of each tram on a given distance

The energy consumption was counted with an energy counter, for the 9 envisaged trams

A = B / C

A = Average energy consumption (KW/vKm)

B = Total energy consumed by the 9 envisaged trams (KW)

C = Total amount of vehicle-kilometers completed by the 9 trams (vKm)

Indicator 19 (Quality of Service) – Survey based perception of the quality of service

Indicator 13 (Awareness level) - Survey based perception of benefits or disadvantages of the chopper driving system

A survey was made to evaluate the impact of the 9 upgraded trams with chopper systems on public transport users. RAT Craiova considers that maximum 30% of total revenues from fares and tickets due to tram transportation.

Craiova population, consisting of 300'000 inhabitants uses public transportation (buses and trams) daily or occasionally. So, taking into consideration the contribution of trams transportation in total revenues of RAT, we considered that 30% of population, meaning 90'000 inhabitants, use trams transport. (see Annex 2 – sample size calculation)

150 questionnaires were circulated in the ex-ante period and the same number ex-post, keeping the same target group. The contact data of ex-ante respondents were kept to be in contact for the ex-post evaluation period. Feedbacks were 115 questionnaires filled in ex-ante and 110 questionnaires filled in ex-post.

The questionnaires for the ex-ante situation were disseminated face-to face to public transport users in stations, inside trams and during workshops organized by MODERN project team. The workshops were

organized during the Communication Campaign and seminar presentation that took place in a pavilion located in the prefecture market (in the downtown).

C1.2 Establishing a Baseline

The baseline was assessed making reference to year 2009 when in Craiova, daily, 27 trams were running and the whole trams fleet consisted in 37 trams. 9 of these 37 trams were disabled and retired from movement because they had high energy consumption driving system. This electric driving system of the 9 trams was built in year 1985.

The results of baseline for each indicator are shown in the following tables:

Table C1.2.1 - Average operating costs

Raw data and indicator calculation	**2009 Ex-Ante values**
Total Operational Costs coming from the 9 trams	49’480.42 €
Total vehicle-km travelled by the 9 trams	297’833 Km
Average operating costs	0.1661 €/vkm

Note: These costs include the energy consumption, maintenance and spare parts

In order to evaluate the Energy efficiency technicians from IPA and RAT installed an energy meter on a tram (KT4 D type) without chopper system. It was considered a distance of 110 Km and made the ratio between total energy consumption and the considered distance in order to get the energy consumption per vKm

Table C1.2.2 - Energy consumption/vKm

Indicators and relevant parameters	**Ex-Ante values**
Energy consumption/vKm	2.80KW/vkm
Total vehicle-km	297’833 Km
Total energy consumption for the 9 trams without choppers	833’931 KWh

The questionnaires were disseminated to public transport users in trams stations and the city centre during the seminar presentation that took place in the prefecture market

115 feedbacks were received from people that expressed their opinion about the transportation by trams. In agreement with the people interviewed their contact data were kept, to evaluate the progress of the measure, using the same target group.

Table C1.2.3 – Quality of service

Questionnaire content	**Ex-Ante values**

Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

How do you estimate the quality of public transport in your city?"	25% very dissatisfied 55% somewhat dissatisfied 19% Satisfied 1% don't know
How do you perceive tram journey, now, before implementing the measure	24% very uncomfortable 53%somewhat comfortable 22%confortable 1% don't know

Table C1.2.4 – Awareness Level

Questionnaire content	**Ex-Ante values**
Do you understand the aim of the measure and its potential benefit?	41% fairly well understand 19% well understand 36% very well understand 4% don't know

C1.3 Building the Business-as-Usual scenario

To have a real comparison of the benefit coming from the measure, the results obtained have to be compared not only with the ex-ante situation, but with the scenario which should have took place if the measure should have not been implemented. This because anyway other interventions should have been carried out anyway, with their relevant results. We have to consider, the so-called- “Business-as-Usual” (BAU) scenario.

BAU scenario is the following:

1. Only one driving system was changed in 2010 (only to test the technology); in this case there are an increase in operation costs but the capital cost is very limited.
2. RAT shall decide to replace 8 trams with new ones, starting to 2014. In this case there are relevant capital costs, and the operative costs are more or less the same as in Modern measure 1.2 implementation.

The individual energy consumption of the tram in BAU case is the same of any tram upgraded through the MODERN project, because we assume that the developed technology should have been more or less the same.

Table C1.3.1- Trams fleet in 2009

Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

Trams type	Number of trams in operation	Total no of trams
KT4D	1 - equipped with contactors old driving system	10 - equipped with contactors old driving system
GT6	9 - equipped with contactors old driving system	9 - equipped with old driving system
Mm5	4 - equipped with contactors old driving system	5 - equipped with old driving system
T4DMTTB	13 - equipped with chopper systems, by construction	13 - equipped with chopper systems, by construction
Total	**27**	**37**

Table C1.3.2 -Trams fleet in 2010

Trams type	Number of trams in operation	Total no of trams
KT4D	2 - equipped with contactors old driving system	6 - equipped with contactors old driving system
	1 - equipped with chopper driving systems by own funds	1 - equipped with chopper driving systems by own funds
GT6	8 - equipped with contactors old driving system	9 - equipped with old driving system
Mm5	3 - equipped with contactors old driving system	5 - equipped with old driving system
T4DMTTB	13 - equipped with chopper systems, by construction	13 - equipped with chopper systems, by construction
Total	**27**	**34**

Table C1.3.3 -Trams fleet in 2011

Trams type	Number of trams in operation	Total no of trams
KT4D	6 - equipped with Chopper driving system through MODERN	6 - equipped with Chopper driving system through MODERN
	1 – equipped with chopper driving systems by own funds	1 – equipped with chopper driving systems by own funds
GT6	3 - equipped with chopper driving systems through MODERN project	3- equipped with chopper driving systems through MODERN project
	4 - equipped with old driving system	6- equipped with old driving system

Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

Trams type	Number of trams in operation	Total no of trams
Mm5	4 - equipped with contactors old driving system	5 - equipped with old driving system
T4DMTTB	12 - equipped with chopper systems, by construction	13- equipped with chopper systems, by construction
Total	30	34

Table C1.3.4 - Trams fleet in 2012

Trams type	Estimated number of trams in operation	Total no of trams
KT4D	6 - equipped with Chopper driving system through MODERN	6 - equipped with Chopper driving system through MODERN
	1 – equipped with chopper driving systems by own funds	1 – equipped with chopper driving systems by own funds
GT6	3 - equipped with chopper driving systems through MODERN project	3- equipped with chopper driving systems through MODERN project
	4 - equipped with old driving system	6- equipped with old driving system
Mm5	0	5 - equipped with old driving system
T4DMTTB	12 - equipped with chopper systems, by construction	13- equipped with chopper systems, by construction
Total	26	34

Evolution of the indicators in BAU is shown in the tables below:

Table C1.3.5 – Business as usual scenario: Average Operating Costs

Indicator	0nly 1 chopper	8 new trams
Average operating cost (2010)	0.1678 €/vkm	0.1474 €/vkm
Average operating cost (2011)	0.1770 €/vkm	0.1196 €/vkm
Average operating cost (2012)	0.1768 €/vkm	0.1196 €v/km

Note.: These operating costs include the energy consumption, maintenance and spares parts costs

Table C 1.3.6 – Business as usual scenario: Indicator 2' (Capital Costs)

Indicator	BAU values
Total capital cost (2010) for 1 chopper purchased by own budget	54.222 €
Total capital cost (2011)	0 €
Total capital cost (2012)	0 €

Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

Table C1.3.7 – Business as usual scenario: Vehicle Fuel Efficiency (Energy consumption/vKm)

Indicator	BAU values
Energy consumption/vKm (2010-11-12) consider that the 9 trams include 8 trams without chopper and 1 tram with chopper BAU Scenario 1	2.69 KW/vKm

C2 Measure results

The results are presented under sub headings corresponding to the areas used for indicators – economy, energy, society and transport.

C2.1 Economy

The revenues within all the scenarios (BAU and Modern) are considered the same because they seem not to be influenced by any solution implementation..

Average operating cost

The operating costs, including the energy consumption, maintenance and spare parts costs, decreased due to implementation of the chopper system. So it shall happen if 8 new trams will be implemented. The chopper system needs very few maintenance costs (around 4% of investment costs); same costs should be used for the new 8 trams.

Table C2.1.1 – Average operating costs: ex-post values

Indicator	Ex-Post Values
Average operating cost (2010)	0.1474 €/vkm
Average operating cost (2011)	0.1196 €/vkm
Average operating cost (2012)	0.1195 €/vkm

Note: These costs include the energy consumption, maintenance and spares parts

Table C2.1.2 – Evolution of Average operating cost in the operation period

Average operating cost (€/vKm)	**2009**	**2010**	**2011**	**2012**
ex-ante	0.1661			
CIVITAS	0.1661	0.1474	0.1196	0.1195
BAU 1 chopper BAU 8 new trams	0.1661 0,1661	0.1678 0,1474	0.1770 0,1196	0.1768 0,1195

Table C2.1.3 – Operating costs evolution between 2009 and 2012

Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

Indicator	Before	B-a-U	After	After –Before	After– B-a-U
Indicator 2 Average Operating costs	0.1661 €/vKm (2009)	0.1678 €/vKm (2010) 0.1770 €/vKm (2011) 0.1768 €/vKm (2012)	0.1474 €/vKm (2010) 0.1196 €/vKm (2011) 0.1195 €/vKm (2012)	-0.0187 (2010) -0.0465 (2011) -0.0466 (2012)	-0.0204 (2010) -0.0573 (2011) -0.0573 (2012)

C2.2 Energy

In order to see the evolution of the energy consumption for the 9 targeted trams, we consider the energy consumption before and after the implementation of the measure.

In situation before we considered 9 trams without chopper system, in BAU situation we considered 8 trams without chopper system and 1 tram with chopper system and in after situation we considered 9 trams with chopper system. As seen in the following, the energy consumption (KW/vKm) decreases due to the implementation of the 9 chopper systems.

The energy consumption (KW/vKm) in 2011 and 2012 is lower by 35% than energy consumption in 2009, which is the baseline year.

In the tables below, it can be seen the evolution of indicator after the implementation of the measure.

Indicator 3 Vehicle Fuel Efficiency (Energy consumption-KW/vKm)

Indicator	Ex-Post values
Energy consumption/vKm (2010) 5 trams without choppers and 4 trams with choppers(by CIVITAS) out of the 9 envisaged trams	2.36 KW/vKm
Energy consumption/vKm (2011- 2012) 9 trams with choppers(by CIVITAS) out of the 9 envisaged trams	1.82 KW/vKm

Chopper driving systems were implemented progressively in the years 2010 and 2011. In 2010, chopper systems were installed on 4 trams, then, in 2011, chopper systems were installed on the rest of 5 trams, so that, in 2011, all 9 trams operated by chopper.

Table C2.2.2- shows a synthetic picture of the indicators evolution since situation before CIVITAS and ending with the situation after implementation of the measure

Indicator	Before	B-a-U	After	After –Before	After – B-a-U
Indicator 3 Vehicle Fuel Efficiency Energy consumption	2.8 KW/vKm (2009)	2.69 KW/vKm (2010) 2.69 KW/vKm (2011)	2.36 KW/vKm (2010) 1.82 KW/vKm (2011)	-0.44 (2010) -0.98 (2011)	-0.33 (2010) -0.87 (2011)

Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

		2.69 KW/vKm (2012)	1.82 KW/vKm (2012)	-0.98 (2012)	-0.98 (2012)

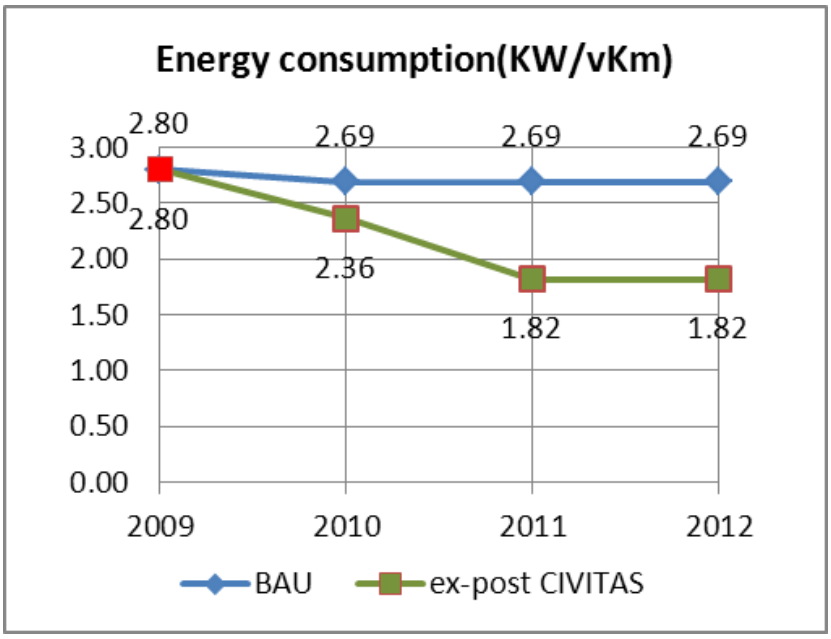


Figure C2.2.1 – Graphic representation of Energy consumption CIVITAS measure vs. BAU

C2.4 Transport

Implementation of the measure led to a change of trams users perception of service quality. The chopper driving system gives a smoother start and stop of trams and for this reason the users feel more comfortable.

Table C2.4.1- shows a synthetic image of the indicator evolution since situation before CIVITAS and ending with the situation after implementation of the measure

The survey was done on the same people interweaved in ex-ante and received 110 feedbacks.

Indicator	Before	B-a-U	After	After –Before	After – B-a-U

Indicator 19 Quality of Service	25 % very dissatisfied 55 % somewhat dissatisfied; 19% Satisfied 1 % don't know (2009)	25 % very dissatisfied 55 % somewhat dissatisfied; 19% Satisfied 1 % don't know (2011)	23 % very dissatisfied 56 % somewhat dissatisfied; 20% Satisfied 1 % don't know (2011)	2 % (decreasing) very dissatisfied 1 % (increasing) somewhat dissatisfied; 1% (increasing) Satisfied 1 % don't know	2 % (decreasing) very dissatisfied 1 % (increasing) somewhat dissatisfied; 1% (increasing) Satisfied 1 % don't know
	24 % very uncomfortable 53%somewhat comfortable 22%confortable 1 % don't know (2009)	24% very uncomfortable 53%somewhat comfortable 22%confortable 1 % don't know (2011)	23 % very uncomfortable 53%somewhat comfortable 23%confortable 1 % don't know (2011)	1 % decreasing very uncomfortable 0%somewhat comfortable 1%increasing comfortable 1 % don't know	1 % decreasing very uncomfortable 0%somewhat comfortable 1%increasing comfortable 1 % don't know
			49 % PT services have been improved last time 25 % PT services have not been improved last time 26% don’t know (2011)		

Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

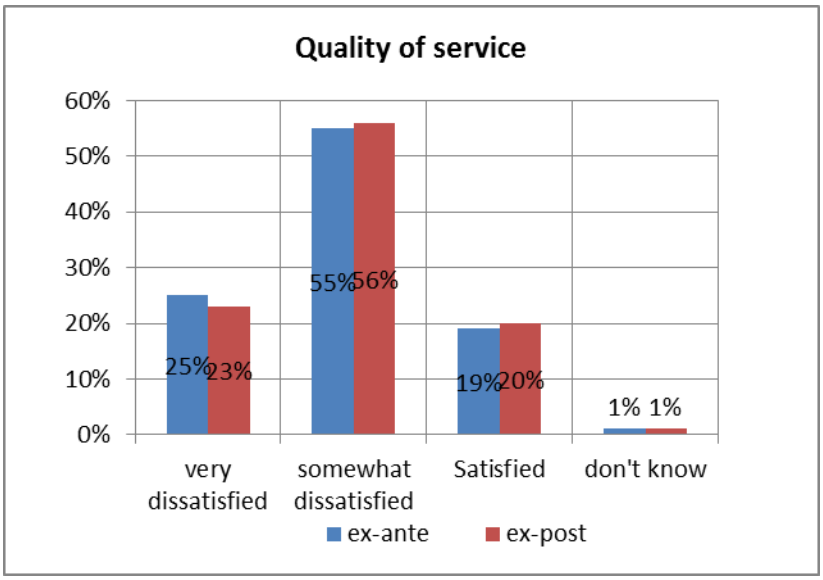


Figure C2.4.2.(1) Graphic representation of Quality service- ex-ante versus ex-post

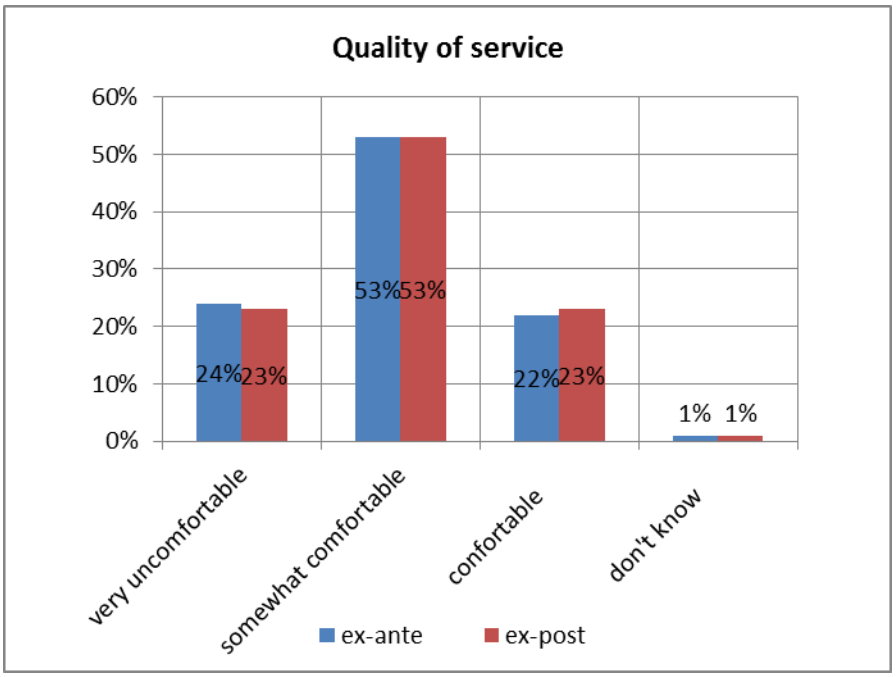


Figure C 2.4.2.(2) Graphic representation of Quality service- ex-ante versus ex-post

Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

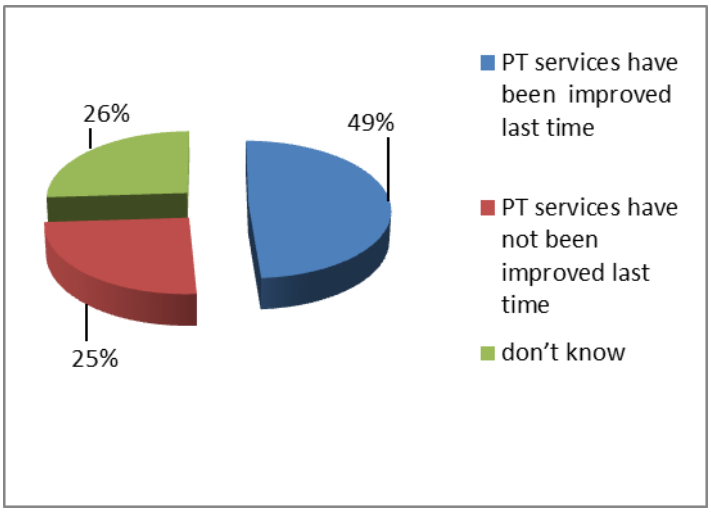


Figure C 2.4.2.(3) Graphic representation of people perception concerning on improved PT services

C2.5 Society

Table C2.5.1- shows a synthetic image of the indicator evolution since situation before CIVITAS and ending with the situation after implementation of the measure

The survey was done on the same people interweaved in ex-ante and received 110 feedbacks

Indicator	Before	B-a-U	After	After –Before	After – B-a-U
Indicator 13 Awareness level	41% fairly well understand; 19% well understand; 36% very well understand 4% don't know (2009)	41% fairly well understand; 19% well understand; 36% very well understand 4% don't know (2011)	36% fairly well understand; 25% well understand; 38% very well understand; 1% don't know (2011)	7% fairly well understand 6% well understand 2% very well understand 3% don't know	7% fairly well understand 6% well understand 2% very well understand 3% don't know

			60 % PT was more useful in the last time 38 % PT was useless in the last time 2 % don't know (2011)		

Awareness level

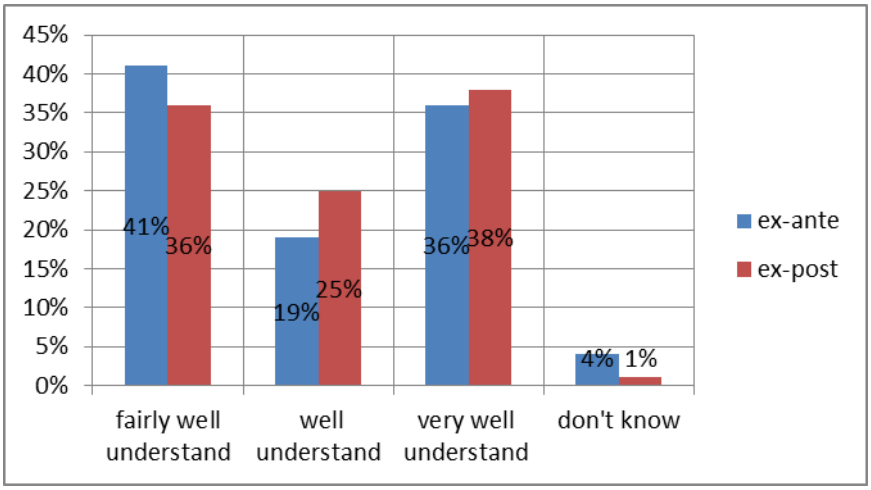


Figure C 2.5.2(1)- Graphic representation of Quality service- ex-ante versus ex-post

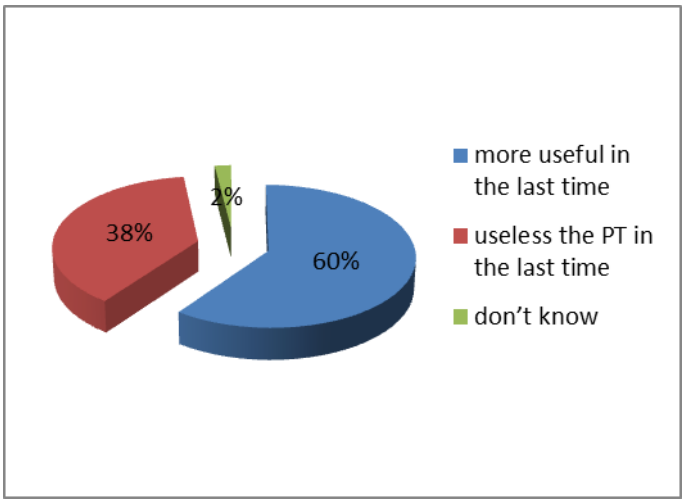


Figure C 2.5.2(2)- Graphic representation of people perception concerning on improved PT services

C2.6 Cost benefit analysis

C2.6.1 Evaluation period for CBA

Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

- Defining reference case for CBA

The reference case for CBA is considered Business as usual situation which means 1 tram endowed with chopper system by own funds and 8 trams without chopper system, out of the 9 trams considered

- Defining lifetime of the measure

The implementation period of the measure is within 2010-2012 and the baseline year is 2009

The life time of the chopper driving system: 10 years

The appraisal period includes the implementation period and the operation period, within 2009-2018, in order to cover the full effect of the measure.

- Discount rate:

3.5% recommended by EC, for the 2007-2013 period

C2.6.2 Method and values for modification

- Description of how the impacts are monetized

This measure involves the installation of chopper driving system on the trams to increase their energy efficiency. The benefit, directly registered by the RAT, will be financial one, not socio-economic, because the measure is a technical one and it does not lead to long-term economic benefits, such as reductions of air pollutant emission, reductions of greenhouse gas or journey time saving. We cannot say that the implementation of the measure has attracted a greater number of passengers who previously used cars. The benefit is simply due to reduced energy and maintenance costs from the trams equipped with chopper driving system. Unfortunately, information on energy producer are not available, hence, the energy used by trams could be produced by Thermal Power Plant, Hydro Power Plant or renewable sources. Therefore, we cannot monetize the benefits brought by emissions reducing due to energy saving

Also, cannot be monetized the journey time saving because chopper system implementation does not influence the tram travel time.

- References of values used

.C2.6.3 Life time cost and benefit

Table C2.6.3-1 Capital cost in the evaluation period (not discounted)

	Cases for comparison	Cost (€)
2009	CIVITAS measure	0
	BAU	0
2010	CIVITAS measure	488070
	BAU	54222
2011	CIVITAS measure	0

Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

	Cases for comparison	Cost (€)
	BAU	0
2012	CIVITAS measure	0
	BAU	0
2013	CIVITAS measure	0
	BAU	0
2014	CIVITAS measure	0
	BAU	0
	CIVITAS measure	0
2015	BAU	0
	CIVITAS measure	0
2016	BAU	0
	CIVITAS measure	0
2017	BAU	0
	CIVITAS measure	0
2018	BAU	0

Table C2.6.3-2 Operation costs(energy consumption costs) in the evaluation period (not discounted)

	Cases for comparison	Values euro
2009	CIVITAS measure	49454.05
	BAU	49454.05
2010	CIVITAS measure	40262.27
	BAU	45824.82
2011	CIVITAS measure	20908.55
	BAU	30916.06
2012	CIVITAS measure	21252.05
	BAU	31423.98
2013	CIVITAS measure	21492.35
	BAU	31779.29

Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

	Cases for comparison	Values euro
2014	CIVITAS measure	22016.42
	BAU	32554.19
2015	CIVITAS measure	22408.69
	BAU	33134.22
2016	CIVITAS measure	22881.37
	BAU	33833.14
2017	CIVITAS measure	23326.50
	BAU	34491.33
2018	CIVITAS measure	23799.41
	BAU	35190.58

Table C2.6.3-3 Maintenance cost in the evaluation period (not discounted)

	Cases for comparison	Values (euro)
2009	CIVITAS measure	26.37
	BAU	26.37
2010	CIVITAS measure	6.10
	BAU	9.76
2011	CIVITAS measure	0.00
	BAU	9.84
2012	CIVITAS measure	0.00
	BAU	8.32
2013	CIVITAS measure	0.00
	BAU	8.49
2014	CIVITAS measure	11713.68
	BAU	1309.98
2015	CIVITAS measure	0.00
	BAU	8.83

Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

	Cases for comparison	Values (euro)
2016	CIVITAS measure	0.00
	BAU	9.01
2017	CIVITAS measure	0.00
	BAU	9.19
2018	CIVITAS measure	3904.56
	BAU	443.13

Note: These costs include spare parts and maintenance costs. After chopper systems implementation, RAT have to conclude maintenance contract, every 4 years, to change the electronic devices. The maintenance contract was calculated as 4% of capital cost.

Table C2.6.3-4 Revenue in the evaluation period (not discounted)

	Cases for comparison	Values (€)
2009	CIVITAS measure	707247.55
	BAU	707247.55
2010	CIVITAS measure	756927.72
	BAU	756927.72
2011	CIVITAS measure	244121.91
	BAU	244121.91
2012	CIVITAS measure	219984.48
	BAU	219984.48
2013*	CIVITAS measure	772066.28
	BAU	772066.28
2014	CIVITAS measure	787507.60
	BAU	787507.60
2015	CIVITAS measure	803257.75
	BAU	803257.75
2016	CIVITAS measure	819322.91
	BAU	819322.91

2017	CIVITAS measure	835709.37
	BAU	835709.37
2018	CIVITAS measure	852423.55
	BAU	852423.55

The years 2011 and 2012 brought low revenues because of interruption of the tramline during the overpass construction (the line was cut into two separate sections, so that some passengers chose different transport solutions). Starting to 2013, RAT assumed that the revenues will have normal values as before cutting the line and will be increased by 2% inflation, from year to year.

C2.6.4 Compare the lifetime costs and benefits

Table C2.6.4-1 Lifetime cost/benefit of CIVITAS measure(Undiscounted)

	Capital cost	Operation costs	Maintenance costs	Other costs	Revenue	Total costs	Total revenues	Cumulated costs
2009	0.00	49454.05	26.37	0.00	707247.55	49480.42	707247.55	657767.13
2010	488070.00	40262.27	6.10	0.00	756927.72	528338.37	756927.72	228589.35
2011	0.00	20908.55	0.00	0.00	244121.91	20908.55	244121.91	223213.36
2012	0.00	21252.05	0.00	0.00	219984.48	21252.05	219984.48	198732.43
2013	0.00	21492.35	0.00	0.00	772066.28	21492.35	772066.28	750573.92
2014	0.00	22016.42	11713.68	0.00	787507.60	33730.10	787507.60	753777.50
2015	0.00	22408.69	0.00	0.00	803257.75	22408.69	803257.75	780849.06
2016	0.00	22881.37	0.00	0.00	819322.91	22881.37	819322.91	796441.53
2017	0.00	23326.50	0.00	0.00	835709.37	23326.50	835709.37	812382.86
2018	0.00	23799.41	3904.56	0.00	852423.55	27703.97	852423.55	824719.59
Total	488070.00	267801.67	15650.71	0.00	6798569.12	771522.38	6798569.12	6027046.74

Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

	1	2	3	4	5	6	7	8	9	10
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018

Undiscounted cash flow

Revenues(€)	707,248	756,928	244,122	219,984	772,066	787,508	803,258	819,323	835,709	852,424
Total costs(€)	49,480	528,338	20,909	21,252	21,492	33,730	22409	22881	23327	27704
Net cash flow (€)	657,767	228,589	223,213	198,732	750,574	753,778	780,849	796,442	812,383	824,720

Discount Factors

Discount Rate	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%
Base Year	2009									

Discounted cash flow

Revenues (€)	707,248	731,331	227,890	198,413	672,811	663,060	653,451	643,980	634,647	625,450
Costs (€)	49,480	510,472	19,518	19,168	18,729	28,400	18,229	17,985	17,714	20,327
Net cash flow (€)	657,767	220,859	208,372	179,245	654,082	634,660	635,221	625,996	616,933	605,122
Cumulative cash flow (€)	657,767	878,626	1,086,998	1,266,244	1,920,326	2,554,986	3,190,207	3,816,203	4,433,136	5,038,258

Table C2.6.4 -6 Lifetime cost/benefit of the reference case- BAU(Undiscounted)

	Capital cost	Operation costs	Maintenance costs	Other costs	Revenue	Total costs	Total revenues	Cumulated costs
2009	0.00	49454.05	26.37	0.00	707247.55	49480.42	707247.55	657767.13
2010	54222.00	45824.82	9.76	0.00	756927.72	100056.58	756927.72	656871.14
2011	0.00	30916.06	9.84	0.00	244121.91	30925.90	244121.91	213196.01
2012	0.00	31423.98	8.32	0.00	219984.48	31432.30	219984.48	188552.19
2013	0.00	31779.29	8.49	0.00	772066.28	31787.77	772066.28	740278.50
2014	1500000.00	32554.19	1309.98	0.00	787507.60	1533864.17	787507.60	-746356.57
2015	3000000.00	33134.22	8.83	0.00	803257.75	3033143.05	803257.75	-2229885.30
2016	3000000.00	33833.14	9.01	0.00	819322.91	3033842.15	819322.91	-2214519.24
2017	3000000.00	34491.33	9.19	0.00	835709.37	3034500.51	835709.37	-2198791.15
2018	1500000.00	35190.58	443.13	0.00	852423.55	1535633.71	852423.55	-683210.15
Total	12054222.00	358601.65	1842.90	0.00	6798569.12	12414666.56	6798569.12	-5616097.43

Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

	1	2	3	4	5	6	7	8	9	10
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018

Undiscounted cash flow

Revenues(€)	707247.55	756927.72	244121.91	219984.48	772066.28	787507.60	803257.75	819322.91	835709.37	852423.55
Total costs(€)	49480.42	100056.58	30925.90	31432.30	31787.77	1533864.17	3033143.05	3033842.15	3034500.51	1535633.71
Net cash flow (€)	657767.13	656871.14	213196.01	188552.19	740278.50	-746356.57	-2229885.30	-2214519.24	-2198791.15	-683210.15

Discount Factors

Discount Rate	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%
Base Year	2009									

Discounted cash flow

Revenues (€)	707,247.55	731,331.13	227,890.42	198,413.40	672,811.15	663,060.27	653,450.70	643,980.40	634,647.35	625,449.56
Costs (€)	49,480.42	96,673.02	28,869.66	28,350.13	27,701.21	1,291,472.47	2,467,463.83	2,384,572.51	2,304,434.76	1,126,742.01
Net cash flow (€)	657,767.	634,658.1	199,020.7	170,063.2	645,109.9	-	-	-	-	-

	13	1	6	7	5	628,412.20	1,814,013.13	1,740,592.11	1,669,787.41	501,292.45
Cumulative cash flow (€)	657,767.13	1,292,425.24	1,491,446.00	1,661,509.26	2,306,619.21	1,678,207.01	-135,806.12	-1,876,398.22	-3,546,185.63	-4,047,478.08

Table 2.6.4-11 Changes in cost

		1	2	3	4	5	6	7	8	9	10
		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Capital cost (€)	CIVITAS measures	0.00	488070.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	BAU	0.00	54222.22	0.00	0.00	0.00	1500000.00	3000000.00	3000000.00	3000000.00	1500000.00
Operating cost (€)	CIVITAS measures	49454.05	40262.27	20908.55	21252.05	21492.35	22016.42	22408.69	22881.37	23326.50	23799.41
	BAU	49454.05	45824.82	30916.06	31423.98	31779.29	32554.19	33134.22	33833.14	34491.33	35190.58
Maintenance cost (€)	CIVITAS measures	26.37	6.10	0.00	0.00	0.00	11713.68	0.00	0.00	0.00	3904.56
	BAU	26.37	9.76	9.84	8.32	8.49	1309.98	8.83	9.01	9.19	443.15
Total (€)	CIVITAS measures	49480.42	528338.37	20908.55	21252.05	21492.35	33730.10	22408.69	22881.37	23326.50	27703.97
	BAU	49480.42	100056.80	30925.90	31432.30	31787.77	1533864.17	3033143.05	3033842.15	3034500.51	1535633.72
	Changes	0.00	428281.57	-10017.35	-10180.24	-10295.42	-1500134.08	-3010734.36	-3010960.77	-3011174.01	-1507929.76

Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

Table 2.6.4 -12 Changes in benefit

			1	2	3	4	5	6	7	8	9	10
			2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Revenue		CIVITAS measures	707247.55	756927.7	244121.9	219984.48	772066.28	787507.6	803257.75	819322.9	835709.37	852423.55
		BAU	707247.55	756927.7	244121.9	219984.48	772066.28	787507.6	803257.75	819322.9	835709.37	852423.55
		Changes (€)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
External cost/benefit	Journey time savings	CIVITAS measures	0	0	0	0	0	0	0	0	0	0
		BAU	0	0	0	0	0	0	0	0	0	0
		Changes (€)	0	0	0	0	0	0	0	0	0	0
	Accident savings	CIVITAS measures	0	0	0	0	0	0	0	0	0	0
		BAU	0	0	0	0	0	0	0	0	0	0
		Changes (€)	0	0	0	0	0	0	0	0	0	0

Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

			1	2	3	4	5	6	7	8	9	10
			2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
	Reductions of air pollutant emission	CIVITAS measures	0	0	0	0	0	0	0	0	0	0
		BAU	0	0	0	0	0	0	0	0	0	0
		Changes (€)	0	0	0	0	0	0	0	0	0	0
	Reductions of green house gas emission	CIVITAS measures	0	0	0	0	0	0	0	0	0	0
		BAU	0	0	0	0	0	0	0	0	0	0
		Changes (€)	0	0	0	0	0	0	0	0	0	0
Changes in total benefit (€)			0	0	0	0	0	0	0	0	0	0

Table 2.6.4-13 NPV calculation

	1	2	3	4	5	6	7	8	9	10
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018

Undiscounted cash flow

Changes in total cost (€)	0	428,282	-10,017	-10,180	-10,295	-1,500,134	-3,010,734	-3,010,961	-3,011,174	-1,507,930
Changes in total benefit (€)	0	0	0	0	0	0	0	0	0	0
Net cash flow (€)	0	-428,282	10,017	10,180	10,295	1,500,134	3,010,734	3,010,961	3,011,174	1,507,930

Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

Discount Factors

Discount Rate	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%
Base Year	2009									

Discounted cash flow

Changes in total cost (€)	0	413,799	-9,351	-9,182	-8,972	-1,263,073	-2,449,234	-2,366,588	-2,286,720	-1,106,415
Changes in total benefit (€)	0	0	0	0	0	0	0	0	0	0
Net cash flow (€)	0	-413,799	9,351	9,182	8,972	1,263,073	2,449,234	2,366,588	2,286,720	1,106,415
Cumulative cash flow (€)	0	-413,799	-404,447	-395,265	-386,293	876,779	3,326,014	5,692,601	7,979,322	9,085,737

Changes in NPV (€)	9,085,737

C2.6.5 Summary of CBA results

The BAU scenario has been compared with the actual one.

The BAU scenario has been compared with the actual one.

In the reference case (BAU), RAT would make 1 Chopper replacement (54'222 Euro) and buy 8 brand new trams; because the value of each new tram should be estimated in 1.5 Million Euro, the total investment costs Is around 12'050'000 €.

With the financial support CIVITAS, RAT Craiova was able to invest in 9 choppers driving systems to replace all the old contactors driving systems of the 9 trams analysed. The capital cost, in this case, is 488'070€.

The results of CBA should be summarized as follows:

1. Modern implementation presented a positive cumulated cash flow around 5.03 Million Euros, that means the investment can be recovered within the period (10 years) by RAT;
2. BAU scenario – only one chopper- and the huge investment for 8 trams were not recovered within the period (10 years) taken into consideration the Cost – Benefit Analysis. The cumulated cash flow in this case is negative one, -4.04 Million Euro.

It seems evident that if the cost of energy is going to grow the recovery of Modern implementation is going to be recovered faster than in the considered case; moreover during the considered period it seems not so easy to take in operation the old trams as they were, so refurbishment or substitution were be necessary in any case.

For the time being the implementation of the measure as it was done seems the best solution, because RAT cannot afford the total fleet renew investment costs.

C3 Achievement of quantifiable targets and objectives

No.	Target	Rating
1	To put back into the service 9 trams	**
2	To install the chopper driving system on the 9 trams in order to decrease up to 40% the electrical consumption of each tram The energy consumption by the trams equipped with chopper system decreased by 35 %	**
3	Increasing of PT users comfort by implementing the new tram driving system which gives smoother start and stop The conclusion of survey was the people awareness increased by 31% and the quality of service perception increased by 1 %. Taking into consideration that the measure is a technical one, these results are satisfactory.	**
NA = Not Assessed O = Not Achieved * = Substantially achieved (at least 50%) ** = Achieved in full *** = Exceeded		

C4 Up-scaling of results

The results of the nine choppers installed thought this measure are very good and the reduction of energy consumption is according our expectations, RAT Craiova takes into account the up-scaling of the measure to the 6 trams GT6 type that remained with contactors driving system in Craiova. The installment of the chopper system is taken into consideration but the investment depends on the budget of Municipality.

C5 Appraisal of evaluation approach

The evaluation strategy focused on a couple of key elements like: economy, energy, transport and society. The indicators for every key element were chosen so that the evaluation of the measure could demonstrate the necessity of the chopper system in Craiova. In order to highlight the impact of the measure on economy, energy consumption, transport and society, we have compared, yearly, CIVITAS measure with reference case(BAU), and note the evolution of the 9 trams which have been equipped with the chopper system. After ex-post measurements we noticed a decreasing of energy consumption and maintenance costs of the trams equipped with the chopper system.

The environmental indicators, CO, CO2, NOx ,and Pm, that initially had been included in evaluation plan, were cancelled because the information on energy producer was not available, hence, the energy used by trams could be produced by Thermal Power Plant, Hydro Power Plant or renewable sources.

The indicator Fuel efficiency was renamed as Energy consumption because it was more suitable to the measure

To carry-out the CBA, the operating revenues and costs from the 9 trams were needed. Therefore, based on the total operating revenues, we calculated the revenue per tram, then we multiplied by the number of trams which gradually were equipped with chopper systems. To calculate operating costs we considered only the costs related to driving system, namely: energy consumption and maintenance costs.

C6 Summary of evaluation results

The key results are as follows:

- In order to highlight the impact of the measure on economic state of RAT Craiova, the energy consumption and maintenance costs arising from the trams with contactors driving system and the same costs arising from the trams endowed with chopper driving system were compared. The results proved that the chopper driving system led to lower operating costs due to energy saving and cheaper maintenance.
- In order to assess the impact of the measure on the public transport users, a survey was carried out and the interviewed people stated their opinion regarding the quality of services after by the implementation of the new driving system on the trams and in the same time, they expressed their point of view on the usefulness of the measure.
- This measure demonstrated that one way to save energy and reduce pollution is not just to scrap the old trams. Application of new technologies can re-vitalize old products Trams from past generations can be maintained (or returned) to circulation avoiding high investments in the fleet renewal with almost the same results and preserving the “charm” of the old trams.
- In order to optimize the energy efficiency of its tram service, the city of Craiova implemented an electronic system that monitored the energy performance of its drivers. The system relies

on temporary data storage on the drivers' own chip-card IDs, making it easy and inexpensive to implement.

- The chopper system is easy to use and provides a better electronic control. The chopper system is a new driving technology assisted by software which store and processes the data from the entire running system. The software allows the online visualization and management of 4 defined electric parameters - network current, engine current, network voltage, and filter voltage.
- The public transport operator RAT rolled out a system that monitored the energy performance of drivers. It was meant to complement a modest capital investment in chopper technology that had been made on the braking systems of nine trams.
- Together with the new chopper technology installed on the nine trams, the monitoring measure was shown to produce energy savings of up to 40%. It is clear that expanding these measures to cover the rest of the city's fleet would be much cheaper than buying new trams.
- Through savings of energy, manual labour and spare parts, one can estimate that the investments required by our solution are covered within 3 years.
- For an unmodified tram, even during normal operation, the speed regulation and braking in rheostat steps causes shocks felt by passengers. The new equipment eliminates the shocks corresponding to start, stop and speed regulation regimes, directly influencing the travellers comfort.
- The high price of new trams (or the necessity to have old trams in historical cities, with modern characteristics) led some public transport operators to upgrade existing vehicles with more efficient driving technologies. However, this equipment doesn't eliminate inefficient driving habits -- another source of wasted energy.
- Based on a study on the trams regarding the dissipation of the heat energy, we concluded that it is necessary to improve the thermal coefficient by changing the windows and the doors with a doubles one. In same time the modernization of the trams means mechanical and electrical improvements and specially the security, safe conditions and traffic/quality conditions for the passengers.
- Given to the good results achieved from the measure they will be of course be maintained in the time and this kind of technology could be applied to other trams which could need upgrade.
- The system has been developed specifically and led to a market product which has an industrial perspective. This solution has, as already mentioned some technical advantage, and also acceptable costs, so that can be convenient in a significant number of cases. The chopper solution has been promoted in the neighbouring countries Bulgaria, Slovakia, Albania and Macedonia on different events, economic missions or partnerships between cities. Following these actions, public transport company from Pleven, Bulgaria and the Pleven Municipality decided to apply this solution to the trolleys fleet to reduce energy consumption. Public transport companies from Pleven made already an assessment of costs and developed a first draft implementation plan.
- The developed system, as seen, has a potential application interest for many other cities at European level, mainly where the lack of resources to completely renew the electrical public transport vehicles fleet. In fact this system gives the possibility to extend the life time of the old vehicles, ensuring anyway performances and travel comfort comparable with those of a modern vehicle. For this reason probably the outcomes of this measure will have further application in other contexts.
- This measure led to a new patent regarding the anti-skating system.
- Taking into consideration the results of the surveys in the evaluation period we can see a change of users perception on quality of service; they feel more comfortable when travelling with trams endowed with chopper driving system due to smoother start and stop The conclusion of survey was the people awareness increased by 31% and the quality of service

perception increased by 1 %. Taking into consideration that the measure is a technical one, these results are satisfactory.

C7 Future activities relating to the measure

The results of the measure will be further disseminated inside of country and in the neighboring countries Bulgaria, Slovakia, Albania and Macedonia in different events, economic missions or partnerships between cities.

Public Transport Company from Pleven, Bulgaria and the Pleven municipality decided to apply this solution to the trolleys fleet to reduce energy consumption. Public transport companies from Pleven made already an assessment of costs and developed a first draft implementation plan.

D Process Evaluation Findings

D.0 Focused measure

1	The measure fits into the EU policy towards clean urban transport (five pillars of the EU Green Paper)
2	The measure fits into the city policy towards sustainable urban transport and / or towards sustainability in general
3	The expected impact on the transport system, environment, economy and/ or society / people is very high
4	The high level of innovativeness of the measure with respect to technique, consortium, process, learning etc
5	The measure is typical for a group of measures or a specific context
6	The possibility of carrying out a good Cost Benefit Analysis
7	Participation of a range of different actors
8	The high degree of complexity of managing the measure
9	The measure is regarded as an example measure
10	Other, *please describe????*

	0	No focused measure
2	1	Most important reason
4	2	Second most important reason
6	3	Third most important reason

D.1Deviations from the original plan-

The deviations from the original plan comprised:

- **Deviation 1** – The only deviation was the development of new ITC equipment (not originally foreseen) for the acquisition, monitoring, storage and processing of the electrical parameters from power distribution stations of trams. This system completes the electric system of the trams and provides real time or off-line information and statistics about the power consumption quality, enabling the identification of solutions for energy and costs saving.

D.2Barriers and drivers

D.2.1 Barriers

Preparation phase

- **Technological barrier** – Trams of different building ages have been used. For this reason it has been necessary to adapt the system to each of the refurbished vehicles.

Implementation phase

- **Technological barrier -** The technical implementing team has faced a really problem because of constructive difference of the trams on which the choppers will be installed.

Operation phase: No barriers encountered

D.2.2 Drivers

Preparation phase

- **Technological driver** –IPA has adapted the chopper system to its own tram fleet by taking advantage of similar applications used worldwide.

- **Positional drivers** – The implementing team exchanged the experience with M08.06 team because these measures will be implemented on the same trams**.**

Planning drivers – An effective planning was carried out for exploiting the results of a previous study on the advanced chopper system technology**.**

Implementation phase

- **Organizational actions** – A good arrangement has been established between the company developing the chopper system and measure team in charge of developing, engineering and installing the chopper system
- **Technological drivers** – The measure was completed with an additional device for reading and storing data referring to the energy consumption on trams. The new device keeps an evidence of the energy consumption by each driver. The new device allows a deeper analysis of the energy consumption and provides more realistic information about the energy consumption of trams which is closer on the main objective of the measure which is energy saving. Data will be stored and processed for each tram but also for each driver and will be used to make management decisions on the trams fleet

Operation phase

- **Driver 1** – No driver encountered

D.2.3 Activities

Preparation phase

- **Organizational actions** – Different types of trams to be tested in order to choose the most appropriate for chopper installation. Some technical documents needed to be produced and cabling re-built.

- **Involvement / communication actions** - The measure was also illustrated by the Local Dissemination Manager who organized conferences and face-to-face interviews bringing together key stakeholders to discuss the sustainability problems to be solved.
- **Technological actions-** Different types of trams to be tested in order to choose the most appropriate for chopper installation. Some technical documents needed to be produced and cabling re-built. Technical implementation team attempt to raise additional technical resources collaborating with professionals in this field of activity or experts that have experience in chopper system driving. The development of anti-skidding of the driving wheels developed by IPA has been proposed as a patent at OSIM (State Office for Inventions and Trademarks).

Implementation phase

- **Technological barriers** – Technical implementation team attempt to raise additional technical resources collaborating with professionals in this field of activity or experts that have experience in chopper system driving

Operation phase

No activities encountered.

D.3 Participation

D.3.1. Measure Partners

- **Measure partner 1** – IPA – Leading role
  IPA SA is a 47 years old Romanian industrial R & D company and is the Romanian national institute for research and development, engineering in energy, automation and IT, with a large experience in European projects in technology transfer and in information dissemination.
  IPA was responsible for the dissemination activities and carrying out the research activity and technical studies in the measure. Since 2011 IPA took over the evaluation activity

- **Measure partner 2** – RAT – Principal participant

  RAT Craiova is main Public Transportation Company in Dolj county. It provides the citizen transportation by trams, buses and micro-buses. RAT Craiova was responsible for the technical specification, acquisition and installation of the chopper systems, as well as the training of the trams users (drivers and maintenance staff). Also, RAT managed the operation and monitoring activities.

- **Measure partner 3** – LCM Occasional participant

  The Local Council of Craiova Municipality (Primaria Municipiului Craiova) was organized and functions according to Law No. 215/2001 regarding Local Public Administration with the subsequent modification and completion.

  Municipality as local government institution has, under the conditions imposed by the public administration law, the decisional right in all matters of local interest: political, social, cultural, educational and technical. Through their structures, the municipality is a complex mechanism which can produce major changes in the quality of urban life under an effective management and coordination.
  The competencies of these bodies related to the project covers both the services provided to the local community (i.e. Public transport service in various forms) and the technical interventions (the urban infrastructure, constructions) that together change the image of the city and bring added value to the quality of life in the areas where they act.
  LCM was the coordinator of the project and since 2009 and assumed the responsibility for the management and administration activity in the MODERN project. Between 2009-2011, LCM carried out the evaluation activity in the project.

D.3.2 Stakeholders

- **Stakeholder 1 – Electric Faculty of Craiova –** It was set up in 1951 being an important and famous technical center of the country. The faculty has a good collaboration with a lot of

industrial entity from the region. Here was elaborated the theoretical study and the technical analyze of the chopper system used by Craiova trams.

- **Stakeholder 2 – Indaeltrac Company** – This is the company which produce, test and install the choppers on the trams foreseen in the project. The company is specialized in production of trams and trains automatic and electro – mechanic devices.
- **Stakeholder 3 – Craiova Electrical Company –** Is the regional provider for electric power. We have a good collaboration in terms of different electric measurements helping us to obtain accuracy data regarding energy consumption and distribution.

D.4Recommendations

D.4.1 Recommendations: measure replication

- **Recommendation 1 –** Do not scrap the old trams, upgrade and use them. Trams from past generations can be returned to circulation by performing upgrades to improve energy consumption parameters and the quality of the service. Also performing the upgrades on internal and external parts, the old trams can be turned into modern ones with much lower costs than investment costs in new trams

- **Recommendation 2** –Collaboration between implementation team and experts can be regarded as a success because the studies and designing must be finished in time.

D.4.2 Recommendations: process (related to barrier-, driver- and action fields)

- **Recommendation 1 -** The measure leader need to organize round tables and meeting, bringing together key stakeholders and project partners to explain the importance of the measure and to share different point of view. Must keep a good communication among partners and ensure all the measure aspects are understood so that the involvement in the activities of the measure could be 100%
- **Recommendation 2** – Technical implementation team must attempt to raise additional technical resources from the collaboration with professionals in this field.

Annex 1: Calculation of energy consumption costs

In 2009, all the 9 trams operated without chopper systems

In 2010, 4 trams were equipped with chopper systems and 5 trams continued to operate without chopper systems(CIVITAS case)

In 2010, RAT assumed that 1 tram would operate with chopper system and 8 trams would operate without chopper systems(BAU case)

In 2011, all the 9 trams operated with chopper systems(CIVITAS case)

In 2011, the situation remained the same with 2010(BAU case)

From 2012, the situation remains unchanged both for CIVITAS and BAU

	Cases for comparison	Energy consumption of 1 tram (KW/vKm)	Km traveled by trams	Total energy Consumption of the 9 trams (KW)	price/Kwh (euro)	Total cost partially (euro)	Total general (euro)
2009	CIVITAS measure	2.8	297833	833931	0.0593	49454.05	49454.05
	BAU	2.8	297833	833931	0.0593	49454.05	49454.05
2010	CIVITAS measure	2.8	151786	424999	0.0623	26488.33	
		1.82	121428	221000	0.0623	13773.93	40262.27
	BAU	2.8	242857	679999	0.0623	42381.34	
		1.82	30357	55250	0.0623	3443.48	45824.82
2011	CIVITAS measure	1.82	174750	318046	0.0657	20908.55	20908.55
	BAU	2.8	155334	434934	0.0657	28592.89	
		1.82	19417	35338	0.0657	2323.17	30916.06
2012	CIVITAS measure	1.82	177781	323561	0.0657	21252.05	21252.05
	BAU	2.8	158027	442476	0.0657	29062.64	
		1.82	19753	35951	0.0657	2361.34	31423.98
2013	CIVITAS measure	1.82	176265	320803	0.0670	21492.35	21492.35

	BAU	2.8	156680	438705	0.0670	29391.25	
		1.82	19585	35645	0.0670	2388.04	31779.29
2014	CIVITAS measure	1.82	177023	322182	0.0683	22016.42	22016.42
	BAU	2.8	157354	440591	0.0683	30107.92	
		1.82	19669	35798	0.0683	2446.27	32554.19
	CIVITAS measure	1.82	176644	321493	0.0697	22408.69	22408.69
	BAU	2.8	157017	439648	0.0697	30644.37	
2015		1.82	19627	35721	0.0697	2489.85	33134.22
2016	CIVITAS measure	1.82	176834	321837	0.0711	22881.37	22881.37
	BAU	2.8	157185	440119	0.0711	31290.77	
		1.82	19648	35760	0.0711	2542.37	33833.14
2017	CIVITAS measure	1.82	176739	321665	0.0725	23326.50	23326.50
	BAU	2.8	157101	439884	0.0725	31899.49	
		1.82	19638	35741	0.0725	2591.83	34491.33
2018	CIVITAS measure	1.82	176786	321751	0.0740	23799.41	23799.41
	BAU	2.8	157143	440001	0.0740	32546.20	
		1.82	19643	35750	0.0740	2644.38	35190.58

Starting from 2013, considered the energy price increase by 2% inflation rate

Calculation of spare parts

The trams equipped with chopper systems do not need spare parts or maintenance provided by technicians from RAT. Every 4 years, in 2014 and 2018, for CIVITAS case, RAT concluded with the provider, a maintenance contract. The value of contract is 4% of capital cost.

Starting to 2013, in BAU, the maintenance costs increase by 2% inflation rate

	Cases for comparison	Cost/unit of spare parts (euro)	No of trams	Total cost partially (euro)	Total general (euro)
2009	CIVITAS measure	2.93	9	26.37	26.37

	BAU	2.93	9	26.37	26.37
2010	CIVITAS measure	1.22	5	6.10	
		0.00	4	0.00	6.10
	BAU	1.22	8	9.76	
		0.00	1	0.00	9.76
2011	CIVITAS measure	0.00	9	0.00	0.00
	BAU	1.23	8	9.84	
		0.00	1	0.00	9.84
2012	CIVITAS measure	0.00	9	0.00	0.00
	BAU	1.04	8	8.32	
		0.00	1	0.00	8.32
2013	CIVITAS measure	0.00	9	0.00	0.00
	BAU	1.06	8	8.49	
		0.00	1	0.00	8.49
2014	CIVITAS measure			11713.68	11713.68
	BAU	1.08	8	8.66	
				1301.33	1309.98
	CIVITAS measure			0.00	0.00
	BAU	1.10	8	8.83	
2015				0.00	8.83
	CIVITAS measure			0.00	0.00
	BAU	1.13	8	9.01	
2016				0.00	9.01
	CIVITAS measure			0.00	0.00
	BAU	1.15	8	9.19	
2017				0.00	9.19
	CIVITAS measure			3904.56	3904.56
2018	BAU	1.17	8	9.37	443.13

				433.78	

Revenues calculation in evaluation period (not discounted)

The revenues per unit are multiplied by number of trams to get the annual revenues from the 9 trams in CIVITAS and BAU. The revenues are the same for both situations, because the chopper systems installation do not influence the revenues. The years 2011 and 2012 brought low revenues because of interruption of the tramline during the overpass construction (the line was cut into two separate sections, so that some passengers chose different transport solutions). Starting to 2013, RAT assumed that the revenues will have normal values as before cutting the line and will be increased by 2% inflation(related to year 2010), from year to year.

	Cases for comparison	revenues/unit(euro)CIVITAS	No of unit(trams)	Total revenues per 9 trams (euro)
2009	CIVITAS measure	78583.06	9	707248
	BAU	78583.06	9	707248
2010	CIVITAS measure	84103.08	9	756928
	BAU	84103.08	9	756928
2011	CIVITAS measure	27124.66	9	244122
	BAU	27124.66	9	244122
2012	CIVITAS measure	24442.72	9	219984
	BAU	24442.72	9	219984
2013	CIVITAS measure	85785.14	9	772066
	BAU	85785.14	9	772066

2014	CIVITAS measure	87500.84	9	787508
	BAU	87500.84	9	787508
2015	CIVITAS measure	89250.86	9	803258
	BAU	89250.86	9	803258
2016	CIVITAS measure	91035.88	9	819323
	BAU	91035.88	9	819323
2017	CIVITAS measure	92856.60	9	835709
	BAU	92856.60	9	835709
2018	CIVITAS measure	94713.73	9	852424
	BAU	94713.73	9	852424

Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
no of vehicles	27	27	27	27	27	27	27	27	27	27
total revenues from fares and tickets (lei)	35,090,359	37,555,260	24,337,077	22,336,886	38306365.2	39072492.5	39853942.4	40651021.2	41464041.6	42293322.46
trams revenues (lei)	9123493.34	9764367.6	3163820.01	2903795.18	9959654.952	10158848.05	10362025	10569265.5	10780650.8	10996263.84
currency lei/euro	4.3	4.3	4.32	4.4	4.36	4.38	4.37	4.38	4.37	4.37
trams revenues (euro)	2121742.64	2270783.16	732365.74	659953.45	2316198.83	2362522.80	2409773.26	2457968.72	2507128.10	2557270.66
revenues/unit(euro)CIVITAS	78583.06	84103.08	27124.66	24442.72	85785.14	87500.84	89250.86	91035.88	92856.60	94713.73
mileage per unit in CIVITAS	33092	30357	19417	19753	25655	23796	22155	22840	23611	23100
mileage per unit in reference case	33092	30357	19417	19753	25655	23796	22155	22840	23611	23100

revenues/unit(euro)in BAU	78583.06	84103.08	27124.66	24442.72	85785.14	87500.84	89250.86	91035.88	92856.60	94713.73

Annex 2: Ex-ante questionnaire

This survey is part of an European project - MODERN (Mobility, development and reducing energy consumption) and aims to collect your experiences in traveling by tram. ***The main objective of the measure is to reduce electricity consumption 40% by installing chopper system on 9 old trams.***

Your answers will be treated confidentially

Thank you for your participation!

Ex-ante questionnaire

M 01.09 ENERGY CONSUMPTION ON TRAMLINE

1. Gender: F ☐ M ☐

2. Age:

Up to 15	15-24	25-45	45-54	55-65	over 65

3. Background (the last education institution graduated):

· master	· faculty	· secondary school	· primary school

4. Labor market status:

employed	unemployed	student

5. Public transport user

yes ☐ no ☐

Awareness level

6. Do y**ou know the MODERN project and measure?**

yes ☐ no ☐ Don't know ☐

7. How important are the following sources of information concerning to install chopper system on the tram, in order to reduce energy consumption?

	un-important	Rather un-important	Rather important	Very important	I don't know
Transport Company of Craiova- RAT website	☐1	☐2	☐4	☐5	☐6
Media	☐1	☐2	☐4	☐5	☐6
Colleagues/acquaintances	☐1	☐2	☐4	☐5	☐6
Forums or similar on the internet	☐1	☐2	☐4	☐5	☐6
Other, please specify below:	☐1	☐2	☐4	☐5	☐6

8. Do you understand the aim of the measure and its potential benefit?

fairly well understand	well understand	very well understand	Don't know

Quality of service

9. **How would you evaluate the quality of public transport in Craiova, now, before implementing the measure?**

Very dissatisfied	Somewhat dissatisfied	satisfied	Very satisfied	Don't know

10. **How do you perceive tram journey, now, before implementing the measure?**

uncomfortable	Somewhat Comfortable	Comfortable	very Comfortable	Don't know

11. **You would extend the measure to all trams of Transport Company?**

yes	no	Don't know

12. Have you ever filled questionnaires for the project -MODERN?

☐1	Yes
☐2	no

Measure title: ENERGY SAVING ON TRAMLINE IN CRAIOVA

City: Craiova Project: MODERN Measure number: 01.09

Ex-post questionnaire

This survey is part of an European project - MODERN (Mobility, development and reducing energy consumption) and aims to collect your experiences in traveling by tram.

The main objective of the measure is to reduce electricity consumption 40% by installing chopper system on 9 old trams

Your answers will be treated confidentially

Thank you for your participation!

Ex-post questionnaire

M 01.09 ENERGY CONSUMPTION ON TRAMLINE

1. Gender: F ☐ M ☐

2. Age:

Up to 15	15-24	25-45	45-54	55-65	over 65

3. Background (the last education institution graduated):

· master	faculty	· secondary school	· primary school

4. Labor market status:

employed	unemployed	student

5. Public transport user

yes ☐ no

Awareness level ☐

6. Do y**ou know about the measure progress?**

yes ☐ no ☐ Don't know ☐

8. How important are the following sources of information concerning to measure progress?

	Very un-important	Rather un-important	Rather important	Very important	I don't know
Transport Company of Craiova- RAT website	☐1	☐2	☐4	☐5	☐6
Media	☐1	☐2	☐4	☐5	☐6
Colleagues/acquaintances	☐1	☐2	☐4	☐5	☐6
Forums or similar on the internet	☐1	☐2	☐4	☐5	☐6
Other, please specify below:	☐1	☐2	☐4	☐5	☐6

8. Do you understand the benefits of the measure after implementation and for the next future?

fairly well understand	well understand	very well understand	Don't know

9. Do you notice the usefulness of the measure in the last time?

yes ☐ no ☐ don't know ☐

Quality of service

10. **How would you evaluate the quality of tram public transport in Craiova, now, after implementation of the measure?**

Very dissatisfied	Somewhat dissatisfied	satisfied	Very satisfied	Don't know

11. **How do you perceive tram journey, now, after implementation of the measure?**

uncomfortable	Somewhat Comfortable	Comfortable	very Comfortable	Don't know

12. **Do you think the tram public transport has been improved in the last time?**

yes	no	Don,t know

13. Have you ever filled questionnaires for the project -MODERN?

☐1	Yes
☐2	no

female	male
45 %	55%

Up to 15	15-24	25-45	45-54	55-65	over 65
5%	5%	26%	31%	23%	10%

Daily user of public transport	Occasional user of public transport
91%	9%

Determination of sample size for a population of 90000 people using trams in Craiova

Variables name and explanations		Variables values
		01.09
n	Sample size	106
t	z-score: the abscissa of the Normal distribution for probability α	1.53
α	**confidence level**, is a percentage and represents how often the true percentage of the population who would pick an answer lies within the **confidence interval** (margin of error).	87.50%
P	percentage of your sample that picks a particular answer	0.87
Q	(1-P)	0.13

d	**confidence interval** (also called margin of error)	0.05
N	population total (if N is enough large the term in the denominator tends to 1 and the formula is reduced to the numerator)	90’000

we consider the confidence level between 85 and 90% (average 87.5%)

M02.04 – Executive summary

In Craiova, before CIVITAS project, the ticketing of the whole public transportation system was based on mechanical validating devices that pierce the paper tickets. The revenues from tickets and season tickets were recorded all together from trams and buses. Public Transportation Company in Craiova had several problems with frauds related to paper tickets validation.

The implementation of a new e-ticketing system for a part of the PT network in Craiova can partially solve the problem related to frauds and give the possibility to collect the money in advance, at least for the lines and vehicles connected to the e-ticketing system.

The purpose of the measure was to integrate the transportation modes based on trams and buses in a common e-ticketing system to have the possibility to record separately the revenues coming from electric transportation (trams) and from road transportation (buses), to have a real time monitoring of the ticketing and to improve the quality of the service.

Within this measure, 80 buses and 27 trams were equipped with e-ticketing validators and integrated in a single system and 30 ticketing automatic machines were installed (10 automatic machines for paper tickets and 20 recharging cards stations).

For a good implementation of the measure, the technical solution for the e-ticketing system applied in Brescia (which is partner of the same MODRERN Project) was adopted in Craiova Public Transport Company. At this purpose, a technological transfer agreement between Brescia Mobilità (PT operator in Brescia) and RAT Craiova has been signed, so the two companies exchanged experiences, information and technical documentation.

The demonstration of the measure within the CIVITAS Modern period showed that this measure was feasible at a relatively low cost in comparison to other ones implemented in other PT operation.

The results obtained in relation to the CBA (Cost-Benefit-Analysis) shows that the measure is both effective and efficient in achieving good positive results in terms of cumulated cost not only during lifetime of the measure but since the first year of implementation. The positive cumulated cost shows that the investment and operating costs can be covered by the collected revenues.

The implementation of the measure brought to RAT many advantages:

- Possibility of real time collection of data about passengers profile;
- Collection of money in advance;
- Limiting the ticket evasion;
- Possibility to integrate 2 transportation systems (electric and road), in a common ticketing system;
- A better knowledge about the number of pas sengers on each line, tram and bus should allow RAT to arrange for a better network management.

A Introduction

A1 Objectives

The measure objectives are:

(G) High level / longer term:

- To modify the modal share
- To introduce advanced ITC technologies

(H) Strategic level:

- To increase the attractivness and accessibility of PT

(I) Measure level:

- To install e-ticketing system on 107 vehicles(80 buses and 27 trams) in order to increase the average number of passengers with (2-3) % and decrease the frauds number of passenger evaders by 3% in PT

A2 Description

PT ticketing system in Craiova was based only on mechanical validation devices, paper tickets and kiosks selling the paper tickets and season tickets. The revenues from tickets and season tickets were collected all together independently from the lines and the vehicles type. Public Transportation Company in Craiova (RAT) recorded several problems related to frauds and ticket evasion with this kind of manual system.

E-ticketing system can avoid the frauds because after blocking of validation devices, the passengers cannot validate the card, and can limit evasion. The e-ticketing system allows the real time collection and analysis of large amounts of data about passengers profile.

This data collection and analysis is necessary to improve the company management: in fact it gives a lot of information which can be used to plan the service. Moreover, this system gives also a financial benefit, as it allows to collect money in advance.

In the public transport system, the requests of the passengers are generally the following:

- easy interchange between different lines and means of transportation,
- efficient and accessible options for the travel.

The card-based method introduced by the e-ticketing systems, give an answer to these requests. The cards, in fact, can be bought and recharged automatically even from home, through the Internet. Because the cards are linked to the single user, they can be annulled if they are lost or stolen. Contact less function of the cards allows the rapid access of the passengers on the PT vehicles. The passengers can use one card for different means of transportation.

The e-ticketing system has the following advantages:

- The passenger has possibility to recharge the card
- Any card validation is transmitted on-line
- The tickets checking is easier and avoid the frauds as when the controller (the operator who check the tickets) goes in the bus or tram, he can block the validating devices.

Another important purpose of the measure was to integrate the transportation mode in Craiova, based on trams and buses in a common e-ticketing system to have the possibility to record separately the revenues coming from electric transportation (trams) and from road transportation (buses) and from the different lines.

Within this measure a significant part of the RAT fleet, namely 80 buses and 27 trams were equipped with e-ticketing system, as follows:

- 2-3 validation devices, depending on the vehicle size, were installed on buses and trams
- 1 on-board display was installed on each vehicle
- 30 ticketing automatic machines including 10 automatic machines for paper tickets and recharging cards installed in passenger stations with 20 recharging cards set installed inside of the RAT tickets selling points

The ticketing automatic machines were placed in the most important stations in the city, in the crowded stations. The picture A2.1 shows a computer from dispatcher and picture A2.2 shows an automatic machine for paper tickets

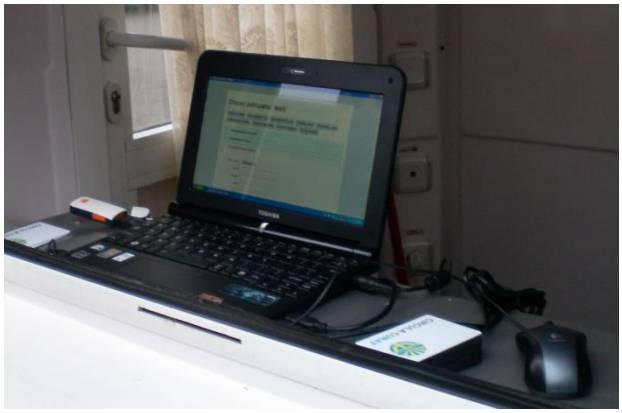


Figure A2.1

Figure A2.2

The e-ticketing system implemented in Craiova by CIVITAS project is a pilot e-ticketing system that allows gradual transition from paper tickets to electronic cards. This is the reason for that the mechanical devices for paper tickets were kept on lines where electronic validation devices were installed. Technical solution for e-ticketing system applied in Brescia was transferred in Craiova PT. For this reason, a technological transfer agreement between PT operator in Brescia and RAT Craiova has been signed, and exchange of experiences, information and technical documentation took place.

The e-ticketing system was part of a wider PT management system implemented within the MODERN Project. It includes other modules and precisely:

- An AVM and info-mobility system (also called GPS/GPRS system)
- A video-surveillance system for bus stations and PT vehicles.

All these systems are based on a common and unitary architecture and share part of the equipment.

For this reason the procurement procedure for purchasing the equipments necessary to the e-ticketing system was carried-out together with the GPS/GPRS and the video-surveillance systems procurement procedure.

This procedure took place through the national tender electronic system and five companies submitted tenders.

The provider installed the whole the e-ticketing system, set the communication between dispatcher and all onboard computers from each vehicles and, put the e-ticketing system into the service.

The overall system architecture is represented in figure A.2.3.

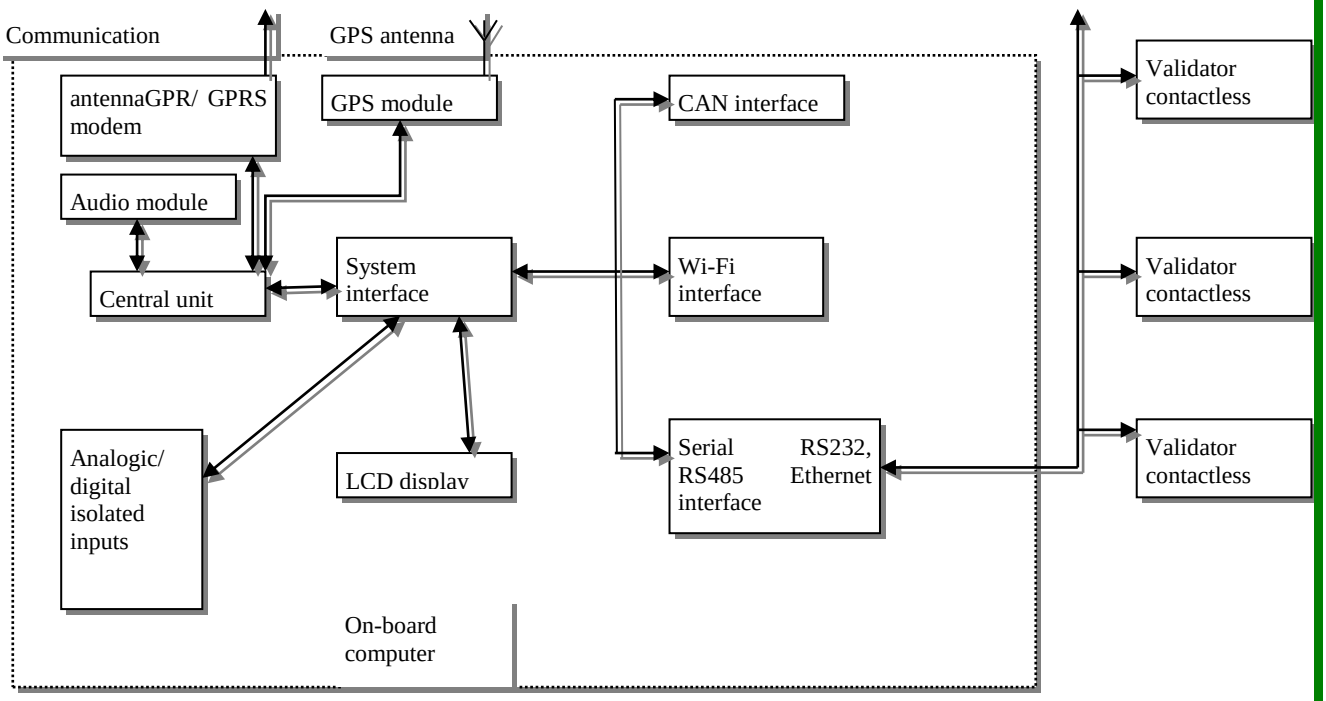


Fig. A2.3. System architecture

The main equipments which make up the system are described in the following with its main technical description:

- Board computer (CB): it was mounted on the vehicles board and it is use to acquire data regarding geographic position and data received from interconnected devices as: electronic informing panels (PDICA); mixed validation unit for contactless cards and paper tickets (VMCH); fixed communication system (EFX)
- Mixed validation units for contactless cards and paper tickets (VMCH): validation for tickets(on normal paper or contactless cards), the possibility to open/close the working session using driver's contactless card, to transmit, when the computer board requests, the stored information about validation, acoustic signaling and optic signaling: display an explicit message for acceptance/rejection of the card etc.

- Terminal Inspector Device (EIT): device portable (hand held) for ticket control
- Contactless cards (CC): are according to ISO 14443 A
- Device Set for Customizing Card Points content: printer for customizing cards, workstation, A4 scanner, webcam, read / write / encoding device for contactless cards, device for security zone reading (hardware module used for MIFARE cards)
- Equipments for Sales and Cards Recharging Point content: printer for fiscal receipts, read / write / encoding devices for contact less cards, workstation, reading device for secure area (hardware module used for MIFARE cards)

The central application software of the e-ticketing system has been implemented using Software Application for Ticketing (AST) consists in two modules: "Front Office" and "Back Office".

Software application for e-ticketing (AST) answers to the subsystems in the following way:

Front Office:

- Subsystem for sale and recharge transport certificates: The sale points which commercialize the contactless cards will use specific equipments (Device Set for Customize Card Points). The subsystem for sale and recharge allows a further extension with new sale points without the intervention of the provider. The transaction is made in on-line operation mode and also in off-line operation mode. Subsystem has to allow the checking of the transactions made in every moment of time in every sale point. At the end of the working day/month it must generates sale reports on each POS in every day/month.
- Subsystem for controlling transport certificates**:** The subsystem for controlling transport certificates must manage the entire control flow for the certificates. With the help of this module the following operations will be accomplished: Verify the validation of transport certificates, Records the controls: number, date, time, hour, vehicles and current routes on which the control was made, Data transfer to Software Application for Ticketing). In case of contactless cards the checking is made electronically through Terminal Inspector Devices (EIT) available for ticket inspectors teams. Each control operation for contactless card will be recorded in EIT for each ticket inspector who will make that operation. The validation unit will be set in state 'control" (blocked) using ticket inspector's card.
- The subsystem for transport certificates validation: The subsystem for transport certificates validation will run on the vehicle. The main functions of this subsystem are: Validation of the travelling documents, Takes over the data from Ticketing Software Application (AST), Transfers to Ticketing Software Application (AST) data concerning and Authentication of the drivers in the system using their cards.

Back Office:

- Subsystem for formatting and pre-charging of the cards: accomplish 2 major functions (formatting the contactless cards delivered by the cards provider and recharging of the cards in order to be commercialized). The subsystem must have the possibility to emit a personalized card including photo, that's why the application it must be able to acquire the photography of the client using, in card customizing points, the following peripherals: web camera and scanner. The subsystem provide the possibility to: check the sales in each sale point in every moment AND at the end of the working day/month to generate sale reports for every POS on every day/month
- Subsystem for user's management: The subsystem ensures the management of all accounts of the Ticketing System users. An account for the user means that the user is authorized by RAT Craiova to use Ticketing Software Application (AST) for

exploitation and commercial uses. The subsystem will define the users ant their rights according with each application and also, it may block or reactivate a user account.

- Management subsystem for users cards (drivers, ticket inspectors): The subsystem will emit the cards for the persons authorized to exploit the functionalities of the ticketing system. These cards will be emitted for drivers and ticket inspectors and the procedure of card customization will be the same as the procedure for the season tickets cards, multiple tickets cards, etc. All users cards will be customized only with rights corresponding to the role that the user has relate to the equipment of the ticketing system.
- Management subsystem for price list offer: have a complex definition level for tariff certificates according the next criteria:
    - the begging of availability period for tariff certificates will be established in the moment of sale;
    - the availability period is configured at the level of minutes, hours, days or months,

This information will be transmitted automatically from this module to the sale, pre-charge, validation and control subsystems of tariff certificates.

- Management subsystem for passengers cards: show the global situation of all the transactions performed by the registered cards in the system. The travelling card will have the possibility to record many tariff certificates.
- Management subsystem for the equipments of the entire system: allows to configure internal data for the validation units, visualize specific information (serial number, ID of the vehicle on which the validation unit is mounted, version of the installed software).
- Administration management subsystem: accomplish the next functions:
- to define administration points(sale/pre-charge points, customizing point);
- to allow the transition form active state to passive state and vice versa;
- to allow the definition of an unlimited number of administration points with the appropriate connections between them;

Subsystem for reporting and statistics defined by the contracting authority before the delivery contract is signed: offers a specified number of statistics and reports regarding: Sales, validations, control, contactless cards(travelling and users);

B Measure implementation

B1 Innovative aspects

The innovative aspects of the measure are:

- **New conceptual approach -** The e-ticketing system allows real time transmitting of the data about passengers profile, necessary to PT company management, collection of money in advance and limiting the fraudulent passengers
- **Use of new technology/ITS -** Possibility to integrate 2 transportation systems (electric and road), in a common ticketing system . This is a new technology and very comfortable for PT users.

- **New physical infrastructure solutions**:

  - 80 buses and 27 trams have been endowed with e-ticketing system as follows: 2-3 validation devices depending on vehicles size and 1 front panel computer for each vehicle;
  - 30 ticketing automatic machines (10 automatic machines for paper tickets and recharging cards installed in passengers stations; 20 recharging cards set installed inside of the RAT tickets selling points).

B2 Research and Technology Development

The RTD task aimed to find a solution for e-ticketing system implementation in Craiova , in order to provide a good service for passengers and set a management tool for public transportation company

- Analisys of the current ticketing system in Craiova and e-ticketing systems available on the market

The ticketing system, in Craiova, has been analyzed and they found that there were many types of tickets and season tickets with different prices considering the number of travels, the validity areas, means of transport and social categories. Besides, the ticket price is different according to the selling place of it (if the selling point is inside of transportation means, the ticket price is higher than the ticket price sold from the special kiosks and automatic devices for tickets)

The types of tickets and commutation licenses that could be bought in Craiova were following:

1. One travel ticket with unique price no matter the distance on route in Craiova.
2. One travel ticket in the exterior of the city (Isalnita).
3. Commutation license for one day.
4. Commutation license for 7 days for 1 route.
5. Commutation license for 15 days for 1 route.
6. Commutation license for 1 route: tramway commutation license, bus commutation license, minibus commutation license.
7. Commutation license for 2 routes.
8. Commutation license for 5 routes.
9. Commutation license for all routes.
10. Commutation license for exterior routes.

The smartcard technologies were analised and they found the cards are distinguishable considering the type of chips and according to the type of communicating interface with the reading device. There are three types of chips associated to these cards: memory, haywire and microcontroller. These names of chips refer to the functionalities that they have:

- The cards of memory type are the electronic variant of the magnetic cards. They have a greater capacity (up to 16 Kb) and offer a greater security compared to the magnetic ones. They do not have integrated logic and they do not calculate, are used only for data memory. The older versions were read-only (could only be read), the new versions use memories that can be read and written and can be protected through a PIN code.
- The cards with haywire have a file system and a set of commands with multiple applications and allow the authorized access to the memory content. They include different variants of no contact cards of MIFARE type or the ones in the Ist class.

- The secured cards with microcontroller contain an operation system and a memory of read/write type that can be updated several times. These cards are like a miniature PC; they calculate, store data and execute commands according to their operation system. Unlike the memory type cards, these cards were designed to assure security.

Two main types of interfaces have been found: contact and contactless.

The contact cards require their introduction into a reader to make direct contact with the conductive element placed on the surface of the card. The contactless cards must be near the reading device (generally around 10 cm) for the data transfer to take place. The transfer is made through the radio wave through the antennas present both in the card and in the reading device.

The research team found that, at this moment, there are three main categories of cards used in the world:

- Philips cards of Mifare type;
- Innovatron Calypso cards;
- Sony Felica cards used in the Asian countries.

The research team found that the memory of the card is limited at the present moment both by the costs of these memory types (EEPROM- Electrically Erasable Programmable Read Only Memory) and also by the restrictions connected to the dimension. At this moment, there are available only memory cards starting from 4 to 64 Kbytes, and appear the ones with 100Kbytes. 2-4 Kbytes of memory are enough for the memory of the information connected to the last 100 transactions (data, hour, location, type of service, etc). Memory is chosen connected to the wished expectations and has a great influence over the price of the card.

Also, they found that the encrypting of the information from the card, the numbering of the transactions made are some of the methods used for stopping and detecting frauds.

After the e-ticketing investment cost analyses, an element that has a great influence on investment is the solution adopted for the tickets replacement. They found 5 methods for issuing a ticket in such a system:

- magnetic cards – in this case one can use both card checkers with or without contact;
- smartcards – only the no contact card checkers will be used;
- value deposit cards –the user will deposit on this card a sum that is generally larger than the cost of one travel but which can be reimbursed;
- banking card – requires a collaboration with the card issuing bodies;
- mobile phone – by SMS or by mobile bar code. This thing implies the communication costs and it is possible by using telephones with NFC (Near Field Communication) technology.

The research team listed the advantages and disadventages of the e-ticketing system:

Interested part	Advantages/disadvantages	
Public transport operator	Advantages	- the continuity of the system and an easier integration of the new systems; - the optimization of the acquisition and maintenance costs; - a better use of financial resources; - more bidders.

	Disadvantages	- standard requests; - special requests are not taken into consideration; - possible extra-costs connected to the standardization of the already existent equipments.
Equipment suppliers	Advantages	- the assurance of inter-operability; - the market development; - less special requests.
	Disadvantages	- "leveling" of products (no increase value); - authentications.

The conclusion was the e-ticketing system has a positive impact over the imagine of public transportation.

- **The technical specifications of the proposed e -ticketing system in Craiova**

Taking into consideration all the aspects mentioned before and also considering the implemented systems inside other operators of public transport at national level, the research team outlined some technical specifications of the e-ticketing system proposed for Craiova.
These technical specifications were included in the technical tender for e-ticketing system purchasing.

Card check

- mix (no contact and on paper);
- minimum technical characteristics:
    - LCD display;
    - interface RS485 and/or Ethernet;
    - accepted cards: ISO 14443 A and ISO 14443 B;
    - transaction storing capacity: minimum 8000 transactions;
    - central unit equipped with minimum 1MB RAM operation memory, minimum 4MB FLASH data memory, minimum 2MB FLASH program memory, processor 32 bits.
    - Protection of the data stored in case of accidental loss of the input voltage;
    - protection degree: minimum IP54;
    - vandalism protection carcass;
    - function time: minimum 80000 hours;
    - input voltage: 16VDC - 33VDC.

- Minimal functional characteristics:
    - Validation of the transport titles (on normal paper and no contact cards);
    - To print on the paper ticket: hour, data, number of the vehicle and the route;
    - To be able to open / shut the working session with the no contact card by the driver;
    - To transmit at board computer's request the stored validation information;
    - Anti-pass back function;

- To allow the blocking of the validation process in the function module – „ticket control" by using the no contact card by the controller;
- To signal in an acoustic and optical way, and by displaying an explicit message for the acceptance/rejection of a validation;
- The taking over of the information in the Software Taxation Application (AST) by the board computer of the prices, „black list", transport lines, drivers in the public transport.

Terminal Inspector Equipment – EIT

- portable.
- minimum characteristics:

  - endowment with autonomous accumulator for minimum 10 hours;
  - LCD display;
  - possibility of data transfer (that means costs);
  - shock resistance;
  - reduced weight;
  - software PC communication.

No contact cards – CC

The no contact cards must be conforming to 14443 A and ISO 14443 B:

- Mifare 1 K cards for the realization of driver /watt man cards and of the cards of the controllers with transport titles;
- Mifare 1 K cards for the commutation licenses and electronic wallet/ multiple tickets.

Set equipments for location card personalization

- printer for cards' personalization;
- PC station;
- A4 scanner;
- WEB camera;
- positive device for reading/writing/codification of no contact cards;
- device for reading the security application (electronic hardware mode used for the security of coding the MIFARE cards).

Set equipments for location selling and recharging cards

- printer for tickets;
- device for reading/writing/ codification of no contact cards;
- PC station;
- device for reading the security application (electronic hardware mode used for the security of coding the MIFARE cards).

Automatic devices for selling tickets

- The automatic devices have the role of issuing travel tickets in the passengers' stations.
- The tickets issued must have standard dimensions; printing must be made on thermal paper with the weight of 110 g/m², no consumables.
- On the surface of the ticket the following information must be written:

- the series of the ticket, the series of the automatic device that issued the ticket, the hour and the minute, the date, and the price;
- all the other information: the name of the company, validity, messages for passengers must be changed in real time from the dispatch application.

- They must accept banknotes and coins, to have the possibility of giving change with at least two types of coins.
- Money must be stored in metallic boxes, with the possibility of being locked for a safe transport.
- The money boxes must be accompanied by monetary, issued by the automatic device, on which the accurate information will be printed about the number of papers and banknotes in this boxes.
- The equipment must resist to bad weather, humidity, dust and vandalism.
- The equipment must be endowed with an alarm system that must be connected to the WEB dispatch application.
- The equipment must permanently be connected to the WEB dispatch application.
- The equipment must be endowed with LCD display.
- The information must be printed in Romanian.

- **The system must allow the configuration for issuing more types of tickets and even commuters' licenses, in this case, the user will have at its disposal a numerical anti-vandalism keyboard for the introduction of the PNC.**

- **The shutting must be made with a special safety key in minimum 5 points.**

- **The equipment must give the change and the tickets in different holes.**

- **Evidence software.**

Software Taxation Applications by AST

The software taxation application is formed by the following modules:

- „Front Office" that contains the software subsystems that interact with the passenger;
- „Back Office" that contains the software subsystems that do not interact with the passenger, but have the role of data centralization, data verification and data validation for obtaining the statistic reports.

"Front Office" module contains:

- the selling subsystem and the recharging of the transport titles;
- the control subsystem of the transport titles;
- the validation subsystem of the transport titles.

"Back Office" module contains:

- Formatting subsystem and pre-charge cards subsystem;
- Users' management subsystem;
- Management subsystem of the operators' cards (drivers in the public means of transport, controllers);
- Management subsystem of the price offer;
- Management subsystem of the passenger's cards;
- Management subsystem of the system's equipments;

- Management stock subsystem;
- Subsystem for reports and statistics defined by the contracting authority before signing the delivery contract.

- Data research and study about e-ticketing system

The public procurement procedures and the legislation for the purchasing the e-ticketing system were studied. The research team analyzed various companies that produce e-ticketing systems and studied implemented solutions in other public transport systems in Romania and in other CIVITAS cities.

The technical solution for e-ticketing system applied in Brescia was a good practice for Public Transportation (PT) in Craiova. For this purpose, a technological transfer agreement has been signed between PT operator in Brescia and RAT Craiova, and exchanged experience, information and technical documentation.(TT agreement is attached to the MERT – Annex1)

B3 Situation before CIVITAS

In Craiova, before the CIVITAS MODERN project, the ticketing of the whole public transportation system was based on mechanical validating devices that pierce paper tickets. The revenues from tickets and season tickets were recorded all together (from trams and buses and for all the lines). Public Transportation Company in Craiova had significant problems with frauds and ticket evasion related to paper tickets validation.

The implementation of the e-ticketing system in Craiova PT can solve these problems, giving the possibility to collect the money in advance, and can insure an accurate accounting of the incomes per each single line.

B4 Actual implementation of the measure

The measure was implemented in the following stages:

Stage 1: Planning and design of the measure (Oct 2008-May 2009)

The activity was detailed in the preceding chapter and included an analysis of the current ticketing system in Craiova and e-ticketing systems available on the market. The advantages and disadvantages of the e-ticketing system were outlined and the technical specifications of the proposed e -ticketing system in Craiova were carried out. These technical specifications were included in the technical tender for e-ticketing system purchasing.

- The technical specifications referred to:
- Card check
- Terminal Inspector Equipment – EIT
- Type of cards: No contact cards – CC
- Equipment for card customization
- Equipment for selling and recharging cards
- Automatic devices for selling tickets
- Application Software for Ticketing - AST

Stage 2: Study about e-ticketing system e-ticketing procurement procedure

- **Technical solution finding** (Oct 2008- Jan 2010)

For the adaptation of the technical solution we considered the field experience of the consortium and of the local and national specifics.

This system should have to respond to the integration possibilities of the two modes of transport in Craiova (trams and buses) and further possibilities of extension on other transport modes.

The adopted technical solution has been implemented with success, and integrated into a single management system all the activities from E-ticketing measure, GPS/GPRS measure and Security in Public Transport measure.

- **Procurement procedure carrying out** (Feb 2010- Jul. 2010)

In this period the public procurement procedures, the legislation for the e-ticketing system purchasing and the integration of the whole Public Transport management system (including as mentioned e-ticketing, GPS/GPRS and video-surveillance) were studied. For this reason, integrated technical specifications for the whole PT management system acquisition were developed. The three relevant MODERN measures (namely 02.04, 05.05 and 08.02), formed a group of actions that constituted an integrated complex system of:

- monitoring,
- security
- management of public transportation in Craiova.

A common procurement procedure for purchasing the equipments necessary to the e-ticketing, GPS/GPRS and video-surveillance systems has been carried out. The procurement procedure took place through the national tender electronic system and five companies' submitted tenders, and the winner was the company ALIEN Concept from Oradea, Romania.

The result of the tender was contested by 4 companies but all the appeals were rejected by the National Claims Settlement Commission. Two of the contestant companies continued to claim the tender result in the Court of Law. The contestation process ended on June 2010 in favor of RAT and the contract with the winner company was signed at the end of June 2010.

- **E-ticketing system delivery and installing** (Aug. 2010-Jan 2011)

The following main activities were carried out

- 80 buses and 27 trams were equipped with e-ticketing system, as follows:
    - 2-3 validation devices, depending on vehicle size, were installed on buses and trams
    - 1 on-board display was installed on the buses and trams
- 30 ticketing automatic machines (10 automatic machines for paper tickets and recharging cards installed in passengers stations; 20 recharging cards set installed inside of the RAT tickets selling points)
- contracts with data transmission companies were signed: RCS-RDS and Vodafone
- the central control room (dispatching) was equipped with server and specific devices for the system's monitoring and displays.
- specific air conditioning system for the dispatching room was installed

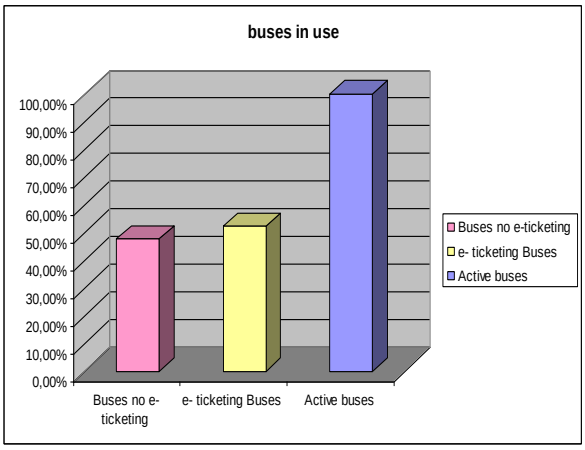
Figure B4.1 – E-ticket machine on a bus

Figure B4.2 – Dispatcher room

The buses have been cabled to a separate communication and power supply network for the e-ticketing system so there is a 24V power supply from the system generator which receives 24V and releases 12V. The 2 x 1,5 supply cable for each identification device and the UTP communication cable from the second or third identification device to the first one and from the first one to the board computer.

The board computer was connected to a GPS/GPRS module that has in the interior a Vodafone data card. The same module was connected to the communication antenna on the roof of the bus.

In the picture B 4.1 the number of the buses and trams equipped with e-ticketing system compared with the overall fleet is shown.



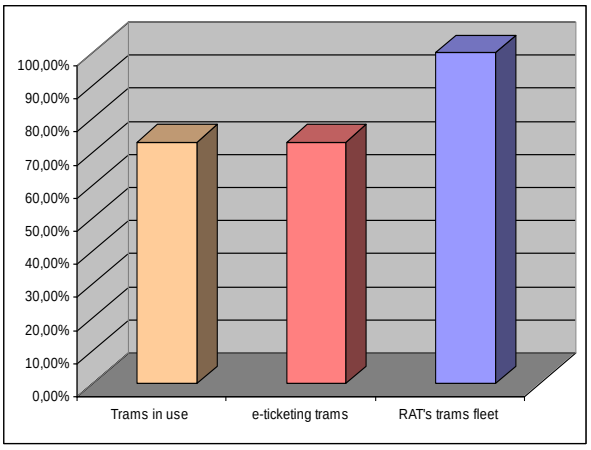


Figure B4.3 – Trams and buses equipped .vs. overall fleet

Stage 4 – Training for involved technicians (Aug 2010- Jan 2011)

The technicians training process has been held in the same time with the system's installation. The technicians appointed from RAT participated at the system installation activity together with the specialists from the company providing the e-ticketing system. During the assembly and installation of the system they learned how the system runs.

Stage 5: System operation (May 2011- Sept 2012)

The e-ticketing system works as follows:

Figure B4.2- dispatcher room

- The communication with the server from the dispatcher is done through a M2M (VPN) protocol that includes Vodafone data cards (purchased through a contract signed with Vodafone) and that are installed on the vehicles and at the dispatcher in a CISCO specialized router that connects the VPN (Virtual Private Network) of the Vodafone to the dispatcher software.
- Using the same method (VPN and Vodafone) the transmission of gathered data from the ticket and recharging card automats (sold tickets, card recharges, money in automat, money in the change boxes) is ensured.
- The 20 recharging card points located in 10 bus stations include a computer with specialized software, one reader, one cash register and the communication with the server through RDS subscriptions of optic fiber internet is ensured.
- The traveler's card point includes a computer with a specialized software, a scanner for reading ID data, card reader and printer for printing cards and it is connected to the central dispatcher through RDS optic fiber internet.

The board computer software takes over each validation from the identification device along with the needed information (date, time, first name, last name, PNC) and sends them to the database server from the dispatcher, introducing them into a database.

Having a real time network at the dispatcher, one can know how many traveling tickets or cards have been sold, how many old cards have been recharged and how many validations have been done in each vehicle.

Equipments used for Software Application for Ticketing:

a. Server for Data Base
b. Server for Software Application for Ticketing
c. Server for Ticket Inspectors Database

For all the applications from each server from above back-up hardware function are provided. Additionally to these active hardware equipments (3 above servers) a forth server are provided for backup of every one of the three working servers in case of damage.

Even if the measure was fully implemented, the e-ticketing system has been only tested (1.254 sold tickets).

B5 Inter-relationships with other measures

The measure is related to other measures as follows:

- **M 05.05** Public Transport Security program in Craiova
- **M 08.02** Info mobility tools for fleet management in Craiova

The measures M 02.04, M05.05 and M 08.02 are closely linked since they share the same infrastructure(buses , trams and monitoring station). A commune procurement procedure was organized for the three measures. The on board control units were integrated to ensure the best performance and to provide an up-to-date technological solution. The monitoring central system of these measures share the same hardware architecture and integrate as much as possible the software applications

C Impact Evaluation Findings

C1 Measurement methodology

C1.1 Impacts and Indicators

Table C1.1: Indicators. Insert your own table where available, use landscape layout as necessary

No.	Impact	Indicator	Data used	Comments
1	Economy	Average Operative revenues	The revenues from fares and tickets	The general revenues decreased after the measure implementation because the tramways lines were shortened during the construction of the overpass which crossed the tram tracks. Shortening of tramways led to fragmentation of travels and hence to decrease the number of passengers. Other reason for that the number of passengers decreased in 2011 and 2012, was related to cancellation of some facilities for pensioners gave by RAT in 2009 and 2010
2A		Average Operating costs	Annual operating costs: Personnel, Energy, Spare parts and maintenance, Other costs	Increased after measure implementation but can be covered by the operating revenues
2B		Capital cost	Investments costs	The cumulated cash flow shows that the investments cost can be recovered.
13	Society	Awareness level	Face to face and phone survey	Face to face and phone surveys to PT referring to having heard of e-ticketing system, understand the aim of the measure and the potential benefits and non benefits of it
14		Acceptance level	Face to face and phone surveys	Perception on acceptability of the e-ticketing system

Local indicator		Proportion of passengers traveling without tickets	%	RAT's registration concerning passengers traveling without tickets
28	Transport	Average occupancy	Number of passengers per vehicle per trip	RAT data base Monitors' registration on tram line(101 102), E1R, E1T, line 9

Detailed description of the indicator methodologies:

Indicator 1 (Average Operating revenues) - Ratio of total income generated from fares and tickets divided by the total vehicle-km per year (€/vehicle-km)

A = B / C

Where: A = Average operational revenue for the service (€/vkm)

B = Total operational revenue coming from trams and buses for the service (€)

C = Total vehicle-kilometers (vkm) traveled by the trams and buses in services

RAT Company provided the revenues coming from season tickets and tickets and Km traveleld by trams and buses in service. Transport Company provided total amount of revenues because they do not have a separately evidence of revenues coming from trams and revenues coming from buses,

but noting that the revenues coming from trams can be estimated, annually, as a percentage of the total revenues, depending on the season tickets sold and number of passengers per trip. The season tickets are the only documents sold by routs or tram lines, while the tickets can be used for buses and trams, too

Indicator 2 A (Average Operating costs) - Ratio of total operating costs incurred by the service divided by the total vehicle-km per year (€/vehicle-km).

A = B / C

where: A = Average operational costs for the service (€/vehicle-km)

B = Total operational costs of the service, including Personnel, Energy, Maintenance, internet communication and supplies costs related to the RAT PT service (€)

C = Total vehicle-km traveled by the trams and buses in services

RAT Company provided all the operation costs related to ticketing service

(See annex 2: Costs calculation)

Indicator 2B (Capital cost) - Investment cost for the e-ticketing system

The Capital cost resulted from the purchasing and installation of e-ticketing systems on 80 buses and 27 trams, 10 automatic ticketing machines and 20 recharging cards computers. The capital cost is according to purchaising invoice.

Indicators 13, 14(Awareness level and Acceptance level) - Survey based perception of benefits or disadvantages of the e-ticketing system

The survey was carried out to evaluate the impact of the e-ticketing system on PT users

The questionnaires included also questions referring to e-ticketing and GPS / GPRS measures, because these measures were implemented on the same vehicles

The sample size was calculated for a population of 300.000 people in Craiova.

To calculate the sample size, some data were used:

- confidence level : 87.50%,
- percentage of people that picks a particular answer: 0.85
- confidence interval (also called margin of error): 0.05

The questionnaires were structured in 2 sections:

- General information about citizens (job, age, gender, education level, contact data)
- Questions referring to the measure by indicator type

a. Acceptance level

The most important questions were:

- What is your opinion related to electronic validating devices and e-ticketing system?(1-3 scale)
- Willingness to implement the measures (Do you want to implement the measure?) (Yes/No/Do not know)
- Which is the reason why you want that the e-ticketing system is implemented? (open question)

b. Awareness level

The most important questions were:

- Have you heard about the measure? (yes/No/Don't know)
- Do you understand the aim of the project and the potential benefits and disadvantages of the measure?(1-3 scale)
- Have you noticed the benefits during the time past?(yes/No/Don't know)

Local indicator(%) – Proportion of passengers that tarveling without tickets

RAT Craiova provided the proportion of passengers that traveling without tickets related to total number of passengers, on the rout E1R, rout E1T, rout no. 9 and tram line.

Indicator 28 Average occupancy(peak/off-peak) average number of passengers per vehicle per trip

The average occupancy indicator is measured by counting the number of passengers in off-peak and peak period of day. The frequency of data collection was once a week, twice a day. The measurements were made once in peak period of the day and once in off-peak of the same day. The monitored lines were: tram line, E1Rbuses rout , E1T buses rout, and rout no.9. These routs have been monitored for 1 month, before and after measure implementation. (See annex 4 – occupancy monitoring)

C1.2 Establishing a Baseline

The baseline is year 2009, when in Craiova, all the trams and buses were operating with mechanical taxation system and RAT Company did not has clearlly records of revenues by type of transportation means and by lines.

Average operating revenues

PT company from Craiova recors the incomes from tickets and season tickets in a common database, without possibility to split the revenues coming from different routs. They estimated the revenues coming from trams, as a percentage of total revenues, depending on season tickets sold and the number of passengers per trip. The season tickets are the only documents sold by routs or tram lines, while the tickets can be used for buses and trams, too. In 2009, before the measure implementation, RAT assumed that the percentage allocated to the trams was 26% of total revenues.

Average operating revenue for buses is calculated as ratio between estimated revenues from buses and mileage of buses and average operating revenue for trams is calculated as ratio between estimated revenues from trams and mileage of trams.

Raw data and indicator calculation	2009 Ex-Ante values
Total revenues from season tickets and tickets coming from trams and buses	8’160’548.6 €
Revenues from trams estimated as percentage of total amount of revenues from season tickets and tickets(the percentage was 26% of total revenues)	2’121’742.6 €
Total mileage of trams fleet	893’497 Km
Average operating revenue for trams	**2.3746 €/vkm**
Revenues from buses estimated as percentage of total amount of revenues from season tickets and tickets(the percentage was 74% of total revenues)	6’038’805.97 €
Total mileage of buses fleet	7’216’618 Km
Average operating revenue for buses	**0.8368 €/vkm**

Average operating costs

Average operating costs were calculated as a ratio between the total operating costs from trams and buses prepared for installation of the e-ticketing system and the total mileage of these trams and buses. We must underline that this is the cost related only to the function of ticketing, and does not include costs like drivers, fuel etc.

Raw data and indicator calculation	**2009 Ex-Ante values**
Total Operational Costs coming from the trams and buses prepared for e-ticketing system*(detalied operating costs are shown in the annex 1)*	11’771.42 €
Total km traveled by the buses prepared for e-ticketing system	2’945’536 Km
Total km traveled by the trams prepared for e-ticketing system	893’497 Km
Average operating cost	0.003 €/vkm

Note: The operating costs include personnel, supplies and other costs, related to the old tiketing system only. Other costs(administration costs) are 20% of personel costs.

Total capital cost

Total capital cost is the cost of investment . In 2009 there was no investment in e-ticketing system.

Raw data and indicator calculation	2009 Ex-Ante values

Investment in the purchase of the e-ticketing system	0,00 €
Total capital cost	0,00 €

Percentage of fraudulent travellers

The travellers without ticket were monitored for 1 month, in September 2010, before e-ticketing implementation. The percentages have been calculated tacking into consideration the number of fraudulent passengers related to total number of passengers.

Buses and trams lines monitored	2010 Ex-Ante values
E- 1T	7%
E-1 R	8%
Line 9	5%
Tram line	7%

Average occupancy

The average number of passengers was monitored for 1 month – September 2010, before the e-ticketing implementation. RAT provided average occupancy for the lines where buses and trams are equipped with e-ticketing system: line E1R, line E1T, line No. 9 and Line No101 (tram line). Occupancy data were collected by RAT personnel, one day a week, in peak and off-peak periods of the day.

Routs and lines monitored	**2010 Ex-Ante values Average occupancy-off-peak**
Line 101- tram line	65%
Rout E1T	50%
Rout E1 R	60%
Rout No. 9	60%

Routs and lines monitored	**2010 Ex-Ante values Average occupancy-peak**
Line 101- tram line	70%
Rout E1T	55%
Rout E1 R	65%
Rout No. 9	65%

Awareness level

The questionnaires were disseminated to public transport users in stations for routs E1T, E1R, line No.9, tram line, and during workshops organized by MODERN project team.

The workshops were organized during the Communication Campaign and seminar presentation that took place in May 2010, in the prefecture market (in downtown). 160 questionnaires were circulated

and 120 feedbacks were received from people that expressed their opinion about the e-ticketing system from which were processed only 119 accordingly with the sample size.

The person interviewed in the ex-ante period of this measure gave their agreement in order to be again interviewed in the ex-post period of the measure.

Questionaire content	**2010 Ex-Ante values**
Public transport user	80 % yes 5 % No 15 % occasionally
fairly well understand	20%
well understand	40%
very well understand	36%
don't know	4%
The most important information source	Media-25% Transport Company of Craiova- RAT website – 40% Colleagues- 30% Forums or similar on the internet- 5%
Do you know the MODERN project and measure ?	3 % yes 97 % No

Acceptance level

Questionaire content	2010 Ex-Ante values
What is your opinion related to electronic validating devices and e-ticketing system?	Less good 25% Good 35% Very good 38 % Don't know 2%
Willingness to implement the e-ticketing system	Accept 83% Do not accept 15% Do not know 2%
Which is the reason for that you want to implement the e-ticketing system? *(For travellers that accept the measure)*	To reduce the tickets selling time 50 % A modern travel mode 30% Old system is obsolete - 3%
Which is the reason for that you do not want to implement the e-ticketing measure ? *(For travellers that do not accept the measure)*	cannot handle e-commerce or any other e- activity 10% extra responsibility related to electronic cards 5%

C1.3 Building the Business-as-Usual scenario

Craiova had no plan to implement an e-ticketing system for bus services. Thus, in the absence of the CIVITAS MODERN project, RAT would not have developed any e- ticketing technology based on electronic devices. In the current risk climate of economic recession it seems very unlikely that such a project would have been completed.

Average operating revenue

In 2010, RAT assumed that the revenues from trams are estimated as 26 % of total revenues from tickets and season tickets recorded in the common data base.

In 2011 and 2012, according to season tickets sold and the number of passengers per trip, RAT assumed the revenues from trams are estimated as 13 % of total revenues from tickets and season tickets. The decreasing of passengers number that used trams in 2011-2012 led to a decreasing of estimated revenues from trams. The number of passengers decreased in 2011-2012 because the tramways have been shortened during the construction of the overpass which crossed the tramways. Shortening of tramways led to fragmentation of travels and hence decreasing the number of passengers

For BAU case, RAT assumed that the revenues could not be influenced by the measure and BAU revenues follow the values recorded by RAT in 2010, 2011 and 2012.

Raw data and indicator calculation	**2010 BAU values**
Total revenues from season tickets and tickets coming from trams and buses	8’733’781.4 €
Revenues from season tickets and tickets coming from trams (26% of total revenues)	2’270’783.16 €
Total mileage of trams fleet	819’643 Km
Average operating revenue for trams	**2.7705 €/vkm**
Revenues from season tickets and tickets coming from buses(74% of total revenues)	6’462’998.23 €
Total mileage of buses fleet	5’922’422 Km
Average operating revenue for buses	**1.0913 €/vkm**

Raw data and indicator calculation	**2011 BAU values**
Total revenues from season tickets and tickets coming from trams and buses	5’633’582.64 €
Revenues from season tickets and tickets coming from trams(13 % of total revenues)	732’365.74
Total mileage of trams fleet	524’251Km
Average operating revenue for trams	**1.3970 €/vkm**
Revenues from season tickets and tickets coming from buses(87% of	4’901’216.90 €

total revenues)	
Total mileage of buses fleet	5’993’980 Km
Average operating revenue for buses	**0.8177 €/vkm**

Raw data and indicator calculation	**2012 BAU values**
Total revenues from season tickets and tickets coming from trams and buses	5’076’565 €
Revenues from season tickets and tickets coming from trams(13 % of total revenues)	659’953.45 €
Total mileage of trams fleet	533’341 Km
Average operating revenue for trams	**1.2374 €/vkm**
Revenues from season tickets and tickets coming from buses(87% of total revenues)	4’416’611.55 €
Total mileage of buses fleet	5’654’378Km
Average operating revenue for buses	**0.781 €/vkm**

Average operating costs

RAT assumed that the operating costs keep the same values over years 2010, 2011 and 2012 because in BAU situation the 80 buses and 27 trams kept the old ticketing system, without CIVITAS project.

All the costs are divided by the real mileage of the 80 buses and 27 trams for the years considered.

Raw data and indicator calculation	**2010 BAU values**
Total Operational Costs coming from the trams and buses with old ticketing system(detalied operating costs are shown in the annex 1)	27’294.93 €
Total km traveled by the 80 buses that kept the old ticketing system	3’665’503 Km
Total km traveled by the 27 trams that kept the old ticketing system	819’643 Km
Average operating costs	0.006 €/vkm

Raw data and indicator calculation	**2011 BAU values**
Total Operational Costs coming from the trams and buses with old ticketing system(detalied operating costs are shown in the annex 1)	27’294.93 €
Total km traveled by the 80 buses that kept the old ticketing system	3’681’844 Km
Total km traveled by the 27 trams that kept the old ticketing system	524’251Km

Average operating cost	0.0064 €/vkm

Raw data and indicator calculation	**2012 BAU values**
Total Operational Costs coming from the trams and buses with old ticketing system(detalied operating costs are shown in the annex 1)	27'294.93 €
Total km traveled by the 80 buses that kept the old ticketing system	3'264'988 Km
Total km traveled by the 27 trams that kept the old ticketing system	533'341Km
Average operating costs	0.0071 €/vkm

Total capital cost

There is no investment cost in e-ticketing system in the BAU scenario.

Indicators and respective parameters	BAU values
Investment in the purchase of the e-ticketing system	0,00 €
Total capital cost	0,00 €

Percentage of fraudulent travellers

The indicator keeps the same ex-ante values by routs, for the years 2011 and 2012, considering no e-ticketing system.

Buses and trams lines monitored	**2011, 2012 BAU values**
E- 1T	7%
E-1 R	8%
Line 9	5%
Tram line	7%

Average occupancy

The indicator keeps the same ex-ante values by routs, for the years 2011 and 2012, considering no e-ticketing system.

Routs and lines monitored	**2011, 2012 BAU values Average occupancy-off-peak**
Line 101- tram line	65%
Rout E1T	50%
Rout E1 R	60%
Rout No. 9	60%

Routs and lines monitored	**2011, 2012 BAU values Average occupancy-peak**
Line 101- tram line	70%
Rout E1T	55%
Rout E1 R	65%
Rout No. 9	65%

Awareness level

The indicator keeps the same ex-ante answers, for the years 2011 and 2012, considering no e-ticketing system.

Questionaire content	**2011, 2012 BAU values**
Public transport user	80 % yes 5 % No 15 % occasionally
fairly well understand	20%
well understand	40%
very well understand	36%
don't know	4%
The most important information source	Media-25% Transport Company of Craiova- RAT website – 40% Colleagues- 30% Forums or similar on the internet- 5%
Do you know the MODERN project and measure ?	3 % yes 97 % No

Acceptance level

The indicator keeps the same ex-ante answers, for the years 2011 and 2012, considering no e-ticketing system.

Questionaire content	2011, 2012 BAU values
What is your opinion related to electronic validating devices and e-ticketing system?	Less good 25% Good 35% Very good 38 % Don't know 2%
Accept to implement the e-ticketing system	Accept 83% Do not accept 15% Do not know 2%
Which is the reason for that you want to implement the e-ticketing system? *(For travellers that accept the measure)*	To reduce the tickets selling time 50 % A modern travel mode 30% Old system is obsolete - 3%

Which is the reason for that you do not want to implement the e-ticketing measure ? *(For travellers that do not accept the measure)*	cannot handle e-commerce or any other e- activity 10% extra responsibility related to electronic cards 5%

C2 Measure results

To evaluate the results, a campaign of data measurement related to the different indicators has been carried out. In this section the analysis of these measurements and the synthesis of the result is outlined.

C2.1 Economy

The years for ex-post measurements are considered 2011 and 2012.

Average operating revenues

After CIVITAS measure, in 2011 and 2012, RAT still recorded the incomes from paper tickets and season tickets in a common database, without possibility to separate the revenues coming from different routes, but they has a record of cards sold by routes and by type. Given that the vehicles connected to e-ticketing system are still running in parallel with mechanical validation devices for paper tickets, it is very difficult to see the influence of the measure on RAT revenues

In 2010, RAT assumed that the revenues from trams are estimated as 26 % of total revenues from tickets and season tickets recorded in the common data base.

In 2011 and 2012, according to season tickets sold and the number of passengers per trip, RAT assumed the revenues from trams are estimated as 13 % of total revenues from tickets and season tickets recorded in the common data base. The decreasing of passengers number that used trams in 2011-2012 led to a decreasing of estimated revenues from trams. The number of passengers decreased in 2011-2012 because the tramways have been shortened during the construction work of the overpass which crossed the tramways. Shortening of tramways led to fragmentation of travels and hence decreasing the number of passengers. Other reason for that the number of passengers decreased in 2011 and 2012, was related to cancellation of some facilities for pensioners gave by RAT in 2009 and 2010

RAT assumed that the revenues from ex-post follow the BAU values, for years 2011 and 2012, noting the revenues from cards sold in 2011 and 2012.

Raw data and indicator calculation	**2011 Ex-post values**
Total revenues from paper season tickets, tickets and electronic cards coming from trams and buses	5’633’582.64 €
Total revenues from paper season tickets and tickets coming from trams and buses	5’632’008.22 €
Revenues from sold cards related to buses and trams connected to e-ticketing	1’574.42 €
Revenues from trams (13% of total revenues)	732’365.74 €
Total mileage trams fleet	524’251Km
Average operating revenue from trams	**1.3970 €/vkm**
Revenues from buses (87 % of total revenues)	4’901’216.90 €
Total km traveled by the buses fleet	5’993’980 Km
Average operating revenue from buses	**0.8177 €/vkm**

Raw data and indicator calculation	**2012 Ex-post values**
Total revenues from paper season tickets, tickets and electronic cards coming from trams and buses	5’076’565 €
Total revenues from paper season tickets and tickets coming from trams and buses	5’066’339.42 €
Revenues from sold cards related to buses and trams connected to e-ticketing	10’225.58 €
Revenues from trams (13% of total revenues)	659’953.45 €
Total mileage of trams fleet	533’341 Km
Average operating revenue for trams	**1.2374 €/vkm**
Revenues from buses (87 % of total revenues)	4’416’611.55 €
Total mileage of buses fleet	5’654’378 Km
Average operating revenue for buses	**0.781 €/vkm**

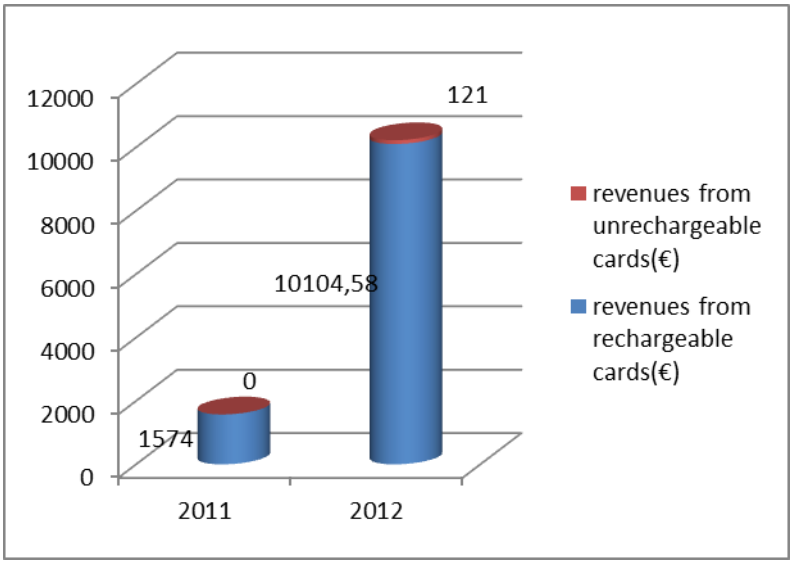


Fig. C2.1.1 – Evolution of revenues from cards sold in 2011-2012

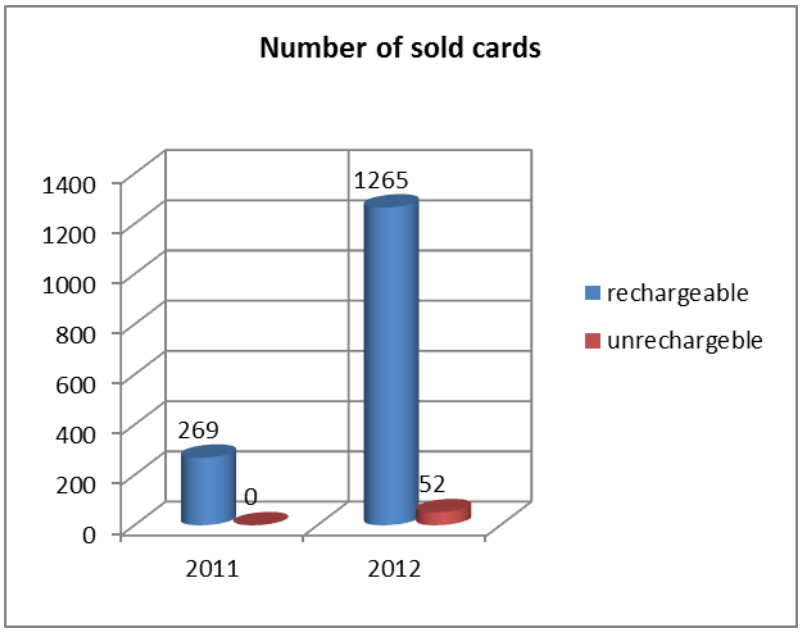


Fig. C2.1.2 – Number of sold cards per type in 2011-2012

Average operating revenue for trams (€/vKm)	2009	2010	2011	2012
ex-ante	2.3746			
BAU	2.3746	2.7705	1.3970	1.2374
ex-post CIVITAS	2.3746	2.7705	1.3970	1.2374

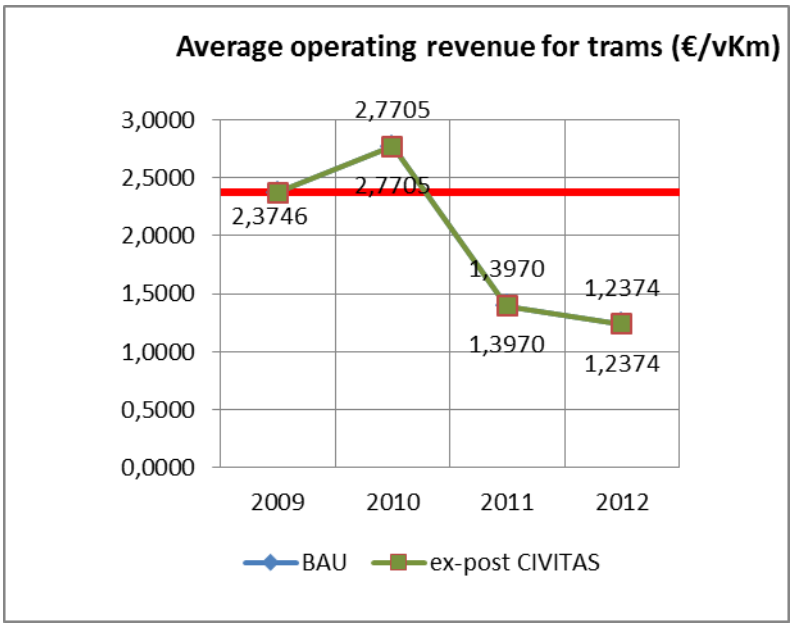


Fig. C2.1.3 – Evolution of average operating revenues for trams

Average operating revenue for buses (€/vKm)	2009	2010	2011	2012
ex-ante	0.8368			
BAU	0.8368	1.0913	0.8177	0.781
ex-post CIVITAS	0.8368	1.0913	0.8177	0.781

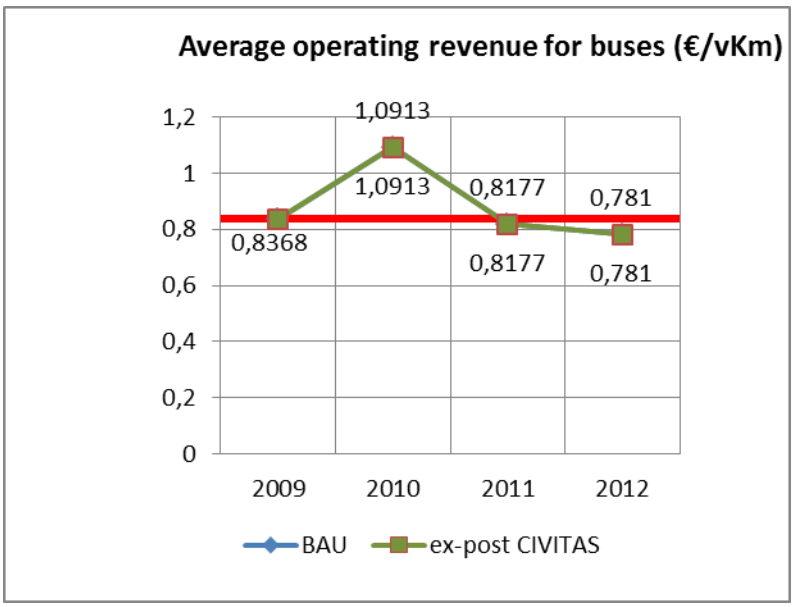


Fig. C2.1.4 – Evolution of average operating revenues for buses

Average operating costs

In the ex-post period, 2011 and 2012, as RAT kept old ticketing system in parallel with e-ticketing system, in addition to current operation costs related to old ticketing system, the operation costs related to e-ticketing raised.

Raw data and indicator calculation	**2011 Ex-post values**
Total Operational Costs coming from the trams and buses with e-ticketing system(detalied operating costs are shown in the annex 1)	39’860.12 €
Total km traveled by the 80 buses with e- ticketing system	3’681’844 Km
Total km traveled by the 27 trams with e- ticketing system	524’251 Km
Average operating cost	0.0094 €/vkm
Raw data and indicator calculation	**2012 Ex-post values**
Total Operational Costs coming from the trams and buses with e-ticketing system(detalied operating costs are shown in the annex 1)	40’613.26 €
Total km traveled by the 80 buses with e- ticketing system	3’264’988 Km

Total km traveled by the 27 trams with e- ticketing system	533'341 Km
Average operating cost	0.0107 €/vkm

Note: the operation costs include internet conection, energy, administartiv and supplies costs.

Average operating costs (€/vKm)	**2009**	**2010**	**2011**	**2012**
ex-ante	0.0031			
BAU	0.0031	0.0061	0.0065	0.0072
ex-post	0.0031	0.0061	0.0095	0.0107

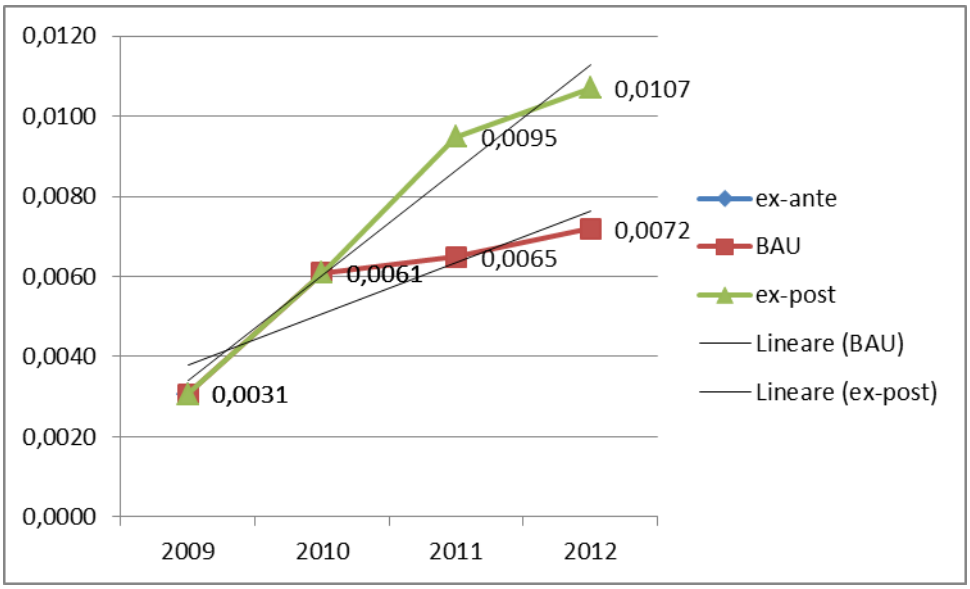


Fig. C2.1.5 – Evolution of average operating costs

Total capital cost

Investment in e-ticketing system:

Indicators and respective parameters	**2011 Ex-post values**
Investment in the purchase of the e-ticketing system	401'484 €
Total capital cost	401'484 €

Percentage of fraudulent travellers

The routs were monitored for 1 month – in September 2011, and September 2012 durig similar days.

Monitoring people of RAT organised checks in buses and trams and recorded the fraudulent travellers. The percentages of fraudulent people are related to total number of passengers.

Buses and trams lines monitored	2011 ex-post values
E- 1T	6%
E-1 R	7%
Line 9	4%
Tram line	6%

Buses and trams lines monitored	2012 ex-post values
E- 1T	5%
E-1 R	6%
Line 9	3%
Tram line	5%

Buses and trams lines monitored	Percentage of fraudulent travelers		
	2010	2011	2012
	Ex-ante	Ex-post	Ex-post
E- 1T	7%	6%	5%
E-1 R	8%	7%	6%
Line 9	5%	4%	3%
Tram line	7%	6%	5%

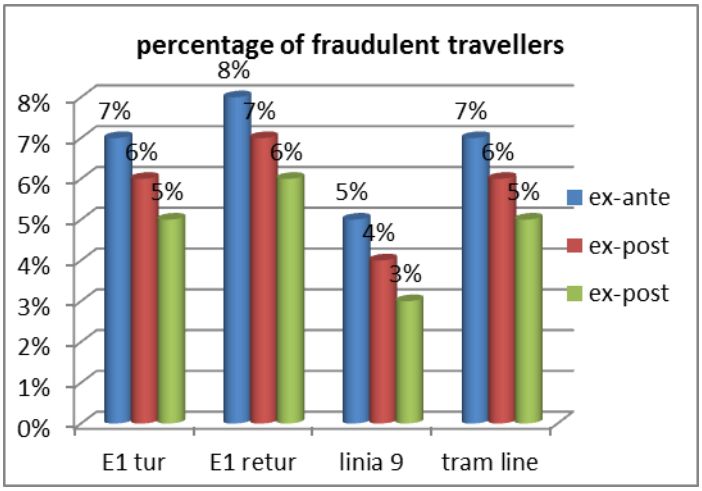


Fig. C2.1.6 – Percentage of fraudolent travellers comparison between ex-ante and ex-post results, by lines

C2.4 Transport

Average occupancy

The indicator was measured in September 2011 and September 2012 to see the trend of the indicator over the system running period.

The data were collected 1 day a week, in peak and off-peak periods.

Buses and trams lines monitored	**maximum number of passengers (100% capacity)**	**Average n. of passengers Average occupancy- off-peak**			**Percentage of passenger**		
		2010	**2011**	**2012**	**2010**	**2011**	**2012**
		Ex-ante	Ex-post	Ex-post	Ex-ante	Ex-post	Ex-post
Line 101- tram line	83	54	37	58	65%	45%	70%
Rout E1T	105	53	43	48	50%	40%	45%
Rout E1 R	105	64	52	58	60%	50%	55%
Rout No. 9	105	63	53	58	60%	50%	55%

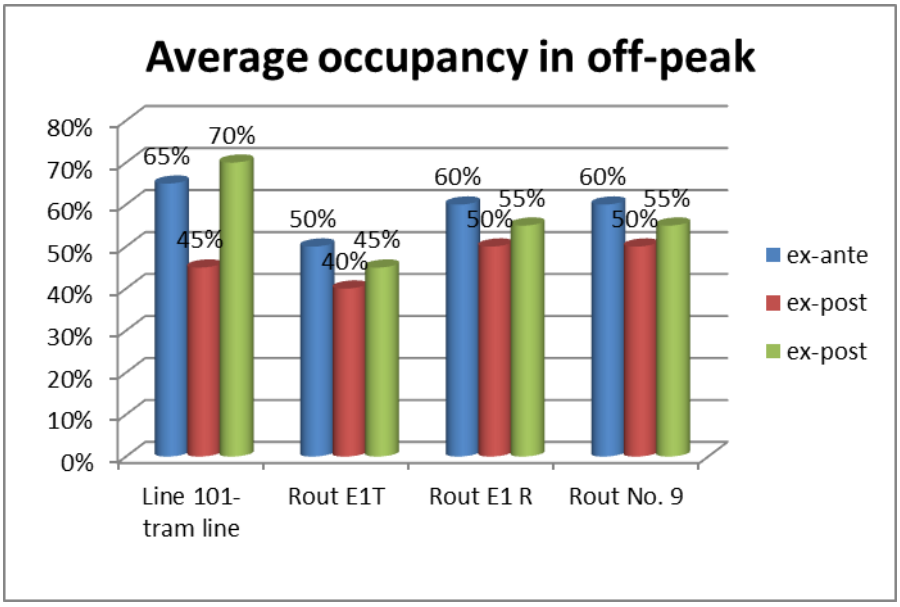


Fig. C2.4.1 – Evolution of average occupancy in off peak

Buses and trams lines monitored	maximum number of passengers (100% capacity)	Average n. of passengers Average occupancy- peak			Percentage of passenger		
		2010	2011	2012	2010	2011	2012
		ex-ante	ex-post	ex-post	ex-ante	ex-post	ex-post
Line 101- tram line	83	58	42	62	70%	50%	75%
Rout E1T	105	58	47	53	55%	45%	50%
Rout E1 R	105	68	58	63	65%	55%	60%
Rout No. 9	105	68	58	63	65%	55%	60%

Note: The counting of people was made in several vehicles of the same type.

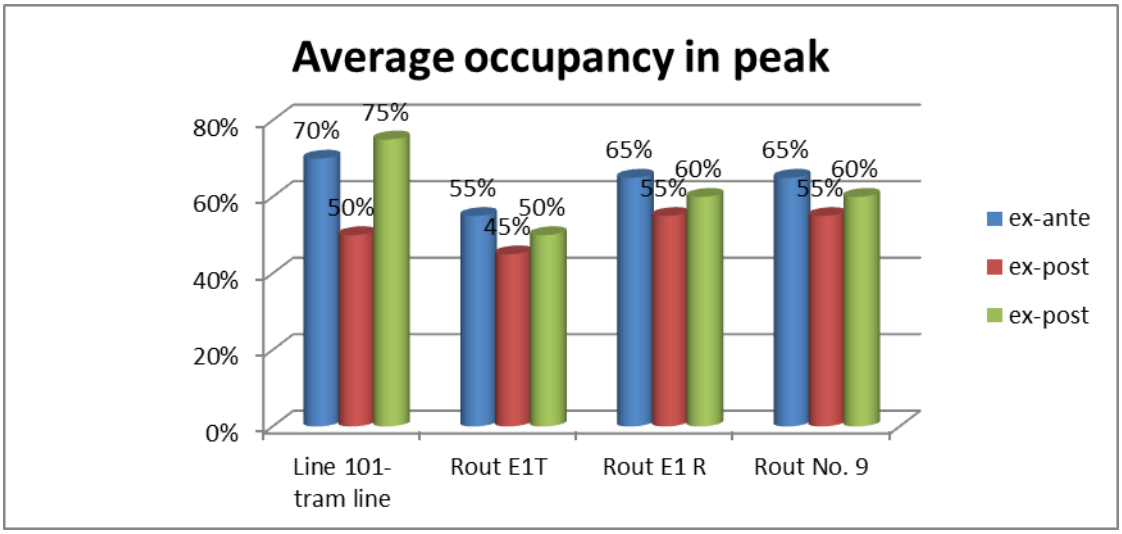


Fig. C2.4.2 – Evolution of average occupancy in peak

In 2011and 2012, average occupancy decreased compared with 2010 because RAT cancelled some discounted season tickets . In 2012, average occupancy increased compared with 2011 but still remained lower than 2010, for buses routs.

For trams, average occupancy decreased in 2011 because of tram line interruption, during overpass construction, but it increased in 2012 more than 2010 and 2011. In August 2012, the construction of overpass finished and the trams operate on whole line, without interruption.

C2.5 Society

Awareness level

The survey was carried out on September 2012, using the same people surveyed for ex-ante evaluation(In agreement with them, their contact data were kept)
160 questioners were circulated by phone and e-mail and 115 feedbacks were received.

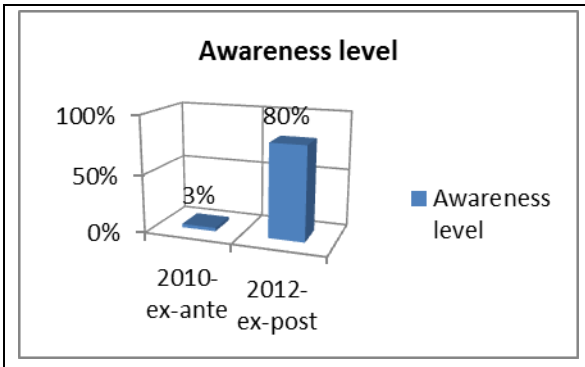
Questionaire content	**2012 values**
Public transport user	85 % yes 3 % No 12 % occasionally
Do you know about the progress of e-ticketing measure?	80% yes 20% no
Do you notice the benefits of the e-ticketing measure in the last time?	88 % yes 10% no 2% do not know

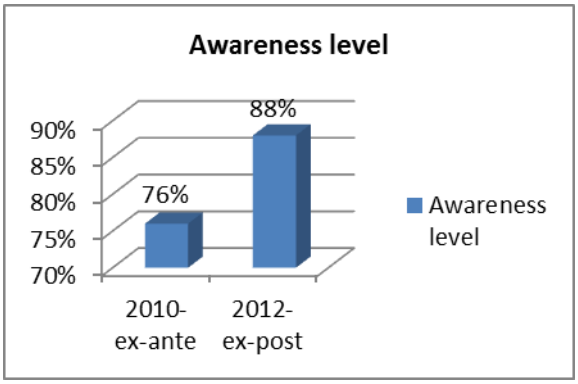
Acceptance level

Questionaire content	**2012 values**
What is your opinion related to electronic validating devices and e-ticketing system?	Less good 14% Good 40% Very good 44 % Don't know 2%
Accept to extend the e-ticketing system to more PT vehicles	Accept 89% Do not accept 10% Do not know 1%

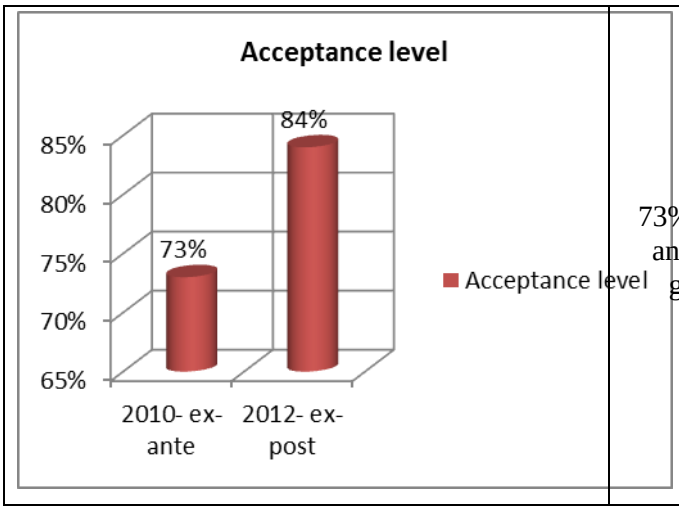
Evolution of indicators **Awareness level and Acceptance level** over the implementation of the measure:

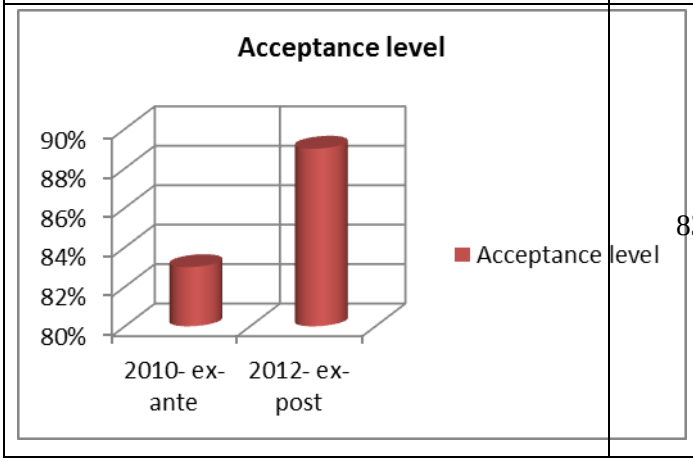
	2010	**2012**
Indicator /Question	"Do you know the MODERN project and e-ticketing measure ?"	"Do you know about the progress of e-ticketing measure?"

	3%	80%

	2010	2012
Indicator /Question	"Do you understand the aim of the measure and the potential benefit?"	Do you notice the benefits of the e-ticketing measure in the last time?
	76%(well and very well understand	88%(noticed the benefit

	2010	2012
Indicator /Question	"What is your opinion related to electronic validating devices and e-ticketing system?"	What is your opinion related to electronic validating devices and e-ticketing system?

	73% (good and very good)	84% (good and very good)

	2010	2012
Indicator /Question	Accept to implement the e-ticketing system	Accept to extend the e-ticketing system to more PT vehicles
	83%	89 %

C3 Achievement of quantifiable targets and objectives

No.	Target	Rating
1	To install e-ticketing system on 80 buses and 27 trams	**
2	To install 10 automatic ticketing machines in 10 bus stations To install 20 recharging cards set inside of the RAT tickets selling points	**
3	To increase the average number of passengers with (2-3) %	** trams

	• Average occupancy increased in 2012 by 5% for trams • Average occupancy decreased by 5% for buses	O buses
4	To decrease the frauds number passengers by 3% in PT • Fraudulent pessengers decreased by 2 % for buses and trams	*
NA = Not Assessed O = Not Achieved = Substantially achieved* (at least 50%) ** = Achieved in full *** = Exceeded		

C4Up-scaling of results

RAT is so enthusiast of the e-ticketing system that decide to extend it to the whole company since the beginning of 2013. In order to have good results RAT decided to cancel the mechanical validation system at the beginning of 2015.

C5 Appraisal of evaluation approach

The evaluation of this measure focused on some indicators across the areas of economy, transport and society, which were to be measured in different ways and calculated.

In the evaluation period of measure, some indicators were cancelled for various reasons, such as: there were no available statistics data or these indicators were not relevant to assess the impact of the measure on transportation mode in Craiova. So, the Modal split indicator was cancelled because no ex-ante statistic data available. Also, the indicators related to fuel efficiency, emissions, quality of service and vehicles speed have been cancelled because they were no relevant for measure evaluation.

Calculation of Average operating revenue indicator was difficult, both before and after implementation of the measure, since RAT was unable to collect revenues separately by transportation modes and routes. In addition, after the e-ticketing system implementation on 80 buses and 27 trams, mechanical ticketing system worked in parallel with e-ticketing system.

The e-ticketing system implemented in Craiova through the CIVITAS MODERN project is a pilot e-ticketing system that allows gradual transition from paper tickets to electronic cards. This is the reason why the mechanical devices for paper tickets were kept on lines where electronic validation devices were installed.

Because of the late implementation of the measure, the operations started only in the last months of year 2011 and only 269 cards were sold; In 2012 , the number of sold cards was very low, only 1.317

This low number of cards sold can be explained by the fact that the people are accustomed to using paper tickets instead of cards, since the vehicles operate both with e-ticketing and mechanical validation system. It seems the transition from paper tickets to electronic cards is very slow

The revenues strictly related to electronic cards sold in the evaluation period are 1574,42 € in 2011 and 10.225,58 € in 2012. Obviously, the operating costs cannot be covered by revenues only from selling cards.

So it is very difficult to make a complete evaluation for such a starting system and performing a CBA does not make sense

A really evaluation and CBA should be made when RAT will change the mechanical validation system in the vehicles connected to e-ticketing in order to have a clear picture of the revenues by lines.

It can be said that Rat is so enthusiast of the system that decide to extend e- ticketing to the whole company since the beginning of 2013,and to quit all the paper system at the beginning of 2015

Although the measure brings increased operation and maintenance costs, RAT will have qualitative benefits, such as:

- Possibility of real time transmitting of the data about passengers profile, necessary to RAT management,
- Collection of money in advance
- Limiting the fraudulent passengers
- Possibility to integrate 2 transportation systems (electric and road), in a common ticketing system

C6 Summary of evaluation results

The key results are as follows:

- **Key result 1 - capital and operating costs** – As expected, capital and average operating cost increased as result of the implementation of the measure, although the contribute of the measure to the increase in the average operating cost has been little.
- **Key result 2- percentage of fraudulent people –** The implementation of the measure resulted in the decrease of the percentage of fraudulent people on the routs monitored by 2% for buses and trams.
- **Key result 3 - Average occupancy –** increased for trams by 5% but decreased for buses routs by 5%.
- **Key result 4 - Awareness level –** increased from 3% to 80% related to knowing measure and from 76 % to 88 % related to the befetits of the measure.
- **Key result 5 - Acceptance level**- increased from 83% to 89%.
- New technologies use is mandatory to renew the Public transport operation; among them the e-ticketing system is one of the key operations.
- The full deployment of e ticketing requires important efforts in communications and long time, this explain why, within the first two year only about 2.000 cards were sold. RAT is going to decide a new communication campaign.
- To organize a full shift to e ticketing, a full deployment of the system is needed; RAT decided for a full implementation within the next two years.
- The advantages for PT operator seems to be very relevant in term of knowledge of origin – destination of passengers, passengers on each line, so allowing a new revision of the whole PT network.
- The cooperation within Modern partners (specially Brescia but even Coimbra) who developed similar approaches was a success factor in the deployment of this measure.

C7 Future activities relating to the measure

The results of the measure will be further disseminated inside of country and in the neighboring countries Bulgaria, Slovakia, Albania and Macedonia in different events, economic missions or partnerships between cities.

D Process Evaluation Findings

D.0 Focused measure

1	The measure fits into the EU policy towards clean urban transport (five pillars of the EU Green Paper)
2	The measure fits into the city policy towards sustainable urban transport and / or towards sustainability in general
3	The expected impact on the transport system, environment, economy and/ or society / people is very high
4	The high level of innovativeness of the measure with respect to technique, consortium, process, learning etc
5	The measure is typical for a group of measures or a specific context
6	The possibility of carrying out a good Cost Benefit Analysis
7	Participation of a range of different actors
8	The high degree of complexity of managing the measure
9	The measure is regarded as an example measure
10	Other, *please describe????*

	0	No focussed measure
2	1	Most important reason
4	2	Second most important reason
8	3	Third most important reason

D.1Deviations from the original plan

The deviations from the original plan comprised:

- **Deviation 1** –I*mplementation of the e-ticketing system on trams* was delayed

6 months delay in implementation of the measure occurred because the e-ticketing providing company has not delivered the software for the 27 trams on-board computers to integrate them in e-ticketing system. The reason why this happened was RAT had no budget to pay the e-ticketing system provider according to the agreement. When RAT received money from Municipality, the provider was paid and e-ticketing system was fully implemented.

D.2Barriers and drivers

D.2.1 Barriers

Preparation phase

- **Problem related barriers:** The measure leader and the team spent additional time in research activity for finding most appropriate technical solution that could make the best transition from paper tickets to chip cards (contact-less).
- **Planning barriers,** Large number of producers, different technologies and system components made difficult to estimate the overall system price.

- **Financial barriers**, Delay of Municipality in introducing the RAT co-financing in their budget.

Implementation phase

- **Institutional barriers**: Complexity of Romanian tender procedures
- **Planning barriers** The period for tender was very long because of contestations, so the implementation of e-ticketing system was delayed.
- **Financial barriers**, Delay of Municipality in introducing the RAT co-financing in their budget.

Operation phase

- **Spatial barriers** The measure was slightly delayed for trams and was completed in due time only for buses. The delay was due to the construction of an overpass which led to the division of the tramline into two isolated sections and trams were divided to run on the two sections during the construction.
- **Financial barriers** The budget for payment the company providing e-ticketing system was not available
- **Problem related barriers** The company providing e-ticketing system has not collaborated and blocked the software writing for onboard computer of the 27 trams. In these circumstances, the measure has been delayed for 6 months.

D.2.2 Drivers

Preparation phase

- **Positional drivers** Implementation team was supported by Brescia team concerning on e-ticketing system. So, research activities were made easier using similar experience from partners.

Implementation phase

- **Positional drivers** Implementation team was supported by Brescia team concerning on e-ticketing system. So, implementation activity was made easier using similar experience from partners.
- **Financial drivers** CIVITAS funding has been essential for activate the budget activation

Operation phase

- **Organizational drivers**, IPA's research team is professional and there was a strong and clear leadership. The measure leader is professional and highly motivated person to implement an e-ticketing system

D.2.3 Activities

Preparation phase

- **Involvement / communication actions**, The measure leader organized round table with key stakeholders sharing different viewpoints. The measure leader and the team organize face-to face interviews with potential producers of e-ticketing systems components.

- **Organizational actions** Meetings of the measure team with RAT top management to emphasize the importance of the measure to obtain their maximum facilitating support.
- **Technological actions** The research team made use of city of Brescia experience to improve their knowledge on e-ticketing protocols and systems in order to make easier the implementation of e-ticketing in Craiova.

Implementation phase

- **Positional actions** RAT Company and city of Brescia closed a collaboration agreement in order to transfer the e-ticketing technology
- **Planning actions** Evaluation team for offers tried to be very quick to recover the wasted time with tender procedures
- **Financial actions** Preparation of a new-year-2010 budget plan by the Municipality to consider the co-financing to RAT.
- **Technological actions** The research team made use of city of Brescia experience to improve their knowledge on e-ticketing protocols and systems in order to make easier the implementation of e-ticketing in Craiova.

Operation phase

- **Planning actions,** Actions to recovery the 6 months delay: organization and planning of assembly / installation of on board equipment and of the traffic tracking system for trams operating in the section where doesn't exist intervention workshop. At the same time have been accelerated the activities to connect trams with the central management system from RAT headquarter.
- **Financial actions** The Municipality found budget for payment the company providing e-ticketing system

D.3 Participation

D.3.1. Measure Partners

- **Measure partner 1** – IPA SA - Leading role

IPA SA is a 47 years old Romanian industrial R & D company and is the Romanian national institute for research and development, engineering in energy, automation and IT, with a large experience in European projects in technology transfer and in information dissemination.

IPA was responsible for the dissemination activities and carrying out the research activity and technical studies in the measure. Since 2011 IPA took over the evaluation activity.

- **Measure partner 2** – RAT – Principle participant

RAT Craiova is main Public Transportation Company in Dolj county. It provides the citizen transportation by trams, buses and micro-buses.

RAT Craiova was responsible for the technical specification, acquisition and installation of the e-ticketing system, as well as the training of trams and buses drivers. Also, RAT managed the operation and monitoring activities.

- **Measure partner 3** – LCM – Occasional participant

The Local Council of Craiova Municipality (Primaria Municipiului Craiova) was organized and functions according to Law No. 215/2001 regarding Local Public Administration with the subsequent modification and completion.

Municipality as local government institution has, under the conditions imposed by the public administration law, the decisional right in all matters of local interest: political, social, cultural, educational and technical. Through their structures, the municipality is a complex mechanism which can produce major changes in the quality of urban life under an effective management and coordination.

The competencies of these bodies related to the project covers both the services provided to the local community (i.e. Public transport service in various forms) and the technical interventions (the urban infrastructure, constructions) that together change the image of the city and bring added value to the quality of life in the areas where they act.

LCM was the coordinator of the project since 2009 and assumed the responsibility for the management activity in the MODERN project. Between 2009-2011, LCM carried out the evaluation activity in the project.

D.3.2 Stakeholders

Stakeholder 1 – Alien Concept Company – The company that provided, installed and tested the e-ticketing system. The Alien Concept SRL company specializes in designing automated solutions, thus a major part of its products is customized to the specific needs of each client.

Their product portfolio includes:

- ticket and subscriptions slot machines;
- ticket validators;
- parking ticket slot machines;
- pedestrian and automotive access control systems;
- GPS tracking solutions for managing the transport fleet;
- embedded control systems of patrol;
- electronic information panels.

Stakeholder 2 – Local Police – activities to reduce fraudulent passengers.

Stakeholder 3 – Associations of retired people - monthly urban transport subscription, using e-ticketing cards.

Stakeholdre 4 – Students - monthly urban transport subscription, using e-ticketing cards.

D.4Recommendations

D.4.1 Recommendations: measure replication

- **Recommendation 1 -** Different view points could facilitate to find out the best solution for satisfying the e-ticketing requirements
- **Recommendation 2** – Using other European cities good practices and experiences lead to achieve a successful implementation of the measure

D.4.2 Recommendations: process (related to barrier-, driver- and action fields)

- **Recommendation 1 -** The measure leader and the team have to organize face-to face interviews with potential producers of e-ticketing systems components.

- **Recommendation 2** – Discussions on e-ticketing requirements among different stakeholders to well understand their requests and expectations. The discussions permitte to focus on a proper design.

Annex 1: Technological Transfer protocol between Brescia Mobilita and RAT Craiova

enterprise europe

PARTNERSHIP AGREEMENT (PA) STATEMENT LETTER [1]

PA title	E-ticketing system		
PA type	X Technological	☐ Commercial	☐ Research

Report of a Partnership Agreement between 'The Parties':

Company / Organisation 1		**Company / Organisation 2**	
Name	Brescia Mobilita SpA. Societa Metropolitana di Mobilita	Name	RAT Craiova (Regia Autonoma de Transport)
Address	25123 Brescia- p.zza S. Padre Pio da Pietrelcina, Brescia, Italy	Address	23, Calea Severinului Street, Craiova, Romania

I, the undersigned, as a bona fide representative of **Brescia Mobilita SpA** and **RAT Craiova** (as 'The Parties' mentioned above) confirm that my company/organisation received assistance and support (as described in the associated PA report) from **the Enterprise Europe Network** to reach the aforementioned Partnership Agreement:

Brescia Mobilita SpA	
Full Name: Pace Severo	**Date:** 23.02.2009
Job Title: Reprezentative	**Signature:**
Full Name: Giandomenico Gangi	**Date:** 23.02.2009
Job Title: Brescia Site coordinator	**Signature:**

Date that the agreement was made between 'The Parties' mentioned above: 19.02.2009 [2] (*dd/mm/yyyy*)

For the signatory Party: would you be willing to have this partnership agreement **PUBLICISED**? X YES ☐NO [3]

Network Partner (not consortium) who provided assistance to company / organisation 1:

Name of Network Partner 1	Enterprise Europe Network – SIMPLER, Alintec Scarl
Contact person	Angelo Gatto

Network Partner (not consortium) who provided assistance to company / organisation 2 (if applicable):

Name of Network Partner 2	RO 4 Enterprise Europe Network – 225288 SC IPA SA-R&D, Engineering and Manufacturing for Automation Equipment
Contact Person	Gabriel Vladut

Network Partner (not consortium) involved in the agreement as 'Third Party' (if applicable)[4]:

Name of Network Partner 3	Consorzio Catania Ricerche Enterprise Europe Network - B.R.I.D.G.economies Consortium, partner
Contact Person	Francesco Cappello

[1] *Legal notice: refer to the privacy rules of the country of each Network Partner. Disclaimer: the EACI declines responsibility for the misuse of this document.*
[2] *This date can either be the date when both parties signed the agreement, or one agreed upon as the actual date of the PA.*
[3] *The EACI confirms that all information disclosed in this form will be treated in the strictest confidence.*
[4] *See PA guidelines for definition of 'Third Party' Network Partner.*

Annex 2: Costs calculation

	Cases for comparison	internet communication costs (euro)	energy costs(euro)	personal costs	maintenance and spare parts costs (euro)	other costs(indirect costs) 20 % of personel costs(euro)	Supplies costs (plastic cards , writing cards tonner, paper tickets etc) (euro)	Total costs
2009	CIVITAS measure	0.00	0.00	2537.85	0.00	507.57	8726.00	11771.42
	BAU	0.00	0.00	2537.85	0.00	507.57	8726.00	11771.42
2010	CIVITAS measure	0.00	3.60	8804.44	0.00	1760.89	16726.00	27294.93
	BAU	0.00	3.60	8804.44	0.00	1760.89	16726.00	27294.93
2011	CIVITAS measure	2381.00	41.86	18523.55	0.00	3704.71	15209.00	39860.12
	BAU	0.00	3.60	8804.44	0.00	1760.89	16726.00	27294.93
2012	CIVITAS measure	2671.00	34.00	18523.55	0.00	3704.71	15680.00	40613.26
	BAU	0.00	3.60	8804.44	0.00	1760.89	16726.00	27294.93

		No of buses and trams	Km traveled by 80 buses	Km travelled by trams fleet- 27 trams	Average cost/vKm
2009	CIVITAS measure	107	2945536	893497	0.0030662

	BAU	107	2945536	893497	0.0030662
2010	CIVITAS measure	107	3665503	819643	0.0060856
	BAU	107	3665503	819643	0.0060856
2011	CIVITAS measure	107	3681844	524251	0.0094768
	BAU	107	3681844	524251	0.0064894
2012	CIVITAS measure	107	3264988	533341	0.0106924
	BAU	107	3264988	533341	0.007186

Km traveled by buses endowed with e-ticketing	Km travelled by trams endowed with e-ticketing	years
2945536	893497	2009
3665503	819643	2010
3681844	524251	2011
3264988	533341	2012

Measure title: INTEGRATING E-TICKETING SYSTEM IN CRAIOVA

City: Craiova Project: MODERN Measure number: 02.04

Detailed operating costs

	internet communication costs	energy costs	personnel costs	maintenance and spare parts costs	other costs	supplies costs (plastic cards, written cards tonner, paper tickets)		Total operating costs(€)
						old ticketing costs	e-ticketing costs	
2009	0	0	2537.85	0.00	507.57	8726.00	0.00	11771.42
2010	0	3.6	8804.44	0.00	2866.09	16726.00	0.00	28400.13
2011	2381	41.86	18523.55	0.00	30081.66	14529.00	680.00	66237.07
2012	2671	34	18523.55	0.00	30081.66	15000.00	680.00	66990.21

Annex 3: Questionnaires and sample size calculation

Instructions

This survey is part of an European project - MODERN (Mobility, development and reducing energy consumption) and aims to collect your experiences in traveling by buses and trams

This measure aims to implement e-ticketing and GPS/GPRS systems on 80 buses and 27 trams.

E-ticketing System to be applied consists of:

- *validation devices installed on buses and trams,*
- *on-board display was installed on each vehicle,*
- *30 ticketing automatic machines(10 automatic machines for paper tickets and recharging cards installed in passengers stations; 20 recharging cards set installed inside of the RAT tickets selling points) and communications equipment that transmit data from sites to RAT dispatcher*
- *20 digital panels with real time information*

Your answers will be treated confidentially. Thank you for your participation!

Ex-ante questionnaire

M 02.04: INTEGRATING E-TICKETING SYSTEM IN CRAIOVA

M08.02 INFOMOBILITY TOOLS FOR FLEET MANAGEMENT IN CRAIOVA

1. Gender: F ☐ 35% ☐ M 65 %

2. Age:

Up to 15	15-24	25-45	45-54	55-65	over 65
5%	25%	20%	25%	10%	15%

3. Background (the last education institution graduated):

· faculty	· secondary school	· primary school
35%	60%	5%

4. Labor market status:

employed	unemployed	pensioners
60%	25%	15%

5. Public transport user

yes ☐ 80% no ☐ 5% occasionally ☐ 15%

Awareness level

6. Do y**ou know the MODERN project and e-ticketing measures?**

yes ☐ 3% no ☐ 97%

Do y**ou know the MODERN project and GPS?GPRS measures?**

yes ☐ 3% no ☐ 97%

7. How important are the following sources of information concerning to e-ticketing and GPS/GPRS system on buses and trams , cards selling points and real time information digital panels ?

	un-important	Rather un-important	Rather important	Very important	I don't know
Transport Company of Craiova- RAT website	☐1	☐2	☐4	☐5	☐6

Media	☐1	☐2	☐4	☐5	☐6
Colleagues/acquaintances	☐1	☐2	☐4	☐5	☐6
Forums or similar on the internet	☐1	☐2	☐4	☐5	☐6
Other, please specify below:	☐1	☐2	☐4	☐5	☐6

8. Do you understand the aim of

- the e-ticketing measure and the potential benefit?

fairly well understand	well understand	very well understand	Don't know
20%	40%	36%	4%

- the GPS/GPRS measure and the potential benefit?

fairly well understand	well understand	very well understand	Don't know
4%	52%	38%	6%

Acceptance level

9. What is your opinion related to

- electronic validating devices and e-ticketing system?

Less good	good	Very good	Don't know
25 %	35%	38%	2%

- GPS system and real time information digital panels

Less good	good	Very good	Don't know
0	10%	80%	10%

10. Willingness to implement the measures:

- e-ticketing system

Accept	Do not accept	Do not know
83 %	15%	2%

- GPS system and real time information digital panels

Accept	Do not accept	Do not know
90%	0	10%

11. Which is the reason for that you want to implement the e-ticketing measure ?

☐1	To reduce the tickets selling time	50 %
☐2	A modern travel mode	30%
☐3	Old system is obsolete -	3%

For travellers that accept the measure

12. Which is the reason for that you want to implement the GPS/GPRS measure ?

☐1	A modern travel mode	15%
☐2	Good time management	85%

For travellers that accept the measure

13. Which is the reason for that you do not want to implement the e-ticketing measure ?

☐1	cannot handle e-commerce or any other e- activity	10%
☐2	extra responsibility related to electronic cards	5%

For travellers that do not accept the measure

14. Which is the reason for that you do not want to implement the GPS/GPRS measure ?

☐1	.....
☐2	……..

For travellers that do not accept the measure

Instructions

This survey is part of an European project - MODERN (Mobility, development and reducing energy consumption) and aims to collect your experiences in traveling by buses and trams

This measure aims to implement e-ticketing and GPS/GPRS systems on 80 buses and 27 trams.

E-ticketing System to be applied consists of:

- validation devices installed on buses and trams,

- on-board display was installed on each vehicle,

Measure title: INTEGRATING E-TICKETING SYSTEM IN CRAIOVA

City: Craiova Project: MODERN Measure number: 02.04

- 30 ticketing automatic machines(10 automatic machines for paper tickets and recharging cards installed in passengers stations; 20 recharging cards set installed inside of the RAT tickets selling points) and communications equipments that transmit data from sites to RAT dispatcher

- 20 digital panels with real time information

Your answers will be treated confidentially.

Thank you for your participation!

Ex-post questionnaire

M 02.04: INTEGRATING E-TICKETING SYSTEM IN CRAIOVA

M08.02 INFOMOBILITY TOOLS FOR FLEET MANAGEMENT IN CRAIOVA

1. Gender: F ☐ 38% ☐ M 62 %

2. Age:

Up to 15	15-24	25-45	45-54	55-65	over 65
3%	30%	25%	26%	6%	10%

3. Background (the last education institution graduated):

faculty	secondary school	primary school
30%	67%	3%

4. Labor market status:

employed	unemployed	pensioners
67%	20%	13%

5. Public transport user

yes ☐ 85% no ☐ 3% occasionally ☐ 12%

Awareness level

6. Do y**ou know about the progress of the e-ticketing measure?**

☐ ☐

80%yes no 20%

Do y**ou know about the progress of GPS/GPRS measure?**

30% yes ☐ no 70% ☐

7. Do you notice the benefits of the e-ticketing measure in the last time?

88% yes ☐ no 10% ☐ 2% don't know ☐

Do you notice the benefits of the GPS/GPRS measure in the last time?

82% yes ☐ no 13% ☐ 5% don't kno ☐

Acceptance level

8. What is your opinion related to

- electronic validating devices and e-ticketing system?

Less good	good	Very good	Don't know
14 %	40%	44%	2%

- GPS system and real time information digital panels

Less good	good	Very good	Don't know
0	15%	80%	5%

9. Accept to keep and extend the e-ticketing system to more PT vehicles:

Accept	Do not accept	Do not know
89 %	10%	1%

Accept to keep and extend the GPS/GPRS system to more PT vehicles:

Accept	Do not accept	Do not know
94%	0	6%

Estimation of sample size

Variables name and explanations		Variables values
n	The sample size	119
t	z-score: the abscissa of the Normal distribution for probability α (consisted of 1.5+0.03 from the table-standard normal probabilities)	1.53
α	**confidence level**, is a percentage and represents how often the true percentage of the population who would pick an answer lies within the **confidence interval** (margin of error).	87.50%
P	percentage of your sample that picks a particular answer. We considered that majority of people will be satisfied if the buses fleet will be replaced with new one	0.85
Q	(1-P)	0.15
d	**confidence interval** (also called margin of error)	0.05
N	population total (if N is enough large the term in the denominator tends to 1 and the formula is reduced to the numerator)	300000

Standard Normal Probabilities

Source: http://people.richland.edu/james/lecture/m170/tbl-norm.html

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141

0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990

Annex 4: Occupancy monitoring

Note relating to meaning the figures in the tables:

- The period 09:00- 10:00 is the period when the data were collected in the morning for off-peak period
- The period 19:00-20:00 is the period when the data were collected in the after-noon for off-peak period
- The period 07:00- 08:00 is the period when the data were collected in the morning for peak period
- The period 15:00- 16:00 is the period when the data were collected in the after-noon for peak period
- Routs monitored includes the following stations:
    - " Electroputere" station-"Piata centrala" station(2 Km lengt- tram line)
    - "Fabrica de confectii " station- "Stadion" Station(1 Km length – E1T rout)
    - "Stadion " station-"Park"station(1 Km length- E1R rout)
    - "Electroputere"station-"Lapus" station(1 Km length- Rout no. 9)
- Maximum number of passengers means the capacity of vehicle:
    - 83 passengers for tram monitored
    - 105 passengers for bus (MAN LC type) monitored

The routs and tram line were monitored for 1 month – September 2010, 2011 and 2012

The passengers travelling between the stations before listed have been counted and the occupancy percentage was calculated as ratio between average number of passengers and maximum capacity of vehicle.

	Average occupancy off-peak hours			09:00-10:00			
Tram	Distance travelled " Electroputere" station-"Piata centrala" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
Line 101		48	83.00	58%	We Sept 1st		
		52	83.00	63%	Th- Sept 9th		
		46	83.00	55%	Fr- Sept 17th		
		70	83.00	84%	We- Sept 22nd		
	2	48	83.00	58%	Th- Sept 30th	Sept	
							2010

	Average occupancy in off-peak hours			19:00-20:00			
Tram	Distance travelled " Electroputere" station-"Piata centrala" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
Line 101		50	83.00	60%	We Sept 1st		
		48	83.00	58%	Th- Sept 9th		
		60	83.00	72%	Fr- Sept 17th		
		51	83.00	61%	We- Sept 22nd		
	2	65	83.00	78%	Th- Sept 30th	Sept	
							2010

	Average occupancy off-peak hours			09:00-10:00			
Line E1T	Distance travelled "Fabrica de confectii " station-"Stadion" Station (Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		55	105.00	52%	We Sept 1st		
		52	105.00	50%	Th- Sept 9th		
		46	105.00	44%	Fr- Sept 17th		
		48	105.00	46%	We- Sept 22nd		
	1	60	105.00	57%	Th- Sept	Sept	2010

					30th		

	Average occupancy in off-peak hours			19:00-20:00			
Line E1 T	Distance travelled "Fabrica de confectii " station- "Stadion" Station (Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		40	105.00	38%	We Sept 1st		
		62	105.00	59%	Th- Sept 9th		
		52	105.00	50%	Fr- Sept 17th		
		50	105.00	48%	We- Sept 22nd		
	1	60	105.00	57%	Th- Sept 30th	Sept	
							2010

	Average occupancy off-peak hours			09:00-10:00			
Line E1R	Distance travelled "Stadion " station- "Park"station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		60	105.00	57%	We Sept 1st		
		55	105.00	52%	Th- Sept 9th		
	1	60	105.00	57%	Fr- Sept 17th	Sept	2010

		71	105.00	68%	We- Sept 22nd		
		68	105.00	65%	Th- Sept 30th		

	Average occupancy in off-peak hours			19:00-20:00			
Line E1 R	Distance travelled "Stadion " station-"Park"station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		70	105.00	67%	We Sept 1st		
		60	105.00	57%	Th- Sept 9th		
		68	105.00	65%	Fr- Sept 17th		
		58	105.00	55%	We- Sept 22nd		
	1	65	105.00	62%	Th- Sept 30th	Sept	
							2010

	Average occupancy off-peak hours			09:00-10:00			
Line 9	Distance travelled "Electroputere"station-"Lapus" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		73	105.00	70%	We Sept 1st		
	1	64	105.00	61%	Th- Sept 9th	Sept	2010

		60	105.00	57%	Fr- Sept 17th		
		68	105.00	65%	We- Sept 22nd		
		79	105.00	75%	Th- Sept 30th		

	Average occupancy in off-peak hours			19:00-20:00			
Line 9	Distance travelled "Electroputere"station-"Lapus" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		70	105.00	67%	We Sept 1st		
		67	105.00	64%	Th- Sept 9th		
		50	105.00	48%	Fr- Sept 17th		
		58	105.00	55%	We- Sept 22nd		
	1	40	105.00	38%	Th- Sept 30th	Sept	
							2010

	Average occupancy in peak			07:00-08:00			
Tram	Distance travelled " Electroputere" station-"Piata centrala" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
Line 101	2	55	83.00	66%	We Sept 1st	Sept	2010

		52	83.00	63%	Th- Sept 9th		
		60	83.00	72%	Fr- Sept 17th		
		64	83.00	77%	We- Sept 22nd		
		57	83.00	69%	Th- Sept 30th		

	Average occupancy in peak hours			15:00-16:00			
Tram Line 101	Distance travelled " Electroputere" station-"Piata centrala" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
		50	83.00	60%	We Sept 1st		
		53	83.00	64%	Th- Sept 9th		
		60	83.00	72%	Fr- Sept 17th		
		67	83.00	81%	We- Sept 22nd		
	2	65	83.00	78%	Th- Sept 30th	Sept	
							2010

	Average occupancy in peak hours			07:00-08:00			
Line E1T MAN LC bus type	Distance travelled "Fabrica de confectii " station-"Stadion" Station (Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
		62	105.00	59%	We Sept 1st		
	1	52	105.00	50%	Th- Sept 9th	Sept	2010

		58	105.00	55%	Fr- Sept 17th		
		53	105.00	50%	We- Sept 22nd		
		60	105.00	57%	Th- Sept 30th		

	Average occupancy in peak hours			15:00-16:00			
Line E1 T	Distance travelled "Fabrica de confectii " station-"Stadion" Station (Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		56	105.00	53%	We Sept 1st		
		62	105.00	59%	Th- Sept 9th		
		52	105.00	50%	Fr- Sept 17th		
		57	105.00	54%	We- Sept 22nd		
	1	65	105.00	62%	Th- Sept 30th	Sept	
							2010

	Average occupancy in peak hours			07:00-08:00			
Line E1R	Distance travelled "Stadion " station-"Park"station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		68	105.00	65%	We Sept 1st		
		62	105.00	59%	Th- Sept 9th		
	1	65	105.00	62%	Fr- Sept	Sept	2010

				17th		
	71	105.00	68%	We- Sept 22nd		
	74	105.00	70%	Th- Sept 30th		

	Average occupancy in peak hours			15:00-16:00			
Line E1 R	Distance travelled "Stadion " station-"Park"station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		75	105.00	71%	We Sept 1st		
		60	105.00	57%	Th- Sept 9th		
		76	105.00	72%	Fr- Sept 17th		
		58	105.00	55%	We- Sept 22nd		
	1	73	105.00	70%	Th- Sept 30th	Sept	
							2010

	Average occupancy in peak hours			07:00-08:00			
Line 9	Distance travelled "Electroputere"station-"Lapus" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		73	105.00	70%	We Sept 1st		
		68	105.00	65%	Th- Sept 9th		
	1	65	105.00	62%	Fr- Sept 17th	Sept	2010

	75	105.00	71%	We- Sept 22nd		
	80	105.00	76%	Th- Sept 30th		

	Average occupancy in peak hours			15:00-16:00			
Line 9	Distance travelled "Electroputere"station-"Lapus" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		74	105.00	70%	We Sept 1st		
		67	105.00	64%	Th- Sept 9th		
		58	105.00	55%	Fr- Sept 17th		
		58	105.00	55%	We- Sept 22nd		
	1	60	105.00	57%	Th- Sept 30th	Sept	
							2010

	Average occupancy off-peak hours			09:00-10:00			
Tram	Distance travelled " Electroputere" station-"Piata centrala" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
Line 101		35	83.00	42%	Th Sept 1st		
		45	83.00	54%	Mo- Sept 5th		
	2	33	83.00	40%	Tu- Sept 13th	Sept	2011

		38	83.00	46%	We- Sept 21st		
		34	83.00	41%	Th- Sept 39th		

	Average occupancy in off-peak			19:00-20:00			
Tram type	Distance travelled " Electroputere" station- "Piata centrala" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
Line 101		37	83.00	45%	Th Sept 1st		
		41	83.00	49%	Mo- Sept 5th		
		38	83.00	46%	Tu- Sept 13th		
		40	83.00	48%	We- Sept 21st		
	2	33	83.00	40%	Th- Sept 39th	Sept	
							2011

	Average occupancy off-peak hours			09:00-10:00			
Line E1T	Distance travelled "Fabrica de confectii " station- "Stadion" Station (Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		38	105.00	36%	Th Sept 1st		
		50	105.00	48%	Mo- Sept 5th		
	1	49	105.00	47%	Tu- Sept 13th	Sept	2011

		45	105.00	43%	We- Sept 21st		
		37	105.00	35%	Th- Sept 39th		

	Average occupancy in off-peak hours			19:00-20:00			
Line E1 T	Distance travelled "Fabrica de confectii " station- "Stadion" Station (Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		39	105.00	37%	Th Sept 1st		
		47	105.00	45%	Mo- Sept 5th		
		44	105.00	42%	Tu- Sept 13th		
		42	105.00	40%	We- Sept 21st		
	1	34	105.00	32%	Th- Sept 39th	Sept	
							2011

	Average occupancy off-peak hours			09:00-10:00			
Line E1R	Distance travelled "Stadion " station- "Park"station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		48	105.00	46%	Th Sept 1st		
		55	105.00	52%	Mo- Sept 5th		
	1	58	105.00	55%	Tu- Sept 13th	Sept	2011

		51	105.00	49%	We- Sept 21st		
		45	105.00	43%	Th- Sept 39th		

	Average occupancy in off-peak hours			19:00-20:00			
Line E1 R	Distance travelled "Stadion " station-"Park"station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		60	105.00	57%	Th Sept 1st		
		52	105.00	50%	Mo- Sept 5th		
		55	105.00	52%	Tu- Sept 13th		
		47	105.00	45%	We- Sept 21st		
	1	51	105.00	49%	Th- Sept 39th	Sept	
							2011

	Average occupancy off-peak hours			09:00-10:00			
Line 9	Distance travelled "Electroputere"station-"Lapus" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		56	105.00	53%	Th Sept 1st		
		60	105.00	57%	Mo- Sept 5th		
	1	52	105.00	50%	Tu- Sept 13th	Sept	2011

		58	105.00	55%	We- Sept 21st		
		42	105.00	40%	Th- Sept 39th		

	Average occupancy in off-peak hours			19:00-20:00			
Line 9	Distance travelled "Electroputere"station-"Lapus" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		52	105.00	50%	Th Sept 1st		
		57	105.00	54%	Mo- Sept 5th		
		50	105.00	48%	Tu- Sept 13th		
		58	105.00	55%	We- Sept 21st		
	1	40	105.00	38%	Th- Sept 39th	Sept	
							2011

	Average occupancy in peak			07:00-08:00			
Tram	Distance travelled " Electroputere" station-"Piata centrala" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
Line 101		41	83.00	49%	Th Sept 1st		
		52	83.00	63%	Mo- Sept 5th		
	2	44	83.00	53%	Tu- Sept	Sept	2011

					13th		
		42	83.00	51%	We- Sept 21st		
		38	83.00	46%	Th- Sept 39th		

	Average occupancy in peak hours			15:00-16:00			
Tram	Distance travelled " Electroputere" station- "Piata centrala" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
Line 101		38	83.00	46%	Th Sept 1st		
		42	83.00	51%	Mo- Sept 5th		
		44	83.00	53%	Tu- Sept 13th		
		41	83.00	49%	We- Sept 21st		
	2	37	83.00	45%	Th- Sept 39th	Sept	
							2011

	Average occupancy in peak hours			07:00-08:00			
Line E1T	Distance travelled "Fabrica de confectii " station- "Stadion" Station (Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		40	105.00	38%	Th Sept 1st		
		50	105.00	48%	Mo- Sept 5th		
	1	40	105.00	38%	Tu- Sept	Sept	2011

					13th		
		53	105.00	50%	We- Sept 21st		
		43	105.00	41%	Th- Sept 39th		

	Average occupancy in peak hours			15:00-16:00			
Line E1 T	Distance travelled "Fabrica de confectii " station- "Stadion" Station (Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		45	105.00	43%	Th Sept 1st		
		55	105.00	52%	Mo- Sept 5th		
		52	105.00	50%	Tu- Sept 13th		
		50	105.00	48%	We- Sept 21st		
	1	46	105.00	44%	Th- Sept 39th	Sept	
							2011

	Average occupancy in peak hours			07:00-08:00			
Line E1R	Distance travelled "Stadion " station- "Park"station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		61	105.00	58%	Th Sept 1st		
	1	60	105.00	57%	Mo- Sept 5th	Sept	2011

		55	105.00	52%	Tu- Sept 13th		
		55	105.00	52%	We- Sept 21st		
		60	105.00	57%	Th- Sept 39th		

	Average occupancy in peak hours			15:00-16:00			
Line E1 R	Distance travelled "Stadion " station-"Park"station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		61	105.00	58%	Th Sept 1st		
		60	105.00	57%	Mo- Sept 5th		
		51	105.00	49%	Tu- Sept 13th		
		58	105.00	55%	We- Sept 21st		
	1	60	105.00	57%	Th- Sept 39th	Sept	
							2011

	Average occupancy in peak hours			07:00-08:00			
Line 9	Distance travelled "Electroputere"station-"Lapus" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		51	105.00	49%	Th Sept 1st		
	1	65	105.00	62%	Mo- Sept	Sept	2011

					5th		
		60	105.00	57%	Tu- Sept 13th		
		62	105.00	59%	We- Sept 21st		
		55	105.00	52%	Th- Sept 39th		

	Average occupancy in peak hours			15:00-16:00			
Line 9	Distance travelled "Electroputere"station-"Lapus" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		60	105.00	57%	Th Sept 1st		
		61	105.00	58%	Mo- Sept 5th		
		58	105.00	55%	Tu- Sept 13th		
		58	105.00	55%	We- Sept 21st		
	1	52	105.00	50%	Th- Sept 39th	Sept	
							2011

	Average occupancy off-peak hours			09:00-10:00			
Tram	Distance travelled " Electroputere" station-"Piata centrala" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
Line 101		58	83.00	70%	Mo Sept 3rd		
	2	52	83.00	63%	Tu- Sept	Sept	2012

					11th		
		48	83.00	58%	We- Sept 19th		
		70	83.00	84%	Mo- Sept 24th		
		60	83.00	72%	Fr- Sept 28th		

	Average occupancy in off-peak hours			19:00-20:00			
Tram	Distance travelled " Electroputere" station- "Piata centrala" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
Line 101		50	83.00	60%	Mo Sept 3rd		
		55	83.00	66%	Tu- Sept 11th		
		60	83.00	72%	We- Sept 19th		
		60	83.00	72%	Mo- Sept 24th		
	2	70	83.00	84%	Fr- Sept 28th	Sept	
							2012

	Average occupancy off-peak hours			09:00-10:00			
Line E1T	Distance travelled "Fabrica de confectii " station- "Stadion" Station (Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	50	105.00	48%	Mo Sept 3rd	Sept	2012

		52	105.00	50%	Tu- Sept 11th		
		46	105.00	44%	We- Sept 19th		
		48	105.00	46%	Mo- Sept 24th		
		51	105.00	49%	Fr- Sept 28th		

	Average occupancy in off-peak hours			19:00-20:00			
Line E1 T	Distance travelled "Fabrica de confectii " station- "Stadion" Station (Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		38	105.00	36%	Mo Sept 3rd		
		50	105.00	48%	Tu- Sept 11th		
		51	105.00	49%	We- Sept 19th		
		47	105.00	45%	Mo- Sept 24th		
	1	44	105.00	42%	Fr- Sept 28th	Sept	
							2012

	Average occupancy off-peak hours			09:00-10:00			
Line E1R	Distance travelled "Stadion " station- "Park"station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	59	105.00	56%	Mo Sept 3rd	Sept	2012

		50	105.00	48%	Tu- Sept 11th		
		60	105.00	57%	We- Sept 19th		
		65	105.00	62%	Mo- Sept 24th		
		55	105.00	52%	Fr- Sept 28th		

	Average occupancy in off-peak hours			19:00-20:00			
Line E1 R	Distance travelled "Stadion " station-"Park"station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		63	105.00	60%	Mo Sept 3rd		
		60	105.00	57%	Tu- Sept 11th		
		61	105.00	58%	We- Sept 19th		
		52	105.00	50%	Mo- Sept 24th		
	1	57	105.00	54%	Fr- Sept 28th	Sept	
							2012

	Average occupancy off-peak hours			09:00-10:00			
Line 9	Distance travelled "Electroputere"station-"Lapus" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus	1	62	105.00	59%	Mo Sept 3rd	Sept	2012

type							
		64	105.00	61%	Tu- Sept 11th		
		60	105.00	57%	We- Sept 19th		
		68	105.00	65%	Mo- Sept 24th		
		57	105.00	54%	Fr- Sept 28th		

	Average occupancy in off-peak hours			19:00-20:00			
Line 9	Distance travelled "Electroputere"station-"Lapus" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		61	105.00	58%	Mo Sept 3rd		
		60	105.00	57%	Tu- Sept 11th		
		50	105.00	48%	We- Sept 19th		
		58	105.00	55%	Mo- Sept 24th		
	1	40	105.00	38%	Fr- Sept 28th	Sept	
							2012

	Average occupancy in peak			07:00-08:00			
Tram	Distance travelled " Electroputere" station-"Piata centrala" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
Line 101		64	83.00	77%	Mo Sept 3rd		
	2	52	83.00	63%	Tu- Sept	Sept	2012

					11th		
		60	83.00	72%	We- Sept 19th		
		64	83.00	77%	Mo- Sept 24th		
		70	83.00	84%	Fr- Sept 28th		

	Average occupancy in peak hours			15:00-16:00			
Tram	Distance travelled " Electroputere" station- "Piata centrala" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
Line 101		61	83.00	73%	Mo Sept 3rd		
		53	83.00	64%	Tu- Sept 11th		
		60	83.00	72%	We- Sept 19th		
		67	83.00	81%	Mo- Sept 24th		
	2	70	83.00	84%	Fr- Sept 28th	Sept	
							2012

	Average occupancy in peak hours			07:00-08:00			
Line E1T	Distance travelled "Fabrica de confectii " station- "Stadion" Station (Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		58	105.00	55%	Mo Sept 3rd		
	1	52	105.00	50%	Tu- Sept	Sept	2012

					11th		
		55	105.00	52%	We- Sept 19th		
		53	105.00	50%	Mo- Sept 24th		
		50	105.00	48%	Fr- Sept 28th		

	Average occupancy in peak hours			15:00-16:00			
Line E1 T	Distance travelled "Fabrica de confectii " station- "Stadion" Station (Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		50	105.00	48%	Mo Sept 3rd		
		60	105.00	57%	Tu- Sept 11th		
		52	105.00	50%	We- Sept 19th		
		50	105.00	48%	Mo- Sept 24th		
	1	49	105.00	47%	Fr- Sept 28th	Sept	
							2012

	Average occupancy in peak hours			07:00-08:00			
Line E1R	Distance travelled "Stadion " station- "Park"station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	58	105.00	55%	Mo Sept 3rd	Sept	2012

		62	105.00	59%	Tu- Sept 11th		
		65	105.00	62%	We- Sept 19th		
		65	105.00	62%	Mo- Sept 24th		
		60	105.00	57%	Fr- Sept 28th		

	Average occupancy in peak hours			15:00-16:00			
Line E1 R	Distance travelled "Stadion " station-"Park"station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		68	105.00	65%	Mo Sept 3rd		
		60	105.00	57%	Tu- Sept 11th		
		71	105.00	68%	We- Sept 19th		
		58	105.00	55%	Mo- Sept 24th		
	1	67	105.00	64%	Fr- Sept 28th	Sept	
							2012

	Average occupancy in peak hours			07:00-08:00			
Line 9	Distance travelled "Electroputere"station-"Lapus" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus	1	67	105.00	64%	Mo Sept 3rd	Sept	2012

type							
		68	105.00	65%	Tu- Sept 11th		
		65	105.00	62%	We- Sept 19th		
		70	105.00	67%	Mo- Sept 24th		
		63	105.00	60%	Fr- Sept 28th		

	Average occupancy in peak hours			15:00-16:00			
Line 9	Distance travelled "Electroputere"station-"Lapus" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type		65	105.00	62%	Mo Sept 3rd		
		60	105.00	57%	Tu- Sept 11th		
		58	105.00	55%	We- Sept 19th		
		58	105.00	55%	Mo- Sept 24th		
	1	60	105.00	57%	Fr- Sept 28th	Sept	
							2012

M03.02 – Executive Summary

The objective of this measure was to implement the access restriction for private cars in a central area of the town, by the installation of barriers in three main access, in order to reduce pollutant emissions' level and the traffic flow.

Before starting this actions the Municipality of Craiova decide to realize several studies regarding the mobility in the centre of the town. So all the mobility modes were analysed and several problems arose:

1. The necessity to revitalize the historical centre by the institution of a large pedestrian zone, starting from the two already existing pedestrian roads.
2. The needs to find solutions for vehicular traffic crossing the town along the axis North South, because of the insufficient road capacity and the presence of several intersections.
3. The needs for a new infrastructure along the axis East West;
4. The large numbers of car parked along the streets that reduced the vehicle flow.

Moreover the situation of the public transport grid was analysed; the current situation seemed to be reliable and good enough to feed the Centre of the town.

So several actions were defined and put in place; firs of all it was decided to start the institution of a pedestrian zone, enlarging the area around the two streets already closed.

An experimentation was started just at the beginning of Modern Project, with very good results. So the Municipality decided to install physical barriers to preserve the pedestrian area; several types of barriers appropriate for access restriction in the city centre were analysed, so as several barriers providers.

The solution adopted by Municipality was to restrict the access in city centre by bollards. During experimentation phase the Municipality used protective fences to mark the restricted area and replaced them with bollards in three places in city centre.

These three places were chosen taking into account the future action of the Municipality to extend pedestrian area throughout the whole historic centre of Craiova.

These bollards are operated by Community Police agents using devices as remote control. The bollards have to be considered an innovative technology for Craiova because they protect the central area and in the same time, allow the access of residents, emergency cars and special services cars. This technology has not been implemented so far in Craiova.

After the studies and the definition of the above mentioned process the Municipality decide to solve the two main problems affecting the traffic flow through the centre of the town, starting the erection of a new bridge East – West and a tunnel North South, just to avoid traffic downtown. These two interventions were completed by the realization of a large underground park. Moreover the Municipality decided to start an important project of building rehabilitation within the area that should be and shall be car free in the future.

The construction of the two passages in Craiova affected the final implementation of the measure. The works in progress did not allow the closure of the streets around the future pedestrian zone because these interventions should have caused the impossibility to cross the town itself

So the implementation of the measure was reduced to the weekend experimentation done at beginning of Modern project and to a few months in between the bollards installation and the start of the erection works.

Because of the impossibility of a full implementation of the measure it was impossible to perform a good evaluation.

In any case it must be said that:

1. The study performed during Modern Project put in evidence to the Municipality the new infrastructure need;
2. The new infrastructures are going to solve huge problems in the town so to avoid heavy and parasitic traffic to cross the central area of the town;
3. The experimentation phase showed the advantages of a new pedestrian zone in the Centre of the town;
4. The experimentations itself showed the high potential of the area, so to induce Craiova Municipality to define and to apply to European commission for a huge rehabilitation plan in the same area.

So, even if the results of this measure considered as itself seem to be v poor it is possible to say that Modern and this measure were in any case very important for Craiova development.

A. Introduction

A1 Objectives

The measure objectives are:

(J) High level / longer term:

- To reduce congestion and emissions due to private cars

(K) Strategic level:

- To reduce the emissions and congestion in the central area

(L) Measure level:

- Implement the access restriction by installation of barriers on 3 main access streets in the downtown which lead to reducing of emissions' level by 10% and the traffic flow by at least 60%.
- Improve the configuration of the public transport service and network to serve the new access restricted area.

A2 Description

Craiova as many other cities faces issues such as high pollution levels, noise, and traffic congestion especially in the central area.

The objective of the measure was to implement the access restriction for private cars, by installation of bollards on three main access streets in the downtown, in order to reduce the emissions level and the traffic flow in this area.

The Municipality of Craiova anticipated the CIVITAS measure and closed the central zone of the city centre, at the night and on week-ends. This initiative is a part of a larger project through which the Municipality want to close gradually the city centre, including the historical zone of the city to create a pedestrian clean zone.

Restricting access in the central area, during the week-end and night was achieved by 2 decisions of the Municipality. The Municipality decided to implement the restriction policies gradually, so that people get used and easy accept these changes.

In this regard two Decisions of the Mayor have been issued. In the first decision, the traffic was forbidden during the weekend and night(in the range 22:00-6:00). In the second decision this night range was extended between 20:00 and 6:00. In January 2009, protective fences were installed to mark the restricted area during the week-end and night (Fig. A2.1 and A2.2). This restriction has been maintened till July 2011 when the construction of a overpass placed near to central area started.

Measure title: Access restriction policies in Craiova

City: Craiova Project: MODERN Measure number: 03.02

Fig. A2.1 – Restricted area

Fig A2.2 – Restricted area

The municipality analysed various types of barriers appropriate for access restriction in the city centre, barriers providers and main features of the barriers. The solution adopted by Municipality was to close the city centre by bollards. Following the Romanian procurement procedure, the bollards were purchased and installed on 3 places, on three main access streets in the city centre.

In the pictures below (Fig. A2.3), the bollards are identified as black circles, the laboratory which record the environmental data is identified as red squar and the central area proposed for 24/24 restriction is covered by gridlines in brown color.

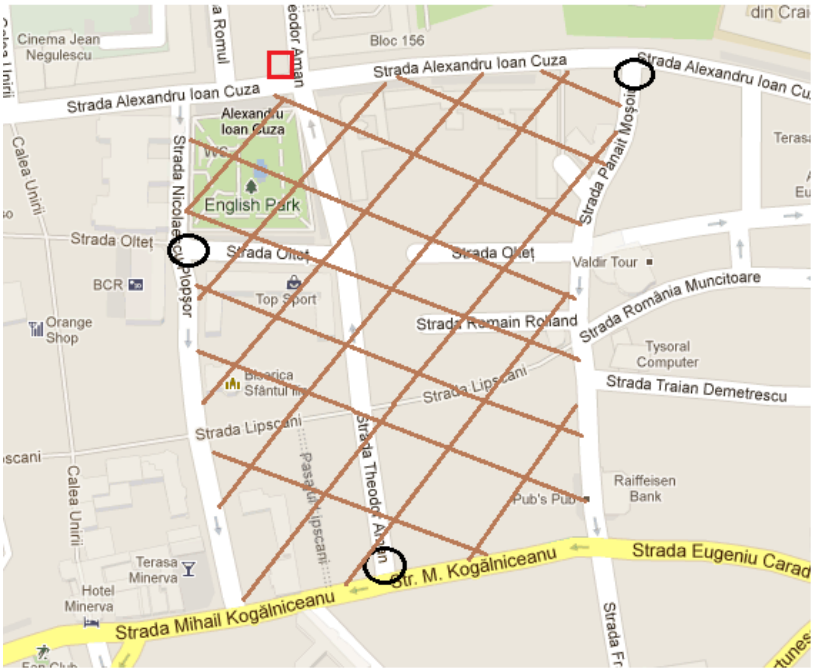


Figure A2.3 – Bollards location

B. Measure implementation

B1 Innovative aspects

The innovative aspects of the measure are:

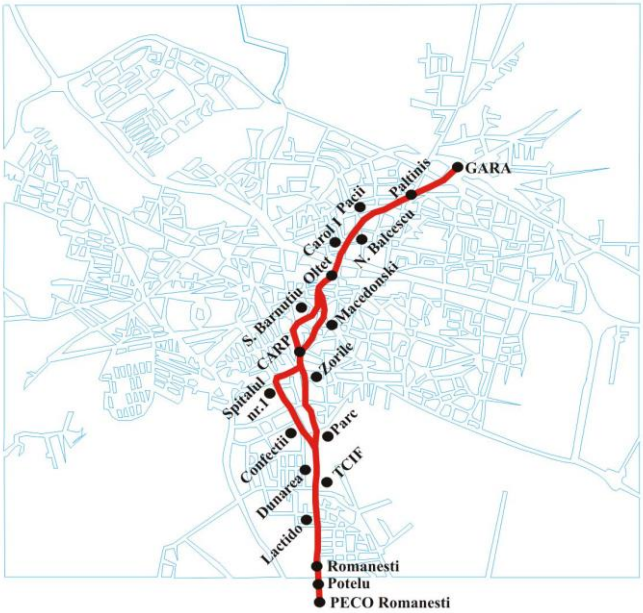
Use of New Technology, Craiova – This is the first time Craiova Municipality has introduced bollards, instead of the usual barriers.

New policy instrument – Thanks to the implementation of the access restriction scheme, the city is aiming at optimizing both private and public traffic flows. This would allow offering a better bus service and increasing the development of social and cultural activities in the restricted area.

B2 Research and Technology Development

- **Analyzing of passengers movements around the city center**

Following this analysis, it was concluded that in Craiova city center the traffic is crowded because there are not enough roads which cross the city from North to the South. There were analyzed the buses stations placed in key points close to city center and the conclusion was that the public transport network was designed in order to ensure the access in the city center in a short time by walk. The downtown is surrounded by several bus and tram stations which and can be reached in 2 - 10 minutes from any direction. In the figure below (Fig. B2.1) is shown the Line 1b that cross the city center. The station "Oltet" is placed in the city center. In the figure B2.2 is shown the line 1R that surrounding the city center.



FigureB2.1- Line 1b

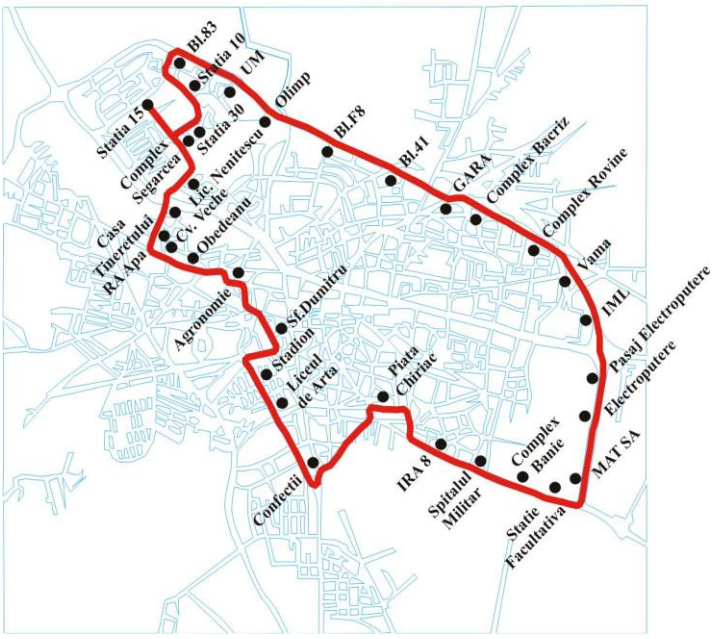


Figure B2.2 – Line 1R

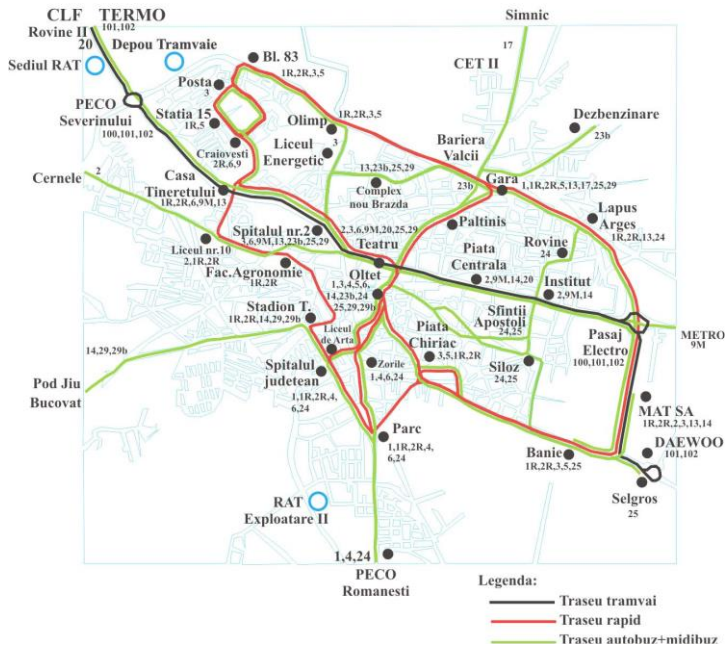


Figure B2.3- buses and trams network

Analyzing of passengers movements on public transport network has shown significant passengers flows in the direction of EV (Titulescu Boulevard - Route Bucharest) especially around the center, the arteries leading into the industrial area Electroputere - Ford and the Way Severin western industrial zone. These streams have values between 4’000 and 8’000 passengers per hour and direction. Significant passenger flows appear in the New Craiovita district, from 4’000 to 6’000 passengers per hour and direction.

NS direction, boulevard Carol I, Olteţ Park Romanescu flows occur from 2000 to 3000 passengers per hour and so and on Dacia Boulevard, the section Station - Passage Electroputere flows over 3000

passengers / hour effective. Be mentioned also the emergence of important flows of passengers in the Street. H. Coanda, direction N - S, for 2000 to 4000 passengers per hour. This suggests the opening of new roads, which make a direct link between Bd Dacia Str. Caracal.

- **Analysis of traffic studies, intersections, signs and parking places.**

The activity was focussed on the current status of the downtown area and forecast of urban areas development.

E79 road is a part of the International E-road network. It begins in Oradea, Romania and ends in Thessaloniki, Greece, also running through Bulgaria. The road is 1,050 km long. The road follows the route Oradea – Beiuş – Deva – Petroşani – Târgu Jiu – Craiova – Calafat – Vidin – Vratsa – Botevgrad – Sofia – Pernik - Blagoevgrad – Kulata/Promachonas (Bulgaria-Greece border crossing) - Serres – Thessaloniki So because of this cross road intersection Craiova is transited by a very large number of transport trucks.

The traffic study shown that many intersections in Craiova are new or reconditioned. Many of the old intersections where modified so that now instead of priority intersection or a traffic light, there are gyratory intersection and now the traffic is more fluent.

Also, the study found that the Municipality manages some projects for the urban development plan of Craiova. Some of the projects are ongoing projects and some of them are finished.

The map of current parking places of Craiova has been analysed. The conclusion was Craiova city is in continuing development and there are about 200 motor vehicles per 1000 citizens. The demand for parking places is very high and the infrastructure of Craiova cannot support an additional number of cars. Because of this problem Craiova needs a lot of parking places for the 298’928 citizens that inhabit the town. Many cars are parked on the left and right side of the street. So the need for additional parking places is required.

The access restriction zone in Craiova was studied (hightlighted in brown colour in the Fig. B2.4)

Figure B2.4 – Access restricted zone

Planning required for pedestrian streets:

- Lipscani Street;

- Romania Muncitoare Street;
- Oltet Street;
- Traian Demetrescu Street;
- Fratii Buzesti Street;
- Nicolae Aman Street;
- Nicolaescu Plopsor Street;
- Recommended planning for urban market on the intersections of the streets: ○ Fratii Buzesti, Lipscani, Romania Muncitoare, Oltet, Romain Rolland si Traian Demetrescu
- Theodor Aman si Lipscani
- Around the Saint Ilie Church

The RTD task concluded with the selection of the appropriate barriers for closure of some access streets in the downtown, and main features of the barriers. The best option of barriers was bollards for closing the central area(Fig B2.5)

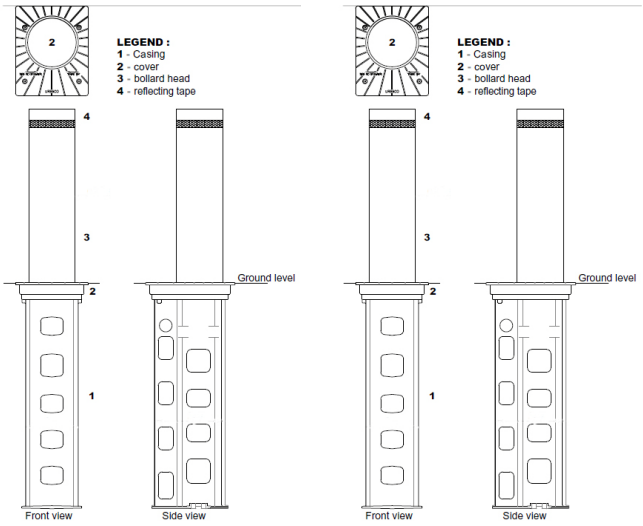


Figure B2.5 – Barrier option

B3 Situation before CIVITAS

In the city of Craiova, Dolj county residence, living about 300.000 people and there are a number of at least 100.000 registered vehicles throughout the entire city, more than 50% being passenger cars.

The central area of Craiova was a very crowded place and the pollutants emissions were often exceeding the limits. The missing of urban secondary large roads makes to cross the city centre the majority of routes in the city leading to air pollution and crowding of the central area.

In 2008, before MODERN project, all streets in central area were available for cars.

Thus, in order to reduce pollution and to save part of the historical centre for pedestrian the Municipality, inside Modern Project commissioned a traffic study of the historical centre; he study was conducted by the Department of Motor Vehicles and Road Transport of the Faculty of Mechanical Engineering – University of Craiova.

The main results of the study was that about 1,700 cars were measured transiting daily the area of the historic centre. Several problems were found:

- the inner streets of the historical centre supported especially local transit traffic at the central level, which generates traffic junctions with main arteries having negative traffic main fluency;
- in the central area there are many public institutions, schools, culture, promenade areas, this actually generate an important flux of visitors;
- the road circulation generates chemical pollution and noise;
- the vibrations resulting in road circulation system affects the old heritage buildings - the existence of traffic congestion;
- the existence of the geometric configuration in some intersections does not compete to a road traffic safety in the area of the historical centre.

With the aid of CIVITAS measure, the Municipality wanted to create a clean area, available for walk to city residents and set up the basis for future actions to rehabilitate the old city centre.

Through this initiative, Municipality decided to pursue the model of many European cities that are concerned by protecting the central historical area in compliance with the principles of the EU Green Paper according to which cities must become spaces clean and high quality of life.

B4 Actual implementation of the measure

Stage 1: Planning and design of the measure

In order to determine how the measure will be applied and integrated into the development strategy of city we had several discussions and meetings with the technical team from Craiova and politicians from the Municipality.

The activity resulted in an analysis of passengers movements around the city center , described in detail within RTD activity.

Stage 2: Traffic and passengers flow study, intersections, sign and parking places

The activity resulted in an WD described in detail within RTD activity.

Town maps and documents related to the development strategy of the city were analyzed in order to define the central restricted area where vehicles access are allowed only on the basis of one special access schemes which will be developed under the CIVITAS measure 07.03

The WD consisted in:

1. Current status, signs and intersections.
2. Forecast of development urban areas.
3. Design of the new restricted area

Stage 3: Implementation of the new PT network

The public transport network was analysed and the conclusion was the bus and tram stations, surrounding the city centre, are placed so that ensure the access in the city center in a short time, by walk. The stations surrounding city centre serve six bus routes and tram line, linking eastern and western districts of the city. The urban structure of Craiova downtown is made up of narrow streets where the flow of vehicles takes place mostly in one direction. In this situation the stations for each of

the two circulation senses were located on different streets, but very close. (In the figure B4.4 are shown the PT stations).

As a consequence, implementation of a new PT network has not been necessary.

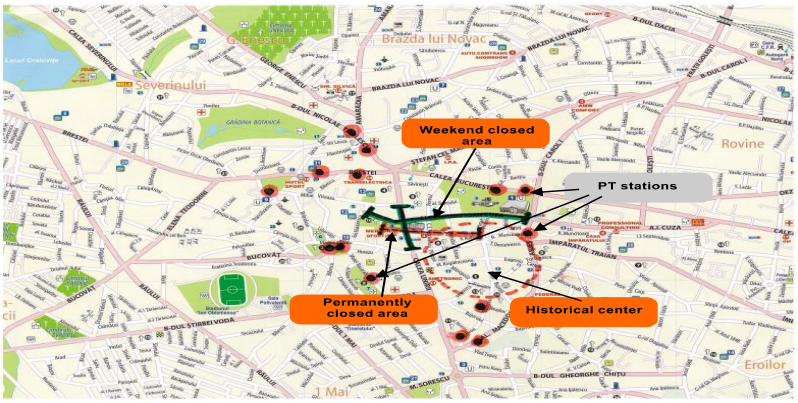


Figure B4.4 – PT stations location

Stage 4: Acquisition procedure and installation of bollards

In July 2011 started the acquisition procedure and the bollards contract was signed in October 2011. The bollards installation started in March 2012 and was completed in April 2012. In the pictures below are shown the 3 points where the bollards were installed (Fig B 4.5-B 4.7).

Figure B 4.5

Figure B 4.6

Figure B 4.7

Stage 5: Impact of project, noise and pollutant emissions

In the first phase of the measure, a study related to computational monitoring of the most important air pollutants produced in Craiova was carried out by Regional Environment Agency. The purpose of the study "report on quality administration of the environment in Craiova (for 2009) realised by the Regional Environment Agency was to investigate the evolution of the concentration for main air pollutants in Craiova city, during the period July 1st 2010-June 30th 2011.

The main air pollutants (NO2, SO2, CO and Pm10) were investigated.

Within the results there was the presentation of the impact of the implementation of several actions programmed by the Administration (several measures included the ones programmed by Modern); the most important ones were:

- Closing the historical centre for road traffic and revitalizing it;
- Developing green areas- "Craiova Green- making pedestrian esplanades;
- Completing of the two central passage (the underpass and the overpass);
- Construction of the underground parking;
- Implementing an efficient traffic routing and traffic lights system to provide functional links between the central roads and the other major roads of Craiova;
- Implementing roundabouts in order to eliminate increasing concentration of air pollutants;

- Improving public transport using bio fuels in Craiova bus fleet;
- Using electric vehicles;
- Carrying out desulphurization installations by the Craiova Energy Complex;
- Wetting the ash and slag deposits of Craiova Energy Complex in the dry season.

As already said, due to the important decision by Craiova Municipality the full implementation of pedestrian zone was not possible during Modern Deployment.

This will be done in a short period, after the completion of the underground passage, the overpass being completed and in operation since autumn 2012 and even if several works will be done starting spring 2013 related to Downtown rehabilitation.

On the specific MODERN objectives:

- The bollards have been acquired and installed;
- The access restrictions were implemented only on weekends and during the nights, while no restriction has been active during the week working days. This because the late acquisition and installation of the bollards conflicted with the need of opening the restricted area to traffic due to the underground passage construction.

Given the fact that the full implementation of the measure was not achieved, it was not possible to carry out the full evaluation process.

B5 Inter-relationships with other measures

The measure is related to other measures as follows:

Measure 07.03- Access restriction policies in Craiova is complementary to measure M07.03 (Policy option for freight distribution schemes in Craiova) since the measure involves limitation of car access in the center to create a walking area for citizen and have lower emissions. The demonstration area almost the same for both measures.

C. Impact Evaluation Findings

C1 Measurement methodology

C1.1 Impacts and Indicators

Table C1.1: Indicators.

No.	Impact	Indicator	Data used	Comments
5-7	Environment	CO level, NOx, NO2, SO2, level Particulate(PM10) level	NO_2, NOx, SO2 and PM10 concentration and CO level	Data provided by Environment Protection Agency are not relevant because of impossibility to implement the measure
13-14	Society	Acceptance Level	Index(%), qualitative	Surveys on PT users, drivers and citizen that live in central area
		Awareness Level	Index(%), qualitative	Surveys on PT users, drivers and citizen that live in central area
21-22	Transport	Traffic flow by vehicle type - peak	No. of vehicles/hour in peak	No. of vehicles in central area in peak hours could not be assessed because of impossibility to implement the measure
		Traffic flow by vehicle type - off peak	No. of vehicles/hour in off-peak	No. of vehicles in central area in off-peak hours could not be assessed because of impossibility to implement the measure

The environmental and transport indicators were cancelled because they cannot be taken into consideration since the access restriction in the city centre has not been implemented.

The only data that could be taken into consideration are the ex-ante data related to awareness and acceptance by residents and drivers passing through the city centre.

Taking into consideration a population of maximum 30’000 people (drivers and residents), a sample of 80 people has been considered. The questionnaires were disseminated face-to-face, during the dissemination actions organized in the city centre.

The questionnaires were structured in 2 sections:

- General information about citizens (job, age, gender, education level, contact data)
- Questions referring to the measure split by indicator type:

Awareness level

Measure title: Access restriction policies in Craiova

City: Craiova Project: MODERN Measure number: 03.02

The most important questions have been the following:

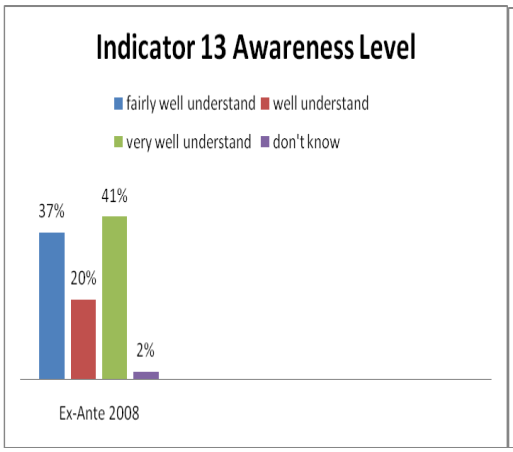
- Have you heard about the measure?(Y/N)
- Do you understand the aim of the project and the potential benefits and not benefits of the measures? (scale 1-3)

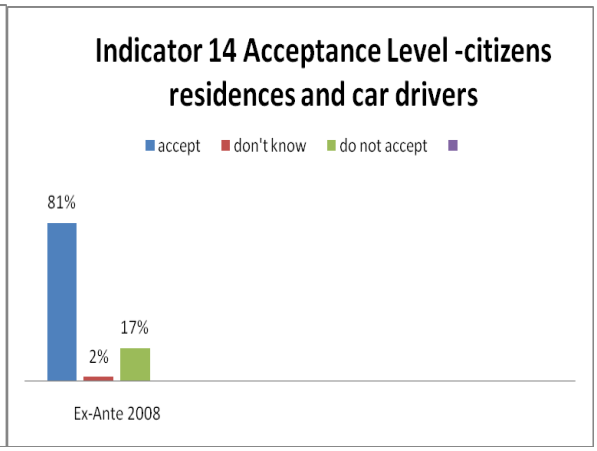
Acceptance level

The most important question has been the following:

- Willingness to implement the measure (Y/N)

Indicator	Ex-Ante 2008
Awareness Level	37%
	20%
	41%
	2%
Acceptance Level	81%
	2%
	17%





C3 Achievement of quantifiable targets and objectives

No.	Target	Rating
1	To reduce the emissions level in central area with 10 %	NA = Not Assessed
2	To reduce the traffic flow by 60% in the central area	NA = Not Assessed
NA = Not Assessed O = Not Achieved ★ = Substantially achieved (at least 50%) ★★ = Achieved in full ★★★ = Exceeded		

C5 Appraisal of evaluation approach

As a complementary project of MODERN, the municipality initiated a Project for the Rehabilitation of the Historical Centre.

In order to decrease the traffic effects generated for closing the Historical centre, there were elaborated a series of priority projects that try to take measures for fluidization of traffic in the central area of the city:

- Building an overpass at the km 0 junction of Craiova city, for taking over the automobile traffic on route E70; This Project is the object of a financing contract between the Municipality and the Regional Development and Tourism Ministry, for the Regional Operational Program, the financing contract being signed on 09.11.2010This project has been ended on 27.07.2012 through the reception of the work done.
- Building an underpass, in the adjacent area of the historical Centre on the Eastern side. This project is the object of a financing contract between the Municipality and the Regional Development and Tourism Ministry, for the Regional Operational Program(ROP), the financing contract being signed on 09.09.2011). This project is still in the implementing stage, respectively in the phase of work execution, the work being ended in September 2013.
- The building an underground parking in the adjacent area of the historical Centre, on the Northern side. This project was submitted for evaluation on 08.02.2012 at the South West Regional Development Agency, the Implementation Body for ROP in order of financing in the Regional Operational Program. 40% of the parking spaces have electrical outlets for charging the batteries of electric cars being equipped and 2 stations for quick loading. Recipients of electric cars will benefit from facilities or even free for the use of parking places, it is cheering buying environmentally friendly means of transport which will lead to the reduction of atmospheric pollution.

All this issues highlight the fact that the measure 03.02. of Project MODERN referring to closing the historical centre could not be put into force without starting of some support projects that help the implementation of this measure.

This being said, Craiova City Hall has analysed and started all these complementary projects for closing the historical centre in order to decrease the consequences and the traffic effects by taking this measures. All of this steps were done sequentially, so by going through all the steps naturally, without which the measure 03.02 could not prove its effectiveness and sustainability.

The construction of the two passages has not made possible the implementation of the measure and consequently, the ex-post data collection was cancelled.

The indicators chosen at the beginning to evaluate the measure were related to environment, transport and society, namely: emission level in restricted area, traffic flow in restricted area, awareness and acceptance by residences and drivers passing through the city centre. The environmental indicators were cancelled because they cannot be taken into consideration since the access restriction in the city centre has not been implemented.

C7 Future activities relating to the measure

As previously described only the barriers installation was the reached objective of this measure, even if within a short period (after the completion of the under pass) the measure will be fully implemented, and it will became a pillar on the Centre rehabilitation process decided by Craiova Municipality.

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

D.1 Deviations from the original plan

The deviations from the original plan comprised:

Deviation 1: Change the task: Installation of the signs and setting of minibuses stations

The original measure description included setting of some minibuses stations to support citizens arriving or departing from the central area. Since the public transport network already have stations around the centre, the development of new stations for minibuses was not justified. So, it has been made a reassessment of current transport network and stations around central area were revised in order to ensure easy access in restricted central area. The budget of the measure decreased according to the tasks shifting resources to measures M02.04, M08.02 and M05.05

Deviation 2: Cancelation of access restriction implementation during weekdays

Craiova Local Council approved a socio-economical development strategy on the medium and long term, in which, four strategic priority objectives were identified for the development of Craiova Municipality. Among them stands the strategic objective no. 5.4.: Urban Regeneration in Craiova Municipality aimed at preserving the architectural style of the Historical City, closing the traffic and setting compact pedestrian areas, creating a network of underground pipelines and communication cables, installing architectural lighting poles to correspond to the architecture of the area.

Within this objective, a number of projects have been identified aimed at designing a new administrative Centre of the city, aimed at decongesting the existing influx of vehicles to the premises of the public authorities and private institutions, looking for solutions to eliminate the transit traffic and to exteriorize the road arteries from the central area which attract heavy traffic.

Of these projects, by far, the project “Rehabilitation of the historical centre of Craiova” is a remarkable one. Thus, in 2008 a first step for developing a Urban Area Plan, for a pilot area, identified in the Historical centre of Craiova, started, aiming at both closing the well defined pilot areas and, more than that, at rehabilitating and modernizing the centre.

The idea of this project was born from the need of realizing the objectives of measure of 03.02 within the Project MODERN and, on the other hand, the need to implement the local development strategic objective regarding the urban regeneration measures in the central area of the town. The Project for the Rehabilitation of the Historical centre in some sense is a consequence of the analysis carried out within the MODERN project.

In this context, the project of revitalization of the historical centre represented the priority no. 1 of Craiova Municipality, a project that took shape in preparation of all necessary documentation for its implementation, was submitted for evaluation to the South West Regional Development Agency, the Implementation Body for ROP on 28.09.2011, by signing the financing contract on 15.06.2012, which we attach to this document.

In addition to architectural and touristic objectives, the project "Rehabilitation and revitalization of the historical centre of Craiova" aims to improve the urban infrastructure through the rehabilitation of

streets and sidewalks and turning them into pedestrian esplanades, rehabilitation of the urban infrastructure by creating new green places and replacing the urban furniture and building water fountains.

All these activities which are going to be undertaken under the above mentioned project are complementary to the measures implemented by Craiova Municipality within the Modern project.

At this moment, the public acquisition procedure is undergoing in order to assign the work execution contract for rehabilitation of historical centre, and the offers, submitted by all the economic operators interested in this project, will be opened on 12 December 2012.

So, it is expected that till the end of the Modern project this contract will be assigned and to proceed accordingly to close the Historical Centre for good and to start the work for achieving the contract.

According to the signed contract, the works of underpass will be finalized in November 2013. So, in the short period between February and May (when the overpass part of the underground passage which will be opened to traffic is ready) other measures of deviation of traffic in central area will be analyzed and undertaken in order not to jam the traffic.

At the beginning of the project for the revitalization of the Historical Centre the possibility of creating severe traffic problems was taken into consideration in the centre area of the city because of closing the traffic in the pilot area situated in the historical centre, having an area of 23.230 square meters, containing a large number of administrative public and private institutions, and a great number of citizens residing in the pilot area.

As a complementary project of MODERN, the municipality initiated a Project for the Rehabilitation of the Historical Centre. In order to decrease the traffic effects generated for closing the Historical centre, a series of priority projects that try to take measures for the traffic decongestion in the central area of the city were elaborated:

- The Building of an uneven passage over ground at the km 0 junction of Craiova city, for taking over the automobile traffic on route E70; This Project is the object of a financing contract between the Municipality and the Regional Development and Tourism Ministry, for the Regional Operational Program, the financing contract being signed on 09.11.2010, that we are attaching at this document (see Annex 3). This project has been ended on 27.07.2012 through the reception of the work done.
- The building of an uneven passage underground, in the adjacent area of the historical Centre on the Eastern side. This project is the object of a financing contract between the Municipality and the Regional Development and Tourism Ministry, for the Regional Operational Program, the financing contract being signed on 09.09.2011, that we are attaching to the present document. We need to specify that this project is still in the implementing stage, respectively in the phase of work execution, the work being ended in September 2013.
- The building of an underground parking in the adjacent area of the historical centre, on the Northern side. We mention that this project was submitted for evaluation on 08.02.2012 at the South West Regional Development Agency, the Implementation Body for ROP in order of financing in the Regional Operational Program. 40% of the parking spaces have electrical outlets for charging the batteries of electric cars being equipped and 2 stations for quick loading. Recipients of electric cars will benefit from facilities or even free for the use of parking places, it is cheering buying environmentally friendly means of transport which will lead to the reduction of atmospheric pollution.

All these issues highlight the fact that the measure 03.02. of Project MODERN referring to closing the historical centre could not be put into force without starting some support projects that help the implementation of this measure.

This being said, Craiova City Hall has analyzed and started all these complementary projects for closing the historical centre in order to decrease the consequences and the traffic effects by taking these measures.

All of these steps were done sequentially, so by going through all the steps naturally, without which this measure could not prove its effectiveness and sustainability.

The national procedure of signing the contracts for the European projects led to delays in implementation of them and this resulted in the impossibility to correlate the construction of the 2 passages and the project of Historical Centre with the implementation of this MODERN measure.

D.2 Barriers and drivers

D.2.1 Barriers

Preparation phase

- **Cultural** – In the city centre there are many institutions that don't agree restriction in the city centre. They don't agree to leave the cars so far from their institution area
- **Financial** – Due to the high cost of infrastructure foreseen for minibuses stations the measure required some changes

Implementation phase

- **Institutional** – Due to Local Council decision to build an under-pass close to Restricted Area the establishment of the barriers placement was delayed
- **Planning** – Due to the necessity to find a new solution to substitute the PT network reconfiguration, additional planning activities were required that induced a delay in implementation
- **Financial -** The budget for the protection of the city central area with barriers was transferred to the Municipality and this action took a time and followed an administrative procedure which produced a slight delay in the measure implementation.
- **Political / strategic** – Legal and administrative issues (legal right to administrate the barriers and the work related to the barriers' installation in the city) which required changes in the budget allocation.

Operation phase

- **Organizational** – The Municipality started to build two passages on the main axis of the city, close to the access restricted area. The works on the overpass caused temporary changes in the traffic regulations in the downtown area declared restricted area to vehicles. For this reason ex-post data for evaluation could not be collected.

D.2.2 Drivers

Preparation phase

- **Cultural** – The citizens living in the central area and not only were very enthusiastic because they can have a clean area to walk and make shopping. In this way the central and historic area of Craiova will be protected

Implementation phase

- **Institutional** – The Municipality has issued a regulation that does not allow the vehicle traffic during the night

Operation phase

- **Institutional** – Integrating the budget to install barriers in the financial structure of the municipality and accelerate its approval process.
- **Cultural** – The Municipality initiative to protect the historic area of the city within a large project for the rehabilitation of the heritage buildings and by construction of pedestrian esplanades.
- **Financial** - Availability of the necessary funds for rehabilitation of the historical centre which includes the city centre restricted to the vehicles traffic through MODERN project.

D.2.3 Activities

Preparation phase

- **Cultural** – Promoting Craiova as a European old capital. MODERN team organized face to face interviews with central institutions and tried to explain the benefits of measure implementation.
- **Financial** – The implementation team find solution to stay in the foreseen budget.
- **Involvement, communication** - Measure leader together dissemination leader organized face-to-face interviews brought together key stakeholders to discuss the sustainability problems to be solved (sharing different viewpoints).

Implementation phase

- **Financial** – After appraising of different solutions, measure leader decided to use bollards. The number of bollards to be purchased depends on the effective building of under-pass
- **Organizational** - Speed up the aquisition process in order to recover the delay and to locate the bollards in the most important points.

Operation phase

- **Problem related** – Elaboration of the traffic management plan during the overpass construction takeing into account the current regime of the downtown as recreation and restricted vehicle access area.

D.3 Participation

D.3.1. Measure Partners

Measure partner 1 – IPA –Leading role

IPA SA is a 47 years old Romanian industrial R & D company and is the Romanian national institute for research and development, engineering in energy, automation and IT, with a large experience in European projects in technology transfer and in information dissemination. IPA was responsible for the dissemination activities and carrying out the research activity and technical studies in the MODERN project of Craiova. Since 2011 IPA took over the evaluation activity

Measure partner 2 – RAT –Ocasional participant

Craiova Public Transport Company is the main public transport operator in the whole Oltenia region. RAT Craiova had no contribution in this measure

Measure partner 3 – LCM - Principal participant

The Local Council of Craiova Municipality (Primaria Municipiului Craiova) was organized and functions according to Law No. 215/2001 regarding Local Public Administration with the subsequent modification and completion. LCM was the coordinator of the project and since 2009 and assumed the responsibility for the management and administration activity in the MODERN project. Between 2009-2011, LCM made the evaluation activity. More than that, LCM was the coordinator of the measure "Access restriction policies in Craiova" and made decisions on closed streets in the demonstration area.

D.3.2 Stakeholders

Stakeholder 1 – South West Oltenia- Environment Agency – providing data regarding the pollutant emissions in city centre and supported the University to elaborate the study refering to the impact of the measure on the city centre. The study is called: "Pollutant dispersion modeling"

- **Stakeholder 2 – Community Police –** Operating barriers with bollards arround the pedestrian central area.
- **Stakeholder 3 – Retailers and shops owners in the central area –** They were surveyed on benefits or not benefits of the acces rectriction in central area **.**
- **Stakeholder 4 - Emergency, Police and Fireman Department -** They have to have obligatory acces inside the central zone to intervene promptly if necessary.
- **Stakeholder 6- Katel Group Company-** Bollards barriers supplier that have a good experience in performing of public works related to traffic safety. Katel Group commercializes all types of traffic signs for permanent signalization, according to STAS 1848 / 1-86; 1848-4 / 1995, with ulterior modification; SR 1848-6 / 1977; SR EN 12368 / 2001; SR EN 60598 / 1 / 2001

D.4Recommendations

D.4.1 Recommendations: measure replication

Not applicable

D.4.2 Recommendations: process (related to barrier-, driver- and action fields)

To analyze the long term urban development strategy in order to know what are the plans of the Municipality , to avoid the difficulties related to measures implementation

Annex 1: Questionnaire

Instructions

This survey is part of the FP7 MODERN project (Mobility, Development and Energy Reduction) and aims to collect experiences in your travels downtown.

The main objective of the measure is to obtain a central area less polluted and crowded. The measure aims to restrict access in downtown

Your answers will be treated confidentially. Thank you for your participation!

Ex-ante questionnaire

Measure 03.02 – Access restrictions policies in Craiova

1. Gender: F 65% ☐ M 35% ☐

2. Age:

Up to 15	15-24	25-45	45-54	55-65	over 65
1%	10%	32%	20%	20%	17%

3. Background (the last education institution graduated):

faculty	secondary school	primary school
42%	57%	1%

4. Labor market status:

employed	unemployed
67%	33%

5. You are:

☐ 62%	citizen passing through or living in the city center
☐ 38%	Car owner that passing through city center

Awareness level

Measure title: Access restriction policies in Craiova

City: Craiova Project: MODERN Measure number: 03.02

6. Do you know the MODERN project and the measure?

1% ☐ yes 99% ☐ no

7. How important are the following sources of information concerning to access restriction in downtown?

70 %- very important –Media

20% - very important - Local Council

5% - very important - colleagues

5 % - very important- forums or internet

	un-important	Rather un-important	Rather important	Very important	I don't know	un-important
Local Council	☐1	☐2	☐3	☐4	☐5	☐6
Media	☐1	☐2	☐3	☐4	☐5	☐6
Colleagues/acquaintances	☐1	☐2	☐3	☐4	☐5	☐6
Forums or similar on the internet	☐1	☐2	☐3	☐4	☐5	☐6
Other, please specify below:	☐1	☐2	☐3	☐4	☐5	☐6

8. Do you understand the aim of the measure and its potential benefit?

fairly well understand	well understand	very well understand	Don't know
37%	20%	41%	2%

Acceptance level

9. What is your oppinion about access restriction in downtown to get a cleaner central area for recreational activities

Less good	good	Very good	Don't know
20%	20%	58%	2%

Measure title: Access restriction policies in Craiova

City: Craiova Project: MODERN Measure number: 03.02

10. Willingness to implement the measure:

Accept	Do not accept	Don't know
81%	17%	2%

11. Which is the first reason for that you want to implement the measure?

96 % - Willingness to have a cleaner central area

4% - Environment concerning

(For people that accept the implementation of the measure)

12. Have you ever filled questionnaires for the project -MODERN?

☐1	Yes
☐2	No 100%

Annex 2: Historical centre revitalization

MUNICIPIUL CRAIOVA
PRIMĂRIA MUNICIPIULUI CRAIOVA
Str. A.I. Cuza, Nr. 7 Tel.: 40251/416235
Craiova, 200585 Fax: 40251/411561
consiliulocal@primariacraiova.ro
www.primariacraiova.ro

PRIMARIA CRAIOVA
ISO 9001

DIRECȚIA ELABORARE SI IMPLEMENTARE PROIECTE
Serviciul Proiecte si Programe de Dezvoltare
Nr. 141863/28.09.2011

Agenția pentru Dezvoltare Regională Sud-Vest Oltenia
Nr. 14652
Ziua 30 Luna 09 Anul 2011
Semnătura.....

Catre,
Agentia de Dezvoltare Regionala Sud-Vest Oltenia

In atentia doamnei Director Marilena Bogheanu

Prin prezenta va inaintam Cererea de finantare pentru proiectul **„Amenajare si Revitalizare Centrul Istoric al Municipiului Craiova"** in vederea solicitarii finantarii nerambursabile in cadrul Programului Operational Regional, Axa prioritara 1- Sprijinirea dezvoltarii durabile a oraselor – Poli urbani de crestere, Domeniul de interventie 1.1 – Planuri integrate de dezvoltare urbana, Sub-domeniul –Poli de crestere.

Primar,
Ec. Antonie Solomon

PRIMAR Județul DOLJ

MUNICIPIUL CRAIOVA
PRIMARIA MUNICIPIULUI CRAIOVA
DIRECTIA ELABORARE SI IMPLEMENTARE PROIECTE
SERVICIUL PROIECTE PROGRAME DE DEZVOLTARE
Nr. 59691/31.05.2012

Către
SERVICIUL ACHIZITII PENTRU OBIECTIVE DE INTERES PUBLIC

Prin prezenta va transmitem alaturat documentatia necesara pentru contractarea serviciilor de lucrari in cadrul proiectului avind ca obiectiv **„Amenajare si revitalizare Centrul istoric al Municipiului Craiova"**:

- FP 31-01,v5, nr.32682/11.04.2012
- Fila Buget local
- Devizul general
- Graficul de achizitii aferent cererii de finantare
- Bugetul proiectului
- HCL nr.471/2010 pentru aprobarea cerere finantare
- HCL nr.346/2011 modificare HCL 471/2010 aprobare cerere finantare
- Autorizatia de construire nr. 1457/29.12.2011
- Documentatia tehnica: caiet de sarcini, Proiect tehnic nr. 12369/2010 elaborat de S.C. PROIECT S.A. :
  Volumul 1 - Memoriu general si memorii tehnice pe specialitati(piese scrise)
  Volumul 2 - Caiete de sarcini pe specialitati (piese scrise)
  Volumul 3 - Liste cantitati de lucrari (piese scrise)
  Volumul 4 - Programul de urmarire si control
  Volumul 5 - Organizare de santier
  Volumul 6 - Piese desenate arhitectura si curenti slabi
  Volumul 7 - Piese desenate rezistenta, instalatii, drumuri-strazi
- documentatia tehnica in format digital (DVD)

Din comisia de licitatie va face parte d-na Floarea Cojan si dl. Gabriel Margineanu.

Director executiv
Dorina Predus

Sef Serviciu
Cristiana Ghitalau

Intocmit
Insp. Laura Conu

SMP 12/01.06.2012

Programul Operațional Regional 2007-2013
Axa prioritară 1 - Sprijinirea dezvoltării durabile a orașelor - poli de creștere
Domeniul major de intervenție 1.1 - Planuri integrate de dezvoltare urbană
Sub-domeniul: *„ Poli de Creștere "*

CONTRACT DE FINANTARE

NR 3185

BENEFICIAR: UAT MUNICIPIUL CRAIOVA

AGENȚIA PENTRU DEZVOLTARE REGIONALA SUD-VEST OLTENIA 2

000001

Programul Operațional Regional 2007-2013
Axa prioritară 1 - Sprijinirea dezvoltării durabile a orașelor - poli de creștere
Domeniul major de intervenție 1.1 - Planuri integrate de dezvoltare urbană
Sub-domeniul: *„ Poli de Creștere "*

Cod SMIS 38624

CONTRACT DE FINANȚARE
prin Programul Operațional Regional 2007-2013
Axa prioritară 1 „Sprijinirea dezvoltării durabile a orașelor - poli urbani de creștere"
Domeniul major de intervenție 1.1 „Planuri integrate de dezvoltare urbană"
***Nr*[1]..... /.....**

Preambul

Părțile:

Ministerul Dezvoltării Regionale și Turismului, cu sediul în București, strada Apolodor nr.17, Latura Nord, sector 5, Tel. 037 211 14 09, fax. 037 211 15 13, cod de înregistrare fiscală 26369185, reprezentat legal de dl.Eduard Hellvig, având funcția de Ministru, **în calitate de Autoritate de Management pentru Programul Operațional Regional 2007-2013** , denumit în cele ce urmează ***AM POR***

prin Agenția pentru Dezvoltare Regională Sud-Vest Oltenia, cu sediul în Craiova, strada Aleea Teatrului nr.2A, judetul Dolj, cod postal 200402 Tel./ fax 040-251-411869/040-251-412780, cod de înregistrare fiscala 11642243, reprezentată legal de d-na Marilena Bogheanu, având funcția de Director, **în calitate de Organism Intermediar pentru Programul Operațional Regional 2007-2013,** denumită în cele ce urmează ***OI***, care semnează în numele și pentru Ministerul Dezvoltării Regionale și Turismului, pe de o parte

și

Unitatea Administrativ-Teritorială Municipiul Craiova, având sediul în str. A.I.Cuza, nr.7, localitatea Craiova, judetul Dolj, cod poștal 200585, România, cod de înregistrare fiscală 4417214, reprezentată legal de dl. Antonie Solomon, având funcția de Primar, identificat prin C.I seria DX nr. 673000, CNP 1551118163221.

în calitate de **Beneficiar,** pe de altă parte,

au convenit încheierea prezentului ***Contract de finanțare*** în următoarele condiții:

AGENȚIA PENTRU DEZVOLTARE REGIONALĂ SUD-VEST OLTENIA 2

Interpretare

(1) În prezentul contract, cu excepția cazului când contextul cere altfel sau a unei prevederi contrare:
   a. Cuvintele care indică singularul includ și pluralul, iar cuvintele care indică pluralul includ și singularul;
   b. Cuvintele care indică un gen includ toate genurile;

[1] Numărul contractului de finanțare

000002

Programul Operaţional Regional 2007-2013
Axa prioritară 1 - Sprijinirea dezvoltării durabile a oraşelor - poli de creştere
Domeniul major de intervenţie 1.1 - Planuri integrate de dezvoltare urbană
Sub-domeniul: *„ Poli de Creştere "*

c. Cuvintele care indică persoane vor include persoane fizice şi/sau juridice, după caz.

(2) Referinţele la orice acte normative se consideră a face referire şi la orice acte normative subsecvente prin care acestea sunt modificate.

ARTICOLUL 1 - OBIECTUL CONTRACTULUI

(1) Obiectul acestui Contract îl reprezintă acordarea finanţării nerambursabile de către AM POR, pentru implementarea Proiectului nr.SV/1/1.1/PC/8/30.09.2011 cod SMIS 38624 intitulat: „AMENAJARE SI REVITALIZARE CENTRUL ISTORIC AL MUNICIPIULUI CRAIOVA", denumit în continuare Proiect.

(2) Beneficiarului i se va acorda finanţarea nerambursabilă în termenii şi condiţiile stabilite prin acordul de voinţă al părţilor, care este constituit din prezentul Contract de finanţare şi anexele acestuia, pe care Beneficiarul declară că le cunoaşte şi le acceptă.

(3) Cererea de finanţare depusă de Beneficiar, rezultată în urma verificărilor, modificărilor şi completărilor efectuate pe parcursul procesului de evaluare şi selecţie, devine anexă la prezentul Contract, făcând parte integrantă din acesta.

(4) Beneficiarul acceptă finanţarea nerambursabilă şi se angajează să implementeze Proiectul pe propria răspundere, în conformitate cu prevederile cuprinse în prezentul Contract şi cu legislaţia naţională şi comunitară în vigoare.

ARTICOLUL 2 - DURATA CONTRACTULUI ŞI PERIOADA DE IMPLEMENTARE A PROIECTULUI

(1) Contractul intră în vigoare la data semnării lui de către ultima parte.

(2) Contractul îşi păstrează valabilitatea 5 ani după expirarea perioadei de implementare a Proiectului aşa cum este stabilită conform prevederilor prezentului articol.

(3) Data începerii implementării Proiectului este ziua următoare intrării în vigoare a prezentului Contract.

(4) Perioada de implementare a Proiectului este de 25 luni.

ARTICOLUL 3 - VALOAREA PROIECTULUI

Valoarea totală a Proiectului este de 76.079.005,88 lei/saptezecisisasemilioanesaptezecisinouamiicincileisioptzecisioptbani din care:

- valoarea totală eligibilă este de 61.480.625,00 lei (finanţare nerambursabilă şi contribuţia Beneficiarului)
- valoare neeligibilă estimată inclusiv TVA aferentă acesteia, este de 0,00 lei
- valoarea TVA aferentă cheltuielilor eligibile este de 14.598.380,88 lei.

după cum urmează:

Valoarea totală a proiectului	Valoarea totală eligibilă a Proiectului, din care:	Valoarea eligibilă nerambursabilă din FEDR		Valoarea eligibilă nerambursabilă din bugetul naţional		Co-finanţarea eligibilă a Beneficiarului		Valoarea TVA aferente cheltuielilor eligibile	Valoarea ne-eligibilă inclusiv TVA aferentă acesteia
(lei)	(lei)	(lei)	(%)	(lei)	(%)	(lei)	(%)	(lei)	(lei)
1 = 2 + 9+10	2 = 3 + 5+7	3	4	5	6	7	8	9	10
76.079.005,88	61.480.625,00	49.399.682,19	80,35	10.851.330,31	17,65	1.229.612,50	2	14.598.380,88	0,00

000003

Annex 3: Overpass

Programul Operațional Regional 2007-2013
Axa prioritară 1 - Sprijinirea dezvoltării durabile a orașelor - poli de creștere
Domeniul major de intervenție 1.1 - Planuri integrate de dezvoltare urbană
Sub-domeniul: *„Poli de Creștere"*

CONTRACT DE FINANTARE

NR 1072

BENEFICIAR: UAT MUNICIPIUL CRAIOVA

AGENȚIA PENTRU DEZVOLTARE REGIONALĂ SUD-VEST OLTENIA 2

MINISTERUL DEZVOLTĂRII REGIONALE ȘI TURISMULUI 6 ROMÂNIA

000001

Programul Operațional Regional 2007-2013
Axa prioritară 1 - Sprijinirea dezvoltării durabile a orașelor - poli de creștere
Domeniul major de intervenție 1.1 - Planuri integrate de dezvoltare urbană
Sub-domeniul: *„Poli de Creștere "*

Cod SMIS 24753

CONTRACT DE FINANȚARE
prin Programul Operațional Regional 2007-2013
Axa prioritară 1 „Sprijinirea dezvoltării durabile a orașelor – poli urbani de creștere"
Domeniul major de intervenție 1.1 „Planuri integrate de dezvoltare urbană"
***Nr*[1]..... /.....**

Preambul

Părțile:

Ministerul Dezvoltării Regionale și Turismului, cu sediul în București, strada Apolodor nr.17, Latura Nord, sector 5, Tel. 037 211 14 09, fax. 037 211 15 13, cod de înregistrare fiscală 26369185, reprezentat legal de Elena Gabriela UDREA , având funcția de Ministru, **în calitate de Autoritate de Management pentru Programul Operațional Regional 2007-2013 ,** denumit în cele ce urmează ***AM POR***

prin

Agenția pentru Dezvoltare Regională Sud-Vest Oltenia, cu sediul în Craiova, str. Unirii, nr. 19, camera 86, Tel. 0040 251 411 869/ fax 0040 251 412 780, cod de înregistrare fiscală 11642243, reprezentată legal de doamna **Marilena Bogheanu**, având funcția de **Director**, **în calitate de Organism Intermediar pentru Programul Operațional Regional 2007-2013,** denumită în cele ce urmează ***OI***, care semnează în numele și pentru Ministerul Dezvoltării Regionale și Turismului, pe de o parte

și

Unitatea administrativ-teritorială Municipiul Craiova având sediul în str. A.I. Cuza, nr. 7, Craiova, județul Dolj, cod poștal 200585 România, cod de înregistrare fiscală 4417214, reprezentată legal de dl Dinca Marinica având funcția de viceprimar, identificat prin C.I seria DX nr. 405002, CNP 1760804280791

în calitate de **Beneficiar,** pe de altă parte,

000002

[1] Numărul contractului de finanțare

Programul Operaţional Regional 2007-2013
Axa prioritară 1 - Sprijinirea dezvoltării durabile a oraşelor - poli de creştere
Domeniul major de intervenţie 1.1 - Planuri integrate de dezvoltare urbană
Sub-domeniul: *„Poli de Creştere"*

au convenit încheierea prezentului ***Contract de finanţare*** în următoarele condiţii:

Interpretare

(1) În prezentul contract, cu excepţia cazului când contextul cere altfel sau a unei prevederi contrare:
   a. Cuvintele care indică singularul includ şi pluralul, iar cuvintele care indică pluralul includ şi singularul;
   b. Cuvintele care indică un gen includ toate genurile;
   c. Cuvintele care indică persoane vor include persoane fizice şi/sau juridice, după caz.

(2) Referinţele la orice acte normative se consideră a face referire şi la orice acte normative subsecvente prin care acestea sunt modificate.

ARTICOLUL 1 – OBIECTUL CONTRACTULUI

(1) Obiectul acestui Contract îl reprezintă acordarea finanţării nerambursabile de către AM POR, pentru implementarea Proiectului nr. SV/1/1.1/PC/1/30.07.2010, SMIS 24753 intitulat: *„CONSTRUIREA UNUI PASAJ SUPRATERAN IN VEDEREA DESCONGESTIONARII TRAFICULUI RUTIER DIN ZONA METROPOLITANA CRAIOVA – REALIZARE PASAJ DENIVELAT SUPRATERAN PESTE INTERSECTIA DE LA KM 0 AL MUNICIPIULUI CRAIOVA IN VEDEREA PRELUARII TRAFICULUI AUTO PE E70, RESPECTIV STR. CALEA BUCURESTI – BVD. NICOLAE TITULESCU"* denumit în continuare Proiect.

(2) Beneficiarului i se va acorda finanţarea nerambursabilă în termenii şi condiţiile stabilite prin acordul de voinţă al părţilor, care este constituit din prezentul Contract de finanţare şi anexele acestuia, pe care Beneficiarul declară că le cunoaşte şi le acceptă.

(3) Cererea de finanţare depusă de Beneficiar, rezultată în urma verificărilor, modificărilor şi completărilor efectuate pe parcursul procesului de evaluare şi selecţie, devine anexă la prezentul Contract, făcând parte integrantă din acesta.

(4) Beneficiarul acceptă finanţarea nerambursabilă şi se angajează să implementeze Proiectul pe propria răspundere, în conformitate cu prevederile cuprinse în prezentul Contract şi cu legislaţia naţională şi comunitară în vigoare.

ARTICOLUL 2 – DURATA CONTRACTULUI ŞI PERIOADA DE IMPLEMENTARE A PROIECTULUI

(1) Contractul intră în vigoare la data semnării lui de către ultima parte.

(2) Contractul îşi păstrează valabilitatea 5 ani după expirarea perioadei de implementare a Proiectului aşa cum este stabilită conform prevederilor prezentului articol.

(3) Data începerii implementării Proiectului este ziua următoare intrării în vigoare a prezentului Contract.

(4) Perioada de implementare a Proiectului este de **28** luni.

000003

Annex 4: Underpass

Programul Operațional Regional 2007-2013
Axa prioritară 1 - Sprijinirea dezvoltării durabile a orașelor - poli de creștere
Domeniul major de intervenție 1.1 - Planuri integrate de dezvoltare urbană
Sub-domeniul: *„Poli de Creștere"*

CONTRACT DE FINANTARE
(model cadru)

NR 1964 / 09.09.2011

BENEFICIAR: UAT MUNICIPIUL CRAIOVA

000001

AGENȚIA PENTRU DEZVOLTARE REGIONALĂ SUD-VEST OLTENIA 2

Programul Operațional Regional 2007-2013
Axa prioritară 1 - Sprijinirea dezvoltării durabile a orașelor - poli de creștere
Domeniul major de intervenție 1.1 - Planuri integrate de dezvoltare urbană
Sub-domeniul: *„Poli de Creștere"*

Cod SMIS 32692

CONTRACT DE FINANȚARE
prin Programul Operațional Regional 2007-2013
Axa prioritară 1 „Sprijinirea dezvoltării durabile a orașelor - poli urbani de creștere"
Domeniul major de intervenție 1.1 „Planuri integrate de dezvoltare urbană"

Nr[1] 1964 / 09.09.2011

Preambul

Părțile:

Ministerul Dezvoltării Regionale și Turismului, cu sediul în București, strada Apolodor nr.17, Latura Nord, sector 5, Tel. 037 211 14 09, fax. 037 211 15 13, cod de înregistrare fiscală 26369185, reprezentat legal de **Elena Gabriela UDREA** , având funcția de **Ministru, în calitate de Autoritate de Management pentru Programul Operațional Regional 2007-2013** , denumit în cele ce urmează ***AM POR***

prin

Agenția pentru Dezvoltare Regională Sud Vest Oltenia, cu sediul în Craiova, jud.Dolj, strada Aleea Teatrului, nr.2A, Tel./ fax 0251.412.780, cod de înregistrare fiscală 11642243, reprezentată legal de dna. **Marilena BOGHEANU**, având funcția de **Director, în calitate de Organism Intermediar pentru Programul Operațional Regional 2007-2013,** denumită în cele ce urmează ***OI***, care semnează în numele și pentru Ministerul Dezvoltării Regionale și Turismului, pe de o parte

și

Unitatea administrativ-teritorială Municipiul Craiova, având sediul în str.A.I.Cuza, nr.7, Craiova, judetul Dolj, România, cod de înregistrare fiscală 4417214, reprezentată legal de dl. **Antonie SOLOMON**, având funcția de **Primar**, identificat prin C.I seria DX nr.673000, CNP 1551118163221

în calitate de **Beneficiar**, pe de altă parte,

au convenit încheierea prezentului ***Contract de finanțare*** în următoarele condiții:

Interpretare

[1] Numărul contractului de finanțare

000002

(1) În prezentul contract, cu excepţia cazului când contextul cere altfel sau a unei prevederi contrare:
   a. Cuvintele care indică singularul includ şi pluralul, iar cuvintele care indică pluralul includ şi singularul;
   b. Cuvintele care indică un gen includ toate genurile;
   c. Cuvintele care indică persoane vor include persoane fizice şi/sau juridice, după caz.

(2) Referinţele la orice acte normative se consideră a face referire şi la orice acte normative subsecvente prin care acestea sunt modificate.

ARTICOLUL 1 - OBIECTUL CONTRACTULUI

(1) Obiectul acestui Contract îl reprezintă acordarea finanţării nerambursabile de către AM POR, pentru implementarea Proiectului nr. **SV/1/1.1/PC/4/24.12.2010,COD SMIS: 32692.** intitulat: **„Construirea unui pasaj subteran in vederea descongestionarii traficului rutier din Zona Metropolitana Craiova - realizare pasaj denivelat subteran pe sub intersectia strazii Aries cu strada A.I.Cuza si respectiv cu strada Imparatul Traian in vederea preluarii traficului auto pe Bvd Carol, str.Aries"**, denumit în continuare Proiect.

(2) Beneficiarului i se va acorda finanţarea nerambursabilă în termenii şi condiţiile stabilite prin acordul de voinţă al părţilor, care este constituit din prezentul Contract de finanţare şi anexele acestuia, pe care Beneficiarul declară că le cunoaşte şi le acceptă.

(3) Cererea de finanţare depusă de Beneficiar, rezultată în urma verificărilor, modificărilor şi completărilor efectuate pe parcursul procesului de evaluare şi selecţie, devine anexă la prezentul Contract, făcând parte integrantă din acesta.

(4) Beneficiarul acceptă finanţarea nerambursabilă şi se angajează să implementeze Proiectul pe propria răspundere, în conformitate cu prevederile cuprinse în prezentul Contract şi cu legislaţia naţională şi comunitară în vigoare.

ARTICOLUL 2 - DURATA CONTRACTULUI ŞI PERIOADA DE IMPLEMENTARE A PROIECTULUI

(1) Contractul intră în vigoare la data semnării lui de către ultima parte.

(2) Contractul îşi păstrează valabilitatea 5 ani după expirarea perioadei de implementare a Proiectului aşa cum este stabilită conform prevederilor prezentului articol.

(3) Data începerii implementării Proiectului este ziua următoare intrării în vigoare a prezentului Contract.

(4) Perioada de implementare a Proiectului este de **28** luni.

ARTICOLUL 3 - VALOAREA PROIECTULUI

Valoarea totală a Proiectului este de **66.051.309,71/** saizecisisasemilioanecincizecisiunumiitreisutenoualeisisaptezecisiunubani din care:

- valoarea totală eligibilă este de **53.737.235,71** lei (finanţare nerambursabilă şi contribuţia Beneficiarului)
- valoare neeligibilă estimată inclusiv TVA aferentă acesteia, este de **278.939,24** lei
- valoarea TVA aferentă cheltuielilor eligibile este de **12.035.134,76** lei.

AGENŢIA PENTRU DEZVOLTARE REGIONALĂ SUD-VEST OLTENIA 2

000003

Annex 5: underground parking application

MUNICIPIUL CRAIOVA
PRIMĂRIA MUNICIPIULUI CRAIOVA
Str. A.I. Cuza, Nr. 7 Tel.: 40251/416235
Craiova, 200585 Fax: 40251/411561
consiliulocal@primariacraiova.ro
www.primariacraiova.ro

PRIMARIA CRAIOVA
ISO 9001

DIRECȚIA ELABORARE SI IMPLEMENTARE PROIECTE
Serviciul Proiecte si Programe de Dezvoltare
Nr. 17398 / 07.02.2012

Agenția pentru Dezvoltare Regională Sud-Vest Oltenia
Nr. 2259
Ziua 08 Luna 02 Anul 2012
Semnătura

Catre,
Agentia de Dezvoltare Regionala Sud-Vest Oltenia

In atentia doamnei Director Marilena Bogheanu

Prin prezenta va inaintam Cererea de finantare pentru proiectul **„Amenajare Parcare Subterana in Zona Teatrului National"** in vederea solicitarii finantarii nerambursabile in cadrul Programului Operational Regional, Axa prioritara 1- Sprijinirea dezvoltarii durabile a oraselor – Poli urbani de crestere, Domeniul de interventie 1.1 – Planuri integrate de dezvoltare urbana, Sub-domeniul –Poli de crestere.

Primar,
Ec. Antonie Solomon

UNIUNEA EUROPEANĂ GUVERNUL ROMÂNIEI

Anexa III/OI/1.A.2

CONFIRMARE DE PRIMIRE A CERERII DE FINANTARE[1]

Numele si adresa solicitantului:
UAT Craiova

Titlul proiectului: Amenajare parcare subterana
în zona Teatrului Național

Nr. unic de inregistrare al cererii de finantare in Registrul special al cererilor de finantare: SU/1/1.1 RO/ 15 / 08.02.2012

Cererea de finantare a fost inregistrata in data: 08.02.2012

Axa prioritara: 1

Domeniul major de interventie: 1.1

Veti fi notificat asupra numarului de inregistrare a cererii de finantare in SMIS, precum si asupra persoanei de contact din cadrul Organismului Intermediar, responsabila cu urmarirea cererii de finantare in procesul de evaluare si selectie.

Nume, prenume reprezentant OI ADR SVO Albu Cristian

Semnatura

Nume, prenume reprezentant solicitant de finantare

Semnătura

[1] Se va semna in doua exemplare originale, unul ramane la sediul OI, celalalt exemplar este inmânat reprezentantului de finantare

UMBRIA, 13 CAM. 25, 87, 49, 200585 CRAIOVA
WWW.SDROLTEMA.RO
TELEFAX: 0040.251.411.888; 0040.251.412.780
OFFICE@ADROLTEMA.RO

M04.08 – Executive summary

The purpose of this measure is to implement software tools for mobility management actions in industrial areas in order to increase the use of dedicated PT service for their daily home to work journeys. By implementing the measure, RAT provides an additional service to the industrial area companies of Craiova, based on analysis of each company needs.

At the beginning of this measure RAT, the PT Company from Craiova provided transportation service to 8 companies on a contractual basis. Around 2000 passengers were daily transported, depending on the companies working program.

The measure provided two actions:

- The design and the implementation of a new software tool, in order to increase this service;
- GPS GPRS implementation on buses operating in industrial area to facilitate the PT service deployment.

A dedicated software application has been developed and uploaded on RAT website in order to manage the commuter's transportation in the industrial area. The management actions are based on interactive web application designed to provide a set of functions to help the industrial customer to define the route according to the employees' residence, route length, and transportation costs. The web application can be used by every interested company

The operation period showed that the number of companies that used the service increased by 50% and the perception on quality of service improved by 8 %. The implementation of the measure led to 12 contracts concluded between companies from industrial area and RAT, in the operation period of the measure.

The key results are as follows:

- The revenues slightly increased by 0,6% after the measure implementation
- The number of commuters slightly increased by 0,26 %. FORD AUTO and other 2 companies which are FORD's partners are the only ones that have increased the number of employees. Some companies, even renewed the contract with RAT for employees transportation, they have dramatically reduced the number of employees because of decreased activity
- In the operation period, 12 contracts have been concluded with PT Company for commuters transportation, thus, the number of contracts increased by 50% compared with ex-ante situation
- Quality of service- improved by 8%.

The new system implemented in Craiova offered us new lessons learnt:

- Better marketing approach by diversification of transportation mode. Instead of long term contract, RAT Craiova accepted daily requests or transportation on demand.
- Orientation towards smaller and medium sized companies involving a number of buses almost equal to that for a single large company.
- Associated services offer for more companies (with less employees) working on the same industrial platform and having the same working-program.

Considering the measure results and the advantages offered by the system (special the software tool developed and on board equipment for GPS / GPRS tracking) it is important to mention that RAT intent to extend this service to all business partner companies using of course the entire dedicated fleet

for companies employees transport service. This will be gradually extended according to the own financial resources.

Results, however, are clearly dependent on the economic activity and justifying the benefits to the potential customers through appropriate dissemination.

In this regard, all potential client companies can access the special software for routes configuration by using RAT or Municipality website.

A Introduction

A1 Objectives

The measure objectives are:

A. High level / longer term:

- To encourage companys from the industrial area and their employees to use dedicated PT services.

B. Strategic level:

- To optimise the routes according to the costs and commuters(employees)collecting stations.

C. Measure level:

- To increase the number of users (employees using the buses for this type of transportation) at least 10%.

A 2 Description

The purpose of the measure is to develop a software tools for a better management of the PT service dedicated to companies operating in the industrial area in order to increase t quality and the number of passengers of PT service.

The system is based upon:

- The design and the implementation of a new software tool, in order to increase this service;
- GPS GPRS implementation on buses operating in industrial area to facilitate the PT service deployment..

The idea was to synchronize the regular bus schedule with the above services; this , means that buses would start their route by shuttling the employees from the city (5 stops) to the factories, continue the usual bus schedule throughout the day and conclude with picking-up the same employees and taking them back to their home in the city.

The route optimization would be based on contract specifications with the individual companies (optimizing travel time and use of bus capacity). The software tools provides an extended service for large companies from Craiova, based on analysis of companies needs.

Measure implied accomplishing of two actions:

1. 10 buses used for employees' transportation in the industrial area were equipped with GPS / GPRS system devices and of on-board computers connected to general dispatcher of RAT. The

buses operate both in urban and industrial area. In industrial area, the buses operate on a contractual basis periodically have renewed periodically

2. A dedicated software program, called "digital maps software" (Fig A2-1) was implemented to RAT. By the aid of this software program, the RAT customers have the possibility to define a route according to the employees' residence, route length, and transportation costs.

The "digital maps software", also allow a better management of the transportation service in industrial area. The software application offers the following functions:

- The digital map allows the visualization of the passengers' picking points and the road links between them, offering the possibility of visual representation of one or more passengers' transport routes.
- The possibility to select from a drop-down list the type of buses for transportation (producer, manufacture year, loading capacity).
- The possibility to select from a drop-down list the journey days in a week (Monday, Thursday....)

This software was designed to help the user to optimize the route for special transport depending on the logistic requirements and transport costs.

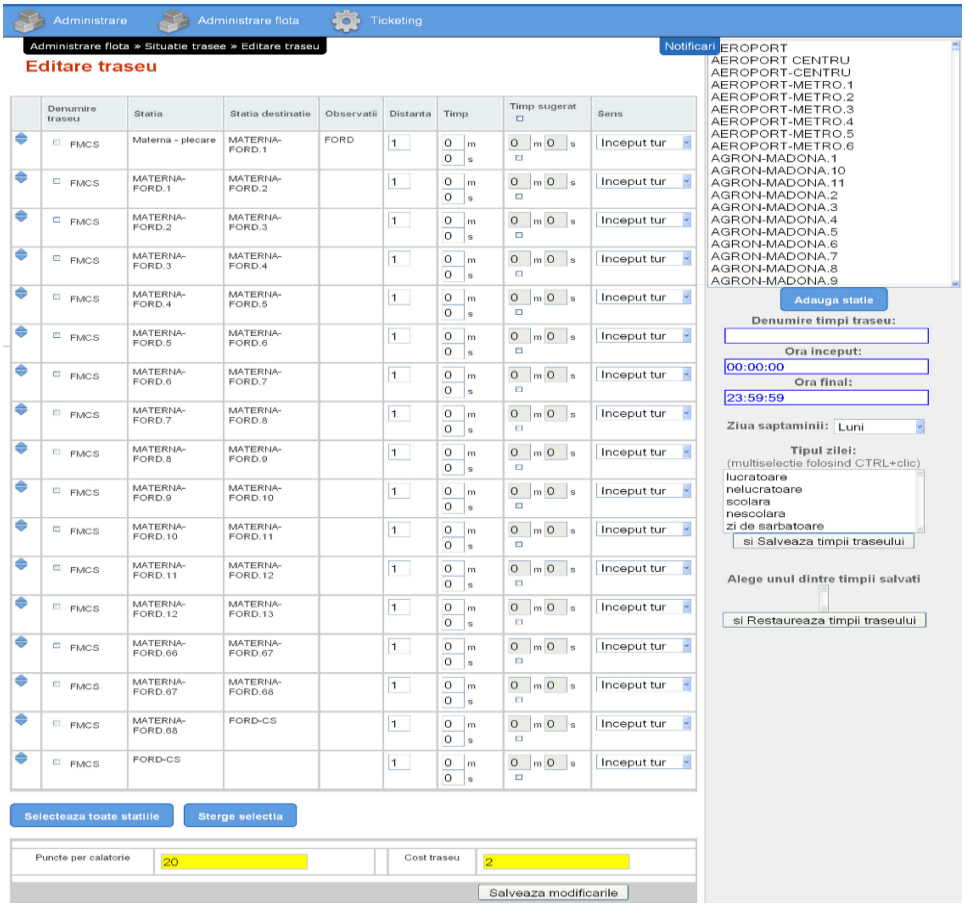


Fig. A2.1 – Screenshot of the software

The “digital map software” is posted on RAT website and it can be used by the any interested company.

B Measure implementation

B1 Innovative aspects

The innovative aspects of the measure are:

- **Use of new technology/ITS** – The mobility management tools involve new technology for data acquisition, communication and vehicles tracking. The "digital maps software" for public transport is for first time used in Craiova.
- **Targeting specific user groups-** The measure targets to a specific PT users- employees from the big companies from the industrial areas of the city.

Hence the most innovative aspect of the measure is the developed software that put potential Customer companies to design its own service, to evaluate relevant costs, to arrange the routs to the most convenient and effective employees transport.

B2 Research and Technology Development

Several documents and studies have been analyzed (traffic and passengers flow study, the existing contracts between RAT and different industrial companies) to assess the current state and to develop a mobility management for this kind of service which allow flexibility in configuring specific routes depending on the needs of companies.

As a result of the planning and design of the measure the best solution to optimize the transportation in industrial areas was to use a mix of digital maps and GPS software solution.

Figure B2.1

The digital maps system for the transportation in industrial area has been designed so as to provide the following functions:

1. Routs configuration; depending on the collection points and on the working program each company defines its rout. The system is able to purpose to the user a first optimization based on distance between the picking poits and the costs.. New routes could be connected with other routes on some sections, so trying to reduce the transport costs for companies.
2. Route optimization; if on the considered section the traffic conditions are difficult and could produce delays. For special transportation services, the most important requirement is to respect the route time schedule defined on the contract. Within the first phase the design of the measure has been completed by the definition of the Software specification. So the digital map software allowed the visualization of the bus stops and the road links among them, so allowing a visual representation of one or more passengers' transport routes.

Depending on visual representations of the paths, changes should be made on the routes and passenger stops (eliminate, add or modify); in the same way, the current route can be modified in order to optimize the company's employee's transportation.

B3 Situation before CIVITAS

Before CIVITAS measure, the commuters transportation was made on contractual basis using the standard routs set by RAT; no customization was allowed neither the issuing of new bus stops.

Following the request of several industrial companies RAT decided to improve this kind of services in order to increase the quality and to attract more customers.

B4 Actual implementation of the measure

The measure was implemented in the following stages:

Stage 1: Planning and design of the measure (Sept 2009-Mar 2010)

A design work carried out mainly for this measure, led to the conclusion that the measure must be connected with the 08.02 one – Info mobility tools for fleet management in Craiova.

The so called "dispatch center" (central monitoring station) to be developed under the measure 08.02 will be the same for both the measures. To complete the design of the measure several documents and studies were analyzed (traffic and passengers flow study, the existing contracts between RAT and different industrial companies, the technical specification for GPS/GPRS system to be implemented in Craiova through measure 08.02). t The status of traffic flows and the current state of delays occurring within PT operations was deeply analyzed in order to designa services able to respect the needed time scheduling.

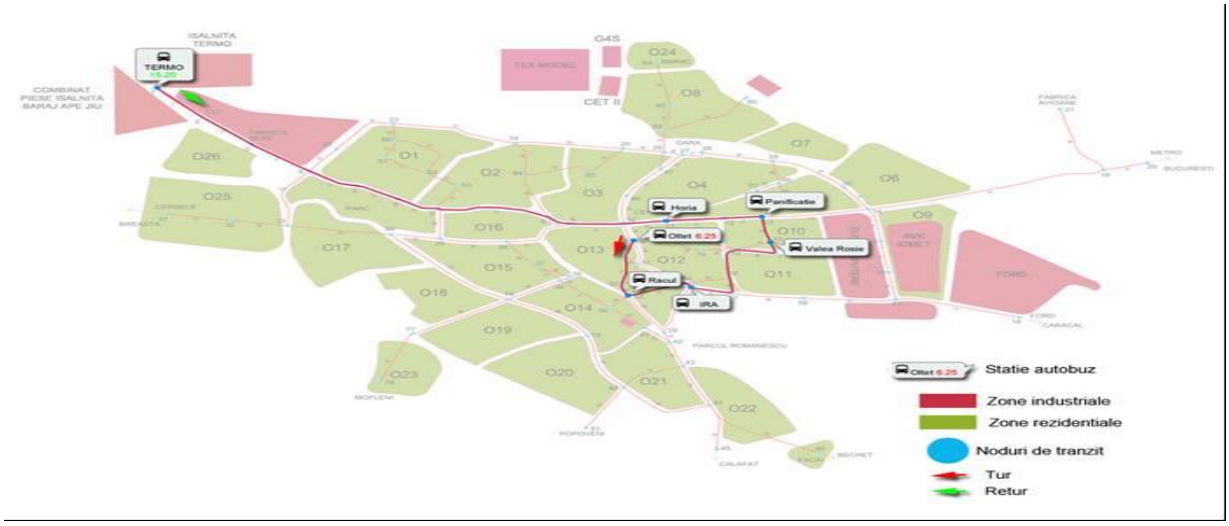


Fig. B4.1 – Digital map – example of route configuring for industrial area transportation

Stage 2: City plans and routes (March 2010-Sept 2010)

At the beginning a digital map of the industrial areas and relevant bus stop points, to pick up the employees, in the city was acquired and specifically developed.

All the contracts signed by RAT with companies in industrial zones were analyzed and tall the relevant data: routes, collecting points, departures points and destination were reported.

Digital maps were installed within the central control and dispatch center and functional tests have been performed.

Stage 3: Software design for digital maps; Implementation of digital maps and software design (Sept 2010-April 2012)

In this stage, the software program was developed.

The digital maps were uploaded on RAT Craiova website from the central control and dispatching system and will be integrated with the GPS/GPRS system developed in the measure 08.02 within the MODERN project.

The application allowed the RAT company management staffs the following operations:

- management tool for special transport routes (for industrial area) that are used for special transport of workers between industrial and residential areas;
- system for route planning and optimization;
- management of the transport system for employees between industrial and residential areas in accordance with contracts agreed between RAT Craiova and companies that activate in those areas.

Stage 4: System operation (May -2012- Oct 2012)

This is a description of how the system works:

- A potential customer may access the digital map (on the RAT's and Municipality's websites) and can select: route, stations, departures points and destination so defining a route according to is specific need.
- After the configuration, it is possible to choice time schedule, bus transport capacity and type:
- Following the choice made above the costs are automatically calculated.
- If the potential customer is satisfied it is possible to submit the SW results to RAT in order to define contract agreement.

The picture B4.1 shows an example of one route configured according to the stations needed.

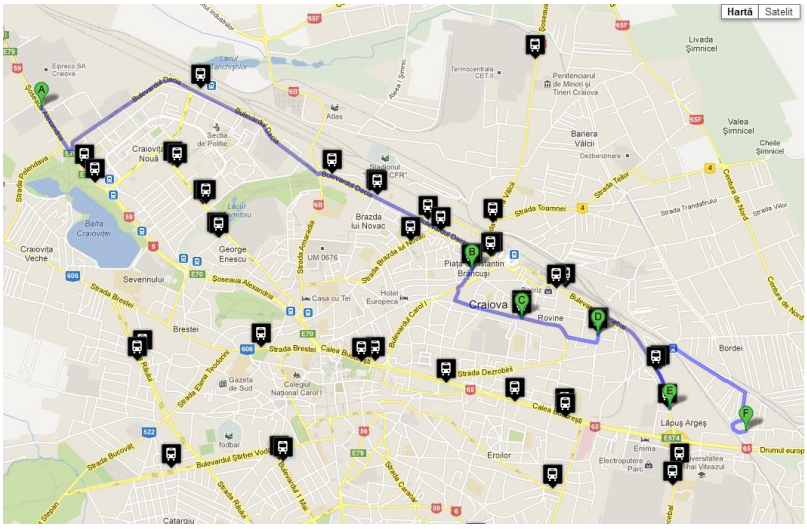


Figure B 4.1 – Example of configuration

The system processes the information provided by customers and calculates the routes and driving directions according to their needs. The software gives the possibility to save driving directions in a custom panel to make possible the return to previous route or share them with others. In the picture B 4.2, the button **"Salvati Traseul"("Save the rout")** means save the route.

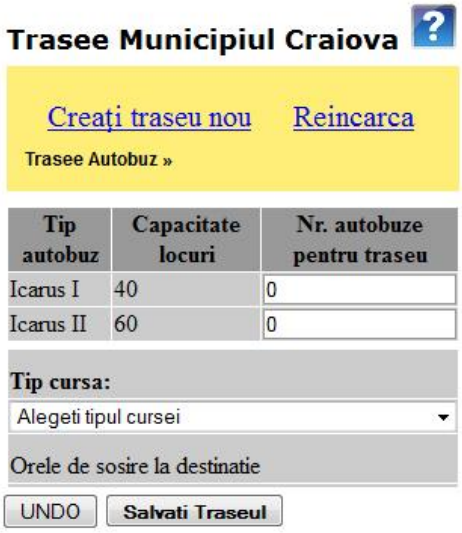


Figure B 4.2 – Software screenshot

The text inside the picture is translated in the following table:

Text in Romanian	**Text in English**
Trasee Municipiul Craiova	Craiova city routes
Creati traseu nou	Create new route
Reincarca	Refresh
Trasee Autobuz	Bus routes
Tip autobuz	Bus type
Capacitate locuri	Capacity
Nr. Autobuze pentru traseu	Number of buses for route
Tip cursa	Type of route
Alegeti tipul cursei	Select type of route
Orele de sosire la destinatie	Hours of arrival at destination
Salvati Traseul	Save route

The digital map system can estimate the fuel cost for each selected route. The fuel cost for the selected route is displayed in the custom panel. Clicking on the route opens up options to specify bus type, time of arrival at destination, route length. The estimated cost per route are automatically calculated and displayed depending on the input values. The table B 4.3 shows a cost estimation for a 9.9 Km length route.

Nr. traseu	Statiile (in ordinea parcurgerii)	Tip autobuz (nr. autobuze)	Tip cursa	Ore sosire la destinatie	Lungimea traseului	Estimare cost
1	St19, St81, St8, 44.31298000000001, 23.84362	Icarus I(1)	tur - retur (gol)	13:30	9.90 Km	40 RON

Figure B 4.3 – example of cost estimation for 9.9 km distance

The text inside the picture is translated in the following table:

Text in Romanian	Text in English
Nr. traseu	No. route
Statiile (in ordinea parcurgerii)	Stations (movement direction)
Tip autobus (nr. autobuze)	Type bus (Bus No.)
Tip cursa	Type of route
Ore de sosire la destinatie	Hours of arrival at destination
Lungimea traseului	Length of the route
Estimare cost	The estimated cost

The digital map system allows the customer to add more stops or vary the direction along the route, to take more commuters. Once the customer agrees with the information provided by the digital map system, the contact with RAT top management could be done via website (Fig. B 4.4)

Figure B 4.4

The text inside the picture is translated in the following table:

Text in Romanian	Text in English
Creati traseu nou	Create new route
Reincarca	Refresh
Trasee Autobuz	Bus routes

Nume companie	company name
Pesoana de contact	Contact person
Email	Email
Telefon	Phone
Comentarii	Comments
Vizualizare rezultate	View results
Trimite traseele selectate la RAT	Send selected routes to RAT

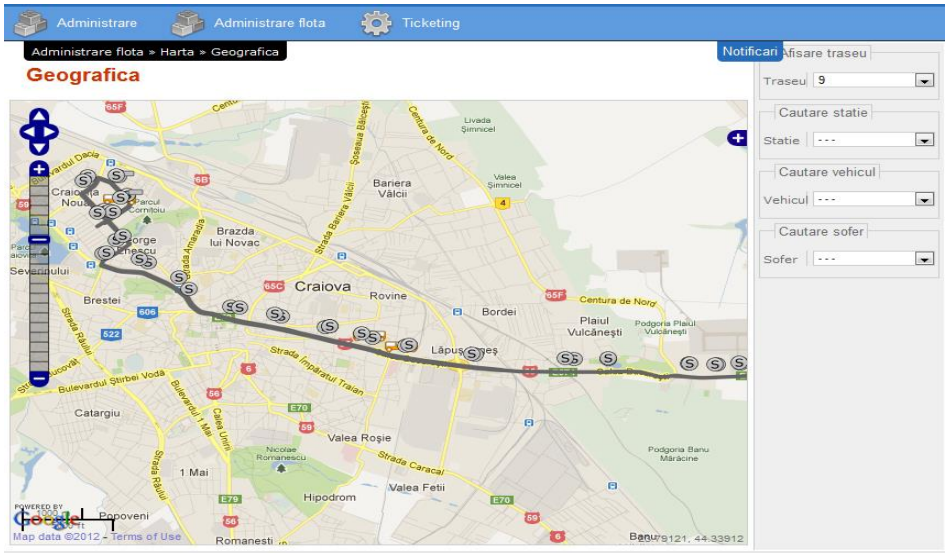


Figure B4.5 – example of a route configured by a customer

The text inside the picture B4.5 is translated in the following table:

Text in Romanian	**Text in English**
Administrare flota-Harta-Geografica	Fleet-management-Geographic map
Notificari	Notifications
Afisare traseu	Show route
Traseu	Route
Cautare statie	Search station
Statie	Station
Cautare vehicul	Vehicle Search
Vehicul	Vehicle
Cautare sofer	Drivers Search
Sofer	Driver

The route is monitored by GPS/GPRS system and the drivers have the possibility to see the passenger's stations on the on board computer screen. Also, it is the possibility that the driver can receive messages if he is in delay or in advance according to the scheduled route

B5 Inter-relationships with other measures

The measure is related to other measures as follows:

- **M08.02 – Infomobility tools for fleet management in Craiova -** From functional view point, the GPS/GPSR – Operation Support System allows the monitoring of the 10 buses providing transportation services for commuters in industrial area

C Impact Evaluation Findings

C1 Measurement methodology

C1.1 Impacts and Indicators

Table C1.1: Indicators.

No.	Impact	Indicator	Data used	Comments
1	Economy	Revenues	Euros/vKm	The revenues coming by passengers (namely season tickets) and payment per Kms
19	Transport	Quality of service	%	Face to face survey
Local indicator		Average number of commuters	No	RAT records referring to number of commuters using the service
Local indicator		Number of companies that use the service	No	RAT records referring to number of companies using the service

Detailed description of the indicator methodologies:

- **Indicator 1 Revenues** - Total income generated from season tickets and payment per Kms for a given period.

- **Indicator 19 (Quality of Service) -** Survey based on perception of the quality of service.

The survey has been done to see the impact of the measure on the commuters that use buses to get to work in the industrial area.

The questionnaires were structured in 2 sections:

1. General information about commuters (age, gender)
2. Question referring to the measure:

    - How do you evaluate the quality of service provided by RAT related to your transportation to work?

- **Local indicator (Average number of commuters) -** RAT provided the monthly number of season tickets that means number of commuters using the service in industrial area.
- **Local indicator (Number of companies that use the service)-** RAT provided the number of companies using the service developed by the measure.

C1.2 Establishing a Baseline

The base line is 2011, when the transportation of the commuters in industrial areas was based on agreements with industrial companies employing these commuters. Routes and stops were set by RAT without any possibility of several analyses and selection of the optimal solutions.

Revenues

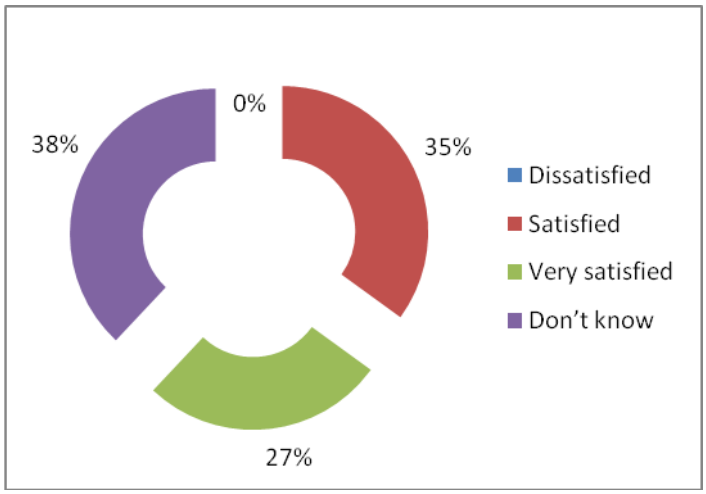
RAT provided all the data related to total revenues buses involved in the measure, in the period May-October 2011. This period of time was considered as reference to make a comparison between the same periods after the implementation of the measure.

Raw data	**May-October 2011 Ex-Ante values**
Total revenues coming from the buses traveling in industrial area	231'810 €

Quality of service

Starting to the number of commuters of 2301 that used the service in September 2011, 200 questionnaires were circulated (see annex 1- sample size calculation).

Questionnaire content	**September 2011 Ex-ante values**
Age	Between (18-40) age 33% Between (40-65) age 67%
Gender	Male 74% Female 26%
How do you evaluate the quality of service provided by RAT related to transportation to work	
Dissatisfied	0%
Satisfied	35%
Very satisfied	27%
Don't know	38%



Average number of commuters

RAT provided the monthly number of sold season tickets that means the number of commuters using the service between May 2011 – October 2011.

The data are related to the buses operating in industrial area.

Indicator	**Ex-Ante values May-October 2011**
Average number of commuters	2'270 commuters

May	**June**	**July**	**August**	**September**	**October**	**Average number of commuters**
2'288	2'271	2'251	2'245	2'301	2'262	2'270

		May	June	July	August	September	October	Average number of tickets
2011	Number of tickets sold related to all companies in industrial area	2'288	2'271	2'251	2'245	2'301	2'262	2'270
	Number of tickets sold related to FORD	1'678	1'667	1'661	1'672	1'671	1'673	1'644
	Difference all companies –FORD	610	604	590	573	630	589	626

Number of companies that use the service

RAT provided the number of companies that concluded a contract with RAT and used the service developed by CIVITAS measure, before the implementation of the measure.

Indicator	**Ex-Ante values 2011**
Number of companies	8 7 companies signed contracts 1 company pay for Kms traveled

C1.3 Building the Business-as-Usual scenario

Without CIVITAS project, RAT Company would have provided a standard transportation mode for the employees of companies located in the industrial area.

So, it can be assumed that the indicators in BAU have the same values as ex-ante.

Revenues

Raw data	**2012 BAU values**
Total revenues coming from the buses traveling in industrial area	231'810 €

Quality of service

Questionnaire content	**BAU values**
Age	Between (18-40) age 33% Between (40-65) age 67%
Gender	Male 74% Female 26%
How do you evaluate the quality of service provided by RAT related to transportation to work	
Dissatisfied	0%
Satisfied	35%
Very satisfied	27%
Don't know	38%

Average number of commuters

Indicator	**2012 BAU values**

Average number of commuters	2’027 commuters

In BAU situation, RAT assumed that the season tickets sold to FORD remain the same but take into consideration the reducing number of employees in industrial area, due to the crisis.

		May	June	July	August	September	October	Average number of tickets
2012	Number of season tickets sold related to all companies in industrial area	273	258	250	239	244	252	383
	Number of season tickets sold related to FORD	1’678	1’667	1’661	1’672	1’671	1’673	1’644
	Total number of season tickets sold	1’951	1’925	1’911	1’911	1’915	1’925	2’027

Number of companies that use the service

Indicator	**2012 BAU values**
Number of companies	8

C2 Measure results

The measurements for ex-post evaluation have been collected between May-October 2012 to include the operation period deployed in the same period (May 2012 to October 2012).

C2.1 Economy

Revenues

In May 2012, the “digital maps software” was implemented to RAT.

RAT provided the revenues from buses involved in the CIVITAS measure, in the period: May - October 2012. Equal to 233’827 € a very slight increase of total revenues from the buses in industrial area.

The figures from the table shows a very slight increase of total revenues from the buses in industrial area, starting to May 2012, after the measure implementation. The increase is due to the service “payment for Km” rather than from season tickets sold in the period of analysis.

Raw data	**May-October 2012 Ex-post values**
Total revenues coming from the buses involved in CIVITAS measure	233’287 €

	Total revenues(euro)
May-October 2012- ex-post	233.287
May-October 2011- ex-ante	231.810

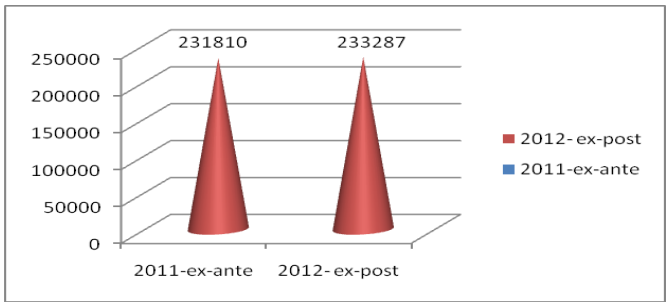


Fig. C2.1.1 – Evolution of operating revenues between May– October; comparative analysis -Ex-ante 2011 and ex-post 2012

Indicator	**Before (date)**	**B-a-U (date)**	**After (date)**	**Difference: After –Before**	**Difference: After – B-a-U**
Revenue	231’810 € (May 2011-October 2011)	231’810 € (May 2012-October 2012)	233’287 € (May 2012-October 2012)	1’477 0,6 % increase	1’477 0,6 % increase

C2.4 Transport

Quality of service

Starting to a target group of 2’302 commuters in September 2012, 200 questionnaires have been circulated among the employees of the companies that used the buses involved in the CIVITAS measure.

Questionnaire content	**September 2012 Ex-post values**
Age	Between (18-40) age 31% Between (40-65) age 69%
Gender	Male 72% Female 28%
How do you evaluate the quality of service provided by RAT related to transportation to work	
Dissatisfied	0
Satisfied	43%
Very satisfied	27%
Don’t know	30%

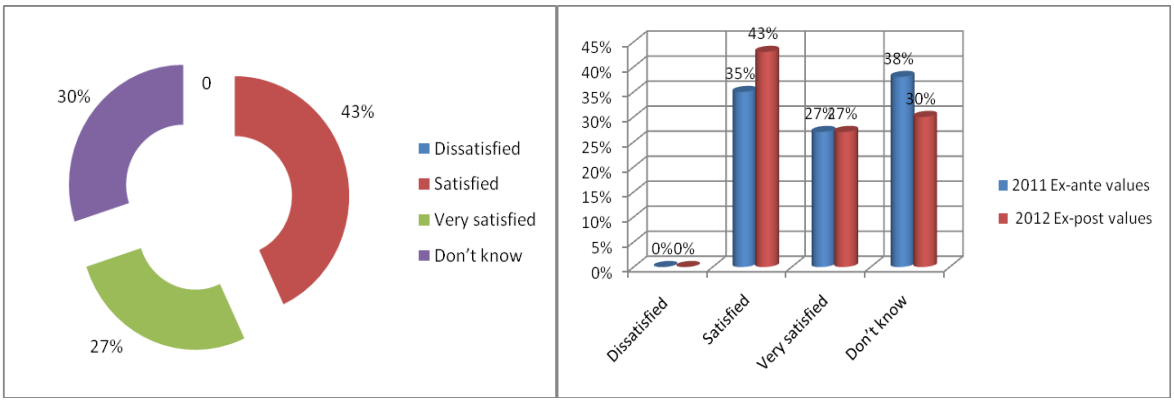


Figure C2.4.1 – Comparative analysis ex-ante – ex-post

Average number of commuters

RAT provided the monthly number of season tickets sold which means the number of commuters using the service in the ex-post period, between May 2012 – October 2012. RAT records showed a very slight increase of average number of commuters in the in ex-post period. The explanation of these results are the following:

- Some companies (as FORD AUTO and 2 satellite companies) increased the number of employees due to the intensive activity;
- Some companies (as Electroputere SA and Avioane Craiova SA) renewed the contract with RAT but dramatically decreased the number of employees due to the reducing activity area.

Indicator	**Ex-post values May-October 2012**
Average number of commuters	2'276 commuters

	Ex-ante-2011	**Ex-post - 2012**
Average number of commuters	2'270	2'276

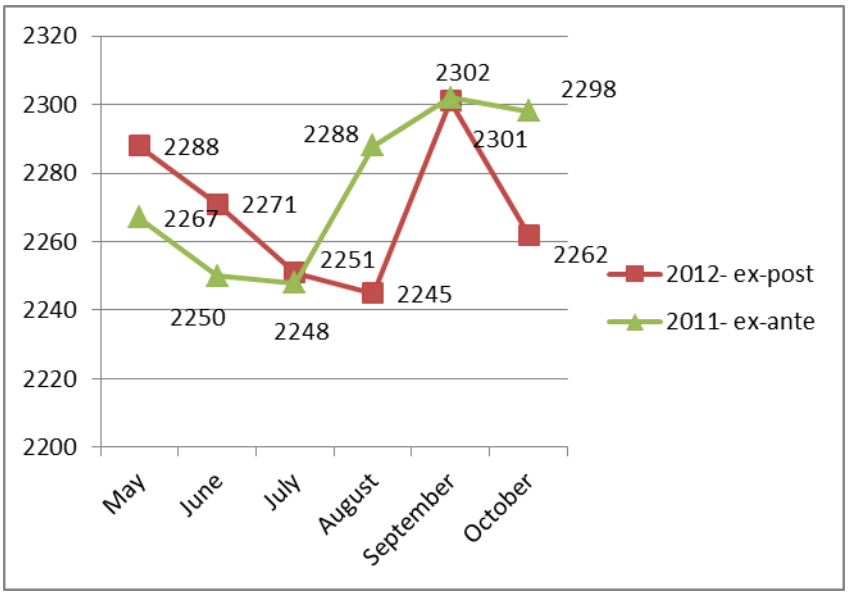


Figure C2.4.2 – Average number of commuters – comparative analysis ex-ante – ex-post

Number of companies that used the service

RAT provided the number of companies that concluded a contract with RAT and used the service of the buses involved in the CIVITAS measure.

Indicator	**2012** **Ex-post values**
Number of companies	12 companies 11 companies signed contracts 1 company used the service and paied for Km travelled

Comparative analyses between season tickets sold to FORD AUTO Company together with 2 satellite companies and season tickets sold to all companies in industrial area using the service

1. Data related to all buses fleet operating in industrial area, using the service

May-Oct 2011

	May	June	July	August	September	October	Average number of tickets
Number of tickets sold	2’288	2’271	2’251	2’245	2’301	2’262	2’270

May-Oct 2012

	May	June	July	August	September	October	Average

							number of tickets
Number of tickets sold	2’267	2’250	2’248	2’288	2’302	2’298	2’276

2. Data related to FORD AUTO company and 2 satellite companies working with FORD AUTO company (SC Johnson Controls Romania SRL and SC Cooper Standard Romania SRL.

May-Oct 2011

	May	June	July	August	September	October	Average number of tickets
Number of tickets sold	1’678	1’667	1’661	1’672	1’671	1’673	1’644

May-Oct 2012

	May	June	July	August	September	October	Average number of tickets
Number of tickets sold	1’994	1’992	1’998	2’049	2’058	2’046	1’893

		May	June	July	August	September	October	Average number of tickets
2011	Number of tickets sold related to all companies in industrial area	2’288	2’271	2’251	2’245	2’301	2’262	2’270
	Number of tickets sold related to FORD	1’678	1’667	1’661	1’672	1’671	1’673	1’644
	Difference all companies in industrial area – FORD	610	604	590	573	630	589	626
2012	Number of tickets sold related to all companies in	2’267	2’250	2’248	2’288	2’302	2’298	2’276

		May	June	July	August	September	October	Average number of tickets
	industrial area							
	Number of tickets sold related to FORD& 2 satellite companies	1’994	1’992	1’998	2’049	2’058	2’046	1’893
	Difference all companies in industrial – FORD&Co	273	258	250	239	244	252	383

The conclusion is the following:

As the table shows above, some companies, using the CIVITAS measure, have been forced to reduce the number of employees due to the economic crisis, from an average of 626 employees to an average of 383 employees(a reducing of 243 people because of crisis). On the other hand, some companies using the CIVITAS measure, which increased the activity, extended the average number of commuters from 1644 to 1893. This means an increase of 249 people using the service.

Indicator	**Before (date)**	**B-a-U (date)**	**After (date)**	**Difference: After –Before**	**Difference: After – B-a-U**
Quality of service	35 % satisfied 27% very satisfied 38 % don’t know (September 2011)	35 % satisfied 27% very satisfied 38 % don’t know (September 2012)	43 % satisfied 27% very satisfied 30% don’t know (September 2012)	8 % increased Satisfaction level	8 % increased Satisfaction level
Average number of commuters	2270 (May-October 2011)	2027 (May-October 2012)	2276 (May-October 2012)	0,26% increased	12 % increased
Number of companies using the service	8 (2011)	8 (2012)	12 (2012)	4	4

C3 Achievement of quantifiable targets and objectives

No.	Target	Rating
1	Integration of the 10 buses into the infomobility system(GPS/GPRS)	**
2	To install digital maps for routs configuration for commuters transportation in industrial area	**
3	To increase the number of users (employees using the buses for this type of transportation) at least 10 % *The average number of commuters increased by 0.26%*	O
	The number of contracts concluded between RAT and companies that use the service have increased by 50 %	***
NA = Not Assessed * = Substantially achieved (at least 50%) ** = Achieved in full *** = Exceeded		

C4 Up-scaling of results

RAT Company promotes by any means its service of transportation for companies employees located in the industrial areas and encourages companies in industrial area and their employees to use dedicated PT services and to use the software aplication for digital maps.

By offering a better transport service for the company RAT hopes to increase the number of companies that use public transportatuon for thei emaployes and also the number of employees using the buses for this type of transportation.

C5 Appraisal of evaluation approach

The evaluation of this measure focused on some indicators across the areas of economy and transport which were to be measured in different ways and calculated.

The indicator "Average operating revenues" has been modify and considered as total revenues from buses operating in the industrial area. The justification of this modification is the fact that in 2011 RAT had no separate records of kilometers travelled in the industrial area, so, we could not calculate the average operating revenue per vKm(€/vKm).

The survey for "Quality of service" assessment was done in cooperation with the companies which used the service. The companies disseminated the questionnaires among the commuters employed of these companies.

The "Average number of commuters" was considered equal with the average number of season tickets sold for industrial area.

An additional indicator was "Number of companies" that concluded contracts for employees transportation because the measure addresses to the companies

C6 Summary of evaluation results

The key results are as follows:

Key result 1 – The revenues slightly increased by 0.6% after the measure implementation.

Key result 2 – The number of commuters slightly increased by 0.26%. FORD AUTO and other 2 companies, FORD partners, are the only ones that have increased the number of employees. Some companies, even renewed the contract with RAT for employees transportation, they have dramatically reduced the number of employees because of decreased activity

Key result 3- In the operation period, 12 contracts have been concluded with PT Company for commuters transportation, thus, the number of contracts increased by 50% compared with ex-ante situation

Key result 4- Quality of service- improved by 8%. The buses stations, configured by the companies which sign contracts with RAT for commuters transportation, are chosen based on home addresses of commuters. After the measure implementation, some commuters realized that the sations are closer to home.

The new system implemented in Craiova offered us new lessons learnt:

- Better marketing approach by diversification of transportation mode. Instead of long term contract, RAT Craiova accepted daily requests or transportation on demand.

- Orientation towards smaller and medium sized companies involving a number of buses almost equal to that for a single large company.
- Associated services offer for more companies (with less employees) working on the same industrial platform and having the same working-program.

Considering the measure results and the advantages offered by the system (special the software tool developed and on board equipment for GPS / GPRS tracking) it is important to mention that RAT intent to extend this service to all business partner companies using of course the entire dedicated fleet for companies employees transport service. This will be gradually extended according to the own financial resources.

Results, however, are clearly dependent on the economic activity and justifying the benefits to the potential customers through appropriate dissemination.

In this regard, all potential client companies can access the special software for routes configuration by using RAT or Municipality website.

C7 Future activities relating to the measure

RAT Company intends to promote by any means its service of transportation for companies employees locatedin the industrial areas and encourages companies in industrial area and their employees to use dedicated PT services.

The use the software application for digital maps is one essential tool to develop this service..

D Process Evaluation Findings

D.0 Focused measure

- *Please fill in the number of the reason from the checklist in the clarification section according to importance.*
- *If it is not clear what the reason(s) is (are), please check this with your Local Evaluation Manager and / or your Project Evaluation Manager.*

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

D.1Deviations from the original plan

The deviations from the original plan comprised:

- **Deviation 1-** Extension of the implementation period

Due to the wrong estimation of time needed for the implementation and testing of the digital maps software, the implementation of the measure had to be extended by 6 months.

- **Deviation 2-** Including of the system operation period

In the work-plan no task for the operation of the system was foreseen. In the 5th contract amendment, 6 months system operation period was added. Therefore, the measure was extended in order to perform all the evaluation procedures.

D.2Barriers and drivers

D.2.1 Barriers

Preparation phase

There have been no barriers in this phase.

Implementation phase

- **Barrier 1 Involvement, communication -** Low number of companies that require special transport.

Operation phase

- **Barrier 1 Problem related** – Reducing of the activity in large companies due to the recession and limitation of the demand for such a service
- **Barrier 2 Involvement – communication -** Low number of companies that require special transport

D.2.2 Drivers

Preparation phase

There have been no drivers in this phase.

Implementation phase

- **Driver 1 Planning -** Flexible software for routes and station configuring

Operation phase

- **Driver 1 – Planning -** Flexible software for routes, station configuring and cost's optimization

D.2.3 Activities

Preparation phase

There have been no activities in this phase.

Implementation phase

- **Activities 1 – Planning -** Better marketing approach by diversification of transportation mode. Instead of long term contract, RAT Craiova accepted daily requests or transportation on demand.

Operation phase

- **Activities 1 – Planning -** Better marketing approach by diversification of transportation mode. Instead of long term contract, RAT Craiova accepted daily requests or transportation on demand.

D.3 Participation

D.3.1. Measure Partners

- **Measure partner 1 – IPA SA - Leading role**

IPA SA is a 47 years old Romanian industrial R & D company and is the Romanian national institute for research and development, engineering in energy, automation and IT, with a large experience in European projects in technology transfer and in information dissemination.

IPA was responsible for the dissemination activities and carrying out the research activity and technical studies in the measure. Since 2011 IPA took over the evaluation activity.

- **Measure partner 2 – RAT- Principle participant**

RAT Craiova is main Public Transportation Company in Dolj county. It provides the citizen transportation by trams, buses and micro-buses.

RAT Craiova uploaded the digital map system on the website and provided the buses for operation. Also, RAT managed the operation and monitoring activities.

- **Measure partner 3 – LCM – Occasional participant**

The Local Council of Craiova Municipality (Primaria Municipiului Craiova) was organized and functions according to Law No. 215/2001 regarding Local Public Administration with the subsequent modification and completion.

Municipality as local government institution has, under the conditions imposed by the public administration law, the decisional right in all matters of local interest: political, social, cultural, educational and technical. Through their structures, the municipality is a complex mechanism which can produce major changes in the quality of urban life under an effective management and coordination.

The competencies of these bodies related to the project covers both the services provided to the local community (i.e. Public transport service in various forms) and the technical interventions (the urban infrastructure, constructions) that together change the image of the city and bring added value to the quality of life in the areas where they act.

LCM was the coordinator of the project since 2009 and assumed the responsibility for the management activity in the MODERN project. Between 2009-2011, LCM carried out the evaluation activity in the project.

D.3.2 Stakeholders

- **Stakeholder 1 - Alien Concept Company** – GPS tracking equipment supplier, tests and installation.
- **Stakeholder 2 -** Ford Company has contract with RAT for commuters transportation
- **Stakeholder 3 -** SC Johnson Controls Romania SRL has contract with RAT for commuters transportation
- **Stakeholder 4 -** SC Cooper Standard Romania SRL SA has contract with RAT for commuters transportation
- **Stakeholder 5** - POLITIA LOCALA Craiova
- **Stakeholder 6**- COMPLEXUL ENERGETIC OLTENIA
- **Stakeholder 7**- SC AVIOANE CRAIOVA SA
- **Stakeholder 8**- SC OMV PETROM SA
- **Stakeholder 9**- SC CUMMINS GENERATOR
- **Stakeholder 10**- TEHNOLOGIES ROMANIA SA
- **Stakeholder 11**- SC TEXMODEL GROUP SRL
- **Stakeholder 12**- SC ELECTROPUTERE SA

D.4Recommendations

D.4.1 Recommendations: measure replication

- **Better marketing approach -** Better marketing approach by diversification of transportation mode. Instead of long term contract, RAT Craiova accepted daily requests or transportation on demand
- **Gradual extending to all business partner companies** - Considering the measure results and the advantages offered by the system (special the software tool developed and on board equipment for GPS/GPRS tracking) it is important to mention that RAT intent to extend this service to all business partner companies using of course the entire dedicated fleet for companies employees transport service. This will be gradually extended according to the own financial resources. In this regard, all potential client companies can access the special software for routes configuration by using RAT or Municipality website.

D.4.2 Recommendations: process (related to barrier-, driver- and action fields)

- **Recommendation 1 -** Orientation towards smaller and medium sized companies involving a number of buse almost equal to that for a single large company.

Annex 1: Sample size calculation for ex-ante and ex-post survey on commuters

Variables name and explanations		Variables values
	measure	4.08
n	sample size for ex-ante survey	200
t	z-score: the abscissa of the Normal distribution for probability α	1.53
α	**confidence level**, is a percentage and represents how often the true percentage of the population who would pick an answer lies within the **confidence interval** (margin of error).	87.50%
P	percentage of your sample that picks a particular answer	0.5
Q	(1-P)	0.5
d	**confidence interval** (also called margin of error)	0.05
N	Total number of commuters in September 2011	2'302

Sample size

$n = [t^2PQ/d^2] / [1 + (t^2PQ/d^2 - 1)/N]$ (1)

where: t = the abscissa of the Normal distribution for probability α
P = expected population value of the proportion
Q = (1-P)
d = margin of error
N = population total

α - in mod obisnuit se foloseste 95%

A preliminary estimate of P (called p) is made from prior information or as an informed guess; so then q = 1-p.
If N is large, a first approximation of *n* is given by:

$n_o = t^2pq/d^2$ (2)

or $n_o = pq/V$ (3)

where $V = d^2/t^2$ is the desired variance of the sample proportion
In practice, n_o is calculated first and so long as n_o/N is quite small, n_o provides a satisfactory estimate of *n*. If not, then from equations (1) and (2) above:

$n = n_o / [1 + (n_o - 1)/N]$

M05.05 – Executive summary

The measure consisted in the implementation of a surveillance system for the public transport system in Craiova, that included surveillance cameras installed in 10 passengers stations (1 camera in each station), 15 buses (3 cameras and one DVR with internal hard disk in each bus), and communication equipment's that transmit images and information from the monitored sites to the a central management centre (called "dispatcher").

This system represents a part of a larger integrated system which was implemented on the Craiova public transport system through the MODERN project. This system includes a vehicle monitoring system and an associated info mobility system and e-ticketing system. All these three different components of the overall system were integrated from the technical point of view, sharing parts of the overall IT architecture.

The purpose of the measure is to supervise the passengers transport and increase the security for public transport in order to be more attractive for citizens. The system allows a rapid intervention of Police to isolate travellers with criminal behaviour in buses or in the area of passengers' stations.

The measure was implemented in the following stages:

- Definition of the integration of the surveillance cameras in the video surveillance system of the Municipality
- Studying of the most important stations with large passenger flow and high risk of vandalism.
- Definition of the technical requirements for the system
- Installation of the surveillance cameras under a schedule agreed by RAT and the equipment provider.
- Installation and running of the overall system

In order to highlight the impact of the measure on the transport, society and security, a set of indicators have been measured: quality of service, awareness, acceptance, perception of security and frauds level.

The key results of evaluation activity are as follows:

- Taking into consideration the surveys carried out on the PT users, the perception of security increased by 6 % and the people feel more protected from pick-pockets or bags thieves;
- The frauds level decreased by 50% because the thieves or agitators are discouraged by surveillance cameras that can record the antisocial events.

The two major lessons learnt regards:

1. The necessity for a good definition of the places where to install the video surveillance; this because a good start of the experimentation could influence the feeling of passengers and avoid the possibility to be forced to change them.
2. To overcome the initial perception of the people that use public transport every day that the Municipality spies them with the video-surveillance cameras. This feeling was only at the beginning of the operating period after a while realizing that those cameras are helping them to get a much nicer travel and a safer environment.

A Introduction

A1 Objectives

The measure objectives are:

A. High level/longer term:

- To encourage more people to use PT

B. Strategic level:

- To reduce the antisocial issues and increase PT safety

C. Measure level:

- To install video surveillance system in 10 public transport stations and 15 buses in order to decrease fraudulent and anti social issues by 10% in PT.
- To reduce the anti social issues in order to increase the passengers` perception of security by 3%.

A2 Description

Public transport is a complex and multi-layered system. Critical elements of this system are the fraudulent and antisocial behaviour of some passengers. In Craiova, the public transport does not offer enough safety to passengers, as it should have.

The most critical points in the security status of public transport in Craiova were:

- Peak hours when buses are crowded
- In the less populated stations
- During the weekend when the number of passengers is lower than in the work days
- At the edge of the city

The measure implementation was therefore important in order to reduce these negative aspects of the public transport in Craiova City.

The system applied consists in the installation of

- 10 in 10 passenger's stations (1 camera for each station),
- 45 video surveillance cameras in 15 buses (3 cameras for each bus) and one DVR with internal hard disk in each bus

- Communications equipment to transmit images and information to the dispatcher (management centre).

The percentages of stations equipped with cameras are 5% of all the passengers' stations and the percentage of buses equipped with cameras is 8 % of the total fleet.

The centre of the system (dispatcher) is located at RAT headquarter. The surveillance system is viewed by RAT headquarter and from there, if a problem exists, it will be communicated to the Local Police to take action and to resolve if possible the problem.

The system allows the rapid intervention of police and isolation of travellers that creates a climate of uncertain journey in the buses or in the public transport stations.

Regarding the video-surveillance cameras placed in the buses, they can store the recorded images on the internal hard disk for a period of 7 days and can be downloaded from DVR with a special device in case of need.

The aim of this measure, by monitoring stations and bus is to encourage more people to leave the private cars for the public transport use.

B Measure implementation

B1 Innovative aspects

The innovative aspect of the measure is the following:

New physical infrastructure solutions – Installation of cameras in public transport stations and buses reprezents a new infrastructure solution in order to decrease the anti social issues that are escalating with the increase of transport capacity.

B2 Research and Technology Development

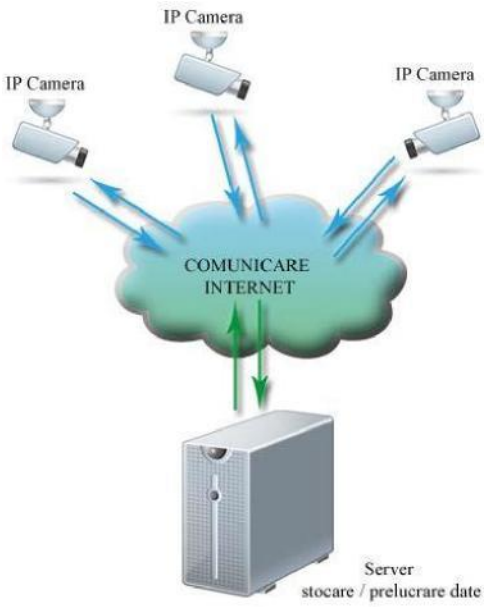
The RTD activity that was dedicated to planning and design of the measure is described below:

- Analysis of existing surveillance systems on the market and their utility in public transport system.
- Identification of the stations and buses that could be equipped with surveillance systems.
- Preparation of specification for the surveillance system for vehicles and stations.

The system assures the video surveillance of the passengers flows from the monitored stations with the help of 10 video cameras; it is a closed - local surveillance circuit. Each camera is IP connected to the dispatch where the monitoring and the storage is being made and the video coding respects the MPEG-4 standard.

- The system is composed of the following elements:
- IP surveillance cameras
- Software common GUI interface
- Server
- Connection between server and the surveillance cameras

The functional scheme of the system is presented in the following figure.



For what concerns the bus stations, the system is composed by a set of 10 cameras IP cameras which communicate in a secure way with the dispatcher through the internet.

The cameras were installed in the following bus stations:

- BRD station,
- station platform,
- Romanescu Park,
- Banie complex,
- Oltet,
- 3F Pharmacy,
- 15 Cv. Noua station,
- Electroputere,
- Siloz,
- Regia de Tutun.

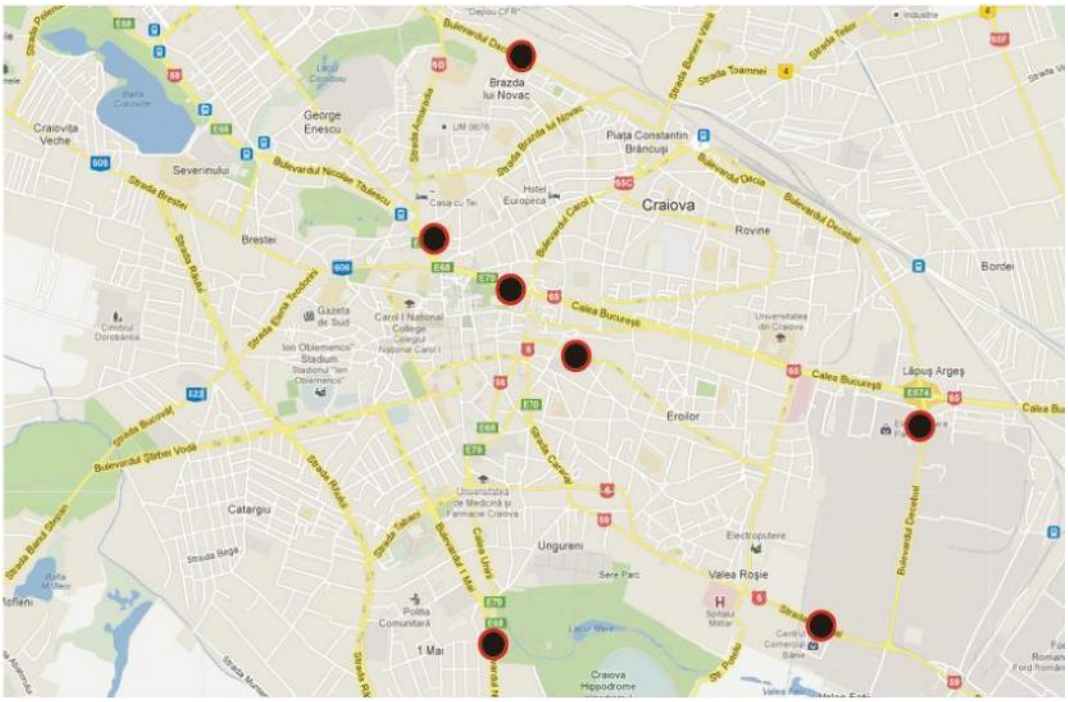


Figure 1 PT stations in which the cameras where installed

The access to the server and to the IP cameras from the closed surveillance circuit is secured with username and password.

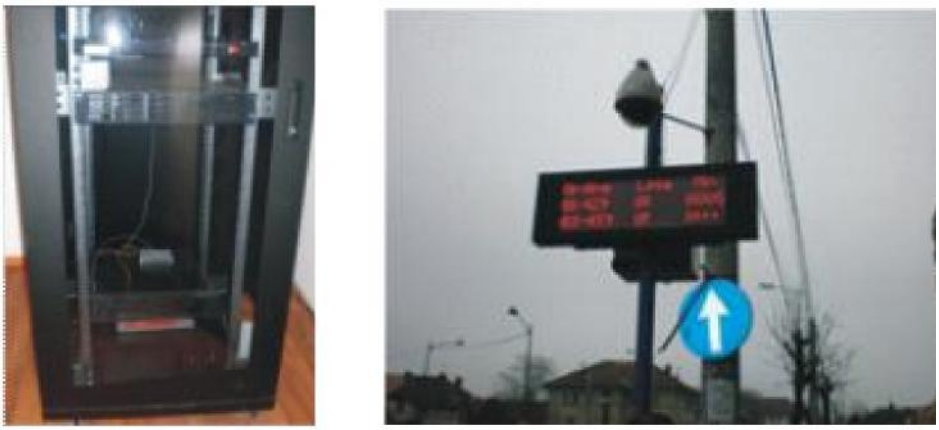


Figure 2 The rack in which the server is installed at the central dispatch

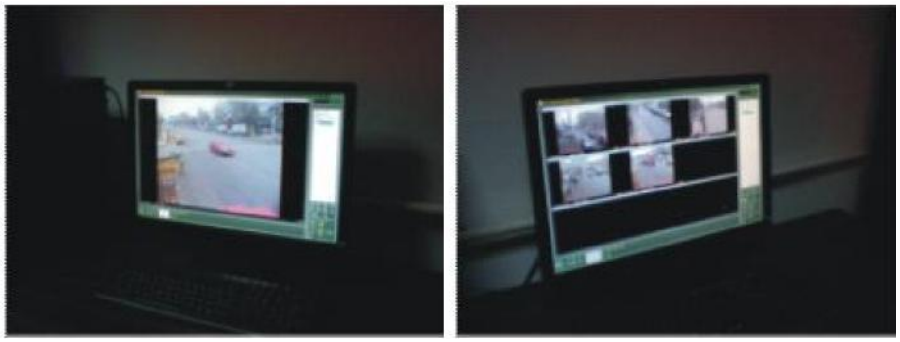
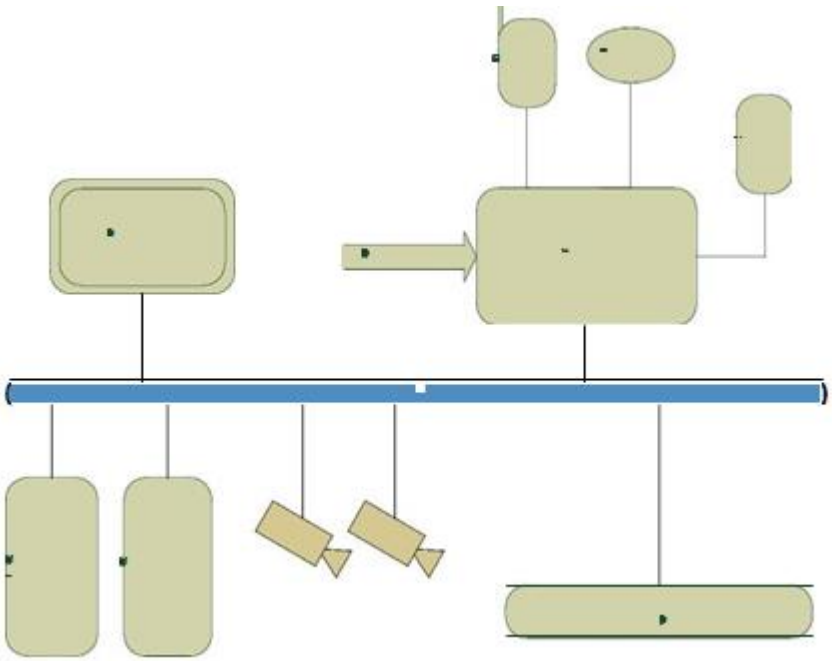


Figure 3 The dispatch centre – live real time video data from a single IP camera

For what concerns the video surveillance system installed on the buses, it is a closed circuit surveillance system, based on cutting edge digital equipment that assures surveillance, recording and high operation flexibility. There is a total number of 45 surveillance cameras installed on 15 buses (3 for each bus – placed strategically in order to assure a complete covering of the interior space).



The 3 surveillance cameras installed into any single bus are connected to an on-board DVR recording system that stores local information for a period of 72 hours; this allows the recovery of the images if some particular event occurs. This information can be afterwards transferred to a computer or a data server (using storage equipment like memory stick or by a direct connection between a laptop and the DVR).

Fig.5 - Surveillance camera in one of the buses

The cameras installed have the following characteristics:

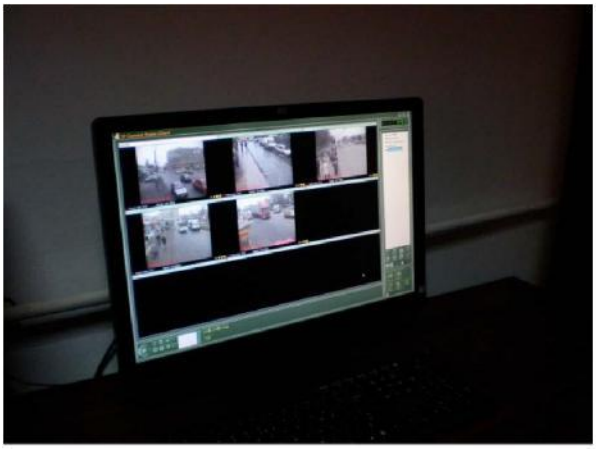
- Minimum resolution of 640x480 pixels;
- Recording rate: a minimum of 5 frames / second;
- The possibility of recording at a diffuse light
- The recordings are encrypted, and accessing them is done only by following a clear authentication procedure

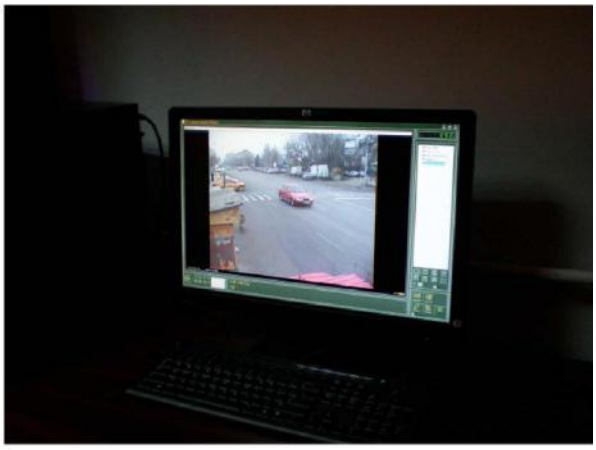
The DVR installed on the bus is a DVR supporting at most 4 video channels, supplied at 24V and with surge protection is also installed in each bus where 3 video surveillance cameras can be found,. The DVR also has a USB port for the storage of backup copies or for the storage of other video information, if necessary. The information is stored for a period of 72 hours and after that they are circularly rewritten (the oldest information is deleted to offer space for the most recent ones).

The system has a central server, hosted in the central dispatch center of PTC Craiova, this being responsible for the coordination of the system, for the expansion of the configurations including other equipment's and for the arbitration of access rights and of permissions into the system. The server has the following configuration:

- Intel core I5 760 @ 2,80 GHz processor, - RAM Memory of - 4GB,
- Storage capacity of HDD- 6 TB,
- Windows 7 operation system, 64 bit.

The access to the server and to the IP cameras from the closed surveillance circuit is secured with user and password.





The surveillance system is mainly devoted to the monitoring of the passengers flows in 10 public transport bus stations and 15 buses, but also brings a contribution to the increase of the security of all the people in the areas of the bus stations where they are installed. Since these cameras were installed up to now, no incidents have been recorded in the monitored areas.

The system displays the video stream in any combination both on a wall screen and on the monitor screen of the operator. The start-up of these operations is being made directly from the client application that is installed on the operator computer.

The operators from the monitoring center have full access to the functionalities offered by the surveillance cameras and the software. The access to these functionalities is restricted only to the rights given to the users by the system administrator. The functionalities of the application are the following:

- Selection of the cameras to be visualized on the screen;
- the software gives the possibility to select one or more cameras to be visualized in real time on the screen;
- The operator can select the visualization of a single camera or more cameras on the single screen.

An integrated technical documentation was implemented for three measures: e-ticketing, GPS and video surveillance equipment (02.04, 08.02, and 05.05). This path was chosen because those three measures form a block and is simpler and more efficient to create from the beginning a complex system for monitoring, security and management of public transportation in Craiova rather than separate systems with no integration between them.

B3 Situation before CIVITAS

The public transport in Craiova didn’t offer enough security to passengers. The negative aspects regarding the lack of security in public transport system are more evident in peak hours and late in the night and especially affect the weaker category of passengers, namely old people, women and children, people who usually take the bus every day. As a consequence, many people prefer to use private transport, for example to take their children to school by own car or taxi rather than by bus or tram.

Some measures have been taken at the city level, but they were targeted to limit the negative aspects due to the violation of the traffic rules which endanger the lives of other road users. The Municipal Police already installed 8 surveillance cameras for traffic monitoring in the main road intersections in Craiova. The cameras were connected to a traffic monitoring centre at the Municipal Police and provided in real time information taken from the traffic.

The need for the surveillance cameras specially for public transport stations was a priority in Craiova and especially for RAT because the antisocial issues and the incidents increased in the past years.

Table 1 Fraudulent levels in Craiova

Sta**tistics main activities of Romanian police in 9 months 2009**	
INDICATORS	TOTAL
I. I. OFFENSES SOLUTION	236’451
- Volume crime - offenses per 100,000 inhabitants	1.1
- Committed in urban areas	143’337
- Committed in rural areas	92.95
- Committed abroad	164
- With losses over 200 thousand USD	1’435
I.1. Legal Crime	104’518
I.2. Economic Crime	46’155
I.3. Crime of another nature	85’778
I. a. SERIOUS CRIMES COMMITTED WITH VIOLENCE	
1 Murder	290
2. Attempted murder	287
3. Impact causing death	65
4. Serious injuries	447
5. Rape	766
6. Robbery - Total	2’009
death victim	8
7. Outrage	416
8. Infanticide	16

B4 Actual implementation of the measure

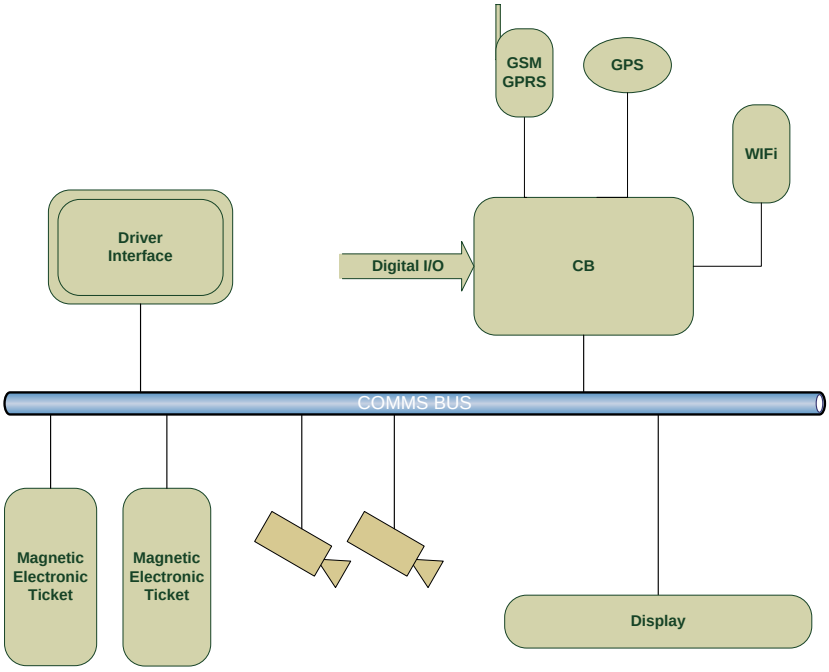
The measure was implemented in the following stages:

Stage 1: Planning and designing the measure (October 2008 – September 2009)

The research team together with the City Hall technicians decided and defined the integration of the surveillance cameras in the video surveillance system of the Municipality. Public procurement procedures and legislation for the purchasing phase of the equipment's were studied and defined. A portfolio of the companies that produce the equipment's was defined through a market analysis.

No	Item	Quantity
	IP cameras	10
	Access Units	3
	Subscribers	10
	DVR	1
	Video processing Software	1
	Put into service	

An overview schema of an integrated system is presented in the figure below:



Stage 2: Definition of methodology and measure concept (June 2009)

This activity was performed through a study on one of the RAT (Public Transport operator in Craiova) most important stations with large passenger flow and high risk of vandalism.

In this stage the stations and transportation vehicles, buses, which to be equipped with surveillance cameras have been identified.

On these basis the technical specifications for the system and the tender documentation has been prepared. The technical specification for the video-surveillance system have been integrated with the ones related to two other sub-system devoted to public transport management, developed in the same framework of the MODERN projects. These integrated systems are:

- the Vehicle monitoring system (AVM or GPS/GPRS system) and the associated Infomobility system developed through the measure M08.02;
- an e-ticketing system developed within the MODERN measure M02.04;
- the video-surveillance system subject of this measure.

These three sub-systems form an integrated system, which share most of the technical components of the overall architecture. All of them are connected to a common central dispatcher for data acquisition and PT management located in RAT headquarters.

This work was the object of a specific deliverable; after its approval the documentation for the tender were prepared and the base for the surveillance system was defined.

Stage 3: Exploitation of the tender and contract definition

All the activities related to the preparation and the exploitation of the tender procedures were carried out regularly. The tender procedure has been exploited in the due time.

The call for tender and the related documents were published in January 2010. The tender procedure took place through the national tender electronic system. The tender winner was nominated in March 2010. The result of the tender was contested by 5 companies but all of them were rejected by National Claims Settlement Commission. Three of the participating companies have lodged appeals. The other two did not attend the tender. Current legislation allows anyone to submit appeals, even if it not participated in the tender. Public procurement legislation is already in a stage of revision and improvement at this chapter. Two of the contestant companies continue to claim the tender result in the Court of Law. These claims lead to a delay in implementation, the contestation process ending in June and the contract with the winner company was signed on 20 of June. Even in the third semester of the project the measure seems to be delayed, when the contract was signed the measure was recovered in the contractual timetable. The installation of the equipment started in June 2010 (month 20) together with the e-ticketing system.

Stage 4 : Test of the system (December 2009- May 2011)

The procurement and installation of the video-surveillance system was carried out by the provider ALIEN Concept Oradea together with the RAT technicians.

A specific schedule was agreed by RAT and the equipment provider in order to minimize the procurement time.

During the installation of the system components, functional tests were performed. Each stage of the testing has been specified in the system installation plan which was part of the contract. The installation plan included partial and final tests. The communication equipment and related software (communication and video processing software) were verified and tested, to assure a good connection between the field equipment and the central acquisition system installed in the RAT dispatcher centre.

The performance of the tested system reached all the specified parameters and the system was approved by RAT Craiova. The problems that the system had during the test phases weren't communicated to us by the equipment provider because the tender documents didn't specify step by step problem information.

The video surveillance cameras were installed on MAN Lion City type buses, using DVR for on board image storing and real time video transmission to the dispatcher centre.

The central station (dispatcher) is located in the RAT control room which contains the integrated management system for the public transport fleet, including e-ticketing equipment, video surveillance devices and the GPS/GPRS tracking system and associated info-mobility system.

Stage 5: Installation and running of the overall system (June 2011- Sept. 2012)

After the finalization of the test the system was completely installed and started its operation.

The system was constantly monitored in order to intervene and correct any operational problems or technical and conceptual malfunctions.

During the operation of the system all the data necessary to perform the evaluation were collected.

B5 Interrelationships with other measures

The measure is related to other measures as follows:

- Measure 02.04 – Integrated e-ticketing system in Craiova
- Measure 08.02 – Info mobility tools for fleet management in Craiova

There is a synergic relation between them because of the same output level objectives. These three measures represent in a way one “smart measure” and the implementation of the equipment will be made on the same public transport vehicles.

C Impact Evaluation Findings

C1 Measurement methodology

C1.1 Impacts and Indicators

Table C1.1: Indicators.

No.	Impact	Indicator	Data used	Comments
2	Economy	Capital cost	Euros	The cost of the surveillance system
19	Transport	Quality of Service	Index %, qualitative	Face to face surveys to PT Perception of service quality of the surveillance system
14	Acceptance	Acceptance Level	Index %, qualitative	Face to face surveys to PT Acceptability of the surveillance system
13	Awareness	Awareness Level	Index %, qualitative	Face to face surveys to PT referring to having heard of surveillance system, understand the aim of the measure and the potential benefits and disadvantages of the measure.
17	Security	Perception of security	Index %, qualitative	Face to face surveys to PT
	Local indicator	Frauds level (%)	%	Recorded data to the RAT Dispatcher

Detailed description of the indicator methodologies:

Indicator 2 (Capital cost) – The capital cost from the budget of the project

Indicator 19 (Quality of Service) – Survey based on the perception of service quality

Indicator 17 (Perception of security) – Survey based on the perception of people security

Indicator 13 (Awareness level) – Survey based on the perception of benefits or disadvantages of the surveillance cameras in public transport vehicles and stations

Indicator 14 (Acceptance level) – Survey based on the perception of the acceptance of surveillance cameras in public transport stations and vehicles

The surveys were made to see the impact on PT users of the surveillance system installed on the RAT buses and stations.

150 questionnaires were distributed for the indicators 13, 14, 17 and 19 and we received back 100 filled questionnaires. The questionnaires were disseminated in bus stations, inside buses, sent by e-mail, or in some workshops organized by the evaluation team.

The feedback for evaluation (BAU situation) was 100 – filled questionnaires and the feedback for ex-post evaluation were 131 filled questionnaires. The questionnaires for BAU situation were

disseminated to public transport users in stations, inside buses and during workshops organized by MODERN project team. The workshops were organized during the Communication Campaign and seminar presentation that took place between 3 - 5 May 2010, 6-7 hours per day in the street and in a pavilion located in the prefecture square (downtown).

In the agreement with the target group the e-mail and phone were kept for further contact for ex-post evaluation period.

The feedback of 100 and 131 questionnaires is satisfying for a population of 300.000 people in Craiova.

To be sure of obtaining such a sample we launched a number of questionnaires -150. The most important questions are:

The questionnaires were structured in 2 sections:

1. General information about citizens (job, age, gender, education level, contact data)
2. Questions referring to the measure split by indicator type:

a. Quality of service:

The most important questions were:

1. How do you estimate the quality of public transport in your city?
2. Do you consider that the quality of services in PT have been improved lately?

b. Perception of security:

The most important questions were:

1. How safe is PT now?
2. Have you had any unpleasant event on PT?
3. Lately, has people security increased?

c. Awareness level

The most important questions were:

1. Have you heard about the measure?
2. Do you recognize the logo of the project?
3. Do you understand the aim of the project and the potential benefits and problems of the measures?
4. Have you noticed some benefit recently?

d. Acceptance level

The most important questions were:

1. How useful do you think the implementation of the measure is?
2. Do you accept or not the implementation of measure?

Local indicator: "Frauds level"- monthly reports of fraudulent passengers and antisocial incidents collected by RAT dispatcher is reported to us. The dispatcher is notified by a PT user of a fraudulent incident and the dispatcher records the notify in a database record. The fraud level is recorded only if the dispatch receives a notification from the PT user, else the fraud level is not registered.

C1.2 Establishing a Baseline

The negative aspects of the security lack in public transport system are more obvious in peak hours and late at night and affect more passengers, especially old people, women and children, people who usually take the bus every day. As a consequence, many people prefer for example to take their children to school by car or taxi not by bus or tram. A consequence of this is that at morning hours when the children are coming to school there are areas that have a very high congestion rate.

It should be said however, that some measures have been taken at the city level in order to limit the negative aspects due to the violation of traffic rules which endanger the lives of other road users. The municipal police has already installed 8 surveillance cameras for traffic survey only, in the biggest road crossroads in Craiova. The cameras are connected to a traffic monitoring center and provide in real time information taken from the traffic.

Unfortunately the legislation in Romania is old and the cameras can't be used directly to administer fines. The procedure is that after a notice has been issued, if the court of justice considers the tapes are released for justice intent.

With the coming of Ford in Craiova the City Council and the municipality are more engaged in the modernization of the road infrastructure and the safety of transport and that of the people that ride the buses or trams every day.

To establish a baseline for this measure it can be said with confidence that, before MODERN project, the municipality didn't take any measures to reduce the fraudulence levels in buses or trams and it would have not been implemented in the future.

The following tables illustrate the answers given by the people interviewed through a questionnaire they had to fill and the information is part of the indicator 19 (quality of service).

Indicators and respective parameters	**Ex-Ante values**
Indicator 19 – Very Dissatisfied	25%
Indicator 19 – Somewhat dissatisfied	55%
Indicator 19 – Satisfied	19%
Indicator 19 – Don't know	1%

Indicators and respective parameters	**Ex-Ante values**
Indicator 19 – Very Uncomfortable	24%
Indicator 19 – Somewhat Uncomfortable	53%
Indicator 19 – Uncomfortable	22%
Indicator 19 – Don't know	1%

The following table illustrates the answers given by the people interviewed through a questionnaire they had to fill and the information is part of the indicator 17 (perception of security).

Indicators and respective parameters	**Ex-Ante values**
Indicator 17 – Unsafe	34%

Indicator 17 – Somewhat safe	55%
Indicator 17 – Safe	9%
Indicator 17 – Very Safe	2%

The following table illustrates the answers given by the people interviewed through a questionnaire they had to fill and the information is part of the indicator 13 (awareness level).

Indicators and respective parameters	**Ex-Ante values**
Indicator 13 – Fairly well understand	41%
Indicator 13 – Well understand	19%
Indicator 13 – Very well understand	36%
Indicator 13 – Don't know	4%

The following table illustrates the answers given by the people interviewed through a questionnaire they had to fill and the information is part of the indicator 14 (acceptance level).

Indicators and respective parameters	**Ex-Ante values**
Indicator 14 – Accept	92%
Indicator 14 – Don't accept	0%
Indicator 14 – Don't know	8%

Indicators and respective parameters	**Ex-Ante values**
Indicator “Frauds Level”	14

Indicators and respective parameters	Ex-Ante values
Indicator 2 – Capital costs	0

C1.3 Building the Business-as-Usual scenario

As mentioned earlier, before MODERN, the municipal police has already installed 8 surveillance cameras for traffic surveillance only, in the biggest crossroads in Craiova. In the absence of the MODERN project it is unlikely that Craiova Municipality would have installed cameras in stations and public transport vehicles, in the next future.

Normally in Craiova people don’t walk more than one hour distance. This means that a person walks around 1 or 1.5 km per day. In this context Public Transport is a very important mean of commuting for most people.

The public transport in Craiova is mainly for people going to work in the morning, for children going to school and for older citizens that can’t walk anymore long distances.

Measure title: PUBLIC TRANSPORT SECURITY PROGRAM IN CRAIOVA

City: Craiova Project: MODERN Measure number: 05.05

The urban development plan for Craiova for the next years is structured mainly for modernizing the transport infrastructure, and not to modernize the vehicles or to improve public security.

Therefore, Business as Usual scenario can be considered the same as the ex-ante situation as the Municipality of Craiova doesn't have a plan to introduce in Public Transport this kind of systems.

It cannot be estimated how much it will increase or decrease because frauds in a city are dependent on many factors that we can't control or assume.

Indicators and respective parameters	**BAU values 2009**
Indicator 19 – Very Dissatisfied	25%
Indicator 19 – Somewhat dissatisfied	55%
Indicator 19 – Satisfied	19%
Indicator 19 – Don't know	1%
Indicators and respective parameters	**BAU values 2010**
Indicator 19 – Very Dissatisfied	25%
Indicator 19 – Somewhat dissatisfied	55%
Indicator 19 – Satisfied	19%
Indicator 19 – Don't know	1%
Indicators and respective parameters	**BAU values 2011**
Indicator 19 – Very Dissatisfied	25%
Indicator 19 – Somewhat dissatisfied	55%
Indicator 19 – Satisfied	19%
Indicator 19 – Don't know	1%
Indicators and respective parameters	**BAU values 2012**
Indicator 19 – Very Dissatisfied	25%
Indicator 19 – Somewhat dissatisfied	55%
Indicator 19 – Satisfied	19%
Indicator 19 – Don't know	1%

Indicators and respective parameters	**BAU values 2009**
Indicator 19 – Very Uncomfortable	24%
Indicator 19 – Somewhat Uncomfortable	53%
Indicator 19 – Uncomfortable	22%
Indicator 19 – Don't know	1%

Indicators and respective parameters	**BAU values 2010**
Indicator 19 – Very Uncomfortable	24%
Indicator 19 – Somewhat Uncomfortable	53%
Indicator 19 – Uncomfortable	22%
Indicator 19 – Don't know	1%
Indicators and respective parameters	**BAU values 2011**
Indicator 19 – Very Uncomfortable	24%
Indicator 19 – Somewhat Uncomfortable	53%
Indicator 19 – Uncomfortable	22%
Indicator 19 – Don't know	1%
Indicators and respective parameters	**BAU values 2012**
Indicator 19 – Very Uncomfortable	24%
Indicator 19 – Somewhat Uncomfortable	53%
Indicator 19 – Uncomfortable	22%
Indicator 19 – Don't know	1%
Indicators and respective parameters	**BAU values 2009**
Indicator 17 – Unsafe	34%
Indicator 17 – Somewhat safe	55%
Indicator 17 – Safe	9%
Indicator 17 – Very Safe	2%
Indicators and respective parameters	**BAU values 2010**
Indicator 17 – Unsafe	34%
Indicator 17 – Somewhat safe	55%
Indicator 17 – Safe	9%
Indicator 17 – Very Safe	2%
Indicators and respective parameters	**BAU values 2011**
Indicator 17 – Unsafe	34%
Indicator 17 – Somewhat safe	55%
Indicator 17 – Safe	9%
Indicator 17 – Very Safe	2%
Indicators and respective parameters	**BAU values 2012**

Indicator 17 – Unsafe	34%
Indicator 17 – Somewhat safe	55%
Indicator 17 – Safe	9%
Indicator 17 – Very Safe	2%

Indicators and respective parameters	**BAU values 2009**
Indicator 13 – Fairly well understand	41%
Indicator 13 – Well understand	19%
Indicator 13 – Very well understand	36%
Indicator 13 – Don't know	4%
Indicators and respective parameters	**BAU values 2010**
Indicator 13 – Fairly well understand	41%
Indicator 13 – Well understand	19%
Indicator 13 – Very well understand	36%
Indicator 13 – Don't know	4%
Indicators and respective parameters	**BAU values 2011**
Indicator 13 – Fairly well understand	41%
Indicator 13 – Well understand	19%
Indicator 13 – Very well understand	36%
Indicator 13 – Don't know	4%
Indicators and respective parameters	**BAU values 2012**
Indicator 13 – Fairly well understand	41%
Indicator 13 – Well understand	19%
Indicator 13 – Very well understand	36%
Indicator 13 – Don't know	4%
Indicators and respective parameters	**BAU values 2009**
Indicator 14 – Accept	92%
Indicator 14 – Don't accept	0%
Indicator 14 – Don't know	8%
Indicators and respective parameters	**BAU values 2010**
Indicator 14 – Accept	92%

Indicator 14 – Don't accept	0%
Indicator 14 – Don't know	8%
Indicators and respective parameters	**BAU values 2011**
Indicator 14 – Accept	92%
Indicator 14 – Don't accept	0%
Indicator 14 – Don't know	8%
Indicators and respective parameters	**BAU values 2012**
Indicator 14 – Accept	92%
Indicator 14 – Don't accept	0%
Indicator 14 – Don't know	8%

Indicators and respective parameters	**BAU values 2009**
Indicator “Frauds Level”	14
Indicators and respective parameters	**BAU values 2010**
Indicator “Frauds Level”	15
Indicators and respective parameters	**BAU values 2011**
Indicator “Frauds Level”	8
Indicators and respective parameters	**BAU values 2012**
Indicator “Frauds Level”	3

Indicators and respective parameters	**BAU values 2009**
Indicator 2 – Capital costs	0
Indicators and respective parameters	**BAU values 2010**
Indicator 2 – Capital costs	0
Indicators and respective parameters	**BAU values 2011**
Indicator 2 – Capital costs	0
Indicators and respective parameters	**BAU values 2012**
Indicator 2 – Capital costs	0

C2 Measure results

The results are presented under sub headings corresponding to the areas used for indicators – economy, energy, environment, society and transport.

C2.1 Economy

Cost of the cameras installed in 10 stations and 15 buses.

Table C2.1.1: the cost of the cameras installed in 10 stations and 15 buses

Indicator	Ex-Ante 2009	BAU 2009	Ex-Post 2010	BAU 2010	Ex-Post 2011	BAU 2011	Difference Ex-Post - Ex Ante	Difference Ex-Post - BAU
Indicator 2' – Capital cost	0	0	0	0	39'000 €	0	39'000 €	39'000 €

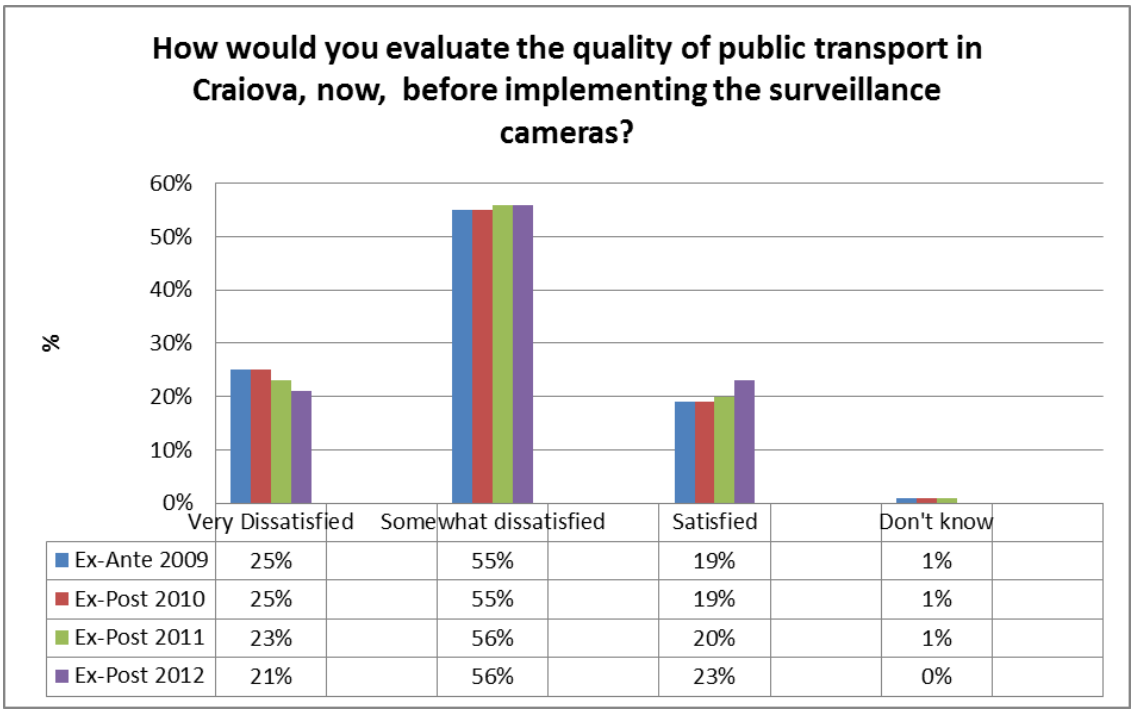
From the table above it is clearly shown that without this project the Municipality wouldn't have invested in security systems for Public Transport.

.

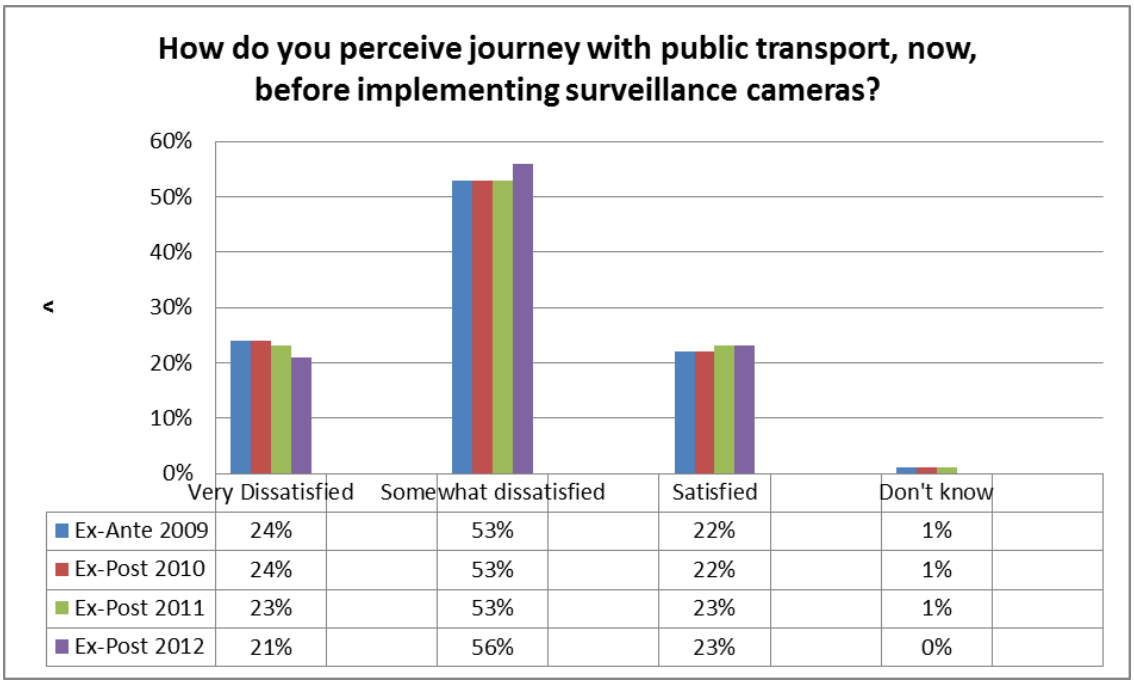
C2.4 Transport

Table C2.4.1: quality of service results

Indicator	Ex-Ante 2009	BAU 2009	Ex-Post 2010	BAU 2010	Ex-Post 2011	BAU 2011	Ex-Post 2012	BAU 2012	Difference Ex-Post - Ex Ante	Difference Ex-Post - BAU
Indicator 19 Quality of Service	25 % very dissatisfied 55 % somewhat dissatisfied; 19% Satisfied 1 % don't know	25 % very dissatisfied 55 % somewhat dissatisfied; 19% Satisfied 1 % don't know	25 % very dissatisfied 55 % somewhat dissatisfied; 19% Satisfied 1 % don't know	25 % very dissatisfied 55 % somewhat dissatisfied; 19% Satisfied 1 % don't know	23 % very dissatisfied 56 % somewhat dissatisfied; 20% Satisfied 1 % don't know	25 % very dissatisfied 55 % somewhat dissatisfied; 19% Satisfied 1 % don't know	21 % very dissatisfied 56 % somewhat dissatisfied; 23% Satisfied	25 % very dissatisfied 55 % somewhat dissatisfied; 19% Satisfied 1 % don't know	-4% very dissatisfied 1% somewhat dissatisfied 4% Satisfied	-4% very dissatisfied 1% somewhat dissatisfied 4% Satisfied
	24 % very uncomfortable 53%somewhat comfortable 22%comfortable 1 % don't know	24 % very uncomfortable 53%somewhat comfortable 22%comfortable 1 % don't know	24 % very uncomfortable 53%somewhat comfortable 22%conforta ble 1 % don't know	24 % very uncomfortable 53%somewhat comfortable 22%comfortable 1 % don't know	23 % very uncomfortable 53%somewhat comfortable 23%comfortable 1 % don't know	24 % very uncomfortable 53%somewhat comfortable 22%comfortable 1 % don't know	21 % very uncomfortable 56%somewhat comfortable 23% comfortable	24 % very uncomfortable 53%somewhat comfortable 22%comfortable 1 % don't know	-3 % very uncomfortable 3%somewhat comfortable 1% comfortable	-3 % very uncomfortable 3%somewhat comfortable 1% comfortable



Picture 16 C2.4.1



Picture 17 C.2.4.2

As it can be seen from the pictures above, the dissatisfied value from the ex-ante period is dropping from 25% to 21% for the first question and from 24% to 21% for the second question. On the contrary, the number of satisfied persons begun to increase in 2011 and 2012. The limited increase is partly due to the fact that these kind of changes in the perception of the quality of public transport need time to be consolidated. So we expect that these values will increase in the future to respectable numbers.

C2.5 Society

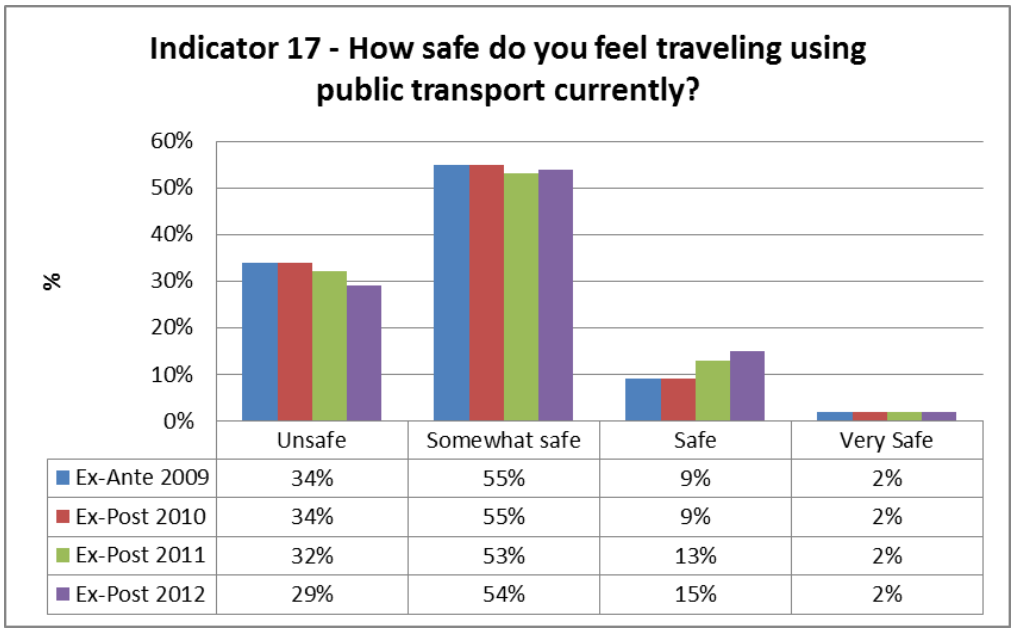
Table C2.5.1: Society indicators values

Indicator	Ex-Ante 2009	BAU 2009	Ex-Post 2010	BAU 2010	Ex-Post 2011	BAU 2011	Ex-Post 2012	BAU 2012	Difference Ex-Post - Ex Ante	Difference Ex-Post - BAU
Indicator17 (Perception of security)	34 % unsafe; 55% somewhat safe; 9%safe; 2 % very safe;	34 % unsafe; 55% somewhat safe; 9%safe; 2 % very safe;	34 % unsafe; 55% somewhat safe; 9%safe; 2 % very safe;	34 % unsafe; 55% somewhat safe; 9%safe; 2 % very safe;	32 % unsafe; 53% somewhat safe; 13%safe; 2 % very safe	34 % unsafe; 55% somewhat safe; 9%safe; 2 % very safe;	29 % unsafe; 54% somewhat safe; 15%safe; 2 % very safe	34 % unsafe; 55% somewhat safe; 9%safe; 2 % very safe;	-5 % unsafe; -1% somewhat safe; 6%safe; 0 % very safe	-5 % unsafe; -1% somewhat safe; 6%safe; 0 % very safe
Indicator 13(Awareness level)	41% fairly well understand; 19% well understand; 36% very well understand 4% don't know	41% fairly well understand; 19% well understand; 36% very well understand 4% don't know	41% fairly well understand; 19% well understand; 36% very well understand 4% don't know	41% fairly well understand; 19% well understand; 36% very well understand 4% don't know	36% fairly well understand; 25% well understand; 38% very well understand; 1% don't know	41% fairly well understand; 19% well understand; 36% very well understand 4% don't know	5% fairly well understand; 51% well understand; 44% very well understand;	41% fairly well understand; 19% well understand; 36% very well understand 4% don't know	-36 fairly well understand; 32 well understand; 8 % very well understand	-36 fairly well understand; 32 well understand; 8 % very well understand
Indicator 14 (Acceptance level)	92 % accept; 8 % don't know	92 % accept; 8 % don't know	92 % accept; 8 % don't know	92 % accept; 8 % don't know	95 % accept; 5 % don't know	92 % accept; 8 % don't know	95 % accept; 2% don't accept 3 % don't know	92 % accept; 8 % don't know	3 % accept; 2% don't accept -5 % don't know	3 % accept; 2% don't accept -5 % don't know

Measure title: PUBLIC TRANSPORT SECURITY PROGRAM IN CRAIOVA

City: Craiova Project: MODERN Measure number: 05.05

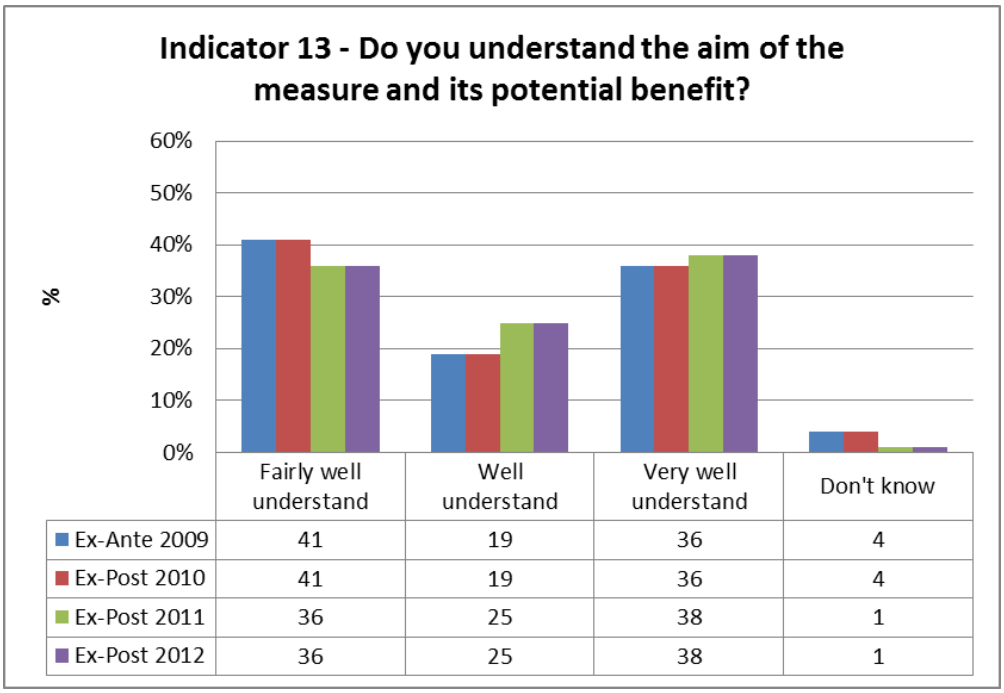
Indicator	Ex-Ante 2009	BAU 2009	Ex-Post 2010	BAU 2010	Ex-Post 2011	BAU 2011	Ex-Post 2012	BAU 2012	Difference Ex-Post - Ex Ante	Difference Ex-Post - BAU
Local indicator:“ Frauds level”	About 13-14 /year	About 13-14 /year	About 13-14 /year	About 13-14 /year	0 antisocial events on lines “ 9” and”E1R”	About 13-14 /year	3 antisocial events(on lines “ 9” and”E1R”) after 6 months of operation system	About 13-14 /year	Decrease by 50% lines “ 9” and”E1R”	Decrease by 50% lines “ 9” and”E1R”



	Unsafe	Somewhat safe	Safe	Very Safe
Ex-Ante 2009	34%	55%	9%	2%
Ex-Post 2010	34%	55%	9%	2%
Ex-Post 2011	32%	53%	13%	2%
Ex-Post 2012	29%	54%	15%	2%

Picture 18 C2.5.1

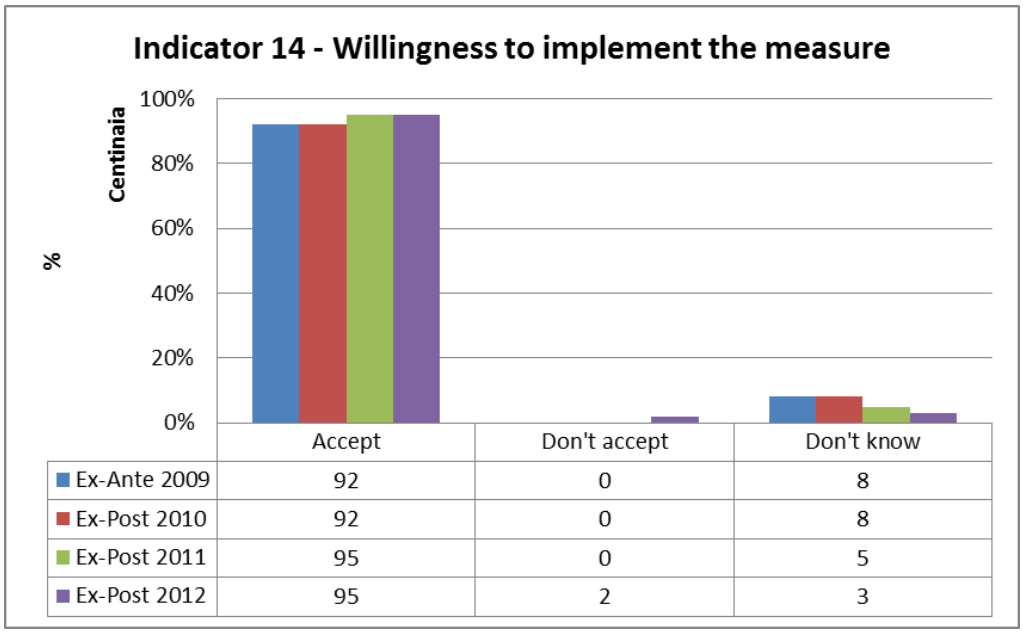
In the picture above at the question How safe do you feel traveling using public transport currently?, there is an improvement in the feeling of safety of the PT users. The values increase from 9% to 15% in two years and the system is only implemented on 15 buses, that is 8% of the total bus fleet of RAT Craiova.



	Fairly well understand	Well understand	Very well understand	Don't know
Ex-Ante 2009	41	19	36	4
Ex-Post 2010	41	19	36	4
Ex-Post 2011	36	25	38	1
Ex-Post 2012	36	25	38	1

Picture 19 C2.5.2

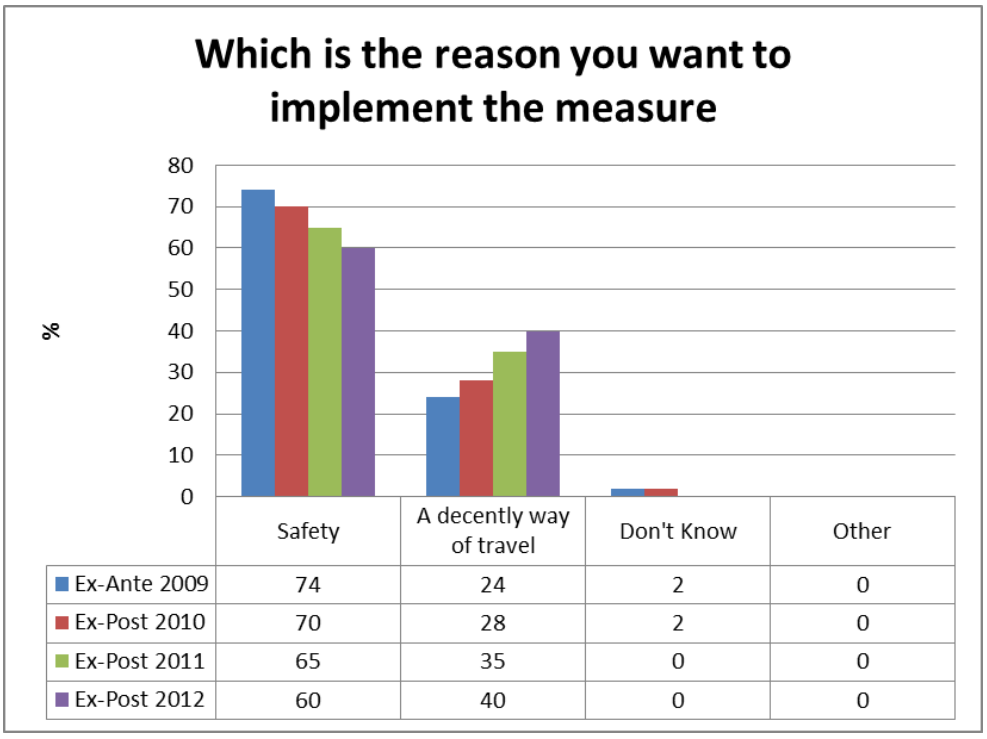
The picture above shows that the measure is very well understood: 38% of the PT users understand what are the advantages and results of this measure.



	Accept	Don't accept	Don't know
Ex-Ante 2009	92	0	8
Ex-Post 2010	92	0	8
Ex-Post 2011	95	0	5
Ex-Post 2012	95	2	3

Picture 20 C2.5.3

As we can see from the picture above all the population of Craiova that uses PT in some form, accept as a positive fact the implementation of this measure.



	Safety	A decently way of travel	Don't Know	Other
Ex-Ante 2009	74	24	2	0
Ex-Post 2010	70	28	2	0
Ex-Post 2011	65	35	0	0
Ex-Post 2012	60	40	0	0

Figure 21 Implementing reason

In the questionnaires one of the questions was about the reasons why this measure should be implemented. As you can see from the figure above an average 65% of the interviewed people want the implementation of this measure as they want more secure public transport vehicles and stations. As expected, after the implementation of the measure, the “security ” answer decreased, while the answer

"a decent way of travel" increased. This is due to the fact that, when people feel themselves safe, then they want more quality in PT.

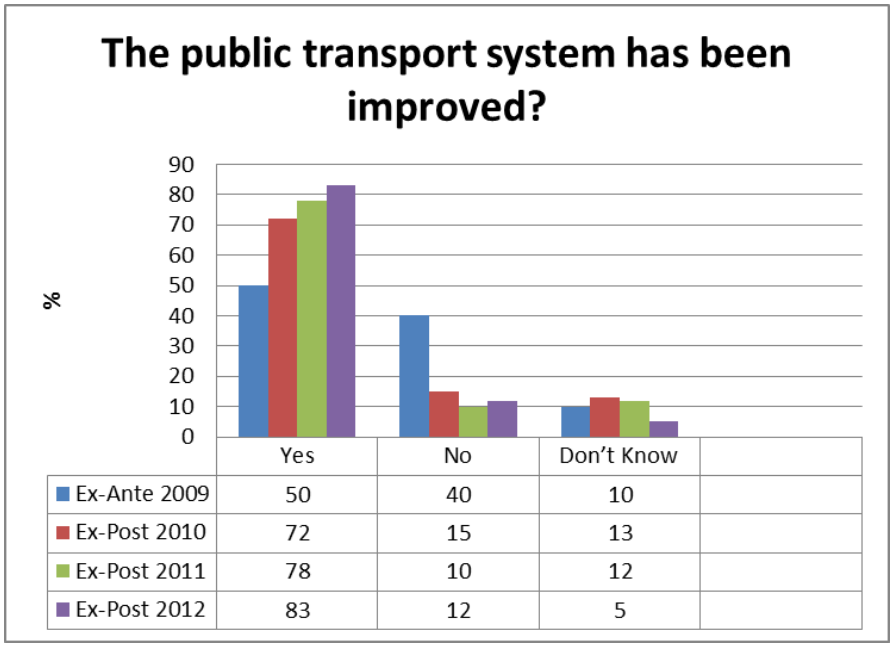
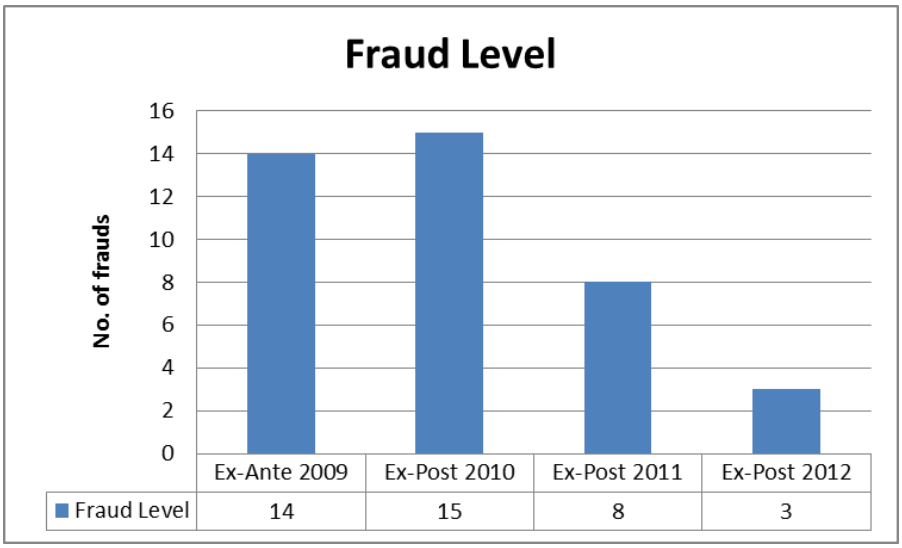


Figure 22 Improvement of the PT



Picture 23 C2.5.4

The fraud level was almost the same in 2010 as in the ex-ante period but in 2011 and 2012 the number of frauds drastically decreased. This decrease should be due to the surveillance system implemented in the PT system.

C3 Achievement of quantifiable targets and objectives

No.	Target	Rating

1	To install video surveillance cameras in 10 stations and 15 buses	**
2	To decrease fraudulent and antisocial issues by 10% in PT	**
3	To increse the perception of security by 3 %	**
NA = Not Assessed O = Not Achieved * = Substantially achieved (at least 50%) ** = Achieved in full *** = Exceeded		

C4 Up-scaling of results

RAT Craiova intents to upscale the measure to trams but it depends on the Municipality budget. rams have a higher average occupancy and an implementation of a surveillance system is needed in order to make trams more pleasant to public transport travelers.

The upscaling of the results is needed but when and how it will be applied is not known, therefore an evaluation of the impact if this measure can be upscaled can't be done at this moment.

C5 Appraisal of evaluation approach

The evaluation strategy of this measure has been focused on surveys (face to face and by e-mail) to public transport users in order to analyze their perception of the service quality, security, and frauds level. Atthe same time, the awareness and acceptance level were assessed.

The number of distributed questionnaires in the ex-ante survey was 150 and the feedback was 100. The number of distributed questionnaires in the ex-post survey (August 2011) was 150 and the feedback was 131.

Each person involved in the ex-ante survey provided to us the telephone number and the e-mail address in order to be involved in the ex-post surveys, too.

The people involved in these surveys were 80% youth (mainly students that use public transport) and 20% people over the age of 35.

The indicator "Fraud level" has been assessed following the recording from each surveillance camera placed on 10 stations and 15 buses.

C6 Summary of evaluation results

The key results are as follows:

Key result 1 – Taking into consideration the surveys done by PT users, the perception of security increased by 4 % and people feel more protected from pocket or bag thieves

Key result 2 – The frauds level decreased by 50% because thieves or agitators are discouraged by surveillance cameras that keep recording the antisocial events. On the other hand, people still block the ticket boxes in stations.

Key result 3- From the surveys, people`s satisfaction concerning the quality of service increased with 4%, also, 95% of surveyed people consider the surveillance system useful and 80% noticed the benefits of the system.

C7 Future activities relating to the measure

Continuous dissemination of the survey's results will make the municipalities from other cities aware of the benefits that come with a system like this and will see our good practices in order to implement the surveillance system to protect the people of their cities.

In the future, Craiova Municipality intents to install surveillance cameras in all important intersections having as the main target traffic monitoring but also public safety.

D Process Evaluation Findings

D.0 Focused measure

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

D.1Deviations from the original plan

The deviation from the original plan comprised:

Deviation 1 – Number of PT vehicles and stations endowed with video surveillance cameras: In the original plan 10 buses, 5 trams and 5 passenger stations were foreseen to be equipped with surveillance cameras. During the project, RAT Company considered more useful to install all the internal surveillance cameras on 15 new buses of the fleet, renouncing to install it on 5 trams. Then, the number of the stations was increased from 5 to 10, as the financial resources achieved allowed a larger number of the monitored stations. This of course gave the possibility to have a better level of service.

D.2Barriers and drivers

D.2.1 Barriers

Preparation phase

Cultural – People feel uncomfortable because of the cameras recording them

Technological – Technological problems, it means the system won't allow the real- time transmission of data just recorded, that leads to a difficult real time detection of antisocial incidents.

Implementation phase

Cultural – Peoples feel uncomfortable because of the cameras recording them

Planning – The period for tender was very long because of appeals, so the implementation of surveillance cameras system was delayed

Technological – Technological problems, it means the system won't allow the real- time transmission of data just recorded, that leads to a difficult real time detection of antisocial incidents.

Operation phase

Cultural – There are people who do not agree being kept under observation and consider the video surveillance system as an invasive tool in terms of its own privacy.

Technological – The system working in the buses doesn't allow the real time transmission of data just recording and the antisocial incidents are viewed on request and in case of complaints.

D.2.2 Drivers

Preparation phase

Organizational – IPA's research team is professional and there was a strong and clear leadership. The measure leader is a professional and highly motivated person to implement the surveillance system in Craiova.

Implementation phase

Planning – Positive results of testing during surveillance system installation

Organizational – IPA's research team is professional and there was a strong and clear leadership. The measure leader is a professional and highly motivated person to implement the surveillance system in Craiova.

Operation phase

Planning – Positive results of testing during installation and operation

Organizational – The technical team is professional and there was a strong and clear leadership. The measure leader is a professional and highly motivated person to implement the surveillance system in Craiova.

D.2.3 Activities

Preparation phase

Cultural – Implementation team and Local Dissemination Manager organized public events during which they explained the positive aspects of the surveillance system for personal security.

Organizational – Meetings of the measure team with RAT top management to emphasize the importance of the measure to obtain their maximum facilitating support. The measures M02.04, M08.02 and M 05.05 are implemented on the same vehicles and work as an integrated system.

Technological – The research team needed additional know-how to solve the data transmissions and try to offer a real time transmission. They tried to establish some collaboration with extern experts to solve the problem.

Implementation phase

Cultural – The implementation team and the Local Dissemination Manager organized public events during which they explained the positive aspects of the surveillance system for personal security.

Planning – The evaluation team for offers tried to be very quick to recover the wasted time with tender procedures.

Organizational – Meetings of the measure team with RAT top management to emphasize the importance of the measure to obtain their maximum facilitating support. The measure M02.04 and M08.02 and M 05.05 are implemented on the same vehicles and work as an integrated system.

Technological – The research team needed additional know-how to solve the data transmissions and try to offer a real time transmission. They tried to establish some collaboration with extern experts to solve the problem.

Operation phase

Cultural – The implementation team and the Local Dissemination Manager organized public events during which they explained the positive aspects of the surveillance system for personal security.

Technological – Monitoring the system in order to adjust, remove malfunctions if necessary and set up the technical parameters so that it operates in optimal mode and provides trust to travelers.

D.3 Participation

D.3.1. Measure Partners

Measure partner 1 Leading Role – IPA – IPA SA is a 47 year old Romanian industrial R & D company and it is the Romanian national institute for research and development, engineering in energy, automation and IT, with a large experience in European projects in technology transfer and information dissemination.

Measure partner 2 Principle Participant – **RAT** – Craiova Public Transport Company is the main public transport operator in the whole Oltenia region. In Craiova Municipality (320,000 inhabitants) it provides the citizen transport by trams, buses and micro-buses it owns (250 vehicles), transporting 65 millions of travellers every year.

Measure partner 3 Occasional Participant – **LCM** – The Local Council of Craiova Municipality (Primaria Municipiului Craiova) was organized and functions according to Law No. 215/2001 regarding Local Public Administration with the subsequent modification and completion.

D.3.2 Stakeholders

Stakeholder 1 – Alien Concept Company- The company is one of the best from Romania regarding the production of video – surveillance cameras equipment for buses and passenger stations. The company supplies all the necessary equipment, installs it and makes the requested tests.

Stakeholder 2 – Local Police – In Craiova it was set up a video monitor centre belonging to the Local Police in order to survey the big intersections of the city. This Police monitor centre can be connected to RAT video monitor centre (10 bus stations), in order to have more information for solving antisocial incidents.

D.4Recommendations

D.4.1 Recommendations: measure replication

Study, Demo platform, Equipment – To study what kind of investment will be made in the demo area to keep the initial place of surveillance cameras in stations and not to be forced to change it.

D.4.2 Recommendations: process (related to barrier-, driver- and action fields)

PT users, Cameras, Safe environment, Afraid – The initial view of the people that use the public transport every day is that the municipality is spying on them with the cameras every time. This feeling is only at the beginning and after a period they realize that those cameras are helping them to get a much nicer ride and a safer environment. For other cities that want to implement the surveillance system in their public transport the indignation of the people who use PT every day is just temporary, but after a while everything is ok.

Annex 1: Ex-ante questionnaire

Instructions

This survey is part of an European project - MODERN (Mobility, development and reducing energy consumption) and aims to collect your experiences in traveling by buses

Surveillance System to be applied consists of cameras installed in 10 stations and 15 buses and communication equipment that will transmit images from monitored sites to RAT dispatcher.

Your answers will be treated confidentially.

Thank you for your participation!

Ex-ante questionnaire

M 05.05: PUBLIC TRANSPORT SECURITY PROGRAM IN CRAIOVA

1. Gender: F ☐ M ☐

2. Age:

Up to 15	15-24	25-45	45-54	55-65	over 65

3. Background (the last education institution graduated):

· master	· faculty	· secondary school	· primary school

4. Labor market status:

employed	unemployed	student

5. Public transport user

yes ☐ no ☐

Awareness level

6. Do you know the MODERN project and measure?

yes ☐ no ☐ Don't know ☐

Measure title: PUBLIC TRANSPORT SECURITY PROGRAM IN CRAIOVA

City: Craiova Project: MODERN Measure number: 05.05

7. How important are the following sources of information concerning installing the camera surveillance system on buses and stations?

	unimportant	Rather unimportant	Rather important	Very important	I don't know
Transport Company of Craiova- RAT website	☐1	☐2	☐4	☐5	☐6
Media	☐1	☐2	☐4	☐5	☐6
Colleagues/acquaintances	☐1	☐2	☐4	☐5	☐6
Forums or similar on the internet	☐1	☐2	☐4	☐5	☐6
Other, please specify below:	☐1	☐2	☐4	☐5	☐6

8. Do you understand the aim of the measure and its potential benefit?

fairly well understand	well understand	very well understand	Don't know

Acceptance level

9. What is your opinion related to installing camera surveillance system in buses and stations?

Less good	good	Quite good	Very good	Don't know

10. Willingness to implement the measure:

Accept	Do not accept

11. Which is the first reason for which you want to implement the measure?

☐1	safety
☐2	A decently way to travel

☐3	Other, specify …….
☐4	Do not know

Quality of services

12. How would you evaluate the quality of public transport in Craiova, now, before implementing the surveillance cameras?

Very dissatisfied	Somewhat dissatisfied	satisfied	Very satisfied	Don't know

13. How do you perceive journey with public transport, now, before implementing surveillance cameras?

uncomfortable	Somewhat Comfortable	Comfortable	very Comfortable	Don't know

14. Have you ever filled questionnaires for the project -MODERN?

☐1	Yes
☐2	no

Perception of security

15. How safe you feel traveling by public transport currently?

unsafe	Somewhat safe	Quite safe	safe	Very safe

Annex 2: Ex-Post Questionnaire

Instructions

This survey is part of an European project - MODERN (Mobility, development and reducing energy consumption) and aims to collect your experiences in traveling by buses

The Surveillance System has applied consists of cameras installed in 10 stations and 15 buses and communication equipment that transmits images from monitored sites to RAT dispatcher

Your answers will be treated confidentially.

Thank you for your participation!

Ex-post questionnaire

M 05.05: PUBLIC TRANSPORT SECURITY PROGRAM IN CRAIOVA

1. Gender: F ☐ M ☐

2. Age:

Up to 15	15-24	25-45	45-54	55-65	over 65

3. Background (the last education institution graduated):

· master	· faculty	· secondary school	· primary school

4. Labor market status:

employed	unemployed	student

5. Public transport user

yes ☐ no ☐

Awareness level

Measure title: PUBLIC TRANSPORT SECURITY PROGRAM IN CRAIOVA

City: Craiova Project: MODERN Measure number: 05.05

6. Do you know about the progress of the measure?

yes ☐ no ☐ Don't know ☐

7. How important are the following sources of information concerning installing the camera surveillance system on buses and stations?

	unimportant	Rather unimportant	Rather important	Very important	I don't know
Transport Company of Craiova- RAT website	☐1	☐2	☐4	☐5	☐6
Media	☐1	☐2	☐4	☐5	☐6
Colleagues/acquaintances	☐1	☐2	☐4	☐5	☐6
Forums or similar on the internet	☐1	☐2	☐4	☐5	☐6
Other, please specify below:	☐1	☐2	☐4	☐5	☐6

8. Do you understand the benefits of the measure after implementation and for the near future?

fairly well understand	well understand	very well understand	Don't know

Have you noticed the benefits of the measure lately?

yes ☐ no ☐ don't know ☐

Acceptance level

10. What is your opinion related to installing camera surveillance system in buses and stations?

Less good	good	Quite good	Very good	Don't know

11. Willingness to keep and extend the surveillance system to more PT vehicles and stations:

Accept	Do not accept

12. Which is the first reason for that you want to keep and extend the surveillance system to more PT vehicles and stations in the near future?

☐1	safety
☐2	A decently way to travel
☐3	Other, specify:…….
☐4	Do not know

Quality of services

13. How would you assess the quality of public transport in Craiova, now, after implementing the surveillance cameras?

Very dissatisfied	Somewhat dissatisfied	satisfied	Very satisfied	Don't know

14. How do you perceive journey with public transport, now, after implementing the surveillance cameras?

uncomfortable	Somewhat Comfortable	Comfortable	very Comfortable	Don't know

15. Do you think the public transport services have been improved lately?

yes	no	Don,t know

16. Have you ever filled questionnaires for the project -MODERN?

☐1	Yes
☐2	no

Perception of security

How safe do you feel traveling by public transport after the implementation of the surveillance system?

unsafe	Somewhat safe	Quite safe	safe	Very safe

Do you think the public transport has been safer lately?

Safer than before	no safer than before	Don't know

The questionnaires were completed by the following class of people:

female	male
39 %	61%

Up to 15	15-24	25-45	45-54	55-65	over 65
3%	2%	22%	38%	20%	15%

citizen passing through or living in the city center	Car owner passing through city center
47 %	53%

M06.04 – Executive summary

The purpose of this measure is to implement an experimental carpooling service for RAT, The Public Transport Company in Craiova.

Carpooling is the sharing of car journeys so that more than one person travels in a car. By having more people using one vehicle, carpooling reduces each person's travel costs such as fuel costs, tolls, and the stress of driving. Carpooling is also seen as a more environmentally friendly and sustainable way to travel as sharing journeys reduces carbon emissions, traffic congestion on the roads, and the need for parking spaces. Craiova Municipality together with RAT management decided to promote this service and to start a first experimentation for RAT employees. So it was decided to set up a special software able to set up the car poolers crew, to promote this service among RAT employees.

Moreover it was decided to arrange a special parking place for car-poolers; this one of most effective way to encourage this type of transportation.

For the measure implementation, a software program was developed. The software program was a website application which groups the people willing for carpooling, taking into consideration their address. The software application allows the identification of groups of maximum 5 employees (that have the shortest moving on foot distance between them).

As a result of software implementation, 33 groups of people involved in car-pooling were created.

The Municipality provided to car-poolers from RAT a special parking place, limiting its access to vehicles transporting at least three people. The plates of the allowed cars were recorded in a database and the access allowed to the parking place only if the car has been registered in the database and transports at least three people.

Even if the measure implementation was delayed and the operation period was short, only two months, the first results and the social impact evaluation sorted very fair results both in the service use than in costs savings and on users willingness to continue the experimentation.

Craiova Municipality is going to decide to implement this measure to other industrial companies, and in several areas of the town.

Even if the operation period was shorter than foreseen, the start-up of the service revealed a good appreciation of the measure. RAT direct involvement and the availability of a car parking place represented an essential tool for a good start up. At the moment RAT have more request from the employees to apply the service than the available reserved places in the parking lot.

A Introduction

A1 Objectives

A. High level / longer term:

- To optimise the traffic flow

B. Strategic level:

- To reduce congestion in crowded industrial area by promoting car pooling

C. Measure level:

- To decrease the using of private cars by 10% in industrial area building parking facility for car poolers

A2 Description

City of Craiova has several modes of public transportation, but they do not cover the whole area of the city. There are limited solutions to reach industrial zones by bus or by tram, in peak or off-peak of the day.

Public transportation beyond the junction area between residential zone and West industrial platform is provided only by tram at large intervals (every hour) which cause discontinuities in transport. The only way of transportation which ensures mobility and independence remains the own cars.

The number of cars in the streets in this zone is approximately 2500 standard vehicles/hour in peak and 2880-3000 standard vehicles/hour in the next 3 years.

In the industrial zone, the parking places are an important problem for RAT Company. This company, located in the Western industrial platform has parking spaces but they are not sufficient for all cars. The traffic flow, in the area around RAT Comapany, is crowded because the cars are parked on the street.

CIVITAS Measure 06.04 consists of the implementation of a carpooling service to encourage this transportation mode for RAT's employees. This type of transport is used mainly for employees transportation to work and refers to pooling a car with other 3 or 4 working colleagues.

The new car pooling service was implemented in four steps:

1. Design of the service scheme
2. Development of a software application able to support the use of the car pooling scheme by the potential users

3. Identifying people that should adopt the car-pooling service
4. Set up of the reserved carpooling parking lot.

The selected scheme is supported by the developed software whose main functions are:

- To provide a support to create the car pooling crews
- To manage the parking spaces reservations
- To calculate the trips parameters and the savings in driven km

The software application allows the identification of groups of minimum 3 - maximum 5 employees (having the shortest walking distance among them). An e-mail is automatically sent to each person containing the addresses of the 4 closest colleagues. If at least 3 members accept the creation of the crew and decide to subscribe for the car pooling service the group is composed and saved in the database. If one or more members do not agree, the program tries to match other people living in the same area and send others e-mails to complete the group.

The figures below show details about the members of the group.

Figure A2.2 Main screen of the cap-pooling application

To facilitate the start-up of the service, Craiova Municipality provided to RAT car-poolers a reserved parking place, close to the RAT facilities.

The following picture shows a schematic drawing of the parking lot. The parking lot is highlighted in grey color.

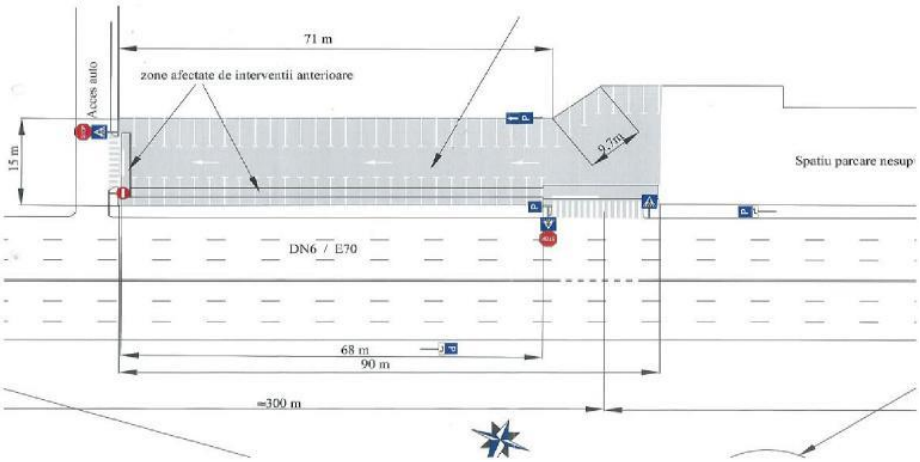


Figure A2.3The reserved parking lot

All the cars involved in the carpooling scheme have to be recorded in the application software database and the access to the parking place is allowed only if the car is registered in the database.

The work program foresaw the following activities:

- Development of the carpooling matching application (software tool) and upload data in the web application;
- Locating the place for the parking facility; .
- Elaboration of the technical requirements for the arrangement of the parking area;
- Launching of the procurement procedure;
- Arrangement of the parking place: division, markings for parking spaces and access ways in the parking;
- Dissemination activities to promote the service among the potential users;
- Launch and exploitation of the carpooling service;

B Measure implementation

B1 Innovative aspects

The innovative aspects of the measure are:

New mode of transport exploited - This measure introduced a new mode of transportation for RAT employees, to the West industrial area of Craiova - carpooling system.

Targeting specific user groups - Carpooling service addresses only to RAT employees.

New physical infrastructure solutions - Municipality set a parking place for RAT employees that use the carpooling service.

B2 Research and Technology Development

Analyzing the possibilities of building a parking for carpooling service

Some parking spaces have been analyzed for carpooling parking building, in the industrial area in the west side of the city. This research activity resulted in finding a of parking lot near the Public Transport Company's headquarters

Traffic study, alternative and flexible services

A traffic study was carried out in the industrial areas where the predominant transportation mode is the private car because public transport is limited in these areas.

This analysis showed that the development of a carpooling service and building of a special parking for carpooling would be an alternative to existing transportation mode in the area.

B3 Situation before CIVITAS

Because of the location of RAT headquarter and because of the working time before the implementation of the car pooling service RAT employees had no other option for transportation to/from work place than their own cars or taxi.

The huge number of cars parked on street or around the RAT headquarter showed how relevant was the necessity to find other solution; moreover the not regulated parking contributed to crowd the area in the industrial zone. The vehicles flow during peak hours was approximately 2.500 standard vehicles / hour and there is a forecast of 2.880-3.000 standard vehicles / hour for the next 3 years.

The set-up of a car pooling service should lead to double the benefits: to reduce up to 1/3 the vehicle flow (if most of the companies start with the same scheme); to reduce of the same percentage the parking space needs. Moreover there would be advantages coming from fuel savings; emission reduction and so on.

This is the reason for that RAT Company together with the Municipality decided to set a carpooling service and to create a parking lot dedicated to RAT carpoolers.

In any case it has to be observed that is the first carpooling parking and service in Craiova and perhaps the first in Romania.

B4 Actual implementation of the measure

The measure was implemented in the following stages:

Stage 1: Planning and design of the measure (Sept 2009-Sept 2012)

In this stage two different aspects of the design matter were analyzed: the existence of transport services in the area and the need to develop a carpooling type service in the area as a transportation alternative system to the methods currently in use.

The analysis carried-out showed that the development of a carpooling service and the arrangement of a special parking for carpooling could be a possible alternative way to the existing transportation mode in the area.

According to these outcomes the service has been designed. During this phase become evident the need of a software application to manage the service, mainly to match the components of the car pooling group and the demand of parking lot for the related cars with the parking space availability. Moreover, the identification of the potential users was done, and the practical methodologies and rules for the service itself were defined.

Stage 2 : Traffic study, alternative and flexible services (March 2010- Sept 2010)

In the first versions of DoW the parking place was foreseen for several companies operating in the "junction area" between the residential zone and the west industrial platform or commuters coming from out of the City.

Several considerations led to a restriction of the objectives:

- The 1st one was that this represented the first experiment of a "professionally based car pooling scheme" in Romania, so that an experimental phase was needed to check the procedures to avoid errors on a large scale;
- The 2nd was more practical: the number of parking spaces available to be reserved to car poolers was too small compared to the need for the whole area of interest.

These considerations led to the conclusion to restrict the service to a first experimentation constituted by the RAT employees. So, the parking place was experimentally devoted to RAT employees who adopt the car-pooling as a transportation mode for their journeys home to work and vice versa. So the location of the parking lot has been selected close to RAT headquarter. The technical requirements for the arrangement of the parking lot were elaborated. The following actions were done:

- Definition of a parking space - Marking the parking places
- Setting the entrance and the exit of the parking lot and marking the access ways inside the parking lot.

The first idea was to equip the parking lot with an automatic plate recognition system based on OCR to recognize the cars entitled to enter the parking and command an electrical barrier. A market analysis was developed in this sense.

The parking place was finalized in terms of arrangement on September 2012.

<u>Launching of the procurement procedure.</u>

Unfortunately at this step organizational and bureaucratic problems arose regarding the property registration of the land where the parking place has to be allocated. This situation led to a first delay and changed the implementation plan.

The Municipality had to organize the public procurement, as owner of the land. The procedure was launched only on August 6, 2012 and recorded a further delay as no bidder was available. The public procurement had to be repeated three times. Finally it was assigned by DOMARCONS SRL on September 2012.

For this reason, the measure implementation was delayed and led to a shortening of operation period.

Stage 3: Implementation of the parking facilities and setting up flexible services (Sept 2010-Sept 2012)

Arrangement of the parking place: division, markings for parking spaces and access ways in the parking.

The accumulated delays made evident that there was no possibility to follow the foreseen way, as the times to install the electrical barriers and finalize the work (given also the winter period which made it difficult the works) were not compatible with the Project schedule. To have the possibility to finalize the measure within the project lifetime and to carry out as much as possible the evaluation, on August 2012 it was decided to renounce to the automatic control of the parking and to exploit the control of the entitled cars by a guard person employee of RAT.

Figure. B4.1 The parking

Development of the carpooling matching application (software tool)

A specific software program was developed for car pooling service in order to be used by the employees of Public Transportation Company.

The main function of the application software was to identify RAT employees living close one to each other (distance walking between them being minimal) and to communicate them via e-mail about the four nearest colleagues in order to create a group of at least 3 people who can travel

together to work, by one car only, to manage the matching, the distances for each person, to calculate the reducing of the distance by applying this services.

The software program is a web application which reserves the places in the parking lot and groups the people willing for carpooling, taking into consideration their home address. Employees, who can set up a group in order to travel by one car, can use the available parking places free of charge.

The first step in searching for potential carpool matches is to enter the personal carpool information. Basically, users can create profiles on the website, and specify whether they are looking for carpooling as a driver or not.

An e-mail is automatically sent to each person in the group announcing about the closest 4 colleagues considering the home address. If at least 3 members accept the creation of the group and want to subscribe through a link found in the initial email, this group will be saved in the software database.

In figure is shown the main page of the software application

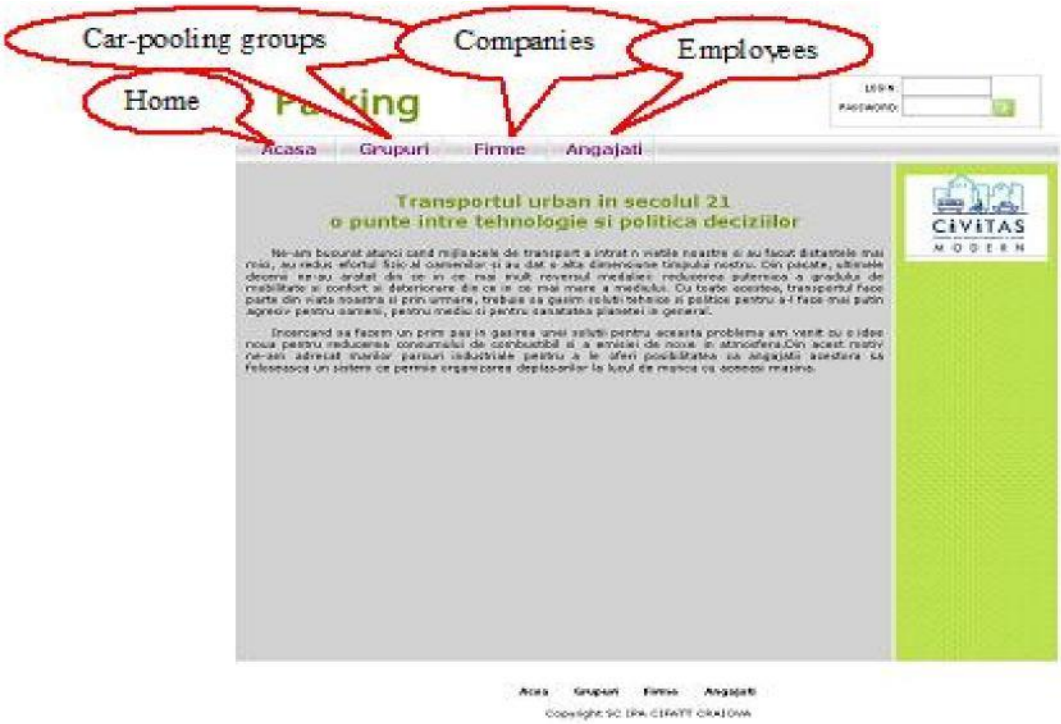


Figure B4.2 – The main page of the software application

Using these details the system can provide the most accurate matches possible. An important step in the data recording is to map the address, and pick the closest address from an interactive map (Figure B4.3).

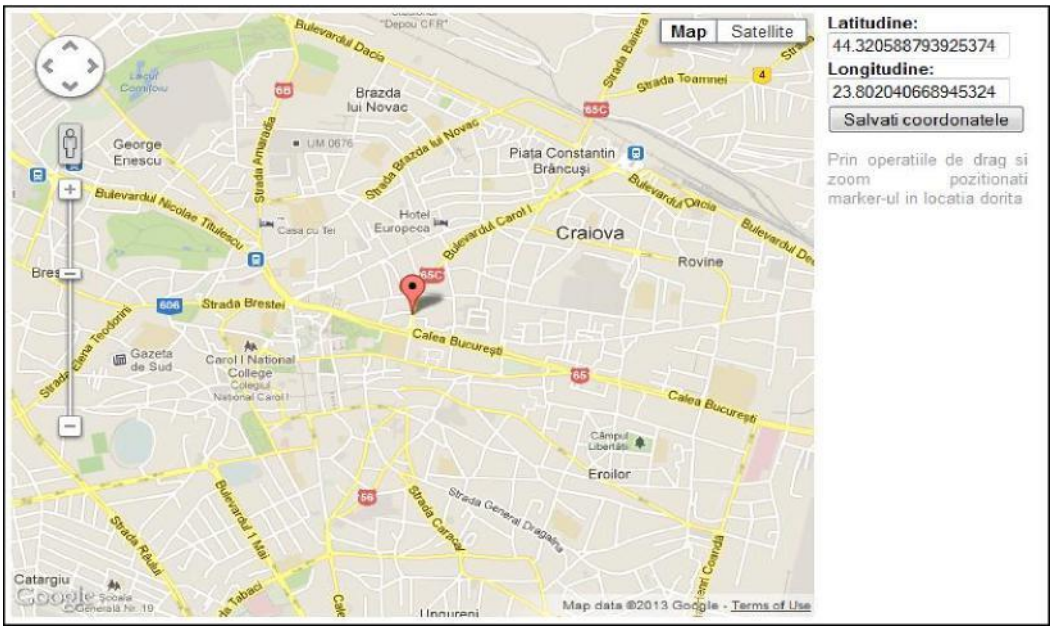


Figure B4.3 – Car-pooling software tool - The interactive map

When the data were recorded, the driver start searching for potential carpool matches. The data recorded are compared with data recorded by other users. The user receives a list with potential matches. Once the user has selected the preferred match, he may contact that person by sending him an e-mail, via site (Figure 9).

Under certain conditions, the system allows the user to be able to choose from a list of potential car poolers.

If one or more members do not agree to this subscription, the program tries to find other people leaving in the same area and send the information e-mail when the group is complete.

Nr. crt.	Nume	Adresa	Date de contact	Firma	Stare	
1	Popa Antonel	Ulmului, 34, , Centru	ppdoru@yahoo.com 0769085909	RAT Craiova	Membru	X
2	Barbu David	Basarabia, 4, , Gara	david-barbu@yahoo.com 0720547911	RAT Craiova	Membru	X
3	Cernea Lucian	Decebal, 66, 23, LAPUS	marianlcn@yahoo.com 0765214071	RAT Craiova	Membru	X
4	Marinescu Virginia	Simion Stoilov, 5, D8, Rovine	virginia_marinescu@yahoo.com 0769198704	RAT Craiova	Membru	X

Figure B4.4 – List of the registered persons

The windows below (Figure B4.5, Figure B4.6) show details about the members of the group.

Figure B4.5 – The users list contains: names, postal address, e-mail address List of the registered persons

Figure B4.6 - Menu for adding the users

Automatic calculation of the distances

When users create accounts, in addition they must enter personal data and geographical coordinates of their location, on the software interactive map and save their relevant coordinates.

Every day the RAT front guard inputs the data regarding who comes at RAT using carpooling system (name of each persons of the group, groups and drivers, using check box of software program for carpoolers and different check box sign for drivers.

Thus RAT has an exact record of groups who come to work every day using this system.

The system calculates and displays the number of kilometers saved based on several criteria:

- Presence of each person that is found inserted by the guard in the daily software database table present day;
- Distance that should have been covered with the cars of all the group components (the driver is excluded). This distance is calculated automatically by the system based on GPS coordinates as the distance between the GPS coordinates of RAT Craiova and GPS coordinates of the person. Distance is not a straight line and is calculated based on designed route.

The software has been tested, implemented and uploaded on the RAT website www.ratcraiova.ro. The first data were uploaded on January 2012 and the application was made available to the RAT employees for its use on September 2012.

Stage 4 System operating (Oct 2012–Nov 2012)

The real scale launch was done on October 2012. The data entered into the system were related to 122 RAT employees over a total of 224.

B5 Inter-relationships with other measures

The measure is not related to any other measure.

C Impact Evaluation Findings

C1 Measurement methodology

C1.1 Impacts and Indicators

Table C1.1: Indicators.

No.	Impact	Indicator	Data used	Comments
Local indicator 1	Transpo rt	Number of car poolers	Number of RAT employees that agree the carpooling service	Data provided by RAT related to people that want to involve in car pooling
Local indicators 2	Energy	Fuel saved Kms saved	Kms saved by carpooling	Calculated for 2 months of demonstration
Indicator 13	Society	Awareness level	Percentage of respondents with knowledge of the measure	Face to face questionnaire

Detailed description of the indicator methodologies:

Local indicator 1 (Number of car poolers) – Is the number of people involved in carpooling

Local indicators 2 (Fuel saved, Kms saved) – The quantity of fuel saved as a result of Kms saved by car owners from RAT involved in carpooling service.

Indicator 13 (Awareness level)

The survey was made to see the impact of the measure on RAT employees. Taking into consideration the RAT employees traveling to work by own car, face to face questionaires have been circulated.

The most important questions are:

1. Gender.
2. Do you know about the measure progress?
3. Do you understand the benefit of the measure?

C1.2 Establishing a Baseline

Before the start up of the carpooling 214 employees from RAT came to work by their own car, so the parking place around RAT was much crowed especially in peak hours. All the indicators were set to "0".

The base line is the year 2010 when the indicators had the following values:

Local indicator 1 – Number of car poolers

Indicator	Ex-Ante values
Number of car poolers	0

Local indicators 2 – Fuel saved, Kms saved

Indicator	Ex-Ante values
Fuel saved (litters)	0
Kms saved	0

Awareness level

214 questionaires have been circulated to potential car pooling people (RAT employees)

Questions	Ex-Ante values
Do you know about the measure?	Yes 70% No 30%
Do you understand the benefit of the measure?	
Do not understand	20%
Well understand	37%
Very well understand	20%
Don't know	23%

C1.3 Building the Business-as-Usual scenario

In absence of MODERN project, carpooling service would have not been implemented, so, RAT assumed that all the indicators keep the ex-ante values.

Local indicator 1- Number of car poolers

Indicator	BAU values
Number of car poolers	0

Local indicators 2- Fuel saved, Kms saved

Indicator	BAU values
Fuel saved (litters)	0

Kms saved	0

Awareness level

Questions	BAU values
Do you know about the measure?	Yes 70% No 30%
Do you understand the benefit of the measure?	
Do not understand	20%
Well understand	37%
Very well understand	20%
Don't know	23%

C2 Measure results

C2.2 Energy

The total number of the RAT employees is 786. The employees in the administrative area (where the carpooling service was implemented) are 224.

The service started as demo on January 2012 (based on the RAT own parking and on the same scheme), as a real scale service on October 2012.

During October and November 2012, the main obtained results were:

- 122 - persons recorded in the RAT car pooling data base.
- 33 - carpooling groups.
- 843 - trips exploited (round trip).
- 6’187.62 driven km saved.
- 711.58 l – fuel savings (11.5 l/100Kms).
- 3.67 Km - trip medium length.

By considering the group of car-pooling users (RAT employees), the kilometers saved by the service have been estimated together with the amount of fuel saved for 2 months of demonstration (Fig. C2.2.1). For the calculation of the fuel saved, we used a consumption of 11.5 liters/100 Km as result of the question (face-in-face) asked to the RAT employees that use the carpooling system.

This consumption was calculated as a yearly mean value: 4 month x 13.5 l/100 Km + 8 month x 10.5 l/100Kms.

Table C2.2.1: energy indicators results

Indicator		Before (date)	BAU	After (date)	Difference: After – Before	Difference: After –BAU
Local indicators	**Fuel saved**	0 (2010)	0 (2011) 0 (2012)	339.53 (October 2012) 372.05 November (2012)	339.53 372.05	339.53 372.05
	Km saved	0 (2010)	0 (2011) 0 (2012)	2’952.382 Km (October 2012) 3’235.237 Km November (2012)	2’952.382 3’235.237	2’952.382 3,235.237

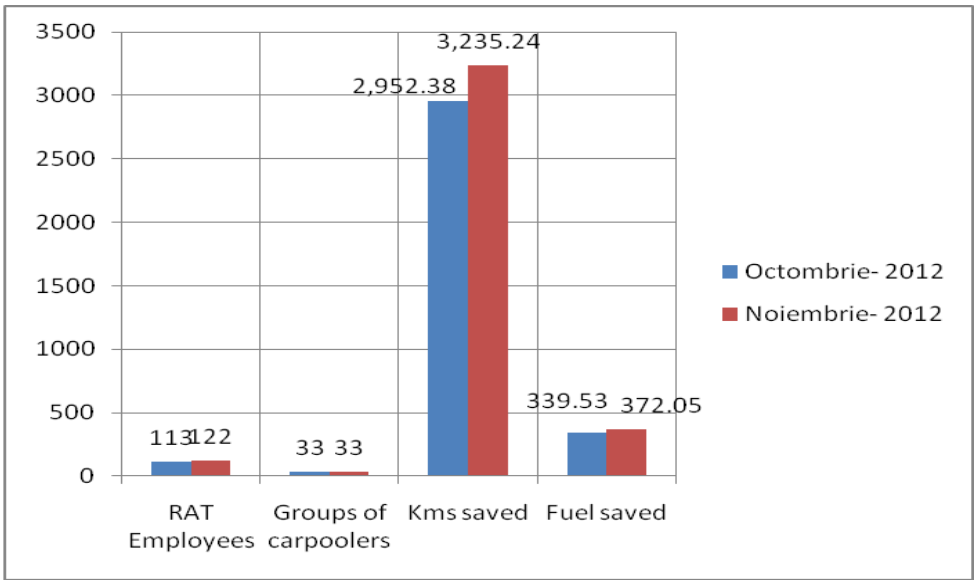


Figure C2.2.1

C2.4 Transport

The people that wanted to involve in car pooling were recorded in a RAT data base starting to January 2012. In January 2012, 1 person recorded in the list and month by month, number of people increased.

During this first period the service was provided using the general RAT parking.

In October and November 2012, when the parking place was available, 113, respectively 122 people that formed 33 groups were involved in carpooling.

Table C2.4.1: transport indicator results

Indicator	Before (date)	BAU (date)	After (date)	Difference: After –Before	Difference: After –BAU
Local indicator Number of car poolers	0 (2010)	0 (October 2011) (November 2011) 0 (October 2012) (November 2012)	113 people involved 33 groups (October 2012) 122 people involved 33 groups (November 2012)	113 people involved 33 groups 122 people involved 33 groups	113 people involved 33 groups 122 people involved 33 groups

Year: 2012	Nr. angajati	Grupuri
January	1	0
February	2	1
March	4	2
April	5	3
May	6	4
June	6	4
July	10	5
August	23	9
September	88	31
October	113	33
November	122	33

Table C2.4.1 – the carpooling groups created

The table C2.4.1 show the groups have been created by carpooling system

C2.5 Society

In ex-post evaluation of awareness level the results of the survey carried out for the deliverable "Social Impact" were used. The survey was applied to 122 RAT employees involved in carpooling, in November 2012

Table C2.5.1:

Indicator	Before (date)	BAU (date)	After (date)	Difference: After – Before	Difference: After – BAU
Awareness level	Know the measure 70% Do not know 30% Do not understand- 20% Well understand 37 % Very well understand 20% Don't know 23 % (2010)	Know the measure 70% Do not know 30% Do not understand- 20% Well understand 37 % Very well understand 20% Don't know 23 % (November 2012)	Know the measure 100% Do not know 0% Do not understand- 0% Well understand 80 % Very well understand 20% Don't know 0 % (November 2012)	30% increased 30% decreased 20% decreased 43% increased 0 23% decreased	30% increased 30% decreased 20% decreased 43% increased 0 23% decreased

Car pooling service started only in October and the survey was made in the first days of November. So the results of this report on socio economic analysis must be evaluated with some concerns:

1. The general perception of the car pooling service is good, and the current users are willing to preserve this service and recommend for an extension to their colleagues and other Companies.
2. In general even the users seem not well informed about the finality of the service; they appreciate very much the advantage to have a reserved car parking place but no more else.
3. The most important obstacle foreseen is the personal mobility limitation due to the car sharing. Even in other European towns, this seems to be the greater obstacle for an extension of this type of mobility mode.
4. The economic advantage seems not well understood by the users.

In any case it is possible to try some conclusions and a few suggestions for future developments:

a. Carpooling is a environmentally friendly and sustainable way to travel through sharing journeys, which could decrease driving stress and contribute to the reduction of pollutant emmissions, decreasing of the traffic on the roads and of parking lot occupancyIt is necessary to improve communications about finality and real advantages of this service; this should help other possible deployments (especially in cases where no reserved car parking place will be available).
b. It seems important to define car-pooling rules (about organization, car parking access, cost division and so on; the app to generate crews is only one starting point.
c. Another opportunity is to create a Car pooling Community to exchange experiences to enforce the use of the service and to start something as a viral dissemination of it.

In conclusion the car-pooling scheme was judged as a good initiative for Craiova and so this demonstration site could became the starting point for this sustainable.

C3 Achievement of quantifiable targets and objectives

No.	Target	Rating
1	Promoting car-pooling and providing a parking facility as a motivation for car-poolers;	★★ = Achieved in full
2	To decrease the using of private cars by 10% in industrial area building parking facility for car poolers The people that wanted to involve in car pooling were recorded in a RAT data base starting to January 2012. 1 person recorded in the list and the number of people have increased month by month. During this time the service was provided at the RAT parking. In October and November 2012, when the parking place was available, 113, respectively 122 people that formed 33 groups were involved in car pooling services. The number of cars decreased from 122 to 33(which means a decrease of 73%)within this operation period of 2 months.	★★ = Achieved in full
NA = Not Assessed O = Not Achieved ★ = Substantially achieved (at least 50%) ★★ = Achieved in full ★★★ = Exceeded		

C4 Up-scaling of results

This project was an opportunity for the municipality to apply this new approch of flexible services for the industrial areas of Craiova by implementing this measure for the first time in the Western industrial area.

The implementing of this measure highlights that carpooling reduces the costs involved in repetitive or long distance driving by sharing cars and paying the main car owner. More than that, it was demonstrated that car pooling could also help reduce congestion and pollution in the industrial areas where the level of the pollution is a very high one. Replacing private automobiles with shared ones directly reduces demand for parking spaces, especially in the industrial areas where there are not enough parking places. The fact that only a certain number of cars can be in use at any one time reduced traffic congestion at peak times. Even more important for congestion, the strong metering of costs provides a cost incentive to drive less.

The municipality intends to further develop this measure to other companies from the Western industrial area and then, to other industrial areas from the Northern and the Eastern part of the city.

C5 Appraisal of evaluation approach

The evaluation of this measure focused on some indicators across the areas of transport, energy and society, which were to be measured in different ways and calculated.

Because of delays in implementation, the people that have expressed their willingness to involve in car pooling service used the parking place a short period of time, for 2 months, in October and November. The short period of operation has not allowed a full impact assessment of the measure.

The emissions indicators were cancelled because of difficulties in evaluation by COPERT software which need information related to EURO category and fuel type for each car involved in car pooling . The emissions were replaced by the local indicators -fuel saved and Km saved- which cloud be calculated for 2 months, only.

The indicator Acceptance level was cancelled because we considered that the people recorded in the car pooling data base, accepted the measure.

Also, it was not possible long-term monitoring of the reaction of people involved in car pooling

Even if the operation period was shorter than foreseen, the start-up of the service revealed a good appreciation of the measure. RAT direct involvement and the avalaibility of a car parking place reprepresented an essential tool for a good start up. At the moment RAT have more request from the employees to apply the service than the available reserved places in the parking lot.

Carpooling is a environmentally friendly and sustainable way to travel through journeys sharing which could decrease driving stress and contribute to the reduction of pollutant emmissions.

The measure and the concept of car-pooling in general were apparently not very well understood by the people. In fact the boards delimiting the parking area use a different wording (in Romanian – reserved parking - service for matching the passengers) to better get the message across.

The promotion of the concept and the dissemination of the pilot service system are very important.

Local administration can offers a number of facilities for car-poolers. These interventions would increase the number of people who use the service.

C6 Summary of evaluation results

The key results are the following:

Key result 1: 122 people that joined the car pooling

Key result 2: 33 groups for car pooling

C7 Future activities relating to the measure

The results of the measure will be further disseminated at the local level in order to inform citizens and, especially, representatives of companies about the benefits of carpooling in the city.After its implementation, the Municipality will extend this measure first of all to the 3 public companies and after that to other companies on the Northern and Eastern industrial areas of Craiova.

The Municpality will organize seminars to promote and disseminate this measure and its benefits and will discuss with all the reprezentatives of public and private companies in order to make them understand that carpooling is a suitable alternative of transport and by adopting this concept all the employees, the companies and not at last Craiova community will be helped.

By this the Municipality will explain them the benfits of reducing the fuel costs, reducing the pollution and contribute to decrease the traffic congestion, especially in the industrial areas where the level of pollution is a very high one.Municpality will highlight during the seminars developed with the

reprezentatives of public and private companies that this measure is part of its local policy of sustainable transport and that’s why the municipality embraces this concept from the very beginning and will try to extend it successfully to others companies from the industrial areas.

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

D.1Deviations from the original plan

The deviations from the original plan comprised:

Deviation 1: ***Defining of the parking service*** – The original measure description form focused on setting up a parking lot placed at the junction between the urban and industrial area of the west side of Craiova. This parking lot had to be located as close as possible to public transport station. People like commuters who came to the city had the possibility to leave their personal cars in this parking lot and they were able to enter the city by public transportation to reach the city centre or their working place. In the same time, this parking lot had to provide a carpooling service for several companies located in the junction between the urban and industrial area of the west side of Craiova. As the number of parking spaces is too small compared with the need for the area of interest, the parking place was experimentally devoted to the Public Transport Company employees who choose to adopt the car-pooling as a transportation mode for commuting to work

Deviation 2: *P**arking equipping*** – In the original measure description form the parking place had to be equipped with one video camera connected to the RAT dispatching center and 2 electronic barriers controlled by the dispatcher and activated by the signal from the camera OCR. When the OCR recognizes the car plate number as entitled to enter the parking lot, opens the barriers.

All the arrangements of the parking place suffered a lot of delays because of procurement procedure.

Unfortunately at this step the Municipality encountered organizational and bureaucratic problems regarding the registration of the land allocated for the parking place in the land register. The property of the parking lot was not well defined in documentation, even the land allocated belongs to the Municipality, so it wasn't clear who could be entitled to call the tender for the electric barriers. This situation led to a first delay and changed the implementation plan.

The Municipality had to organize the public procurement, as owner of the land. The procedure was launched only on August 6, 2012 and recorded a further delay as no bidder was available. The public procurement had to be repeated three times. Finally it was assigned by DOMARCONS SRL on September 2012.

For this reason, the measure implementation was delayed and led to a shortening of operation period, hence a long-term monitoring of the reaction of people involved in car pooling was not possible

D.2Barriers and drivers

D.2.1 Barriers

Preparation phase

No barriers encountered.

Implementation phase

Institutional – The Municipality could not prove that is the owner of the land where the parking should be arranged . This was the reason for that The Municipality could not organise public procurement for electric barriers purchaising and installing. This situation led to delays and changes in implementation plan

Organizational – The Municipalily had to organise public procurement for parking arranging. The procedure delayed because no bidder available. The public procurement had to be repeated two times. For this reason, the measure implementation was delayed and led to a shortening of operation period

Operation phase

Problem related – Very short period of operation, only 2 months.

D.2.2 Drivers

Preparation phase

No drivers encountered.

Implementation phase

Technological – Development of a software application as a tool supporting the car-poolers.

Involvement, communication –organizing a public event during which municipality promotes and presents this measure. They spread questionnaires concerning on the measure objectives and ask for people feedback.

D.2.3 Activities

Preparation phase

No activities have been performed.

Implementation phase

Involvement, communication – Enhance the communication actions in order to make known and promote the car-pooling service and the use of IT tool.

Institutional – The Municipality changed the implementation plan and found solution for parking place arrangement which does not involve construction work. The solution was giving up the electric barriers and put road markings and signs and paved damaged area.

Operation phase

RAT made all the efforts to encurage the people to join the car pooling .

D.3 Participation

D.3.1. Measure Partners

Measure partner 1 – IPA Occasional participant

IPA SA is a 47 years old Romanian industrial R & D company and is the Romanian national institute for research and development, engineering in energy, automation and IT, with a large experience in European projects in technology transfer and in information dissemination.

IPA was responsible for the dissemination activities and carrying out the research activity and technical studies in the measure. IPA Craiova developed the software tool for matching RAT employees, by groups and by destinations. Since 2011 IPA took over the evaluation activity.

Measure partner 2 – RAT Principle participant

Craiova Public Transport Company is the main public transport operator in the whole Oltenia region. RAT provides the citizen transport by trams, buses and micro-buses.

In this measure, the employees of RAT Craiova are involved in car-pooling service.

Measure partner 3 – LCM Leading role

The Local Council of Craiova Municipality (Primaria Municipiului Craiova) was organized and functions according to Law No. 215/2001 regarding Local Public Administration with the subsequent modification and completion.

LCM was the coordinator of the project and since 2009 and assumed the responsibility for the management and administration activity in the MODERN project. Between 2009-2011, LCM made the evaluation activity. In this measure, LCM made decisions on parking lot arranging and implementation of the signs for a good visibility of the parking lot.

D.3.2 Stakeholders

Stakeholder 1 ELPRECO SA is one of the manufacturers of construction materials in Romania, constantly concerned with upgrading products and customer satisfaction. ELPRECO produce masonry blocks and boards for insulation brick, cement tile, road and pedestrian paving, curbs, sewer and pressure pipes.

Stakeholder 2 Craiova Brewery was the first brewery in the country to determine the amount of bitter hops, a company owned by Brau Union Romania (owned by the Austrian group BBAG), became a member of the Heineken Group

Stakeholder 3 Baumax offers a wide range of products including building materials, interior and exterior decorations, sanitary products, furniture, electronics and appliances, gardening products.

Stakeholder 4 Praktiker offers over 40’000 products including building materials, interior and exterior decorations, sanitary products, furniture, electronics and appliances, gardening products. The variety of products and services belong to the tailored plus range, which are available right in the store: special orders, paint color, financial services, transportation, return guarantee, wood cutting and sewing services. In early 2008, the DIY retailer had 20 stores, each about 100 people working unit.

All these companies used the parking place up to measure implementation.

D.4Recommendations

D.4.1 Recommendations: measure replication

Recommendation 1: Communication related- Enhance the communication actions in order to make known and promote the benefits of the car-pooling service.

D.4.2 Recommendations: process (related to barrier-, driver- and action fields)

Recommendation 1: Approvals related – Take into consideration and prepare all necessary approvals for parking arrangement and be aware that all these documents take time.

Annex 1: Questionnaire

Instructions

This survey is part of the FP7 MODERN project (Mobility, Development and Energy Reduction) and aims to collect experiences in your travels downtown.

The main objective of the measure is to decrease the using of private cars by 10% in industrial area building parking facility for car poolers

Your answers will be treated confidentially.

Thank you for your participation!

Ex-ante questionnaire for RAT employees

Measure 06.04 – FLEXIBLE SERVICES FOR INDUSTRIAL AREAS IN CRAIOVA

1. Gender: F ☐ 30% M ☐ 70%

Awareness level

2. Do you know about the measure?

70% ☐ yes ☐ no 30%

3. Do you understand the benefit of the measure?

Do not understand	well understand	very well understand	Don't know
20%	37%	20%	23%

4. Which is the first reason for that you want to involve in car pooling action?

☐1	Environment concerning
☐2	Economical benefits 70%
☐3	Traffic jam 30%
☐4	Others, specify:……..
☐5	Do not know

Measure title: **Policy option for freight distribution schemes in craiova**

City: **Craiova** **Project:** **MODERN** **Measure number:** **07.03**

M07.03 – Executive summary

The measure focus on the developing of policy options for freight distribution management in the city centre.

The urban area of Craiova is composed by several activity centres that require large amounts of goods for functioning. Purpose of this measure was to develop, implement and test a new scheme for goods distribution within the town, with special attention to city Centre. The central areas as focus point of urban activities are unable to deal with high-intensity traffic flows. The freight transport process is hindered by lack of capacity in combination with high passenger traffic intensities. Opposite, the passengers' traffic is hindered by goods traffic. These problems appear in the large cities of the European Union and began also to increase in Craiova too.

The objectives defined in this measure are: the improving of the freight distribution, system reducing the chemical pollution with 10% and decreasing the number of vehicles for goods transport that operate in the zone of interest with 5%.

The measure developed step-by-step, beginning with studying the freight distribution process in Craiova, compared with other Romanian and EU cities experiences.

This led to examine several opportunities for Craiova city: scheme dealing with central hub in which all the needed goods have to be concentrated and distributed for the mile with environmental friendly vehicle, scheme in which, to avoid traffic congestion the freight distribution will be managed by several time windows and so on. Moreover it was developed a study aimed to characterize the central area of the town in terms of road situation, economic activity, goods need and possible organisation.

During the study the interactions between this measure, the one related to the centre town traffic closure, the heavy works related to the construction of the bridge and the tunnel and the project for City centre rehabilitation came out , so generating a new picture of the work to be done. The study prepared a scenario with several proposals to be implemented.

Due to the complexity of the scenario and to the necessity to wait the completion of the works and of the rehabilitation Craiova Municipality decided only to improve the existing scheme just introducing a new zone and by an increase of entrance fee. The new freight goods distribution scheme was approved with HCL"DECISION NO. 448 regarding the local taxes in 2012".

The new system consist in a division of zones from one large zone to two zones one smaller zone B (basically the city centre) and another one zone A (the rest of the freight distribution zone in the city). The freight distribution scheme in zone B consists in a new tax and a division of the taxes by what good they transport and type of vehicle are transporting the goods.

In the framework of this measure, as a result of the implementing of this new scheme, a social impact was realised.

The MODERN project in Craiova had good results in the area of decongesting the crowded intersections from the city centre and in reducing the pollution in the area of interest.

Our recommendations for other cities that want to implement this kind of measures are:

- Before implementing a new good distribution systems make a survey with a target group the local distributors about how they see a new scheme and what are their wishes about this;
- Make the distribution scheme based on car capacity, car weight and level of pollution;
- All new changes take time and are money consuming, depending on the acceptance of the population on the city hall;

- Integrate in every step you make the relevant stakeholders;
- The freight distribution scheme, especially in the restricted areas, centre city, must be very flexible to permit the organization of different social and cultural activities (encouraging riding a bicycle, children entertainment, free air shows).

Measure title: **Policy option for freight distribution schemes in craiova**

City: **Craiova** **Project:** **MODERN** **Measure number:** **07.03**

A Introduction

A1 Objectives

The measure objectives are:

(M) High level / longer term:

- To reduce congestion and emissions in city centre due to freight distribution vehicles
- To provide to people a clean air in the city centre for walking and shopping

(N) Strategic level:

- To reduce the emissions and congestion in the central area by implementing of taxation rules for freight vehicles

(O) Measure level:

(1) To Implement freight distribution specific schemes for vehicles in the central area in order to reduce the emissions level in this area by 10 % and reduce the number of freight vehicles operating in this area by 5 %

A2 Description

The central area of Craiova was subjected to several interventions. Among them the works for the erection of a bridge and of a tunnel, shown in the following figure represents the first phase of the whole rehabilitation of the Historical centre.

Measure title: **Policy option for freight distribution schemes in craiova**

City: **Craiova** **Project:** **MODERN** **Measure number:** **07.03**

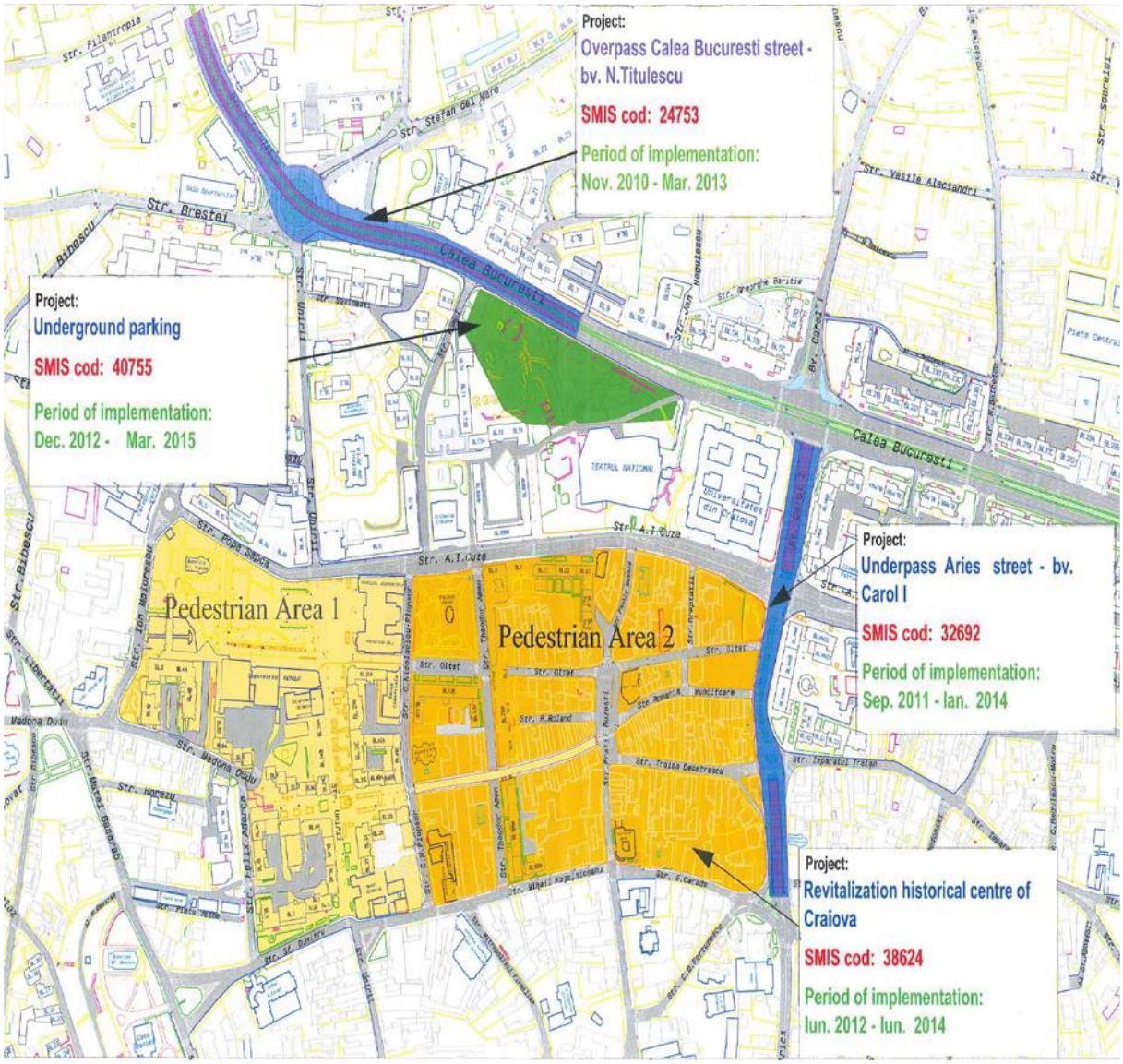


Figure A2.24 – Rehabilitation of the historical centre

Within this context Craiova Municipality decided to enforce the freight distribution scheme already adopted just adding a new zone for Historical Centre and slightly modifying the access fees.

Areas were defined as follows:

- zone A
- zone B (corresponding to the historical Centre).

Measure title: **Policy option for freight distribution schemes in craiova**

City: **Craiova** **Project:** **MODERN** **Measure number:** **07.03**

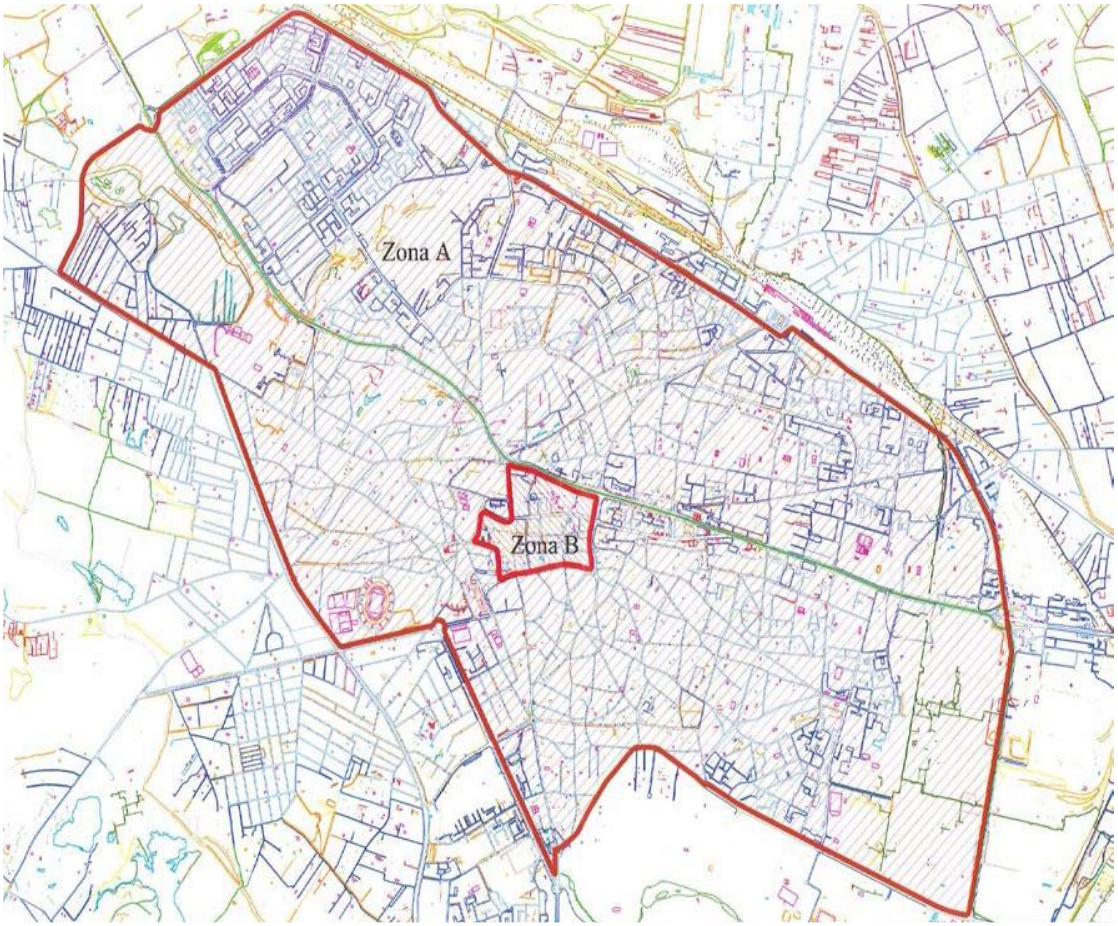


Figure A.25 – Map showing the 2 zones delimiting the freight distribution areas

The new distribution scheme approved by the municipality is the following:

Area	Specifications	Tax level for the year 2012 (lei/day/vehicle)
Perimeter "A": Dacia Avenue – Decebal avenue – Caracal street – Corneliu Coposu street – 1 Mai avenue – Stirbei Voda avenue – Pelendava street; from which is excepted the perimeter "B"	For transporting perishable goods (meat, fish, dairy products, wine etc.) and construction materials	12 Lei
	For transporting other types of goods	24 Lei
Perimeter "B": Calea Bucuresti avenue – Carol I avenue – Aries street – M. Kogalniceanu street – Sf. Dumitru street – Felix Aderca street – Madona Dudu street – Ion Maiorescu street – Mihai Viteazu street	For transporting perishable goods (meat, fish, dairy products, wine etc.) and construction materials	15 Lei
	For transporting other types of goods	30 lei

Measure title: **Policy option for freight distribution schemes in craiova**

City: **Craiova** **Project:** **MODERN** **Measure number:** **07.03**

Particular attention was paid to the next particular aspects:

- Free access for rapid intervention vehicles and those that are subordinated to the municipality.
- Special taxation for access to the city's main leisure area (Nicolae Romanescu park)

Entering in the area restricted by the distribution scheme is allowed on the basis of a pass stamped and signed by the mayor staff in charge of the freight distribution. All the companies can make a choice if they want to pay the distribution fee daily, monthly or yearly.

After fee payment operators and companies get the pass and are obliged to show it on display so that the police can see it.

Access control is at this stage performed by local police on the basis of “manual” identification of vehicle.

By defining areas within the city, the local authorities are provided with the means to obtain info concerning freight transport vehicles (which represent mandatory input data for establishing a freight distribution system).

The new scheme presents the following advantages:

1. A decrease of accesses, due to the increase of tax fees;
2. Better vehicles capacity utilization, so increasing the loads transported for each of the journeys;
3. Enhancement of the information about the number of vehicles accessing to the Central area of the town and about the current needs of goods for economic activities operating there.

Even a reduction in the number of heavy vehicles was observed the effects related to better environmental quality and to traffic congestion reduction were not so clear because of the rehabilitation works occurring in the same period.

B Measure implementation

B1 Innovative aspects

The innovative aspects of the measure are:

New conceptual approach – The main innovative aspect achieved in this measure is urban zoning in zones A and B. The generated benefits are great: providing consistency of fiscal instruments, development of modern procurement practices, better information control, networking possibilities with other measures, etc.

Also the zoning, as the new measure, gives possibilities regarding future research directions:

- Building useful databases
- Developing local initiatives with distribution schemes modern and flexible which take into account the supply schedule, supply routes and common tax benefits.

A second innovative aspect is represented by the **adaptive structure concept** which offers possibilities to represent and quantize the modalities of apparition in a hierarchical structure, especially in terms of implementing some economic instruments (which will generate advantages for local communities, economic agents and institutions that develop their activity in the targeted urban zones).

B2 Research and Technology Development

Planning and design of the measure was the first RTD activity and refers to the definition and implementation of the measure. The introduction of this measure involves the acceptance of companies and institutions in the area besides a thorough analysis of existing situation to develop a realistic and effective logistic plan. During this RTD activity many aspects have been investigated - the existing situation, downtown plans, project's documentation on closing of the city centre, the current regulations on the freight distribution in the city – and the area for good distribution where the scheme developed under this measure will be applied has been identified.

The analysis carried out showed that economic activities in these areas are mainly shops and offices. Commercial activities are those involving a large volume of goods circulation (see fig. B2.1), both the supply of shops and for the delivery to the buyers. The impact of the measure will be more pronounced on commercial operators than on other stakeholders.

Measure title: **Policy option for freight distribution schemes in craiova**

City: **Craiova** **Project:** **MODERN** **Measure number:** **07.03**

Figure B2.1 – Traffic flows in the city

In parallel, a study about the solutions adopted by other cities, in order to understand better the rules applied and to verify the possibility of their adoption in Craiova and to evaluate the most appropriate solution for the city, was carried out.

In cooperation with the Municipality the technical content of the measure has been defined and the necessary steps to implement this measure have been set up. Goods distribution scheme in the centre will be a differential tax scheme based on the criteria of the different level of emissions of the vehicle, to prevent as much as possible pollution in the downtown area. At the same time the scheme will foresee incentive as well, for those operators using cars with low pollution levels.

The RTD tasks are generally targeted to study the current structure of the goods distribution in Craiova, to identify the target area for the application, and the technical content of the measure.

To create a very detailed good distribution plan were identified some topic that have to be deeply investigated: number of companies in the area of interest, number and type of vehicles used by each company for good transportation, supply frequency and volumes, GHG emissions and standard emissions of distribution vehicles, loading / unloading points. For this it is needed to appoint a specialized company to perform a study on these topics and to provide us the required data to develop a regulation to supply goods.

Goods distribution has a great impact on several social-economical groups in the city: companies based in the target areas, residents, Municipality, environment agency and others. As usual it is difficult in this situation to find a good balance among the interests of each group and to create consensus. Discussions and debates with operators in the area to find optimal solutions are necessary and elaboration of a distribution scheme plan more based on benefits than on restrictions and charges.

B3 Situation before CIVITAS

Before the implementation of this measure the regulation scheme for freight distribution in Craiova was about the good distribution in the whole metropolitan area. The Craiova Local Council approved the regulation in 2009 Resolution No. 449.as follows:

Measure title: **Policy option for freight distribution schemes in craiova**

City: **Craiova** **Project:** **MODERN** **Measure number:** **07.03**

"The tax for access of vehicles with weight over 3.5 tons, in the perimeter of Craiova municipality raging between: Dacia Avenue – Decebal Avenue – Caracal Street – Corneliu Coposu Avenue – 1 Mai Avenue – Stirbei Voda Avenue – Brestei Avenue Pelendava Street is the following:

Specification	Starting 2010 (lei/day/vehicle) 1 Euro = 4,32 lei
For transporting perishable goods (meat, fish, dairy products, wine etc.) and construction materials	12 Lei
For transporting other types of goods	24 lei

Free access for:

- Vehicles belonging to Craiova municipality and other public institutions;
- Vehicles belonging to military units, medical transportation cars, fire-cars, country police cars, penitentiary cars;
- Vehicles used for sanitation;
- Auto-vehicles used for gas tanks for stoves, waste pickup and funeral transportation.

B4 Actual implementation of the measure

The measure was implemented in the following stages:

Stage 1: Planning and design of the measure (Sept 2009- Sept 2010)

The planning and designing of the measure were realised at the beginning of the project. Modern partners and main stakeholder were organized in a team in charge to define the working steps and to find the best solution.

The main actions that were undertaken in this task were several meetings with the Municipality in which all aspects were investigated.

An analysis of the economic activities within the defined area and their characteristics has been carried out. The analysis showed that economic activities in target area are mainly shops and offices. Commercial activities need a large volume of goods circulation, both for the supply of shops and for the delivery to the buyers.

Stage 2: Study for goods distribution in Craiova (May 2010- Dec. 2011)

The first action decided by the working group in charge for design and pllan the measure was to carry out a study on the current structure of the goods distribution in Craiova.

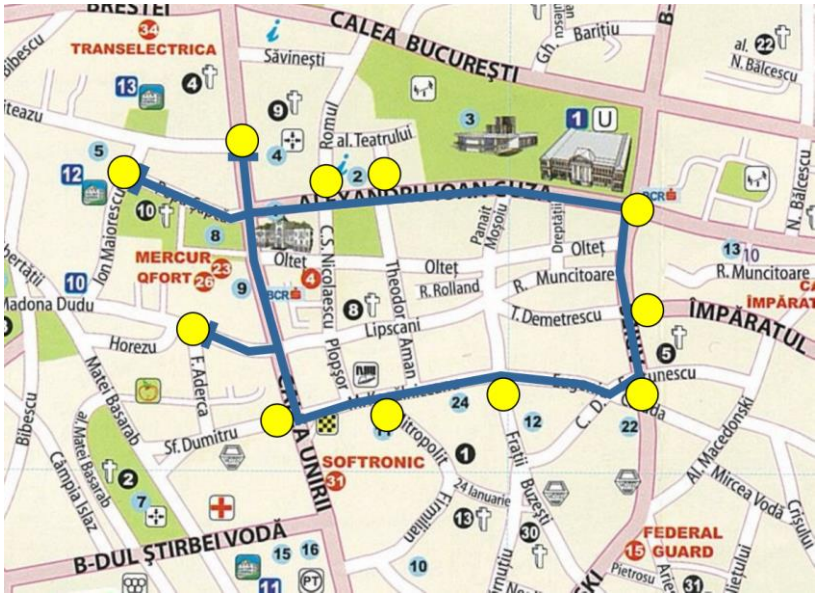
The analyse of the current structure of the goods distribution was based on some topics that we investigated: number of companies in the area of interest, number and type of vehicles used by each company for good transportation, supply frequency and volumes, GHG emissions and standard emissions of distribution vehicles, loading / unloading points.

The results of the study described in detail in the deliverable 07.03.04 should be summarized as follows:

Measure title: **Policy option for freight distribution schemes in craiova**

City: **Craiova** **Project:** **MODERN** **Measure number:** **07.03**

- Definition of the area in which the measure will be applied and the potential access points.



FigureB4.1 – Area defined for the freight distribution scheme and potential access points

- Research on other European cities experiences. In the rules design driver elements are:

  - urbanistic situation, with special reference to road and parking capacity;
  - description of the needs in terms of volume and merceology;
  - vehicles' characteristics in terms of load capacity, engine pollution level, fuel and all others data;
  - general organization: central or local hubs, nigth operations, time windows et cetera.

- Mapping of the economic activities in the downtown area. (This activity was described in details in the deliverable 07.03.04)

Measure title: **Policy option for freight distribution schemes in craiova**

City: **Craiova** **Project:** **MODERN** **Measure number:** **07.03**

Figure B4.2 – Map of the economic activities in downtown area

Because goods distribution has a great impact on several social-economical groups in the city and it is difficult to find a good balance among all the involved interests several meetings with all the stakeholders and operators were organized,

After a tender a specialized company was incharged to develop a study. The results of the study consisted in a detailed goods distribution plan, describing several options to be submitted to the Municipality for the implementation.

The conclusions can be summarized as follows:

a) Analytical description of the target zone reporting

- the characteristics of the central area
- Classification of the area on the basis of the different types of activities
- Definition of the access points

b) 5 schemes for the space organization:

1. *The scheme of urban logistic areas* consisting of grouping the logistic operators closer to the areas of a high density of beneficiaries (closer to the central area) and has as main objectives the decrease of the number of vans that use the main urban arteries and the increase of productivity for the delivery services.

For the realization of this scheme large real estate investments are necessary for the creation of urban logistic areas, without being required any modifications of technologies from the transporters and the beneficiaries. Application of this scheme requires interventions of the municipality, department of urbanism and the administration of territory, as well as the involvement of all transporters and operators from the logistic chain.

2. *The scheme with urban distribution centres* in which goods destined for central beneficiaries are deposited, the activities of distribution being reunited and conducted by a single operator named by the municipality.

The advantages in this case are the following:

- the reduction of transport routes for good vehicles
- the improvement of the usage of urban space
- the limitation of noise created by the goods transport vehicles in certain day periods

Applying this scheme creates inadequacies in the connection transporter – beneficiary and that is why a new delivery schedule must be created having relatively high function costs.

3. *The scheme with dedicated stationary locations for the realization of deliveries and supplies* avoiding the inconveniences of the other road users.

In this case, the deliveries from the stationary locations of the area to the beneficiaries within a radius of about 100 m are being made on foot (eventually by carriages).

The relation between the transporter and beneficiary does not change, and the sequence of the performed operations is the same, the only changing being the distance travelled on foot, with the merchandise. For applying this scheme low investments are being required, the exploitation costs remaining approximately the same, but it is necessary the implication of the carriers in creating the adequate routes.

4. *The scheme with points (locations) for goods accumulation* in which the supply of these locations is being made by the transporters after the rush hours. The pursued objectives are: the fulfilling of the poor accessibility areas requirements and the satisfaction of the less available beneficiaries.

This scheme modifies the placement of the delivery locations; the scheme requires important efforts for the realization of interactions between the actors of the logistic chain.

5. *The scheme with urban logistic boxes* consists of the placement of some containers, of variable dimensions, in locations accessible to beneficiaries that would constitute temporary deposits for goods, supplied by the transporters after the rush hours, without being necessary the presence of beneficiaries.

Moreover it was proposed a new solution for the freight distribution scheme, based on other European cities experience.

Measure title: **Policy option for freight distribution schemes in craiova**

City: **Craiova** **Project:** **MODERN** **Measure number:** **07.03**

The application of this scheme requires low involvement from authorities, but modifies the relations between transporters and beneficiaries (the locations of the delivery points and the schedule are being modified).

Beside the solutions proposed on the basis of the freight goods distribution study, in Craiova city, presented above, the deployment team from IPA proposed a new solution for the freight distribution scheme, based on model from other European cities.

You can see, below, the proposal made by IPA:

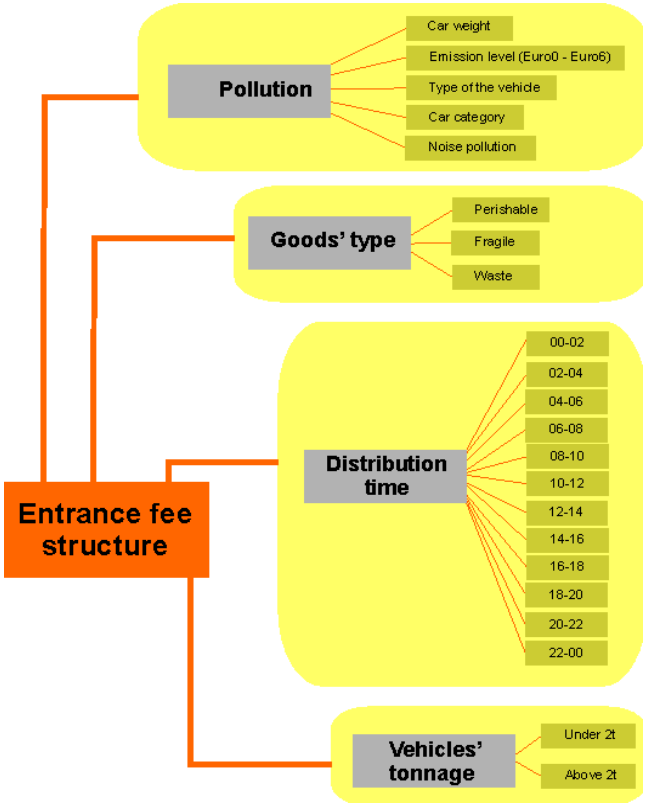


Figure B4.3 – fee policy proposal

After the implementation of the MODERN measure 07.03 the new good distribution scheme approved by the Municipality and the Local Council was introduced in the "DECISION NO. 448 on the approving of the local taxes in 2012"

The decision contains more information about the local taxes in Craiova but below is extracted from the decision the paragraphs regarding the taxes for the distribution scheme.

The fee for the permits access of the vehicles weighing more than 3.5 tons in area "A" and "B" of Craiova is set at the following levels:

Area	Specifications	Tax level for the year 2012 (lei/day/vehicle) 1 Euro = 4.4 lei

Perimeter "A": Dacia Avenue – Decebal avenue – Caracal street – Corneliu Coposu street – 1 Mai avenue – Stirbei Voda avenue – Pelendava street; from which is excepted the perimeter "B"	For transporting perishable goods (meat, fish, dairy products, wine etc.) and construction materials	12 Lei
	For transporting other types of goods	24 Lei
Perimeter "B": Calea Bucuresti avenue – Carol I avenue – Aries street – M. Kogalniceanu street – Sf. Dumitru street – Felix Aderca street – Madona Dudu street – Ion Maiorescu street – Mihai Viteazu street	For transporting perishable goods (meat, fish, dairy products, wine etc.) and construction materials	15 Lei
	For transporting other types of goods	30 Lei

- The following categories of auto-vehicles are exempted from the tax fee:
- Auto-vehicles belonging to budgetary units from the Craiova municipality;
- Auto-vehicles for interventions of any kind at economical units and public institutions;
- Auto-vehicles belonging to military units, medical transportation cars, fire-cars, country police cars, penitentiary cars;
- Auto-vehicles used for sanitation;
- Auto-vehicles used for transportation to the population of Craiova gas tanks for stoves;
- Auto-vehicles used for transportation of the employee to and from the work place;
- Auto-vehicles that performs waste pickup and funeral transportation.

Stage 3: implementation of the goods distribution scheme in Craiova

The new good distribution scheme approved by the Municipality and the Local Council was introduced in the "DECISION NO. 448 on the approving of the local taxes in 2012"

The new scheme entered operationally in force from 01.01.2012 and the fees for the heavy vehicles are collected by the Municipality of Craiova.

The entrance in the area restricted by the distribution scheme can be done by using a pass stamped and signed by the mayor staff in charge with the freight distribution. All the companies can choose if they want to pay the distribution fee daily, monthly or yearly. The fee is then paid accordingly with their choice, meaning that they pay the sum for a day multiplied by the number of days they will enter the zone. After the payment companies get the pass and are imposed to put it on display so that the police that enforce the distribution scheme can see it.

Stage 4: social impact study

Due to the relevance of the measure it was decided to perform a Socio impact study about the new freight distribution scheme; the results of this study are described in the Del 7.3.08. Assessment of the social impact gave important information about the perception of the population and operators about the effect of the measure implementation. The conclusions can be summarized as follows:

1. Most of the interviewed was informed about the new scheme implementation;

2. There is a huge approval about the general objectives of the measure.
3. The new scheme was accepted by the operators (both Distribution companies and shopkeepers) and does not generated excessive new costs.

The necessity for City Centre requalification is well known and the possibility to develop and implement new schemes should be well accepted.

B5 Inter-relationships with other measures

The measure is related to other measures as follows:

The Measure 07.03. and **The measures M 03.02** aim to reduce the emissions in the central area. The implementation area is the same for both measures.

C Impact Evaluation Findings

C1 Measurement methodology

C1.1 Impacts and Indicators

Table C1.1: Indicators.

No	Impact	Indicator	Data used	Comments
13-14	Society	Acceptance Level Awareness Level	Number of freight vehicles moving in the city centre	The number are count by the Police in relevant access points
25	Transport	Freight vehicles number in demo areas	Face to face survey	Surveys on dealers and merchants in central area

Indicator 13 (Awareness level)

Indicator 14 (Acceptance level)

The survey was made to see the impact of the measure on drivers that crossed the demonstration area and residents, people living around the demonstration area, shopkeepers and transport operators. Taking into consideration a population of maximum 30'000 people consisted in drivers and residents and using the methodology of sample size calculation, we found a sample of 74 people.

130 questionnaires were circulated (to make sure that we get the sample) in ex-ante period and the same number in ex-post, keeping the same dedicated target group. Also, the contact data of ex-ante respondents were kept to be in contact for ex-post evaluation period.

Feedbacks were: 80 questionnaires filled in ex-ante and 95 questionnaires filled in ex-post.

The questionnaires for ex-ante were disseminated face-to face to people within the Communication Campaign and seminar presentation that took place in a pavilion located in the prefecture market (in the downtown) . The questionnaires in ex-post were filled face to face, by phone or e-mail using the contact data of dedicated target group.

The feedbacks of 80 and 95 questionnaires are slightly more than the sample of 74 people calculated.

The questionnaires were structured in 2 sections:

- General information about citizens (job, age, gender, education level, contact data)
- Questions referring to the measure split by indicator type:

Awareness level

The most important questions are:

Have you heard about the measure?

1. Do you recognize the logo of the project?
2. Do you understand the aim of the project and the potential benefits and not benefits of the measures?
3. Have noticed the benefits lately?
4. How useful do you think the implementation of the measure is?

For this indicator the question taken into consideration has been the number 3. The other questions in the survey were taken to reduce the errors in the filling of the questionnaire and in order to make the survey as real as possible.

Acceptance level

The most important questions are:

1. "How useful do you think the implementation of the measure is?"
2. Do you accept or not the implementation of measure?
3. Are you affected by the measure
4. Willingness to implement the measure

For this indicator the only question that we have taken into consideration is number 4. The other questions in the survey were taken to reduce the errors in the filling of the questionnaire and in order to make the survey as real as possible.

Indicator 25 (Freight Movement)

The information regarding the indicator 25, freight movement, was provided by the Municipality of Craiova. The freight distribution vehicles were controlled and counted by the Local Police and Road Police that then informed the Municipality about the results.

C1.2 Establishing a Baseline

Big industrial and commercial companies have own system for goods distribution uncorrelated at a central (urban) level. This kind of policy exists in Craiova at a low scale, and doesn't take into consideration the free air pollution. It is about the freight distribution cars entering into Craiova fair and fruits and vegetables markets, which have access only 2 hours in the morning and 2 hours in the night to not disturb the commercial activity. There is not a logistic policy for freight distribution in the city centre which leads many times to discomfort and unpleasant situations for residents and even for firms located in the centre.

The only regulation scheme for freight distribution in Craiova that was available before the implementation of this measure, was about the good distribution in the metropolitan area. The Craiova Local Council approved the regulation in 2009 in the Local Council Resolution No. 449.

The regulation is in the Article 33 of the Local Council Resolution No. 449 and below is it's translation in English:

"The tax for the release of the documents for free access for auto-vehicles with weight over 3.5 tones, in the perimeter of Craiova municipality, raging between: Dacia Avenue – Decebal Avenue – Caracal

Street – Corneliu Coposu Avenue – 1 Mai Avenue – Stirbei Voda Avenue – Brestei Avenue Pelendava Street is chosen accordingly:

Specification	Level for 2010 (lei/day/auto-vehicles) 1 Euro = 4,32 lei
For transporting perishable goods (meat, fish, dairy products, wine etc.) and construction materials	12 Lei
For transporting other types of goods	24 Lei

The following categories of auto-vehicles are exempted from the tax fee:

- Auto-vehicles belonging to budgetary units from the Craiova municipality;
- Auto-vehicles for interventions of any kind at economical units and public institutions;
- Auto-vehicles belonging to military units, medical transportation cars, fire-cars, country police cars, penitentiary cars;
- Auto-vehicles used for sanitation;
- Auto-vehicles used for transportation to the population of Craiova gas tanks for stoves;
- Auto-vehicles used for transportation of the employee to and from the work place;
- Auto-vehicles that performs waste pickup and funeral transportation.

Indicators and respective parameters	**Ex-Ante values**
Indicator 25 – Freight Movement	1’115 veh/day

C1.3 Building the Business-as-Usual scenario

Interviews with representatives of the Local Council have been organised to understand what would have been the actions of Municipality referring the central area restriction in the case that MODERN project wouldn't have been implemented.

The initiative of the Municipality was that in 2011 to begin the work in the city centre and to close all adjacent roads and accesses gradual as the work advance. This initiative was stopped because of the construction of the overpass bridge and the underpass road in the city centre. These constructions are very important for the traffic management in Craiova due to an increase in the last 10 years of the vehicles that are registered in Craiova**.**

Indicators	**BAU Values**
Indicator 25 – Freight Movement (2009)	1'115 veh/day
Indicator 25 – Freight Movement (2010)	1'115 veh/day
Indicator 25 – Freight Movement (2011)	1'115 veh/day
Indicator 25 – Freight Movement (2012)	1'115 veh/day

C2 Measure results

C2.4 Transport

The new distribution scheme introduced two new zones for the freight distributors, zone A and zone B. Zone B is the area of interest for us. The evaluation begins from the ex-ante period, meaning the year 2009 and in the present 2012. The new freight distribution scheme was implemented and started from 01.01.2012.

The values of the vehicles' structure and number in the central area were gathered by the Craiova Municipality. These are taken from the data basis with all the cars that transport goods in the central zone.

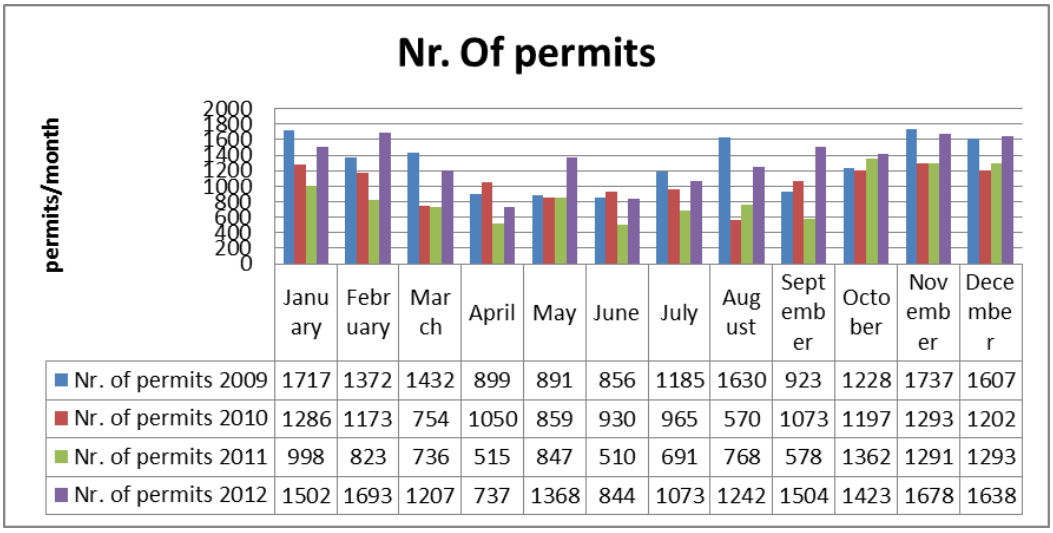
Under the new freight distribution scheme of the town, in order to a vehicle can enter the interest zone it needs a license for free passage for good distribution. This license is released by the Craiova Municipality, based on what it can be gathered information about the goods distribution, such as: the identification number of the vehicle, the company and the number of days when it is realised the goods distribution, etc.

Indicators	BAU Values
Indicator 25 – Freight Movement (2009)	1'115 veh/day
Indicator 25 – Freight Movement (2010)	1'250 veh/day
Indicator 25 – Freight Movement (2011)	1'335 veh/day
Indicator 25 – Freight Movement (2012)	968 veh/day

The commercial vehicles /day that enters in the area of interest is then needed. The value provided has been calculated based on the permits and is a medium between all the distribution vehicles that enter in a year in area of interest and the number of days in a year and can be seen below.

Measure title: **Policy option for freight distribution schemes in craiova**

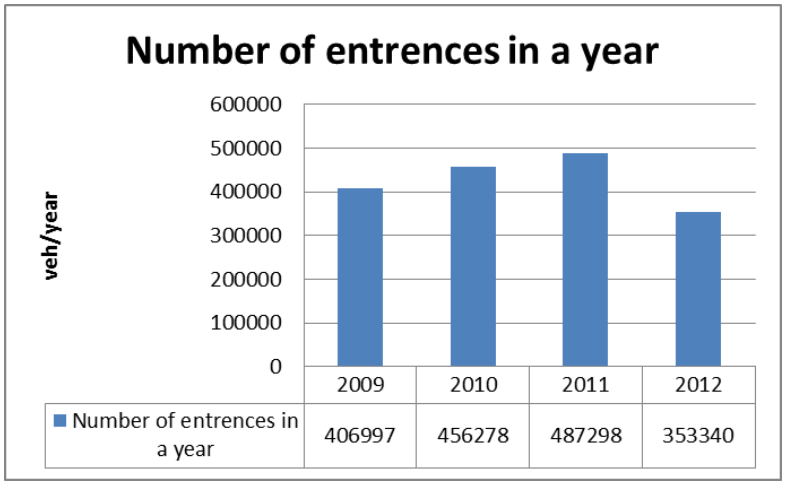
City: **Craiova** **Project:** **MODERN** **Measure number:** **07.03**



	January	February	March	April	May	June	July	August	September	October	November	December
Nr. of permits 2009	1717	1372	1432	899	891	856	1185	1630	923	1228	1737	1607
Nr. of permits 2010	1286	1173	754	1050	859	930	965	570	1073	1197	1293	1202
Nr. of permits 2011	998	823	736	515	847	510	691	768	578	1362	1291	1293
Nr. of permits 2012	1502	1693	1207	737	1368	844	1073	1242	1504	1423	1678	1638

Figure C2.4.1 – Number of permits issued per month

The above figure shows how many permits are issued every year divided to every month. In the next figure the number of vehicles/year that enter into the area of interest based on the number of permits issued daily, weekly, monthly, yearly are shown.



	2009	2010	2011	2012
Number of entrences in a year	406997	456278	487298	353340

Figure C2.4.2 – number of entrances per year

It can be noted that the number is very high but divided to 300 day in a year find the numbers for distribution vehicles that enter the area of interest daily.

Measure title: **Policy option for freight distribution schemes in craiova**

City: **Craiova** **Project:** **MODERN** **Measure number:** **07.03**

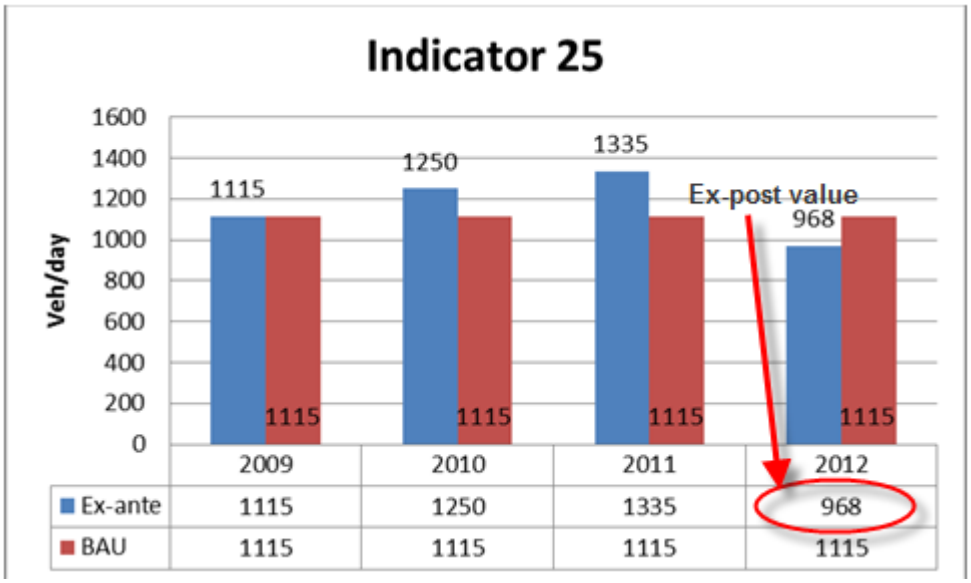


Figure C2.4.3 – Vehicles per day trend

As can be seen from the figure above the trend of the transport vehicles that enter the area of interest in a day had a growth trend until the first of the 2012.

At the beginning of 2012 the new distribution scheme enters into operation and caused a reduction of 13% from 2009.

The difference between the 2011 and 2012 is about 27%.

The number of access passes is for all commercial vehicles on which the freight distribution scheme is applied (all commercial vehicles over 3.5 tons).

The conclusion from this figures is that although the distribution scheme is hasn't changed very much the new scheme had done what we had proposed to do at the beginning of MODERN project meaning, a reduction of 5% of transport cars in the area o f study, meaning zone B of the new distribution scheme.

Indicators	Ex-ante	BAU	Ex-post	Ex-post–Ex-ante	Ex-post - BAU
Indicator 25 Freight Movement	(2009) 1'115 veh/day (2010) 1'250 veh/day (2011) 1'335 veh/day	(2009) 1'115 veh/day (2010) 1'115 veh/day (2011) 1'115 veh/day (2012) 1'115 veh/day	(2012) 968 veh/day	Decreased by: (2009) 13% veh/day (2010) 22% veh/day (2011) 27% veh/day	Decreased by: (2009) 13% veh/day (2010) 13% veh/day (2011) 13% veh/day

C2.5 Society

Data collection concerning the indicators involved the organization of questionnaire surveys to focus group, on their attitudes and perceptions of central area restriction.

The filling of the questionnaires was realised by a target group composed from representative categories of people for the community in the area of interest.

Our interest regarding these questionnaires was to find out how the society feels the changings due to the freight distribution scheme.

The results obtained after answering the questionnaires by the target group can be seen in the table below.

Fig C2.5.2 to C2.5.4 show a picture of society indicators evolution.

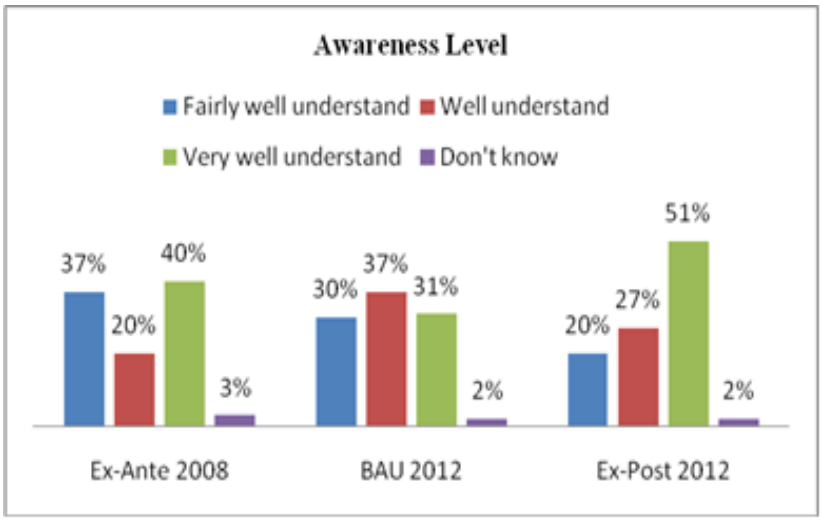


Figure C2.5.2

Measure title: **Policy option for freight distribution schemes in craiova**

City: **Craiova** **Project:** **MODERN** **Measure number:** **07.03**

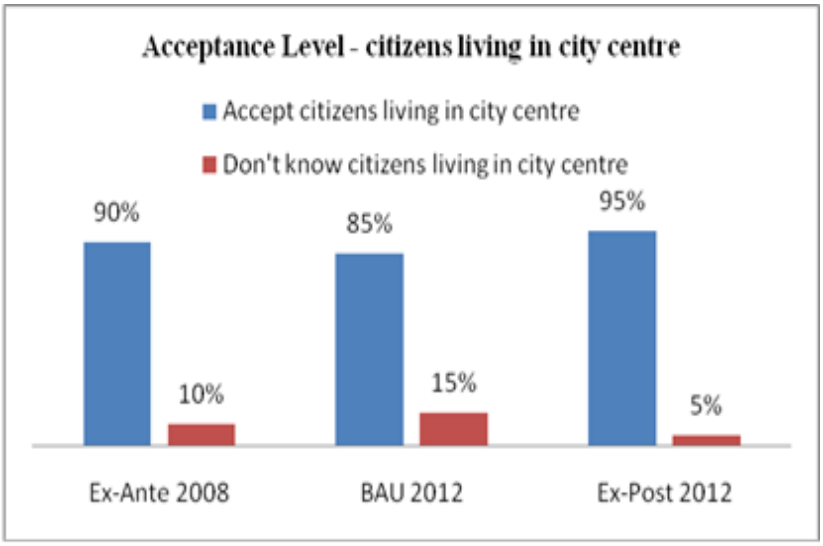


Figure C2.5.3

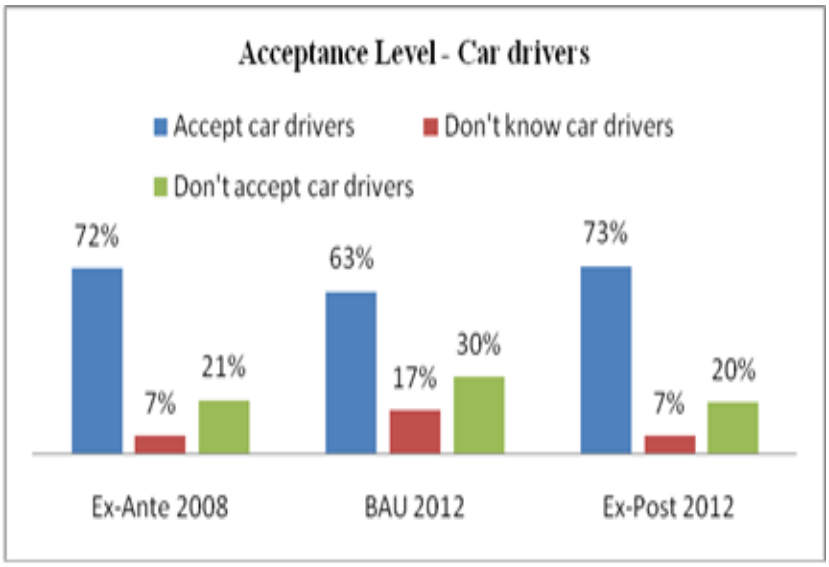


Figure C2.5.4

The figures above shows that the awareness levels for this measure is very high and maxim 5% from the people that completed the questionnaires didn't know about the measure and what it does to the environment and city centre.

On the other hand the acceptance level among the drivers is very high this meaning that not only the people that are in the pedestrian area want the changes but also the drivers that need to transit the closed are every day and now are taking detours around this area.

Indicator	Ex-Ante	BAU	Ex-Post	Difference: After – Before	Difference: After – B-a-U

Measure title: **Policy option for freight distribution schemes in craiova**

City: **Craiova** **Project:** **MODERN** **Measure number:** **07.03**

Indicator	Ex-Ante	BAU	Ex-Post	Difference: After – Before	Difference: After – B-a-U
Indicator 13 Awareness level	37% fairly well understand; 20% well understand; 40% very well understand 3% don't know (2008)	30% fairly well understand; 37% well understand; 31% very well understand 2% don't know (2012)	20% fairly well understand; 27% well understand; 51% very well understand 2% don't know (2012)	-17	-10
				7	-10
				11	-20
				-1	0
Indicator 14 Acceptance Level	Citizens living in city centre: 90 % accept; 10 % don't know **(2008)**	Citizens living in city centre: 85 % accept; 15 % don't know **(2012)**	Citizens living in city centre: 95 % accept; 5 % don't know **(2012)**	5	-10
				-5	-10
	cars drivers: 72%accept and 21%don't accept; 7% don't know (2008)	cars drivers: 63%accept and 30%don't accept; 17% don't know **(2012)**	cars drivers: 73%accept and 20%don't accept; 7% don't know **(2012)**	1	10
				-1	-10
				0	-10

C3 Achievement of quantifiable targets and objectives

No.	Target	Rating
1	To reduce the number of vehicle operating in the area of study with 5% The reduction of the vehicle operating in the area of study compared to 2012 are as follow: - 2009 – 13% - 2010 – 22% - 2011 – 27%	★★★ = Exceeded for the indicator 25
NA = Not Assessed O = Not Achieved ★ = Substantially achieved (at least 50%) ★★ = Achieved in full ★★★ = Exceeded		

C4 Up-scaling of results

The up-scaling of the results is uncertain now because of the new changes that take place in Craiova.

Although the social impact showed us that the population want's a new and improved freight distribution scheme for now the current scheme will remain unchanged. We have faith that after the finalization of the underpass and overpass the work for the modernization of the historical centre of Craiova will began. In that moment a new distribution scheme will need to be implemented so that the pedestrian area that the municipality will create will remain unpolluted and clear of cars.

C5 Appraisal of evaluation approach

In order to know the awareness and acceptance level of the measure, we have circulated 130 questionnaires to drivers and citizens that live in central area, in the ex-ante period, and the same number in the ex-post. We received 80 feedbacks – filled questionnaires in the ex-ante and 95 feedbacks in the ex-post. The conclusion of survey was the awareness level increased by 27%, acceptance level increased by 5% for citizens living in city centre and by 1% for drivers, too.

The freight movement indicator was evaluated by the evidence provided to us by the municipality of Craiova based on their database with the freight distribution vehicles that enter the area of interest the traffic flow decreased by average of 20% in the area of interest, respectively zone B of the new distribution scheme.

C6 Summary of evaluation results

The key results are as follows:

- **Key result 1 – Freight Movement** – the freight distribution vehicles was reduced by the measure implementation by a average of 20% compared with the year 2009, 2010 and 2011.
- **Key result 2 – Acceptance and awareness level** – Generally, the measure was accepted by drivers and the distributors. Awareness level increased by 27 %, acceptance level increased by 5%.

C7 Future activities relating to the measure

The results of the measure will be further disseminated inside of country in order to inform drivers, citizens and the transport companies and, especially, representatives of Municipalities about the benefits of freight distribution schemes in the city. Up to the end of 2013, the rehabilitation of historical centre will be finished and we hope that a new and improved freight distribution scheme will operate in Craiova.

More coherent and periodical communication with the population is mandatory, aiming to present the necessity of the freight distribution schemes as measure to reduce the traffic congestion and CO_2 in the city.

Craiova city needs a revision of the adopted freight distribution schemes, according the implementation of the rehabilitation plan of the historical city centre.

Measure title: **Policy option for freight distribution schemes in craiova**

City: **Craiova** **Project:** **MODERN** **Measure number:** **07.03**

The Municipality of Craiova is willing to foster the use of clean vehicles for freight distribution. The new underground parking prevue to be built near the centre city has the capacity of 600 cars (partly dedicated to electric cars).

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

D.1Deviations from the original plan

The deviations from the original plan comprised:

- **Delay** – The measure registered a delay of 5 month within the task 07.03.02 where a study for goods distribution in Craiova had to be performed. The delay was due to a longer time devoted to preliminary meetings with the Municipality and because, of some improvement of the study itself. This unexpected activity led to the extension of the task with 5 months.

D.2 Barriers and drivers

D.2.1 Barriers

Preparation phase

No barriers have been encountered.

Implementation phase

- **Planning -** Insufficient technical planning and analysis to determine requirements of measure implementation, insufficient economic planning and market analysis to determine requirements for measure implementation, lack of user needs analysis: limited understanding of user requirements Implementation team found that not enough data and information to elaborate better freight schedule in the central area.
- **Involvement, communication -** Constructive and open involvement of policy key stakeholders, constructive and open consultation and involvement or citizens or users. The Municipality has provided some studies on historical centre where the measure will be implemented.

Operation phase

- **Institutional -** The extension of the City Council review and approval process has delayed the implementation of the scheme.
- **Problem related -** A large number of data was required for the scheme elaboration which produced a delay in the scheme implementation.

- **Planning** - Implementation team found that not enough data and information are available to elaborate a freight distribution scheme in the central area.

D.2.2 Drivers

Preparation phase

No drivers have been encountered.

Implementation phase

- **Institutional** - Facilitating administrative structures, procedures and routines, facilitating laws, rules, regulations and their application, facilitating structure of organizations and programs. The Municipality has issued a regulation that does not allow the vehicle traffic during the night.

Operation phase

- **Political / strategic** - The Municipality is aware that the distribution of goods in the city centre must be regulated and supported by local policies.
- **Institutional** - The Municipality implemented two regulations related to freight distribution in the city: first regulation covers the metropolitan area and is based on a fee for the free access in the Craiova city area of the auto-vehicles with weight over 3.5 tonnes and the second one applies in the central area of the city and limits the vehicle access during the night.

D.2.3 Activities

Preparation phase

No activities have been performed.

Implementation phase

- **Planning** - Raising or attempting to raise additional 'time budget' for the measure , (re)conduct the economic and technical planning as well as analysis to determine requirements of measure implementation, (re)conduct market analysis to determine requirements for measure implementation, thoroughly analysing user needs analysis to better understand the user requirements. Implementation team has requested for a reconsideration of working plan

Operation phase

- **Political / strategic** - Speed up the decisional procedure of the municipality and adoption of a simplified scheme based on charging for accessing the city centre.
- **Planning** - Implementation team has requested for a rescheduling of the timetable according to the currently progress in the work.

- **Organizational** - Good cooperation and partnership with University from Craiova in understanding the freight distribution models

D.3 Participation

D.3.1. Measure Partners

- **Measure partner 1 – IPA** – IPA SA is a 47 years old Romanian industrial R & D company and is the Romanian national institute for research and development, engineering in energy, automation and IT, with a large experience in European projects in technology transfer and in information dissemination.

  IPA was responsible for the dissemination activities and carrying out the research activity and technical studies in the MODERN project of Craiova. Since 2011 IPA took over the evaluation activity.

- **Measure partner 2 – LCM** – The Local Council of Craiova Municipality (Primaria Municipiului Craiova) was organized and functions according to Law No. 215/2001 regarding Local Public Administration with the subsequent modification and completion.

  LCM was the coordinator of the project and since 2009 and assumed the responsibility for the management and administration activity in the MODERN project. Between 2009-2011, LCM made the evaluation activity. More than that, LCM was the coordinator of the measure "Access restriction policies in Craiova" and made decisions on closed streets in the demonstration area.

D.3.2 Stakeholders

- **Stakeholder 1 – South West Oltenia- Environment Agency –** providing data regarding the pollutant emissions in city centre and supported the University to elaborate the study referring to the impact of the measure on the city centre. The study is called: "Pollutant dispersion modelling"
- **Stakeholder 2 – Community Police –** Operating barriers with bollards around the pedestrian central area.
- **Stakeholder 3 – Retailers and shops owners in the central area –** They were surveyed on benefits or not benefits of the access restriction in central area.
- **Stakeholder 4 - Emergency, Police and Fireman Department - They** have to have obligatory access inside the central zone to intervene promptly if necessary.

D.4Recommendations

D.4.1 Recommendations: measure replication

- **Apply a better and improved freight distribution scheme:**

  - Make the distribution scheme based on car capacity, car weight and level of pollution
  - Before implementing a new good distribution systems make a survey with a target group the local distributors about how they see a new scheme and what are their wishes about this.
  - All new changes take time and are money consuming, depending on the acceptance of the population on the city hall
  - Integrate in every step you make the local distributors and work together with them in order to have a well understood and an operational distribution scheme.

D.4.2 Recommendations: process

- **Organizational; City development strategy -** To analyse the urban development startegy of Municipality to avoid the barriers which could delay the measure implementation.

M08.02 – Executive summary

Aim of this measure is the design, the test and the implementation of a new system to monitor the Public Transport in the city of Craiova.

Vehicle tracking systems are commonly used by fleet operators for fleet management functions such as fleet tracking, routing, dispatch, on-board information and security. Along with commercial fleet operators, urban transit agencies use the technology for a number of purposes, including monitoring schedule adherence of buses in service, triggering changes of buses' destination sign displays at the end of the line (or other set location along a bus route), and triggering pre-recorded announcements for passengers.

Data collected as a transit vehicle follows its route is often continuously fed into a computer program which compares the vehicle's actual location and time with its schedule, and in turn produces a frequently updating display for the driver, telling him/her how early or late he/she is at any given time, potentially making it easier to adhere more closely to the published schedule. Such programs are also used to provide customers with real-time information as to the waiting time until arrival of the next bus or tram/streetcar at a given stop, based on the nearest vehicles' actual progress at the time, rather than merely giving information as to the *scheduled* time of the next arrival.

Transit systems providing this kind of information assign a unique number to each stop, and waiting passengers can obtain information by entering the stop number into an automated telephone system or an application on the transit system's website. Some transit agencies provide a virtual map on their website, with icons depicting the current locations of buses in service on each route, for customers' information while others provide such information only to dispatchers or other employees.

Before the start of CIVITAS Modern activities related to this measure RAT (the Public Transport Company managed its service by direct operator’s control. This way only the start and the end of each run could be controlled while no records were made during the run itself. Moreover the maintenance schedule and fuel consumptions were recorded by operators, with low reference to mileage, so generating not so reliable data not so useful for Company management. So RAT and Craiova Municipality decided to implement a new AVL system within MODERN project. The solution of installing GPS/GPRS equipment should provide several benefits, like: increase the reliability of the public transport system, provide better access to real time route information, set up of a service data base suitable for a better company management and for the revision of PT service.

The measure consists of the implementation of GPR/GPRS modules on 80 buses and 27 trams and installing 20 info panels for travelers in the main station and in several bus stops. TheaVL system operates by GPR/ GPRS system so acquiring data regarding the “on time position” using the GPS module and data transmission along with other information (ride times, speed, and fuel consumptions) by GPRS module.

The implementation of this produced the following advantages:

- For RAT, the PT Company in Craiova Bus tracking system allows to:
    - Monitor schedule adherence of bus in service;
    - Monitor the fuel consumption;
    - Real time inform drivers about advance – delay at each bus stops
    - Set up of a data base with records of bus service in order to verify the quality of service
- For passengers;

- The information about the effective schedule at each bus stop;
- A better quality of the service.

So the main purpose of RAT, constituted as a development strategy is represented by the modernization of public transport activity in order to meet diverse urban demands in this field. The new electronic integrated system which was implemented at RAT Craiova allows achieving outcomes as:

- Increasing the efficiency of urban transport activities ;
- Saving material, human, financial and temporal resources; the system eliminates the manual monitoring activity and allows saving fuel and money offering the fuel consumption chart by each route.
- Increasing of the passengers satisfaction level (timeliness races, easy modalities to pay transport titles, information panels from stations, safe and punctual transport relying on the significant increase of vehicle movement adherence level at circulation graphics.

Several lessons were learnt by the implementation of this measure:

- The collaboration of Modern partners in the design phase and in the procurement one was essential for the success of the implementation of the new infomobility system in Craiova.
- The infomobility system represents an important tool for the development of a new culture in the PT management: It is the first step of IT introduction within RAT; Craiova Municipality is waiting to have significant results from this implementation.
- The implementation of such a system requires a complex effort in terms of coordination of all the actors involved: Municipality, tender winner, communication and power supply companies. Such a complex management represented one of the most important lessons learnt within this measure.

A Introduction

A1 Objectives

The measure objectives are:

(P) High level / longer term:

- To improve information flows and optimise the traffic
- To introduce advanced ITC technologies in the PT process

(Q) Strategic level:

- To optimise the urban traffic and PT fleet by using real time technic-GPS/GPRS applications

(R) Measure level:

(1) To manage the PT fleet by endowing 80 buses and 27 trams with info mobility tools in order to improve the accuracy of time keeping by 15% and the average occupancy by 5%

A2 Description

Basic function in all fleet management systems is the vehicle tracking component.

Before the start of CIVITAS MODERN project, in Craiova there was an ineficientlly fleet management system that led to errors and inaccurate information. Buses and trams were in delay and PT users did not have information about arriving vehicles.

Old traffic management system from RAT was based on human elements called “track officers” placed at the end of rout in order to validate the tracking sheet for each vehicle. The track officer decided the start for a new trip for every vehicle according to the timetable. Also, the daily activity of each vehicle is monitored by some employees from RAT that calculate the Km traveled by each vehicle on considered rout.

Considering all mentioned above, Craiova needed an eficient and modern fleet management system, without human errors, that can provide a quality public transportation service.

Figure A2.1- Info-panels

The purpose of the measure was then to implement GPS/GPRS – Operation Support System consisted mainly in the following:

- GPS/GPRS modules installed on 80 buses and 27 trams . The GPS/GPRS modules gather the coordinates that are specific to vehicle position on the route through the communication antenna from the global system and send them to the server which stores them in a data base. These positions are compared every 60 seconds to the immobile positions of the stations where info panels are installed and by

determinations done by the dispatcher software, the time when the bus reaches the stations is being displayed;

- a software that contains all routes in town installed on the board computer in each vehicle
- 2 servers and specific devices for the system's monitoring: RACKs (stands for electronic devices), displays
- 20 info panels for travelers(fig.A2.1).

The Info-mobility tools are integrated in a system with two main features: the first is the fleet monitoring with AVM -Automatic Vehicle Monitoring based on GPS and the second is the passenger information with data provided by AVM system.

The procurement procedure for purchasing the equipments necessary to the GPS/GPRS system was carry-out together with e-ticketing and surveillance cameras systems procurement procedure. This procedure took place by national tender electronic system and five companies submitted tenders.

B Measure implementation

B1 Innovative aspects

The innovative aspects of the measure is:

- **Use of new technology/ITS:** The implementation of the fleet management system represented a significative innovation for RAT; since the start-up of the complex of measures dealing with infomobility, e- ticketing and video surveillance the company operated only on operators records and there was not any IT to help the management. The improvement in quantity and quality of the information should help management to improve:

- Organization of the PT services, in terms of knowledge and management of passengers' frequentation of each line.
- fleet management costs; by a more accurate knowledge of effective mileage on each route
- Number of passengers using the service; this particularly because of the better information about the bus / trams passage at each stop.
- Network design, by taking into the account the new needs detected by the system.

B2 Research and Technology Development

The RTD task aimed to find a solution for GPS/GPRS system implementation in Craiova , in order to provide a good service for passengers and set a management tool for public transportation company.

Generally speaking the major constituents of the GPS based tracking system are the following:

1. GPS tracking device: The device fits into the vehicle and captures the GPS location information apart from other vehicle information at regular intervals to a central server. The other vehicle information can include fuel amount, engine temperature, altitude, reverse geocoding, door open/close, tire pressure, cut off fuel, turn off ignition, turn on headlight, turn on taillight, battery status, GSM area code/cell code decoded, number of GPS satellites in view, glass open/close, fuel amount, emergency button status, cumulative idling, computed odometer, engine RPM, throttle position, and a lot more.
2. GPS tracking server: The tracking server has three responsibilities: receiving data from the GPS tracking unit, securely storing it, and serving this information on demand to the user.
3. User interface: The UI determines how one will be able to access information, view vehicle data, and elicit important details from it.

The system installed in Craiova has been composed by:

- A board computers, incorporating a GPS GPRS module and a data transmission card type Vodafone installed on 80 buses and 27 trams;

- A central station ("the dispatcher); Through GPS the position (longitude and latitude) of the vehicle is transmitted to the central dispatcher room every 30 seconds. In the dispatcher room it is configured a map with all the routes based on Google map application containing the coordinates of the passenger's stations and the coordinates of approx. 10 intermediate points between 2 stations. By unify these points the routes are defined. The soft analyze the coordinates sent by vehicles and give automatically the vehicles positions on the map.
- 20 info panels for passengers; these can supply passengers all information transmitted by the central dispatcher. passengers. The software calculate the difference between the vehicles coordinates and the static position of the panel and applying an average predefined vehicles speed obtain the time for the next bus arrival in the passenger station.
- The system is working using database regarding:
    - Routes and passengers stations coordinates
    - Vehicles inventory number and type
    - Drivers name and allocated card number

The system supervises and controls the activities related to public transport and provides a powerful decision support. The Info-mobility tools are integrated in a system with two main features: the first is the fleet monitoring with AVM - Automatic Vehicle Monitoring based on GPS and the second is the passenger information with data provided by using GPRS technology available in the info-mobility system.

An important function is diagnosis - each vehicle has a board computer who gathers information related to number of kilometers, fuel consumptions, functioning hours, etc. It is, also, possible to implement a "predictive" maintenance program based on the information collected by the system, traffic conditions, and recommendation of the manufacturer for each vehicle.

Figure B2.1 – Informaiton panels

One of the information panels with expected remaining time to the bus arrivals

Vehicle tracking is one of the main functions of a FMS. This is made, usually, using GPS technology. The info-mobility system is made up of:

- GPS/GPRS modules integrated in one on-board computer were installed on 80 buses and 27 trams. The GPS/GPRS modules gather the coordinates that are specific to vehicle positions on the route through the communication antenna from the global system and send them to the application server which stores them in a data base. These positions are compared every 60 seconds to the ones of the bus stops where info panels are installed. By software can on time predict o the arrival time that is displayed on the panels;
- data base containing all the information related to roads, routes, time scheduling, vehicle data and the position of each stops. This data base with related management software was installed on the on-board computer from each vehicle and in Central Server too;
- 2 servers and specific devices for the system's monitoring: RACKs (stands for electronic devices) and displays;
- 20 real-time info panels for travellers.

Software applications for Fleet Management (ASMF)

ASMF has the following functionalities:

- Operation based on access rights
- Web type interactive graphic interface
- Registers the performed actions;
- Prints/displays reports on printer/display;
- Connection with other applications through standard interfaces;
- Creates safe copies („backup") and restores data in case of damages („restore");

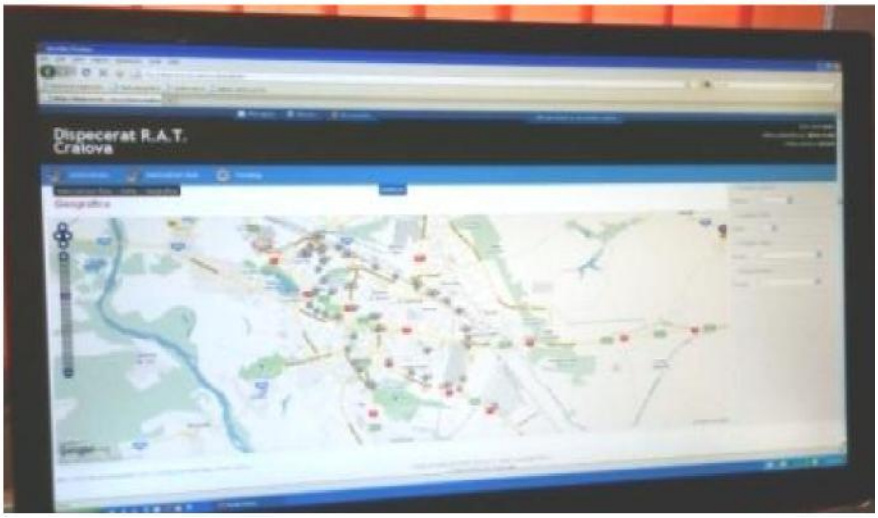


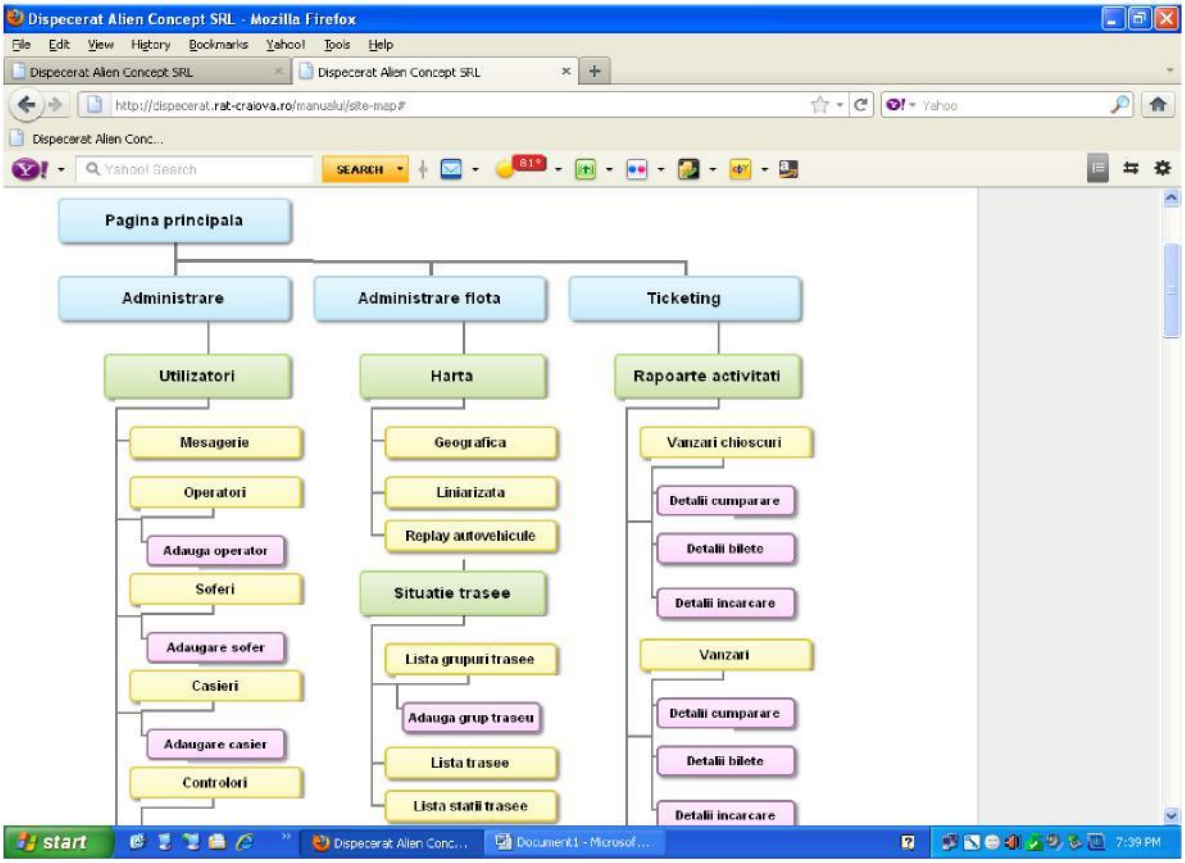
Figure B2.2 – software application screenshot

A central dispatcher for GPS monitoring was set up. Dedicated software was installed and a database was filled up with the following information: no. of bus, drivers name, GPS parameters and routes to be monitored. The system allows to optimize the bus routes and to plan the drivers by shift / bus no. / line.

The main routines developed in the program are:

- Administration of personnel and equipment
- Personnel management
- Adding user names for drivers, cashiers, inspectors
- Editing users data
- Eliminating users in management
- Working equipment administration
- Public transport vehicles administration

The system can be operated from any computer on the internet network, as it is a web-based application, giving management access possibility by using user name and password access system.



By using the system, predefined messages can be sent from buses to the dispatcher and reverse. The system permit permanent to the driver to see if the bus is in delay or advanced from his position comparing with the ideal time from planning.

The 20 digital panels for real time information about the time remaining for buses arrivals in the passenger's stations can inform in real time passengers about the effective time schedule.

The identification of the driver working that day is done through an employee card that is put to the identification device before starting the work shift.

Being a research and development pilot project the initially number of buses, trams, passengers' stations foreseen in the project was smaller than the entire fleet, or passenger's stations belonging of RAT.

The system respects the measure objectives and the spirit of the MODERN project an is operational for:

- GPS/GPRS tracking system on 3 trams routes from 3
- GPS/GPRS tracking system on 4 buses routes from 17
- GPS/GPRS tracking devices installed on 27 trams foreseen in the project from 34
- GPS/GPRS tracking devices installed on 80 buses foreseen in the project from 169
- 20 passengers stations endowed with real time digital panel information from 236

- Central dispatcher room installed at RAT headquarter where electronic reports regarding the GPS/GPRS tracking system and real time information in terms of time and locations are issued

INFO-Mobility system's application

- Passengers stations management
- Adding passenger's stations in the system
- Viewing added passenger's stations
- Routes and their organizing in groups of routes
- Adding and editing routes
- Deleting routes from the database
- Groups of routes
- Adding a pattern and a hourly type
- Allocation of daily schedule for drivers
- Vehicles route (itinerary)
- Adhesion to circulation graphic
- Performed semi strokes/ strokes
- Travelling times - distance between stations
- Display, information, messaging, journal
- Activities reports
- Drivers activities reports
- Activities scheduling
- Daily schedule
- Ideal graphic
- Driver's activity sheet
- Vehicles activities reports
- Driven kilometers
- Speed diagram
- Travelling times
- Topographical map
- Stations map
- Panels
- Panels display

In terms of electronic **reports**, the system provides:

- Daily added program
- Vehicle ideal schedule
- Roadmap for vehicles
- View level diagram
- Vehicles replay
- Travel time distance between stations
- Panels display
- View speed diagram
- Geographical map
- Schedules templates
- Drivers
- Routes station list
- Vehicles messages

Main results coming from the system are:

- Accuracy of passenger information in the stations about next bus arrival
- Automatic communication between drivers and central dispatcher room by predefined messages
- Alerts regarding technical revisions
- Electronic reports
- Vehicles fuel consumption

All these data are used by RAT in order to manage the public transport giving the possibility to reduce the fuel consumption by analyzing each route leading to cost reduction and also to improve the quality of the service in front of the citizens.

<u>Real Time Information Panels:</u>

1. Informing set panels for passengers in urban transport vehicles – PDICA

Main technical requirements:

- Minimum resolution:

- Front-side panel – 16 x 120 dots (16 vertical dots and 120 horizontal dots);
- Lateral panel: – 16 x 120 dots (16 vertical dots and 120 horizontal dots);
- Back–side panel – 16 x 32 dots(16 vertical dots and 32 horizontal dots);
- informing panel for passengers –5x80 dots (5 vertical dots and 80 horizontal dots);

- Led:

  - viewing angle – minimum 110/60 degree;
  - luminosity–approx. 500mc;

- Communication:

  - Local – RS232, isolated RS485 ;

- Operating voltage:

  - 18VDC 36V DC;

- Functional requirements :

  - Display mode: static/cyclic or flow;
  - Two different sets of fonts;
  - Luminosity control- automatic with sense device;
  - The information on the panel to be controlled by the Board Computer.

2. Panels for informing passengers in stations – PICS

Main technical requirements

- The panels will have 2, 3, 4, 5 rows (one rows=7x100 LEDs). On each panel one row will be used to display information from the City Hall and advertising messages; the other rows will display the routes which are (or not) GPS monitored.
- The colour of the LED: yellow
- mobile communication with ASMF
- Power supply voltage 230v/50Hz from public electricity network
- Metallic case vandal and bad weather resistant
- Firmware maintenance at distance

Functional requirements:

- For GPS monitored routes it must display information about: number and destination of the route, estimated time until the next vehicles arrive, hour an minute when the vehicle must be in station or minute and hour for departure in both end-lines points
- For unmonitored routes the panel displays the frequency or minute and hour when the vehicle is passing through station and minute and hour for departure in both end-lines points

- The information is displayed static, cyclic or flow;
- The luminosity of the panel is adjusted by measuring the outside luminosity with a sensing device.

Traffic Management System

System's architecture:

- the system must have a modular structure to allow the development in more than one stage, functionally and, also, quantitative.

Components:

- Local (fixed) communication equipment – EFX
- To make the Wi-Fi communication the following equipments, for one depot, are needed:
  - Workstation with
    - DualCore 2GHz;
    - RAM 1GB;
    - HDD 80 GB;
    - CD-ROM;
    - Network board;
    - 2x COM, 1x LPT, 1x USB 2.0;
    - LCD 15", resolution 1024x768;
    - mouse, keyboard;
    - NTFS file system;
    - Antivirus program;
    - UPS 500 VA;
    - Access point type equipment (fixed communication);
    - Radio mode with access point function;
    - Operation modes: 802.11 b/g for access point function;
    - Wi-fi certificate;
    - Adjustable transmitting power security
    - Operational temperature: -20°C ... +70°C.

Software applications for Fleet Management (ASMF)

ASMF must have the following functionalities:

- Operation based on access rights
- Web type interactive graphic interface
- Registers the performed actions;
- Prints/displays reports on printer/display;
- Connection with other applications through standard interfaces;
- Creates safe copies(„backup") and restores data in case of damages („restore").

B3 Situation before CIVITAS

Before the MODERN project start up, the fleet management in Craiova was based on RAT employers "the monitor" operating at the head of the buses lines, in charge of the validation of the daily activity sheet of each vehicle and driver. The "monitor" was also in charge of the starting time for a new run for every vehicle according to the foreseen schedule. Among his duty there was also the evaluation of each bus mileage considering the route where they were operating.

B4 Actual implementation of the measure

The measure was implemented in the following stages:

Stage 1: Planning and designing the measure (Oct 2008-Sept 2009)

Several discussions and meetings between specialists from RAT and IPA and politicians from Craiova municipality were held, in order to determine how the solution will be applied and integrated into the Urban Development Strategy of the city. Finally the specialists from RAT and IPA and the politicians from Craiova Municipality Local Council got to a common point. This point refers to a PT management system. This integrated PT management system includes: e-ticketing, GPR/ GPRS and video surveillance.

The overall system was designed, based on three main hardware and software components; namely, the GPS tracking device and board computer; the central station (dispatcher); and the infomobility applications (based on the real time information data displayed on digital panels located in passenger's stations).

The information to the travelers regarding the route is provided by means of electronic panels installed in vehicles (3 panels have been installed outside each vehicle).

Stage 2: GPS/GPRS research ; GPS/GPRS system procurement procedure (Oct 2008-Jan 2011)

<u>Technical specifications of the GPS/GPRS system (Oct 2008-May 2009)</u>

The objective of this project was to create an effective PT information system for citizens and to optimize fleet management by using real time technical-GPS/GPRS applications and by the installation of info mobility tools.

The technical specifications of the GPS/GPRS and ITC system were carried out considering the technical system applied in Brescia City. All this were included in the technical tender for GPS/GPRS system purchasing.

<u>Procurement procedure carrying out (Feb 2010- Jul. 2010)</u>

In this period of time the public procurement procedures, the legislation for the GPS/GPRS system purchasing and the integration of whole public transport management system were studied. The whole public transport management system included: e-ticketing, GPS/GPRS system and video surveillance equipments and, the integrated technical specification for the whole system acquisition was developed.

The three measures, 02.04, 05.05 and 08.02, formed an integrated group of actions that developed a complex system of: monitoring, security and management of public transportation in Craiova.

A common procurement procedure for purchasing the equipments necessary to the eticketing, GPS/GPRS and surveillance cameras systems has been defined. The procurement procedure took place by national tender electronic system and five companies' submitted tenders.

The result of the tender was contested by 4 companies but all of them were rejected by National Claims Settlement Commission. Two of the contestant companies continued to claim the tender result in the Court of Law. The contestation process ended in June in favor of RAT and the contract with the winner company was signed at the end of June.

GPS/GPRS system delivery and installing (Aug. 2010-Jan2011)

In this stage, the GPS/GPRS system was delivered and installed and every subsystem was tested and calibrated for the purpose of implementing the system. The GPS/GPRS system that consisted in:

- GPS/GPRS modules installed on 80 buses and 27 trams;
- The software to manage all the system;
- 2 servers and specific devices for buses and trams monitoring. 20 info panels for travellers.

During the installing of the system, partial and final tests were organized in order to achieve the compatibility between the ideal graphic route time and the real time software tool and its modules allowing the switching between specific possibilities.

Each stage of the test has been specified in the system installation plan which was part of the contract. The communication equipment and related software were verified and tested to assure a good connection between the field equipment and the central acquisition system installed in the RAT dispatcher centre.

The test verifies that the system performance reached all the specified parameters so the system was approved by RAT Craiova.

After the finalization of the test the system was completely installed and started its operation. The system was constantly monitored in order to intervene and correct any operational problems or technical and conceptual malfunctions.

During the operation of the system all the data necessary to perform the evaluation were collected.

Equipments mounting and installation were made by RAT together with integrated system providing company.

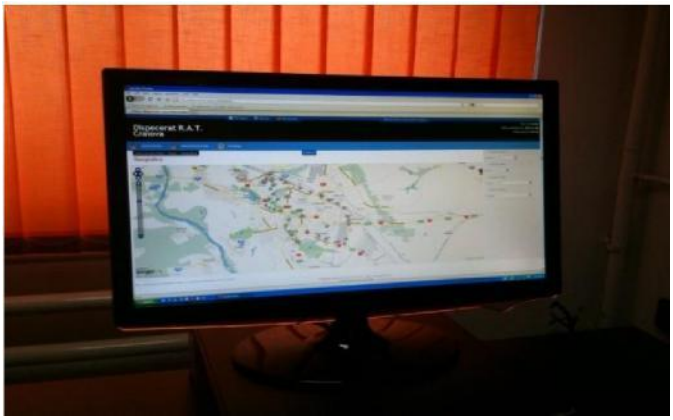


Figure B4.1 – Bus tracking example

The system was implemented at RAT.

Stage 3 Training for involved technicians (Aug 2010- Jan 2011)

The technician's training process has been held in the same time with the system's installation.

The training was provided for the following categories of technicians:

- Maintenance (hardware and software)
- Software configuration
- Data base
- System operation

B5 Inter-relationships with other measures

The measure is related to other measures as follows:

- **M 02.04** Integrated e-ticketing system in Craiova
- **M 05.05** Public Transport Security program in Craiova

The measures M 02.04, M05.05 and M 08.02 are closely linked since they share the same infrastructure(buses , trams and monitoring station). A commune procurement procedure was organized for the three measures. The on board control units were integrated to ensure the best performance and to provide an up-to-date technological solution. The monitoring central system of these measures share the same hardware architecture and integrate as much as possible the software applications.

C Impact Evaluation Findings

C1 Measurement methodology

C1.1 Impacts and Indicators

Table C1.1: Indicators.

No.	Impact	Indicator	Data used	Comments
2A	Economy	Average Operating costs	Euros/vKm	Annual operating costs: personnel, spare parts, maintenance, other costs
2B		Capital cost	Euros	Investments costs
18	Transport	Accuracy of time keeping	RAT records in "Daily activity sheet"	RAT data base
19		Quality of Service	Survey on PT users	Perception of the quality of service of public transportation (trams and buses). Face to face surveys
28		Average occupancy	Number of passengers per vehicle per trip	RAT data base Monitors' registration on tram line(101 102), E1R, E1T, line 9

Detailed description of the indicator methodologies:

Indicator 2 A (Average Operating costs) - Ratio of total operating costs incurred by the service divided by the total vehicle-km per year (€/vehicle-km).

A = B / C

where: A = Average operational costs for the service (€/vehicle-km)

B = Total operational costs of the service, including Personnel, Maintenance, internet communication and other costs related to the GPS/GPRS tracking service (€)

C = Total vehicle-km traveled by the trams and buses in services

RAT Company provided all the operation costs related to GPS/GPRS tracking service. (See annex 1: Costs calculation)

Indicator 2B (Capital cost) - Investment cost for the GPS/GPRS system

The Capital cost resulted from the purchasing and installation of GPS/GPRS systems on 80 buses and 27 trams and 20 information digital panels. The capital cost is according to purchasing invoice.

Indicator 18 (Accuracy of time keeping) – percentage of public transport services that arrive within an acceptable interval around the planned times given by timetables.

RAT provided annual reports related to accuracy of time kipping for trams and buses. The routs monitored were: tram line, rout E1T, E1R and rout no.9.

Indicator 19 (Quality of Service) - Survey based perception of the quality of service

The survey showed the perception of PT users on waiting time and information panels in stations. The sample size was calculated for a population of 300'000 inhabitants.

The questionnaires were structured in 2 sections:

- General information about citizens (job, age, gender, education level, contact data)
- Questions referring to the measure:
  - "How do you estimate the quality of service from view point of waiting time and information on vehicle arrival in the station?"(scale1-4)

Indicator 28 Average occupancy(peak/off-peak) average number of passengers per vehicle per trip

The average occupancy indicator is measured by counting the number of passengers in off-peak and peak period of day. The frequency of data collection was once a week, twice a day. The measurements were made once in peak period of the day and once in off-peak of the same day. The monitored lines were: tram line, E1Rbuses rout , E1T buses rout, and rout no.9. These routs have been monitored for 1 month, before and after measure implementation.(See annex 2- occupancy monitoring)

C1.2 Establishing a Baseline

Old traffic management system from RAT was based on human elements called "track officers" placed at the end of rout end validated the tracking sheet for each vehicle. The track officer decided the start for a new trip for every vehicle according to the timetable. Also, the daily activity of each vehicle was monitored by some employees from RAT that calculate the Km traveled by each vehicle on considered rout.

Average operating costs

Average operating costs have been calculated as ratio between total operating costs from trams and buses prepared for installation of GPS/GPRS system and total mileage of these trams and buses.

Raw data and indicator calculation	2009 Ex-Ante values
Total Operational Costs coming from the trams and buses prepared for GPS/GPRS system*(detalied operating costs are shown in the annex 1)*	30'139 €
Total km traveled by the buses prepared for GPS/GPRS system	2'945'536 Km
Total km traveled by the trams prepared for GPS/GPRS system	893'497 Km
Average operating cost	0.0078 €/vkm

Note: The operating costs include personnel and other costs, related to the fleet monitoring system only. Other costs(administration costs) are 20% of personel costs

Total capital cost

Total capital cost is the cost of investment. In 2009 there was no investment in GPS system.

Raw data and indicator calculation	**2009 Ex-Ante values**
Investment in the purchase of the GPS/GPRS system	0.00 €
Total capital cost	0.00 €

Accuracy of time keeping

Up to 2010, every vehicle had a daily activity sheet, issued by the driver. The driver brought the daily activity sheet to the dispatcher . At the dispatcher, the arrival and departure hours were written in the daily activity sheet. At the end of working day, a person charged with monitoring of the routs prepared a report necessary for mileage and fuel consumption calculation. The same person charged with monitoring of the routs issued a report relating to framing vehicles in schedule (accuracy of time keeping).

The accuracy of time keeping was monitored, in September 2010, before GPS/GPRS. The delay was between 10 and 15 minutes depend on traffic conditions and the driver had not the possibility to receive automatic messages regarding the position (if he is in delay or in advance comparing with the route timing).

Buses and trams lines monitored	**2010 Ex-Ante values**
E- 1T	50%
E-1 R	55%
Line 9	65%
Line 101- Tram line	70%

Average occupancy

The average number of passengers was monitored for 1 month – September 2010, before GPS/GPRS system implementation. RAT provided average occupancy for the routes where buses and trams will be equipped with GPS/GPRS system: Route E1R, Route E1T, Route No. 9 and Line No101 (tram line). Occupancy data were collected by RAT people, one day a week, in peak and off-peak period of the day.

Routs and lines monitored	2010 Ex-Ante values Average occupancy- off-peak
Line 101- tram line	65%
Rout E1T	50%
Rout E1 R	60%
Rout No. 9	60%

Routs and lines monitored	2010 Ex-Ante values Average occupancy- peak

Line 101- tram line	70%
Rout E1T	55%
Rout E1 R	65%
Rout No. 9	65%

Quality of service

The questionnaires were disseminated to public transport users in stations for routs E1T, E1R, Rout No. 9 , tram line, and during workshops organized by MODERN project team. The workshops were organized during the Communication Campaign and seminar presentation(Fig. C1.2.1) that took place in May 2010, in the prefecture market (in the downtown).

120 feedbacks were received from people that expressed their opinion about the fleet monitoring system and information panels in the stations. In agreement with the dedicated target group it was kept contact data to evaluate the progres of the measure.

Questionaire content	**2010 Ex-Ante values**
Public transport user	80 % yes 5 % No 15 % occasionally
What is your view about the waiting time in the stations?	
Less good	75 %
Good	20%
Very good	3%
Don't know	2%
What is your view about no information related to vehicles arriving?	
Less good	98 %
Good	0
Very good	0
Don’t know	2%

C1.3 Building the Business-as-Usual scenario

In the absence of CIVITAS project, Craiova was not intended to implement GPS/GPRS system for fleet management. In the current risk climate of economic recession it seems very unlikely that such a project would have been completed.

Average operating costs

RAT assumed that the opertaing costs keep the same values over years 2010, 2011 and 2012 because in BAU situation the 80 buses and 27 trams kept the old fleet monitoring system, without CIVITAS project. All the costs are devided by the real mileage of the 80 buses and 27 trams for the years considered.

Raw data and indicator calculation	**2010 BAU values**
Total Operational Costs coming from the trams and buses with old fleet monitoring system (detalied operating costs are shown in the annex 1)	30’139.2 €
Total km traveled by the 80 buses that kept the old fleet monitoring system	3’665’503 Km
Total km traveled by the 27 trams that kept the old fleet monitoring system	819’643 Km
Average operating cost	0.0067€/vkm

Raw data and indicator calculation	**2011 BAU values**
Total Operational Costs coming from the trams and buses with old fleet monitoring system (detalied operating costs are shown in the annex 1)	30’139.2 €
Total km traveled by the 80 buses that kept the old fleet monitoring system	3’681’844 Km
Total km traveled by the 27 trams that kept the old fleet monitoring system	524’251Km
Average operating cost	0.0072€/vkm
Raw data and indicator calculation	2012 BAU values
Total Operational Costs coming from the trams and buses with old fleet monitoring system (detalied operating costs are shown in the annex 1)	30’139.2 €
Total km traveled by the 80 buses that kept the old fleet monitoring system	3’264’988 Km
Total km traveled by the 27 trams that kept the old fleet monitoring system	533’341Km
Average operating cost	0.0079€/vkm

Total capital cost

There is no investment cost in GPS/GPRS system.

Indicators and respective parameters	**BAU values**
Investment in the purchase of the GPS/GPRS system	0.00 €

Total capital cost	0.00 €

Accuracy of time keeping

The indicator keeps the same ex-ante values by routs, for the years 2011 and 2012, considering no GPS/GPRS system.

Buses and trams lines monitored	**2011, 2012 BAU values**
E- 1T	50%
E-1 R	55%
Line 9	65%
Line 101- Tram line	70%

Average occupancy

The indicator keeps the same ex-ante values by routs, for the years 2011 and 2012, considering no GPS/GPRS system

Routs and lines monitored	**2011, 2012 BAU values Average occupancy-off-peak**
Line 101- tram line	65%
Rout E1T	50%
Rout E1 R	60%
Rout No. 9	60%

Routs and lines monitored	**2011, 2012 BAU values Average occupancy-peak**
Line 101- tram line	70%
Rout E1T	55%
Rout E1 R	65%
Rout No. 9	65%

Quality of service

The indicator keeps the same ex-ante answers, for the years 2011 and 2012, considering no GPS/GPRS system.

Questionaire content	**2011, 2012 BAU values**
Public transport user	80 % yes 5 % No 15 % occasionally
What is your view about the waiting time in the stations?	
Less good	75 %
Good	20%
Very good	3%
Don't know	2%
What is your view about no information related to vehicles arriving?	
Less good	98 %
Good	0
Very good	0
Don’t know	2%

C2 Measure results

The results are presented under sub headings corresponding to the areas used for indicators – economy, energy, environment, society and transport.

C2.1 Economy

The years for ex-post measurements are considered 2011 and 2012

Average operating costs

In ex-post period, 2011 and 2012, the costs related to the fleet monitoring had a significant decrease after the measure implementation as 6 personnel units formerly devoted to this task were shifted to other jobs thanks to the new system. In the same time, the new system implementation brought additional internet and maintenance costs.

Raw data and indicator calculation	**2011 Ex-post values**
Total Operational Costs coming from the trams and buses with GPS system(detalied operating costs are shown in the annex 1)	17’481 €
Total km traveled by the 80 buses with GPS system	3’681’844 Km

Total km traveled by the 27 trams with GPS system	524'251Km
Average operating cost	0.0042 €/vkm
Raw data and indicator calculation	**2012 Ex-post values**
Total Operational Costs coming from the trams and buses with GPS system (detalied operating costs are shown in the annex 1)	17'971 €
Total km traveled by the 80 buses with GPS system	3'264'988 Km
Total km traveled by the 27 trams with GPS system	533'341Km
Average operating cost	0.0047 €/vkm

Note: the operation costs include internet conection, personnel and administartiv costs

Average operating costs (€/vKm)	2009	2010	2011	2012
ex-post	0.0079	0.0067	0.0042	0.0047

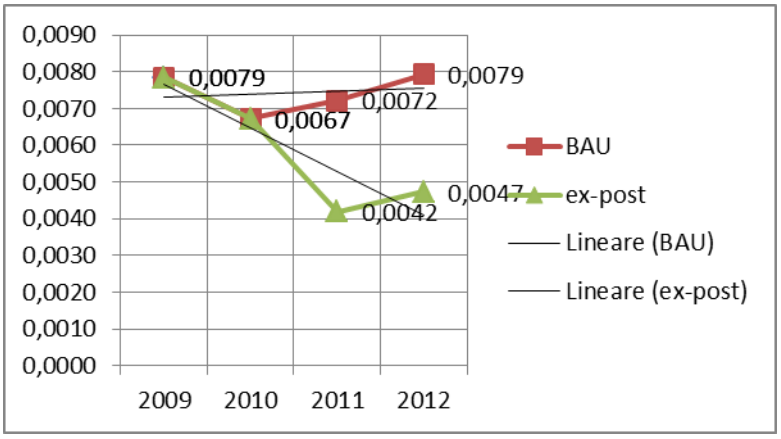


Figure C2.1.2 – Evolution of average operating costs

Total capital cost

GPS system has 10 years lifetime and the annual depreciation is 16796.5 €.

Indicators and respective parameters	**2010 Ex-post values**
Depreciation	0.00 €
Investment in the purchase of the GPS system	167'965 €
Total capital cost	167'965 €
Indicators and respective parameters	2011 Ex-post values

Depreciation	16’796.5 €
Total capital cost	151’168.5 €
Indicators and respective parameters	2012 Ex-post values
Depreciation	16’796.5 €
Total capital cost	134’372 €

C2.4 Transport

Accuracy of time keeping

The routs were monitored for 1 month – in September 2011, respectiv September 2012.

After GPS/GPRS system implementation, The daily activity sheet is issued by the computer. The vehicles frequency can be improved because the monitoring system can issue a speed diagrame for each vehicle monitored. After the GPS system implementation the accuracy of time keepin has been improved.

Buses and trams lines monitored	**2011 – Ex-post values**
E- 1T	70%
E-1 R	75%
Line 9	85%
Line 101- Tram line	85%

Buses and trams lines monitored	**2012 – Ex-post values**
E- 1T	75%
E-1 R	80%
Line 9	90%
Line 101- Tram line	90%

Accuracy of time keeping(%)	**2010 ex-ante**	**2011-ex-post**	**2012 - ex-post**
E- 1T	50%	70%	75%
E-1 R	55%	75%	80%
Line 9	65%	85%	90%
Line 101- Tram line	70%	85%	90%

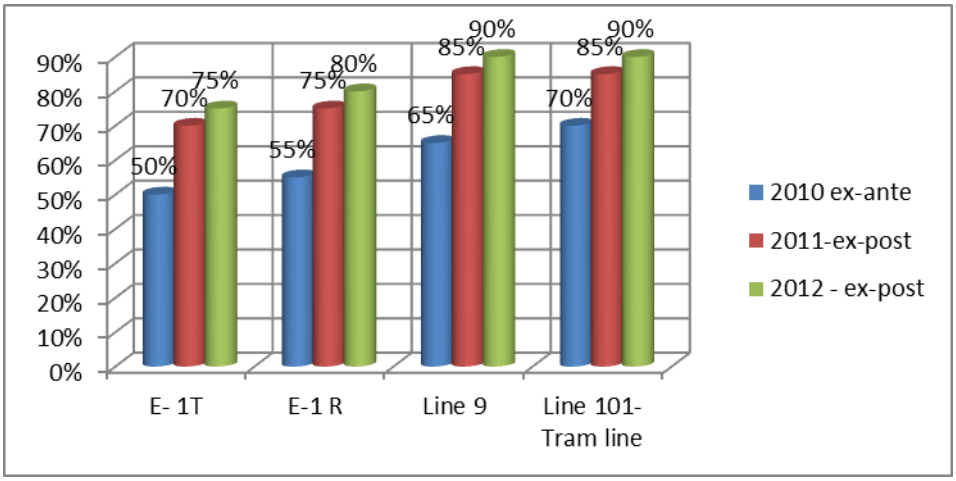


Figure C2.4.1 – Accuracy of time keeping evolution

Average occupancy

The indicator was measured in September 2011 and September 2012 to see the trend of the indicator over the system running period.

The data were collected 1 day a week, in peak and off-peak period.

Routs and lines monitored	**2011-ex-post values Average occupancy- off-peak**	**2012-ex-post values Average occupancy- off-peak**
Line 101- tram line	45%	70%
Rout E1T	40%	45%
Rout E1 R	50%	55%
Rout No. 9	50%	55%

Routs and lines monitored	**2011, ex-post values Average occupancy- peak**	**2012, ex-post values Average occupancy- peak**
Line 101- tram line	50%	75%
Rout E1T	45%	50%
Rout E1 R	55%	60%
Rout No. 9	55%	60%

Average occupancy- off-peak	**2010**	**2011**	**2012**

Average occupancy- off-peak	2010	2011	2012
	ex-ante	ex-post	ex-post
Line 101- tram line	65%	45%	70%
Rout E1T	50%	40%	45%
Rout E1 R	60%	50%	55%
Rout No. 9	60%	50%	55%

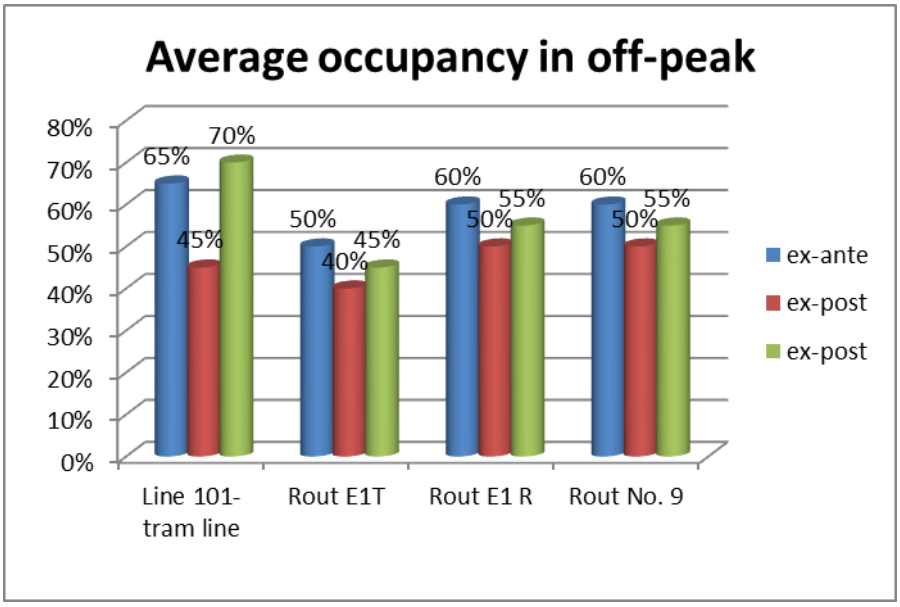


Figure C2.4.2 – Evolution of average occupancy in off peak

Average occupancy- peak	2010	2011	2012
	ex-ante	ex-post	ex-post
Line 101- tram line	70%	50%	75%
Rout E1T	55%	45%	50%
Rout E1 R	65%	55%	60%
Rout No. 9	65%	55%	60%

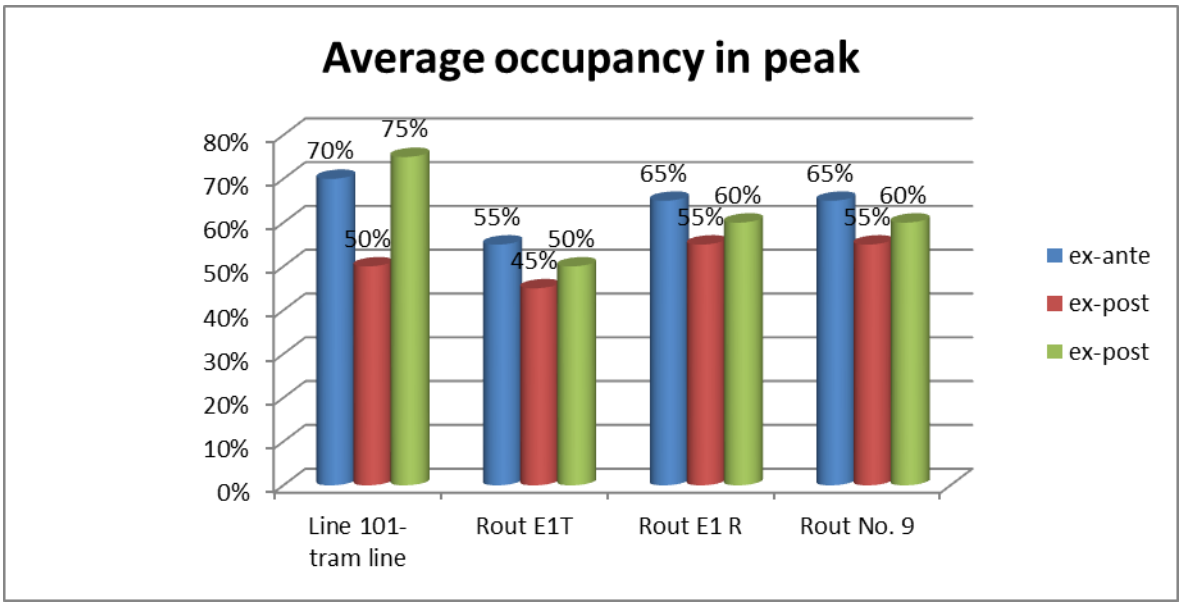


Figure C2.4.3 – Evolution of average occupancy in peak

In 2011and 2012, average occupancy decreased compared with 2010 because RAT cancelled some discounted season tickets . In 2012, average occupancy increased compared with 2011 but still remained lower than 2010, for buses routs.

For trams, average occupancy decreased in 2011 because of tram line interruption, during overpass construction, but it increased in 2012 more than 2010 and 2011. In August 2012, the construction of overpass finished and the trams operate on whole line, without interruption.

C2.5 Society

The survey was carried out on September 2012, using the same people surveyed for ex-ante evaluation (In agreement with them, their contact data were kept). The questioners were circulated by phone and e-mail and 115 feedbacks were received.

Quality of service

Questionaire content	**2012 Ex-Post values**
Public transport user	85 % yes 3 % No 12 % occasionally
What is your view about the waiting time in the stations?	
Less good	5 %
Good	82%
Very good	11%

Questionaire content	**2012 Ex-Post values**
Don't know	2%
What is your view about information panels placed in stations?	
Less good	0
Good	87%
Very good	11%
Don't know	2%

What is your view about the waiting time in the stations?	**2010 Ex-Ante values**	**2012 Ex-Post values**
Less good	75%	5%
Good	20%	82%
Very good	3%	11%
Don't know	2%	2%

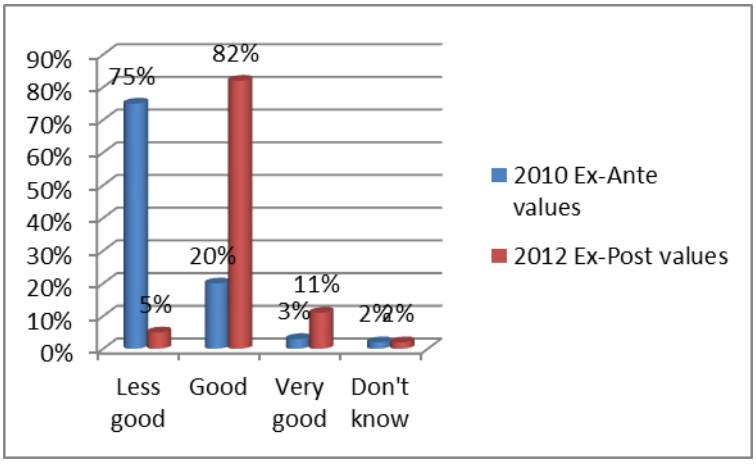


Figure C2.4.4 – Quality of service perception (related to waiting time)

What is your view about no information on vehicles arriving? (2010)	**2010 Ex-Ante values**	**2012 Ex-Post values**

What is your view about information panels placed in stations? (2012)		
Less good	98%	0
Good	0	87%
Very good	0	11%
Don't know	2%	2%

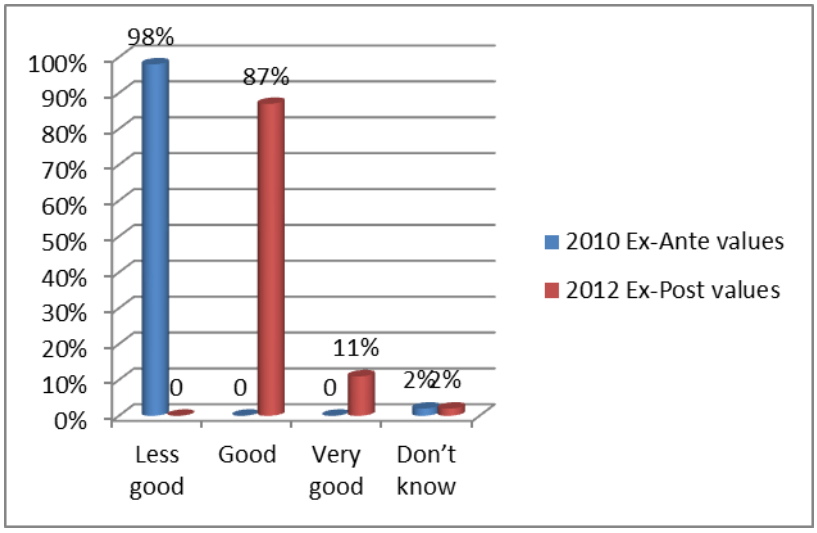


Figure C2.4.5 – Quality of service perception (related to information panels)

C3 Achievement of quantifiable targets and objectives

No.	Target	Rating
1	To endow 80 buses and 27 with GPS/GPRS system	**
2	To install 20 digital information panels in main stations	**
3	To improve the accuracy of time keeping by 15% Routs: E1T, E1R and No. 9 - Accuracy of time keeping increased by 25% Tram line- Accuracy of time keeping increased by 20%	***
4	To improve the average occupancy by 5% Average occupancy increased in 2012 by 5% for trams Average occupancy decreased by 5% for buses	**trams O buses

No.	Target	Rating
NA = Not Assessed O = Not Achieved ★ = Substantially achieved (at least 50%) ★★ = Achieved in full ★★★ = Exceeded		

C4 Up-scaling of results

Subject to the availability of financial resources, RAT Craiova has the intention to gradually equip the entire fleet with GPS/GPRS tracking system and the stations with real time information digital panels, expanding the system to the entire fleet in order to provide users with comprehensive real-time information on bus schedules and to build up a more complete database that would improve the optimization results.

C5 Appraisal of evaluation approach

The evaluation of this measure focused on some indicators across the areas of economy, transport and society, which were to be measured in different ways and calculated.

In the evaluation period of measure, some indicators were cancelled for various reasons, such as: there were no available statistics data or these indicators were not relevant to assess the impact of the measure on transportation mode in Craiova. So, the Modal split indicator was cancelled because no ex-ante statistic data available. Also, the indicators related to fuel efficiency and emissions have been cancelled because they were no relevant for measure evaluation.

Finally, also the calculation of average operating revenues indicator was difficult, both before and after implementation of the measure, since RAT was unable to collect revenues separately by transportation modes and routes. For this reason also this indicator has not been considered in the evaluation exercise.

C6 Summary of evaluation results

The key results are as follows:

Key result 1 - capital costs – As expected, capital cost increased as result of the implementation of the measure

Key result 2 - operating costs/vKm- decreased by 41%; as result of measure implementation, some jobs, related to lines monitoring, were cancelated.

Key result 3 - Average occupancy- increased by 5 % for trams line but decreased by 5 % for buses routs.

Key result 4 – Quality of service:

- increased by70 % related to Perception on waitig time
- increased by 98 % related to Perception on information panels

Key results 5 – Accuracy of time keeping- increased due to the measure implementation, namely:

- Routs: E1T, E1R and No. 9 - Accuracy of time keeping increased by 25%
- Tram line- Accuracy of time keeping increased by 20%

In conclusion the new electronic integrated system which was implemented at RAT Craiova allows achieving outcomes as:

- Increasing the efficiency of urban transport activities;
- Saving material, human, financial and temporal resources; the system eliminates the manual monitoring activity and allows saving fuel and money offering the fuel consumption chart by each route.
- Increasing of the passengers satisfaction level (timeliness races, easy modalities to pay transport titles, information panels from stations, safe and punctual transport relying on the significant increase of vehicle movement adherence level at circulation graphics.

C7 Future activities relating to the measure

Subject to the availability of financial resources, RAT Craiova has the intention to gradually equip the entire fleet with GPS/GPRS tracking system and the stations with real time information digital panels, expanding the system to the entire fleet in order to provide users with comprehensive real-time information on bus schedules and to build up a more complete database that would improve the optimization results.

D Process Evaluation Findings

D.0 Focused measure

▪

1	The measure fits into the EU policy towards clean urban transport (five pillars of the EU Green Paper)
2	The measure fits into the city policy towards sustainable urban transport and / or towards sustainability in general
3	The expected impact on the transport system, environment, economy and/ or society / people is very high
4	The high level of innovativeness of the measure with respect to technique, consortium, process, learning etc
5	The measure is typical for a group of measures or a specific context
6	The possibility of carrying out a good Cost Benefit Analysis
7	Participation of a range of different actors
8	The high degree of complexity of managing the measure
9	The measure is regarded as an example measure
10	Other, *please describe????*

	0	No focussed measure
2	1	Most important reason
4	2	Second most important reason
8	3	Third most important reason

D.1Deviations from the original plan

- **Deviation 1** – Implementation of the GPS/GPRS system on trams was delayed

6 months delay in implementation of the measure occurred because the GPS system providing company has not delivered in time the software for the 27 trams on-board computers to integrate them in fleet management system. The reason why this happened was t financial problems RAT had during 2011.

D.2Barriers and drivers

D.2.1 Barriers

Preparation phase

- **Planning barriers**: Large number of producers, different technologies and system components made difficult to estimate the overall system price.
- **Financial barriers:** Delay of Municipality in introducing the RAT co-financing in their budget

Implementation phase

- **Institutional barriers**: Complexity of Romanian tender procedures led to the delay in implementation
- **Planning barriers:** The period for tender was very long because of contestations, so the implementation of GPS system was delayed.

- **Financial barriers**: Delay of Municipality in introducing the RAT co-financing in their budget.

Operation phase

- **Spatial barriers**: Lack of favorable technical conditions for installation of equipment foreseen in this measure due to segmentation of the transport with trams and of the trams fleet in two isolated sections. This operation was required during construction of an overpass on the path of the tramway.

D.2.2 Drivers

Preparation phase

- **Positional drivers:** Implementation team was supported by Brescia team concerning on info -mobility tools. So. research activities were made easier using similar experience from partners.

Implementation phase

No drivers have been encountered.

Operation phase

- **Organizational drivers**: Mobilization and professionalism of the RAT team to organize the work and to create the technical conditions necessary to diminish the delays.

D.2.3 Activities

Preparation phase

- **Institutional actions**, Measure leader, site coordinator and the manager of the project discussed with RAT's administration concerning to the importance of the measure implementation offering examples of other European cities.
- **Involvement / communication actions**, The measure leader organized round table with key stakeholders sharing different viewpoints. The measure leader and the team organized face-to face interviews with potential producers of info-mobility tools components.
- **Organizational actions**, Meetings of the measure team with RAT top management to emphasize the importance of the measure to obtain their maximum facilitating support. The measure M02.04 and M08.02 and M 05.05 are implemented on the same vehicles and work as a integrated system
- **Technological actions**, The research team made use of city of Brescia experience to improve their knowledge on communication systems protocols in order to make easier the implementation of info-mobility tools in Craiova.

Implementation phase

- **Planning actions:** Evaluation team for offers tried to be very quick to recover the wasted time with tender procedures.

Operation phase

- **Institutional actions**: Several discussions and meetings of the top management and technicians of RAT aiming to establish the plan of action considering the line and trams fleet segmentation, so that the delay's effects on the project work plan to be as small as possible.
- **Organizational actions**: Organization of the workshop on the Eastern segment of the tramway to allow installation of equipment in optimal technical conditions.

D.3 Participation

D.3.1. Measure Partners

- **Measure partner 1 – IPA SA - Leading role**

IPA SA is a 47 years old Romanian industrial R & D company and is the Romanian national institute for research and development, engineering in energy, automation and IT, with a large experience in European projects in technology transfer and in information dissemination.

IPA was responsible for the dissemination activities and carrying out the research activity and technical studies in the measure. Since 2011 IPA took over the evaluation activity

- **Measure partner 2 – RAT- Principle participant**

RAT Craiova is main Public Transportation Company in Dolj county. It provides the citizen transportation by trams, buses and micro-buses. RAT Craiova was responsible for the technical specification, acquisition and installation of the GPS system, as well as the training of trams and buses drivers. Also, RAT managed the operation and monitoring activities.

- **Measure partner 3 – LCM – Occasional participant**

The Local Council of Craiova Municipality (Primaria Municipiului Craiova) was organized and functions according to Law No. 215/2001 regarding Local Public Administration with the subsequent modification and completion.

Municipality as local government institution has, under the conditions imposed by the public administration law, the decisional right in all matters of local interest: political, social, cultural, educational and technical. Through their structures, the municipality is a complex mechanism which can produce major changes in the quality of urban life under an effective management and coordination.

The competencies of these bodies related to the project covers both the services provided to the local community (i.e. Public transport service in various forms) and the technical interventions (the urban infrastructure, constructions) that together change the image of the city and bring added value to the quality of life in the areas where they act.

LCM was the coordinator of the project since 2009 and assumed the responsibility for the management activity in the MODERN project. Between 2009-2011, LCM carried out the evaluation activity in the project.

D.3.2 Stakeholders

Stakeholder 1 - Alien Concept Company – The company that provided, installed and tested the GPS/GPRS system. The Alien Concept SRL company specializes in designing automated solutions, thus a major part of its products is customized to the specific needs of each client.Their product portfolio includes:

- ticket and subscriptions slot machines;
- ticket validators;
- parking ticket slot machines;
- pedestrian and automotive access control systems;
- GPS tracking solutions for managing the transport fleet;
- embedded control systems of patrol;
- electronic information panels.

D.4Recommendations

D.4.1 Recommendations: measure replication

- **Recommendation 1** – European cities good practices. Using other European cities good practices and experiences lead to achieve a successful implementation of the measure.

D.4.2 Recommendations: Development strategy of Municipality

- **Recommendation 1 -** Take into account the urban development strategy of Municipality to avoid the difficulties and delays in the measure implementation or operation period

Annex 1: Cost calculation

	Cases for comparison	internet communication costs	energy costs	personal costs	maintenance and spare parts costs	other costs (indirect costs) 20 % of personnel costs	Supplies costs	Total costs (euro)
2009	CIVITAS measure	0.00	0.00	25116.00	0.00	5023.20	0.00	30139.20
	BAU	0.00	0.00	25116.00	0.00	5023.20	0.00	30139.20
2010	CIVITAS measure	0.00	0.00	25116.00	0.00	5023.20	0.00	30139.20
	BAU	0.00	0.00	25116.00	0.00	5023.20	0.00	30139.20
2011	CIVITAS measure	5804.00	0.00	9731.00	0.00	1946.20	0.00	17481.20
	BAU	0.00	0.00	25116.00	0.00	5023.20	0.00	30139.20
2012	CIVITAS measure	6294.00	0.00	9731.00	0.00	1946.20	0.00	17971.20
	BAU	0.00	0.00	25116.00	0.00	5023.20	0.00	30139.20
2013	CIVITAS measure	6419.88	0.00	9925.62	0.00	1985.12	0.00	18330.62
	BAU	0.00	0.00	25618.32	0.00	5123.66	0.00	30741.98
2014	CIVITAS measure	6548.28	0.00	10124.13	6718.60	2024.83	0.00	25415.84
	BAU	0.00	0.00	26130.69	0.00	5226.14	0.00	31356.82
2015	CIVITAS measure	6679.24	0.00	10326.62	6852.97	2065.32	0.00	25924.15
	BAU	0.00	0.00	26653.30	0.00	5330.66	0.00	31983.96
2016	CIVITAS measure	6812.83	0.00	10533.15	6990.03	2106.63	0.00	26442.64
	BAU	0.00	0.00	27186.37	0.00	5437.27	0.00	32623.64
2017	CIVITAS measure	6949.08	0.00	10743.81	7129.83	2148.76	0.00	26971.49
	BAU	0.00	0.00	27730.09	0.00	5546.02	0.00	33276.11

	Cases for comparison	internet communication costs	energy costs	personal costs	maintenance and spare parts costs	other costs (indirect costs) 20 % of personnel costs	Supplies costs	Total costs (euro)
2018	CIVITAS measure	7088.07	0.00	10958.69	7272.43	2191.74	0.00	27510.92
	BAU	0.00	0.00	28284.70	0.00	5656.94	0.00	33941.63
2019	CIVITAS measure	7229.83	0.00	11177.86	7417.88	2235.57	0.00	28061.14
	BAU	0.00	0.00	28850.39	0.00	5770.08	0.00	34620.47
2020	CIVITAS measure	7374.42	0.00	11401.42	7566.23	2280.28	0.00	28622.36
	BAU	0.00	0.00	29427.40	0.00	5885.48	0.00	35312.88

		No of buses and trams	Km traveled by 80 buses	Km travelled by trams fleet	Average cost/vKm
2009	CIVITAS measure	107	2945536	893497	0.0078507
	BAU	107	2945536	893497	0.0078507
2010	CIVITAS measure	107	3665503	819643	0.0067198
	BAU	107	3665503	819643	0.0067198
2011	CIVITAS measure	107	3681844	494251	0.004186
	BAU	107	3681844	494251	0.0072171
2012	CIVITAS measure	107	3264988	533341	0.0047313
	BAU	107	3264988	533341	0.0079349

Annex 2: occupancy monitoring

Note relating to meaning the figures in the tables:

- The period 09:00- 10:00 is the period when the data were collected in the morning for off-peak period
- The period 19:00-20:00 is the period when the data were collected in the after-noon for off-peak period
- The period 07:00- 08:00 is the period when the data were collected in the morning for peak period
- The period 15:00- 16:00 is the period when the data were collected in the after-noon for peak period
- Routs monitored includes the following stations:
  - " Electroputere" station-"Piata centrala" station(2 Km lengt- tram line)
  - "Fabrica de confectii " station- "Stadion" Station(1 Km length – E1T rout)
  - "Stadion " station-"Park"station(1 Km length- E1R rout)
  - "Electroputere"station-"Lapus" station(1 Km length- Rout no. 9)
    - Maximum number of passengers means the capacity of vehicle:
      - 83 passengers for tram monitored
      - 105 passengers for bus (MAN LC type) monitored

The routs and tram line were monitored for 1 month – September 2010, 2011 and 2012

The passengers travelling between the stations before listed have been counted and the occupancy percentage was calculated as ratio between average number of passengers and maximum capacity of vehicle.

	Average occupancy off-peak hours			09:00-10:00			
Tram	Distance travelled " Electroputere" station-"Piata centrala" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
Line 101	2	48	83.00	58%	We Sept 1st	Sept	2010
		52	83.00	63%	Th- Sept 9th		
		46	83.00	55%	Fr- Sept 17th		
		70	83.00	84%	We- Sept 22nd		
		48	83.00	58%	Th- Sept 30th		

	Average occupancy in off-peak hours			19:00-20:00			
Tram	Distance travelled " Electroputere" station-"Piata centrala" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
Line 101	2	50	83.00	60%	We Sept 1st	Sept	2010
		48	83.00	58%	Th- Sept 9th		
		60	83.00	72%	Fr- Sept 17th		
		51	83.00	61%	We- Sept 22nd		
		65	83.00	78%	Th- Sept 30th		

	Average occupancy off-peak hours			09:00-10:00			
Line E1T	Distance travelled "Fabrica de confectii " station- "Stadion" Station (Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	55	105.00	52%	We Sept 1st	Sept	2010
		52	105.00	50%	Th- Sept 9th		
		46	105.00	44%	Fr- Sept 17th		
		48	105.00	46%	We- Sept 22nd		
		60	105.00	57%	Th- Sept 30th		

	Average occupancy in off-peak hours			19:00-20:00			

Line E1 T	Distance travelled "Fabrica de confectii " station- "Stadion" Station (Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	40	105.00	38%	We Sept 1st	Sept	2010
		62	105.00	59%	Th- Sept 9th		
		52	105.00	50%	Fr- Sept 17th		
		50	105.00	48%	We- Sept 22nd		
		60	105.00	57%	Th- Sept 30th		

	Average occupancy off-peak hours			09:00-10:00			
Line E1R	Distance travelled "Stadion " station-"Park"station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	60	105.00	57%	We Sept 1st	Sept	2010
		55	105.00	52%	Th- Sept 9th		
		60	105.00	57%	Fr- Sept 17th		
		71	105.00	68%	We- Sept 22nd		
		68	105.00	65%	Th- Sept 30th		

	Average occupancy in off-peak hours			19:00-20:00			
Line E1 R	Distance travelled "Stadion " station-"Park"station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year

MAN LC bus type	1	70	105.00	67%	We Sept 1st	Sept	2010
		60	105.00	57%	Th- Sept 9th		
		68	105.00	65%	Fr- Sept 17th		
		58	105.00	55%	We- Sept 22nd		
		65	105.00	62%	Th- Sept 30th		

	Average occupancy off-peak hours			09:00-10:00			
Line 9	Distance travelled "Electroputere"station-"Lapus" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	73	105.00	70%	We Sept 1st	Sept	2010
		64	105.00	61%	Th- Sept 9th		
		60	105.00	57%	Fr- Sept 17th		
		68	105.00	65%	We- Sept 22nd		
		79	105.00	75%	Th- Sept 30th		

	Average occupancy in off-peak hours			19:00-20:00			
Line 9	Distance travelled "Electroputere"station-"Lapus" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus	1	70	105.00	67%	We Sept 1st	Sept	2010

type							
		67	105.00	64%	Th- Sept 9th		
		50	105.00	48%	Fr- Sept 17th		
		58	105.00	55%	We- Sept 22nd		
		40	105.00	38%	Th- Sept 30th		

	Average occupancy in peak			07:00-08:00			
Tram	Distance travelled " Electroputere" station-"Piata centrala" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
Line 101	2	55	83.00	66%	We Sept 1st	Sept	2010
		52	83.00	63%	Th- Sept 9th		
		60	83.00	72%	Fr- Sept 17th		
		64	83.00	77%	We- Sept 22nd		
		57	83.00	69%	Th- Sept 30th		

	Average occupancy in peak hours			15:00-16:00			
Tram	Distance travelled " Electroputere" station-"Piata centrala" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
Line 101	2	50	83.00	60%	We Sept 1st	Sept	2010
		53	83.00	64%	Th- Sept 9th		

	60	83.00	72%	Fr- Sept 17th		
	67	83.00	81%	We- Sept 22nd		
	65	83.00	78%	Th- Sept 30th		

	Average occupancy in peak hours			07:00-08:00			
Line E1T	Distance travelled "Fabrica de confectii " station- "Stadion" Station (Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	62	105.00	59%	We Sept 1st	Sept	2010
		52	105.00	50%	Th- Sept 9th		
		58	105.00	55%	Fr- Sept 17th		
		53	105.00	50%	We- Sept 22nd		
		60	105.00	57%	Th- Sept 30th		

	Average occupancy in peak hours			15:00-16:00			
Line E1 T	Distance travelled "Fabrica de confectii " station- "Stadion" Station (Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	56	105.00	53%	We Sept 1st	Sept	2010
		62	105.00	59%	Th- Sept 9th		
		52	105.00	50%	Fr- Sept 17th		
		57	105.00	54%	We- Sept 22nd		

		65	105.00	62%	Th- Sept 30th		

	Average occupancy in peak hours			07:00-08:00			
Line E1R	Distance travelled "Stadion " station-"Park"station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	68	105.00	65%	We Sept 1st	Sept	2010
		62	105.00	59%	Th- Sept 9th		
		65	105.00	62%	Fr- Sept 17th		
		71	105.00	68%	We- Sept 22nd		
		74	105.00	70%	Th- Sept 30th		

	Average occupancy in peak hours			15:00-16:00			
Line E1 R	Distance travelled "Stadion " station-"Park"station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	75	105.00	71%	We Sept 1st	Sept	2010
		60	105.00	57%	Th- Sept 9th		
		76	105.00	72%	Fr- Sept 17th		
		58	105.00	55%	We- Sept 22nd		
		73	105.00	70%	Th- Sept 30th		

	Average occupancy in peak hours			07:00-08:00			
Line 9	Distance travelled "Electroputere"station-"Lapus" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	73	105.00	70%	We Sept 1st	Sept	2010
		68	105.00	65%	Th- Sept 9th		
		65	105.00	62%	Fr- Sept 17th		
		75	105.00	71%	We- Sept 22nd		
		80	105.00	76%	Th- Sept 30th		

	Average occupancy in peak hours			15:00-16:00			
Line 9	Distance travelled "Electroputere"station-"Lapus" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	74	105.00	70%	We Sept 1st	Sept	2010
		67	105.00	64%	Th- Sept 9th		
		58	105.00	55%	Fr- Sept 17th		
		58	105.00	55%	We- Sept 22nd		
		60	105.00	57%	Th- Sept 30th		

Average occupancy off-peak hours			09:00-10:00			

Tram	Distance travelled " Electroputere" station-"Piata centrala" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
Line 101	2	35	83.00	42%	Th Sept 1st	Sept	2011
		45	83.00	54%	Mo- Sept 5th		
		33	83.00	40%	Tu- Sept 13th		
		38	83.00	46%	We- Sept 21st		
		34	83.00	41%	Th- Sept 39th		

	Average occupancy in off-peak			19:00-20:00			
Tram type	Distance travelled " Electroputere" station-"Piata centrala" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
Line 101	2	37	83.00	45%	Th Sept 1st	Sept	2011
		41	83.00	49%	Mo- Sept 5th		
		38	83.00	46%	Tu- Sept 13th		
		40	83.00	48%	We- Sept 21st		
		33	83.00	40%	Th- Sept 39th		

	Average occupancy off-peak hours			09:00-10:00			
Line E1T	Distance travelled "Fabrica de confectii " station-"Stadion" Station (Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus	1	38	105.00	36%	Th Sept 1st	Sept	2011

type							
		50	105.00	48%	Mo- Sept 5th		
		49	105.00	47%	Tu- Sept 13th		
		45	105.00	43%	We- Sept 21st		
		37	105.00	35%	Th- Sept 39th		

	Average occupancy in off-peak hours			19:00-20:00			
Line E1 T	Distance travelled "Fabrica de confectii " station- "Stadion" Station (Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	39	105.00	37%	Th Sept 1st	Sept	2011
		47	105.00	45%	Mo- Sept 5th		
		44	105.00	42%	Tu- Sept 13th		
		42	105.00	40%	We- Sept 21st		
		34	105.00	32%	Th- Sept 39th		

	Average occupancy off-peak hours			09:00-10:00			
Line E1R	Distance travelled "Stadion " station- "Park"station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	48	105.00	46%	Th Sept 1st	Sept	2011

		55	105.00	52%	Mo- Sept 5th		
		58	105.00	55%	Tu- Sept 13th		
		51	105.00	49%	We- Sept 21st		
		45	105.00	43%	Th- Sept 39th		

	Average occupancy in off-peak hours			19:00-20:00			
Line E1 R	Distance travelled "Stadion " station- "Park"station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	60	105.00	57%	Th Sept 1st	Sept	2011
		52	105.00	50%	Mo- Sept 5th		
		55	105.00	52%	Tu- Sept 13th		
		47	105.00	45%	We- Sept 21st		
		51	105.00	49%	Th- Sept 39th		

	Average occupancy off-peak hours			09:00-10:00			
Line 9	Distance travelled "Electroputere"station- "Lapus" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	56	105.00	53%	Th Sept 1st	Sept	2011
		60	105.00	57%	Mo- Sept 5th		

		52	105.00	50%	Tu- Sept 13th		
		58	105.00	55%	We- Sept 21st		
		42	105.00	40%	Th- Sept 39th		

	Average occupancy in off-peak hours			19:00-20:00			
Line 9	Distance travelled "Electroputere"station-"Lapus" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	52	105.00	50%	Th Sept 1st	Sept	2011
		57	105.00	54%	Mo- Sept 5th		
		50	105.00	48%	Tu- Sept 13th		
		58	105.00	55%	We- Sept 21st		
		40	105.00	38%	Th- Sept 39th		

	Average occupancy in peak			07:00-08:00			
Tram	Distance travelled " Electroputere" station-"Piata centrala" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
Line 101	2	41	83.00	49%	Th Sept 1st	Sept	2011
		52	83.00	63%	Mo- Sept 5th		
		44	83.00	53%	Tu- Sept 13th		
		42	83.00	51%	We- Sept 21st		

	38	83.00	46%	Th- Sept 39th		

	Average occupancy in peak hours			15:00-16:00			
Tram	Distance travelled " Electroputere" station-"Piata centrala" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
Line 101	2	38	83.00	46%	Th Sept 1st	Sept	2011
		42	83.00	51%	Mo- Sept 5th		
		44	83.00	53%	Tu- Sept 13th		
		41	83.00	49%	We- Sept 21st		
		37	83.00	45%	Th- Sept 39th		

	Average occupancy in peak hours			07:00-08:00			
Line E1T	Distance travelled "Fabrica de confectii " station- "Stadion" Station (Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	40	105.00	38%	Th Sept 1st	Sept	2011
		50	105.00	48%	Mo- Sept 5th		
		40	105.00	38%	Tu- Sept 13th		
		53	105.00	50%	We- Sept 21st		
		43	105.00	41%	Th- Sept 39th		

	Average occupancy in peak hours			15:00-16:00			
Line E1 T	Distance travelled "Fabrica de confectii " station- "Stadion" Station (Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	45	105.00	43%	Th Sept 1st	Sept	2011
		55	105.00	52%	Mo- Sept 5th		
		52	105.00	50%	Tu- Sept 13th		
		50	105.00	48%	We- Sept 21st		
		46	105.00	44%	Th- Sept 39th		

	Average occupancy in peak hours			07:00-08:00			
Line E1R	Distance travelled "Stadion " station-"Park"station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	61	105.00	58%	Th Sept 1st	Sept	2011
		60	105.00	57%	Mo- Sept 5th		
		55	105.00	52%	Tu- Sept 13th		
		55	105.00	52%	We- Sept 21st		
		60	105.00	57%	Th- Sept 39th		

Average occupancy in peak hours			15:00-16:00			

Line E1 R	Distance travelled "Stadion " station-"Park"station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	61	105.00	58%	Th Sept 1st	Sept	2011
		60	105.00	57%	Mo- Sept 5th		
		51	105.00	49%	Tu- Sept 13th		
		58	105.00	55%	We- Sept 21st		
		60	105.00	57%	Th- Sept 39th		

	Average occupancy in peak hours			07:00-08:00			
Line 9	Distance travelled "Electroputere"station-"Lapus" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	51	105.00	49%	Th Sept 1st	Sept	2011
		65	105.00	62%	Mo- Sept 5th		
		60	105.00	57%	Tu- Sept 13th		
		62	105.00	59%	We- Sept 21st		
		55	105.00	52%	Th- Sept 39th		

	Average occupancy in peak hours			15:00-16:00			
Line 9	Distance travelled "Electroputere"station-"Lapus" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year

MAN LC bus type	1	60	105.00	57%	Th Sept 1st	Sept	2011
		61	105.00	58%	Mo- Sept 5th		
		58	105.00	55%	Tu- Sept 13th		
		58	105.00	55%	We- Sept 21st		
		52	105.00	50%	Th- Sept 39th		

	Average occupancy off-peak hours			09:00-10:00			
Tram	Distance travelled " Electroputere" station-"Piata centrala" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
Line 101	2	58	83.00	70%	Mo Sept 3rd	Sept	2012
		52	83.00	63%	Tu- Sept 11th		
		48	83.00	58%	We- Sept 19th		
		70	83.00	84%	Mo- Sept 24th		
		60	83.00	72%	Fr- Sept 28th		

	Average occupancy in off-peak hours			19:00-20:00			
Tram	Distance travelled " Electroputere" station-"Piata centrala" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
Line 101	2	50	83.00	60%	Mo Sept 3rd	Sept	2012
		55	83.00	66%	Tu- Sept 11th		

	60	83.00	72%	We- Sept 19th		
	60	83.00	72%	Mo- Sept 24th		
	70	83.00	84%	Fr- Sept 28th		

	Average occupancy off-peak hours			09:00-10:00			
Line E1T	Distance travelled "Fabrica de confectii " station- "Stadion" Station (Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	50	105.00	48%	Mo Sept 3rd	Sept	2012
		52	105.00	50%	Tu- Sept 11th		
		46	105.00	44%	We- Sept 19th		
		48	105.00	46%	Mo- Sept 24th		
		51	105.00	49%	Fr- Sept 28th		

	Average occupancy in off-peak hours			19:00-20:00			
Line E1 T	Distance travelled "Fabrica de confectii " station- "Stadion" Station (Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	38	105.00	36%	Mo Sept 3rd	Sept	2012
		50	105.00	48%	Tu- Sept 11th		
		51	105.00	49%	We- Sept 19th		

		47	105.00	45%	Mo- Sept 24th		
		44	105.00	42%	Fr- Sept 28th		

	Average occupancy off-peak hours			09:00-10:00			
Line E1R	Distance travelled "Stadion " station-"Park"station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	59	105.00	56%	Mo Sept 3rd	Sept	2012
		50	105.00	48%	Tu- Sept 11th		
		60	105.00	57%	We- Sept 19th		
		65	105.00	62%	Mo- Sept 24th		
		55	105.00	52%	Fr- Sept 28th		

	Average occupancy in off-peak hours			19:00-20:00			
Line E1 R	Distance travelled "Stadion " station-"Park"station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	63	105.00	60%	Mo Sept 3rd	Sept	2012
		60	105.00	57%	Tu- Sept 11th		
		61	105.00	58%	We- Sept 19th		
		52	105.00	50%	Mo- Sept 24th		
		57	105.00	54%	Fr- Sept 28th		

	Average occupancy off-peak hours			09:00-10:00			
Line 9	Distance travelled "Electroputere"station-"Lapus" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	62	105.00	59%	Mo Sept 3rd	Sept	2012
		64	105.00	61%	Tu- Sept 11th		
		60	105.00	57%	We- Sept 19th		
		68	105.00	65%	Mo- Sept 24th		
		57	105.00	54%	Fr- Sept 28th		

	Average occupancy in off-peak hours			19:00-20:00			
Line 9	Distance travelled "Electroputere"station-"Lapus" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	61	105.00	58%	Mo Sept 3rd	Sept	2012
		60	105.00	57%	Tu- Sept 11th		
		50	105.00	48%	We- Sept 19th		
		58	105.00	55%	Mo- Sept 24th		
		40	105.00	38%	Fr- Sept 28th		
	Average occupancy in peak			07:00-08:00			
Tram	Distance travelled " Electroputere" station-"Piata centrala" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year

Line 101	2	64	83.00	77%	Mo Sept 3rd	Sept	2012
		52	83.00	63%	Tu- Sept 11th		
		60	83.00	72%	We- Sept 19th		
		64	83.00	77%	Mo- Sept 24th		
		70	83.00	84%	Fr- Sept 28th		

	Average occupancy in peak hours			15:00-16:00			
Tram	Distance travelled " Electroputere" station-"Piata centrala" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
Line 101	2	61	83.00	73%	Mo Sept 3rd	Sept	2012
		53	83.00	64%	Tu- Sept 11th		
		60	83.00	72%	We- Sept 19th		
		67	83.00	81%	Mo- Sept 24th		
		70	83.00	84%	Fr- Sept 28th		

	Average occupancy in peak hours			07:00-08:00			
Line E1T	Distance travelled "Fabrica de confectii " station- "Stadion" Station (Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	58	105.00	55%	Mo Sept 3rd	Sept	2012
		52	105.00	50%	Tu- Sept 11th		

		55	105.00	52%	We- Sept 19th		
		53	105.00	50%	Mo- Sept 24th		
		50	105.00	48%	Fr- Sept 28th		

	Average occupancy in peak hours			15:00-16:00			
Line E1 T	Distance travelled "Fabrica de confectii " station- "Stadion" Station (Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	50	105.00	48%	Mo Sept 3rd	Sept	2012
		60	105.00	57%	Tu- Sept 11th		
		52	105.00	50%	We- Sept 19th		
		50	105.00	48%	Mo- Sept 24th		
		49	105.00	47%	Fr- Sept 28th		

	Average occupancy in peak hours			07:00-08:00			
Line E1R	Distance travelled "Stadion " station-"Park"station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	58	105.00	55%	Mo Sept 3rd	Sept	2012
		62	105.00	59%	Tu- Sept 11th		
		65	105.00	62%	We- Sept 19th		
		65	105.00	62%	Mo- Sept 24th		

		60	105.00	57%	Fr- Sept 28th		

	Average occupancy in peak hours			15:00-16:00			
Line E1 R	Distance travelled "Stadion " station-"Park"station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	68	105.00	65%	Mo Sept 3rd	Sept	2012
		60	105.00	57%	Tu- Sept 11th		
		71	105.00	68%	We- Sept 19th		
		58	105.00	55%	Mo- Sept 24th		
		67	105.00	64%	Fr- Sept 28th		

	Average occupancy in peak hours			07:00-08:00			
Line 9	Distance travelled "Electroputere"station-"Lapus" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	67	105.00	64%	Mo Sept 3rd	Sept	2012
		68	105.00	65%	Tu- Sept 11th		
		65	105.00	62%	We- Sept 19th		
		70	105.00	67%	Mo- Sept 24th		
		63	105.00	60%	Fr- Sept 28th		

	Average occupancy in peak hours			15:00-16:00			
Line 9	Distance travelled "Electroputere"station-"Lapus" station(Km)	average no of passengers	maximum number of passengers	Average occupancy	day	month	year
MAN LC bus type	1	65	105.00	62%	Mo Sept 3rd	Sept	2012
		60	105.00	57%	Tu- Sept 11th		
		58	105.00	55%	We- Sept 19th		
		58	105.00	55%	Mo- Sept 24th		
		60	105.00	57%	Fr- Sept 28th		

Annex 3: Survey

Instructions

This survey is part of an European project - MODERN (Mobility, development and reducing energy consumption) and aims to collect your experiences in traveling by buses and trams

This measure aims to implement GPS/GPRS systems on 80 buses and 27 trams.

GPS/GPRS System consists of:

- monitoring system for 80 buses and 27 trams

- 20 digital panels with real time information

Your answers will be treated confidentially.Thank you for your participation!

Ex-ante questionnaire

M08.02 INFOMOBILITY TOOLS FOR FLEET MANAGEMENT IN CRAIOVA

1. Gender: F ☐ 35% M ☐ 65 %

2. Age:

Up to 15	15-24	25-45	45-54	55-65	over 65
5%	25%	20%	25%	10%	15%

3. Background (the last education institution graduated):

· faculty	· secondary school	· primary school
35%	60%	5%

4. Labor market status:

employed	unemployed	pensioners
60%	25%	15%

5. Public transport user

yes	no	occasionally
80%	5%	15%

Quality of service

6. How do you evaluate the quality of public transportation in Craiova?

- What is your view about the waiting time in the stations?

Less good	good	Very good	Don't know
75 %	20%	3%	2%

- What is your view about no information related to vehicles arriving?

Less good	good	Very good	Don't know
98 %	0	0	2%

Instructions

Measure title: INFOMOBILITY TOOLS FOR FLEET MANAGEMENT IN CRAIOVA

City: Craiova Project: MODERN Measure number: 08.02

This survey is part of an European project - MODERN (Mobility, development and reducing energy consumption) and aims to collect your experiences in traveling by buses and trams

The purpose of the measure was to implement GPS/GPRS system on 80 buses and 27 trams.

GPS/GPRS System consists of:

- monitoring system for 80 buses and 27 trams

- 20 digital panels with real time information

Your answers will be treated confidentially

Thank you for your participation!

Ex-post questionnaire

M08.02 INFOMOBILITY TOOLS FOR FLEET MANAGEMENT IN CRAIOVA

1. Gender F 46% M 54 %

2. Age:

Up to 15	15-24	25-45	45-54	55-65	over 65
3%	30%	25%	26%	6%	10%

3. Background (the last education institution graduated):

faculty	secondary school	primary school
30%	67%	3%

4. Labor market status:

employed	unemployed	pensioners
67%	20%	13%

5. Public transport user

yes 85% no 3% occasionally 12%

Quality of service

6. How do you evaluate the quality of public transportation in Craiova?

- What is your view about the waiting time in the stations?

Less good	good	Very good	Don't know
5 %	82%	11%	2%

- What is your view about no information related to vehicles arriving?

Less good	good	Very good	Don't know
0	87%	11%	2%

Estimation of sample size

Variables name and explanations		Variables values
n	The sample size	119
t	z-score: the abscissa of the Normal distribution for probability α (consisted of 1.5+0.03 from the table-standard normal probabilities)	1.53
α	**confidence level**, is a percentage and represents how often the true percentage of the population who would pick an answer lies within the **confidence interval** (margin of error).	87.50%
P	percentage of your sample that picks a particular answer.	0.85
Q	(1-P)	0.15
d	**confidence interval** (also called margin of error)	0.05
N	population total (if N is enough large the term in the denominator tends to 1 and the formula is reduced to the numerator)	300000

M08.06 – Executive summary

The measure consists in installation of the remote control devices on nine trams in order to create priority traffic lights system in three crowded crossroads of Craiova City. The priority traffic lights system is one of the measures used for shortening the travel time for public transport vehicles, trams in our case.

The system, operated by radio communication, changes the traffic lights from red to green when the trams are approaching to the crossroad and subsequently all the correlations of the priorities of the traffic lights. Due to the shortening of travel time the priority traffic lights system should be an efficient method to make public transport more attractive within urban mobility. The Municipality of Craiova, in cooperation with Traffic Police and RAT Craiova, analyzed the traffic flow on the tram line in Craiova and defined the crossroads appropriate to implement the new priority traffic light system.

During the study phase several technical solution were analyzed; it has been selected the one based on radio module (emitter) connected to the tram onboard computer and a radio receiver placed on the traffic lights. The implementation team manufactured nine radio emitters to be placed on board of nine trams. The equipment for green light controlling were installed on the same nine trams upgraded by chopper system within the measure M01.09. IPA manufactured the radio receivers to be installed in the three crossroads linked to the green light system. The green light system was tested to verify the communication between radio emitters and receivers.

For a good operation of the system, 18 tram drivers were trained to be able to use the system. The training program consisted of theoretical knowledge about green light controlling and devices. The training reached its objective so tram drivers became able to efficiently use the system in traffic. The training has also achieved the acceptance of the tram drivers for the newly implemented system, as the system is put into function manually by the drivers.

The evaluation shows that the average tram speed increased by 14% in peak and by 13% in off-peak, and the average passenger's occupancy increased by 1% in peak and by 7% in off-peak, after the measure implementation.

The key results are as follows:

- The traffic lights priority system led to an increase of tram's speed in peak and off-peak hours. The three intersections up-dated through the project are located in the most crowded area of the city and the distances between them are almost equal.
- The traffic lights priority system contribute to shorten the travel time for public transport.
- The traffic lights priority system led to shorten travel time for public transport users, so, the average occupancy slightly increased compared with the situation before.

The figures show a slight change as opposed to the expected at the beginning of the project, because the implementation period was very short. This is due to the important work done by the Municipality in order to build an important overpass in city center which affected the tram line, dividing the line into two trunks.

Nevertheless the traffic light priority system induced significant increase in tram speed and punctuality and consequently the following aspects will be improved:

- Punctuality, reducing the influence of other traffic interferences on the service; this should increase the attractiveness of PT among potential passengers;
- Costs, reducing working times by the drivers.

A Introduction

A1 Objectives

The measure objectives are:

(S) High level / longer term:

- To improve the traffic flow
- To decrease the congestion in the city

(T) Strategic level:

- To optimise the traffic and reduce the crowding in the city main intersections

(U) Measure level:

- To create in Craiova a preferential traffic light regulation by endowing 9 trams with on-board devices for traffic lights priority in order to increase the average vehicle speed by 15%.

A2 Description

In Craiova, during last years the number of private cars considerably increased and so during rush hours the, traffic became very crowded. Up to now a UTC (Urban Traffic Control) has not yet installed and every traffic light system operates on its own program and scheduling. To overcome this situation, in several crossroads the Municipality decided to replace the traffic lights with roundabouts in order to reduce waiting time at traffic lights, in peak hours.

Moreover the Municipality was interested in developing a traffic lights system for cars with preset timing. This system had to be integrated with a priority traffic lights system for trams to shorten travel time on the main street of the city connecting the East and West side of the city. Craiova Municipality together with the Traffic Police department analyzed the most crowded crossroads on west east axis and selected three junctions near to the city center.

Measure title: Priority traffic light regulation for PT in Craiova

City: Craiova Project: MODERN Measure number: 08.06

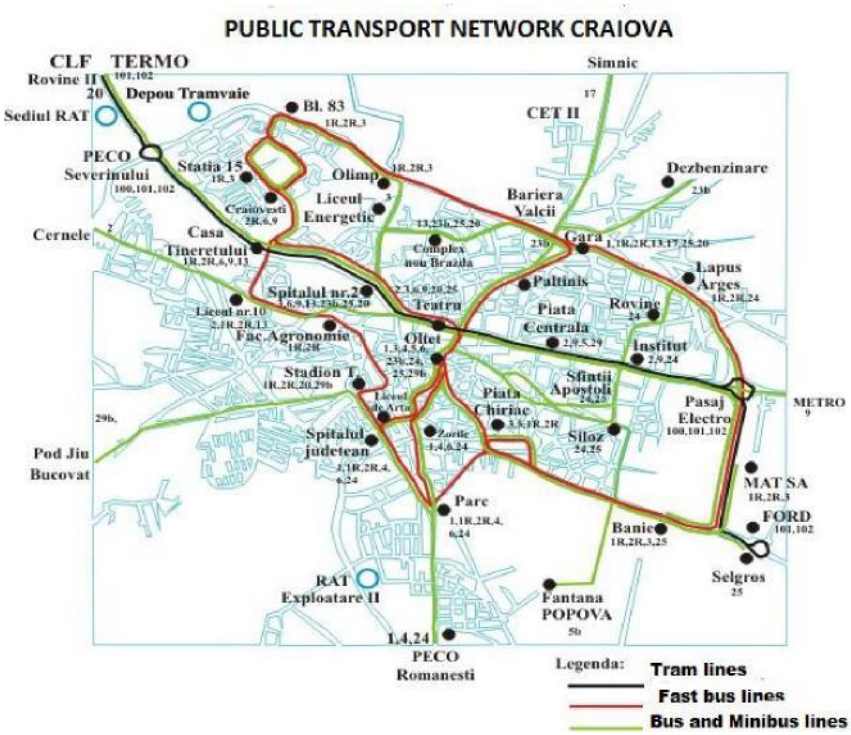


Figure A2.1 – PT network of Craiova

IPA and Municipality developed a study in order to define the better technology for the system deployment. First of all a system based on the tram detection by a magnetic sensor was examined. This system seemed to be not suitable because the tram stops are too much near to the crossroads and the system has to wait for passengers loading and unloading.

It was decided to operate on short distance radio transmitters operated by tram drivers.

The radio emitters onboard of trams communicate with radio receivers placed in the intersections by GPRS and change the red light when trams are approaching the crossroads.

The switching of the red light in green light is done by trams' drivers by pressing the button on the radio emitter placed onboard of trams.

As long as the tram passes through the crossroad with a green light, all the other vehicles and pedestrians, are not allowed passing through the crossroad.

The green light timing is about twenty seconds, enough for any tram that crosses the crossroad. Therefore, the implementation of priority traffic light regulation led to shorten the travel time, therefore the trams became more attractive for the travelers.

In the figure below it is shown a tram passing through a crossroad linked to the priority traffic light system.

Traffic light in this case is situated on the third pillar (see in Figure A2.2) and allows to the tram to take the left side direction at the end of underpass.

Figure A2.2 – traffic lights location example

B Measure implementation

B1 Innovative aspects

Even though for main European cities, green light is a well-known and long last operated feature of the traffic management system, in Romania is little implemented; for Craiova being indeed a novelty. The system itself represents the first attempt to improve the public transport priority in traffic.The main aspects of the innovation are:

- **New physical infrastructure solutions-** Installing of on-board devices controlling the traffic lights in 3 important intersections in Craiova represents new infrastructure solution in order to reduce traffic congestion.
- **Use of new technology –** The first implementation of priority traffic light regulation leaded to a shortening of the traveling time making the trams more attractive for travelers.

B2 Research and Technology Development

Traffic and routes study

A study was made on the possibility of streamlining the traffic in the Craiova city. It was analysed actual situation din Craiova on street nerwork, traffic monitoring and management. The conclusion of this study was that Craiova has an insufficient capacity of the street network and radical changes must be taken to streamline city traffic

There are two key solutions: implementing a “green wave” system and increasing the number of roundabouts.

Finding the optimal solution for priority traffic light system in Craiova

A technical study was made to find the optimal solution for implementation of priority traffic light system

The chosen solution was radio control made with a radio module providing communication between emitter placed on bord of tram and receiver placed on the traffic light.

The remote control for the “green wave” system consists in two different parts:

- Emitter unit which is placed inside the tram
- Receiver unit which is placed in traffic intersection, nearby the automation cabinets for traffic lights(not every intersection has the “green wave” system).

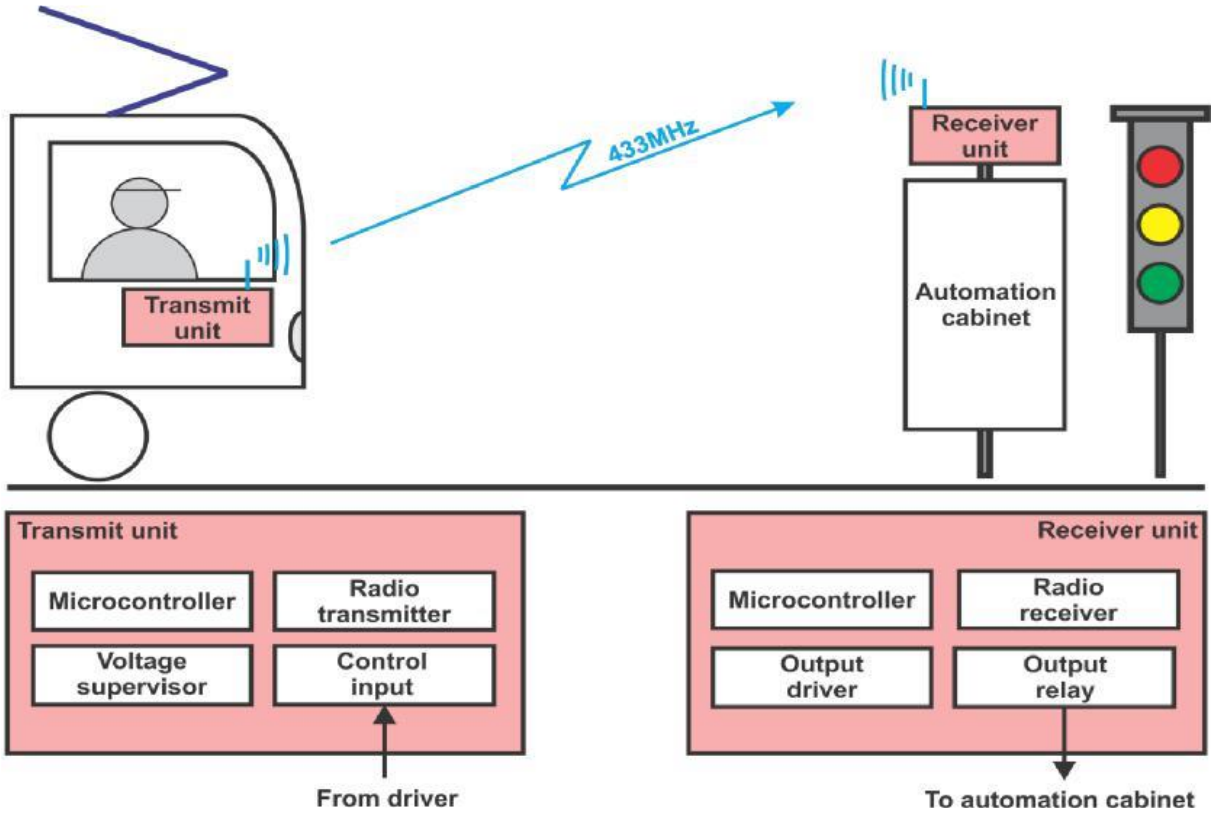


Figure B2.1 – System description

Every one of these two units has a multi-channel radio module (narrow bandwidth: 433,875MHz - 434,650MHz). The radio channel is hardware preselected.

The emitter unit is power supplied from the same source as the drive system of the tram.

In order to increase the life-time of these systems, and also to increase the time-period for maintenance, the devices were designed with high reliability parts and enclosures with a high protection degree.

Also, for a good propagation of the radio signal, helical omnidirectional antennas were used. Antennas are placed outside so the covered area in open-field is increased up to 200m distance for 10mW emission power.

The emission power is restricted to 10mW for the free bandwidth frequency (433 MHz) according to national authorities in this domain.

Because of the extreme operation conditions (regarding the ambient temperature) all electronic components have extended temperature range.

The power supply of the emitter units is a continuous voltage which must be in [16-36 Vdc) range. Technical characteristics:

- Frequency bandwidth: 433,875 - 434,650 MHz;
- Operation distance: up to 200 m;
- Number of radio channels:16 preselected channel with the possibility for extension up to 32;
- Bandwidth for each radio channel: 25 kHz;

- Power consumption: 34mA (emitter), 30mA (receiver);
- Receivers' sensitivity: -120dBm (for 12dB SINAD);
- Emitter's power: 10dBm (10mW);
- Radio modules according to EN 300 220-3 and EN 301 489-3.

Figure B2.2 – receiver and transmitter units

B3 Situation before CIVITAS

Before CIVITAS project, in Craiova there were two tram lines. Along the tram lines there were eleven crossroads, ten of those equipped with timing traffic lights.

The eleventh crossroad, placed in the East side of the city, had been endowed with "green light" system for tram operated by inductive sensors to detect the tram. The disadvantage of such a system was the traffic light keeps green light for a preset time of few seconds.

Taking into consideration that the trams had to cross the eleven crowded crossroads, Municipality decided to upgrade three of them close each other placed in the city center.

B4 Actual implementation of the measure

The measure has been implemented in the following stages:

Stage 1: Planning and design of the measure (Oct 2008-March 2010)

In this stage, studies were made on the possibility of streamlining the traffic in the Craiova city. Municipality in cooperation with the Traffic Police and RAT Craiova choose and defined the suitable crossroads to apply priority system.

Several meetings and discussions took place between technical team from IPA Craiova and Municipality in order to integrate the measure in the Urban Development Strategy of Craiova city.

Stage 2: Technical study (June 2009 -Jan 2010)

In this stage several items were discussed, analyzed and defined; among them the most important are the ones related to the technical choice, the interaction between the system and other vehicles flow and the possible benefit.

First of all the current experiences were analyzed:

- The system now in operation in the city is based on time keeping of green light as long as the cars run with a constant legal speed of 50 km / hour, allowing crossing two intersection. This solution was not suitable because it does not to distinguish PT from other vehicles so reducing the required priority effect.
- An automatic system based on the tram detection by a magnetic sensor: this system seemed to be not suitable because the tram stops are too much near to the crossroads and the system has to wait for passengers loading and unloading.

After a deep examination about several technical solutions it was decided to use a radio module (emitter) connected to the tram onboard computer and a receiver placed on the traffic lights. This system will be operated by the tram driver only when the tram approaches the traffic light. This system was considered proper and safe to be applied on tram line.

Stage 3: Training of trams drivers for using the system (January 2010- May 2010)

The training process for trams drivers was necessary to prepare them to drive the trams with the new equipment. 18 drivers were trained in this period which means 2 drivers a tram. The training program consisted of theoretical knowledge about the devices (placed on-board of trams) which control the green light. The theoretical knowledge was completed with practical ones in the testing period.

Stage 4: Manufacture, installation and testing of green light system - (September 2010)

IPA, as the partner in charge with the implementation of the system, manufactured the nine radio emitters that were placed on board of the trams. The measure was implemented on board the nine trams with chopper system up-graded within the measure M01.09.

The same team manufactured the radio receivers installed in the three crossroads linked to the green light system.

The receivers included specific hardware and software to set communication between traffic lights and trams. In the figure above a radio emitter box placed on the right side of tram onboard is shown. On the emitter box there is a button to activate the green light when the tram is close to traffic light.

After the installation of the radio devices, the green light system was tested for two weeks. The test consisted in:

- Checking communication between receiver and emitter
- Validation of data transmitting.

During the tests it became evident that the approaching tram can shorten too much the green time to pedestrians. So it was decided to give a specific information to pedestrians about the new system. At this regard the citizens were informed through the periodical information campaign and trough the announcements inside of the public transport vehicles about the need to pay attention to the chronometer which shows how many second remain to cross the street, of course considering the spare secure time programmed in the traffic light sequences.

A small delay in traffic light operation mode (just keeping yellow light for a few seconds) has to be installed in order to keep more safe the whole operation.

Stage 5: System running (Oct 2010- March 2012)

In this stage, the 9 trams endowed with green light radio modules, started their operation in the city. The three crossroads up-graded with radio receivers are marked in red on the map below (Fig. B4.2)

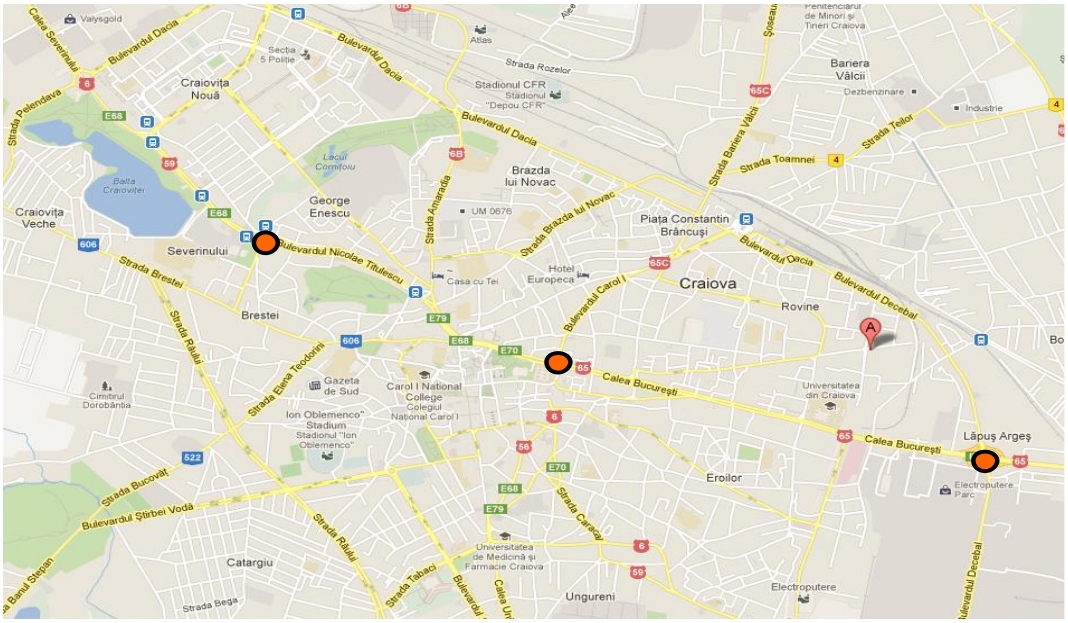


Figure B4.1 – The 3 intersections marked in red

The interruption of tram line due to the overpass construction didn't give us the possibility to perform a long evaluation period but before the start of the construction we had enough time (five months) to assess the measure results, so enough data for the evaluation of the measure were collected.

B5 Inter-relationships with other measures

The measure is related to other measures as follows:

M 01.09 Energy Saving on Tramline in Craiova- The measure M01.09 aims to implement chopper driving systems on the same nine trams endowed with green light radio modules. The passengers that use the trams with chopper driving system implemented by M01.09 tend to use them more, because the trams run faster as a result of M08.06 measure implementation. Increasing of occupancy in trams equipped with chopper systems and adapted to the "green light- traffic light priority", can lead to the increasing of revenues from tickets.

C Impact Evaluation Findings

C1 Measurement methodology

C1.1 Impacts and Indicators

Table C1.1: Indicators. Insert your own table where available, use landscape layout as necessary

No.	Impact	Indicator	Data used	Comments
2	Economy	Capital cost	Euros	The value of the equipments installed on 9 trams(emitters) and 3 intersections(receivers)
23	Congestion levels	Average vehicle speed – peak	journey time measures (h) distance for demonstration(Km)	Technic department from RAT Craiova Distance traveled in Km/ trip Time/trip(peak) speed=distance/time
24	Congestion levels	Average vehicle speed - off peak	journey time measures(h) distance for demonstration(Km)	Technic department from RAT Craiova Distance traveled in Km/ trip Time/trip(off peak) speed=distance/time
28	Vehicle occupancy	Average occupancy	Number of passengers per vehicle per trip	RAT data base Monitors' registration on tram line(101 and 102 tram lines)

Detailed description of the indicator methodologies:

Indicator 2 Capital cost- The value of equipments from the project budget

Indicator 23 (Average vehicle speed – peak)- ratio between the distance traveled and time for trip in peak.

For data collection a tram trip including the three crossroads up-graded by the measure was considered; the travel time for the considered trip was recorded. It was analyzed a way Km long of tram line; the frequency of data collection was twice a day, in peak period, in the same day of week before and after the implementation of the measure.

Indicator 24 (Average vehicle speed – off peak)- ratio between the distance traveled and time for trip in off-peak.

Data were collected using the same procedure of average speed measurements.

Indicator 28 (Average occupancy-peak/off-peak)- average number of passengers per vehicle per trip

The average occupancy indicator is measured by counting the number of passengers in off-peak and peak period of day. The frequency of data collection was twice a week in peak and twice a week in off- peak, in the same day. This indicator was measured by 2 people from RAT Company by empirical counting of passengers in tram.

A KT4D type tram eqquipped with green light system, has 38 seats, and it can transport maximum 83 passengers(100% loading). The average occupancy was calculated making ratio between passengers in the tram and the maximum number of passengers(83) .

The peak and off-peak periods of the day are following :

- 05:30- 08:00- peak 1
- 08:00-12:30 – off-peak1
- 12:30- 18:00 – peak2
- 18:00- 21:30 – off-peak 2

The average occupancy and average speed are measured in the same conditions, in the same demonstration area and in the same period of day.

C1.2 Establishing a Baseline

The year 2009 is considered a baseline, when in Craiova this measure was not implemented. At those times there was no priority traffic light regulation for public transport and the crossroads were crowded.

The data for the indicators average speed and average occupancy have been collected twice a day in peak and twice a day in off-peak, in the same day of week, between October 2009 and February 2010.

The results of baseline for each indicator are shown in the tables below:

Table C1.2.1 – Capital cost ex-ante value

Indicator	**Ex-Ante values- 2009**
Capital cost	0

Table C1.2.2 – Average speed (peak hours) ex-ante value

Indicators and respective parameters	**Ex-Ante values- Oct 2009- Feb 2010**
Distance travelled (Km)	5 Km
Average time/trip(h)	20,4 min
Average speed in off-peak hours	15Km/h

Table C1.2.3 – Average speed (off-peak hours) ex-ante value

Indicators and respective parameters	**Ex-Ante values- Oct 2009- Feb 2010**
Distance travelled (Km)	5 Km
Average time/trip(h)	21,6 min
Average speed in peak hours	14Km/h

Table C1.2.43 – Average occupancy (off-peak hours) ex-ante value

Indicators and respective parameters	**Ex-Ante values- Oct 2009- Feb 2010**
Distance travelled (Km)	5 Km
Average No of passengers	45
Max number of passengers	83
Average occupancy off-peak hours	54%

Table C1.2.53 – Average occupancy (peak hours) ex-ante value

Indicators and respective parameters	**Ex-Ante values- Oct 2009- Feb 2010**
Distance travelled (Km)	5 Km
Average No of passengers	70
Max number of passengers	83
Average occupancy peak hours	84%

C1.3 Building the Business-as-Usual scenario

In the absence of MODERN part-funding it is unlikely that a priority traffic light system would have been implemented in Craiova, at this stage and in the near future.

Table C1.3.1- Capital cost in BAU

Indicator	**BAU**
Capital cost	0

Table C1.3.2 - Average speed in off-peak hours in BAU

Indicator	**BAU**
Average speed in off-peak hours (Oct 2010-Feb 2011)	15Km/h

Table C1.3.3 - Average speed in peak hours in BAU

Indicator	**BAU**
Average speed in peak hours(Oct 2010-Feb 2011)	14Km/h

Table C1.3.4 - Average occupancy off-peak hours in BAU

Indicator	**BAU**
Average occupancy off-peak hours(Oct 2010-Feb 2011)	54%

Table C1.3.5- Average occupancy peak hours in BAU

Indicator	**BAU**
Average occupancy peak hours(Oct 2010-Feb 2011)	84%

C2 Measure results

The results are presented under sub headings corresponding to the areas used for indicators – economy, and transport.

C2.1 Economy

Indicator 2 – Capital cost

Indicator	Ex-Post Values
Capital cost (2010)	7'200 Euro

Table C2.1.1: Indicator values

Indicator	Before	B-a-U	After	After – Before	After – B-a-U
Indicator 2' Capital cost	0	0	7200 Euro (2010)	7'200 Euro	7'200 Euro

C2.4 Transport

In Craiova, off-peak hours are between 08:00-12:30 and 18:00- 21:30 and peak hours between 05:30-08:00 and 12:30- 18:00

The data were collected between October 2010 and February 2011. For demonstration, there were chosen the periods of day between: 09:00-10:00 and 19:00- 20:00 in off-peak and the periods between: 07:00-08:00 and 15:00-16:00 in peak. It was considered the same demonstration area as ex-ante which includes the three upgraded intersections.

The average speed and average occupancy, in peak and off-peak, show a slight increase due to the traffic lights priority system.

Table C2.4.1 shows average speed in off-peak hours

Indicators and respective parameters	Ex-Post Values Oct 2010- Feb 2011
Distance travelled (Km)	5 Km
Average time/trip(h)	17.4 min
Average speed in off-peak hours	17 Km/h

Table C2.4.2 shows average speed in peak hours

Indicators and respective parameters	**Ex-Post Values Oct 2010- Feb 2011**
Distance travelled Electroputere station-Bila station(Km)	5 Km
Average time/trip(h)	18.6 min
Average speed in peak hours	16 Km/h

Table C2.4.3-shows average occupancy off-peak hours

Indicators and respective parameters	**Ex-Post Values Oct 2010- Feb 2011**
Distance travelled (Km)	5 Km
Average No of passengers	51
Max number of passengers	83
Average occupancy off-peak hours	61%

Table C2.4.4 shows average occupancy peak hours

Indicators and respective parameters	**Ex-Post Values Oct 2010- Feb 2011**
Distance travelled Electroputere station-Bila station(Km)	5 Km
Average No of passengers	71
Max number of passengers	83
Average occupancy peak hours	85%

For what concerns the average occupancy, it is worth noting that this indicator is influenced by the measure M01.09-“ Energy saving on tramline in Craiova” operating on the same trams. The level of comfort increased after implementation of the measure 01.09 combined with the travel time decreased after the implementation of the measure 08.06 led to increasing of passengers number using the trams.

The traffic lights priority system led to a shortening of travel time for public transport users. In the autumn of 2010, 1 hypermarket placed close to “Electroputere station” was opened to the people. This station is part of “green light system”. So, the people who live in west side of the city were encouraged to use the trams to reach the location of hypermarket, due to the shortening of time per trip. Therefore,, the average occupancy increased compared with the situation before.

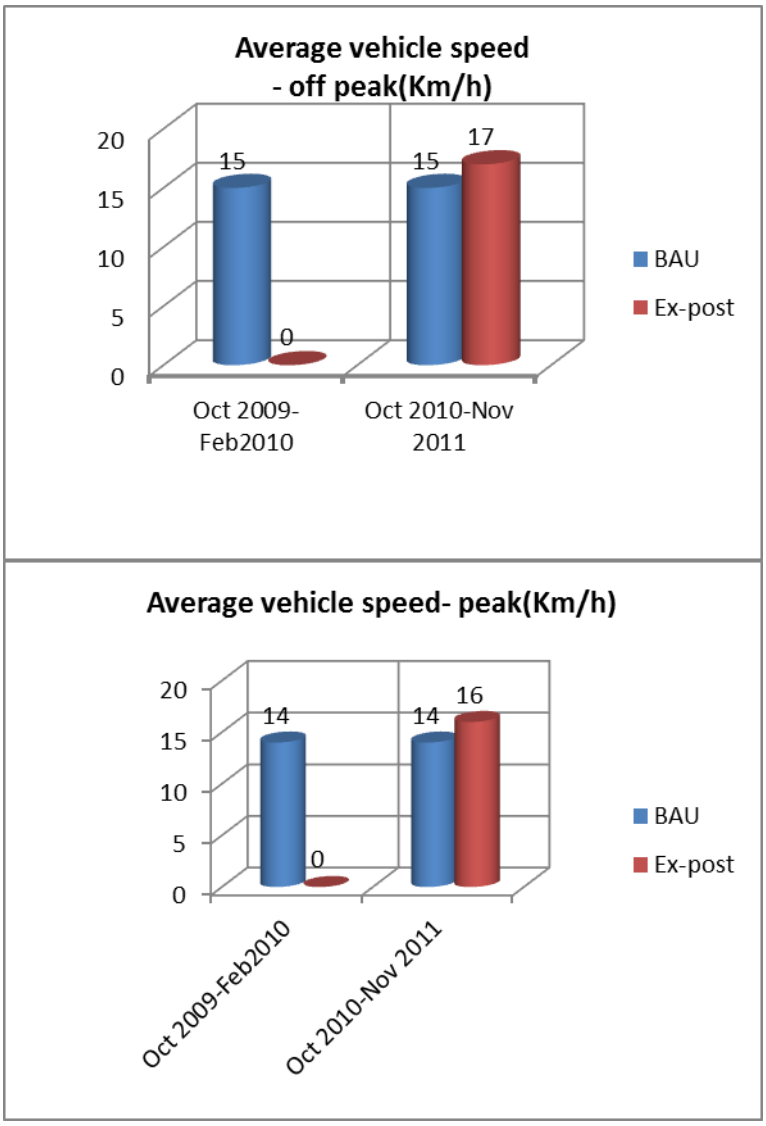


Fig C2.4.1-graphical evolution of average vehicle speed in peak/off-peak

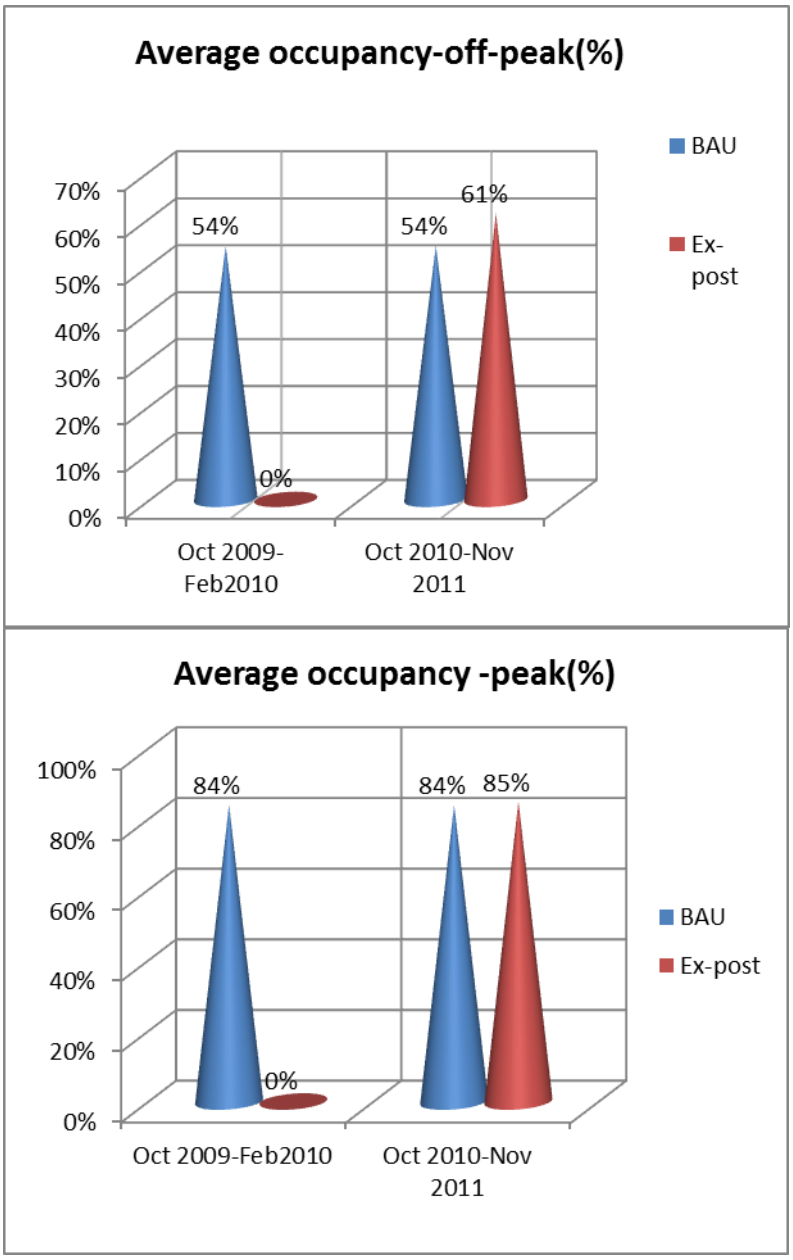


Fig C2.4.2- graphical evolution of average occupancy in peak/off-peak

Table C2.4.1:

In this table the indicator values are listed synthetically to have an overview of the three scenarios.

Indicator	Before	B-a-U	After	After – Before	After – BaU
Indicator 28 (Average occupancy-peak)	84% in peak (Oct 2009 -Feb 2010)	84% in peak (Oct 2010 -Feb 2011)	85% in peak (Oct 2010 -Feb 2011)	Increasing by 1% in peak	Increasing by 1% in peak
Indicator 28 (Average occupancy-off-peak)	54% off-peak (Oct 2009 - Feb 2010)	54% off-peak (Oct 2010 -Feb 2011)	61% off-peak (Oct 2010 - Feb 2011)	Increasing by 7% in off peak	Increasing by 7% in off peak
Indicator 23 (Average vehicle speed–peak)	14 km/h (Oct 2009 -Feb 2010)	14 km/h (Oct 2010 -Feb 2011)	16 km/h (Oct 2010 -Feb 2011)	2Km/h	2Km/h
Indicator 24 (Average vehicle speed – off peak)	15 km/h (Oct 2009 -Feb 2010)	15 km/h (Oct 2010 - Feb 2011)	17 km/h (Oct 2010 - Feb 2011)	2Km/h	2Km/h

Note: for more details make reference to Annex 1- Indicators Calculation in ex-ante and ex-post

C3 Achievement of quantifiable targets and objectives

No.	Target	Rating
1	To endow 9 trams with on-board units for traffic lights controll To endow 3 intersections with receivers in comunication with the trams's remotes control	**
2	To create in Craiova a preferential traffic light regulation	**
3	To increase the average transportation speed/km by 15 % After measure implementation, the average transportation speed of the trams increased by 14 % in peak and 13 % in off- peak for a demonstration period of 5 months	** **

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

C4 Up-scaling of results

The system developed by the measure was a pilot system. Considering the results of the measure, RAT Craiova intent to install radio receivers in the rest of 8 crossroads on the tram line, according to available budget. On the other hand, Municipality want to integrate the "green light" system in the traffic management system in Craiova.

C5 Appraisal of evaluation approach

The evaluation strategy of the measure focused on measurements of transport indicators: Average vehicle speed(peak and off-peak) and average occupancy(peak and off-peak). The evaluation activity sought to prove the advantages of priority traffic lights regulation that has been implemented in 3 crowded intersections in Craiova. In order to calculate the indicator average vehicle speed, we chosen the demonstration area as 5 Km of tramline that includes the three crossroads linked in green light system . The average vehicle speed was calculated as ratio between distance travelled and travel time. From the vehicle occupancy point of view, RAT Craiova gave the number of passengers travelling with trams in peak and off-peak period of day.

The data were collected one day weekly, twice a day in peak period and twice a day in off-peak period,in the same day, for 6 months (October 2009-March 2010) in ex-ante and 5 months (October 2010-February 2011) in ex-post. The ex-post evaluation period was shortened with one month because the Municipality began the construction of overpass and two crossrods of three were no available.

The indicator Average operating cost was cancelled because the 9 radio emitters and the receivers placed on the traffic lights do not bring additional operating cost. The priority traffic lights system consists in pasive electronic elements which do not need maintenance or spare parts at least 5 years.

The evaluation measurements for this measure proved an increasing of trams speed on the demonstration area and a slight increasing of occupancy, due to the priority traffic lights regulation.

C6 Summary of evaluation results

The key results are as follows:

Key result 1 – The traffic lights priority system led to an increase of tram's speed in peak and off-peak, by 14 % respectively 13 %. The 3 crossroads up-graded by the project are located in the most crowded area of the city and the distances between them are almost equal. The traffic lights priority system contribute to a shortening of travel time for public transport users.

Key result 2 - The traffic lights priority system led to a shortening of travel time for public transport users, so, the average occupancy slightly increased compared with the situation befor. The difference between ex-post and ex-ante measurements is not a big one because the operation period was short and the public transport users have not had time to realize the advantages of the priority system of traffic lights.

Key result 3- Average occupancy increased by 1 % in peak and 7 % in off-peak due to measure implementation combined with the effect of M01.09 (Energy saving on tramline in Craiova).

C7 Future activities relating to the measure

The traffic light priority system induced significant increase in tram speed and punctuality. The increase in Public transport speed should give several advantages for passengers and for the Company who operates this service. This advantages are relating:

- Punctuality, reducing the influence of other traffic interferences on the service. This should increase the attractiveness of PT among potential passengers;
- Costs, reducing working times by the drivers.

Therefore RAT is going to ask to implement the system to all the fleet and to other crossroads.

D Process Evaluation Findings

D.0 Focused measure

X	0	No focussed measure
2	1	Most important reason
4	2	Second most important reason
7	3	Third most important reason

D.1Deviations from the original plan

Deviation 1- Shortening of demonstration period

Because of overpass construction in the measure demonstration area, the operation period of the priority traffic light system and thus the ex-post evaluation period were affected. The overpass construction led to the cancellation of 2 crossroads linked to priority traffic light system. Initially, 2 years period of system operation and monitoring was stipulated. This period should be reduced to five months for ex-post data collection to evaluate the measure.

D2 Barriers and drivers

D.2.1 Barriers

Preparation phase

- **Institutional** – There was new approach of municipality regarding the urban roads (setting up roundabout system in many intersection)
- **Planning** – The measure should take into account the existing upgrade of the traffic light system in Craiova
- **Spatial -** There was the risk don't find a good route for preferential traffic light because of urban roads architecture

Implementation phase

No barriers have been encountered.

Operation phase

- **Problem related** – The overpass construction led to the cancellation of 2 crossroads linked to priority traffic light system, during the construction work. This situation led to the shortening of operation period.

D.2.2 Drivers

Preparation phase

- **Positional** – The implementing team exchanged the experience with M 01.09 team because these measures will be implemented on the same trams
- **Involvement, communication –** Regular meetings helped provide a forum for discussion and development of the measure

Implementation phase

- **Institutional** – The Municipality has realised that the tram's priority system is effective one and decided to implement the priority system in more intersections in Craiova, in the future.
- **Positional** – The implementing team exchanged the experience with M 01.09 team because these measures will be implemented on the same trams.

Operation phase

- **Institutional** – The Municipality was aware about the efficiency of the tram's priority system and included the main roads of the city in a project focused on the "green light" system.

D.2.3 Activities

Preparation phase

- **Planning** – Some analisys to evaluate the possibility to integrate preferential traffic lights with existing traffic lights.

Implementation phase

No activities have been performed.

Operation phase

- **Problem related** – Collection of data for ex-post evaluation before the starting the work on the overpass, when the overall system (3 light intersections) was operational.
- **Political / strategic -** Considering that the MODERN measure is only a demonstrative action, the municipality included in the urban strategy for the next years an extended "green light" priority system on the main roads of the city.

D.3 Participation

D.3.1. Measure Partners

- **Measure partner 1 –** The Local Council of Craiova Municipality (Primaria Municipiului Craiova) was organized and functions according to Law No. 215/2001 regarding Local Public Administration with the subsequent modification and completion.

  Municipality as local government institution has, under the conditions imposed by the public administration law, the decisional right in all matters of local interest: political, social, cultural, educational and technical. Through their structures, the municipality is a complex mechanism which can produce major changes in the quality of urban life under an effective management and coordination.
  LCM was the coordinator of the project since 2009 and assumed the responsibility for the management and administration activity in the MODERN project. Between 2009-2011, LCM made the evaluation activity. In this measure, LCM chose the appropriate crossroads, in colaboration with Traffic Police and RAT

- **Measure partner 2** – IPA SA is a 47 years old Romanian industrial R & D company and is the Romanian national institute for research and development, engineering in energy, automation and IT, with a large experience in European projects in technology transfer and in information dissemination.

  IPA was responsible for the dissemination activities and carrying out the research activity and technical studies. Since 2011 IPA took over the evaluation activity.

- **Measure partner 3 - RAT** – Craiova Public Transport Company is the main public transportation operator in the whole Oltenia region.

  RAT Craiova made available the 9 trams for demonstation

D.3.2 Stakeholders

- **Stakeholder 1 – Traffic lights and traffic signs Dept. of Craiova –** modifying traffic lights in order to allow priority in intersections when the trams are approaching.
- **Stakeholder 2 – Traffic Police Department-** Analisys and involvment in the modification of traffic lights sequence temporization.

D.4Recommendations

D.4.1 Recommendations: measure replication

- **System compatibility –** Make some studies in order to find compatibility between existing system and the < green light> system to be implemented.

D.4.2 Recommendations: process (related to barrier-, driver- and action fields)

- **City development strategy** – Take into account the urban development strategy of Municipality to avoid the delay or shortening of the measure implementation or operation period.

Annex1: Ex-ante values of indicators

Indicator 24 (Average vehicle speed – off peak)

The data were collected from each tram endowed with remote control device for priority traffic light

Note relating to meaning the figures in the tables:

- The period of time within 08:00-12:30 is the entire off-peak period, in the morning
- The period 09:00- 10:00 is the period when the data were collected in the morning for off-peak period
- The period of time within 18:00- 21:30 is the entire off-peak period, in the after-noon
- The period 19:00-20:00 is the period when the data were collected in the after-noon for off-peak period
- The period 05:30- 08:00 is the entire peak period, in the morning
- The period 07:00- 08:00 is the period when the data were collected in the morning for peak period
- The period 12:30- 18:00 is the entire peak period, in the after-noon
- The period 15:00- 16:00 is the period when the data were collected in the after-noon for peak period
- Distance travelled between Electroputere station and Bila station(Km) is the demonstration area with a length of 5 km
- Time/trip is the trip time measured in minutes and hours
- Speed(Km/h) is the trams speed calculated as ratio between distance travelled and the trip time

	Average speed in off-peak hours 08:00-12:30 (This is the entire off-peak period, in the morning)			09:00-10:00 (This is the period when the data were collected)			
Tram type KT4 D	Distance travelled Electroputere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
Line 101	5	19	0.32	15.79	Th Oct 1st	October	2009
	5	20	0.33	15.00	Mo-Oct 5th		
	5	19	0.32	15.79	Tu- Oct 13th		
	5	20	0.33	15.00	We-Oct 21st		

	5	19	0.32	15.79	Th- Oct 29th		
	Average speed		0.32	15.47			
	Average speed in off-peak hours 18:00- 21:30			19:00-20:00			
Tram type KT4 D	Distance travelled Electroputere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
Line 102	5	19	0.32	15.79	Th Oct 1st	Oct	2009
	5	21	0.35	14.29	Mo-Oct 5th		
	5	19	0.32	15.79	Tu- Oct 13th		
	5	21	0.35	14.29	We-Oct 21st		
	5	18	0.30	16.67	Th- Oct 29th		
	Average speed		0.33	15.36			
	Average speed in off-peak hours 08:00-12:30			09:00-10:00			
Tram type KT4 D	Distance travelled Electroputere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 101	5	21	0.35	14.29	Mo-Nov 2nd	Nov	2009
	5	19	0.32	15.79	Tu-Nov 10th		
	5	22	0.37	13.64	We-Nov		

					18th		
	5	21	0.35	14.29	Th-Nov 26th		
	5	19	0.32	15.79	Mo-Nov 30th		
	Average speed		0.34	14.76			
	Average speed in off-peak hours 18:00- 21:30			19:00-20:00			
Tram type KT4 D	Distance travelled Electroputere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 102	5	20	0.33	15.00	Mo-Nov 2nd	Nov	2009
	5	20	0.33	15.00	Tu-Nov 10th		
	5	19	0.32	15.79	We-Nov 18th		
	5	21	0.35	14.29	Th-Nov 26th		
	5	20	0.33	15.00	Mo-Nov 30th		
	Average speed		0.33	15.02			
	Average speed in off-peak hours 08:00-12:30			09:00-10:00			

Tram type KT4 D	Distance travelled Electroputere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 101	5	21	0.35	14.29	Th-Dec 3rd	Dec	2009
	5	21	0.35	14.29	Mo-Dec 7th		
	5	19	0.32	15.79	Tu-Dec 15th		
	5	20	0.33	15.00	Mo-Dec 21st		
	5	21	0.35	14.29	We-Dec 23rd		
	Average speed		0.34	14.73			
	Average speed in off-peak hours 18:00- 21:30			19:00-20:00			
Tram type KT4 D	Distance travelled Electroputere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 102	5	21	0.35	14.29	Th-Dec 3rd	Dec	2009
	5	21	0.35	14.29	Mo-Dec 7th		
	5	21	0.35	14.29	Tu-Dec 15th		
	5	22	0.37	13.64	Mo-Dec 21st		

	5	20	0.33	15.00	We-Dec 23rd		
	Average speed		0.35	14.30			
	Average speed in off-peak hours 08:00-12:30			09:00-10:00			
Tram type KT4D	Distance travelled Electroputere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 101	5	20	0.33	15.00	We-Jan 6th	Jan	2010
	5	21	0.35	14.29	Mo-Jan 11th		
	5	21	0.35	14.29	Fr- Jan 15th		
	5	20	0.33	15.00	Tu- Jan 19th		
	5	21	0.35	14.29	Th- Jan 28 th		
	Average speed		0.34	14.57			
	Average speed in off-peak hours 18:00- 21:30			19:00-20:00			
Tram type KT4D	Distance travelled Electroputere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 102	5	20	0.33	15.00	We-Jan 6th	Jan	2010
	5	20	0.33	15.00	Mo-Jan 11th		

	5	21	0.35	14.29	Fr- Jan 15th		
	5	22	0.37	13.64	Tu- Jan 19th		
	5	20	0.33	15.00	Th- Jan 28 th		
	Average speed		0.34	14.58			
	Average speed in off-peak hours 08:00-12:30			09:00-10:00			
	Distance travelled Electroputere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
	5	20	0.33	15.00	Mo- Feb 1st	Feb	2010
	5	21	0.35	14.29	Tu - Feb 9th		
	5	21	0.35	14.29	We- Feb 17th		
	5	19	0.32	15.79	Mo- Feb 22nd		
	5	21	0.35	14.29	Fr- Feb 26th		
	Average speed		0.34	14.73			
	Average speed in off-peak hours 18:00- 21:30			19:00-20:00			
	Distance travelled Electroputere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
	5	21	0.35	14.29	Mo- Feb 1st	Feb	2010

	5	20	0.33	15.00	Tu - Feb 9th		
	5	21	0.35	14.29	We- Feb 17th		
	5	20	0.33	15.00	Mo- Feb 22nd		
	5	19	0.32	15.79	Fr- Feb 26th		
	Average speed		0.34	14.87			
	Average speed in off-peak hours 08:00-12:30			09:00-10:00			
	Distance travelled Electroputere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
	5	20	0.33	15.00	Mo- Mar 1st	Mar	2010
	5	20	0.33	15.00	Tu - Mar 9th		
	5	21	0.35	14.29	We- Mar 17th		
	5	20	0.33	15.00	Th Mar 25th		
	5	21	0.35	14.29	We Mar 31st		
	Average speed		0.34	14.71			
	Average speed in off-peak hours 18:00- 21:30			19:00-20:00			

	Distance travelled Electroputere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
	5	19	0.32	15.79	Mo- Mar 1st	Mar	2010
	5	20	0.33	15.00	Tu - Mar 9th		
	5	21	0.35	14.29	We- Mar 17th		
	5	20	0.33	15.00	Th Mar 25th		
	5	20	0.33	15.00	We Mar 31st		
	Average speed		0.33	15.02			

Indicator 23 (Average vehicle speed– peak)

	Average speed in peak hours (05:30-08:00)			07:00-08:00			
Tram type KT4 D	Distance travelled Electroputere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
Line 101	5	19	0.32	15.79	Th Oct 1st	October	2009
	5	23	0.38	13.04	Mo- Oct 5th		
	5	19	0.32	15.79	Tu- Oct 13th		
	5	20	0.33	15.00	We- Oct		

					21st		
	5	22	0.37	13.64	Th- Oct 29th		
	Average speed			14.65			
	Average speed in peak hours 12:30-18:00			15:00-16:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
Line 102	5	20	0.33	15.00	Th Oct 1st	Oct	2009
	5	23	0.38	13.04	Mo- Oct 5th		
	5	19	0.32	15.79	Tu- Oct 13th		
	5	22	0.37	13.64	We- Oct 21st		
	5	18	0.30	16.67	Th- Oct 29th		
	Average speed			14.83			
	Average speed in peak hours 05:30-08:00			07:00-08:00			

Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 101	5	21	0.35	14.29	Mo- Nov 2nd	Nov	2009
	5	19	0.32	15.79	Tu-Nov 10th		
	5	22	0.37	13.64	We- Nov 18th		
	5	18	0.30	16.67	Th- Nov 26th		
	5	20	0.33	15.00	Mo- Nov 30th		
	Average speed			15.08			
	Average speed in peak hours 12:30-18:00			15:00-16:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 102	5	20	0.33	15.00	Mo- Nov 2nd	Nov	2009
	5	23	0.38	13.04	Tu-Nov 10th		
	5	22	0.37	13.64	We- Nov		

					18th		
	5	21	0.35	14.29	Th- Nov 26th		
	5	17	0.28	17.65	Mo- Nov 30th		
	Average speed			14.72			
	Average speed in peak hours 05:30-08:00			07:00-08:00			
Tram type KT4 D	Distance travelled Electropute station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 101	5	21	0.35	14.29	Th- Dec 3rd	Dec	2009
	5	24	0.40	12.50	Mo- Dec 7th		
	5	25	0.42	12.00	Tu- Dec 15th		
	5	20	0.33	15.00	Mo- Dec 21st		
	5	24	0.40	12.50	We- Dec 23rd		
	Average speed			13.26			
	Average speed in peak hours			15:00-16:00			

	12:30-18:00						
Tram type KT4 D	Distance travelled Electropute re station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 102	5	23	0.38	13.04	Th- Dec 3rd	Dec	2009
	5	23	0.38	13.04	Mo- Dec 7th		
	5	24	0.40	12.50	Tu- Dec 15th		
	5	22	0.37	13.64	Mo- Dec 21st		
	5	23	0.38	13.04	We- Dec 23rd		
	Average speed			13.05			
	Average speed in peak hours 05:30-08:00			07:00-08:00			
Tram type KT4 D	Distance travelled Electropute re station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 101	5	24	0.40	12.50	We- Jan 6th	Jan	2010
	5	23	0.38	13.04	Mo- Jan 11th		

	5	25	0.42	12.00	Fr- Jan 15th		
	5	25	0.42	12.00	Tu- Jan 19th		
	5	23	0.38	13.04	Th- Jan 28 th		
	Average speed			12.52			
	Average speed in peak hours 12:30-18:00			15:00-16:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 102	5	23	0.38	13.04	We- Jan 6th	Jan	2010
	5	23	0.38	13.04	Mo- Jan 11th		
	5	24	0.40	12.50	Fr- Jan 15th		
	5	22	0.37	13.64	Tu- Jan 19th		
	5	23	0.38	13.04	Th- Jan 28 th		
	Average speed			13.05			
	Average speed in peak			07:00-08:00			

	hours 05:30-08:00						
	Distance travelled Electroputere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
	5	24	0.40	12.50	Mo- Feb 1st	Feb	2010
	5	23	0.38	13.04	Tu -Feb 9th		
	5	25	0.42	12.00	We- Feb 17th		
	5	25	0.42	12.00	Mo- Feb 22nd		
	5	24	0.40	12.50	Fr- Feb 26th		
	Average speed			12.41			
	Average speed in peak hours 12:30-18:00			15:00-16:00			
	Distance travelled Electroputere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
	5	23	0.38	13.04	Mo- Feb 1st	Feb	2010
	5	25	0.42	12.00	Tu -Feb		

					9th		
	5	24	0.40	12.50	We- Feb 17th		
	5	23	0.38	13.04	Mo- Feb 22nd		
	5	23	0.38	13.04	Fr- Feb 26th		
	Average speed			12.73			
	Average speed in peak hours 05:30-08:00			07:00-08:00			
	Distance travelled Electropute ere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
	5	22	0.37	13.64	Mo- Mar 1st	Mar	2010
	5	23	0.38	13.04	Tu -Mar 9th		
	5	25	0.42	12.00	We- Mar 17th		
	5	25	0.42	12.00	Th Mar 25th		
	5	24	0.40	12.50	We Mar 31st		
	Average speed			12.64			
	Average			15:00-			

	speed in peak hours 12:30-18:00			16:00			
	Distance travelled Electropute re station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
	5	22	0.37	13.64	Mo- Mar 1st	Mar	2010
	5	25	0.42	12.00	Tu -Mar 9th		
	5	24	0.40	12.50	We- Mar 17th		
	5	22	0.37	13.64	Th Mar 25th		
	5	23	0.38	13.04	We Mar 31st		
	Average speed			12.96			

Indicator 28 (Average occupancy off-peak)

	Average occupancy off-peak hours 08:00-12:30			09:00-10:00			
Tram type KT4 D	Distance travelled Electropute re station-Bila station(K	No of passengers	Maximum no of passengers	Average occupancy	day	month	year

	m)						
Line 101	5	45	83.00	54%	Th Oct 1st	Oct	2009
	5	49	83.00	59%	Mo- Oct 5th		
	5	42	83.00	51%	Tu- Oct 13th		
	5	51	83.00	61%	We- Oct 21st		
	5	42	83.00	51%	Th- Oct 29th		
	Average occupancy	45.8		55%			
	Average occupancy in off-peak hours 18:00-21:30			19:00-20:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
Line 102	5	42	83.00	51%	Th Oct 1st	Oct	2009
	5	48	83.00	58%	Mo- Oct 5th		
	5	42	83.00	51%	Tu- Oct 13th		
	5	51	83.00	61%	We- Oct 21st		
	5	40	83.00	48%	Th- Oct		

					29th		
	Average occupancy	44.6		54%			
	Average occupancy off-peak hours 08:00-12:30			09:00-10:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
line 101	5	45	83.00	54%	Mo- Nov 2nd	Nov	2009
	5	52	83.00	63%	Tu-Nov 10th		
	5	46	83.00	55%	We- Nov 18th		
	5	48	83.00	58%	Th- Nov 26th		
	5	41	83.00	49%	Mo- Nov 30th		
	Average occupancy	46.4		56%			
	Average occupancy in off-peak hours 18:00-21:30			19:00-20:00			

Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	No of passengers	Maximum no passengers	Average occupancy	day	month	year
line 102	5	40	83.00	48%	Mo- Nov 2nd	Nov	2009
	5	41	83.00	49%	Tu-Nov 10th		
	5	48	83.00	58%	We- Nov 18th		
	5	50	83.00	60%	Th- Nov 26th		
	5	42	83.00	51%	Mo- Nov 30th		
	Average occupancy	44.2		53%			
	Average occupancy off-peak hours 08:00-12:30			09:00-10:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
line 101	5	42	83.00	51%	Th- Dec 3rd	Dec	2009
	5	46	83.00	55%	Mo- Dec 7th		
	5	48	83.00	58%	Tu- Dec		

					15th		
	5	50	83.00	60%	Mo- Dec 21st		
	5	42	83.00	51%	We- Dec 23rd		
	Average occupancy	45.6		55%			
	Average occupancy in off-peak hours 18:00-21:30			19:00-20:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
line 102	5	40	83.00	48%	Th- Dec 3rd	Dec	2009
	5	42	83.00	51%	Mo- Dec 7th		
	5	46	83.00	55%	Tu- Dec 15th		
	5	44	83.00	53%	Mo- Dec 21st		
	5	41	83.00	49%	We- Dec 23rd		
	Average occupancy	42.6		51%			
	Average occupancy			09:00-10:00			

	off-peak hours 08:00-12:30						
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
line 101	5	46	83.00	55%	We- Jan 6th	Jan	2010
	5	44	83.00	53%	Mo- Jan 11th		
	5	55	83.00	66%	Fr- Jan 15th		
	5	52	83.00	63%	Tu- Jan 19th		
	5	45	83.00	54%	Th- Jan 28 th		
	Average occupancy	48.4		58%			
	Average occupancy in off-peak hours 18:00-21:30			19:00-20:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
line 102	5	42	83.00	51%	We- Jan	Jan	2010

					6th		
	5	45	83.00	54%	Mo- Jan 11th		
	5	40	83.00	48%	Fr- Jan 15th		
	5	46	83.00	55%	Tu- Jan 19th		
	5	40	83.00	48%	Th- Jan 28 th		
	Average occupancy	42.6		51%			
	Average occupancy off-peak hours 08:00-12:30			09:00-10:00			
	Distance travelled Electropute ere station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
	5	45	83.00	54%	Mo- Feb 1st	Feb	2010
	5	43	83.00	52%	Tu -Feb 9th		
	5	56	83.00	67%	We- Feb 17th		
	5	52	83.00	63%	Mo- Feb 22nd		
	5	46	83.00	55%	Fr- Feb 26th		
	Average occupancy	48.4		58%			

	Average occupancy in off-peak hours 18:00-21:30			19:00-20:00			
	Distance travelled Electroputere station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
	5	41	83.00	49%	Mo- Feb 1st	Feb	2010
	5	44	83.00	53%	Tu -Feb 9th		
	5	41	83.00	49%	We- Feb 17th		
	5	46	83.00	55%	Mo- Feb 22nd		
	5	41	83.00	49%	Fr- Feb 26th		
	Average occupancy	42.6		51%			
	Average occupancy off-peak hours 08:00-12:30			09:00-10:00			
	Distance travelled Electroputere station-Bila station(K	No of passengers	Maximum no of passengers	Average occupancy	day	month	year

	m)						
	5	45	83.00	54%	Mo- Mar 1st	Mar	2010
	5	43	83.00	52%	Tu -Mar 9th		
	5	56	83.00	67%	We- Mar 17th		
	5	52	83.00	63%	Th Mar 25th		
	5	46	83.00	55%	We Mar 31st		
	Average occupancy	48.4		58%			
	Average occupancy in off-peak hours 18:00-21:30			19:00-20:00			
	Distance travelled Electropute re station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
	5	41	83.00	49%	Mo- Mar 1st	Mar	2010
	5	44	83.00	53%	Tu -Mar 9th		
	5	41	83.00	49%	We- Mar 17th		
	5	46	83.00	55%	Th Mar 25th		

	5	41	83.00	49%	We Mar 31st		
	Average occupancy	42.6		51%			

Indicator 28 (Average occupancy in peak)

	Average occupancy in peak 05:30-08:00			07:00-08:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
Line 101	5	70	83.00	84%	Th Oct 1st	Oct	2009
	5	60	83.00	72%	Mo- Oct 5th		
	5	65	83.00	78%	Tu- Oct 13th		
	5	60	83.00	72%	We- Oct 21st		
	5	77	83.00	93%	Th- Oct 29th		
	Average occupancy	66.4		80%			
	Average occupancy			15:00-16:00			

	in peak hours 12:30-18:00						
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
Line 102	5	75	83.00	90%	Th Oct 1st	Oct	2009
	5	62	83.00	75%	Mo- Oct 5th		
	5	63	83.00	76%	Tu- Oct 13th		
	5	70	83.00	84%	We- Oct 21st		
	5	78	83.00	94%	Th- Oct 29th		
	Average occupancy	69.6		84%			
	Average speed in peak hours 05:30-08:00			07:00-08:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
line 101	5	72	83.00	87%	Mo- Nov 2nd	Nov	2009
	5	63	83.00	76%	Tu-Nov		

					10th		
	5	60	83.00	72%	We- Nov 18th		
	5	72	83.00	87%	Th- Nov 26th		
	5	77	83.00	93%	Mo- Nov 30th		
	Average occupancy	68.8		83%			
	Average speed in peak hours 12:30-18:00			15:00-16:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
line 102	5	75	83.00	90%	Mo- Nov 2nd	Nov	2009
	5	63	83.00	76%	Tu-Nov 10th		
	5	69	83.00	83%	We- Nov 18th		
	5	73	83.00	88%	Th- Nov 26th		
	5	76	83.00	92%	Mo- Nov 30th		
	Average occupancy	71.2		86%			
	Average			07:00-			

	speed in peak hours 05:30-08:00			08:00			
Tram type KT4 D	Distance travelled Electropute re station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
line 101	5	77	83.00	93%	Th- Dec 3rd	Dec	2009
	5	75	83.00	90%	Mo- Dec 7th		
	5	73	83.00	88%	Tu- Dec 15th		
	5	60	83.00	72%	Mo- Dec 21st		
	5	71	83.00	86%	We- Dec 23rd		
	Average occupancy	71.2		86%			
	Average speed in peak hours 12:30-18:00			15:00-16:00			
Tram type KT4 D	Distance travelled Electropute re station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
line 102	5	76	83.00	92%	Th- Dec	Dec	2009

					3rd		
	5	66	83.00	80%	Mo- Dec 7th		
	5	59	83.00	71%	Tu- Dec 15th		
	5	68	83.00	82%	Mo- Dec 21st		
	5	75	83.00	90%	We- Dec 23rd		
	Average occupancy	68.8		83%			
	Average speed in peak hours 05:30-08:00			07:00-08:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
line 101	5	78	83.00	94%	We- Jan 6th	Jan	2010
	5	67	83.00	81%	Mo- Jan 11th		
	5	69	83.00	83%	Fr- Jan 15th		
	5	62	83.00	75%	Tu- Jan 19th		
	5	79	83.00	95%	Th- Jan 28 th		
	Average occupancy	71		86%			

	Average speed in peak hours 12:30-18:00			15:00-16:00			
Tram type KT4 D	Distance travelled Electropute re station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
line 102	5	76	83.00	92%	We- Jan 6th	Jan	2010
	5	71	83.00	86%	Mo- Jan 11th		
	5	62	83.00	75%	Fr- Jan 15th		
	5	67	83.00	81%	Tu- Jan 19th		
	5	76	83.00	92%	Th- Jan 28 th		
	Average occupancy	70.4		85%			
	Average speed in peak hours 05:30-08:00			07:00-08:00			
	Distance travelled Electropute re station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year

	5	79	83.00	95%	Mo- Feb 1st	Feb	2010
	5	67	83.00	81%	Tu -Feb 9th		
	5	69	83.00	83%	We- Feb 17th		
	5	62	83.00	75%	Mo- Feb 22nd		
	5	80	83.00	96%	Fr- Feb 26th		
	Average occupancy	71.4		86%			
	Average speed in peak hours 12:30-18:00			15:00-16:00			
	Distance travelled Electropute ere station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
	5	81	83.00	98%	Mo- Feb 1st	Feb	2010
	5	71	83.00	86%	Tu -Feb 9th		
	5	62	83.00	75%	We- Feb 17th		
	5	67	83.00	81%	Mo- Feb 22nd		
	5	79	83.00	95%	Fr- Feb 26th		
	Average occupancy	72		87%			

	Average speed in peak hours 05:30-08:00			07:00-08:00			
	Distance travelled Electropute ere station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
	5	77	83.00	93%	Mo- Mar 1st	Mar	2010
	5	67	83.00	81%	Tu -Mar 9th		
	5	69	83.00	83%	We- Mar 17th		
	5	62	83.00	75%	Th Mar 25th		
	5	76	83.00	92%	We Mar 31st		
	Average occupancy	70.2		85%			
	Average speed in peak hours 12:30-18:00			15:00-16:00			
	Distance travelled Electropute ere station-Bila station(K	No of passengers	Maximum no of passengers	Average occupancy	day	month	year

	m)						
	5	76	83.00	92%	Mo- Mar 1st	Mar	2010
	5	71	83.00	86%	Tu -Mar 9th		
	5	62	83.00	75%	We- Mar 17th		
	5	67	83.00	81%	Th Mar 25th		
	5	75	83.00	90%	We Mar 31st		
	Average occupancy	70.2		85%			

Ex-post indicators values

Indicator 24 (Average speed in off-peak)

	Average speed in off-peak hours 08:00-12:30			09:00-10:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
Line 101	5	18	0.30	16.67	Fr-Oct 1st	Oct	2010
	5	18	0.30	16.67	Mo-Oct 4th		
	5	17	0.28	17.65	Tu-Oct 12th		

	5	19	0.32	15.79	We Oct 20th		
	5	18	0.30	16.67	Th-Oct 28th		
	Average speed			16.69			
	Average speed in off-peak hours 18:00-21:30			19:00-20:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
Line 102	5	19	0.32	15.79	Fr-Oct 1st	Oct	2010
	5	17	0.28	17.65	Mo-Oct 4th		
	5	16	0.27	18.75	Tu-Oct 12th		
	5	18	0.30	16.67	We Oct 20th		
	5	19	0.32	15.79	Th-Oct 28th		
	Average speed			16.93			
	Average speed in off-peak hours 08:00-12:30			09:00-10:00			

Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 101	5	17	0.28	17.65	Mo- Nov 1st	Nov	2010
	5	18	0.30	16.67	Tu- Nov 9th		
	5	16	0.27	18.75	We- Nov 17th		
	5	18	0.30	16.67	Th- Nov25th		
	5	16	0.27	18.75	Tu- Nov 30th		
	Average speed			17.70			
	Average speed in off-peak hours 18:00-21:30			19:00-20:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 102	5	17	0.28	17.65	Mo- Nov 1st	Nov	2010
	5	19	0.32	15.79	Tu- Nov 9th		
	5	17	0.28	17.65	We- Nov		

					17th		
	5	18	0.30	16.67	Th- Nov25th		
	5	16	0.27	18.75	Tu- Nov 30th		
	Average speed			17.30			
	Average speed in off-peak hours 08:00-12:30			09:00-10:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 101	5	16	0.27	18.75	Th- Dec 2nd	Dec	2010
	5	17	0.28	17.65	Mo- Dec 6th		
	5	16	0.27	18.75	Th- Dec 9th		
	5	18	0.30	16.67	Tu- Dec 14th		
	5	17	0.28	17.65	We- Dec 22nd		
	Average speed			17.89			
	Average speed in off-peak hours			19:00-20:00			

	18:00-21:30						
Tram type KT4 D	Distance travelled Electropute re station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 102	5	18	0.30	16.67	Th- Dec 2nd	Dec	2010
	5	16	0.27	18.75	Mo- Dec 6th		
	5	17	0.28	17.65	Th- Dec 9th		
	5	16	0.27	18.75	Tu- Dec 14th		
	5	17	0.28	17.65	We- Dec 22nd		
	Average speed			17.89			
	Average speed in off-peak hours 08:00-12:30			09:00-10:00			
Tram type KT4 D	Distance travelled Electropute re station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 101	5	18	0.30	16.67	Th- Jan 6th	Jan	2011
	5	17	0.28	17.65	Mo- Jan 10th		

	5	19	0.32	15.79	Fr- Jan 14th		
	5	17	0.28	17.65	Tu- Jan 18th		
	5	18	0.30	16.67	We- Jan 26th		
	Average speed			16.88			
	Average speed in off-peak hours 18:00-21:30			19:00-20:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 102	5	18	0.30	16.67	Th- Jan 6th	Jan	2011
	5	17	0.28	17.65	Mo- Jan 10th		
	5	19	0.32	15.79	Fr- Jan 14th		
	5	17	0.28	17.65	Tu- Jan 18th		
	5	18	0.30	16.67	We- Jan 26th		
	Average speed			16.88			
	Average speed in off-peak			09:00-10:00			

	hours 08:00-12:30						
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 101	5	19	0.32	15.79	Tu- Feb 1st	February	2011
	5	16	0.27	18.75	We- Feb 9th		
	5	19	0.32	15.79	Th- Feb 17th		
	5	18	0.30	16.67	Fr- Feb 25th		
	5	17	0.28	17.65	Mo- Feb 28th		
	Average speed			16.93			
	Average speed in off-peak hours 18:00-21:30			19:00-20:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 102	5	17	0.28	17.65	Tu- Feb 1st	February	2011
	5	18	0.30	16.67	We- Feb		

					9th		
	5	19	0.32	15.79	Th- Feb 17th		
	5	18	0.30	16.67	Fr- Feb 25th		
	5	19	0.32	15.79	Mo- Feb 28th		
	Average speed			16.51			
	Average speed in off-peak hours 08:00-12:30			09:00-10:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 101	5	19	0.32	15.79	Monday-21st	February	2011
	5	17	0.28	17.65	Tuesday-22nd		
	5	18	0.30	16.67	Wednesday-23rd		
	5	19	0.32	15.79	Thursday-24th		
	5	19	0.32	15.79	Friday-25th		
	Average speed			16.34			
	Average			19:00-			

	speed in off-peak hours 18:00-21:30			20:00			
Tram type KT4 D	Distance travelled Electropute re station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 102	5	16	0.27	18.75	Monday-21st	February	2011
	5	18	0.30	16.67	Tuesday-22nd		
	5	19	0.32	15.79	Wednesday-23rd		
	5	16	0.27	18.75	Thursday-24th		
	5	18	0.30	16.67	Friday-25th		
	Average speed			17.32			
	Average speed in off-peak hours 08:00-12:30			09:00-10:00			
Tram type KT4 D	Distance travelled Electropute re station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 101	5	18	0.30	16.67	Monday-	February	2011

					28th		
	5	19	0.32	15.79	Tuesday-1st		
	5	18	0.30	16.67	Wednesday-2nd		
	5	17	0.28	17.65	Thursday-3rd		
	5	17	0.28	17.65	Friday-4th		
	Average speed			16.88			
	Average speed in off-peak hours 18:00-21:30			19:00-20:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 102	5	16	0.27	18.75	Monday-28th	February	2011
	5	18	0.30	16.67	Tuesday-1st		
	5	18	0.30	16.67	Wednesday-2nd		
	5	16	0.27	18.75	Thursday-3rd		
	5	18	0.30	16.67	Friday-4th		
	Average speed			17.50			

Indicator 23 (Average speed in peak)

	Average speed in peak hours 05:30-08:00			07:00-08:00			
Tram type KT4 D	Distance travelled Electropute re station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
Line 101	5	18	0.30	16.67	Fr-Oct 1st	Oct	2010
	5	18	0.30	16.67	Mo-Oct 4th		
	5	19	0.32	15.79	Tu-Oct 12th		
	5	20	0.33	15.00	We Oct 20th		
	5	19	0.32	15.79	Th-Oct 28th		
	Average speed			15.98			
	Average speed in peak hours 12:30-18:00			15:00-16:00			
Tram type KT4 D	Distance travelled Electropute re station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
Line 102	5	20	0.33	15.00	Fr-Oct 1st	Oct	2010

	5	18	0.30	16.67	Mo-Oct 4th		
	5	19	0.32	15.79	Tu-Oct 12th		
	5	18	0.30	16.67	We Oct 20th		
	5	20	0.33	15.00	Th-Oct 28th		
	Average speed			15.82			
	Average speed in peak hours 05:30-08:00			07:00-08:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 101	5	19	0.32	15.79	Mo- Nov 1st	Nov	2010
	5	16	0.27	18.75	Tu- Nov 9th		
	5	16	0.27	18.75	We- Nov 17th		
	5	19	0.32	15.79	Th-Nov25th		
	5	20	0.33	15.00	Tu- Nov 30th		
	Average speed			16.82			

	Average speed in peak hours 12:30-18:00			15:00-16:00			
Tram type KT4 D	Distance travelled Electropute re station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 102	5	19	0.32	15.79	Mo- Nov 1st	Nov	2010
	5	19	0.32	15.79	Tu- Nov 9th		
	5	17	0.28	17.65	We- Nov 17th		
	5	20	0.33	15.00	Th- Nov25th		
	5	18	0.30	16.67	Tu- Nov 30th		
	Average speed			16.18			
	Average speed in peak hours 05:30-08:00			07:00-08:00			
Tram type KT4 D	Distance travelled Electropute re station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year

line 101	5	19	0.32	15.79	Th- Dec 2nd	Dec	2010
	5	18	0.30	16.67	Mo- Dec 6th		
	5	19	0.32	15.79	Th- Dec 9th		
	5	20	0.33	15.00	Tu- Dec 14th		
	5	19	0.32	15.79	We- Dec 22nd		
	Average speed			15.81			
	Average speed in peak hours 12:30-18:00			15:00-16:00			
Tram type KT4 D	Distance travelled Electropute re station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 102	5	19	0.32	15.79	Th- Dec 2nd	Dec	2010
	5	18	0.30	16.67	Mo- Dec 6th		
	5	17	0.28	17.65	Th- Dec 9th		
	5	19	0.32	15.79	Tu- Dec 14th		
	5	20	0.33	15.00	We- Dec 22nd		
	Average speed			16.18			

	Average speed in peak hours 05:30-08:00			07:00-08:00			
Tram type KT4 D	Distance travelled Electropute re station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 101	5	19	0.32	15.79	Th- Jan 6th	Jan	2011
	5	18	0.30	16.67	Mo- Jan 10th		
	5	19	0.32	15.79	Fr- Jan 14th		
	5	18	0.30	16.67	Tu- Jan 18th		
	5	20	0.33	15.00	We- Jan 26th		
	Average speed			15.98			
	Average speed in peak hours 12:30-18:00			15:00-16:00			
Tram type KT4 D	Distance travelled Electropute re station-Bila station(K	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year

	m)						
line 102	5	18	0.30	16.67	Th- Jan 6th	Jan	2011
	5	18	0.30	16.67	Mo- Jan 10th		
	5	19	0.32	15.79	Fr- Jan 14th		
	5	18	0.30	16.67	Tu- Jan 18th		
	5	20	0.33	15.00	We- Jan 26th		
	Average speed			16.16			
	Average speed in peak hours 05:30-08:00			07:00-08:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 101	5	19	0.32	15.79	Tu- Feb 1st	Feb	2011
	5	17	0.28	17.65	We- Feb 9th		
	5	19	0.32	15.79	Th- Feb 17th		

	5	18	0.30	16.67	Fr- Feb 25th		
	5	19	0.32	15.79	Mo- Feb 28th		
	Average speed			16.34			
	Average speed in peak hours 12:30-18:00			15:00-16:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 102	5	18	0.30	16.67	Tu- Feb 1st	Feb	2011
	5	18	0.30	16.67	We- Feb 9th		
	5	19	0.32	15.79	Th- Feb 17th		
	5	18	0.30	16.67	Fr- Feb 25th		
	5	19	0.32	15.79	Mo- Feb 28th		
	Average speed			16.32			
	Average speed in peak hours 05:30-			07:00-08:00			

	08:00						
Tram type KT4 D	Distance travelled Electropute re station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 101	5	17	0.28	17.65	Monday-21st		2011
	5	18	0.30	16.67	Tuesday-22nd		2011
	5	19	0.32	15.79	Wednesday-23rd		2011
	5	20	0.33	15.00	Thursday-24th		2011
	5	19	0.32	15.79	Friday-25th		2011
	Average speed			16.18			
	Average speed in peak hours 12:30-18:00			15:00-16:00			
Tram type KT4 D	Distance travelled Electropute re station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 102	5	18	0.30	16.67	Monday-21st	February	2011
	5	18	0.30	16.67	Tuesday-22nd	February	2011

	5	19	0.32	15.79	Wednesday-23rd	February	2011
	5	18	0.30	16.67	Thursday-24th	February	2011
	5	19	0.32	15.79	Friday-25th	February	2011
	Average speed			16.32			
	Average speed in peak hours 05:30-08:00			07:00-08:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 101	5	18	0.30	16.67	Monday-28th	February	2011
	5	18	0.30	16.67	Tuesday-1st	March	2011
	5	18	0.30	16.67	Wednesday-2nd	March	2011
	5	19	0.32	15.79	Thursday-3rd	March	2011
	5	18	0.30	16.67	Friday-4th	March	2011
	Average speed			16.49			
	Average speed in peak hours			15:00-16:00			

	12:30-18:00						
Tram type KT4 D	Distance travelled Electropute re station-Bila station(Km)	time/trip(min)	time/trip(h)	speed(Km/h)	day	month	year
line 102	5	19	0.32	15.79	Monday-28th	February	2011
	5	18	0.30	16.67	Tuesday-1st	March	
	5	17	0.28	17.65	Wednesday-2nd	March	
	5	17	0.28	17.65	Thursday-3rd	March	
	5	18	0.30	16.67	Friday-4th	March	
	Average speed			16.88			

Indicator 28(Average occupancy off-peak)

	Average occupancy off-peak hours 08:00-12:30			09:00-10:00			
Tram type KT4 D	Distance travelled Electropute re station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
Line 101	5	51	83.00	61.45%	Fr-Oct 1st	Oct	2010
	5	50	83.00	60.24%	Mo-Oct 4th		

	5	48	83.00	57.83%	Tu-Oct 12th		
	5	47	83.00	56.63%	We Oct 20th		
	5	50	83.00	60.24%	Th-Oct 28th		
	Average occupancy			59.28%			
	Average occupancy in off-peak hours 18:00-21:30			19:00-20:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
Line 102	5	48	83.00	57.83%	Fr-Oct 1st	Oct	2010
	5	54	83.00	65.06%	Mo-Oct 4th		
	5	50	83.00	60.24%	Tu-Oct 12th		
	5	49	83.00	59.04%	We Oct 20th		
	5	51	83.00	61.45%	Th-Oct 28th		
	Average occupancy			60.72%			
	Average occupancy off-peak			09:00-10:00			

	hours 08:00-12:30						
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	No of passengers	maximum no of passengers	Average occupancy	day	month	year
line 101	5	52	83.00	62.65%	Mo- Nov 1st	Nov	2010
	5	51	83.00	61.45%	Tu- Nov 9th		
	5	46	83.00	55.42%	We- Nov 17th		
	5	45	83.00	54.22%	Th- Nov25th		
	5	51	83.00	61.45%	Tu- Nov 30th		
	Average occupancy			59.04%			
	Average occupancy in off-peak hours 18:00-21:30			19:00-20:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
line 102	5	47	83.00	56.63%	Mo- Nov 1st	Nov	2010

	5	49	83.00	59.04%	Tu- Nov 9th		
	5	49	83.00	59.04%	We- Nov 17th		
	5	50	83.00	60.24%	Th- Nov25th		
	5	53	83.00	63.86%	Tu- Nov 30th		
	Average occupancy			59.76%			
	Average occupancy off-peak hours 08:00-12:30			09:00-10:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
line 101	5	53	83.00	63.86%	Th- Dec 2nd	Dec	2010
	5	51	83.00	61.45%	Mo- Dec 6th		
	5	46	83.00	55.42%	Th- Dec 9th		
	5	47	83.00	56.63%	Tu- Dec 14th		
	5	50	83.00	60.24%	We- Dec 22nd		
	Average occupancy			59.52%			

	Average occupancy in off-peak hours 18:00-21:30			19:00-20:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
line 102	5	55	83.00	66.27%	Th- Dec 2nd	Dec	2010
	5	50	83.00	60.24%	Mo- Dec 6th		
	5	49	83.00	59.04%	Th- Dec 9th		
	5	47	83.00	56.63%	Tu- Dec 14th		
	5	52	83.00	62.65%	We- Dec 22nd		
	Average occupancy			60.96%			
	Average occupancy off-peak hours 08:00-12:30			09:00-10:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(K	No of passengers	Maximum no of passengers	Average occupancy	day	month	year

	m)						
line 101	5	56	83.00	67.47%	Th- Jan 6th	Jan	2011
	5	53	83.00	63.86%	Mo- Jan 10th		
	5	50	83.00	60.24%	Fr- Jan 14th		
	5	52	83.00	62.65%	Tu- Jan 18th		
	5	50	83.00	60.24%	We- Jan 26th		
	Average occupancy			62.89%			
	Average occupancy in off-peak hours 18:00-21:30			19:00-20:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
line 102	5	55	83.00	66.27%	Th- Jan 6th	Jan	2011
	5	50	83.00	60.24%	Mo- Jan 10th		
	5	53	83.00	63.86%	Fr- Jan 14th		
	5	49	83.00	59.04%	Tu- Jan		

					18th		
	5	53	83.00	63.86%	We- Jan 26th		
	Average occupancy			62.65%			
	Average occupancy off-peak hours 08:00-12:30			09:00-10:00			
Tram type KT4 D	Distance travelled Electropute station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
line 101	5	51	83.00	61.45%	Tu- Feb 1st	Feb	2011
	5	50	83.00	60.24%	We- Feb 9th		
	5	52	83.00	62.65%	Th- Feb 17th		
	5	47	83.00	56.63%	Fr- Feb 25th		
	5	50	83.00	60.24%	Mo- Feb 28th		
	Average occupancy			60.24%			
	Average occupancy in off-peak hours 18:00-			19:00-20:00			

	21:30						
Tram type KT4 D	Distance travelled Electropute re station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
line 102	5	54	83.00	65%	Tu- Feb 1st	Feb	2011
	5	50	83.00	60%	We- Feb 9th		
	5	52	83.00	63%	Th- Feb 17th		
	5	53	83.00	64%	Fr- Feb 25th		
	5	50	83.00	60%	Mo- Feb 28th		
	Average occupancy			62%			
	Average occupancy off-peak hours 08:00-12:30			09:00-10:00			
Tram type KT4 D	Distance travelled Electropute re station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
line 101	5	55	83.00	66%	Monday-21st	February	2011
	5	50	83.00	60%	Tuesday-22nd	February	2011

	5	51	83.00	61%	Wednesday-23rd	February	2011
	5	53	83.00	64%	Thursday-24th	February	2011
	5	51	83.00	61%	Friday-25th	February	2011
	Average occupancy			63%			
	Average occupancy in off-peak hours 18:00-21:30			19:00-20:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
line 102	5	54	83.00	65%	Monday-21st	February	2011
	5	52	83.00	63%	Tuesday-22nd	February	2011
	5	53	83.00	64%	Wednesday-23rd	February	2011
	5	50	83.00	60%	Thursday-24th	February	2011
	5	52	83.00	63%	Friday-25th	February	2011
	Average occupancy			63%			
	Average occupancy off-peak			09:00-10:00			

	hours 08:00-12:30						
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
line 101	5	54	83.00	65%	Monday-28th	February	2011
	5	53	83.00	64%	Tuesday-1st	March	2011
	5	53	83.00	64%	Wednesday-2nd	March	2011
	5	51	83.00	61%	Thursday-3rd	March	2011
	5	49	83.00	59%	Friday-4th	March	2011
	Average occupancy			63%			
	Average occupancy in off-peak hours 18:00-21:30			19:00-20:00			
Tram type KT4 D	Distance travelled Electropute ere station-Bila station(Km)	No of passengers	Maximum no of passengers	Average occupancy	day	month	year
line 102	5	53	83.00	64%	Monday-28th	February	2011

	5	50	83.00	60%	Tuesday-1st	March	2011
	5	51	83.00	61%	Wednesday-2nd	March	2011
	5	52	83.00	63%	Thursday-3rd	March	2011
	5	50	83.00	60%	Friday-4th	March	2011
	Average occupancy			62%			