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MICRO-LOGISTIC DISTRIBUTIVE SYSTEM ANALYSIS: CASE STUDY

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Abstract: This work emphasizes the central-historical center of the town of Bitola as a characteristic micro-logistic distributive system. For the purpose of the future studying: developing and adopting of the CRVRModel, one month analysis has been conducted, (from the middle of May till the middle of June 2005.). State-of-the-Art Analysis pointed at the types of delivery vehicles, their approach, delivery frame time, quality of the load-unload manipulations, and load factor. Here the quantitative and qualitative measures are presented.

Key words: city logistics, micro-logistic system, measure of effectiveness.

1. INTRODUCTION

City of Bitola, and generally its historical core face with great traffic congestion problem as a result of different activities concentration, with different functions on limited space and the inherited road infrastructure.
Namely, the urban goods transportation is carrier of many positive and negative effects. So, it is completely clear that an efficient micro-logistic distributive system is an imperative for solving of the transportation problems and reasonable securing of fast delivery of goods, services and information in the urban areas.

2. GENERAL CHARACTERISTICS OF THE NARROW CENTRAL AREA OF TOWN OF BITOLA - NCAB

According to the new territorial distribution, study area, known as NCAB has 30ha surface [3]. The land assignment is a complex mix of a large number of activities, or developed urbane area. The traffic network is quite specific and formed as a result of the inherited town structure in the central part. It is characterized with non-regular, winding form and geometric profile which is not dimensioned for the modern necessities in the town. For detailed analysis, six zones are defined ($z=1,....,6$), (figure 1), where z=zone, [1].

Fig.1.Number of zones defined in the NCAB

3. QUANTITATIVE MEASURE ANALYSIS

Data for the type and the quantity of delivered goods as quantitative measures of effectiveness were conducted through 200 questionnaires prepared and successfully realized during May and June 2005.
The data provided us large number of information, but for the needs of this work we will present only those that relate to the type, the quantity of daily delivered goods and the number of deliveries, (figure 2-5), taken as input parameters in the mathematical model for calculating the overall quantity of goods that daily and yearly has been loaded to the NCAB.

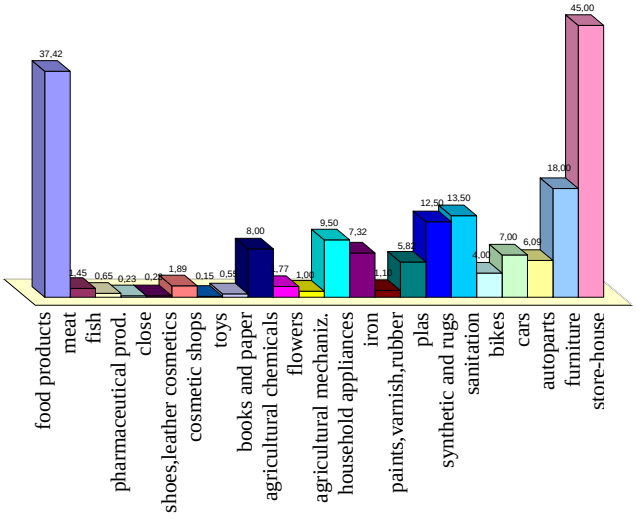

Fig.2. Quantity of one delivery goods (t), by type

Field analysis showed the existence of minor number of specialized points, contrary to the combination of several types of goods in one selling place. Namely, 22 categories of goods are separate and analyzed: food products, meat, fish, pharmaceutical products, close, shoes and leather products, cosmetics, toys, books and paper, agricultural chemicals, flowers, agricultural mechanization, household

appliances, paints, varnish, rubber and plastics, iron, synthetic and rugs, sanitation, bikes, cars, furniture.

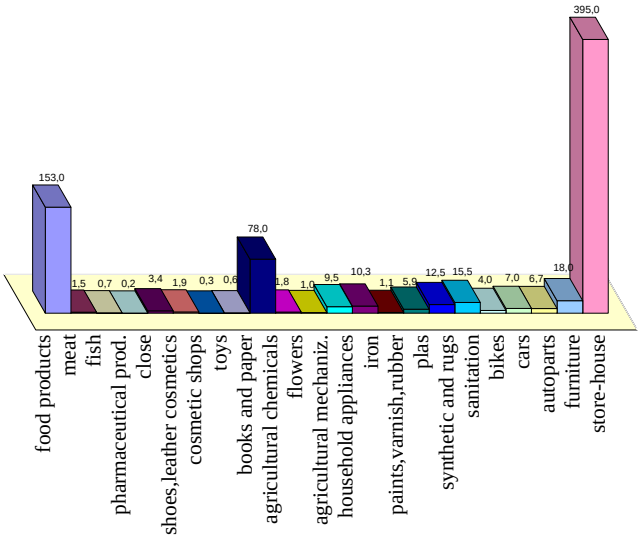

Fig.3. Quantity of daily delivered goods (t), by type

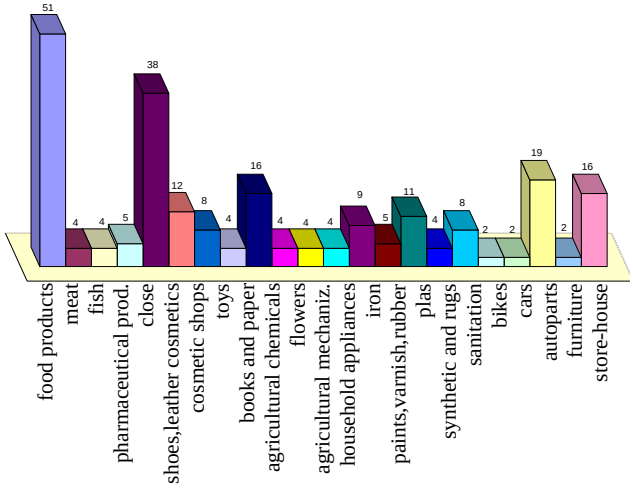

Fig.4. Daily number of deliveries, by type of goods

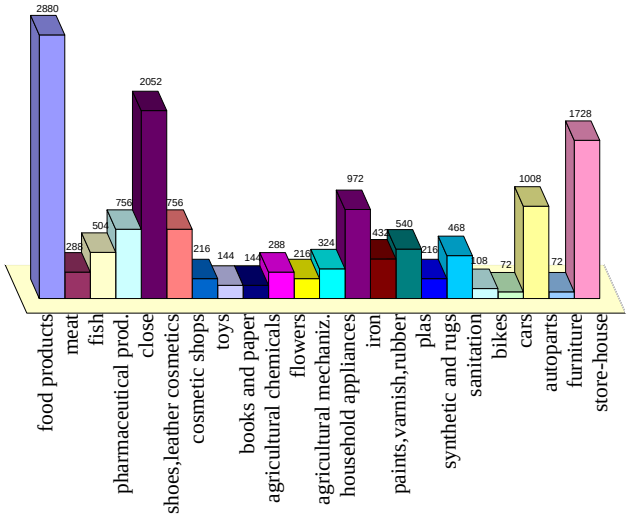

Fig.5. Yearly number of deliveries, by type of goods

As mentioned before, with the collected data for the type and the quantity of the delivered goods (by one delivery and daily) as an parameters as well as with its average values for each of the defined zones (z=1,…,6), a mathematical modes has been conducted.

4. DESCRIPTION OF THE DEFINED MATHEMATICAL MODEL

The calculation steps of our mathematical model are as follows:

First step: Define the total quantity of delivered goods by zone, daily/yearly:

Qvk,d^{z} - Total quantity of delivered goods by zone, daily

Qvk,g^{z} - Total quantity of delivered goods by zone, yearly

Second step: Defining the equation for establishing Qvk,d^{z} as well as Qvk,g^{z}

$$Qvk,d^{z}=\sum_{i=1}^{m}Qi,d^{z} \quad (1)$$

$$Qvk,g^{z}=\sum_{i=1}^{m}Qi,g^{z} \quad (2)$$

Where:

Qi,d^{z} - Total quantity of each type of the delivered goods by zone, daily

Qi,g^{z} - Total quantity of each type of the delivered goods by zone, yearly

$z=1,2,3,4,5,6$ - Zone number

$i=1,2....22$ - Type of goods

Third step: Defining the equation for establishing Qi,d^{z} as well as Qi,g^{z}

$$Qi,d^{z}=q_{i,d}^{pr}\cdot n_i^{z} \quad (3)$$

$$Qi,g^{z}=q_{i,g}^{pr}\cdot n_i^{z} \quad (4)$$

Where:

$q_{i,d}^{pr}$ - Average quantity of each type of the delivered goods by sale points, daily

$q_{i,g}^{pr}$ - Average quantity of each type of the delivered goods by sale points, yearly

$i=1,2....22$ - Type of goods

n_i^{z} - Number of sale points in each zone (z)

Fourth step: Define the average quantity of delivered goods by types in one point, daily/yearly:

$$q_{i,d}^{\ pr} = \frac{Qi,d^{\ vk}}{N_i} \quad (5)$$

$$q_{i,g}^{\ pr} = \frac{Qi,g^{\ vk}}{N_i} \quad (6)$$

Where:

$Qi,d^{\ vk}$ - Total daily quantity of delivered goods in NCAB

$Qi,g^{\ vk}$ - Total yearly quantity of delivered goods in NCAB

N_i - Total number of sale points by type in NCAB

For the simplification of the calculation steps, as well as for latter connecting of the data in a related data base, we have chosen the Microsoft EXCEL packet.
Model results are shown in table 1, named as simplified quantity of goods table.

Table 1. *Total quantity of goods (tone), by types, by zones and totally in NCAB, daily*

type of goods		ZONE					
i	N_i	1	2	3	4	5	6
1	15	0.00	20.40	30.59	40.79	30.59	30.59
2	8	0.18	0.18	0.18	0.73	0.00	0.18
3	4	0.00	0.00	0.33	0.33	0.00	0.00
4	6	0.04	0.04	0.08	0.04	0.00	0.04
5	34	0.71	0.10	1.62	0.71	0.30	0.00
6	12	0.31	0.00	0.31	0.31	0.94	0.00
7	4	0.07	0.00	0.20	0.00	0.00	0.00
8	4	0.00	0.14	0.28	0.00	0.14	0.00
9	2	0.00	0.00	78.00	0.00	0.00	0.00
10	6	0.00	0.59	0.00	1.18	0.00	0.00
11	3	0.33	0.00	0.33	0.33	0.00	0.00
12	5	1.90	1.90	0.00	3.80	0.00	1.90
13	17	1.21	0.00	4.86	2.43	1.21	0.61
14	5	0.22	0.00	0.88	0.00	0.00	0.00
15	11	0.00	0.53	1.60	1.07	1.60	1.07
16	3	4.17	0.00	4.17	4.17	0.00	0.00
17	4	7.75	3.88	3.88	0.00	0.00	0.00
18	2	0.00	0.00	0.00	4.00	0.00	0.00
19	2	0.00	7.00	0.00	0.00	0.00	0.00
20	13	0.51	0.51	0.51	2.57	1.03	1.54
21	2	0.00	0.00	9.00	0.00	9.00	0.00
22	2	0.00	0.00	197.50	0.00	0.00	197.50
		17.41	**35.27**	**334.32**	**62.45**	**44.82**	**233.43**
		727.7 (t)					

As it shown, total daily quantity of delivered goods in NCAB, is:

$$\sum_{i=1}^{m} Qi,d^{\ vk},\ i=1,2,.....22 = 727,7(t)$$

Total yearly quantity of delivered goods is also calculated, and is:

$$\sum_{i=1}^{m} Qi,g^{\ vk},\ i=1,2,.....22 = 160469,4(t)$$

According to the table 2, we can present the daily burden in each zone, (figure 6).

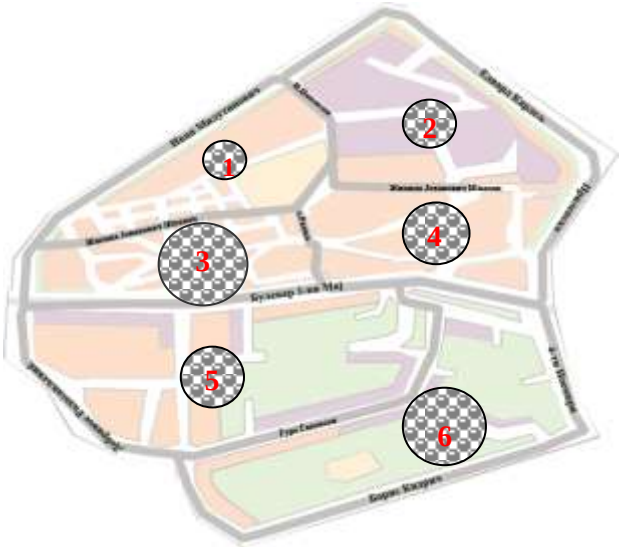

Fig. 6. Daily burden by zones in NCAB

Legend:

0 - 20 (t)

20 - 60 (t)

60 - 150 (t)

150 - 250 (t)

250 - 350 (t)

5. QUALITATIVE MEASURE ANALYSIS

Daily delivery frame time is one of the several qualitative measures. That's important parameter for later defining of the quality of service in the NCAB.

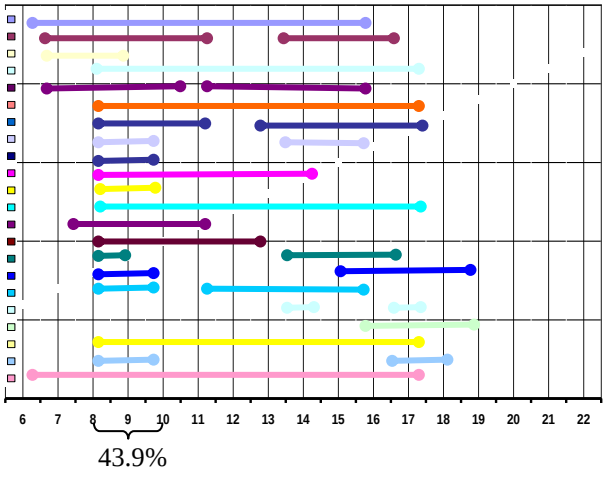

Fig.6. Daily delivery frame time by type of goods

As it's shown (figure 6), 43.9% from the total number of the deliveries is realized among $8^{\underline{00}}$ – $10^{\underline{00}}$ a.m. The number of the deliveries is lower between $12^{\underline{00}}$ – $18^{\underline{00}}$ p.m., and lowest in the night hours.

Delivery vehicles access, parking, and the quality of their loading and unloading operations are also the parameters of the analysis. Namely, there's no mistake with the consideration of the preference that the operations are "chaotic". Unfortunately, from the terrain analysis we had concluded and describe the situation like this:

- limited access because of the illegally parked TAXI vehicles;
- limited access because of the inappropriate road geometry;
- manually handled loading and unloading operations;
- deficiency of loading ramps;
- conflicts between delivery vehicles;
- conflicts among delivery vehicles and other traffic consumers; est.

6. CONCLUSION

Here a mathematical model for determining the type of delivered goods, daily and yearly burden by zones and in the whole historical core of the town of Bitola - NCAB is developed and presented. A model as well as other defined qualitative and quantitative parameters as measures of effectiveness for our micro-logistic system, are describing detail approach and methodology which should be applied on every micro-logistic distributive system analysis. Namely, this kind of model, as well as the methodology in a whole, can very simply be adapted for other micro logistical system.

The development of such a methodology is a primary key in planning and managing successful city logistic strategy. This way, we can talk about the integration of the cargo transportation in the local planning process, step by step. Finally, this is the only way for creating sustainable Local Street for all traffic and transport utilities, and for achieving the greater range of quality of service and quality of life in the urban areas.

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