Indicator Fact Sheets

BUCHAREST

Indicator Fact Sheets

List of indicators

TELLUS objective	Indicator	Unit of the indicator
Reduce congestion	Mean journey times	Minutes
	Journey vehicle speed	Km/h, derived
	Average vehicle speed	Km/h, derived
	Low journey speed	km/hr, derived
	Excessive journey time	%
	Accuracy of timekeeping	%
	Excessive queue length	m
	Excessive queue time	minutes
	Parked vehicle counting	no.
	Traffic level rating	%
	Traffic levels	no. of vehicles in a certain period
Reduce air pollution	Level of CO	milligramme/m³
	Level of SO_2	milligramme/m³
	Particulate level	milligramme/m³
Reduce noise	Noise level	dB(A)
Reduce emissions	CO_2 emissions	g/vkm, derived
	NOx emissions	g/vkm, derived
Increase of public trans-port use	Average modal split-PAX	PAX/transport m
	Passenger capacity	Pkm/day, quantitative, collected, measurement
	Patronage	No PAX/day, quantitative, col-lected measurement
	Total no. trips	Trips/day, collected, quantitative, measurement
	Fare structure	Index, qualitative, collected, sur-vey
	Information sites	No. of sites, quantitative, collected measurement
	information accessibility	%, qualitative, collected, survey
	Passengers satisfaction level	Index, qualitative, collected, sur-vey
	Vehicle capacity	vkm/day, quantitative, visual esti-mation
Improvement of intra-organisational co-operation at the city level	Quality of intra-organisational co-operation	Qualitative terms
Achievement of political and public awareness	Media exposure	Qualitative and quantitative terms
	Events organised	

TELLUS objective monitoring and evaluation

Indicator Fact Sheet for TELLUS objective "reduce congestion"

TELLUS Key Indicator: mean journey time between given locations

(trip-related congestion measures)

Derived indicators: journey vehicle speed, average vehicle speed, low journey speed, excessive journey time, accuracy of timekeeping

Context, Description of the indicator

The indicator "mean journey time" is appropriate to measure the phenomenon congestion. The longer the mean journey time between given location is, the lower is the flow of traffic and the average speed.

The unit of observation is the trip. The quality of the transport system is described by the effects of congestion on travel conditions. The measure refers to the congestion experienced by users and includes the duration of waiting, and the total trip time due to congestion. The rationale of taking the trip as the relevant unit of analysis is that trip-making behaviour such as route choices and mode and departure-time choices are based on the characteristics of the entire trip.

The mean journey time between given locations yield the average speed on the selected routes.

Unit of the indicators

Minutes

Indicator-related objectives

Reduce congestion by 5% until 2006
Reduce congestion by 10% until 2010

Critical aspects of the objectives

The road congestion problem is an example of a self-reinforcing process with feedback loops stimulating car use. Policies aimed at reducing road traffic congestion and improving speeds lead to a further proliferation of the system. Therefore any congestion policy should contain travel speeds within economically tolerable limits.

Less congestion expressed by lower journey times and increasing average speeds means to make travelling by car more attractive.

More car use because of decreased journey times means more negative effects on environment-related, social-related, mobility behaviour-related and road traffic-related objectives. Hence the achievement of the TELLUS objectives becomes more difficult.

Methods of measurement

The indicator "mean journey times" is a direct indicator. In addition the indicator allows the calculation of the journey vehicle speed, average vehicle speed, low journey speed, excessive journey time, and accuracy of timekeeping as derived indicators.

The indicator "mean journey times" is obtained directly from traffic surveys.

Source of data and analysis

The data are collected by the survey team of RATB and by the RAR Research Department, and they are analyzed by working group of WP 5, WP11 as well as RAR Research Department.

Time table to collect and analyse the data

Retrospective view from 2000 till 2004 for WP5 and month 17 and 41 for WP11 for their specific aspects and a continuous monitoring of vehicle speed during the TELLUS project.

Development of the indicator value

Work package 5.5

Unirii Square area belong to the inner city ring region and is located at about half kilometre of the "point zero" which represents the Bucharest's urban centre, being characterised by an important infrastructure development and by an accentuated architectural heterogeneousness.
The placement of the lab was established considering different factors such as: accessibility of the electrical supply, visibility, avoidance of the different interference sources related to the parked vehicles along the street, pedestrians and operators safety and the security of the measurement instruments - Figure 1.

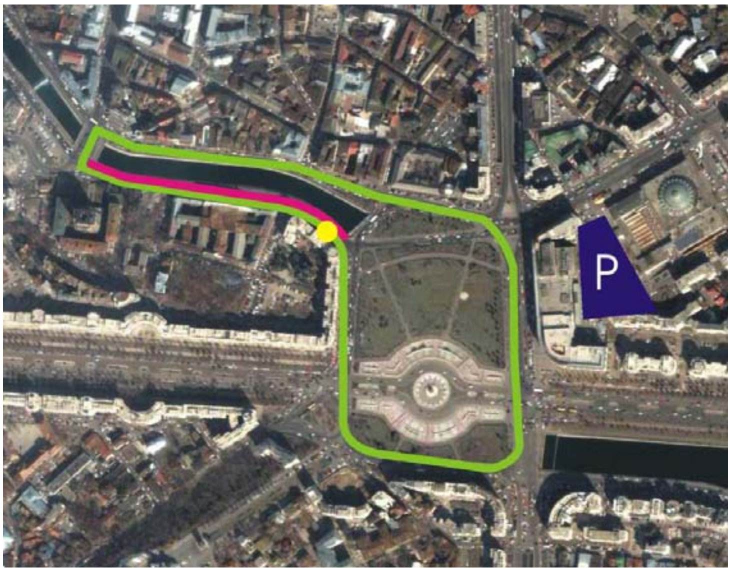


Figure 1 *– General map of the Unirii Square infrastructure. The placement of the RAR lab is marked with yellow dot. Red route = 360m, green route = 1855m. The blue area represents the new parking.*

The spatial coordinates which defines the measurement point for the air quality measurements were:
- distance from the nearest building façade – 8m;
- height of the measurement device admission point – 1.8m
- distance from the major crossroad (Unirii Square) – 40m;
- distance from the median axle of the nearest lane – 4.5m;
- distance from the pavement – 3m.

Other dimensional elements of the infrastructure:
- number of the lanes: 6 (3 per way);
- street width: 24m;

- northern pavement width: 6m;
- southern pavement width: 11m.

The two ways are segregated along 64m by the Dambovita River with the due pedestrians' infrastructures.
All the measurements were carried out on sunny days and without traffic incidents.

1st period: 2001 – 2002 - there were carried out 4 measurements as follows: 2 in October 2001 and the other 2 in February 2002 on Monday and Tuesday. The results were:

2'6" – along the red route (360m);

2nd period: 14 -16 of June 2005 - were carried out 19 representative measurements. The average vehicles speed was:

2'41" – along the red route (360m);

Workpackage 11.4 and 11.5

The surveys to determine the mean journey time (and the all indicators derived) were carried out between March – May 2003 in 11 RATB's lines, which cover the entire area of the city, as follows:

- 5 bus routes
- 3 tram routes
- 1 light rail route
- 2 trolleys routes.

For each route the measurements were split in 4 ranges: 07:00 – 09:00, 10:00 – 12:00, 15:00 – 17:00 and 18:00 – 20:00 in order to cover the peaks and the time between them.
The results are:

- **buses: 32'36";**
- **trolleys: 41'20";**
- **trams: 39'52";**
- **light rail: 27'51".**

Relation to other indicator systems

Study (institution or country)	**Proposed Indicator with regard to the issue**
METEOR (EU: CIVITAS Initiative)	- Daily trip length (peak and off peak) - Average vehicle speed (peak and off peak)
TERM	Average journey length and time per person, by mode and purpose (work/education, business, shopping, leisure, holidays).
MAESTRO	- mean journey time - journey vehicle speed - low journey speed - excessive journey time - accuracy of timekeeping

References

EEA: Are we moving in the right direction? Indicators on transport and environment integration in the EU. TERM 2000. Environmental issues series No 12. Copenhagen 2000.
METEOR (2002): WP4 Project Impact Evaluation. Task 4.1. Evaluation Guidelines
TRR: Maestro guidelines, January 2000, Table F-7: Indicators: Urban sector
RAR:Traffic and Air Pollution indicators for the Unirii Square area – Bucharest, 2000 - 2005

TELLUS objective evaluation

Indicator Fact Sheet for TELLUS objective "reduce congestion"

Indicators: average vehicle speed, journey vehicle speed, low journey speed (trip-related congestion measures)

Context, Description of the indicator

The indicators "average vehicle speed, journey vehicle speed, low journey speed" are derived indicators and reflect the phenomenon congestion.

The unit of observation is the trip. The quality of the transport system is described by the effects of congestion on travel conditions. The measure refers to the congestion experienced by users and includes the duration of waiting, and the total trip time due to congestion. The rationale of taking the trip as the relevant unit of analysis is that trip-making behaviour such as route choices and mode and departure-time choices are based on the characteristics of the entire trip.

The mean journey time between given locations yield the average speed on the selected routes.

Unit of the indicators

Km/hr (derived)

Indicator-related objectives

Reduce congestion by 5% until 2006
Reduce congestion by 10% until 2010

Methods of measurement

All three indicators are derived indicators, being calculated considering the distance between the two points of measurement and the necessary time to travel between these points.

Source of data and analysis

The data are collected by the survey team of RATB and by the RAR Research Department, and they are analyzed by working group of WP 5, WP11 as well as RAR Research Department.

Time table to collect and analyse the data

Month 6 and 42 for WP5 and month 17 and 41 for WP11 for their specific aspects and a continuous monitoring of vehicle speed during the TELLUS project

Development of the indicator value

Workpackage 5.5

- average vehicle speed

1st period: 2000 – 2004

10,28 km/h – along the red route (360m);
14,50 km/h – along the green route (1855m).

2nd period: 14 -16 of June 2005

8,05 km/h – along the red route (360m);
11,2 km/h – along the green route (1855m).

In 2005 the average vehicle speed along the red route was with approx. 22% lower than between 2001 and 2002.
Because the traffic flow values during the 2000 – 2005 are kept between the same limits with a very small increase, about 1%, the reasons for the very important decreasing of the average speed must be found in other causes. These are the introduction of access restriction in historical centre together with the construction of the parking in the area which leads to diminish the street width along the research lane due to the illegal parking, as well as the increase of disorderly in traffic and the indiscipline of pedestrians.
A solution for traffic fluidisation and directly for increasing the speed would be a better correlation of traffic lights. On the other hand the Municipality foresees to build other 3 parking garages around this area in the next future.

- **low journey speed**

1st period:

8,20 km/h – along the red route (360m);

2nd period:

5,31 km/h – along the red route (360m);

During the second period the journey speed was with 34% lower than in the first period. This means the considerations related to the average vehicle speed remain unchanged.

Workpackages 11.4 and 11.5

- journey vehicle speed:

- **buses: 16,38 km/h;**
- **trolleys: 13,76 km/h;**
- **trams: 14,52 km/h;**
- **light rail: 20,98 km/h.**

- average vehicle speed:

- **buses: 16,0 km/h;**
- **trolleys: 11,6 km/h;**
- **trams: 14,6 km/h;**
- **light rail: 14,6 km/h.**

- yearly average vehicles speed:

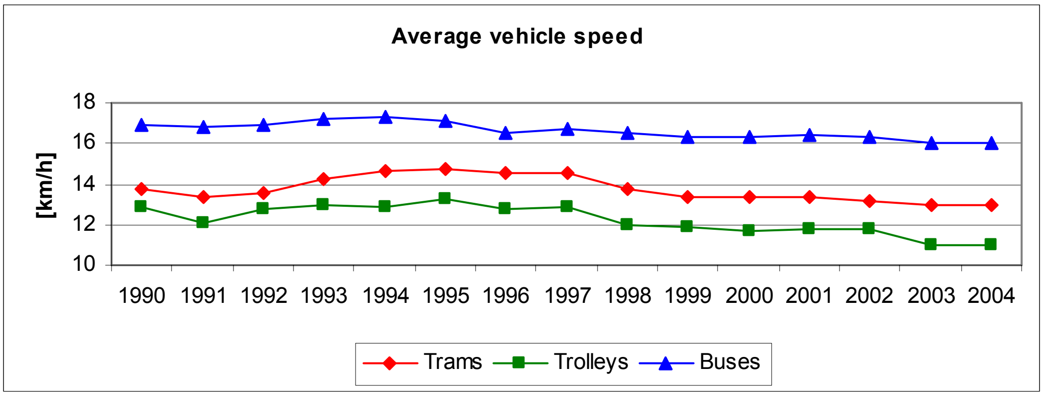


Figure 2: *Yearly variation of the public transport vehicle average speed*

Comparing the journey speed and the average network speed, significant differences can be seen only for trolleys and for light rail, 18,6% and, respectively 43,7%.
The continuously increase of cars number as well as illegal parking along the street, together with the dependency of trolleys by the infrastructure could be the main causes of decreasing the average speed.
The light rail has segregated lane and green light, thus the average speed increases significantly.
Along the years, the public transport vehicle average speed (Figure 2) decrease significantly. The main reasons are the increase of the cars number, illegal parking along the streets and the general traffic disorder.
The solutions to improve this parameter could be the introduction of segregated lanes for public transport, prioritisation and construction of parking facilities.

Relation to other indicator systems

Study (institution or country)	**Proposed Indicator with regard to the issue**
METEOR (EU: CIVITAS Initiative)	- Daily trip length (peak and off peak) - Average vehicle speed (peak and off peak)
TERM	Average journey length and time per person, by mode and purpose (work/education, business, shopping, leisure, holidays).

References

EEA: Are we moving in the right direction? Indicators on transport and environment integration in the EU. TERM 2000. Environmental issues series No 12. Copenhagen 2000.
METEOR (2002): WP4 Project Impact Evaluation. Task 4.1. Evaluation Guidelines
TRR: Maestro guidelines, January 2000, Table F-7: Indicators: Urban sector
RAR:Traffic and Air Pollution indicators for the Unirii Square area – Bucharest, 2000 - 2005

TELLUS objective monitoring and evaluation

Indicator Fact Sheet for TELLUS objective "reduce congestion"

Indicator: excessive journey time

(trip-related congestion measures)

Context, Description of the indicator

This indicator represents the difference the proportion between the longest transit time and the mean transit time (measured for the same transit number) and the mean transit time.
The indicator is dependant on the traffic conditions.

Unit of the indicators

Minutes, seconds

Indicator-related objectives

Reduce congestion by 5% until 2006
Reduce congestion by 10% until 2010

Methods of measurement

Data are obtained directly from traffic surveys.

Source of data and analysis

RAR Research Department

Time table to collect and analyse the data

Month 6 and 42.

Development of the indicator value

1st period: from the 4 representative measurements carried out, the mean journey time was 126" and the maximum journey time was 158". Accordingly, the excessive journey time was:
25,4% – along the red route (360m);
2nd period: from the 19 representative measurements carried out, the mean journey time was 161" and the maximum journey time was 244". Accordingly, the excessive journey time was:
51,5% – along the red route (360m);

Considering the variation of the average speed analyzed above and taking into account that the transit time is inversely proportional with it, is normally that the evolution of supplementary transit time to have an increasing trend, from 25,4% to 51,5%. Furthermore, the increase of the transit time is more significant than the decrease of speed in 2005 comparing with 2000 – 2004 due to the number of measurements which was bigger in 2005.

Relation to other indicator systems

Study (institution or country)	**Proposed Indicator with regard to the issue**
METEOR (EU: CIVITAS Initiative)	- -
TERM	-
MAESTRO	- excessive queue time
	-

References

TRR: Maestro guidelines, January 2000, Table F-7: Indicators: Urban sector
RAR:Traffic and Air Pollution indicators for the Unirii Square area – Bucharest, 2000 - 2005

TELLUS objective monitoring and evaluation

Indicator Fact Sheet for TELLUS objective "reduce congestion"

Indicator: accuracy of timekeeping

(trip-related congestion measures)

Context, Description of the indicator

The "accuracy of timekeeping" represents the percentage of services arriving within a given interval of timetable.

For the ex-ante evaluation the indicator was calculated for the RATB's network, and for ex-post evaluation it was calculated for a bus route which experimented the in a pilot study the GPS system.

Unit of the indicator

%

Indicator-related objectives

Reduce congestion by 5% until 2006
Reduce congestion by 10% until 2010

Methods of measurement

In the first stage the data were obtained by the survey operators directly from the vehicles involved. In the second stage, the data were obtained on basis of records made by the localisation system.

Source of data and analysis

RATB Operational Department

Time table to collect and analyse the data

Month 6 and 42.

Development of the indicator value

From the data analyse the accuracy of timekeeping for the RATB network was:

7,19%

For the bus route considered in the pilot study a decrease of the deviation in the bus schedule was observed. The results of the two measurements are:

	Ex-ante	Ex-post	Relatively difference
End of the route no.1	0,0%	5,71%	5,71%
End of the route no.2	5,26%	2,63%	-2,63%

Only the introduction of the GPS doesn't solve the problem of keeping the bus schedule, it only high-lights this problem, quantify it and helps to find the solutions
Knowing the place and the moment of deviation through the data provided by the GPS the measures to correct the causes can be taken: reanalyzing the bus schedule, and together with other actors involved, measures for traffic fluidisation or prioritisation for public transport vehicles.

Relation to other indicator systems

Study (institution or country)	**Proposed Indicator with regard to the issue**
METEOR (EU: CIVITAS Initiative)	- -
TERM	-
MAESTRO	- accuracy of timekeeping

References

TRR: Maestro guidelines, January 2000, Table F-7: Indicators: Urban sector

TELLUS objective monitoring and evaluation
Indicator Fact Sheet for TELLUS objective "reduce congestion"
Indicator: excessive queue length (trip-related congestion measures)

Context, Description of the indicator

This queue length represents the number of vehicles waiting for green light, counted from the traffic light to the last car.

The excessive queue length represents the difference between the maximum queue length and the average queue length.

Unit of the indicator

Meters

Indicator-related objectives

Reduce congestion by 5% until 2006
Reduce congestion by 10% until 2010

Methods of measurement

Data are obtained from traffic survey.

Source of data and analysis

RAR Research Department

Time table to collect and analyse the data

Month 6 and 42.

Development of the indicator value

1st period: from the 4 representative measurements carried out, the average queue length was 137m and the maximum queue length was 160m. Accordingly, the excessive queue length was:

23 m – along the red route (360m);

2nd period: from the 19 representative measurements carried out, the average queue length was 146m and the maximum queue length was 360m. Accordingly, the excessive journey time was:

214 m – along the red route (360m);

Relation to other indicator systems

Study (institution or country)	**Proposed Indicator with regard to the issue**
METEOR (EU: CIVITAS Initiative)	- -
TERM	-
MAESTRO	- excessive queue length

References

TRR: Maestro guidelines, January 2000, Table F-7: Indicators: Urban sector
RAR:Traffic and Air Pollution indicators for the Unirii Square area – Bucharest, 2000 - 2005

TELLUS objective monitoring and evaluation

Indicator Fact Sheet for TELLUS objective "reduce congestion"

Indicator: excessive queue time
(trip-related congestion measures)

Context, Description of the indicator

This indicator represents the time spent queuing at a specific point.

Unit of the indicators

Minutes, seconds

Indicator-related objectives

Reduce congestion by 5% until 2006
Reduce congestion by 10% until 2010

Methods of measurement

Data are obtained directly from traffic surveys.

Source of data and analysis

RAR Research Department

Time table to collect and analyse the data

Month 6 and 42.

Development of the indicator value

- **Queue time**

1st period::

1'36" – along the red route (360m);

2nd period :

1'34" – along the red route (360m);

Relation to other indicator systems

Study (institution or country)	**Proposed Indicator with regard to the issue**
METEOR (EU: CIVITAS Initiative)	- -
TERM	-
MAESTRO	- excessive queue time

References

TRR: Maestro guidelines, January 2000, Table F-7: Indicators: Urban sector
RAR: Traffic and Air Pollution indicators for the Unirii Square area – Bucharest, 2000 - 2005

TELLUS objective monitoring and evaluation

Indicator Fact Sheet for TELLUS objective "reduce congestion"

TELLUS Key Indicator: parked vehicle counting

Context, Description of the indicator

The parking problem in Unirii Square should be analyzed from two aspects: one is the lack of parking facilities in the central area combined with the densely populated residential area and the other is on-street parking, which reduces effective traffic capacity and sometimes can serve as an obstacle for the vehicles and pedestrians traffic.

Unit of the indicators

Veh. No.

Indicator-related objectives

Reduce congestion by 5% until 2006
Reduce congestion by 10% until 2010

Methods of measurement

In order to find the on-street parking conditions, a parking survey was carried out during the period from mid-October to the end of November, 1999. The main purpose of the survey was to estimate the approximate parking demand in the central area. The survey area is the central area illustrated in Figure 3. The survey was made by simply counting the total number of parked cars on the street during the hours 9:30-11:30 and 17:00-18:30. Since business and commercial facilities are concentrated in this area, the morning survey period time may be regarded as the peak parking time.

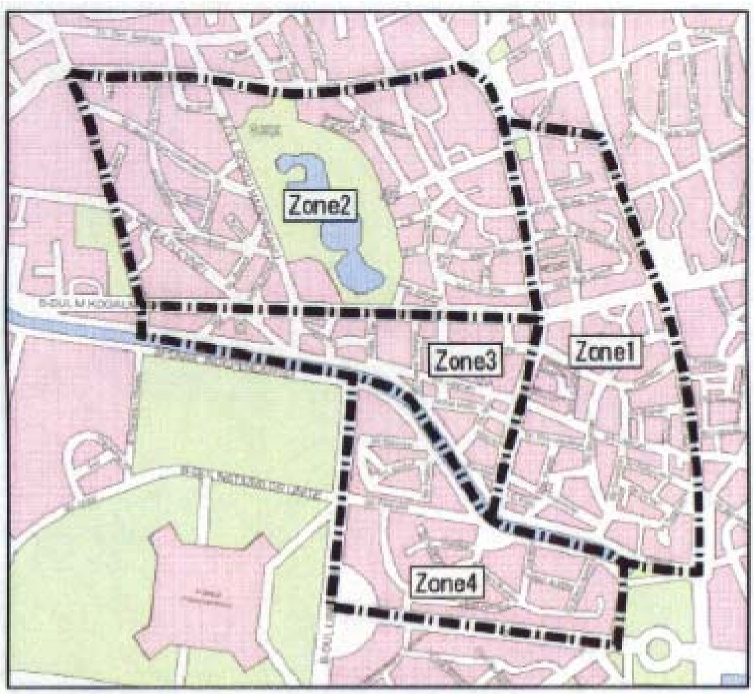


Figure 3: *Car parking survey area*

Source of data and analysis

The data are collected by operator survey team from RATB and are analyzed by WG of WP 5.5.

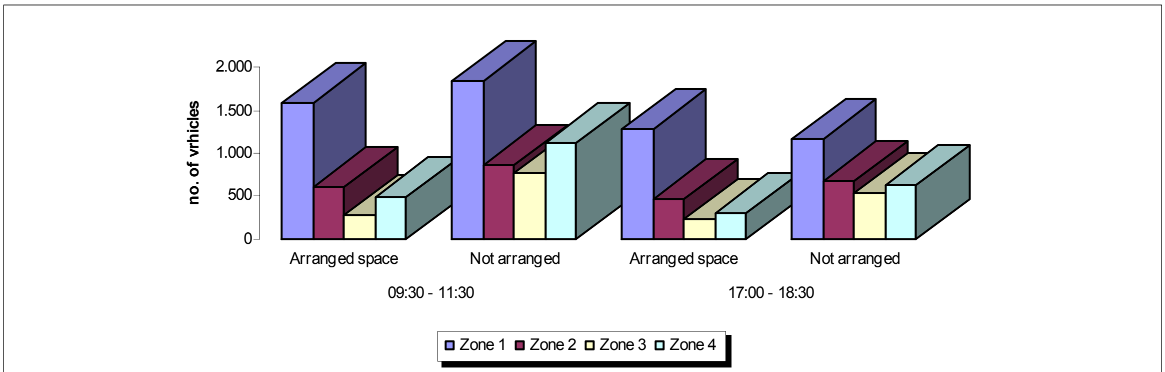
Time table to collect and analyse the data

Month 6

Development of the indicator value

The following points are noticed from the survey results:

- the total numbers of the on-street parked cars is more than 7.500. Among the four zones, the zone 1 shows the highest parking demand;
- the number of parked cars in non-arranged areas is higher than in the arranged area for zones 2, 3 and 4
- the difference between the morning and the afternoon hours could appear due to the people employed in the area.



Source: Bucharest Masterplan

Figure 4: *Number of vehicles parked in the city centre*

Figure 5 shows the future parking developments in the city centre.
The green area represents the access restriction, which has already begun to be introduced, and the hatched areas represent the future underground parkings. This area corresponds to the Zones 1, 2 and 3 considered in the ex-ante evaluation.
The red area represents the new parking.

Figure 5: *The access restriction area*

Relation to other indicator systems

Study (institution or country)	**Proposed Indicator with regard to the issue**
METEOR (EU: CIVITAS Initiative)	- -
TERM	-

References

JICA: Bucharest Masterplan

TELLUS objective monitoring and evaluation

Indicator Fact Sheet for TELLUS objective "reduce congestion"

TELLUS Key Indicator: traffic level rating

Context, Description of the indicator

This indicator is important to find the attitude of local inhabitants and the wanted direction is to increase.

Unit of the indicators

%

Indicator-related objectives

Reduce congestion by 5% until 2006
Reduce congestion by 10% until 2010

Methods of measurement

Qualitative opinion survey within the demonstration area. The survey was carried out on a sample of 1270 persons – pedestrians and drivers

Source of data and analysis

The data are collected by operator survey team from RATB and are analyzed by WG of WP 5.5.

Time table to collect and analyse the data

Month 6.

Development of the indicator value

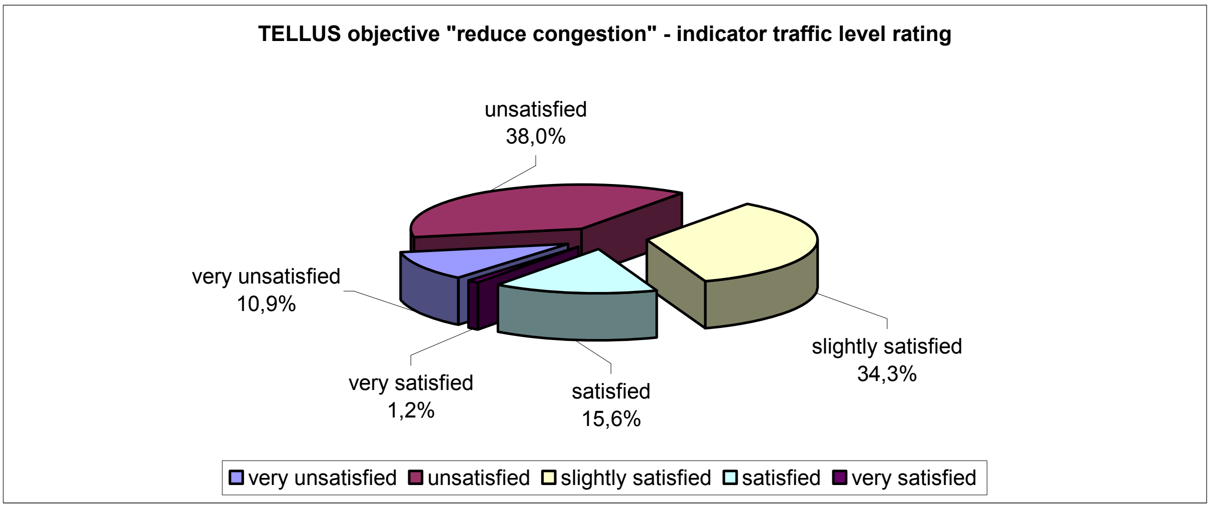


Figure 6: *Traffic level rating within the study area*

The survey revealed a high degree of unsatisfied persons related to the traffic in the study area – 10,9% of the interviewees are very unsatisfied and 38% are unsatisfied.

This showed the need for reorganising the traffic in the central area of the city, by construction of new parking and a better traffic management.

Relation to other indicator systems

Study (institution or country)	**Proposed Indicator with regard to the issue**
METEOR (EU: CIVITAS Initiative)	- -
TERM	-
MAESTRO (TTR)	traffic level rating

References

TTR – Maestro guidelines, January 2000

TELLUS objective monitoring and evaluation

Indicator Fact Sheet for TELLUS objective "reduce congestion"

TELLUS Key Indicator: traffic levels

Context, Description of the indicator

Central area, including Unirii Square, is characterised by an intense traffic level along the routes with overtaking capacity. As example, only along the analysed section, the average traffic level is over 80.000 veh/day, which represents more than 10% of vehicles registered in Bucharest. This phenomenon is as much unfavourable as in the central area, due to its multiple functions (head offices, commercial centres, cinemas, theatres etc.), is creating the highest density of traffic all day long, existing as follows and a high population density (residents and pedestrians),

As a main characteristic, it was observed that daily traffic levels are generally balanced along the two lanes (quasi-symmetrical traffic),

Unit of the indicators

Vehicle/day, vehicle/hour

Indicator-related objectives

Reduce congestion by 5% until 2006
Reduce congestion by 10% until 2010

Methods of measurement

Quantitative traffic survey.

Source of data and analysis

RAR Research Department

Time table to collect and analyse the data

Month 6 and 42.

Development of the indicator value

1st period - 2000-2004: there was made 7 observations along 24 hours of the traffic flow, the main indicators being showed in the table below:

Year	Month	Day	Daily traffic level [veh/day]	Maximum hourly traffic level [veh/h]	Peak hour
2000	May	Thursday	85.070	6.240	13
	August	Marti	79.040	5.970	11
2001	June	Thursday	89.680	6.380	9
	September	Thursday	86.010	6.470	12
2002	April	Monday	83.610	5.830	13
2003	August	Wednesday	78.100	5.760	13
2004	September	Wednesday	88.270	6.350	10

The daily traffic flow resulted from the measurements during the summer holidays (August 2000 and August 2003) are lower then usually with about 10%. The maximum hourly traffic level is during noon (10-13). These values don't have the tendency to increase, being set in a range of ±10% which corresponds with the measurements error.
The average value of maximum hourly traffic level is:

84.254 veh/24h

If the summer months are excluded, the average value of maximum hourly traffic level is:

86.528 veh/24h

2nd period - 2005: there was made 7 observations along 24 hours (one week) of the traffic level, the main indicators being showed in the table below:

Year	Month	Day	Daily traffic level [veh/day]	Maximum hourly traffic level [veh/h]	Peak hour
2005	May	Monday	83.560	5.850	18
		Tuesday	88.390	6.610	9
		Wednesday	83.760	5.810	9
		Thursday	87.350	6.020	9
		Friday	93.110	6.080	20
		Saturday	74.000	4.960	13
		Sunday	57.800	3.960	14

It can be seen that the traffic level during weed-end (Saturday and Sunday) are significantly lower than the average working day, 15% on Saturday, respectively 33% on Sunday.
The average value of maximum hourly traffic flow is:

81.139 veh/24h

In order to compare the first period, when any measurement wasn't carried out on week-end, and the second period, an average of the daily traffic flow was calculated:

87.234 veh/24h

The evolution of the average daily traffic flow shows an increase with 1%

Relation to other indicator systems

Study (institution or country)	**Proposed Indicator with regard to the issue**
METEOR (EU: CIVITAS Initiative)	- -
TERM	
EST	-
MAESTRO (TTR)	traffic level
CSD	-
NFP (Switzerland)	-
BPI/PRR	-

References

TRR: Maestro guidelines, January 2000, Table F-7: Indicators: Urban sector

RAR: Traffic and Air Pollution indicators for the Unirii Square area – Bucharest, 2000 – 2005

TELLUS objective monitoring and evaluation

Indicator Fact Sheet for TELLUS objective "reduce air pollution"

TELLUS Key Indicator: CO level

Context, Description of the indicator

The transport sector is a major source of air pollution, and the dominant source in urban areas. Exposure to air pollution can cause adverse health effects, most acute in children, asthmatics, and the elderly, and can damage vegetation and materials (notably, the cultural heritage).

Within the transport sector, road traffic is the most important contributor to urban air pollution. While national and EU regulations aimed at automobile emission reductions have resulted in considerably lower emissions per vehicle, the continuous expansion of the vehicle fleet is partly offsetting these improvements.[1]

CO is produced by the incomplete burning of carbon in fuels. High concentrations of CO occur along roadsides in heavy traffic, particularly at major intersections. The health effects of CO vary depending on the length and intensity of exposure and the health of the individual. Effects of CO include dizziness, headache, fatigue, visual impairment, reduced work capacity, reduced manual dexterity, and poor learning ability.[2]

Unit of the indicators

$\mu g/m^3$

Indicator-related objectives

Reduce air pollution to levels below national and EC directives until 2006

Methods of measurement

The base of the air quality evaluation was a recent and complete emissions inventory within the study area, which includes, besides the traffic data as a mobile ground source, the industrial major sources and the other ground stationary sources (diffuses). The general approach consisted in the first major phase of urban modelling describes the urban general level of pollution, followed by the second phase of street modelling in the vicinity of route infrastructure from Unirii Square, based on traffic and pollution measurements carried out by the mobile laboratory of RAR.

In this purpose a sequential usage procedure was considered, in cascade (chained), by applying two computerised operational models for the traffic pollution: OML-Multi (5.00) for urban pollution and WinOSPM (5.0.64) for street contribution.

Source of data and analysis

Registrul Auto Roman (Romanian Automotive Authority) – Research Department

Legal basis, standard values, political objectives

[1] EEA (2000), p. 27.
[2] See METEOR (2002), Annexes

EU directive: Directive 2000/69/EC of the European Parliament and of the Council

	Averaging period	**Limit value**	**Margin of tolerance**	**Date by which limit value is to be met**
Limit value for the protection of human health	Maximum daily 8-hour mean	10 mg/m^3	6 mg/m^3 on 13 December, reducing on 1 January 2003 and every 12 months thereafter by 2 mg/m^3 to reach 0% by 1 January 2005	1 January 2005

National directives

The new Normative (harmonized with European Union Directive) regarding the settlement of the limit values, threshold values and the criteria and measurement methodology related to the SO_2, NO_2, NOx, PM_{10}, $PM_{2,5}$, Pb, CO, O_3 from the environment, in force from 1st of January 2003 (Water and Environment Protection Ministry Disposition No. 592/25th June 2002).

	Averaging period	**Limit value**	**Margin of tolerance**	**Date by which limit value is to be met**
Limit value for the protection of human health	Maximum daily 8-hour mean	10 mg/m^3	6 mg/m^3 (60%) on 1st January 2004, reducing on 1 January 2005 and every 12 months thereafter by 2 mg/m^3 to reach 0% by 1 January 2007	1 January 2007

Law no. 3/2001 for ratification of the Kyoto Protocol, which settles the legal frame for control and monitoring of the greenhouse gas emissions.

Time table to collect and analyse the data

Retrospective view from 2001 to 2004.

Development of the indicator value

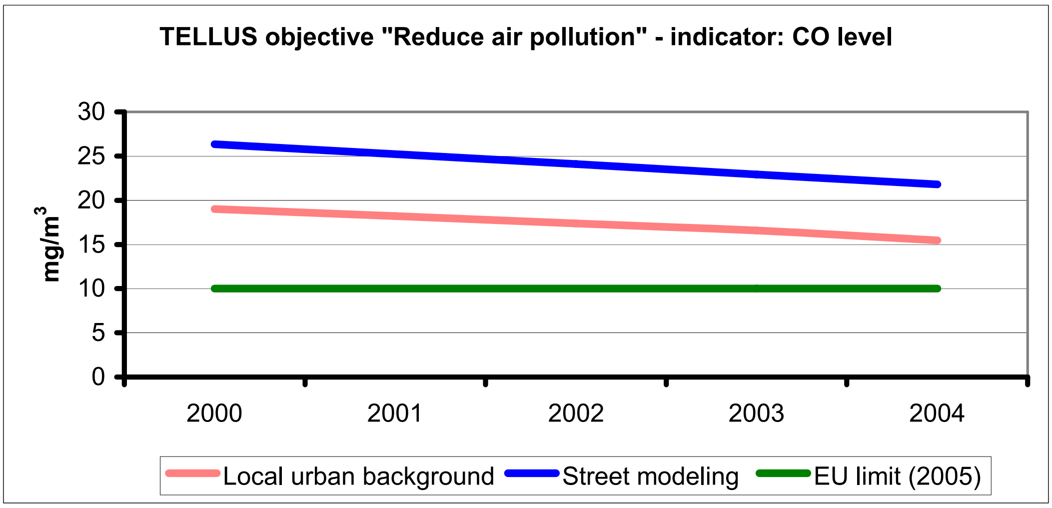


Figure 7: *CO level variation*

Relation to other indicator systems

Study (institution or country)	**Proposed Indicator with regard to the issue**
METEOR (EU: CIVITAS Initiative)	- -
TERM	annual emissions of CO in kilo tonnes: emission reduction by 26% between 1990 and 2000
EST	-
Maestro guidelines (TTR)	- CO levels
CSD	-
NFP (Switzerland)	-
BPI/PRR	-

References

RAR: Air quality evaluation in the vicinity of the route infrastructure within Unirii Square – Bucharest, 2000 - 2004

Water and Environment Protection Ministry Disposition No. 592/25th June 2002

TELLUS objective monitoring and evaluation

Indicator Fact Sheet for TELLUS objective "reduce air pollution"

Indicator: level of SO_2

Context, impacts

The transport sector is a major source of air pollution, and the dominant source in urban areas. Exposure to air pollution can cause adverse health effects, most acute in children, asthmatics, and the elderly, and can damage vegetation and materials (notably, the cultural heritage).

Within the transport sector, road traffic is the most important contributor to urban air pollution. While national and EU regulations aimed at automobile emission reductions have resulted in considerably lower emissions per vehicle, the continuous expansion of the vehicle fleet is partly offsetting these improvements.[3]

Unit of the indicator

$\mu g/m^3$

Indicator-related objectives

Reduce air pollution to levels below national and EC directives until 2006

Methods of measurement

See CO level

Source of data and analysis

RAR Research Department

Legal basis, standard values, political objectives

EU directive:
Council Directive 1999/30/EC

[3] EEA (2000), p. 27.

	Averaging period	Limit value	Margin of tolerance	Date by which limit value is to be met
Limit value for the protection of human health	1 hour	350 µg/m^3 not to be exceeded more than 24 times a calendar year	43% on the entry into force of this Directive, reducing on 1 January 2004 and every 12 months thereafter by equal annual percentages to reach 0% by 1 January 2007	1 January 2007
Limit value for the protection of human health	24 hours	125 µg/m^3 not to be exceeded more than 3 times a calendar year	no	1 January 2007
Limit value for the protection of ecosystems	Calendar year and winter time (1st October – 31st March)	20 µg/m^3	no	1 January 2007

National directives

The new Normative (harmonized with European Union Directive) regarding the settlement of the limit values, threshold values and the criteria and measurement methodology related to the SO_2, NO_2, NOx, PM_{10}, $PM_{2,5}$, Pb, CO, O_3 from the environment, in force from 1st of January 2003 (Water and Environment Protection Ministry Disposition No. 592/25th June 2002).

	Averaging period	Limit value	Margin of tolerance	Date by which limit value is to be met
Limit value for the protection of human health	1 hour	350 µg/m^3 not to be exceeded more than 24 times a calendar year	43% on the entry into force of this Directive, reducing on 1 January 2004 and every 12 months thereafter by equal annual percentages to reach 0% by 1 January 2007	1 January 2005
Limit value for the protection of human health	24 hours	125 µg/m^3 not to be exceeded more than 3 times a calendar year	none	1 January 2005
Limit value for the protection of ecosystems	Calendar year and winter time (1st October – 31st March)	20 µg/m^3	none	1 January 2005

Law no. 3/2001 for ratification of the Kyoto Protocol, which settles the legal frame for control and monitoring of the greenhouse gas emissions.

Time table to collect and analyse the data

Retrospective view from 2001 to 2004.

Development of the indicator value

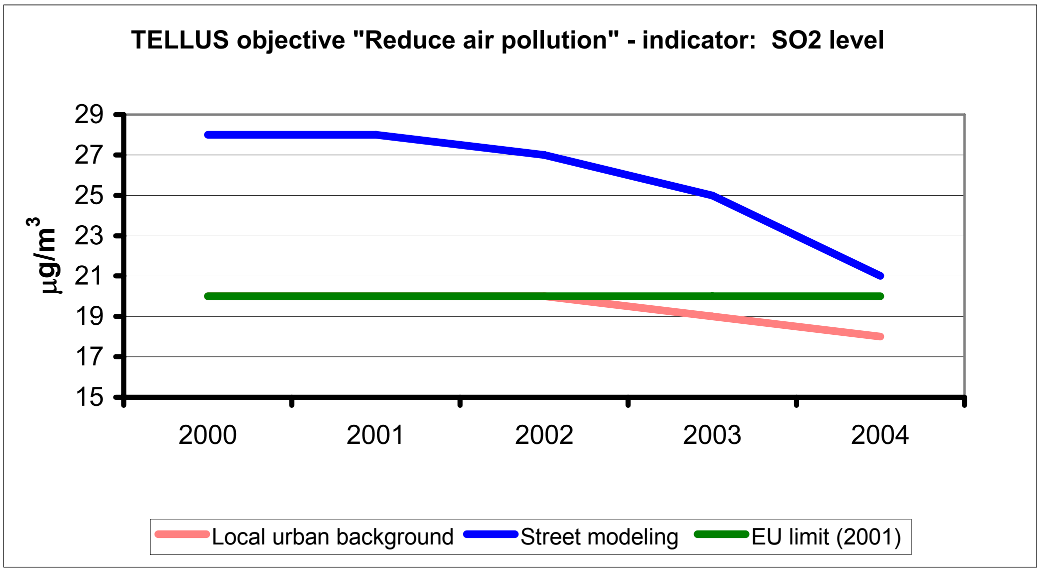


Figure 8: *SO_2 level variation*

Relation to other indicator systems

Study (institution or country)	**Proposed Indicator with regard to the issue**
METEOR (EU: CIVITAS Initiative)	-
TERM	- annual emissions of SO2 in kilo tonnes: emission reduction by 36% between 1990 and 2000 - exceedance days of air quality limit values of SO2 in urban areas: air quality directives have resulted in emission reductions and decreasing ambient concentrations; number of days on which the EU limit value was exceeded decreased between 1990 and 1999; Since 1995 80% of the population has not been exposed to SO2 concentrations above the limit value during more than three days
EST	-
CSD	-
NFP (Switzerland)	-
BPI/PRR (UBA Germany)	-

References

EEA: Are we moving in the right direction? Indicators on transport and environment integration in the EU. TERM 2000. Environmental issues series No 12. Copenhagen 2000.

METEOR (2002): WP4 Project Impact Evaluation. Task 4.1. Evaluation Guidelines.

RAR: Air quality evaluation in the vicinity of the route infrastructure within Unirii Square – Bucharest, 2000 - 2004

Water and Environment Protection Ministry Disposition No. 592/25th June 2002

TELLUS objective monitoring and evaluation

Indicator Fact Sheet for TELLUS objective "reduce air pollution"

Indicator: level of PM_{10}

Context, impacts

The transport sector is a major source of air pollution, and the dominant source in urban areas. Exposure to air pollution can cause adverse health effects, most acute in children, asthmatics, and the elderly, and can damage vegetation and materials (notably, the cultural heritage).

Within the transport sector, road traffic is the most important contributor to urban air pollution. While national and EU regulations aimed at automobile emission reductions have resulted in considerably lower emissions per vehicle, the continuous expansion of the vehicle fleet is partly offsetting these improvements.[4]

Particulate matter is primarily emitted by diesel engines. Because of the adverse health effects Particulate matter is the most severe air pollution problem affecting large cities. Particulate matter irritates the membranes of the respiratory system, causing increased respiratory symptoms and diseases like cancer.

Current trends show that gasoline is more and more substitute by diesel because of the higher energy efficiency.

Unit of the indicator

µg/m³

Indicator-related objectives

Reduce air pollution to levels below national and EC directives until 2006.

Critical aspects

EC directives are not sufficient to prevent serious health risks.

Methods of measurement

See CO level considerations.

Source of data and analysis

RAR Research Department

Legal basis, standard values, political objectives

EU directive: Council Directive 1999/30/EC

[4] EEA (2000), p. 27.

	Averaging period	Limit value	Margin of tolerance	Date by which limit value is to be met
Stage 1				
24-hour limit value for the protection of human health	24 hours	50 μg/m^3 PM_{10}, not to be exceeded more than 35 times a calendar year	50% on the entry into force of this Directive, reducing on 1 January 2001 and every 12 months thereafter by equal annual percentages to reach 0% by 1 January 2005	1 January 2005
Annual limit value for the protection of human health	Calendar year	40 μg/m^3 PM_{10}	20% on the entry into force of this Directive, reducing on 1 January 2001 and every 12 months thereafter by equal annual percentages to reach 0% by 1 January 2005	1 January 2005
Stage 2(1)				
24-hour limit value for the protection of human health	24 hours	50 μg/m^3 PM_{10}, not to be exceeded more than 7 times a calendar year	To be derived from data and to be equivalents on the Stage 1 limit value	1 January 2010
Annual limit value for the protection of human health	Calendar year	20 μg/m^3 PM_{10}	50% on 1 January 2005 reducing every 12 months thereafter by equal annual percentages to reach 0% by 1 January 2010	1 January 2010

(1) Indicative limit values to be reviewed in the light of further information on health and environmental effects, technical feasibility and experience in the application of Stage 1 limit values in the Member States.

National directives

The new Normative (harmonized with European Union Directive) regarding the settlement of the limit values, threshold values and the criteria and measurement methodology related to the SO_2, NO_2, NOx, PM_{10}, $PM_{2,5}$, Pb, CO, O_3 from the environment, in force from 1st of January 2003 (Water and Environment Protection Ministry Disposition No. 592/25th June 2002).

	Averaging period	Limit value	Margin of tolerance	Date by which limit value is to be met
Stage 1				
24-hour limit value for the protection of human health	24 hours	50 μg/m^3 PM_{10}, not to be exceeded more than 35 times a calendar year	50% on the entry into force of this Directive, reducing on 1 January 2001 and every 12 months thereafter by equal annual percentages to reach 0% by 1 January 2007	1 January 2007
Annual limit value for the protection of human health	Calendar year	40 μg/m^3 PM_{10}	20% on the entry into force of this Directive, reducing on 1 January 2001 and every 12 months thereafter by equal annual percentages to reach 0% by 1 January 2007	1 January 2007
Stage 2(1)				
24-hour limit value for the protection of human health	24 hours	50 μg/m^3 PM_{10}, not to be exceeded more than 7 times a calendar year	To be derived from data and to be equivalent on the Stage 1 limit value	1 January 2010
Annual limit value for the protection of human health	Calendar year	20 μg/m^3 PM_{10}	50% on 1 January 2005 reducing every 12 months thereafter by equal annual percentages to reach 0% by 1 January 2010	1 January 2010

(1) Indicative limit values to be reviewed in the light of further information on health and environmental effects, technical feasibility and experience in the application of Stage 1 limit values in the Member States.

Law no. 3/2001 for ratification of the Kyoto Protocol, which settles the legal frame for control and monitoring of the greenhouse gas emissions.

Time table to collect and analyse the data

Retrospective view from 2001 to 2004.

Development of the indicator value

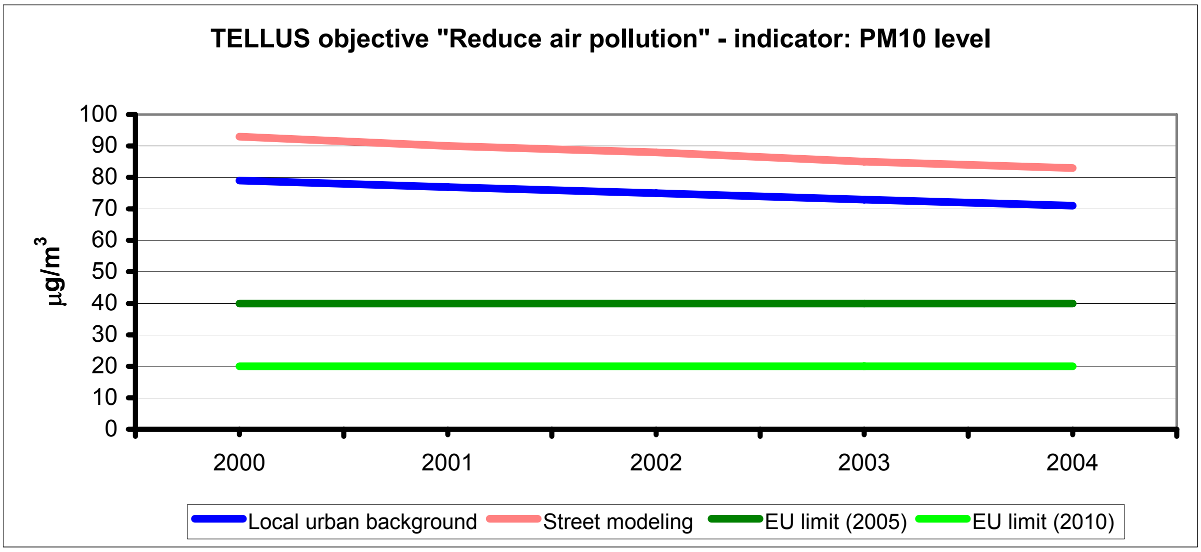


Figure 9: *PM_{10} level variation*

Belonging to the inner ring of the city, Unirii Square represents one of the most crowded area by the traffic flow point of view, not only from Bucharest but also from the country.
Evaluation of the air quality and the pollutant impact produced by the traffic in this area along 2000 – 2004, showed frequently exceeding of the limit values specified by the EU Directives for nearly all pollutants analysed.
Regarding the yearly variation of the polluting level it can be point out a continuous and progressive decrease, this tendency being assigned to the renewing of the fleet as well as to the improvement of the fuel quality in this period.

Relation to other indicator systems

Study (institution or country)	**Proposed Indicator with regard to the issue**
METEOR (EU: CIVITAS Initiative)	Particulate levels (PM_{10} concentration on an annual basis, in ppm or g/m³)
TERM	emissions of PM in kilo tonnes
EST	-
CSD	-
NFP (Switzerland)	PM_{10} level at the places of residence (% excessively burdened people)
BPI/PRR	-

References

EEA: Are we moving in the right direction? Indicators on transport and environment integration in the EU. TERM 2000. Environmental issues series No 12. Copenhagen 2000.
METEOR (2002): WP4 Project Impact Evaluation. Task 4.1. Evaluation Guidelines
RAR: Air quality evaluation in the vicinity of the route infrastructure within Unirii Square – Bucharest, 2000 - 2004
Water and Environment Protection Ministry Disposition No. 592/25th June 2002

TELLUS objective monitoring and evaluation

Indicator Fact Sheet for TELLUS objective "reduce noise"

Indicator: Noise level

Context, impacts

Recent studies showed that hard and circulatory disease is significantly raised by a traffic noise above 65-70 dB(A). This happens due to the raise of the pulse and blood pressure. The digestion decrease and muscular tonus raised, this symptoms being a sign of stress.
Traffic noise in urban areas, where the speeds don't exceed 60km/h, comes mainly from the engines end exhaust installations and in areas where the speeds exceeds 60 km/h it comes from the interaction of tyres with road.
Public transport represents also an important noise source. Presence of the surface public transport vehicles increase the noise pollution, especially along the main roads, where more lanes – buses, trolleybuses and trams – are added to the usual traffic.[5]
According to experts noise levels from transport which do not impair health should be in all places below 65 dBA and in residential areas below 55 dBA during the day and below 45 dBA at night.[6]

Unit of the indicator

dB(A)

Indicator-related objectives

Reduce noise to levels below national and EC directives until 2006

Methods of measurement

i) Left side: high building (see page IX of your environmental report);
ii) Right side: lower buildings (see page X of your environmental report);
iii) Distances (as preliminarily estimated in our meeting):

- pedestrian walk (left side) 4 m	
- 3 traffic lanes	10 m (3x 3.3m)
- safety space to channel	1 m
- channel	25 m
- safety space	1m
- 3 traffic lanes	10 m (3x 3.3m)
- pedestrian walk (right side)	3 m
- close to traffic lights	< 50m

iv) Noise will be calculated for both street sides – in front of the building and on the level of 1.75m (ear level):
v) Traffic data: according to table 14 (environment report) (02.09.2004)

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5 Bucharest Environment Protection Agency, Annual report 2002, p.67
6 OECD (1999), p. 23.

vi) Selected hour: peak hour: 10 hours
vii) Traffic lane AI, AII, A III: lanes close to environmental measure point;
viii) Traffic lane DI, DII, D III: lanes far from environmental measure point;
ix) P: percentage of trucks

Source of data and analysis

Legal basis, standard values

National directives

Ministry of Health Order No. 538/1997 which stipulates the emplacement of the economical objective with source of noise and vibration and dimensioning of the sanitary protected areas will be made thus within the protected territory the continuous equivalent acoustic level (Leq), measured at a distance of 3 m in front of the building an 1,5 m above the ground, should not exceed 50 dB(A) and sound curve 45. During the nights (22:00 – 6:00) should be lower than day values with 10db(A).

Time table to collect and analyse the data

Development of the indicator value

Left side (A)		Right side (D)	
Traffic lane A I (p=2,2%)	72,83	Traffic lane D I (p=2,8%)	75,26
Traffic lane A II (p=2,2%)	70,64	Traffic lane D II (p=2,8%)	72,9
Traffic lane A III (p=2,2%)	68,6	Traffic lane D III (p=2,8%)	70,82
Traffic lane D III (p=2,8%)	61,5	Traffic lane A III (p=2,2%)	60,02
Traffic lane D II (p=2,8%)	61,06	Traffic lane A II (p=2,2%)	59,56
Traffic lane D I (p=2,8%)	60,65	Traffic lane A I (p=2,2%)	59,15
Noise at the left side at the building, about 1.75 m (ear level) (in dB(A)	76,2	Noise at the right side at the building, about 1.75 m (ear level) (in dB(A)	78,3

The calculation is an estimate because detailed data on location of traffic lights, exact measurements of buildings, street and channel characteristics are not yet considered. The noise level is influenced by the traffic and its composition, the traffic lights (they cause stopping and starting noises), the surface of the street, the characteristic of the buildings and the reflection within the street canyon and so on. Nevertheless, the results from the 'about-calculation' show the direction. The peak hour traffic is with 2,660 (A) / 3,530 (D) cars and 60 (A) / 100 (D) trucks/buses relatively high. The estimated noise level on both sides of the Splaiul Independentei is with about 76 and 78 (dB(A)) relatively high.
The noise calculation could be made for each hour and as well for different years if detailed data are available.

Relation to other indicator systems

Study (institution or country)	**Proposed Indicator with regard to the issue**
METEOR (EU: CIVITAS Initiative)	Noise perception (% of population exposed, broken down into 5 different perception bands of L_{day} and L_{night}, classification: absolutely dissatisfied, partly dissatisfied, absolutely satisfied, partly satisfied, neither satisfied nor dissatisfied)
NFP (Switzerland)	Noise level at the places of residence (% excessively burdened people)
BPI/PRR (UBA Germany)	Percentage of inhabitants exposed to noise levels under 65 dB(A) at days, percentage of inhabitants exposed to noise levels under 45 dB(A) at nights, resp. percentage of road length
TERM (EU: European Environment Agency)	- percentage of population exposed to 4 transport noise exposure levels (in L_{dn}): 45<55 dB, 55-65 dB, 65-75 dB and >75 dB - percentage of population highly annoyed by traffic noise from various transport modes
EST (OECD)	Noise levels from transport

References

EEA: Are we moving in the right direction? Indicators on transport and environment integration in the EU. TERM 2000. Environmental issues series No 12. Copenhagen 2000.

METEOR (2002): WP4 Project Impact Evaluation. Task 4.1. Evaluation Guidelines

OECD, Dist.: 24-Sep-1999: Environmentally Sustainable Transport. Final Report on Phase II of the OECD EST Project. Volume 1: Synthesis Report.

TELLUS objective monitoring and evaluation

Indicator Fact Sheet for TELLUS objective "reduce traffic related CO_2 emissions"

Indicator: CO_2 emissions

Context and impacts

Directly and indirectly, fossil fuels provide the energy for almost all transport activities. Transport is the fastest growing energy consumer in the EU.[7] Carbon dioxide emissions (CO_2) are also a surrogate for the use of fossil fuels. CO_2 emissions from transport in the EU increased by 15% between 1990 and 1998. Road transport is the main cause of this increase and contribute 84% of CO_2 emissions from the transport in 1998[8].

The global impact of fossil fuel use is that the atmospheric concentrations of the greenhouse gases carbon dioxide, methane (CH_4) and nitrous oxide (N_2O) have grown significantly. Carbon dioxide is the transport emission of greatest concern in respect of global impacts on account of its likely involvement in climate change.

From R.A.T.B. point of view is important to know the contribution of RATB's vehicle fleet emissions to the whole traffic related CO_2 emissions and what measures can be taken in order to reduce CO_2 emissions.

Unit of the indicator

Tonnes

Indicator-related objectives

Reduce traffic related CO_2 emissions by 5% until 2006
Reduce traffic related CO_2 emissions by 10% until 2010

Methods of measurement

As base of calculation for the emission inventory in COPERT III emission model was considered the following parameters:

- Fleet (per type: passenger cars, light duty vehicles <3,5t, heavy duty vehicle, buses, mopeds, motorcycles)
- fuel consumption and type
- traffic conditions
- emission factors
- meteorological conditions.
- mileage distribution: 51,4% urban, 48,6% rural

Source of data and analysis

RAR – Research Department

[7] EEA (2001), p. 14.
[8] EEA (2001), p. 14.

RATB – International Project Department

Political objectives

Romanian Environment Ministry – "Clean Romania" Programme 2002 – This programme aims to focus all the forces from social and political frame: government, syndicates, local public administrations etc. for initiation and implementation of a concrete project as to offer the population a clean environment.

Time table to collect and analyse the data

Retrospective view: From 2001 until the end of the TELLUS project: the data is calculated using COPERT III model for every year.

Development of the indicator value

From the simulation resulted a quantity of **1.790.458 t** of CO_2 resulted from traffic in 2001. In year 2004, according to the mathematical model, the quantity was **2.168.691** t of CO_2 which means a 20% increase.

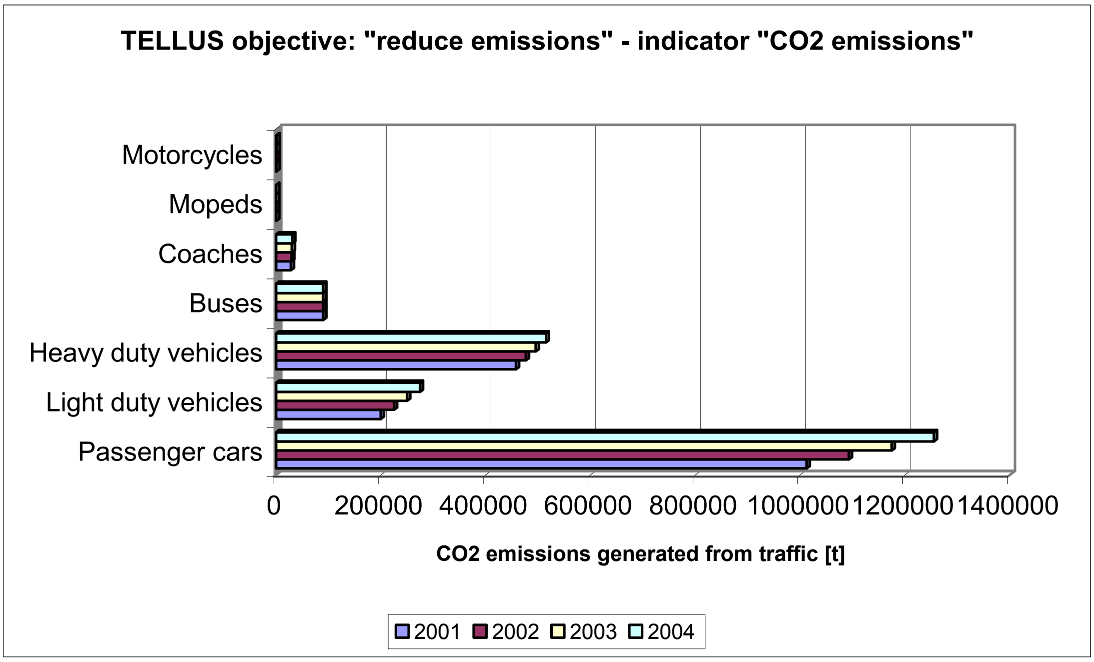

Figure 10: *CO_2 emissions generated from traffic*

The main contribution to the CO_2 emissions belongs to the private cars – 56% in 2001 and 58% in 2004.

On the second place, the heavy duty vehicles have as well an important contribution to the CO_2 emissions. The introduction of access restriction for this kind of vehicles or usage of light duty vehicles for goods transportation can lead to an attenuation of the CO_2 emissions.

Relation to other indicator systems

Study (institution or country)	**Proposed Indicator with regard to the issue**
METEOR (EU: CIVITAS Initiative)	CO_2 emissions (CO_2 per vkm (g/km) derived)
TERM (EU: European Environment Agency)	annual emissions of CO_2 from transport in million tonnes: emission reduction by 8.5%; emission cuts in first half of decade due to economic downturn; since 1995 emissions have been rising; in 2000 emissions reduced slightly; main driving forces are volumes of passenger and freight transport and related energy consumption
EST (OECD)	CO_2 emissions
CSD (Germany)	CO_2 emissions (t/a)
NFP (Switzerland)	Emissions of greenhouse gases (in t CO_2 equivalent/a)
BPI/PRR	CO_2 emissions (t/inhabitant/a)

References

Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (Hrsg.): Nachhaltige Entwicklung in Deutschland. Entwurf eines umweltpolitischen Schwerpunktprogramms. Bonn 1998.

EEA: Are we moving in the right direction? Indicators on transport and environment integration in the EU. TERM 2000. Environmental issues series No 12. Copenhagen 2000.

EEA: Indicators tracking transport and environment integration in the European Union. TERM 2001. Copenhagen 2001.

METEOR (2002): WP4 Project Impact Evaluation. Task 4.1. Evaluation Guidelines

OECD, Dist.: 24-Sep-1999: Environmentally Sustainable Transport. Final Report on Phase II of the OECD EST Project. Volume 1: Synthesis Report.

TELLUS objective monitoring and evaluation

Indicator Fact Sheet for TELLUS objective "reduce NOx emissions"

TELLUS Key Indicator: NOx emissions

Context, impacts

As a result of the introduction of catalytic converters NOx emissions of the transport sector fell significantly during the last years. Nevertheless the transport sector is the main polluter of NOx and its percentage of the total NOx emissions increases continuously.

NOx emissions are an important contributor to acid rain, acid deposition, and eutrophication, which can alter the ecosystems of water bodies, forests and meadowlands. In addition to local and regional effects, Nox emissions can have global effects in that nitrogen oxides can contribute to global warming, directly and indirectly. In Europe, transportation accounts for 60 per cent of NOx emissions.[9]

In many parts of Europe, critical loads for acidification and eutrophication are exceeded by a factor of two to four, indicating that ecosystems are at risk of being damaged and their sustainability endangered.[10] Consideration of depositions of nitrogen compounds across Europe in relation to critical loads has indicated that for many areas even reduction of NOx emissions from transportation to zero would not be sufficient to meet critical loads for deposition of nitrogen compounds in many areas. Critical levels for ozone would also be exceeded.[11]

Because of the TELLUS objective "reduce NOx emissions from heavy traffic" the indicator "NOx emissions" relates primarily to heavy traffic. For the sake of completeness and comparability NOx emissions from the whole road traffic will be assessed.

Unit of the indicator

Tonnes

Indicator-related objectives

Reduce NOx emissions from public transport by 5% until 2006
Reduce NOx emissions from public transport by 10% until 2010

Methods of measurement

As base of calculation for the emission inventory in COPERT III emission model was considered the following parameters:

- fleet (per type: passenger cars, light duty vehicles <3,5t, heavy duty vehicle, buses, mopeds, motorcycles)
- fuel consumption and type
- traffic conditions
- emission factors

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[9] OECD 1999, p. 13.
[10] A critical load has been defined as "the highest deposition of a compound that will not cause chemical changes leading to long-term harmful effects on ecosystem structure and function."
[11] OECD 1999, p. 21

- meteorological conditions.
- mileage distribution: 51,4% urban, 48,6% rural

Source of data and analysis

RAR – Research Department
RATB – International Project Department

Political objectives

Romanian Environment Ministry - “Clean Romania” Programme 2002 – This programme aims to focus all the forces from social and political frame: government, syndicates, local public administrations etc. for initiation and implementation of a concrete project as to offer the population a clean environment.

Time table to collect and analyse the data

Retrospective view: 2001. The Emission data of the following years will be collected until the end of the TELLUS project.

Development of the indicator value

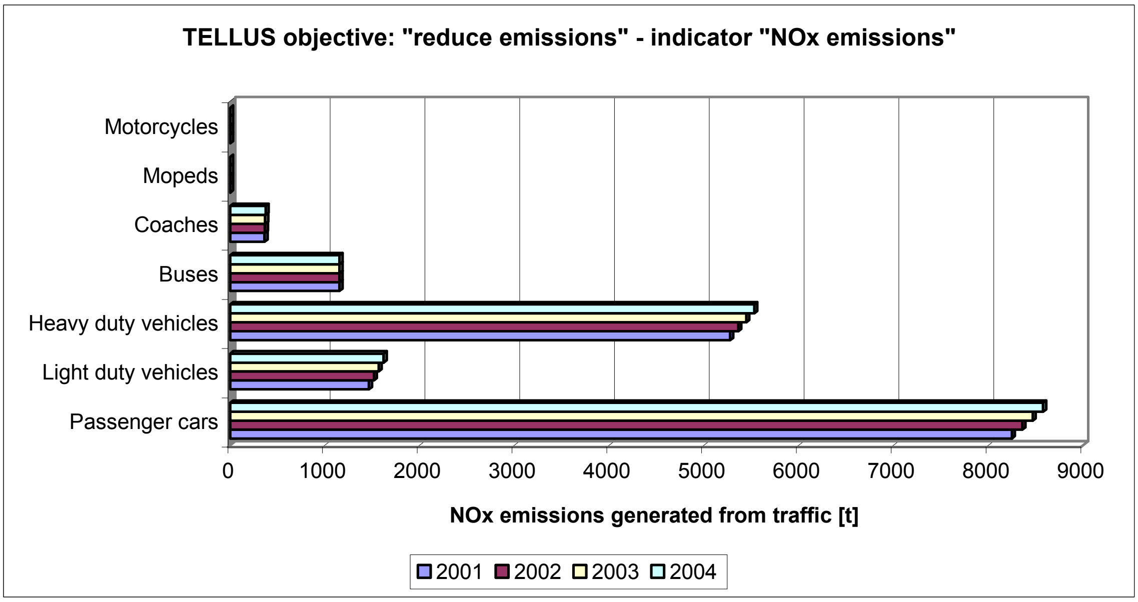


Figure 11: *NO_x emissions generated from traffic*

From the simulation resulted a quantity of **16.511 t** of NO_x resulted from traffic in 2001. In year 2004, according to the mathematical model, the quantity was **17.264** t of NO_x which means a 4,6% increase. The main contribution to the NO_x emission belongs to the passenger cars, but it corresponds with 50% from the total emissions in 2001 as well in 2004.

Relation to other indicator systems

Study (institution or country)	**Proposed Indicator with regard to the issue**
METEOR (EU: CIVITAS Initiative)	NOx emissions (NOx per vkm (g/km) derived)
TERM (EU: European Environment Agency)	emissions of NOx in kilo tonnes: emission reduction by 14% between 1990 and 2000; NOx is the key pollutant to acidifying substances, ozone precursors and secondary particulate emissions

References

EEA: Are we moving in the right direction? Indicators on transport and environment integration in the EU. TERM 2000. Environmental issues series No 12. Copenhagen 2000.

METEOR (2002): WP4 Project Impact Evaluation. Task 4.1. Evaluation Guidelines

OECD, Dist.: 24-Sep-1999: Environmentally Sustainable Transport. Final Report on Phase II of the OECD EST Project. Volume 1: Synthesis Report.

TELLUS objective monitoring and evaluation

Indicator Fact Sheet for TELLUS objective "increase public transport use"

Indicators: average modal split, passenger capacity, patronage, no. of trips, fare structure, information sites, information accessibility, passenger satisfaction level, vehicle capacity

Description of the indicators, relevance

Growing attractiveness of public transport should be mirrored in increasing numbers of passenger kilometres and passengers.

Unfortunately prices for public transport are increasing while those for car use remain about constant. Alternatives to the car are often lacking or less attractive, or unadapted to new urban patterns. Initiatives like improved services are emerging to counter this trend but these have as yet had little impact.[12]

Total passenger kilometres travelled in the EU have more than doubled over the period 1970-1997. The average growth rate of 2.8% per year is even higher than the average growth in GDP over the same period (2.5% per year).[13]

Passenger car transport is the mode most used in the EU: over the period from 1980 to 1997 its share rose from 66 to 77%.

Shares of rail are decreasing, as the train is often not considered to be an attractive option despite increasing congestion on roads, partly because of inefficient rail services.

The modal shares of walking and cycling have fallen. Yet half of all car trips are less than 6 km, for which cycling is often faster than driving (in urban areas); 10 % are less than 1 km, an ideal walking distance.[14]

Motorised vehicles are a burden on the environment in terms of emissions, noise, congestion. Further more the amount of space in the cities for alternative usage decreases. The performance of measures should be monitored through the dynamics of modal split. The modal split of non motorised modes should increase in the context of successful demonstration measures.

Unit of the indicator

Passenger/transport mode, Passenger kilometres/day, Passengers/day, Trips/day(year), index, no. of sites, %, index, vkm/day

Indicator-related objectives

Increase of public transport use by 5% until 2006
Increase of public transport use by 10% until 2010

Critical aspects

[12] EEA (2001), p. 23.
[13] EEA (2000), p. 48.
[14] EEA (2001), p. 23.

Increasing numbers of passenger kilometres and passengers are not necessarily combined with decreasing numbers in car kilometres and are consequently not appropriate to show a trend towards more sustainability.

Methods of measurement

R.A.T.B. operational data and opinion surveys carried out in collaboration with RATB's Operational Department and Marketing Department.
Since 2002 the RATB's web page has contained a questionnaire related to the "Passenger satisfaction level". This questionnaire consists of 17 questions, among them being the "fare structures" and "passengers information". To this questionnaire, around 350 persons respond yearly. The satisfaction index is situated between [-1;1].

Source of data and analysis

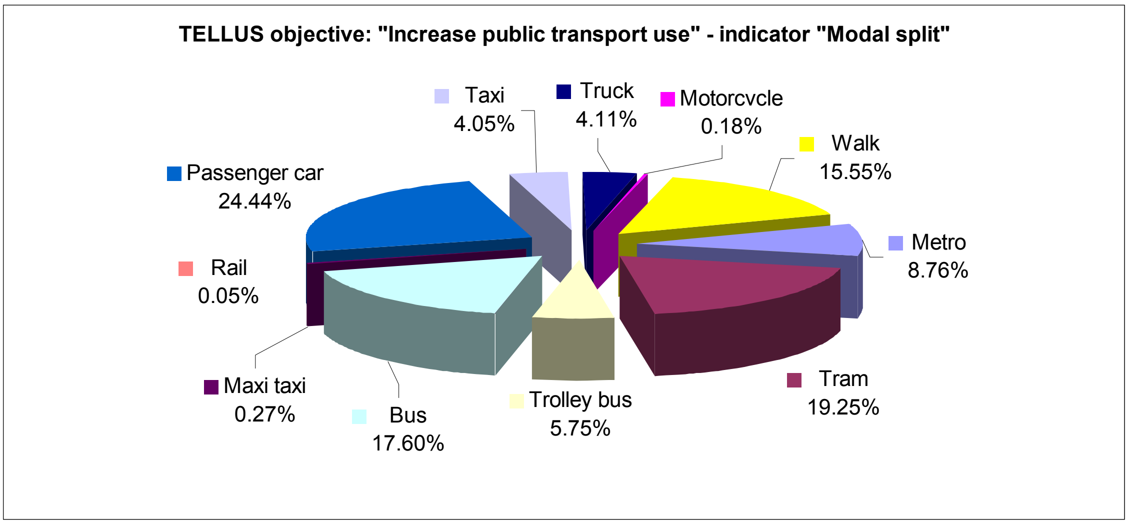
RATB – International Project Department
- Operational Department
- Marketing and Commercial Department

Time table to obtain and analyse the data

Retrospective view: since 1994 until end of the TELLUS project, the data will be obtained yearly.

Development of the indicator value

Average modal split



Source: Bucharest Masterplan

***Figure 12:** Average modal split in Bucharest*

Figure 12 shows the number of trips by mode. The number of trips by the public transport mode (metro, tram, trolley, bus, maxi-taxi) was 2.961.387, which accounts for 51,4% of the total trips by all transport modes. On the other hand, the number of trips by passenger cars was 1.408.834, or 24,4%.

Passenger capacity, patronage, total number of trips

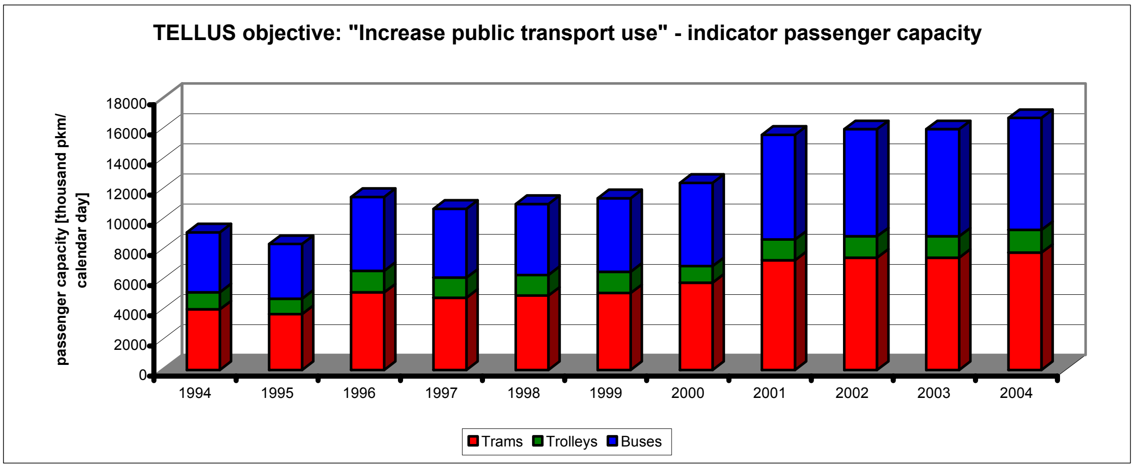


Figure 13:

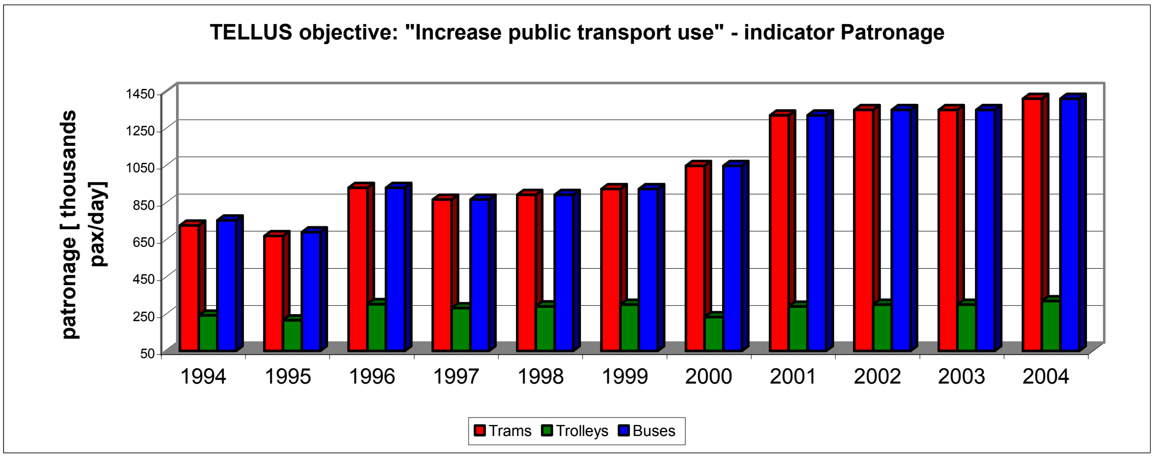


Figure 14:

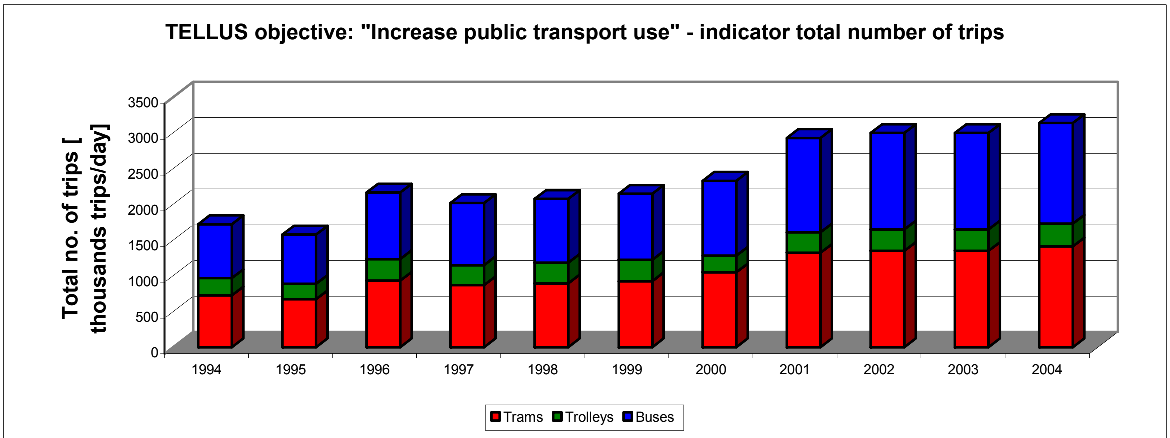


Figure 15:

The graphs show a continuously and significant evolution of the passenger capacity, patronage and the total number of trips during the TELLUS project.

Fare structures

The actual fare structures mostly satisfy the passengers need – an index of 0,08 for 2002 and 0,17 for 2004.

To increase the satisfaction level a supplementary survey is needed in order to adapt more the fare offer to the population needs. The diversification of the fare structure and the introduction of a common fare (for metro and for surface public transport) can increase the attraction of public transport in the next future. The increase of the index in 2004 can represent a result of the campaign for the introduction of a common fare RATB – Metrorex.

Information sites

At the beginning of the TELLUS project – 2001 in Bucharest were **5 information centres**. At the end of the project their number almost tripled – **14 information centres** of which 4 are also Public Relation Centres.

Information accessibility

Despite of increasing the number of the information sites the population opinion related to the information accessibility still remains negative for 2004 having an index -0,43, being a little bit higher than in 2002, respectively -0.48. Thus, more information points are needed and a specific survey can provide additionally data related to the information required.

Vehicle capacity

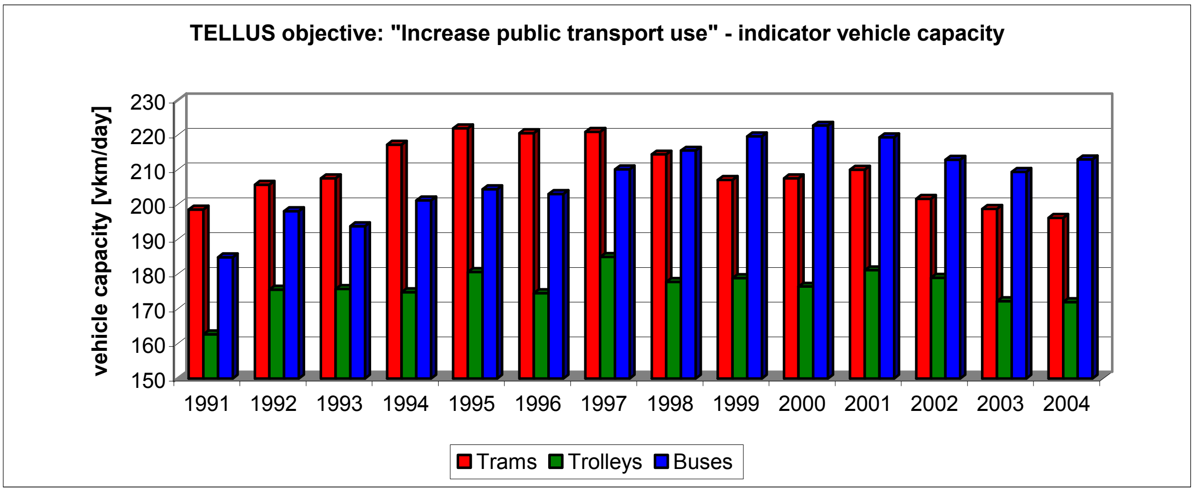


Figure 16:

The vehicle capacity decrease during the latest years, but considering the increase of passenger's number, means a better fleet management, adapted to the passenger needs.

Passenger satisfaction level

The passenger satisfaction level decrease during latest years from -0.04 in 2002 to -0.05 in 2004. These results cannot be interpreted as a failure of the project, because the questionnaire contains issues which are not related to the project: traffic safety, interchange time, relations between passengers and RATB's personnel, security, comfort etc.

Relation to other indicator systems

Study (institution or country)	**Proposed Indicator with regard to the issue**
METEOR (EU: CIVITAS)	-
TERM (EU: European Environment Agency)	Passenger-km travelled by mode of transport

References

EEA: TERM 2001. Indicators tracking transport and environment integration in the European Union. Copenhagen 2001.

TELLUS objective monitoring and evaluation

Indicator Fact Sheet for TELLUS objective "improvement of intra-organisational co-operation at the city level"

Indicator: Quality of intra-organisational co-operation

Description of the indicators, relevance

A successful transport and environmental policy requires a good co-operation between the different stakeholders. With regard to TELLUS the risks that could affect a successful implementation of the demonstration measures could be reduced by a good co-operation between the relevant departments and institutions. Not only the TELLUS project can benefit from an improved intra-organisational co-operation but also further projects in the field of sustainable transportation for example the development of integrated policy strategies for the transport sector.

Unit of the indicator

Qualitative terms (Analysis of qualitative interviews)

Indicator-related objectives

Improvement of intra-organisational co-operation

Methods of measurement

Bucharest will carry out a survey in 2005.
During the TELLUS project lifetime, a matrix with all the departments from RATB's, Municipality and other organisation which are/will be involved in the project will be defined. Based on this matrix a specific survey will be developed. The questionnaire will be filled using the method of direct interviews.

Source of data and analysis

The survey is carried out and analysed by the TELLUS evaluation team.

Development of the indicator value

Categories	Development
Information exchange	+
Process speed	+
Available channels	±
Cooperation	+

++ evident improved; + moderate improvement; ± no change

Time table to obtain and analyse the data

Survey and analyse of the data in 2005.

Relation to other indicator systems

Study (institution or country)	**Proposed Indicator with regard to the issue**
METEOR (EU: CIVITAS)	-
NFP (Switzerland)	-
BPI/PRR (UBA Germany)	The indicator is a question which can be proved by a simple yes/no statement. The question with regard to intra-organisational co-operation is: Exists an integrated transportation development plan?
TERM (EU: European Environment Agency)	inter-ministerial co-operation approach to transport and environment by ad hoc studies and questionnaires
EST (OECD)	-
CSD (Germany)	- -

References

TELLUS objective monitoring and evaluation

Indicator Fact Sheet for TELLUS objective "Achievement of political and public awareness for TELLUS"

Indicator: media exposure

Indicator: events organised

Description of the indicators, relevance

Acceptance of transport and environment policies correlates positively with availability of information and awareness of environmental problems. Public awareness and knowledge of environmental problems is therefore central to the development of appropriate transport policies.[15]

Political and public awareness for TELLUS has two meanings: awareness for the several *demonstration measures* of the TELLUS project and awareness for the *TELLUS objectives* on the city level which should be reached by the implementation of the demonstration measures.

Awareness for demonstration measures: The better people are informed about the new measures the more likely they will take advantage of the measures and the better the measure performance will be.

Awareness for TELLUS objectives: Beside awareness for the demonstration measures TELLUS will also raise awareness for the necessity of a more environmentally friendly and a more efficient transportation system which takes into account the variety of consequences of the transport sector. These issues are expressed in the TELLUS objectives. Awareness for these issues raises the acceptance for integrated policy strategies too.

The better politicians are aware of such topics the better the chances of implementation of a sustainable transportation policy and planning will be.

Unit of the indicator

Analysis

Indicator-related objectives

Achievement of awareness

Methods of measurements

The assessment of the TELLUS objective is done by a media analysis. Following **media** are analysed:

- newspapers, transport journals, flyers,
- events and meetings,
- internet.

The analysis is done according to the following criteria:

- for **media exposure**: target groups, coverage (spatial, number of people reached), keynote of the article, internal-/external-initiated

[15] EEA (2000), p. 123.

- for **events organised:** local, national, international; internal or public meeting, number of participants.
- for **presentations given:** context of the presentation/kind of meeting where the presentation is given (local, national, international; internal or public meeting, number of participants), keynote of the presentation, speaker).

The issue of political awareness is checked out by looking on the integration of the TELLUS demonstration measures into local transport policy.

Source of data and analysis

Data collection and analysis is done by the dissemination WP team.

Time table to obtain and analyse the data

The collection of the relevant data is done continuously.

Development of the indicator value

Events organised	Media exposure
March 2002 – Presentation within the National Research Conference	March 2002 – Poster on TELLUS within the National Research Conference
November 2002 – Test site visit	April 2004 – TELLUS Poster
July 2003 – Press Conference – Public transport modernisation in Bucharest	April 2004 – TELLUS flyer – “Mobility in a cleaner city”
January 2004 – Workshop “Public Transport Integrated Management”, organized with RATB’s managers and Municipality representatives.	
April 2004 – Test site visit	
April 2004 – The 11th CODATU Congress	

Relation to other indicator systems

Study (institution or country)	**Proposed Indicator with regard to the issue**
METEOR (EU: CIVITAS)	Awareness level: knowledge of the new integrated measures on account of provided information. Data collection could be done by means of surveys (questionnaires or face to face interviews).
NFP (Switzerland)	-
BPI/PRR (UBA Germany)	-
TERM (EU: European Environment Agency)	Public awareness and attitude towards the environmental threats brought about by the transport sector.
EST (OECD)	-

References

EEA: Are we moving in the right direction? Indicators on transport and environment integration in the EU. TERM 2000. Environmental issues series No 12. Copenhagen 2000.

METEOR (2002): WP4 Project Impact Evaluation. Task 4.1. Evaluation Guidelines.