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Integration of the Kosovo Road Network into the Pan-European Transport Network

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Abstract Integration of the Kosovo road network in the Pan-European network, means, first of all, to establish a road system and infrastructure that is in accordance with the requirements and standards of Pan-European road networks, and secondly, to use / promote the geographical position of the Kosovo main road network, making it able to meet the requirements of Pan-European road networks. Beside the fulfillment of the constructive/ technical / geometrical requirements towards the road infrastructure, the road transport network needs to guarantee to its users a high, uniform and continuous level of services, as well as road commodity and safety. In this thesis, there is also treated the position of the Kosovo road network, the main road directions of Kosovo and its compatibility with the needs of the Pan-European connection, the roads and corridors of the Balkans in context to the Pan-European corridors. In the continuation of the thesis, through the Software Trans CAD, there is conducted the analysis and the modeling of the Kosovo and Balkan road network, the analysis of the best connection and the shortest roads of Balkan countries. The identification of obstruction and the presentation of possibilities for the orientation of the flux of goods in a shorter road, in the function of reduced transport costs. The comparison of advantages and disadvantages of the existing roads (the eighth Pan-European corridor, the Tenth Pan-European Corridor, Via Egnatia etc), the economical sustainability and competition, the service quality, limitations (both natural, environmental / season or humane), transport capacities.

Keywords Kosovo, Roads, Modeling with Trans CAD

1 Introduction

The development of road infrastructure is the determining factor of economic development of our country, it is an essential element of economic cooperation, scientific, cultural, free movement of people etc., cooperation which is wider and deeper every day, being the current priority. It is clear that the Balkan and European integration, the first phase of which is the Stability Pact, constrain the integration of road network of our country in the Pan-European infrastructural network transport, as an appropriate link with the Trans-European network of European community. Final stabilization of peace in the Balkans, coexistence in diversity, free movement of goods, capital and ideas requires you to shorten to the maximum the time of contact between producers and users. And it is Kosovo that has something to offer in this field to the Balkans and beyond, with its important position as a connecting bridge, and important link of the Pan-European corridors. Kosovo is located in the center of Eastern Europe and it is claimed to have been historically an important crossroad of the Balkan Peninsula. Road construction VI and VII, their connection with the Pan European corridors VIII and X, enabling integration and better links of Kosovo with neighboring countries but also in neighboring countries with each other, this connection enables that a part of the international traffic (goods and Passengers) from Eastern Europe can be redirected towards Kosovo to the Adriatic sea ports, and from the Adriatic to the Black Sea through Kosovo as the shortest route.

Table 1. The road network in Kosovo

Competence / Type	Paved	%	Unpaved	%	Total in Km
MI	1810	94.2	111	5.8	1921
Motorway	68				68
National	599	99.3	4	0.7	603
Regional	1173	91.6	107	8.3	1280
Municipal					5034
Local					4463
Urban					571
Total					6985

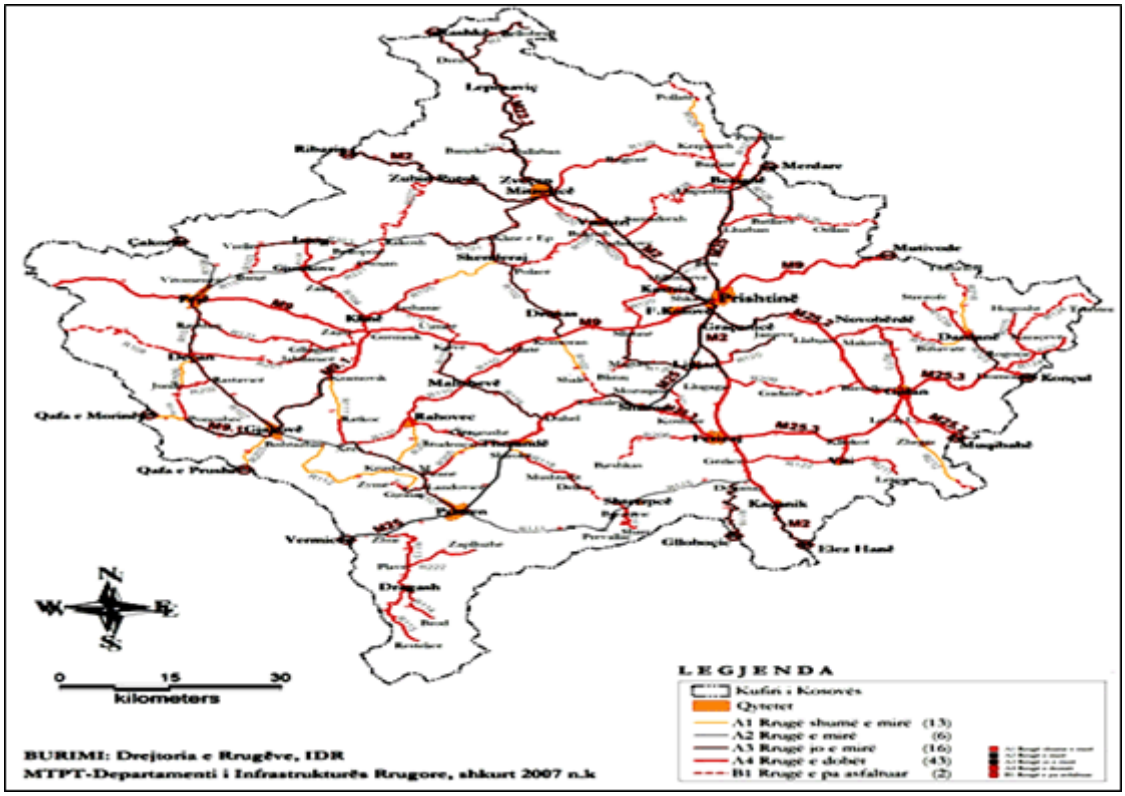


Figure 1. Map of national and regional roads in Kosovo

1.1. The Primary Road Network in Kosovo

In Figure 2, below, there is presented the primary (main) road network of Kosovo which enables connection to the Core Road Network of South East Europe (SEETO) and further complete of integration in Pan - European Transport networks.

Figure 2. Kosovo's primary road network that integrates with Network SEETO and further the Pan European networks

The road network of the first category includes the new highway (until now built 82 km long) that connects Kosovo from border in Vermica (border with Albania) with Kosovo's capital Pristina, to continue further to the border with Serbia in Merdare border crossing point, further being connected with the city of Nis which is a transit joint of the Pan European Corridor X.

2. Pan-European Transport Corridors (PETC)

Ten Pan-European Transport Corridors are determined in the second Pan-European Transport in Crete, March 1994, as routes in Central and Eastern Europe that require major investments over the oncoming ten to fifteen years. Other additions were made at the third conference in Helsinki in 1997, therefore, these corridors are named as "Crete Corridors" or "Helsinki Corridors", regardless of their geographical location. A tenth corridor was proposed after the end of the war between the states of the former Yugoslavia. Recently, there is approved an eleventh corridor stretching from Romania, through Serbia and Montenegro to Italy. It is known that this corridor will pass through Belgrade and will incorporate highway Belgrade - Bar (Montenegro). Corridors, in varying order, include road, rail and navigable waterway itineraries.

Figure 3. Pan European Network Corridor

Table 2. Ten Pan European Corridors

I	(North-South) Helsinki - Tallinn - Riga - Kaunas and Klaipeda - Warsaw and Gdansk ● Branch A (Via/Rail Hanseatica) - St. Petersburg - Riga - Kaliningrad - Gdansk - Lübeck ● Branch B (Via Baltic/E 67) - Helsinki - Warsaw.
II	(East-West) Berlin - Poznań - Warsaw - Brest - Minsk - Smolensk - Moscow - Nizhny Novgorod
III	Brussels - Aachen - Cologne - Dresden - Wrocław - Katowice - Kraków - Lviv - Kiev ● Branch A - Berlin - Wrocław
I V	Dresden/Nuremberg - Prague - Vienna - Bratislava - Győr - Budapest - Arad - Bucharest - Constanța /Craiova - Sofia - Thessaloniki / Plovdiv - Istanbul.
V	(East-West) Venice - Trieste/Koper - Ljubljana - Maribor - Budapest – Uzhhorod Lviv - Kiev. 1,600 km (994 mi) long. ● Branch A - Bratislava - Žilina - Košice - Uzhhorod ● Branch B - Rijeka - Zagreb - Budapest ● Branch C - Ploče - Sarajevo - Osijek - Budapest
VI	(North - South) Gdańsk - Katowice - Žilina, with a western branch -Katowice-Brno.
VII	(Danube River) (northwest-southeast) -2,300 km (1,429 mi) long.
VIII	Durrës - Tirana - Skopje - Sofia - Plovdiv - Burgas - Varna. 1,500 km (932 mi) long.
IX	Helsinki - Vyborg - St. Petersburg - Pskov - Gomel - Kiev - Ljubashevka - Chişinău - Bucharest -Dimitrovgrad - Alexandroupolis. 3,400 km (2,113 mi) long. The main sub-branches: St. Petersburg - Moscow - Kiev. ● Branch A - Klaipeda - Vilnius - Minsk - Gomel ● Branch B - Kaliningrad - Vilnius - Minsk - Gomel ● Branch C - Ljubashevka - Rozdilna - Odessa
X	Salzburg - Ljubljana - Zagreb - Beograd - Niš - Skopje - Veles - Thessaloniki. ● Branch A: Graz - Maribor - Zagreb ● Branch B: Budapest - Novi Sad – Beograd ● Branch C: Niš - Sofia - Plovdiv - Dimitrovgrad - Istanbul through Corridor IV ● Branch D: Veles - Prilep - Bitola - Florina - Igoumenitsa

In addition to the above corridors, later determined four transportation areas as important modal corridors:

- Barents Euro-Artic Transport Zone: Multimodal Transportation Zone covering the northern provinces of Sweden, Finland and Norway as well as Murmansk and Arkhangelsk and Karelia Republics and Komi of the Russian Federation.
- Black Sea Transport Area: Seaside countries of the Black Sea (Turkey, Georgia, Russia, Ukraine, Romania, Bulgaria) as well as Greece and Moldova (observer status to Armenia and Azerbaijan)
- Adriatic Ionian Sea Transport Area Sea: Adriatic and Ionian Seaside countries (Albania, Bosnia and Herzegovina, Croatia, Greece, Italy, Slovenia, Serbia and Montenegro)
- Mediterranean Transport Area (MEDA countries): Algeria, Cyprus, Egypt, Israel, Jordan, Lebanon, Malta, Morocco, Palestinian Territories, Syria, Tunisia and Turkey.

2.1. Pan European Road Network Who Influence in Kosovo Road Network

Corridors and branches which directly affect transport and Kosovo road network are:

- **Corridor IV** - Dresden / Nuremberg - Prague - Vienna - Bratislava - Győr - Budapest - Arad – Bucharest Constanța / Craiova - Sofia - Thessaloniki / Plovdiv - Istanbul: creating links through Serbia and Macedonia.
- **Corridor V** - (East-West) Venice - Trieste / Koper - Ljubljana - Maribor - Budapest - Uzhhorod - Lviv - Kyiv: creating links with Sarajevo (BH) via Serbia and Montenegro.
- **Corridor VII** - (Danube River) (northwest-southeast): as waterways who performs multi-modal transport corridors IV, V, VIII and X.
- **Corridor VIII** - Durres - Tirana - Skopje - Sofia - Plovdiv - Burgas - Varna: about creating routes that pass through the territory of Albania and Macedonia.
- **Corridor X** - Salzburg - Ljubljana - Zagreb - Belgrade - Niš - Skopje - Veles - Thessaloniki: creating connection via Nis (SR) and Skopje (MK).
- **Adriatic and Ionian Sea Transport Area**: Adriatic and Ionian Seaside countries (Albania, Bosnia and Herzegovina, Croatia, Greece, Italy, Slovenia, Serbia and Montenegro)

3. Mathematical Apparatus That Will Be Used for Implementation of the Project for the Integration of Kosovo Road Network into the PAN European Network

At first thrugh trans CAD software program we analyze which is the capacity of the Kosovo road network, the level of service (LOS), which enables the connection and integration of Kosovo in the Pan-European transport network. With TransCAD was calculated the flow of vehicles in Kosovo's main road network (roads: 6, 6a, 6b, and 7) defining clearly the Kosovo road network capacity for a period of time from 2012 - 2021.

3.1. Kosovo's Road Network –AADT

Based on analysis AADT on main roads of Kosovo in 2010 (Table 3), with TransCAD we calculate the level of service (LOS) for Kosovo main roads which connect and integrate it into the Pan European Network (Table 6)

Table 3. AADT on the main roads of Kosovo in 2010

Code	Name	Road	Car	Minibus	Pick Up	Medium Truck	Heavy Truck	Articulated Truck	Bus	TOTAL
C1	Doganaj	M2	6,083	160	386	175	22	513	55	7,393
C2	Vataj	R116	849	15	38	33	4	16	5	961
C3	Sojeve	M25.3	5,579	188	456	223	28	116	59	6,649
C4	Pasijan	M25.2	1,385	39	95	61	8	8	10	1,615
C5	Raniluk	M25.3	5,394	86	207	100	12	81	41	5,921
C6	Konjuh	M25	8,813	249	605	311	39	322	105	10,445
C7	Caraljevo	M25.3	4,943	214	527	378	47	317	61	6,487
C8	Babush	M2	9,912	316	769	441	55	442	95	12,031
C9	Slatina	M9	6,577	202	525	282	81	323	81	8,070
C10	Slivovo	M25.2	3,340	63	151	65	8	35	50	3,711
C11	Grastica	M9	2,780	100	243	122	15	49	12	3,322
C12	Vranidol	M25	9,428	208	504	235	29	248	142	10,795
C13	Milosheve	M2	9,217	254	617	325	41	208	41	10,702
C14	Brobanic	R101	2,910	81	197	106	13	93	23	3,423
C15	Kushtove	M2	2,427	67	163	86	11	55	11	2,819
C17	Zahaq	M9	6,032	229	556	279	35	166	97	7,394
C18	Dranoc	R107	6,096	194	468	207	26	145	97	7,232
C19	Pirana	R107	7,393	263	639	357	45	253	123	9,072
C20	Vlasnje	M25	6,293	217	529	319	40	202	95	7,695
C21	Prizren	R115	2,780	100	243	122	15	49	12	3,322
C22	Xerxe	R110	5,238	174	421	191	24	117	59	6,224
C25	Vitak	R101	1,568	39	94	51	6	43	10	1,811

3.2. Kosovo Road Network the Level of Service (LOS)

Results of the TransCAD application presented in the following table, relevant traffic flow of the Kosovo road network. Table 4 and 5 show the traffic data used to determine the capacity of roads, and reports volume / road capacity. Defining of the level of service and density: Density of vehicles is counted using the following equation:

$$D = vp / S \quad (1)$$

D - Density (car/km/lane),
Vp - Flow (car/hour/lane), and
S - Average speed of the car (km/hour)

Table 4. AADT and Report Volume /capacity in Kosovo's main road network (Rout 6,6a,6b, and Rout 7)

Roads	AADT	Volume / Capacity Proportion		
		2012	2018	2021
R-6	7,393	0.6	0.8	0.92
R-7	10,445	0.86	1	1
R-6	20,941	0.58	0.79	0.92
R-7	6,487	0.52	0.7	0.81
R- 6	12,031	0.97	1	1
R-6b	8,070	0.65	0.87	1
R- 6b	16,414	0.46	0.62	0.72
R- 7	10,795	0.87	1	1
R- 7	12,487	0.35	0.47	0.55
R- 7	8,554	0.69	0.92	1
R- 6a	10,812	0.87	1	1
R- 6a	20,855	0.59	0.79	0.91
R- 6a	8,144	0.66	0.88	1
R-6a	2,819	0.23	0.3	0.35
R- 6b	7,394	0.6	0.8	0.92
R- 7	7,695	0.22	0.29	0.34

Source: by Author

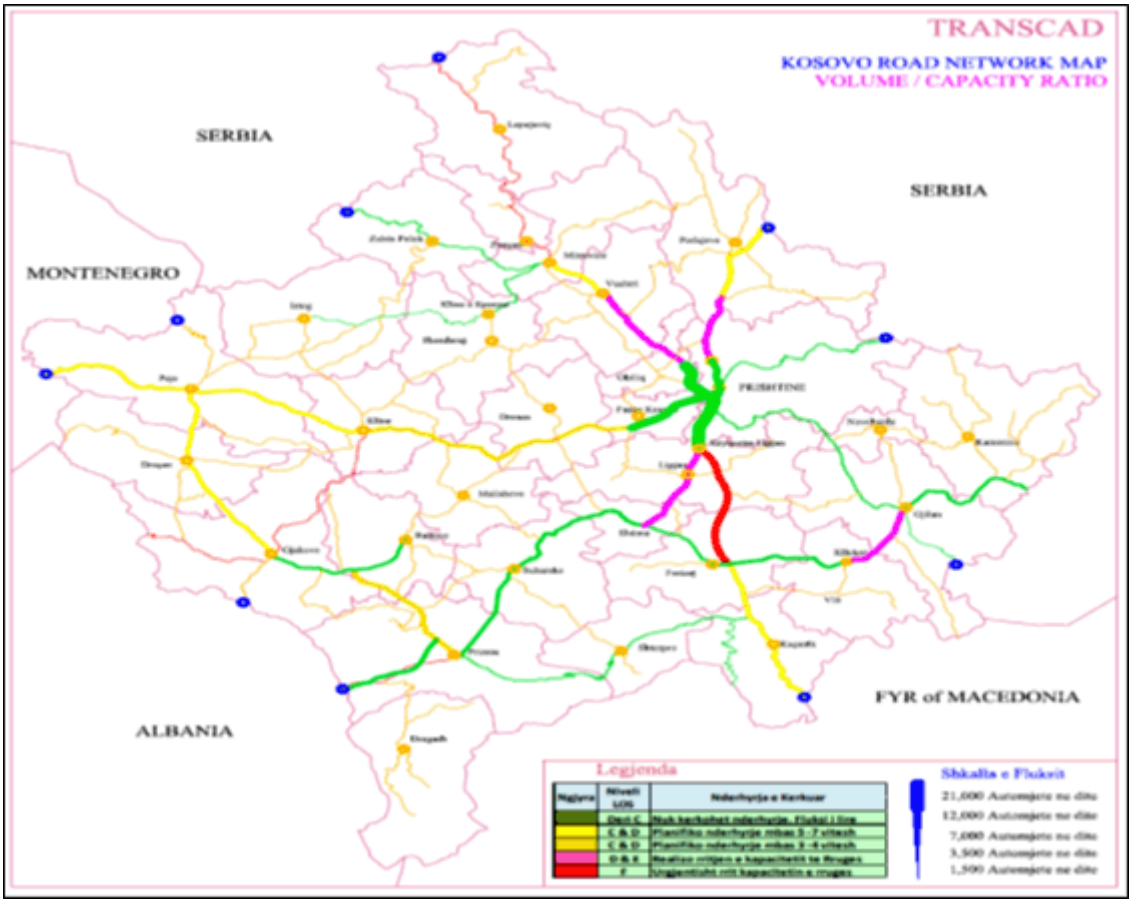
1. When volume/road proportion capacity amounts to 0.8, according to European and American standards should be increased road capacities through expansion, increasing the number of lanes or passing on a highway because the level of service deteriorates significantly.

2. The maximum value of the ratio volume / road capacity is 1, and it shows that the route has the lowest level of service F, which signals its blocking. Table 7 below given color codes and intervention required to increase transportation capacity, traffic volume, of road infrastructure.

Table 5. Color code and Level of service (LOS)

Color code	Level of Service (LOS)	Intervention Requested
	to C	Increasing road capacity is not required. The free flow
	C & D	Plan to increase road capacity after 5 -7 years
	C & D	Plan to increase road capacity after 3 -4 years
	D & E	Make and increase road capacity
	F	Urgently increases the capacity of the road

Source: by Author



Source by: Author

Figure 4. Kosovo road capacity calculated with Trans CAD

3.3. Mathematical Modeling of the Road Network and Traffic

Classic model used in TransCAD for analysis, optimization and forecasting of traffic in a road network model with 4 Stages is held pursuant to the Protocol and the following steps:

Trips generation: determines the frequency of origins or destinations in each zone by purpose of travel, based on the Land Use and demographics of families, as well as other socio-economic factors.

Trips distribution: match origins with destinations, often through using function of gravity model, which is equivalent to an entropy maximization model

Modal choice calculates the trips between each origin and destination that uses a one way (mode) specified transportation. This is in the final logit model.

Shortest trips: sets the travels performed with specific ways of transportation between origin and destination, according to certain routes. For scheduling road itineraries there is applied the Wardrop principle for user equilibrium in which each user chose the shortest path (travel time), this choice is performed in the same way by any other user.

Generation stage of trips (trips generation): mathematical models that are commonly used type of linear regression models as well as those using the gravitational at the distribution stage. Linear regression is used to find the correlation relationship between the number of movements from one area to generate the statistical data stochastic special qualities of the area, as are the number of residents, number of vehicles, macroeconomic indicators, etc. Cubic polynomial regression fits with a set of simulation dates.

Band of reliability is a simultaneous generation with simultaneous 95% confidence band constructed using the Scheffe method. The purpose of regression analysis is to model the expected value of a variable y in terms of the value of an independent variable (or independent variables vector) x. In the simple linear regression, the model is of the following type:

$$y = \boldsymbol{a_0} + \boldsymbol{a_1}\mathbf{x} + + \varepsilon \quad (2)$$

In many configurations of such a linear relationship there may not stand, for example, in the case of traffic volume dependence of the degree of motorization (number of auto vehicles per thousand inhabitants). In this case we can propose a quadratic model in the form of:

$$y = a_0 + a_1 x + a_2 x^2 + \varepsilon \quad (3)$$

In this model, when the rate of motorization varies from x to x + 1 units, traffic volume varies with the derivative of the expression a1 + 2a2x. The fact that the change in volume of traffic depends on x is what makes this non-linear dependence (This should not be confused with the statement

that this is a non-linear regression, but this is still the case of a linear regression). In general, we can model the expected value of y as a sequence of n polynomial benefiting the general model of polynomial regression:

$$y = a_0 + a_1 x + a_2 x^2 + a_3 x^3 + ... + a_n x^n + \varepsilon \quad (4)$$

The model of trip distribution: travel distribution model (O-D matrix) will use the Gravitational Model developed according to the following mathematical formula:

$$T_{ij} = k*(G_i^a * A_j^a) / C_{ij}^b \quad (5)$$

Where:

i & j Zone of origins and destinations.

Tij Passenger traffic flow (road transport) between zones **i** and **j .**

Gi Number of trips generated by the area of **i.**

Aj Number of trips attracted by zone **j** .

Cij Obstacles or resistance to travel between zones **i** and **j** .

(a function of travel time between **i** and **j**).

Whereas the factors a, b and k are constants to be determined conclusively as a value during the calibration of the model and represent the specific characteristics of concrete road infrastructure, *Modal choice stage*: mathematical model used in this step is modeling logit model: logit is a number p between 0 and 1 that is calculated by the formula:

$$\text{logit}_{(p)} = \log\left(\frac{p}{1-p}\right) = \log(p) - \log(1-p) \quad (6)$$

The grounds of the logarithmic function has little importance in this case, as long as it is greater than 1, but the natural logarithm with the base "e" is the one used most often.

Description of the shortest Trips: a mathematical model used in this case is the Wardrope or that of equilibrium users: Determination of equilibrium: to determine the traffic routes and its derivatives of the transport network we must have regulations and they are known as Equilibrium Conditions of Wardrope (1952). Optimal equilibrium of the user can be found by solving non-linear programming problem:

$$\min \sum_a \int_0^{va} Sa\,(x)dx \quad (7)$$

3.4. Presentation of the GIS Map, Integration of Kosovo road network in to Pan European network created in Trans CAD

The first step of the Trans CAD application procedure is the definition of the service area of study. Given the topic of study: Integration of Kosovo's road network into the Pan-European networks of transport, we selected the study area as an area that lies between the area of the Pan-European Networks and TEN-T (Trans-European Networks) and SEETO (South East European Transport Observatory) zone.

This selection is based on the argument that the analysis of OD (origin-destinations) of the traffic of goods and passengers should not only include the SEETO project area, but also other important areas of the world that are traffic generators and/or centroid-joints influential in the network: Chisinau (Moldova), Lviv (Ukraine), Kiev (Ukraine), Odessa (Ukraine), Istanbul (Turkey), which are also important joints of the Pan-European Corridors. Also, they should be excluded from the system the centroid joints that are away from the field of impact on Kosovo's road network. In Figure 5 below presented our project study area, extracted from the Google satellite imaging system.

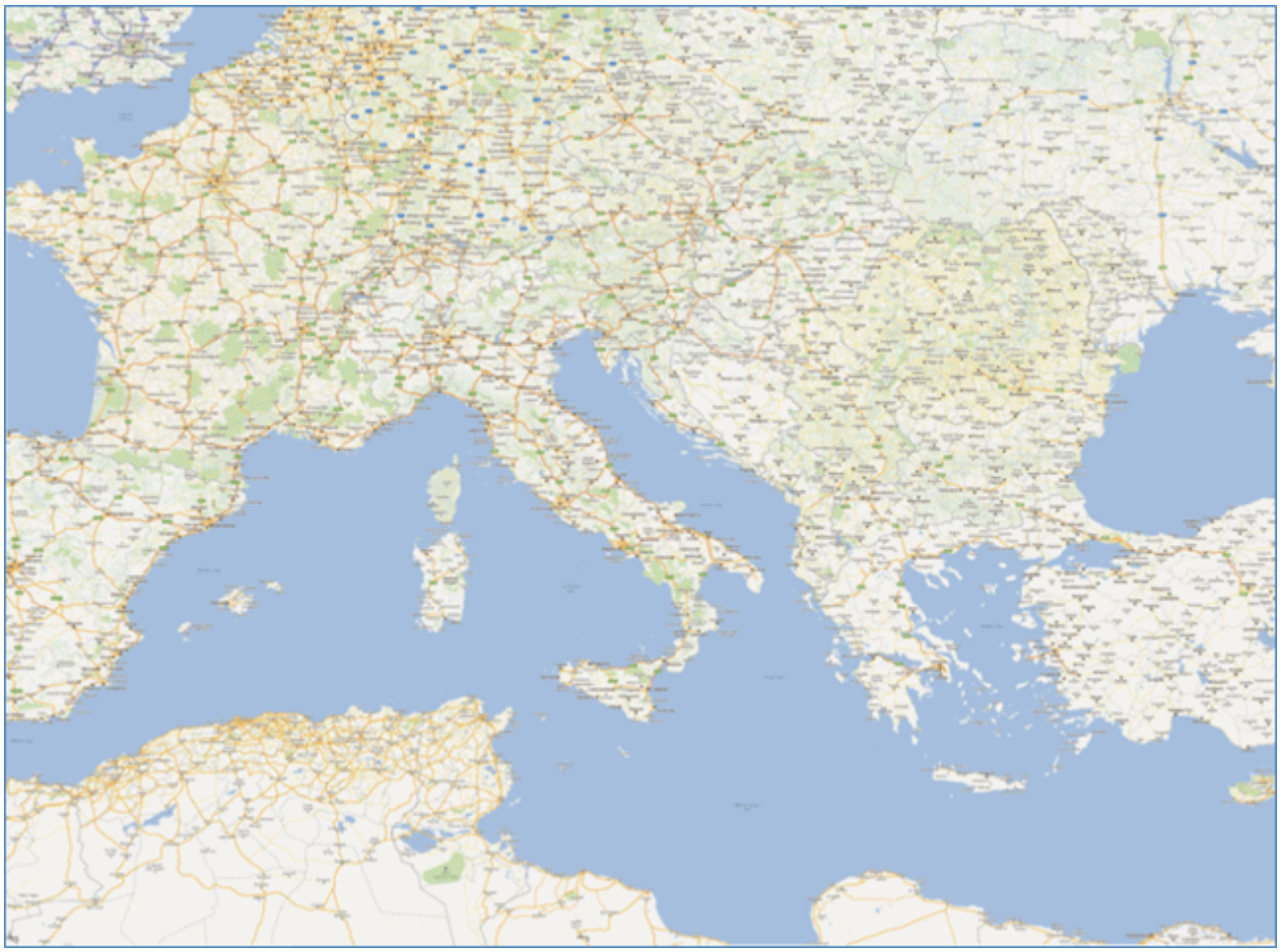


Figure 5. Project Study Area, road network integration of Kosovo in Pan European network

S*econd step* is to digitalize the study area, the road and rail network, for the zone of the Pan-European networks, SEETO, TEN-T and in more details for Kosovo and Albania.

Digitalization was performed on geo-referenced images according to the coordinate system of Europe, on the program AutoCad Map 3D 2009. The digitalization process was followed by the process of topology and the clean-up, preparing the system for the zonal polygonation as well as for establishing road and railroad networking as well as the introduction of the centroids in the system.

The further elaboration of the GIS File-system was performed in ArcGIS 9.3.2, where there was conducted the File-format conversion into "shape", which allows the transfer / conversion in the TransCAD program. The coordinates system used is: Class - Europe, Zone - Bartholomew. In Figure 6 below there is given the map of the study area - states, performed with TransCAD.

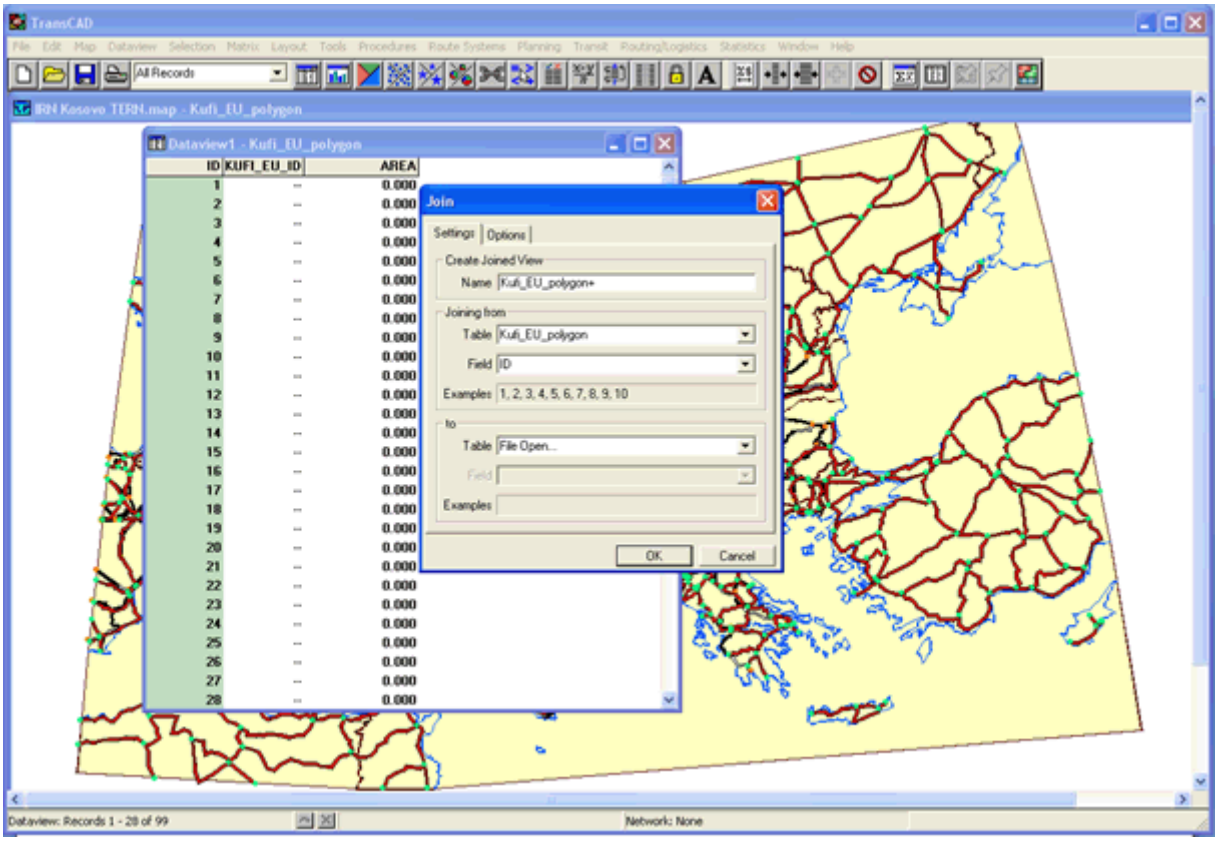
Figure 6. Map of project study area road network integration of Kosovo in Pan European network

In the following, there are given the areas and transport networks of Kosovo and our Study Area. For each layer there is given the relevant panel with vector system of crosses and joints according to the road and rail network.

Tables / Matrixes of the System: After creating the graph architecture and networking system of road and rail transport of Kosovo, the Pan-European Transport Network, Trans-European Transport Network and Transport Networks of South East European Transport Observatory (SEETO), there is passed the information link for states, cities and centroids / important joints of the transport network, roads, railways and important geographical, technical, economic, demographic and social data, with geographical network / physical environment constructed in GIS to Trans CAD.

The data inputs of the program are structured by a matrix of type date formats and Excel table format: xls, xlsx, which serve as the basis for converting formats transferable to Trans CAD: dbd, bin, mtx, dbf and tab.

The data were obtained from the European Counsel (EC) Reports on Pan-European Networks, Trans-European Networks of Transport (TEN-T), the European Road Transport Networks (TERN), project reports for South East European Transport Observatory (SEETO), from the World Bank publications, government projects and publications that contain important data on Kosovo. In the following image there is given the panel during the process of linking the data in the table with layers of transport networks and other system features.



Source by: Author

Figure 7. Linking tables with layers of transport networks

On the basis of algorithms and procedures described, there was conducted comprehensive modeling of the primary and secondary road networks of Kosovo, primary Balkan road network (SEETO) and European road Network.

The model has the following features:

- The model built for the road network also includes the main European rail network which is part of the European multimodal network and cannot be left out of the modeling process
- Modeling of the study area includes 38 countries of which 36 European and two Mediterranean countries, with a total population of approximately 787.4 million and 24.7 million km2 area.
- Graph of the study area consists of 102 sub areas, 38 primary centroids of capital cities and 102 secondary sub areas or major traffic centers, from 1,057 joints and 1,414 road arches as well as 321 joints and 414 railway arches.
- Transportation graphite model in the study area covers a road network with a total length of 5,668,712 km and a railway network in a length of 419.287 km.
- The model with the above mentioned characteristics is able to successfully accomplish the objectives of the study by determining:
- The existing transport capacity of Kosovo road network, for goods and passengers.

4. Determination of Transit and International Transport in Kosovo Road Network

The essence of determining and integration process of Kosovo road network into Pan European networks is without a doubt the definition of international and transit traffic will be able to withdraw and afford Kosovo's main road network: Road 6, 6a, R 6b and Road 7 .

To solve this problem through modeling and simulation of Kosovo's road network (KRN) and the European Road Transport Network (TERN), it is necessary to calculate the matrix of Origin - Destination (OD) of the movement of goods and passengers between states belonging to the Transport network, Kosovo road Network and Trans European Transport Networks.

4.1. Traffic forecast generation (Freight and Passenger)

Traffic will be generated according to the following links:

1. Italy (East and South): Kosovo, Macedonia, Bulgaria, Romania, Turkey
2. Spain: Kosovo, Macedonia, Bulgaria, Romania, Turkey
3. Portugal: Kosovo, Macedonia, Bulgaria, Romania, Turkey
4. Switzerland: Kosovo, Macedonia, Bulgaria, Turkey
5. France: Kosovo, Macedonia
6. Moldova: Kosovo, Italy, Spain, Portugal

Figure 8. Kosovo road network in context of Pan European Transport Corridors

Following in Table (6 and 7) is given generating traffic of goods and passengers to and from Pan Europian Corridors, by countries, Sea Ports through Kosovo road network.

Tabela 6. Forecast Traffic Generation, and international transit according to the SEETO Kosovo Road Network 2013

Roads	Annual Average Daily Traffic (AADT) i HGV	Traffic equivalent in passenger Vehicles (AADT in PCU)
Road R6a	3,106 (trucks/day)	9,318 (pcu/day)
Road R6b	248 (trucks/day)	744 (pcu/day)
Road R7	3,122 (trucks/day)	9,366 (pcu/day)

Source by: Author

Source by: Author

Figure 9. Freight traffic generation in Kosovo road network

Table 7. International traffic generated (additional)

Annual traffic forecast, international and transit, the number of passenger cars on the road R7, R 6a and R 6b		
Roads	Yearly Number of Vehicles	AADT Vehicles / Day
Rruga R7	2,346,012	6,427
Rruga R6b	13,023	36
Rruga R6a + R6b	213,527	585
Rruga R7 + R6a	4,799,065	13,148
Rruga R7 + R6a +R6b	395,711	1,084
Total : International + Transit	7,767,338	21,280

Source by: Author

Source by: Author

Figure 10. Passenger Car traffic generation in Kosovo road network

4.2. Trade on Origin Destination Relation (OD Goods Matrix)

With the aim of issuing real results have exploited as software Trans CAD program, in order to analyze the movement of the flow of goods in relation origin - destination as mathematical model is taken gravity model

Gravity model assumes that travels produced in origin and attracted to a destination are in proportion to the total production of trips in total attraction in origin and destination. For determining the goods OD matrix (in tons) will be basis on the data for international trade of Kosovo, Albania and other countries of the region. As international trade data are given in tons (1000 kg) only for European Union countries trade to give other states the study area that are provided in value (Euro), will be used to report data value (Euro) / weight (Tons) in international trade. After calculating the matrix of total transport (road, rail, air and sea) in tons, will be calculated OD Matrix Road transport in Tons.

In this form (in tons) OD matrix of international transport and transit road will be converted into the format of Trans CAD and to be ready for simulation process and the determination of the potential flow of goods that will circulate in Kosovo's road network.

Table 8. Reports the value (Euro) / Weight (tons) in international trade

Member states	Code	Value ratio € / Ton goods		
		Import	Export	Import + Export
Croatia	HR	799.31	1,696.56	1,240.93
Iceland	IS	1,945.83	1,633.09	1,805.67
Norway	NO	562.64	2,193.06	746.23
Switzerland	CH	7,328.13	3,216.54	4,268.90
Albania	AL	833.91	1,009.62	946.24
Kosovo	KS	2,394.37	1,436.21	1,533.66
Belarus	BY	423.66	2,589.75	899.02
Bosnia and Herzegovina	BA	737.22	1,320.70	1,001.70
Montenegro	ME	1,395.00	1,573.98	1,558.58
Macedonia	MK	1,955.51	1,338.81	1,522.27
Moldova	MD	1,348.38	1,826.86	1,519.54
Serbia	RS	1,237.24	1,903.09	1,607.94
Russia	RU	547.97	4,205.88	803.74
Turkey	TR	2,155.80	1,659.21	1,822.61
Ukraine	UA	281.51	2,440.19	623.52

Source by: Author

Table 9. OD matrix of goods in international trade by weight (tons) 2012

Matrica OD e mallrave, ne ton	Shtete EFTA CIS	Croatia	Iceland	Norway	Switzerland	Albania	Kosovo	Belarus	Bosnia and Herzegovina	Montenegro	Macedonia	Moldova	Serbia	Russia	Turkey	Ukraine	Total
Shtete EFTA CIS	**Kodi**	**HR**	**IS**	**NO**	**CH**	**AL**	**KS**	**BY**	**BA**	**ME**	**MK**	**MD**	**RS**	**RU**	**TR**	**UA**	
Croatia	HR	0	1,602	65,472	356,534	74,772	53,876	31,867	1,445,046	156,060	148,020	3,758	586,086	1,256,649	257,222	59,015	**4,495,979**
Iceland	IS	1,602	0	-	-	-	-	28,328	8	243	124	-	-	-	-	-	**30,304**
Norway	NO	65,472	-	0	-	2,161	-	337,298	12,019	720	4,150	11,705	30,755	2,814,375	1,424,932	75,537	**4,779,125**
Switzerland	CH	356,534	-	-	0	149,451	9,324	60,850	19,493	6,125	33,033	7,546	54,676	2,458,310	1,173,387	-	**4,328,730**
Albania	AL	74,772	-	2,161	149,451	-	192,508	1,860	32,961	25,857	107,210	130	404,303	115,697	375,509	49,260	**1,531,678**
Kosovo	KS	53,876	-	-	9,324	192,508	0	-	52,454	12,532	258,799	-	170,908	-	125,375	4,195	**879,972**
Belarus	BY	31,867	28,328	337,298	60,850	1,860	-	0	3,664	686	2,579	292,720	128,814	37,562,012	422,418	6,797,606	**45,670,702**
Bosnia and Herzegovina	BA	1,445,046	8	12,019	19,493	32,961	52,454	3,664	0	155,241	134,913	4,710	1,091,198	790,482	318,838	10,020	**4,071,047**
Montenegro	ME	156,060	243	720	6,125	25,857	12,532	686	155,241	0	17,026	92	394,616	13,553	25,748	4,231	**812,729**
Macedonia	MK	148,020	124	4,150	33,033	107,210	258,799	2,579	134,913	17,026	0	652	613,016	190,290	378,030	44,677	**1,932,519**
Moldova	MD	3,758	-	11,705	7,546	130	-	292,720	4,710	92	652	0	1,507,322	435,367	156,149	4,962,226	**7,382,376**
Serbia	RS	586,086	-	30,755	54,676	404,303	170,908	128,814	1,091,198	394,616	613,016	1,507,322	0	1,424,453	411,431	147,564	**6,965,143**
Russia	RU	1,256,649	-	2,814,375	2,458,310	115,697	-	37,562,012	790,482	13,553	190,290	435,367	1,424,453	0	32,222,645	31,703,337	**110,987,171**
Turkey	TR	257,222	-	1,424,932	1,173,387	375,509	125,375	422,418	318,838	25,748	378,030	156,149	411,431	32,222,645	0	780,898	**38,072,583**
Ukraine	UA	59,015	-	75,537	-	49,260	4,195	6,797,606	10,020	4,231	44,677	4,962,226	147,564	31,703,337	780,898	0	**44,638,567**
Total		**4,495,979**	**30,304**	**4,779,125**	**4,328,730**	**1,531,678**	**879,972**	**45,670,702**	**4,071,047**	**812,729**	**1,932,519**	**7,382,376**	**6,965,143**	**110,987,171**	**38,072,583**	**44,638,567**	**276,578,624**

Source by: Author

Table 10. Modal Split of international transport in Kosovo, the base weight, in tons

Value/weight proportion	Euro/ton	Import + Export		Modal split
		Euro	Ton	
Sea	1,011	207,503	205	0.02%
Road	2,692	2,146,456,723	797,346	68.48%
Rail	472	122,804,220	260,345	22.36%
Air	52,294	46,391,433	887	0.08%
Water	400	134,087	335	0.03%
Combined	472	29,213,361	61,893	5.32%
Fixed equipment	1,011	43,890,329	43,413	3.73%
Total		2,389,097,656	1,164,425	100.00%

Source by: Author

Table 11. Modal Split of international transport in Albania, based on the Euro value

Albanian national transport by type of transport (2013)					
	Road Transport	Rail transport	Maritime transport	Air Transport	Total
Transport volume in tons	1,107,410	140,300	3,984,000	2,290	5,234,000
Modal Split (%)	21.16%	2.68%	76.12%	0.04%	100.00%

Source by: Author

On the basis of mathematical calculations made with Trans CAD Software program, it turns out that the road network through Kosovo is a transit or destination can be marketed around 10 million/t of goods per year.

5. Conclusions

There can be no sustainable development of transport in the Balkans without of its integration in transport networks in European networks and without integrating Kosovo road network into the European road network, for themselves Kosovo position in the center of the Balkan Peninsula.

With consideration that Kosovo's transportation network meets the Trans European standards of Transport Networks (TEN-T), and the Trans European Road Network (TERN), and after determining the OD matrices of goods and passengers in the study area of Kosovo road network integration in Pan European network (RNI in PERN), with TransCAD's side was calculated the flow of vehicles in Kosovo's main road network (roads 6, 6a, 6b, and 7) defining clearly the Kosovo road network capacity for a period of time from 2012 - 2021.

Integration of Kosovo's road network in Pan European Network creates the necessary conditions for withdrawal, in the primary road network in Kosovo, to an expected traffic of goods, international and transit through the territory of the Republic of Kosovo, about 10 mil/tons of goods per year, or about 1,270,359 heavy trucks (HGV) a year, needed to transport them. Annual Average Daily Traffic (AADT) was 3,480 trucks/day or about 10,440 equivalent cars (PCU).

With construction of the Kosovo roads (6, 6a, 6b, and 7), the distances of routes between countries in Southeast Europe, from Black Sea to Adriatic Sea have changed. Port of Durres represents the shortest path between countries (in Southeast Europe, from Black Sea to Adriatic Sea), this advantage is not exploited so far.

The shortest distance is a determining factor for transit, directing the flow of goods because that directly affects the cost of goods (reduction of transport costs in relation from origin to destination).

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