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PROFESSIONAL PAPER

Application of Modern Information Systems for More Efficient Removal of Parking Violators

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Abstract: PUC „Parking servis" Novi Sad, which has parking spaces organization and exploitation as its narrower activity, in its structure has the Transportation Office whose main task is the removal of parking violators by the order of a competent authority. In this paper Transportation Service's work organization, transport organization and potential upgrades in business conduct via modern information technologies, will, above all, be considered, as well as the roll of the Transportation Service inside the system of PUC „Parking servis", and it's contribution to the Company, from a financial aspect. Described income and cost data are based on the company's data of business conduct in 2013. Three main measure suggestions will be considered, all based on advanced use of information technologies, implementation of a dispatching unit, and suitable patrol unit- Vehicle of Observatory Purpose (VOP)- maximum, minimum, and real, type of advanced business management.

Key words: GPS, Modern information technologies, Organization of transport, removal of parking violators.

INTRODUCTION

Issues and goals of the paper

Public companies in Serbia are getting worse, in the sense of business conduct, due to various social irregularities and insufficient use of contemporary social achievements in the sphere of information systems, and insufficient effort on improving the management of each company.

In order to avoid this, and based on the example of PUC „Parking servis", Novi Sad, certain measures will be proposed to show potential income upgrades which the Company could actualize applying them in its business conduct, so that it remains sustainable (profitable) and consistent.

Research methodology

Key steps on which work research has been conducted are following:

- Possibilities of advanced GPS and GSM technologies use by the Transport Services work units,
- Integration of a dispatching centre and Vehicle of Opservatory Purpose (VOP units), as key factors of advanced GPS and GSM use.
- Transport Service income analysis,
- Transport Services potential future income analysis based on previous steps.

TECHNOLOGY OF IRREGULARLY PARKED VEHICLES REMOVAL

Information about irregularly parked vehicles are gathered from: citizens (tips), managers of parking control, communal inspectors, traffic inspectors, police officers on sight, vehicle owners and public intervention teams managers of Public Utility Companies, but also by personal insight of the special towing vehicles crews.

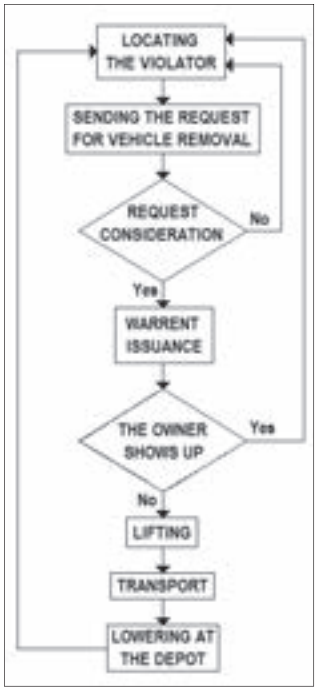

Figure 1. Process of a parking violator removal

All information concerning the necessity for vehicle removal, except those based on the crews personal insight, are forwarded to the vehicle admittance correspondent which based on those information send the Special Towing Vehicle (STV) crew on an intervention. Photographs of the vehicles in violation are delivered to the on-duty police officer seated on the Companies removed vehicles depot. Removal of vehicles by STVs, on any grounds, can only be authorized by a written warrant issued by an authorized law enforcer. The removal process is depicted on Figure1.

Table 1. Working performance of Transport Service in 2013 [1]

Month	All Removed Vehicles	Police	Communal inspection	Traffic inspection	Relocated	Distance travelled [km]	[km/ veh]
January	1042	825	172	0	45	12 695	12,2
February	898	727	114	0	57	11 352	12,6
March	961	881	51	0	29	13 331	13,9
April	851	745	66	0	40	12 670	14,9
May	868	615	165	4	84	11 465	13,2
June	726	565	71	0	90	11 323	15,6
July	819	460	236	0	123	12 482	15,2
August	501	341	121	0	39	9 274	18,5
September	785	551	166	0	68	11 959	15,2
October	1088	742	276	1	69	14 747	13,5
November	1080	817	207	0	56	13 717	12,7
December	1095	720	319	0	56	13 214	12,1
TOTAL	10 714	7 989	1964	5	756	148 229	13,8

TRANSPORT SERVICE BUSINESS ANALYSIS IN 2013.

It's necessary to review the business management of the Traffic Service, from natural and financial aspect. Table 1 gives insight to work performance of TS.

From Table 1 a conclusion emerges that the month with the highest number of removed vehicles is December ($N_{RVdec}^{2013} N_{RVdec}^{2013}$= 1095 veh), on the other hand the month with least vehicles removed is August (N_{RVavg}^{2013} N_{RVavg}^{2013} = 501 veh).

Average number of removed vehicle in 2013 is 893 vehicles. Coefficient of imbalance in the number of vehicles removed is defined by the relation between the highest number of removed vehicles and the average number of removed vehicles of the same period in time, and in this situation it equals:

$$\eta_{veh}^{2013} = \frac{N_{RVdec}^{2013}}{\bar{N}_{RV}} = \frac{1.095}{893} = 1,23 \quad (1)$$

$\eta_{veh}^{2013} \eta_{veh}^{2013}$ - Coefficient of imbalance in the number of vehicles removed in 2013, $N_{RVdec}^{2013} N_{RVdec}^{2013}$ - highest number of removed vehicles (December, 2013); $\bar{N}_{RV} \bar{N}_{RV}$- average number of removed vehicles in 2013.

As it can be seen in Table 1, total number of vehicles removed in 2013 is $* N_{RV}^{2013} * N_{RV}^{2013}$= 10.714 vehicles. For further calculation reduced number of vehicles removed will be used, based on the subtraction of the number of Relocated vehicles from the total number of vehicles removed in 2013, due to the difference in the type of service.

Kilometrage realized by STVs in the discussed period of time is $AK_{2013} AK_{2013}$= 148 229 km. Necessary upgrades in the work of the Transport Service will be based on reducing the number of redundant kilometers i.e. those kilometers travelled by STVs in order to find parking violators.

From the financial aspect[2] insight in costs and incomes must be given in order to deduce the profit in 2013, which is in direct connection to the natural aspect of business management. Data in Table 2 show the income of Transport Service (TS) in 2013 per month.

Table 2. Income of Transport Service by months in 2013.

	$N_{RVm}^{2013} N_{RVm}^{2013}$ (vehicles)	$\bar{P}^m \bar{P}^m$ [€]
January	997	60 265,44
February	841	50 835,74
March	932	56 336,39
April	811	49 022,34
May	784	47 390,28
June	636	38 444,15
July	696	42 070,96
August	462	27 926,41
September	717	43 340,34
October	1019	61 595,27
November	1024	61 897,50
December	1039	62 804,20
	Σ	601 929,04

Due to the existence of two different types of STVs in the vehicle depot of Companies Transport Service (big and small STVs) further in this paper cost analysis of 2013 will be conducted in dependence of the type and usage of the ones mentioned above. Table 3 shows different costs depending on the type of STV, and Total Costs in 2013.

Table 3. TS's costs in 2013

	COSTS			
	Big STVs		Small STVs	
	€/km	Total (€)	€/km	Total (€)
Fuel	0,35	31 916,26	0,20	11 873,39
Oil	0,06	4 787,44	0,03	1 781,01
Pneumatics	0,04	3 638,29	0,02	1 178,17
Maintenance and repair	0.24	22 146,12	0,12	7 171,46
Amortization	-	73 808,15	-	20 674,55
Insurance and registration	-	2 628,12	-	700,83
Total		138 924,40		43 379,41
Total		182 303,80		
Wages		211 931,70		
Liability insurance		17 520,81		
SUM		411 756,30		
Non-production costs (10%SUM)		41 175,63		
TOTAL		452 931,90		

The next step is to obtain the parameter based on the relation of total costs and kilometrage in 2013. Being so that the costs of the TS in 2013 were T = 452 931,90 €, above mentioned parameter will be:

$$\bar{t}_{km} = \frac{T}{AKm} = \frac{452.931,90}{148.229} = 3,06\ €/km \quad (2)$$

$\bar{t}_{km}\bar{t}_{km}$ - TS's cost per kilometer in 2013.

Table 4 contains data regarding the fuel poured kilometers travelled and fuel consumption for every STV of the TS.

Table 4. Individual relevant costs of STVs in 2013.

STVs Mark	Travelled [km]	Poured fuel [l]	Consupmtion [l/100]
B1 - IVECO	24 780	6 756,93	27,26
B2 - IVECO	26 500	7 066,16	26,66
B3 - DAILY	28 344	4 411,45	15,56
B4 - IVECO	23 282	5 360,73	23,02
B5 - DAILY	30 129	4 332,73	14,38
B6 - DAF	8 754	2 521,96	28,81
ZASTAVA ZŽ	6 969	1799	25,81

Since the income in 2013 was P = 601 929,04 €, and total costs were T = 452 931,90 €, the profit equals (untaxed):

$$\Pi = P - T$$
$$\Pi = 601\,929,04 - 452\,931,90 \quad (3)$$
$$\Pi = 148\,997,14\ €$$

$\Pi\Pi$ - TS's profit in 2013.

SUGGESTIONS OF UPGRADES IN BUSINESS MANAGEMENT

In order to reduce exploitation costs, mainly the variable ones, a more detailed usage of the existing GPS technology is being suggested, which is in direct connection to facilitation of the parking violators localization. An approach of this type requires a more intense communication line based on the relation VOP crew - Dispatching centre - STV crew. In a communication line like this the dispatcher as a subject must be enrolled in TS's affairs securing more efficient removal executions.

Main component of such system would be the GMS technology. Through it the dispatcher could be informed via VOP crews about cites of violation. This information can later be distributed orderly to different STV units, insuring every unit knows which cite to visit. Escort member of a single crew enters the data received via GSM into the GPS interface device inside STV, the shortest route is selected, and travel can commence. The dispatcher monitors the movement of every STV on field and ensures no double-action take place, by assigning every STV to a different removal task. In case of a citizen tip regarding a violation, dispatcher would be obligated to send out a VOP crew on the spot to ensure the validity of the tip, so that the STVs don't travel in vain.

GPS characteristics:

- uninterrupted connection of dispatching service and vehicles, regardless of their amount,
- unlimited area of vehicle tracking, only limitation - GPS coverage,
- simple installment and use of GPS interface,
- Possibility of a more efficient route planning and significant reductions regarding exploitation costs

GSM technology takes a very significant position in transport, due to its benefits like[3]:

- Communication on the base driver - dispatcher - other actors in Transport Company
- Emergency calls in case of an accident or any kind of failure,
- exchange of textual messages and other types of digital data
- Recording of the communication flow,
- Integration with other existing systems.

In order to avoid the interference of two or more STVs on the same assignment, the dispatcher must clearly define which vehicle is sent to a specific location. This

would lead to a precise assignment distribution among the STVs patrolling in the same zone. Important issue in this case scenario would be how to evenly assign taskas, in order not to overload any specific STV crew.

The number of VOP units would be depending on the number of "empty" autokilometers travelled by STV's and the number of the kilometers that VOP units can realize with regard to their work hours, and technical-exploitative factors.

Main focus of the reorganization proposal lays on the tendency to transfer the „empty" autokilometers AK_p from STVs to the passenger vehicles which VOP unit is comprised of, and whom are in direct connection to the tracking of the parking violators.

PROJECTED STATES BUSINESS ANALYSIS

Considering the various measures of business reorganization three types stand out. First one is based on the use of the whole current TS's system. Ti comprises of TS in its current condition with added (necessary) VOP units (optimistic type).

Calculation in use for the considered type of business enhancement does not differ much from the other types, so many of the same figures and calculation methods will be used for the other two types of potential business advances, although the results will mostly be very different.

5.1 Optimistic type of projected business conduct

This type shows all the potential of implementation of the VOP units, dispatching center into the TS's system with advanced use of GPS and GSM technologies, regarding the increase in work productivity.

Basic date needed for income and costs calculation in the case of this, and other types of projected business conduct, will be the autokilometers that STVs and VOPs have to realize, in order to define the indicators of projected business management, and give an insight to the advances that such system reorganization would offer.

Since the optimistic type of business conduct is approximately closest to the existing one in 2013, the biggest number of data necessary for its calculation (as well as other types) will be gathered processing the 2013 business indicators.

$$\bar{\bar{T}} = \bar{t}_{at} + t_w + \bar{t}_{wa} + \bar{t}_l + \bar{t}_{atw} + \bar{t}_{id} = 35 \text{ min}$$
$$\bar{\bar{T}} = \bar{t}_{at} + t_w + \bar{t}_{wa} + \bar{t}_l + \bar{t}_{atw} + \bar{t}_{id} = 35 \text{ min}[4] \quad (4)$$

$\bar{T}\,\bar{T}$ - average turnover duration; $\bar{t}_{at}\bar{t}_{at}$ - average travel time to violation location; $t_w t_w$ - time spent on waiting for the owner of the vehicle to show up; $\bar{t}_{wa}\bar{t}_{wa}$ - warrant affirmation time; $\bar{t}_l\bar{t}_l$ - lifting time; $\bar{t}_{atw}\bar{t}_{atw}$ - average time of confiscated vehicle transport; $\bar{t}_{id}\,\bar{t}_{id}$ - average time of lowering the vehicle on the TS's depot.

Use of VOP units would mean that when the crew of that unit would be, after sighting the violator, in obligation to inform the dispatching centre, only after the expiration of the time waiting for the owner to show up, so that the STV units can do their job.

This means that average turnover duration for STV changes and in this particular case is:

$$\bar{\bar{T}} = \bar{t}_{at} + \bar{t}_l + \bar{t}_{atw} + \bar{t}_{id} =$$
$$\bar{T} = 10 + 5 + 10 + 5 = 30 \text{ min} \quad (5)$$

The next thing to do is to determine the maximum number of vehicles that can be removed per shift, based on the 30 minute turnover:

$$N_{ic}^{RV} = (n_{rv/h} \cdot H_r \cdot A_r) \cdot (n_s \cdot N_{wd} + n_{ssun} \cdot N_{sun}) =$$
$$N_{ic}^{RV} = (2 \cdot 8 \cdot 6) \cdot (2 \cdot 313 + 1 \cdot 52) = 65\,088 \text{ veh} \quad (6)$$

$N_{ic}^{RV}N_{ic}^{RV}$ - total number of potentially removed vehicles in an ideal case; $n_{rv/h}n_{rv/h}$ - number of removed vehicles per hour; H_rH_r - duration of the shift; A_rA_r - number of working STVs; n_sn_s - number of working day shifts; N_{wd} N_{wd} - number of working days in 2013 (including Saturdays); $n_{ssun}n_{ssun}$ - number of shifts on Sunday; $N_{sun}N_{sun}$ - number of Sundays in 2013.

Therefore in the ideal case of exploitation, with the use of VOP units to shorten the turnover time for STVs, the number of potentially removed vehicles would be $N_{ic}^{RV}N_{ic}^{RV}$ = 65 088 vehicles.

In correlation to the average fee price from 2013 (60,45€), income on an annual level would be:

$$P_{aps}^{2013} = N_{ic}^{RV} \cdot f = 65\,088 \cdot 60{,}45 =$$
$$P_{aps}^{2013} = 3\,934\,360{,}00 \quad (7)$$

Having in mind that this operative level is practically unfeasible, due to the lack of that amount of parking violators, and impossibility of all STV being functional for work, it can only be used as absolutely ideal i.e. the borderline of advanced business management in this particular case.

Average speed of a STV is $\bar{v}\bar{v}$ = 25 km/h. This means that the ideal kilometrage necessary for the removal of one parking violator is:

$$\bar{s} = \bar{v} \cdot \bar{t} = 25 \cdot \frac{20}{60} = 8{,}33 \text{ km} \quad (8)$$

$\bar{s}\bar{s}$ - Ideal travel kilometrage per turnover; $\bar{v}\bar{v}$ - average speed of a STV; $\bar{t}\bar{t}$ - average time of travelling.

Combining the existing data on the number of removed vehicles in 2013, average number of kilometers necessary for the removal of that amount of violators can be calculated:

$$AK_{id} = \bar{s} \cdot {}^{*}N_{RV}^{2013} = 8{,}33 \cdot 10\ 714 =$$
$$AK_{id} = 89\ 248 \text{ km} \quad (9)$$

$AK_{id}AK_{id}$ - Total ideal autokilometers traveled in 2013; ${}^{*}N_{RV}^{2013}{}^{*}N_{RV}^{2013}$ - Total number of removed vehicles in 2013;

The next necessary thing to do is to subtract the ideal autokilometers from the total number of autokilometers in 2013, in order to acquire autokilometers traveled during "patrolling" - those realized while searching for the violators.

$$AK_{pat} = AK - AK_{id} = 148\ 229 - 89\ 248 =$$
$$AK_{pat} = 58\ 981 \text{ km} \quad (10)$$

$AK_{pat}AK_{pat}$ - autokilometers realized during patroling; $AKAK$ - total autokilometers of STVs in 2013.

Obtained information represents the kilometrage that needs to be switched to VOP units, in order to liberate STVs from patrolling, and by doing so reduce their exploitation costs.

From earlier calculations the need emerges to derive the patrolling and useful kilometers from total autokilometers, and to give insight to their participation:

$$\%_{id} = \frac{89\ 248}{148\ 229} \cdot 100 = 60{,}2\% \quad (11)$$

$$\%_{id} = \frac{58\ 981}{148\ 229} \cdot 100 = 39{,}8\% \quad (12)$$

In an ideal annual level case STVs could remove the following number of vehicles:

$$N_{ia}^{RV} = n_{rv/h} \cdot (H_r - 1) \cdot A_r \cdot (n_s \cdot N_{wd} + n_{ssun} \cdot N_{sun})$$
$$N_{ia}^{RV} = 2 \cdot 7 \cdot 5 \cdot (2 \cdot 313 + 1 \cdot 52) = 47\ 460 \text{ veh} \quad (13)$$

This leads to the fact that the number of ideal autokliometers in this particular case is:

$$AK_{id}^{al} = \bar{s} \cdot N_{ia}^{RV} = 8{,}33 \cdot 47\ 460 = 395\ 342 \text{ km} \quad (14)$$

When this, above shown, total ideal kilometrage on annual level is divided by the percentage of ideal kilometrage, and afterwards multiplied by the patrolling kilometers percentage, the result represents the patrolling autokilometers for that projected annual level.

$$AK_{pat}^{al} = \frac{AK_{id}^{al}}{\%_{id}} \cdot \%_{pat} = \frac{395\ 342}{60{,}2} \cdot 39{,}8 =$$
$$AK_{pat}^{al} = 261\ 372 \text{ km} AK_{pat}^{al} = 261\ 372 \text{ km} \quad (15)$$

$$AK_{VOP}^{pot} = \bar{v}_s \cdot (H_r - 1) \cdot (n_s \cdot N_{wd} + n_{ssun} \cdot N_{sun}) =$$
$$AK_{VOP}^{pot} = 35 \cdot 7 \cdot (2 \cdot 313 + 1 \cdot 52) = 166\ 110 \text{ km} \quad (16)$$

$AK_{VOP}^{pot}AK_{VOP}^{pot}$ - Potential kilometrage a VOP unit could realize on annual level.

As can be seen from stated above there is a need for two VOP units, to cover the projected patrolling autokilometers (261.372 km). In this case the necessary number of VOP workers is ten.

Table 5. Total costs of the Transport Service in the projected state

	TROŠKOVI					
	Big STVs		Small STVs		VOPs (Skoda FABIA)	
	€/km	Total (€)	€/km	Total (€)	€/km	Total (€)
Fuel	0,35	85 245,29	0,20	31 309,42	0,12	31 941,65
Oil	0,06	13 858,96	0,03	4 700,47	0,02	4 785,53
Pneumatics	0,04	9 718,17	0,02	3 106,63	0,004	984,58
Maintenance and repair	0.24	59 154,11	0,12	18 909,92	0.04	11 448,62
Amortization	-	73 808,15	-	20 674,55	-	3 673,99
Insurance and registration	-	2 628,12	-	700,83	-	334,80
Total		244 412,80		79 401,82		53 169,17
Total				376 983,80		
Wages				253 981,60		
Liability insurance				17 520,81		
SUM				648 486,21		
Non-production costs				64 848,62		
TOTAL				713 334,83		

Since the suggested type is far more massive than the standard annual performances, it is clear that the number of failed removal procedures will increase, but not more than 50%. Being that the TS's incomes are in direct correlation with the number of removed vehicles it is clear that they will change in the same nature.

$$\bar{P}_{proj}^{real} = P_{proj}^{real} \cdot 0{,}50 = N_{ia}^{RV} \cdot f \cdot 0.50 =$$
$$\bar{P}_{proj}^{real} = 47\ 460 \cdot 60{,}45 \cdot\ 0{,}50 =$$
$$\bar{P}_{proj}^{real} = 1\ 434\ 402{,}10\ € \quad (17)$$

Having in mind that the costs don't change, not even in the case that the vehicle owner appears, one thing left to do is to calculate the real potential profit - gain from this type of projected state.

$$\bar{\Pi}_{proj}^{real} = P_{proj}^{real} - T_{proj}^{2013} =$$
$$\bar{\Pi}_{proj}^{real} = 1\,434\,402{,}10 - 713\,334{,}83 = \quad (18)$$
$$\bar{\Pi}_{proj}^{real} = 721\,067{,}27\ €$$

The following part of this paper gives insight to the ratio regarding the increase of income and costs based on real (2013) and projected state comparison.

$$\uparrow \bar{T} = \frac{713\,729{,}05}{452\,931{,}90} = 1{,}57 \quad (19)$$

$$\uparrow \bar{P} = \frac{1\,434\,402{,}10}{601\,929{,}4} = 2{,}38 \quad (20)$$

Figure 2 graphically describes the increase ratio for incomes and costs.

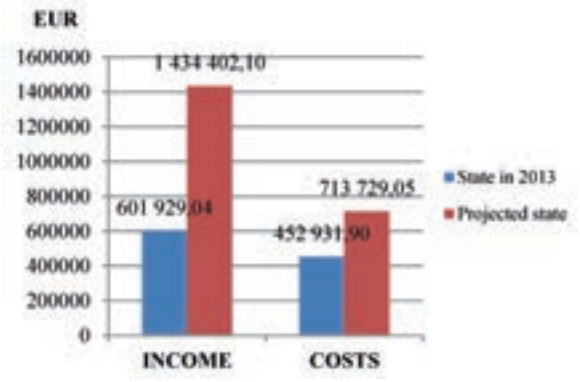

Figure 2. Comparative financial state for the 2013 and the projected state

Pessimistic type of projected business conduct

In case that the pessimistic type is applied the use of only one VOP unit would be needed, and complementary to that one STV. In this case coefficient of VOP unit exploitation would be under 1, while the STV's would equal 1 annually.

Maximum annual kilometrage that one STV can travel is:

$$AK_{STV} = \bar{v} \cdot (H_r - 1) \cdot (n_s \cdot N_{wd} + n_{ssun} \cdot N_{sun}) =$$
$$AK_{STV} = 25 \cdot 7 \cdot (2 \cdot 313 + 1 \cdot 52) = 118\,650\ \text{km} \quad (21)$$

As the average number of autokilometers travelled, if the place of violation is known, is $\bar{s}\bar{s}$ = 8.33 km the total number of potential removed vehicles would be:

$$\bar{N}_{min}^{RV} = \frac{AK_p}{\bar{s}} = \frac{118\,650}{8{,}33} = 14\,244\ \text{veh} \quad (22)$$

Based on this the expected income for this type of business conduct can be calculated, with review of exploitation parameters in 2013 (50% decrease applies here as well as in the other types). Expected income would than equal:

$$\bar{P}_{min} = N_{min}^{RV} \cdot f \cdot 0.50 =$$
$$\bar{P}_{min} = 14\,244 \cdot 60{,}45 \cdot 0{,}50 = \quad (23)$$
$$\bar{P}_{min} = 430\,502{,}00\ €$$

In a system like this, it is necessary to include the crews for the VOP unit. This means that three shifts are needed, so six employees will be assigned to the VOP unit.

Expenses of such system are significantly smaller compared to those of 2013 because they need only one of every unit, and they are shown in Table 6.

Table 6. Projected costs of pessimistic type of business conduct

	Costs			
	Big STV		VOP (Skoda FABIA)	
	€/km	Total (€)	€/km	Total (€)
Fuel	0,35	41 940,67	0,12	9 586,33
Oil	0,06	6 818,61	0,02	1 436,23
Pneumatics	0,04	4 781,34	0,004	295,49
Maintenance and repair	0.24	29 103,81	0.04	3 435,96
Amortization	-	14 761,63	-	1 836,99
Insurance and registration	-	525,62	-	167,40
Total		97 931,68		16 758,42
Total		114.690,10		
Wages	39 737,19		31 537,45	
Liability insurance		2 917,21		
SUM		188 881,95		
Non-production costs		18 888.19		
TOTAL		207 770,14		

Profit of this type of business conduct would equal:

$$\bar{\Pi}_{min} = P_{min} - T_{min} =$$
$$\bar{\Pi}_{min} = 430\,502{,}00 - 207\,770{,}14 = \quad (24)$$
$$\bar{\Pi}_{min} = 222\,731{,}82\ €$$

Real type of projected business conduct

It is necessary to consider which type of business conduct would be most feasible, based on contemplating the relation between internal interest of the Transport Service, and the external aspect (interests of the local community).

Since the considered number of STVs in the year 2013 was six, to maintain the jobs of all employees in the process, a management reorganization of such nature so that the TS will consist out of four STVs and two VOP units, will be considered.

Total kilometrage that four STV's can travel annually is:

$$AK_{STV}^{real} = n_{STV} \cdot AK_{STV}$$
$$AK_{STV}^{real} = 4 \cdot 118\,650 = 474\,600\ \text{km} \quad (25)$$

In accordance to that the annual VOP kilometers (patrolling kilometers) can be calculated:

$$AK_{VOP}^{real} = \frac{AK_{STV}^{real} \cdot 0{,}398}{0{,}602} =$$
$$AK_{VOP}^{real} = \frac{474\,600 \cdot 0{,}398}{0{,}602} = 313\,772 \text{ km} \quad (26)$$

Having in mind that one VOP unit can annually travel up to $AK_{VOP}^{pot} AK_{VOP}^{pot}$ = 166 110 km it is clear that in this particular case two VOP units would be needed. Since the crews of STV and VOP units are of the same quantity, necessity would emerge that a part of STV's crew transfers to the work assignments of VOP units.

In this case the number of workers would remain the same, so there would be no need for hiring additional work force. Wages in that case for the VOP units crew could go up from 438 to 626 EUR.

The expected number of vehicles that could be removed for the referred kilomtrage is:

$$\bar{N}_{real}^{RV} = \frac{AK_{STV}^{real}}{\bar{s}} = \frac{474\,600}{8{,}33} = 56\,975 \text{ veh} \quad (27)$$

Incomes of this system are calculated in the same manner as those for the other type of business conduct:

$$\bar{P}_{real} = N_{real}^{RV} \cdot f \cdot 0.50 =$$
$$\bar{P}_{real} = 56\,975 \cdot 60{,}45 \cdot 0{,}50 = \quad (28)$$
$$\bar{P}_{real} = 1\,721\,978{,}00\ €$$

The STV assembly should consist out of 2 Small STV's and 2 Big STV's. With a review of the kilometers distribution (60,7%; 39,3%) in the current kilometrage the distribution would be $AK_{STV}^{b} AK_{STV}^{b}$=288 082 km and $AK_{STV}^{s} AK_{STV}^{s}$=186 518 km.

The costs of the real type of business conduct are shown in Table 7.

Table 7. Projected costs of the real type of business conduct

	COSTS					
	Big STVs (2)		Small STVs (2)		VOP (Skoda FABIA) (2)	
	€/km	Total (€)	€/km	Total (€)	€/km	Total (€)
Fuel	0,35	101 831,88	0,20	37 875,49	0,12	38 345,32
Oil	0,06	16 555,57	0,03	5 686,22	0,02	5 744,93
Pneumatics	0,04	11 609,09	0,02	3 758,14	0,004	1181,97
Maintenance and repair	0,24	70 664,00	0,12	22 875,62	0.04	13 743,85
Amortization	-	59 046,52	-	20 674,55	-	3 673,99
Insurance and registration	-	1051,25	-	700,83	-	334,80
Total		260 758,30		91 570,85		63 024,87
Total	415 354,02					
Wages	208 777,92					
Liability insurance	11 651,34					
SUM	635 783,28					
Non-production costs	63 578,33					
TOTAL	699 361,61					

So the profit is:

$$\bar{\Pi}_{real} = \bar{P}_{real} - T_{real} =$$
$$\bar{\Pi}_{real} = 1\,721\,978{,}00 - 699\,361{,}61 = \quad (29)$$
$$\bar{\Pi}_{real} = 1\,022\,616{,}39\ €$$

In this (real) type of business reorganization, compared to the state recorded in 2013, for 50% higher costs, the income would be almost 300% higher, having in mind that the accounts are made for the first year of the exploitation of the new business system. The expected profit would be seven times bigger than the one in 2013. The advantage of such system would reflect in the maintenance of work places, more rational and eco-friendly use of STV units, no need for special investments since the Company already has all the necessary equipment and resources for such reorganization.

CONCLUSION

Generally, the various parking policies are vital nowadays for every developed city regardless its' size.

They can contribute greatly in organizing the traffic system of an area and ameliorate the driving conditions for the users of the streets[5].

Applying the contemporary information technologies the STV units work efficiency can be significantly optimized, and in accordance with that the state of Companies management as well. In the PUC „Parking servis" Novi Sad, Transport Service is not the only revenue maker. It represents only a part of the Companies system. Having in mind that it plays a repressing role, it is clear that there is the necessity for her to act only in the case of a violation. The Company itself should invest more from its budget in order to improve the parking conditions in the city.

LITERATURE

[1] Dobrić, M. and Stanković, N. Uticaj rada specijalnih teretnih vozila „pauk" na bezbednost saobraćaja u Novom Sadu. *XII Međunarodni simpozijum "Prevencija saobraćajnih nezgoda na putevima 2014"Bor,* October 2014, pp. 231-240.

[2] Gladović, P. *Organizacija drumskog saobraćaja*. Fakultet tehničkih nauka Novi Sad, Novi Sad, 2008.

[3] Gladović, P. *Informacioni sistemi u drumskom transportu*. Fakultet tehničkih nauka Novi Sad, Novi Sad, 2010.

[4] Hadžimuratović, R. and Dobrić, M. *Organizacija prevoza robe i putnika*. Svjetlost Sarajevo, Sarajevo 1989.

[5] Spiliopoulou, C. and Antoniou, C. Analysis of illegal parking behavior in Greece, *Procedia - Social and Behavioral Sciences*, *Transport Research Arena 2012*, Vol. 48, Athens, Greece, 2012, pp. 1622–1631.

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[1] Zahavi Y. and Ryan, M. James. Stability of Travel Components Over Time. *Transportation Research Record*, 750 (1980), 70-75.

Book [2]

[2] Shinar, D. *Psychology on the Road: The Human Factor in Traffic Safety*. John Wiley & Sons, Inc., New York, 1978.

Article in a Periodical [3]

[3] Jolliffe, J.K. and Hutchinson, T.P. A Behavioural Explanation of the Association Between Bus and Passenger Arrivals at a Bus Stop. *Transportation Science*, 9, 3 (August 1, 1975), 248-282.

Government Report [4]

[4] Dempsey, J. Barry. *Climatic Effects of Airport Pavement Systems: State of the Art*. Report DOT2DRD-75-196. FHWA, U.S. Department of Transportation, 1976.

Web Page [5]

[5] Stevens, R.C. Testimony Before United States Senate Special Committee on the Year 2000 Technology Problem. Sept. 10, 1998. http://www.senate.gov/~y2k/statements/091098stevens.html. Accessed Oct. 5, 1998.

CD-ROM [6]

[6] Martinelli, D.R. A Systematic Review of Busways. *Journal of Transportation Engineering* (CD-ROM), Vol. 122, No. 3, May–June 1996.

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