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

Mladen Dobrić1, Milica Miličić2, Pavle Gladović3, Filip Dobrić4
1Prof. Dr, Evropski Univerzitet ”Brčko Distrikt”, Brčko, Bosna i Hercegovina, dobric_mladen@yahoo.com
2Doc. Dr, Faculty of Technical Science, Novi Sad, Srbija, mmilicic@uns.ac.rs
3Prof. Dr, Faculty of Technical Science, Novi Sad, Srbija, anipa@eunet.rs
4MSc, filipdobric@yahoo.com

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 role of the Transportation Service inside the system of PUC „Parking servis”, and its 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 Observatory 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.
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]

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

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_{RV}^{2013} = 1095 veh), on the other hand the month with least vehicles removed is August (N_{RV}^{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:

\[
\frac{N_{RV}^{2013}}{N_{RV}} = \frac{1.095}{893} = 1.23
\]

As it can be seen in Table 1, total number of vehicles removed in 2013 is \(N_{RV}^{2013} = 10.714\) 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 \(AK_{2013} = 148 229\) 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 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.

<table>
<thead>
<tr>
<th>Month</th>
<th>Income (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>60 265,44</td>
</tr>
<tr>
<td>February</td>
<td>50 835,74</td>
</tr>
<tr>
<td>March</td>
<td>56 336,39</td>
</tr>
<tr>
<td>April</td>
<td>49 022,34</td>
</tr>
<tr>
<td>May</td>
<td>47 390,28</td>
</tr>
<tr>
<td>June</td>
<td>38 444,15</td>
</tr>
<tr>
<td>July</td>
<td>42 070,96</td>
</tr>
<tr>
<td>August</td>
<td>27 926,41</td>
</tr>
<tr>
<td>September</td>
<td>43 340,34</td>
</tr>
<tr>
<td>October</td>
<td>61 595,27</td>
</tr>
<tr>
<td>November</td>
<td>61 897,50</td>
</tr>
<tr>
<td>December</td>
<td>62 804,20</td>
</tr>
<tr>
<td>TOTAL</td>
<td>601 929,04</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>COSTS</th>
<th>Big STVs</th>
<th>Small STVs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>€/km Total (€)</td>
<td>€/km Total (€)</td>
</tr>
<tr>
<td>Fuel</td>
<td>0,35 31 916,26</td>
<td>0,20 11 873,90</td>
</tr>
<tr>
<td>Oil</td>
<td>0,06 4 787,44</td>
<td>0,03 1 781,01</td>
</tr>
<tr>
<td>Pneumatics</td>
<td>0,04 3 638,29</td>
<td>0,02 1 178,17</td>
</tr>
<tr>
<td>Maintenance and repair</td>
<td>0.24 22 146,12</td>
<td>0.12 7 171,46</td>
</tr>
<tr>
<td>Amortization</td>
<td>- 73 808,15</td>
<td>- 20 674,55</td>
</tr>
<tr>
<td>Insurance and registration</td>
<td>- 2 628,12</td>
<td>- 700,83</td>
</tr>
<tr>
<td>Total</td>
<td>138 924,40</td>
<td>43 379,41</td>
</tr>
</tbody>
</table>

Total 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:

\[
\ell_{\text{km}} = \frac{T}{AKm} = \frac{452,931,90}{148,229} = 3,06 \, €/\text{km}
\]

\( \ell_{\text{km}} \) - 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.

<table>
<thead>
<tr>
<th>STVs Mark</th>
<th>Travelled [km]</th>
<th>Poured fuel [l]</th>
<th>Consumption [l/100]</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1 - IVECO</td>
<td>24 780</td>
<td>6 756,93</td>
<td>27,26</td>
</tr>
<tr>
<td>B2 - IVECO</td>
<td>26 500</td>
<td>7 066,16</td>
<td>26,66</td>
</tr>
<tr>
<td>B3 - DAILY</td>
<td>28 344</td>
<td>4 411,45</td>
<td>15,56</td>
</tr>
<tr>
<td>B4 - IVECO</td>
<td>23 282</td>
<td>5 360,73</td>
<td>23,02</td>
</tr>
<tr>
<td>B5 - DAILY</td>
<td>30 129</td>
<td>4 332,73</td>
<td>14,38</td>
</tr>
<tr>
<td>B6 - DAF</td>
<td>8 754</td>
<td>2 521,96</td>
<td>28,81</td>
</tr>
<tr>
<td>ZASTAVA 22</td>
<td>6 969</td>
<td>1 799</td>
<td>25,81</td>
</tr>
</tbody>
</table>

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

\[
\Pi = P - T
\]

\[
\Pi = 601,929,04 - 452,931,90
\]

\[
\Pi = 148,997,14 \, €
\]

\( \Pi \) - 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 tasks, 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 AKp 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.

\[ \bar{T} = \bar{t}_{at} + \bar{t}_w + \bar{t}_{wa} + \bar{t}_i + \bar{t}_{atw} + \bar{t}_{id} = 35 \text{ min} \]  
\[ \bar{t} = \bar{t}_{at} + \bar{t}_w + \bar{t}_{wa} + \bar{t}_i + \bar{t}_{atw} + \bar{t}_{id} = 35 \text{ min}[4] \]

\[ \bar{T} - \text{average turnover duration; } \bar{t}_{at} - \text{average travel time to violation location; } \bar{t}_w - \text{time spent on waiting for the owner of the vehicle to show up; } \bar{t}_{wa} - \text{warrant affirmation time; } \bar{t}_i - \text{lifting time; } \bar{t}_{atw} - \text{average time of confiscated vehicle transport; } \bar{t}_{id} - \text{average time of lowering the vehicle on the TS’s depot.} \]

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:

\[ \bar{t} = 10 + 5 + 10 + 5 = 30 \text{ min} \]

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:

\[ N_{ic}^{RV} = (n_\{rv/h\} \cdot t_{hr} \cdot A_{rp}) \cdot (n_{wr} \cdot N_{wd} + n_{sun} \cdot N_{sun}) = \]
\[ N_{ic}^{RV} = (2 \cdot 8 \cdot 6) \cdot (2 \cdot 313 + 1 \cdot 52) = 65 \text{ 088 veh} \]

\[ N_{ic}^{RV} N_{ic}^{RV} = \text{total number of potentially removed vehicles in an ideal case; } n_\{rv/h\} = \text{-number of removed vehicles per hour; } t_{hr} = \text{-duration of the shift; } A_{rp} = \text{-number of working STVs; } n_{wr} = \text{-number of working day shifts; } N_{wd} = \text{-number of working days in 2013 (including Saturdays); } n_{sun} = \text{-number of shifts on Sunday; } N_{sun} = \text{-number of Sundays in 2013.} \]

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 \[ N_{ic}^{RV} N_{ic}^{RV} = 65 \text{ 088 vehicles.} \]

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

\[ P_{gps}^{2013} = N_{ic}^{RV} f \cdot 65 \text{ 088} \cdot 60.45 = \]
\[ P_{gps}^{2013} = 3 \text{ 934 360,00} \]

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 \( \bar{\nu} = 25 \text{ km/h.} \) This means that the ideal kilometrage necessary for the removal of one parking violator is:

\[ \bar{s} = \bar{\nu} \cdot \bar{t} = 25 \cdot \frac{20}{60} = 8.33 \text{ km} \]

\( \bar{s} \) - Ideal travel kilometrage per turnover; \( \bar{\nu} \) - average speed of a STV; \( \bar{t} \) - 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:
\[ AK_{id} = 5 \cdot N_{RV}^{2013} = 8.33 \cdot 10^{7} 14 = \]
\[ AK_{id} = 89,248 \text{ km} \]

\[ AK_{id},AK_{id} = \text{Total ideal autokilometers traveled in 2013; } \]
\[ N_{RV}^{2013},N_{RV}^{2013} = \text{Total number of removed vehicles in } \]
\[ 2013; \]

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.

\[ AK_{pat} = AK - AK_{id} = 148,229 - 89,248 = \]
\[ AK_{pat} = 58,981 \text{ km} \]

\[ AK_{pat},AK_{pat} = \text{autokilometers realized during patrolling; } \]
\[ AK_{id},AK_{id} = \text{total autokilometers of STVs in 2013.} \]

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:

\[ \%_{id} = \frac{89,248}{148,229} \cdot 100 = 60.2\% \]
\[ \%_{id} = \frac{58,981}{148,229} \cdot 100 = 39.8\% \]

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

\[ N_{RV}^{id} = n_{rv/h} \cdot (H_{r} - 1) \cdot A_{r} \cdot (n_{s} \cdot N_{wd} + n_{stun} \cdot N_{stun}) \]
\[ N_{RV}^{id} = 2 \cdot 7 \cdot 5 \cdot (2 \cdot 313 + 1 \cdot 52) = 47,460 \text{ veh} \]

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

\[ AK_{id}^{id} = 5 \cdot N_{RV}^{id} = 8.33 \cdot 47,460 = 395,342 \text{ km} \]

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.

\[ AK_{pat}^{id} = \frac{AK_{id}^{id}}{\%_{id}} \cdot \%_{pat} = \frac{395,342}{60.2} \cdot 39.8 = \]
\[ AK_{pat}^{id} = 261,372 \text{ km} AK_{pat}^{id} = 261,372 \text{ km} \]

\[ AK_{Pat}^{pot} = \tilde{v}_{z} \cdot (H_{r} - 1) \cdot (n_{s} \cdot N_{wd} + n_{stun} \cdot N_{stun}) \]
\[ AK_{Pat}^{pot} = 35 \cdot 7 \cdot (2 \cdot 313 + 1 \cdot 52) = 166,110 \text{ km} \]

\[ AK_{Pat}^{pot},AK_{Pat}^{pot} = \text{Potential kilometrage a VOP unit could realize on annual level.} \]

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

<table>
<thead>
<tr>
<th>TROŠKOVI</th>
<th>Big STVs</th>
<th>Small STVs</th>
<th>VOPs (Skoda FABIA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>€/km</td>
<td>Total (€)</td>
<td>€/km</td>
<td>Total (€)</td>
</tr>
<tr>
<td>Fuel</td>
<td>0.35</td>
<td>85,245,29</td>
<td>0.20</td>
</tr>
<tr>
<td>Oil</td>
<td>0.06</td>
<td>13,858,96</td>
<td>0.03</td>
</tr>
<tr>
<td>Pneumatics</td>
<td>0.04</td>
<td>9,718,17</td>
<td>0.02</td>
</tr>
<tr>
<td>Maintenance and repair</td>
<td>0.24</td>
<td>59,154,11</td>
<td>0.12</td>
</tr>
<tr>
<td>Amortization</td>
<td>-</td>
<td>73,808,15</td>
<td>-</td>
</tr>
<tr>
<td>Insurance and registration</td>
<td>-</td>
<td>2,628,12</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>244,412,80</td>
<td>79,401,82</td>
<td>53,169,17</td>
</tr>
<tr>
<td>Total</td>
<td>713,334,83</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wages</td>
<td>253,981,60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liability insurance</td>
<td>17,520,81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUM</td>
<td>648,486,21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-production costs</td>
<td>64,848,62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>713,334,83</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.

\[ P_{real}^{proj} = P_{real}^{proj} \cdot 0.50 = N_{RV}^{id} \cdot f \cdot 0.50 = \]
\[ P_{real}^{proj} = 47,460 \cdot 0.60,45 \cdot 0.50 = \]
\[ P_{real}^{proj} = 1,434,402,10 \text{ €} \]

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.
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.

\[
\begin{align*}
\bar{T} & = \frac{713\,729.05}{452\,931.90} = 1.57 \\
\bar{P} & = \frac{1\,434\,402.10}{601\,929.4} = 2.38
\end{align*}
\]

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

**Table 6. Projected costs of pessimistic type of business conduct**

<table>
<thead>
<tr>
<th>Costs</th>
<th>Big STV</th>
<th>VOP (Skoda FABIA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\text{\euro}/\text{km})</td>
<td>Total (\text{\euro})</td>
<td>(\text{\euro}/\text{km})</td>
</tr>
<tr>
<td>Fuel</td>
<td>0.35</td>
<td>41,940.67</td>
</tr>
<tr>
<td>Oil</td>
<td>0.06</td>
<td>6,818.61</td>
</tr>
<tr>
<td>Pneumatics</td>
<td>0.04</td>
<td>4,781.34</td>
</tr>
<tr>
<td>Maintenance and repair</td>
<td>0.24</td>
<td>29,103.81</td>
</tr>
<tr>
<td>Amortization</td>
<td>-</td>
<td>14,761.63</td>
</tr>
<tr>
<td>Insurance and registration</td>
<td>-</td>
<td>525.62</td>
</tr>
<tr>
<td>Total</td>
<td>97,931.68</td>
<td>16,758.42</td>
</tr>
<tr>
<td>Wages</td>
<td>39,737.19</td>
<td>31,537.45</td>
</tr>
<tr>
<td>Liability insurance</td>
<td>2,917.21</td>
<td></td>
</tr>
<tr>
<td>SUM</td>
<td>188,881.95</td>
<td></td>
</tr>
</tbody>
</table>

Profit of this type of business conduct would equal:

\[
\bar{\Pi}_{\text{min}} = \bar{P}_{\text{min}} - \bar{T} = \bar{P}_{\text{min}} = 430\,502.00 - 207\,770.14 = 222\,731.82 \text{ \euro}
\]

**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:

\[
\begin{align*}
AK_{\text{STV}} &= n_{\text{STV}} \cdot AK_{\text{STV}} \\
AK_{\text{STV}} &= 4 \cdot 118\,650 = 474\,600 \text{ km}
\end{align*}
\]

In accordance to that the annual VOP kilometers (patrolling kilometers) can be calculated:
Having in mind that one VOP unit can annually travel up to $AK^\text{pot}_{\text{VOP}}$ = 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:

$$\bar{N}_{\text{real}} = \frac{AK^\text{real}_{\text{VOP}} \cdot 0.398}{0.602} = 474 \, 600 \cdot 0.398 \over 0.602} = 313 \, 772 \, \text{km} \quad (26)$$

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

$$\bar{P}_{\text{real}} = \frac{AK^\text{real}_{\text{VOP}}}{\bar{S}} \cdot f \cdot 0.50$$

$$\bar{P}_{\text{real}} = 56 \, 975 \cdot 60.45 \cdot 0.50$$

$$\bar{P}_{\text{real}} = 1 \, 721 \, 978.00 \, \text{€} \quad (28)$$

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 $AK^2_{\text{STV}} = 288 \, 082 \, \text{km}$ and $AK^2_{\text{STV}} = 186 \, 518 \, \text{km}$.

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

<table>
<thead>
<tr>
<th>COSTS</th>
<th>Big STVs (2)</th>
<th>Small STVs (2)</th>
<th>VOP (Skoda FABIA) (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>€/km</td>
<td>€/km</td>
<td>€/km</td>
<td>€/km</td>
</tr>
<tr>
<td>Fuel</td>
<td>0.35</td>
<td>0.20</td>
<td>0.12</td>
</tr>
<tr>
<td>101</td>
<td>831.88</td>
<td>37 875.49</td>
<td>38 345.32</td>
</tr>
<tr>
<td>Oil</td>
<td>0.06</td>
<td>0.03</td>
<td>0.02</td>
</tr>
<tr>
<td>16 555.57</td>
<td>5 686.22</td>
<td>5 744.93</td>
<td></td>
</tr>
<tr>
<td>Pneumatics</td>
<td>0.04</td>
<td>0.02</td>
<td>0.004</td>
</tr>
<tr>
<td>11 609.09</td>
<td>3 758.14</td>
<td>1181.97</td>
<td></td>
</tr>
<tr>
<td>Maintenance and repair</td>
<td>0.24</td>
<td>0.12</td>
<td>0.04</td>
</tr>
<tr>
<td>70 642.00</td>
<td>22 875.62</td>
<td>13 743.85</td>
<td></td>
</tr>
<tr>
<td>Amortization</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>54 046.52</td>
<td>20 674.55</td>
<td>3 673.99</td>
<td></td>
</tr>
<tr>
<td>Insurance and registration</td>
<td>-</td>
<td>700.83</td>
<td>334.80</td>
</tr>
<tr>
<td>- 1051.25</td>
<td>700.83</td>
<td>334.80</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>260</td>
<td>91 570.85</td>
<td>63 024.87</td>
</tr>
<tr>
<td>€/km</td>
<td>758.30</td>
<td>63 024.87</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>415 354.02</td>
<td>63 024.87</td>
<td></td>
</tr>
<tr>
<td>Wages</td>
<td>208 777.92</td>
<td>63 024.87</td>
<td></td>
</tr>
<tr>
<td>Liability insurance</td>
<td>11 651.34</td>
<td>63 024.87</td>
<td></td>
</tr>
<tr>
<td>SUM</td>
<td>635 783.28</td>
<td>63 024.87</td>
<td></td>
</tr>
<tr>
<td>Non-production costs</td>
<td>63 578.33</td>
<td>63 024.87</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>699 361.61</td>
<td>63 024.87</td>
<td></td>
</tr>
</tbody>
</table>

So the profit is:

$$\bar{\Pi}_{\text{real}} = \bar{P}_{\text{real}} - T_{\text{real}}$$

$$\bar{\Pi}_{\text{real}} = 1 \, 721 \, 978.00 - 699 \, 361.61 \quad (29)$$

$$\bar{\Pi}_{\text{real}} = 1 \, 022 \, 616.39 \, \text{€}$$

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**


