TRIP DISTRIBUTION AND TRAFFIC ASSIGNMENT FLOW OF ROADS NETWORK IN URBAN AREA IN VLORA, WITH TRANSCAD

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ABSTRACT

During the performance in planning process of the traffic flows in an urban area, the case of Vlora City, a very important stage is the distribution trip phase or the build of the matrix of tripping O-D. For the build of this matrix is important the balanced table of trip, generated and extruded. Method that have to be used for the distribution trip, is gravitational method. Build of tripping matrix is the base for the loading in the roads network of the urban zone. This is accomplished next phase that is the traffic assignment phase (assignment). Assignment of traffic flow over the road network will be based in method "all or nothing". Both phases have to be worked in TRANSCAD program. On the base results, we will draw the relevant conclusions, which will be issuing the part of network less loaded and the issuing parts with more heavily loaded.

Keywords: *distribution, trip, flow, assignment, method.*

1. INTRODUCTION

City of Vlora is an urban zone, which in recent years has begun to feel the effect of a huge traffic flow. From year to year, the number of vehicles have been increased. By being a touristic town, in summer and winter time, is demonstrated the flow of increase vehicles. Vlora have a great potential of development, in terms of truism as well as in commercial and industrial fields. This refers to the position as a seaside town and with the port connected on it, and being one the connected gate between Albania and Italy, and with other countries. After '90, in town has a huge increase of rural population toward the city, which is still continue till now.

This has make the traffic flow over the roads network in city to be feels more, not only in the certain periods of the year, but also in the peak hours. This situation has led to an urgent needed plan and a better distribution of traffic flow over the roads network. In this time we don't have an engineering using method for the planning of traffic flow over the roads network in city, below I will present a method how it can be done.

For the realizing this, first of all is necessary to build the tripping table generated and extruded, in which for our study we will take it from a previous work. Table has come from the calculation of tripping regression, relying on on-line data extracted from the relevant institution relating on number of population, the assets, activities and the measurements of traffic flow which are measured in certain points of roads network of urban zone.

Balanced trip table in one column contains generating trip and in the other column are the diverted trip. This table, with TRANSCAD program, by using gravitational method, will be spread for every pair O-D, by taking in the end the trip matrix. This matrix contains traffic flow that will be done for every pair O-D.

On the base of tripping matrix for every pair O-D we will pass the traffic assignment fluxes over the road network in the urban zone. For the traffic assignment fluxes will be used the method "all or nothing". After we assign the matrix over the road network, we see also the other part of network that is less loaded and also those more heavily loaded.

The importance of this work, is based in the fact of base of outcoming result can be make a better organization of traffic flow, by diverting it from the other part of network assignment in that less assignment. At the same time can be serve also like a base for planning investment for possible intervention in infrastructure or the building of new infrastructure. Graphic of traffic flow over the road network can be served also as a base for urban development, by keep the acceptable reports between house living and the number of available vehicles. Also, another intervention for traffic flux reduce, can be the alternative of planning urban transport.

2. MATERIAL AND METHODS

For the realization of this work, we will focus on the classic model of transport. Classic model is split in four phases. In the first phase gather the social – economic data and those for the territory. Also made measure of traffic flow over the road network in urban zone, which will become the tripping plan. Second phase is the generated phase and the trip attraction, with such factors as, population, activates, number of vehicles etc. During this phase, also is effecting prediction for the future by using. If we will have to anticipate a later period for example year 2030, we chose the technique of growing factor. Basic equation is:

$$T_i = F_i \cdot t_i \qquad (1)$$

where T_i and t_i are respectively prediction for the future and actual trip in zone i, and F_i is the growing factor. The only problem of this method is the estimating of F_i, other part is useless. Factor is connected with variables like population (P), incomings (I) and the number of ownership vehicles in a function below:

$$F_i = \frac{f(P_i^d, I_i^d, C_i^d)}{f(P_i^c, I_i^c, C_i^c)} \quad (2)$$

where ***f*** can be a function without parameters, and service *d* and *c* describe the current year and the incoming year too. Over the base of founded formula from the regresion, recalculating once more the generating attracting trip. After recalculating, we make the balanced table, so number of generated attracted trips must be the same.

Third phase is the distributing tripping phase or builded phase of tripping matrix O-D. Every cell of trip matrix in every row *i*, contain the origin of trips in a zone and every respective cell of column *j*, destination in the other area that it corresponds. Main diagonal corresponds travel within the area. T_{ij} is the number of trips between origin *i*and destination *j*. All the traveling group is marked with $\{T_{ij}\}$ or T. O_i is the total number of tripping that it has the origin in zone *i*, and D_j is total number of tripping that has the destination in zone *j*.

Building of this matrix is based in the model of gravitational distribution, in analogy with gravitational model of Newton. The simple formulation of gravity model is expressed as follow:

$$T_{ij} = \frac{\alpha P_i P_j}{d_{ij}^2} \quad (3)$$

where P_i and P_j are population origin and the destination, d_{ij} is distance between *i* and *j*, while α is the factor of probability (with unit of distance – trip^2 / population^2).

Using of method with analogy with law of gravity, instead of total population, use of total trip (O_i and D_j) and a parameter *n*, for calibrating like power for d_{ij}.

Fourth and final phase is the traffic assignment phase. Through this phase is made the matrix assignment of trip over the road network which is in review. Too many methods are used for the assignment traffic flow over the road network, but we will use technique "all or nothing assignment" which is also more simple method. This method assumes that there are no traffic jams and drivers have the same attributes in the selection of the road and they perceive in the same way method. This means that every driver for going from *i*to *j* will chose the same road, and no other driver has chosen another road to go from *i* to *j*. Algorithm of traffic assignment is a procedure which it attract matrix T for tree of shortest path and produce fluxes $V_{A,B}$ in connection (between nodes A and B). All the algorithmic of attraction started with beginner phase, in this case, making all $V_{A,B} = 0$ and then apply one of the two classic methods: method pair to pair and between approximations.

Method pair by pair: in this case we start from an origine and we take destination take on. In the beggining we start with $V_{A,B} = 0$. Then we continue for every pair (*i*,*j*).

Walking through: this method is known as method "cascade" and it assignment the accumulated fluxes from the nodes to connections by follow the minimal cost tree from a origin *i*.

2. RESULTS AND DISCUSSION

Continuing the above reason, as the beginning we present the unbalanced table. This table is built by connecting statistically through mathematical regression, generated and attracted trips with other factors, which are the population, number of ownership vehicles, number of activities, etc. With "Origin" we mark the centroid codes, which are the center zones, and ID are numbers of identification zones.

Table 1. Unbalanced table of generated and attracted trips for years 2012 – 2030

Origin	ID	Gen_'12	Attr_'12	Gen_'30	Attr_'30
123	1	450	703	1517	812
142	2	1223	1408	1606	2286
124	3	971	818	1713	1288
146	4	246	1103	1001	745
134	5	495	447	1789	920
143	6	360	796	1167	1730
131	7	754	433	1909	579
156	8	612	987	374	1644
140	9	369	456	1335	808
147	10	423	116	951	406
151	11	488	475	475	1034
150	12	746	628	895	1392
144	13	400	470	380	922
148	14	879	433	400	1094
127	15	15	36	487	506
126	16	919	383	181	1462
152	17	2127	1755	4255	4698
128	18	1001	829	754	1512
154	19	475	666	1487	1216
129	20	33	7	225	178
122	21	948	584	1455	1722
176	22	19	22	79	123
136	23	905	1410	1487	2836
138	24	669	545	1499	657
132	25	780	1073	548	1984
Total		16304	16584	27969	32554

This table doesn't guarantee that number of generated trips from zone O_i, to be equal with attracted trips from zone D_j, according to equation below:

$$\sum_i O_i = \sum_j D_j \quad (4)$$

For this reason, normal practice, is that all destinations D_j to be multiplied from a factor f, which is given like below:

$$f = T \Big/ \Sigma_j D_j \quad (5)$$

As a conclusion, by doing the procedure of balanced trips with TRANSCAD, we can give the final balanced table for all generated attracted trips from each zones, for both years we took in consideration.

Table 2. Balanced table of generated and attracted trips for years 2012 – 2030

Origin	ID	Gen_'12	Attr_'12	Gen_'30	Attr_'30
123	1	450	691	1517	697
142	2	1223	1384	1606	1964
124	3	971	804	1713	1106
146	4	246	1084	1001	640
134	5	495	439	1789	790
143	6	360	782	1167	1486
131	7	754	426	1909	497
156	8	612	970	374	1412
140	9	369	449	1335	694
147	10	423	114	951	349
151	11	488	467	475	889
150	12	746	618	895	1196
144	13	400	462	380	792
148	14	879	426	400	940
127	15	15	36	487	435
126	16	919	376	181	1256
152	17	2127	1725	4255	4036
128	18	1001	815	754	1299
154	19	475	654	1487	1045
129	20	33	7	225	153
122	21	948	574	1455	1479
176	22	19	22	79	106
136	23	905	1386	1487	2436
138	24	669	536	1499	565
132	25	780	1055	548	1705
Total		16304	16304	27969	27969

After having the balanced table above, of generated and attracted trips, we can continue through TRANSCAD the procedure of distributing trips, which is based in the gravitational model of distribution.

For the year 2012, distributed matrix will be reflected as in the table above. In rows are reflected origin fluxes for each zone, while in columns are fluxes for each zone as a destination. In diagonal of trip matrix are trips that can take place inside each area and who consider as zero.

Same procedure will be make with TRANSCAD also for year 2030, table that reflect trip matrix with the same data as the table of 2012, is given below. After we build trip matrix, we start the last phase, which is the phase of assignment fluxes of traffic over the road network, of urban space of Vlora. Also this phase will be realized with TRANSCAD.

As we mentioned above, we will use the method "all or nothing assignment". Graphical presentation of traffic over the road network with method "all or nothing assignment" also realized with TRANSCAD program, is presented below.

In this graphic are presented traffic fluxes over the road network in city of Vlora with method "all or nothing", realized with TRANSCAD, for year 2012 and 2030. For each part of network are presented also fluxes value. We can easily see each part of network more assignment and those less assignment. Over the base of this presentation we will do also the analyses and conclusions.

Figure 1 Introduction of traffic fluxes over the road network of urban space in city of Vlora with method "all or nothing", realized with TRANSCAD for year 2012

Figure 2 Introduction of traffic fluxes over the road network of urban space in city of Vlora with method "all or nothing", realized with TRANSCAD for year 2030

Table 3. Distributed matrix of trips with gravitational model for year 2012

2012	Des																									
Orig.	122	123	124	126	127	128	129	131	132	134	136	138	140	142	143	144	146	147	148	150	151	152	154	156	176	Tot.
122		58	55	24	2	48	0	26	61	26	82	29	27	91	40	25	78	6	23	34	26	103	34	48	1	948
123	24		27	11	1	22	0	12	29	13	39	14	13	45	19	12	39	3	11	17	13	48	16	23	1	450
124	41	48		24	2	49	0	28	66	29	88	31	29	101	43	27	77	7	24	36	27	106	35	51	1	971
126	35	39	47		2	53	0	25	61	25	84	30	24	81	43	25	60	6	23	33	24	111	37	50	1	919
127	1	1	1	0		1	0	0	1	0	1	0	0	1	1	0	1	0	0	1	0	2	1	1	0	15
128	37	41	51	27	2		0	27	68	27	93	35	27	89	51	28	64	7	27	38	28	130	43	59	1	1001
129	1	1	1	1	0	2		1	2	1	3	1	1	3	2	1	2	0	1	1	1	5	1	2	0	33
131	28	32	41	18	2	39	0		53	22	71	25	21	72	34	21	51	5	19	28	21	83	28	40	1	754
132	29	34	42	19	2	42	0	23		23	77	28	23	75	38	24	53	6	21	31	23	92	31	44	1	780
134	19	22	27	12	1	25	0	15	35		45	16	14	48	22	14	34	3	12	18	14	54	18	26	1	495
136	35	40	50	24	2	52	0	28	69	27		33	27	88	45	27	63	7	25	36	27	111	37	52	1	905
138	23	26	33	16	1	36	0	18	46	18	60		18	58	35	20	41	5	19	26	19	83	28	40	1	669
140	14	17	20	8	1	18	0	10	25	11	32	12		37	16	11	26	3	9	14	11	40	13	20	0	369
142	51	60	76	30	3	65	0	37	89	38	116	42	40		58	37	95	9	33	49	37	141	47	68	2	1223
143	12	14	17	9	1	20	0	9	24	9	32	13	9	31		11	22	3	11	15	11	49	16	23	0	360
144	14	16	20	9	1	20	0	11	27	11	35	14	11	36	19		25	3	11	17	12	47	15	23	1	400
146	12	14	15	6	1	13	0	7	17	7	22	8	8	26	11	7		2	6	9	7	27	9	13	0	246
147	15	17	21	9	1	20	0	11	28	11	36	14	12	38	19	13	27		12	18	13	48	16	24	1	423
148	29	34	41	20	2	44	0	22	57	22	74	31	23	74	45	26	52	6		38	27	114	37	58	1	879
150	25	30	37	17	1	37	0	19	49	20	64	26	21	66	37	23	47	6	23		26	93	30	48	1	746
151	17	20	24	11	1	24	0	13	32	13	41	16	14	44	23	15	31	4	14	23		58	19	30	1	488
152	77	86	107	56	5	128	1	58	147	58	197	80	58	190	123	65	135	16	68	92	67		117	194	3	2127
154	16	18	22	11	1	26	0	12	30	12	41	16	12	39	25	13	28	3	13	18	13	72		32	1	475
156	20	23	28	14	1	32	0	15	38	15	51	21	16	50	32	18	35	4	19	26	19	106	29		1	612
176	1	1	1	0	0	1	0	0	1	0	2	1	0	2	1	1	1	0	1	1	1	2	1	1		19
Total	574	691	804	376	36	815	7	426	1055	439	1386	536	449	1384	782	462	1084	114	426	618	467	###	654	970	22	16304

Table 4. Distributed matrix of trips with gravitational model for year 2030

2030	Des																								
Orig.	122	123	124	126	127	128	129	131	132	134	136	138	140	142	143	144	146	147	148	150	151	152	154	156	176	Tot.
122		56	70	70	25	69	8	28	89	45	134	29	39	116	73	40	43	18	45	60	45	236	51	62	5	1455
123	119		71	66	24	66	7	28	89	46	133	29	41	119	73	40	45	19	46	62	47	229	50	63	5	1517
124	106	51		77	29	78	8	34	106	55	158	34	47	142	86	47	47	22	53	72	53	269	59	74	6	1713
126	10	5	7		3	9	1	3	11	5	17	4	4	13	10	5	4	2	6	7	5	32	7	8	1	181
127	28	13	21	23		23	2	9	30	15	45	10	12	36	25	13	12	6	15	19	14	78	17	21	2	487
128	40	18	30	37	12		4	14	46	22	70	16	18	52	43	21	16	9	25	31	22	138	31	36	3	754
129	11	5	8	10	3	11		4	12	6	19	4	5	14	12	6	4	2	7	9	6	46	9	11	1	225
131	103	48	81	84	31	87	9		121	61	181	39	49	144	97	53	44	24	59	78	57	302	67	82	7	1909
132	30	14	23	25	9	26	3	11		17	55	12	15	42	30	16	13	7	18	24	18	93	20	25	2	548
134	98	47	78	79	29	81	9	37	114		168	37	48	141	91	50	43	23	56	75	55	284	63	78	6	1789
136	84	39	65	72	26	76	8	31	103	48		34	40	116	84	44	36	20	51	66	48	262	58	71	6	1487
138	73	34	57	64	22	71	8	27	91	42	135		36	102	86	43	31	19	51	65	46	262	58	72	5	1499
140	74	36	59	56	21	59	6	26	83	42	120	27		108	68	38	33	18	43	58	44	210	46	59	5	1335
142	97	47	78	73	27	75	8	33	105	54	154	34	48		85	47	43	22	53	71	53	263	58	73	6	1606
143	57	27	44	51	17	57	7	21	70	33	104	27	28	79		34	24	15	43	52	37	227	50	62	4	1167
144	19	9	15	16	6	17	2	7	23	11	34	8	10	27	21		8	5	13	18	13	64	14	18	1	380
146	67	33	48	44	16	44	5	19	60	31	89	19	27	80	49	27		12	30	41	31	152	33	42	3	1001
147	48	23	38	38	14	41	5	17	57	28	83	20	25	69	50	29	21		32	44	33	155	34	44	4	951
148	19	9	15	16	6	18	2	7	23	11	34	9	10	27	23	12	8	5		19	14	74	16	21	2	400
150	45	22	35	36	13	40	4	16	54	25	78	19	23	63	50	27	20	12	34		34	160	34	47	4	895
151	24	12	19	19	7	21	2	8	28	14	41	10	12	34	26	14	11	7	17	25		82	17	24	2	475
152	238	108	178	217	70	240	32	84	280	131	421	105	112	318	294	135	98	59	177	217	154		234	335	19	4255
154	70	32	53	64	21	72	9	25	84	39	126	31	33	94	88	40	29	17	51	62	44	316		81	5	1487
156	17	8	13	15	5	17	2	6	20	10	30	8	8	23	21	10	7	4	14	17	12	89	16		2	374
176	4	2	3	3	1	3	0	1	4	2	6	2	2	5	4	2	2	1	3	4	3	14	3	4		79
Total	1479	697	1106	1256	435	1299	153	497	1705	790	2436	565	694	1964	1486	792	640	349	940	1196	889	4036	1045	1412	106	27969

3. CONCLUSIONS

Judging by the appearance of traffic flows on the road network of the city of Vlora, we can say that it is completely possible to use engineering planning modeling traffic flows.

To realize this, it is necessary to gather all information from institutions as civil offices for number of population, registration vehicles office, tax offices for the number of businesses, the road network and administrative division planning offices in municipalities, etc.

From graphic presentation we see that traffic flow will be increased on road network, compare year 2012 with year 2030. This comparison is made by considering that the road network of the urban area is the same. For year 2030 is considering also the build of Vlora city by-pass, which will reduce the traffic flow in entrance, from highway, in northern part.

Noted that the part of road network along the seaside is less assignment and it has to be found a solution for the part of fluxes who are passing by. This can be realized by the local authorities, who can invest in the improvement of the road, both in quality and in the expansions.

Another intervention that can be realized, is also the better organization of traffic, especially in the heavy assignment parts.

4. REFERENCES

[1] WILLUMSEN, L. G., ORTUZAR, J. D. D. *Modelling Transport. 4th edition, Wiley*, 2011
[2] CASCETTA, E., . *Transportation Systems Analysis: Models and Applications. 2nd edition, Springer*, 2009
[3] Marco Fuhrman *Appunti sulla regression lineare.*
[4] Census of population and houses, year 2011.
[5] Resident Office of Tax Statistics, Municipality of Vlora, year 2011.
[6] Statistics of Directory of Car Registration in Vlora, year 2011.
[7] Map in AUTOCAD of Vlora Municipality.
[8] Trafic plan of Vlora Municipality, year 2001.
[9] Natioanl Plan of Transport, year 2010.
[10] Used Software: TRANSCAD and STAPRO.