

**“THE VARDAR RAPID RAIL”
RAPID RAILWAY LINE IN THE CITY OF SKOPJE
MACEDONIA**

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Abstract

This paper is a public transport policy proposal for building a rapid rail system in the city of Skopje, Macedonia; replacing the proposed plan by the local government to build a tram system.¹ Analyses are made of the public transport improvement options emphasizing on the comparison of the rapid rail and the tram systems, where it is determined that the rapid rail is a more economically beneficial investment. A detailed plan for the proposed “Vardar rapid rail” system is analyzed with its future impact on city development, where it is concluded that it will promote prosperity and better quality of life for the city inhabitants.

¹http://www.mtv.com.mk/mk/vesti/nauka/34343/tramvaj_ili_trolejbus_vo_skopje__dvete_opcii_se_razgleduvaat.aspx **Macedonian radio television news.**

Introduction

A part of the Microeconomics is efficient allocation of resources, and intercity public transport is allocating human resources. Improving the public transport will result in better allocative efficiency and thus increase productivity. In Skopje, there is no investment interest in the public transport from the private sector, because of many factors which are not the subject of interest in this paper so they will not be elaborated. From the market situation it can be concluded that the improvement of the public transportation system in Skopje by government intervention is justified. In economics terminology, government investment in the public transport service is positive to the economic development, because of the “externality” exception of “the Fundamental Theorem of Microeconomics”.²

²Principles of Economics fourth edition, Cengage learning, N. Gregory Mankiw, 2008, Externalities page 203.

1. General information of Skopje

Skopje is the Capital and the largest city in the Republic of Macedonia and the country's political, cultural, academic and economic Centre. Officially, it has 506 926 inhabitants from the 2002 census³, but in 2011 it has an estimate of one million inhabitants including migrate workers, tourists and students. Skopje is located in the north part of Macedonia, with geographical coordinates 42°0'N 21°26'E, on a surface of 1818 km², 23 kilometers in length and 9 kilometers wide, sitting on 245 meters above sea level⁴.

The Vardar River flows in the middle of the city along its length 19 km in total length within the city limits, dividing it in to two parts connected with 18 vehicle, railway and pedestrian bridges.

Skopje is located in the Skopje Valley between the mountains Vodno, Karagica, Osoj, Zeden, Skopska Crna Gora. Skopje is located on a seismic active region, where earthquakes are frequent. The last devastating Earthquake was in 1963 where 80% of the city was destroyed, and since that year the modern city planning was initiated.⁵

Other geological characteristics are the underground water basins on the whole area of the city,⁶ which is yet another construction obstacle in the city development.

³ <http://www.stat.gov.mk/publikacii/knigaXI.pdf>

⁴ <http://www.skopje.gov.mk/EN/DesktopDefault.aspx?tabindex=0&tabid=33>

⁵ http://www.meseisforum.net/1963_skopje.pdf

⁶ Hydrogeology and hydro geological characteristics of Macedonia, Stojan Velkov

1.1.Transport and Infrastructure

Skopje has a widely developed road infrastructure which has been given an intensive impulse of improvement in the last decade.

The only public transport service in Skopje is the Bus transport run by ”JSP” Public Bus Service and several Private Bus companies. Other ways of transport is the widely available Taxi service companies.

1.1.1 Skopje Bus transport

The bus transport system has been the only means of public transport in Skopje for many years. It has a developed network of bus lines and bus stops and a vast fleet of busses, public and private bus companies. Recently the bus fleet of the Public Transport Service was refreshed with new busses and it is planned in several years the whole drive park to be changed with new busses.⁷

Table 1, Bus lines⁸

Buss lines	Number of lines	Length of lines in Km	Average length of lines in Km	Bus stops
Total	72 day, 4 night	1.115,30 Km	15,49 Km	1001
City lines	31	337,90 Km	10, 90 Km	496
City Suburb Lines	41	777,40 Km	18, 96 Km	505

⁷ <http://www.novamakedonija.com.mk/NewsDetal.asp?vest=2231193331&id=14&setIzdanie=22214>

⁸ <http://www.jsp.com.mk/jspinside.aspx?page=2>

1.1.2 Public transport analysis

According to the statistics in 2010 a total of 50.000.000 people use the Bus public transport.¹⁰ The statistical methods used to get this number are highly inaccurate.

According to the public transport passenger's structure, 64.9% of the passengers are pre-paid ticket users, meaning it is paid in advance for the use of the bus service, and there is no electronic system to calculate if these passengers have used the transport on that date, but it functions in the way that the ticket is paid for the year and used or not it is calculated that you have used the transport every day of the year. Also in these statistics, the private bus service users are not calculated, where the ticket is more expensive and there is no monthly or yearly ticket plan, so it has far less number of passengers compared to the JSP public service. Some researchers estimate the real number is about 48.22 million passengers yearly of the whole buss transport.¹¹ Taken this relative number in account we can calculate that daily there are 132109 passengers using the buss transport. The JSP public transport has a bus fleet of 42160 passenger's capacity¹² and an approximately same number for the private busses, calculating hourly for a period of 12 hours together they have the maximum capacity to transport 1011840 passengers in 12 hours. Coming to the conclusion that only 13.2 % of the population is using the public transport, but the buss transport has the capacity to “comfortably” transport about 50% of the population. The public bus transport in Skopje is a well-developed system, but its efficiency is limited by the general vehicle

¹⁰Yearly work report of JSP Skopje in 2010. Public Traffic Company Skopje, April 2011.

¹¹Regulation of public transport system in the City of Skopje: organizational and financial issues Slaven M. Tica

¹² <http://www.novamakedonija.mk/NewsDetal.asp?vest=7191016264&id=14&setIzdanie=21726>, article on the calculation of the public transport capacity, Nova Makedonija newspaper.

traffic where there are no separate road lines for busses, caused manly due the lack of space. Traffic congestion makes the Bus transport slow, inefficient and undesirable way of transport for the population. From this, it can be concluded that there is very little that can be done to improve this system by directly investing in it, solution can be found in introducing other public transport systems that are not direct traffic participants, which will decrease traffic congestions and thus improving the buss transport efficiency.

1.2. Replacing the tram project with a rapid rail project

The Local government of Skopje has made plans on investing in the public transport in order to improve allocative efficiency. Funds have been planned to be invested in the sector where it was announced that a feasibility study has been done for building a tram system, details from the feasibility study to build the tram has not been published. This Research paper will analyze the options for improving the public transport, and will prove that building a tram system in the city will not be the best choice of the existing options for its improvement. Reallocation of the planed funds should be done to a more efficient public policy, such as building a rapid rail system.

As a substitute for the tram, the “Vardar railway line” will be proposed, a low cost effective rapid rail that will improve public transport and promote city development.

Therefore, the analytical approach will be in the following order:

- Future development possibilities in the public transport sector
- Rapid rail versus Tram system analysis
- The “Vardar rapid railway line” proposal project

- Benefits and future prospects

2. Future development

Skopje population grows constantly caused mainly by migration of population from rural to urban areas, and as such transport of people is becoming even more challenging. The current transport system is not efficient enough to satisfy the demands for transport of the inhabitants, and if the population grows, it will be even more inefficient. The road infrastructure improvement measure has been almost exhausted. And as for the current public transport there are no separate road lines for busses, and if the roads have more vehicles it will slowdown traffic thus making the buss transport even more inefficient. Transport will become time and cost consuming, where improvement of the public transport is of a high priority. Not just to prepare for the future challenges, but also to solve the current traffic problems which are causing a loss to the economy, and slowing down the economic development. The public debate on how to improve the public transport has divided the public opinion between the following options: building a tram system, building high speed rail, improving the infrastructure for alternative green transport and improving the road infrastructure. The favorite for the local government is the tram system for witch a feasibility study has been conducted. A brief analysis will be done for all the options, emphasizing on the choices between the trams versus high speed rail, where argumentation of facts will conclude that the Rapid Rail is the currently best public policy.

2.1. Improving the road infrastructure

Road infrastructure is very important; it is the basic element of city transportation.

The city of Skopje has undergone a massive transformation of its road infrastructure over the years, especially in the period of 2006-2011, the local and central governments have heavily invested resources, which lead to rapid improvement of the road infrastructure.¹³ Plans on underground roads projects are being made in order to satisfy the demands because of the space limit above ground.¹⁴ Road development has its limits, such as space, cause of private ownership of land and existing object. Furthermore it promotes using of private vehicles' for transport, where at the moment there is already an oversaturation of the roads capacities. It is also an air pollution factor, Skopje biggest pollution source are the vehicles. The Air pollution is at a very high level showed by the latest analysis, where during the day time it increases dramatically to very serious health threatening levels, and at night it decreases to almost no pollution.¹⁵ The other factors of pollution in the city are the factories, but their chimneys usually smoke during the night not to cause social provocation, where the Macedonian population have the mentality to protest and closed factories because of pollution.¹⁶ These factors clearly indicate that the vehicles are the cause of the air pollution in Skopje. The increase of oil price in the past years also has made private

¹³ http://vmro-dpmne.org.mk/Dokumenti/Manifest_za_reformi_i_razvoj.pdf Reforms and development manifest 2011, election program VMRO -Democratic party for Macedonian national unity.

¹⁴ <http://www.novamakedonija.com.mk/NewsDetal.asp?vest=1221195407&id=14&setIzdanie=22446>

¹⁵ <http://www.skopjecentar.ekoinformatika.mk/> Skopje breathes, live online web portal for measurements of air quality in Skopje.

¹⁶ See example , city of Veles protests against factory restart <http://elitestv.com/pub/2011/11/macedonia-veles-says-%E2%80%9Cno%E2%80%9D-to-lead-poisoning-governm ent-remains-ambiguous>

vehicle travel uneconomical. Developing the road infrastructure only makes vehicle ownership a necessity in order to be able to travel in the city. Where young people or other lower economically situated social groups who can't afford a private vehicle are diminished of the possibility to travel to distant parts of the city or makes the travel very long and inconvenient; in economical perspective, it means lose in job opportunities. Roads improvement is important and it should be continued as a process in the city development, but it should not be the primary focus on the means to improve transpiration within the city, mass public transportation in big cities is a better option to increase allocative efficiency and it should be given priority.

2.2. Improving the infrastructure for alternative green transport

Green transport is the best way to go, bicycling or simple walking is healthy and it has no cost, but it has its limitations. Walking and bicycling distance is limited by the person's physical abilities and also is time consuming. There are seasons in Skopje that are not so suitable for outdoor activities, such as the summers where the weather is too warm for people to go outside where temperatures can reach up to 47 degrees Celsius and in the winter the temperature can go up to minus 25.¹⁷ To be more accurate the warmest average max/ high temperature is 31 °C (88 °F) in July & August, the coolest average min/ low temperature is -3 °C (27 °F) in January & February.¹⁸ But generally there are seasons suitable for outdoor activities where

¹⁷ <http://www.meteorologyclimate.com/extreme-temperature-records.htm>

¹⁸ <http://www.climateemp.info/macedonia/>

people can use the widely available sidewalks, and the local government have build a few lines for bicycling, but not so enough to make connected infrastructure because of space limitation. Also it has to be mentioned that the Macedonian culture and mentality consider alternative green transport is referred to the usage of Vespa (scooter). It can be concluded that Green transport occasionally can be just used as subliminate but in general it is not very efficient in transporting people in a city of this size.

2.3. Tram and trolleybus

“Tramway”, “Trolley car”, “Streetcar” is an electric railway with a “light volume” traffic capacity compared to heavy rail; light rail may use shared or exclusive rights-of-way, high or low platform loading and multi-car trains or single cars.¹⁹

“Bus trolley”, “trolley coach”, or trackless trolley is an electric, rubber-tired transit vehicle, manually steered, propelled by a motor drawing current trough overhead wires from a central power source not on board the vehicle.²⁰

The Tram and Trolley bus are electricity fueled transport vehicles, from overhead current wires connected to a central power source not aboard the vehicle. The trams are the predecessors of the modern heavy railways for urban transport. The tram itself evolved in to a modern one, not because it is a very cost efficient way for transport

¹⁹ http://www.apta.com/resources/reportsandpublications/Documents/Transit_Glossary_1994.pdf American Public Transport Association, glossary of transit terminology, July 1994.

²⁰ http://www.apta.com/resources/reportsandpublications/Documents/Transit_Glossary_1994.pdf American Public Transport Association, glossary of transit terminology, July 1994.

rather because the old tram systems needed to be modernized, in order to use the already existing rail infrastructure, where the rails stay the same and the tram carts modernized. The difference between Tram and Trolley is that the tram moves on rails, and the trolleybus on rubber tires. From the two the concerning the electricity consumption the Tram spends less electricity because it has an electricity recycling system, where the part of the kinetic energy is used to recycle electricity of small quantities. Cost installation for the tram is higher than for the trolleybus because the trolleybus doesn't need rails. Trolleybus can go around obstacles and brake faster than trams, while trams are grounded to the rails, for which a special rail line needs to be constructed and it is more space demanding. Tram rides are convenient smooth and comfortable way of ride but a very slow one. It can be concluded that trolleybuses are a more technologically advanced and efficient than trams.

To build tram rails it takes a lot of ground space, where Skopje is already in shortage unless a major reconstruction of the city is done, which is an expensive investment. If that is the case, then it is better to improve the already existing bus transport where it lacks in separate bus lines, then to build a rail lines and electricity wires supply for the vehicles. Trolley buses are not considered in the plan of the local government, but they are a better option than the tram. Trolley busses either use a separate line, which already there is a lack in space, or share the general road infrastructure with the other vehicles. They are the same with the bus it only has a different power source, and it will not solve the already existing traffic congestion. Both tram and trolley buses don't have complete exclusive road lines, they have to go through crossroads and wait

for traffic lights. Either they are full time or part time participants in the general urban traffic transport, and this also does not efficiently solve the traffic congestion problem in Skopje, and it will probably even make a contribution to it. If we look at world trends in public transportation investments, it can be concluded that there is no trend in building new tram or trolley systems. Accent is given on modernizing and reviving the old tram systems in cities where the tram rail and the infrastructure already exist,²¹ but even that has proven to be of a very high cost.²²

From all the options on improving the public transport, implementing a trolley bus or tram will be the least effective choice of investment.

2.4. Rapid rail

“Rapid rail”, “subway”, “elevated” (railway), or metropolitan railway (metro) is

An electric Railway with the capacity for a “heavy volume “of traffic and characterized by exclusive rights-of-way, multi-car trains, high speed and rapid acceleration, sophisticated signaling and high platform loading.²³

Rapid urban rail is the most efficient technologically achieved way of public transport.

It is fast in speed, it runs on exclusive rail tracks away from other vehicles traffic, above or underground. It is a green way of transport because it uses electricity as a power source. Building an underground subway is the most convenient way to

²¹ See for example Reconstruction analysis of several tramway systems

<http://homepage.ntlworld.com/c.fuller1/Trams.html>

²²<http://www.independent.co.uk/news/business/trams-hit-cost-barrier-1342433.html> newspaper article on reconstruction of the London tram.

²³ http://www.apta.com/resources/reportsandpublications/Documents/Transit_Glossary_1994.pdf American Public Transport Association, glossary of transit terminology, July 1994.

improve public transport because it doesn't occupy ground space needed for other structures, but it is a more expensive choice than the above ground railway. That is why in recent years above ground railway is the first choice for developing cities if there is space availability.²⁴

Skopje is located on an earthquake based soft ground with many underground water basins, where building an underground subway in such conditions can be done in a very complex design to achieve a stable and secured structure,²⁵ which means higher cost of construction than in more optimal conditions. Skopje is to some extent limited on space to build elevated rail, but there are several areas that are vacant and suitable for it.

The basin of the river Vardar flow from west to east and cuts the city into almost two equal parts in the city length. One bank of the river is a recreational and sport area, but the other bank of the river still stay undeveloped and almost natural.

The Vardar River has 11 kilometers of flow into urban city areas making it a perfect location for building a rapid rail, which doesn't have to be underground or elevated but a ground and low cost rail. This Main line of the rapid rail system in the city will work as a release valve or a main artery to reduce traffic congestion and improve intercity transport.

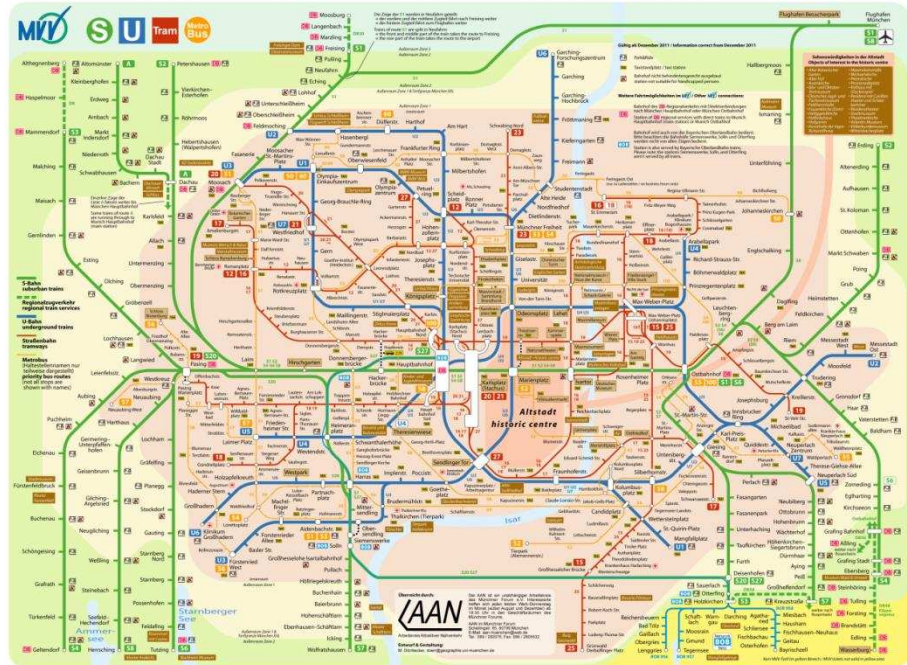
²⁴ See recently build Dubai rapid rail, has only 4 underground station out of 29, <http://www.railway-technology.com/projects/dubai-metro/>

²⁵design of deep underground stations in soft soil Conditions, J. Herbschleb, J.C.W.M. de wit, 2009

2.5. Other City solutions

2.5.1 Munich, Germany

According to a recent study, Munich has the best public transport system in Europe.²⁶ Munich has a population of 2.6 million people and



has a public transport system consisted

Pic. 1 Map of Munich public transport

of aboveground and underground rapid rail, bus system and tram system.

The majority of the share in the public transport service is the rapid rail, and the least share is to the tram system about 15-20 % and it is located in the old part of the city, and it must be noted that it exists since 1876, which grew together with the city and is preserved as a part of the city architecture. If the tram was very effective as means of public transport the whole city would have been tram connected, but the fact that is not the case, and the reason why the rapid rail was introduced is clear.

²⁶<http://www.eurotestmobility.com/eurotest.php?itemno=346&PHPSESSID=23cdbee73bcc94f3fb107859d49b35b>
a Euro Test 2010.

2.5.2 Medellin, Columbia

Meddling is the second largest city in

Columbia with about 2 million

inhabitants.²⁷ The city stretches out in a

north-south direction along the Aburrá

Valley, and it has 2 Rapid Rail lines,

where line A is 23.2 km and runs along

the Abbura valley, and line B is 5.6 km

and goes from east to west connecting

with line A.²⁸ Meddling is one of the

largest GDP contributors of Columbia²⁹,

and its economic success is debated to be mostly contributed by the construction of

the rapid rail system, which is the only one in Columbia. Meddling and Skopje have

the same or similar city area layout; both cities are in a lengthy layout and have a river

that flows in the middle. The Valley of the river in Meddling was used as the most

appropriate undeveloped real-estate to cut down expenses of guide ways. Population

size of meddling is over about 2 million compared to Skopje 1 million, but when the

first portion of the rapid rail was opened in 1985, Meddling population was a little

over a million.



²⁷ Official web portal of Medellín:

<http://www.medellin.gov.co/irj/portal/medellinIngles?NavigationTarget=navurl://eb498601189147535ffb66cf24f44041>

²⁸ <http://www.urbanrail.net/am/mede/medellin.htm> Medellín metro

²⁹ Proexport Colombia. Retrieved May 8, 2008. "participation of the cities GDP by countries provided by the International Cooperation Agency of Medellín",

<http://www.proexport.com.co/VBeContent/NewsDetail.asp?ID=7658&IDCompany=16>



Pic.3 Meddling Rapid Rail along the river bank³⁰



Pic.4 The undeveloped north bank of the river Vardar, the proposed building area³⁰

³⁰ Source: Google Earth images

We can conclude that from previous public policy experiences proven to be economically beneficial, the proposed similar project in Skopje will be beneficial for its meant purposes.

2.6. Rapid Rail versus Tram

Comparing the Rapid railway and Tram systems, the key points will be cost, efficiency and space availability.

2.6.1 Cost comparative analysis

The Transportation Decision Making: Principles of Project Evaluation and Programming research gives estimates cost of rail projects worth in 2005 dollars.³¹

Cost estimates for building a light rail(tram) system, in another location in Skopje given the same mileage of 6.83508 where an average of 22% Guide ways cost is calculated, gives the following calculation: $(5.87)(6.83508)=40.1219196$

$(40.1219196)(100/22)= \$182.372361\text{million}(2005)=202\text{ million GDP Deflator}$

calculation of 2012=**155 Milion Euros**

Because of the specific of the projects, different approach must be done to estimate more precisely of the price of the Vardar valley project, where the main cost are the railroad track; rail stop stations; the bridge over the river “Lepenec”(50 meters); construction cost.

The gathered information from several different sources estimate the price of laying rail tracks, calculating the costs for: Steel rail; Rail fastener; Concrete sleeper; Subsoil;

³¹ Transportation Decision Making: Principles of Project Evaluation and Programming

By Kumares C. Sinha, Samuel Labi, 2007 page 81.

Ballast volume. Total average cost 375000-500000euro/km for Construction material only not including Construction cost, where for 11 km= 4.125000-5.500000MillionEuros cost.

The cost of building a 50 meters length and 8 meters width bridge, which is 400 square meters, estimate price is 802400 Euros.³²

Rail stop stations are estimated to be worth 10 % and 13% for vehicles of the total project value.³³

The total estimate price of the project is

$\{(4125000 \sim 5500000) + (802400)\} (23\%) = 6.060702 \sim 7.751952$ Million Euros total cost

excluding construction cost and labor. Taking maximum logically acceptable

percentage of 100% for construction and labor, the total price will be of an estimate

12.121404~15.503904 million Euros

From the referred researches it can be concluded that the biggest cost of building and underground metro is the underground structure compared to the low cost of the Vardar rail is due to the low cost of guide way construction, where the proposed land of use is above ground and it is undeveloped and free of other objects.

The Cost of building a tram system is of lower cost than constructing an underground metro but compared to the Vardar rail is Roughly 13 times more expensive.

Government ordered feasibility studies estimate an 160 million Euros, and the high cost is due the building of the guide ways construction cost where a major makeover

³²http://www.dor.state.ne.us/letting/state_bridge_summary2_2008.pdf bridge costs analysis, construction division USA

³³Transportation Decision Making: Principles of Project Evaluation and Programming
By Kumares C. Sinha, Samuel Labi, 2007,.page 80

of the existing road infrastructure is needed.³⁴

The tram project of the research study estimated 155 million Euros, and the feasibility studies ordered by the government 160 million Euros, is of 5 million Euros difference where including the other variables previously analyzed, makes the referred research study cost calculation relatively accurate.

If the mathematical calculations of the referred studies are accurate for the tram, then the variables used for the proposed Vardar rapid rail project from the same study is highly probable that is also accurate in **12.1~15.5 million Euros**. There is no release data on how long will be the tram rail in order to more accurately compare the costs between the two projects, where the calculations are made on the same length as the Vardar proposed project **11 kilometers**

2.6.2. Comparative Efficiency

The general characteristics of Rapid rail and Tram are the following:

- Rapid rail is significantly faster than tram rail³⁵; it has the capacity to handle large volume of passengers³⁶; its running operational cost is more expensive than the tram system³⁷; and takes time for passengers to get off from the platforms to access the streets.

- Trams are significantly slow way of transport³⁸; Can handle smaller volume of passengers compared to the rapid rail; Takes up existing road space, or close down a

³⁴http://www.mtv.com.mk/mk/vesti/nauka/34343/tramvaj_ili_trolejbus_vo_skopje__dvete_opcii_se_razgleduvaat.aspx, Macedonian radio and television news

³⁵ The Washington DC USA, is a new modern metro and it goes 120 km per hour, and don't participate in the general traffic so there are no traffic light stops compared to the tram.

³⁶ The rapid rail carries more train carts compared to the tram.

³⁷ The rapid rail has Higher speed and increased usage of brakes, shorter life span of other equipment

³⁸ Trams are depended on the traffic, lower speed of the tram because of the general traffic limitation speed

existing road; Tram Carts have a high cost compared to passengers capacity³⁹; passengers can easily get on and off and accesses the streets; Running cost is less expensive than Rapid rail⁴⁰.

If we take into account the previous analysis of this paper we can conclude that some positive attributes of the trams cannot be taken into account of the current transport situation of Skopje. The running cost of trams will not be lower than the rapid rail because it will not be a time efficient and attractive way of transport for the inhabitants, concluding that it will not be economically self-sustaining and transport efficient.

2.6.3. Space Availability

The construction of a tram system running through the urban areas requires a major reconstruction of previous infrastructure; it will either replace some parts of the existing road infrastructure or destroy the green zones of the city. Removing the green zones of the city is ecologically unacceptable; so far the road development has made the government cut down trees that are the oasis of the city, further diminishing will lead to very deserted and unhealthy living environment. The other option is to replace the existing infrastructure, which is recently built. This is also unacceptable closing new roads for a tram which is economically illogical. The Vardar Railway line is proposed to be constructed on an undeveloped location so it doesn't replace existing road infrastructure, and it doesn't imply removing any tree lines.

³⁹ Tramway cost reduction, David Gibson, 2010.

⁴⁰ Slower but longer life span of equipment, kinetic energy usage to recycle power

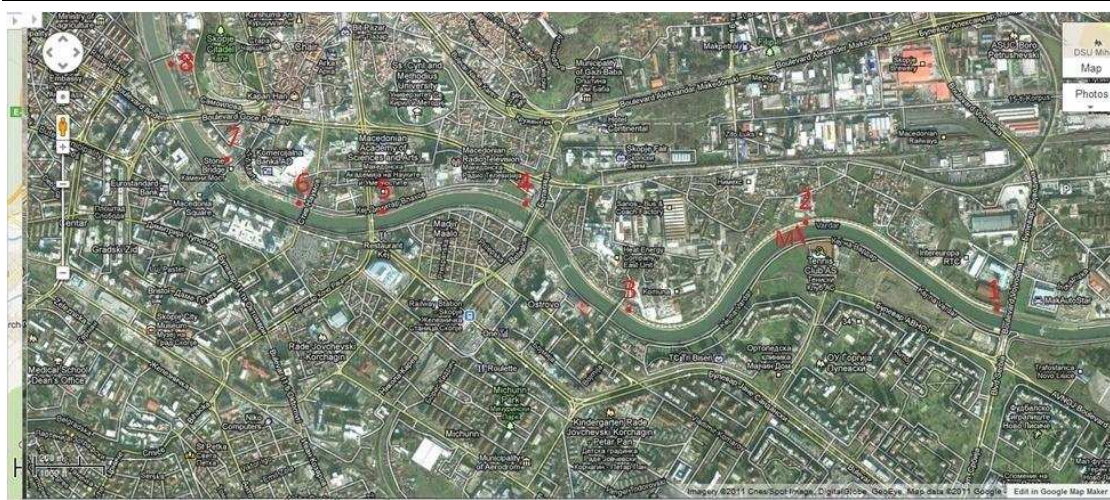
3. Vardar rapid rail line

The Vardar rail will pass closely near numerous important city object and locations.

Following the proposed plan, the important locations and rail stops are:

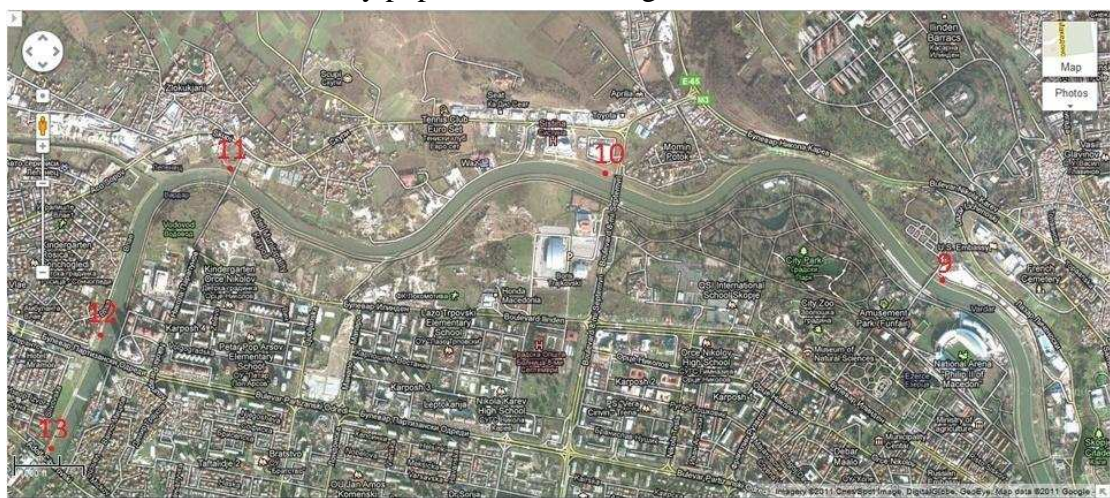
1. Novo Lisice: densely populated area in Skopje; bridge connection.
2. MZT: sport arena; planed bridge to be constructed⁴¹.
3. Aerodrom: densely populated area; bridge connection.
4. Zeleznicka: Rail station; Skopje fair; bridge connection.
5. MRTV: Macedonian radio and television, Ministry of internal affairs passport, id and driving license department; Macedonian Academy of Sciences and Arts; University St. Kiril and Metodius; Judicial courts; bridge connection.
6. Makedonska Opera I Balet: Macedonian opera and ballet; Criminal court; Hotel Holiday Inn; Trade Mall; bridge connection.
7. Stone bridge: Macedonia Square, Museum of the Macedonian struggle; Museum of the Holocaust; Macedonian Theater Hal; st.Dimitrija Church; bridge Connection, Stone bridge, the structural land mark symbol of Skopje.
8. Kale: Macedonia government building; Kale citadel; Sport medicine hospital; Macedonian Custom headquarters; Bridge Connection.

⁴¹ <http://www.vest.mk/default-mk.asp?ItemID=70E846E5EC7C5D4CA4EAB3615FC9382A>, Vest newspaper article, new bridge investment plan voted by the district council



Skopje Map.1 from 1 through 8 stops stations positions ⁴²

9. Filip Vtori: National Arena Philip the second; Amusement park; Skopje Zoo; Skopje City Park; US embassy; Summer night clubs complex; bridge Connection.
10. Boris Trajkovski, sport Arena complex Boris Trajkovski, Hotel Alexander Palace, Swimming pool Karposh; bridge Connection.
11. Zlokukjani: Zlokukjani neighborhood; bridge Connection
12. Partiznaski odredi: densely populated area; Private Hospital “Neuromedica”; bridge Connection.
13. Zeleznicki Most: densely populated area; bridge Connection.



Skopje Map.2 from 9 through 13 stops stations positions ⁴³

⁴² Map Source: Google Earth

3.1. Technology

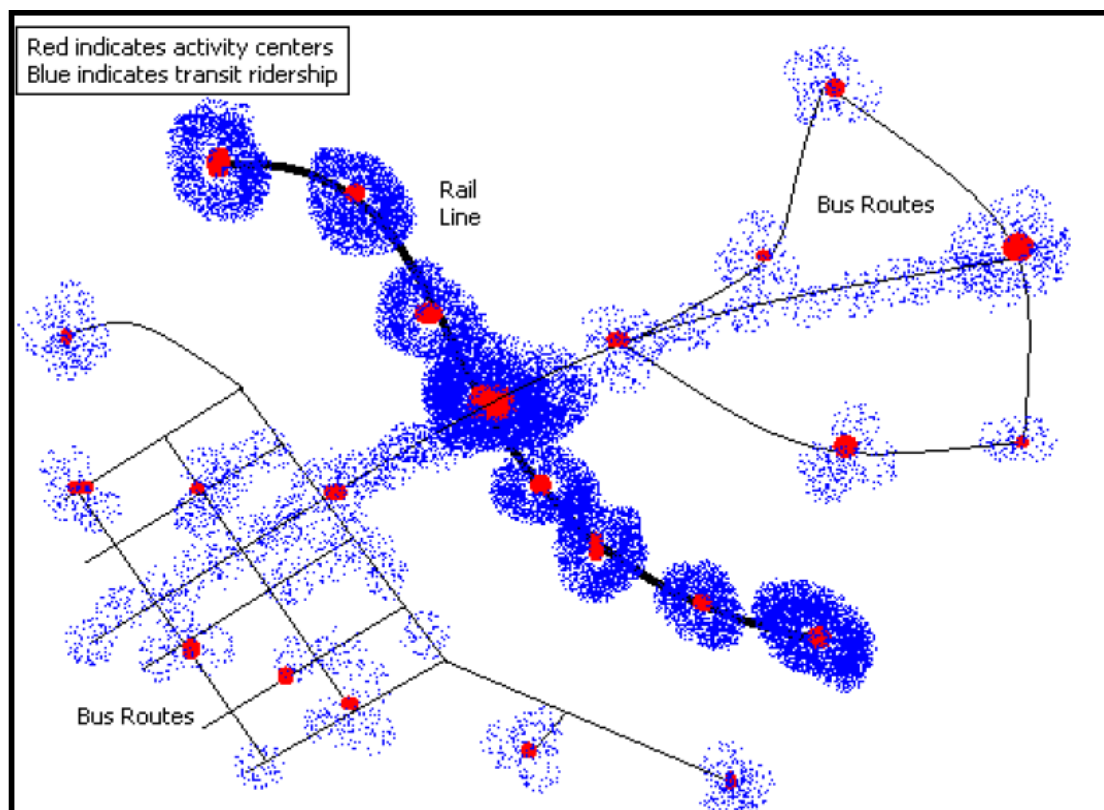
A more detailed research should be done for the technology used from the rapid rail.

Applying the most advanced up to date applicable technology, introducing a fast; comfortable and economical transport.

3.2. Unification of the public transport

Allocating bus stops near the rapid rail station stops will establish a connected public transport network and implementing a unified ticketing paying system will establish a more efficient public transport system.

The rapid rail system should be included in the unification. A good example of unified public transport ticketing system that should be looked at is the city of Milan, Italy.⁴⁴



⁴³ Map Source: Google Earth

⁴⁴ <http://www.atm-mi.it/en/ViaggiaConNoi/Biglietti/Pages/Biglietti%20Urbani.aspx>, official website of Milan transport agency

Illustration 1 Rail and bus travel impacts: this picture illustrates differences between rail and bus transit travel impacts. Rail provides service to a limited number of stations. Those stations can stimulate more intense development, with increased population and employment density, higher per capita transit ridership and walking trips, and lower per capita vehicle ownership and trips. Bus transit can serve more destinations, including some dispersed, suburban activity centers, but attracts fewer riders per capita, and by itself has little or no effect on land use patterns. Both types of transit can attract more riders and become more effective if implemented with supportive transport and land use policies.⁴⁵

3.3 Cost and benefits analysis for building the Vardar Rapid rail

3.3.1 Direct Benefits

Travel time savings for users of the Vardar railway; Vehicle operation and parking cost savings to travelers who change from auto to public transport; decreasing traffic congestion by lowering the personal transport vehicles participating in traffic, and parked cars; Macedonia is an oil import Country, decreasing the usage of oil based fuels will make saving for the country; improved access to jobs and amenities to public transport dependent travelers in the city; improving allocative efficiency, mobility and economical transportation of the population; traffic accident reductions and safer transportation because of decreased traffic congestion and lower auto users; reduced greenhouses, reduced environmental damage and promotion of a better living

⁴⁵Evaluating Public Transit Benefits and Costs, Best Practices Guidebook, 2 October 2011
Todd Litman, Victoria Transport Policy Institute

environment; reduced public transport operating costs due to the increased efficiencies and higher usage..

3.3.2 Indirect Benefits

Increased economic activity and/or agglomeration of businesses; benefits from property development due to the Vardar rail investment; Growth in employment in the Vardar rail service area; government benefits from increased taxes generated by the new development.

3.3.3 Costs

Capital costs of materials and equipment; cost of planning and design; Infrastructure construction costs; capital costs for new rail and rail carts; operation and maintenance costs.

3.4 Problems and Solutions

It can be argued that some of the locations where the rapid rail will pass are not so developed or densely populated areas. But then we can look at this issue, and ask the question, are these areas undeveloped because of undeveloped infrastructure? Where Experiences showed that building a rapid rail line increased real-estate investment and land pricing of the affected regions.⁴⁶ From this it can be concluded that the construction of this line will not only connect important areas in the city, but also promote development in other less urbanized parts of the city.

⁴⁶ http://www.rtd-fastracks.com/media/uploads/nm/impacts_of_rail_transit_on_property_values.pdf, Impacts Of Rail Transit On Property Values Roderick B. Diaz ,Booz• Allen& Hamilton Inc. Mclean, VA

The only rearrangement of the urban plan because of the proposed rail track is in the center of the city at the stone bridge. The bridge itself is not the problem, but the newly placed statues next to it will have to be relocated. And about all the bridges that the rail line will pass under, there is no question if they are high enough, the fact is they are, but even if they are not then it is very easy to dig in a meter lower at the location, making the track go a under without making any changes to the existing bridges.

3.5 Future phases of rapid rail development

As any city in the world the rapid rail construction, the network of railings grows in phases, simultaneously as the city grows and develops. Such in the case of Skopje rapid rail, the Vardar rail will be the First phase, lengthening and connected with other rail lines should be established. Implementing a broad and efficient network of rapid rail using preferably leveled or ground rail system that will connect the entire urban areas and suburbs will promote better efficiency and overall inhabitants' usage of the public transport.

Conclusion

The government strategies to improve the Public transport service are positive and supported by the population, but academic researches should be made and considered very carefully before making any Grand investments in the public transport. Likewise the planned Tram system is not the best option of development, where this paper proves that the proposed Vardar rapid rail project will be more beneficial to the urban and economic development of Skopje. It will provide a better efficient transport and it has a highly lower construction cost. The statements given in news press media from certain companies that previously had established cooperation of selling busses to the public transport service, claiming interest in selling trams and trolleybuses for the city development,⁴⁷ seems overambitious in propagating the building of a tram system in Skopje. Logic is that private companies prefer profit in selling goods no matter if the goods are beneficial to the buyer. And as previously analyzed the trend and policy making is to build rapid rail not tram systems⁴⁸, where experience showed rapid rail is more beneficial. It will be a big mistake in city planning if a tram system is built in Skopje at the given moment, it will not improve the public transport as proved by the given facts but rather it will be a loss of time and resources. The **12.1~15.5 million Euros** vardar rapid rail projects versus **160 million Euros** for a tram railway project is

⁴⁷ <http://www.telma.com.mk/index.php?task=content&cat=&rub=6&item=13157>, news Telma television, Macedonia

⁴⁸ <http://mic-ro.com/metro/table.html?feat=CICOOPLGSTLSDP&orderby=OP&sort=ASC&unit=&status=> world metro database

a staggering difference. Mathematics is the most precise method of calculation, the references of the studies are there to recalculate and confirm. Simple logic will also confirm that it is less expensive to build a rail in a free obstacles area compared to building it in a urban developed area with massive reconstruction and special architectural modifications.

Taking into consideration the costs and economic development effects, where it was proven by this research paper that the Vardar rapid rail will be more beneficial.

The conclusion is that the “Tram project”, should be replaced by the proposed “Vardar rapid rail project”.

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