

# IMPLEMENTING THE TRAM-TRAIN SYSTEM FOR PUBLIC TRANSIT, THE KEY TO AN EFFICIENT MOBILITY IN THE WESTERN DEVELOPMENT REGION AND DKMT EURO-REGION

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**Abstract:** The world urban population growth brings challenges that concern every one of the three components of the organic growth: economic, social and ecologic (Little D., Arthur, 2014). Their development will induce the necessity to assure extremely effective mobility networks, efficiency being the first characteristic analysed in the competition between Development Regions. Western Development Region's Center is Timisoara Municipality. The Timis county benefits from the densest railroad network in Romania 90.4 km / 1000 km<sup>2</sup> (Maxim et al, 2007), Timisoara being the center of a rail transport system planned and developed by the Hungarian administration in the second half of the XIX<sup>th</sup> century. Political systems and interventions in the last 50 years kept retained a sustainable cross-border development that had the potential to place Timisoara not only in the Center of the Romanian Western Region and historical Banat region, but also of the entire DKMT European region. Studying the Western practice for intermodal systems and the potential of urban structures in the European Region, our study proposes the implementation of a hybrid tram-train rail transport system, connecting Timisoara to urban nuclei subordinated in a distance of maximum 60 km. Once implemented and integrated in the intermodal network, this kind of solution brings economic, social and ecologic benefits for DKMT in general and for every community apart, representing a win/win thinking for local administrations.

**Keywords:** Euro-region, urban system, connectivity, mobility, integrated transport system, tram-train

## 1. INTRODUCTION

Today, the world population reaches 7,21 billion people (US Census Bureau, 2014) and it is forecasted that by 2050 it will reach 8,92 billions, out of which 70% will live in urban settlements (United Nations, 2004). The predominance of mobility based on private vehicles makes that the total time spent in traffic jams is three times higher than 1990, and although the value of investments will rise up to even four times the level today, the system will collapse. The consequences in the ecologic component will multiply. This fact shows that it is necessary to introduce a new, innovative transport system, integrated at each region's scale, with a management based on performance, with a great efficiency in what concerns the ratio between energy consumption and the number of people transported, so, as a conclusion, having a minimum impact over the environment (Lerner, 2012).

In the same period of time, the demand for mobility will rise 2,6 times, and the challenges felt by each metropolitan area will refer to air pollution, CO<sub>2</sub> emissions growth, sound pollution, traffic chaos, traffic safety, quality of life being in continuous decrease, land occupy politics, public transport overuse and the lack of capability in assuring parking spaces for vehicles. Mobility will need investments in a much higher measure than education, environment and health (van Audenhove et al, 2012).

This sort of example is, in perspective, Timisoara growth pole, with an existent situation as a result of 157 year of investment and materialization in development of the public transport system, inside the city (Timisoara Metropolitan Area) and in the urban fringe (Timisoara Urban System).

## 2. METHODOLOGY

This paper aims to arouse the interest in what proves to be the most efficient means of transport for the urban area that necessitates an efficient service of the central and highest living density areas, in relation to the less developed suburbs, down to which the city concentrates its development. The study is realized by observing the main parameters that define the implementation of this system in some similar situations in Europe.

The historic study is used to show the importance of the railroad transport system in Timisoara's influence area for its development in the modern age, as well as its importance in the pre-existent cross-border connections. A quantitative and qualitative evaluations is performed in order to obtain the potential of an integrated mobility system, and by conceptual design and reporting to the municipal network of public spaces the best station placements are obtained, correlated to an accessibility level expressed for short, medium and long distances.

### **3. THE CURENT STAGE**

#### **3.1. Geopolitical context**

At the beginning of the XXI<sup>st</sup> century, 15 year after turning the regime from the communist perspective to the democratic one Romania entered two influence spheres that established its role, by adherence to NATO (2004) and, after 3 years, to European Union (2007). In this context, the mobility in the Timisoara Urban System is in the moment of a radical perspective change. At a global level, Romania can represent the intermediate space of development of economic exchange operations between Asia end Europe, for countries in Central and Eastern Europe. For this, it is necessary to exploit the transfer opportunities for passengers and goods through the European corridors, from Eastern (Instanbul, Constanta) to the Western Europe (Budapest, Bratislava, Prague). Timisoara is passed by the Oriental Corridor (Arad – Timisoara – Calafat – Sofia – Salonic – Istanbul) for cargo, overlapped by the IV<sup>th</sup> Pan European Corridor that ends in Salonic or Istanbul.

#### **3.2. The importance of public transit for the modern evolution of Timisoara Urban System**

Along with the passage to Austro-Hungarian administration, in the first half of the 18<sup>th</sup> century, Timisoara Municipality's influence area became an important pole in the configuration of the modern settlement system. Until 1918, the territory outside Timisoara was colonized either by the Habsburgs administration, either by the Hungarian one (Oprîș, 2007). By interventions in mobility there were initiated, one by its time, the railroad lines that connected Timisoara to Szeged through Jimbolia and Kikinda, and further, to Budapest and Vienna, and included further destinations as Bazias, Arad, and Orsova to Bucharest. In 1908, nine lines were already used, completing the connection of Timisoara to its hinterland: Sannicolau Mare, Lipova, Radna, Buzias, Deta, Varias etc.. In this way the commuting was supported at a regional scale, strengthening the Timisoara urban system. In its inside, a significant moment was the insertion of the electric tram, in 1899, connecting the Citadel (who's defense walls were reduced in size in this time) to the satellite neighborhoods: Fabric, Josefîn and Mehala. All of these followed the plans of systematization in this period for urban development in a radio-centric system.

The territorial political movement that followed the First World War divided the Banat province in three separate areas, with separate administration and fluctuating dimensions. The system that we call Timisoara Growth Pole, the center of this region, remained to Romania, but its influence basin was divided by principles that denied the historic evolution and geographic or anthropic reasons. The Second World War resulted in Romania's spatial isolation from its regional neighbors and infrastructure connections destroyed. The only ones that were kept were the ones that reached Beograd by Moravita – Vrsac, respectively Kikinda by Jimbolia. Inside the city, the tram network extends, as well as the trolley network, launched in 1943.

Passing from a centralized economic system to the private one, brought by 1989, resulted in the decrease of the urban fringe railroad utilization rate. This was a result of the growing of the more efficient bus transport system alternative and the lack of investment in maintenance and development that can maintain the railroad system in competition to the bus. Inside Timisoara, investments were made by capital repairs of the existent networks (continued until now, with perspective to insert new vehicles), and the airport in Giarmata became the second in importance by passengers count, after Bucharest – Otopeni, for internal and external transport.

### **3.3. Technical data**

We take the basic data to underline the mobility system profile from Timis County Territorial Development Plan (PATJ Timis) for Timisoara Municipality and its immediate urban fringe, the Timis County (Urban Team et al, 2013). Today, there are 18,5 highway kilometers, with potential to complete the Timisoara - Lugoj segment, 563 national and European roads, 1145 County roads and 1222 Communal roads. Six metropolitan bus tracks are used for the municipality relation to the suburban area and 7 authorized bus stations that complete the interurban in the Western Development Region, other regions and the European Union. Concerning the railroad network, Timisoara is passed by the national 900 National Railroad Artery and 18 second class lines, in a total of 795 kilometers, 91.4 km / 1000 sqkm, twice the national average. The 900 Railroad Artery is included I the IV<sup>th</sup> Pan European Corridor. Every year, there are 2657451 travelers leaving the county, out of which Timisoara represents the greatest share (80,1%). The main railroad terminal is the Northern Railroad Station. Concerning the goods transport, 712026 tons are sent, out of which 500965 from the Timisoara Metropolitan Area. 90% of the goods sent come from the Ronat sorting station. Concerning the aerial transport, Timisoara Traian Vuia International Airport (AIT-TV) remains the third in the country, after Henri Coanda in Bucharest and Cluj Napoca, in the quantity of transported passenger and goods.

The main connections between urban area and the urban fringe are made by the road infrastructure, with an estimation of about 73910 persons riding personal vehicles, 15135 commuting by bus, and 5306 by railroad. These data is offered by the background study developed for the new General Urban Plan of Timisoara Municipality (Planwerk et al, 2012), disclosing a predilection for individual vehicles transport, overloading the road infrastructure (especially in the central area and the general interest urban functions).

### **3.4. Malfunctions**

In order to underline the main malfunctions in Timisoara Urban System we use studies made by CCPUT / RCUPT between 2007 – 2012 (Radoslav et al., 2007, 2010, 2011, 2012), as well as the results of interviews concerning stakeholders from the local, county and national level, ATI-TV administration, CFR administration, as a result of several educational research partnerships initialed in this way. Thereby, the following weak points were highlighted:

- A. Timisoara Municipality has only 319279 inhabitants (according to the latest People and Household Census in 2011), so it is too low in order to be competitive at a European scale;
- B. Timisoara's interior layout is divided by the railroad track in its layout today, creating mobility and accessibility problems;
- C. There are not any adequate transit exchange stations for travelers' transfer between different transport means, either for the internal passenger flow (between households and the main urban functions) or for the external one (between the neighborhoods with highest density, regional scale focus points and the external area – the Timis County, Western Development Region and DKMT Euro-Region);
- D. There are weak connections between Timisoara Municipality and highway and national and European roads network;
- E. There are weak connections between urban Timisoara and the AIT-TV airport.

## **4. REFERENCE MODELS**

Finding transport means efficient both small and big distance represented an objective for many municipalities developed at the end of the XIX<sup>th</sup> century and the beginning of the XX<sup>th</sup> century. The first reference to a system that combines heavy and light rail systems is in Hobart, Tasmania, in 1924, where the local administration proposed a system that combines the advantages of the tramway to the ones of the train, taking profit for the identical gauge (The Mercury, 1924). In this paper we analyze three Western European examples of tram train implementation, in reference cases. We shall note that, in our days, Szeged Municipality started some studies to introduce a tram train system that links Szeged to Mako (12 km) and Hódmezővásárhely (21 km).

### 4.1. Germany: Karlsruhe and Saarbrücken

The two case studies have dimensions and cultures that are similar to Timisoara. The integrated approach to public transit was realized by local and bundeslands' administrations, through the extension of the public transit into the urban fringe, at 60, respectively 33 kilometers.

In Karlsruhe (294761 inhabitants in 2010), locals travel from inside the city to a regional level without making a change in the means of transport. The vehicles combine different rolling systems, alternating between the tramway inside the urban areas and the train specific one outside. KVV, the operator, applies different payment systems, according to the distance and the destination. Railroad transport is the backbone of the local transport system, being connected in interchange nodes to bus lines and park-and-rides.

The total network length dedicated to the hybrid means is up to 262.4 kilometers, with 12 lines and a total of 188 stations. In Saarbrücken, city of about 180515 inhabitants, the main operator is Saarbahn. The tram-train system connects the city to the urban fringe, Saarland. The second means of transport is the tramway, inserted to complement and interchange the tram-train for local short distances. The network length is up to 33.6 kilometers, with 34 stations. Each vehicle comes as early as 7 minutes to the one before him, in the central area.

### 4.2. France: Mulhouse

A city being close to the German border, Mulhouse reaches 111156 inhabitants inside the city and 278206 in the metropolitan area, with a rich tradition of transit (host of the biggest cars and trains museums in Europe). The tradition itself is the sign of a good host for the innovative transport systems implementation, as the tram-train is. The three tramway lines are completed with the tram-train line that connects the Central Station to Vallee de la Thur suburb. The pace between vehicles is about 20 minutes, in two directions, for a total amount of 11 stations, so in conclusion 27 daily travels made by 12 vehicles and 6000 travelers carried in the central area. For the good operation of the system, a partnership was realized between 4 operators: Solea, SNCF, M2A and Region Alsace. There is a proposal to extend the system to Kruth, from 22.4 kilometers today, up to 63 kilometers.

## 5. PROPOSAL

### 5.1. Implementing the 3T system: TIMISOARA-TRAM-TREN

Taking into concern every aspect enounced earlier, we propose a hybrid public transit system, an innovation to Eastern Europe, for mobility and commuting on short and medium distances to the major interest urban functions in Timisoara. This combines the advantages of the tramway for urban movement to the advantages of the suburban regional trains, representing the modern society's answer to suburban community expansion around the big cities. In Timisoara, the system can utilize the advantages of an equal gauge to the ones of the tramway, inserting elastic bogies to adapt the vehicles. The proposal is based on already approved mobility strategies, 2005 being the year that offered an idea to utilize the current railroads for the metropolitan transport system. (Timisoara City Council, 2005) All these, realized through a participation between RCUPT / CCPUT and Timisoara City Hall, are updated according to the following criteria:

a) The identification of UTRs (Territorial Reference Units) with the highest living density. These are placed in the Northern area, all along the Cetatii Boulevard, Miresei and Divizia 9 Cavalerie streets, as well as in South, form Dambovita (South-Western), Calea Sagului, Calea Martirilor – Giroc, respectively Soarelui area;

b) Proximity of major urban functions (work places, services and institutions), in the Central area services and institutions and in the suburb for the main work places (industrial platforms, logistic and production centers);

c) The preexistence of a tramway network, in the central median axis (Brediceanu street, Revolutiei and 3 August Boulevards), on the northern arch (Cetatii Boulevard) and the southern one (G-ral Dragalina, King Carol Boulevards, J.N. Preyer street, Dambovita, Liviu Rebreanu, Iosif Bulbuca, Stan Vidrighin, Stefan the Great Boulevards, Dacia and M. Kogalniceanu streets);

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- d) Street profile adaptability, especially along the great boulevards, where the new network can run in a platform separate from the other transport means;
- e) Possibility to run through degraded historical sites and, as a consequence, bringing them back to life through a step-by-step regeneration process that starts with the tram-train (Fabric Neighborhood – Traian square, Josefin Neighborhood – J.N. Preyer street);
- f) A great potential for urban settlements that lie in a radius of less than 50 – 70 kilometers from Timisoara, to represent terminals for this system, with a minimum of 10313 inhabitants in Lipova – Radna and a maximum of 164665 inhabitants in Arad, travelling through other meaningful settlements. The total population being served by the system is of 955150 inhabitants for 8 terminal stations and 10 possible lines achievable in consecutive stages;
- g) University Center proximity and students' dormitories (at a distance of at most 1 kilometer – 20 – 30 minutes in walk from the nearest stations)
- h) A possibility to connect aerial means of transport at a high distance (by European Union's approval of the co-financing scheme in order to rehabilitate the existent railroad and its connection to the national railroad network), so a replacement for the precarious connections to AIT-TV airport;
- i) Evaluating the potential of railroad reorganization by replacing the existent Northern and Eastern Train Stations with rail terminals bearing the same name, as a point out of which the tram train leaves the railroad and enters the urban tramway network;
- j) A possibility to create new development centers in the Eastern area of Timisoara, an area being recognized as the most feasible one by previous Master Plans, in the area of UMT, Padurea Verde (The Green Forest), Ghiroda and Giarmata Vii;
- k) A good opportunity to remedy the lack of continuity in the ecologic corridors by extending Behela stream and connecting it to the dry stream beds in the Solventul area, on a trail that follows the railroad line inside the city (UMT, Timisoara East, Timisoara North, Solventul).
- The system can be efficiently implemented in three stages and ten steps in the suburban area, regenerating focus points in Timisoara and around railroad stations in the terminal train stations in the smaller cities.

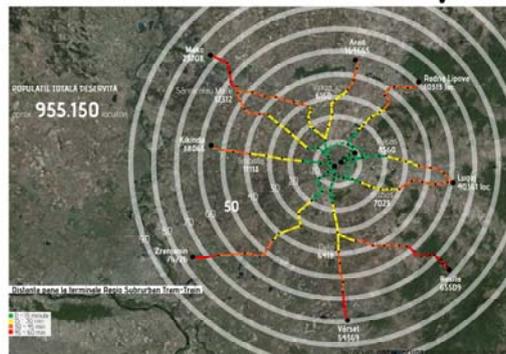


Fig. 1. Total population served at a regional scale.

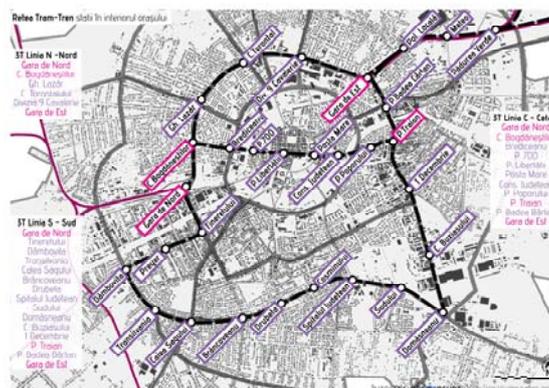


Fig. 2. Tram-train stations inside the city.

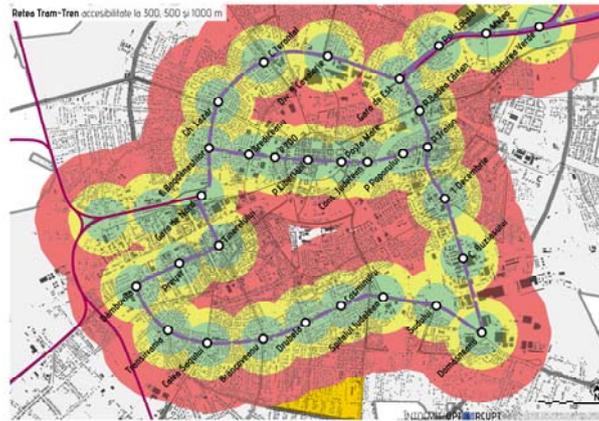


Fig. 3. Catchment areas for stations, at 300, 500 and 1000 meters.

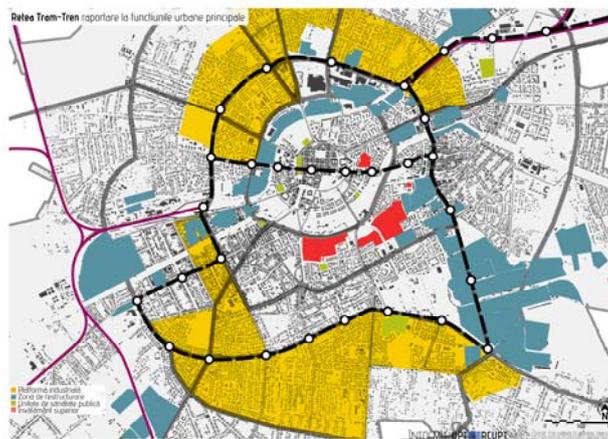


Fig. 4. Covering the main urban function: living, regeneration areas, hospitals and university campus.

## 5.2. Feasibility and opportunities

There are opportunities to implement the integrated railroad transport system, financed by the European Bank for Development and Reconstruction and the European Union, conditioned by three aspects:

- a) Existence of an approved SUMP – Sustainable Urban Mobility Plan, according to the laws and standards required;
- b) Existence of a public service contract that corresponds to the 1370 / 2007 European Regulation;
- c) Existence of an administrative capacity to implement such a project.

## 5.3. Development scenarios

In order to solve the malfunctions and harness the opportunities, several sectorial scenarios are proposed. These are first base conditions for the development of an urban system between Timisoara and Arad as a center of DKMT Euro-Region.

Condition A: regarding the necessary catchment basin for an urban entity that is relevant at a global scale: it is obvious that today, the population of Timisoara's Urban System, Timisoara Metropolitan Area and Timisoara Municipality cannot be in an external competition because of the quantitative and infrastructure network connection deficiencies. Creating an integrated urban system between Timisoara and Arad (Radoslav et al, 2012), with a population that exceeds 500000 inhabitants, regional integrated competitive systems can be sustained.

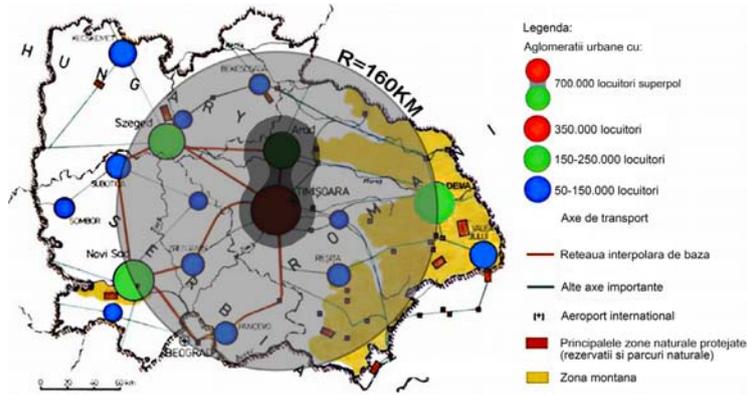


Fig. 5. Proposed urban system Timișoara – Arad (Radoslav 2010).

Condition B: regarding the conflicts between road and railroad networks, we propose the total banishment of the track lines between Northern Timisoara station and Eastern Timisoara station. In this moment, there are two possibilities that are taken into concern, with proposals to insert either a metro line (urban underground train, Planwerk et al, 2012), either the complete discharge and substitution with the tram-train system and integrated urban politics. Our proposal was analyzed once again in a workshop called GN-GE: between Northern and Eastern Stations, organized by RUR, Western Subsidiary, during a symposium (Urbanism between research and good practices) in September 2014, in Timisoara. The solutions relate to an already announced scenario (Oprîș, 1987), based on the conclusions of architect Albert Krausz in 1947, foreseeing a ecologic corridor supported by the Behela water stream that is continued by connection to the dry beds of water in Solventul area. In this way, a blue – green corridor can be introduced, supported by the couple water streams (Bega – Behela) and the bordering green spaces.



Fig. 6. By removing the track between the Eastern and Northern Stations we make room for an internal ring of light rail transport and an external ring of heavy transport.



Fig. 7. Green corridors proposed after implementing the 3Y system.

Condition C: regarding the interchange nodes for the transfer between urban and suburban transport systems, as well as inside in order to connect to the neighborhoods of highest living density, we propose another 3+1 main exchange nodes between road, heavy rail and light rail transit at Ronat, Northern Timisoara and Eastern Timisoara. Today's stations can be specialized, in this way, for commuting persons at distances up to (and over) 60 kilometers from Timisoara, in national and cross border territories (in former Banat province). Around the new interchange cores there will be designed new major and minor public spaces that are of the greatest importance to the city (Radoslav, 2011b).



Fig. 8. Proposed interchange cores.



Fig. 9. Infrastructure projects proposed to connect the network to higher level networks.

Condition D: concerning the connection to European and national networks, we propose in the first place to complete the Western exterior ring road and more connections between Timisoara Municipality and A1 Motorway through Express roads. RCUPT proposal, together with SC Plancontrol SRL is based on the basic requirement to connect the majority of logistic and production cores (over 10) in this area of the city to the external network. Fleets over 1000 trucks transit the town every day, producing pollution and traffic jams. The measures foresee connection strengthening between the existent external ring road and A1 Motorway by enlargement up to 4 lanes for the county road that connects A1 to Timisoara from the NE and by building an Express road that avoids Remetea Mare and connects A1 to Timisoara from the East, at the entrance from Ghiroda, passing by the Johnny Weissmuller proposed intermodal center.

Condition E: redevelopment for the intermodal node at AIT-TV International Airport represents the connection of Timisoara Urban System to higher administration levels. The studies we did at RCUPT (Radoslav, 2007) prefigured this core's importance and the connection to a high speed train that connects the Northern Sea (Rotterdam) to the Black Sea (Bucharest – Constanta). Introducing the new intermodal core concept, we propose an air station for passengers and cargo, centralized bus station for services that are destined or pass Timisoara, railroad station and for the light rail, as well as a park&ride for the interchange to personal vehicles and complementary urban functions: business center, expo center and the JW Logistic Center at Remetea Mare.



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### IMPLEMENTAREA SISTEMULUI TRAM-TREN PENTRU TRANSPORTUL ÎN COMUN, CHEIA PENTRU O MOBILITATE EFICIENTĂ ÎN REGIUNEA DE DEZVOLTARE VEST ȘI EUROREGIUNEA DKMT

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**Rezumat:** Creșterea populației urbane la nivel mondial aduce cu sine provocări care țin de toate cele trei componente de bază ale creșterii organice: economică, socială și ecologică (Little D., Arthur, 2014). Dezvoltarea acestora va induce necesitatea asigurării unor rețele de mobilitate extrem de eficiente, eficacitatea fiind prima caracteristică analizată în ceea ce privește concurența dintre Regiunile de Dezvoltare. Centrul Regiunii de Dezvoltare Vest este Municipiul Timișoara. Județul Timiș beneficiază de cea mai densă rețea de căi ferate din România, 90,4 km / 1000 km<sup>2</sup> (Maxim et al, 2007), Timișoara fiind centrul unui sistem de transport pe șine planificat și dezvoltat de administrația maghiară încă din partea a doua a secolului al XIX-lea. Sistemele politice și intervențiile din ultimii 50 de ani au ținut în loc o dezvoltare transfrontalieră sustenabilă care putea pune municipiul nu numai în centrul Regiunii Vest și al Banatului istoric, ci al întregii euroregiuni DKMT. Studiind practica occidentală în ceea ce privește sistemele intermodale și potențialul structurilor urbane din euroregiune, studiul nostru propune implementarea unei rețele de transport pe șine hibrid de tip tram-tren, conectând Timișoara cu nucleele urbane subordonate pe o distanță maximă de 60 de kilometri. Odată implementată și integrată rețelelor complementare, o astfel de soluție aduce beneficii economice, sociale și ecologice pentru euroregiune în general și pentru fiecare comunitate în parte, reprezentând o gândire de tip câștig/câștig pentru administrațiile implicate.