TITLE: THE ROLE OF TRAMWAYS IN THE USSR AND THE GDR IN THE 1950-1960s: UNDERSTANDING THE CONFLICTS AND PRIORITIES

Abstract: The development of urban public transport after WWII in GDR and the USSR was a controversial and complex matter; presenting at the same time an urgent necessity to prepare road infrastructure for growing automobile traffic, as well as having a tramway system that functioned efficiently. The combination of these two modes of transport infrastructure in city streets was a new issue in urban planning. Due to the city planning modernisation paradigm tramways' role were inferior to that of motorised transport, which was the leading planning principle in both Western and Eastern Blocs.

Although the role of the tramway both in GDR and the USSR was reduced; it was not completely eliminated and was in fact continually developed with modernisation and restructuration of the tramway network. This raises questions such as - Why did trams maintain their importance? And, how can its restructuring process and its interaction with road infrastructure in the 1950s and 1960s be explained? This article argues that the relationship between motorised transport and the tram was not only dominated by motorised transport infrastructure, but in fact changed in relation to factors such as the level of consolidation of the tram network; the culture of tramway planning; financial possibilities of rebuilding cities and; ideas of urban planners.

In a broader perspective, tramway lines were used as a tool to provide accessibility between important functional zones to determine the direction of balanced, compact and coherent urban development. The aim of the study will be to understand the period when ideas about road infrastructure planning and its interaction with tramway infrastructure emerged, in order to distinguish the level and purpose of priority given to each mode of urban transport.

Keywords: tramway, motorised transport, public transport infrastructure, urban planning, spatial conflicts.

I. INTRODUCTION

The history of tramway development in the 1950s-1960s in the so-called Eastern Bloc is controversial because the period of urban reconstruction coincided with the extensive development of vehicular and pedestrian traffic within the paradigm of the rationalisation of urban planning. The modernisation of the city went hand in hand with the process of abandoning

the tramway to replace it with non-rail public transport such as buses and trolleybuses, a very similar development pattern, although with different degrees of completion, for both Western and Socialist Europe, and the USSR. If in Western Europe tram lines were mostly eliminated to avoid conflicts in urban traffic, in Socialist Europe and the USSR this was done in a selective and irregular manner, which makes it interesting to try and understand the reasons for these variations. To this end, the two countries, the USSR and the GDR are fascinating as they have similarities and variations in urban transport policy.

Why did tram planning vary? When and why was other motorised transport important? How did the tram network adapt to the new urban traffic conditions? When did the tram have priority? What criteria were applied in decisions on the selection of urban transport modes and in the development of the tram network in cities? This article explains that, in GDR and the USSR, trams were sometimes given an important role in public transport planning and on other occasions they were denied this role in favour of other modes of transport. All this was changing both in relation to the political-economic contexts of different countries, and in relation to the development of the discipline of transport and urban planning during this period.

Within the extension of the paradigm of motorisation in urban transport, the tram was considered the cause for spatial conflicts. From the 1930s, both in the USSR and in the GDR, there were discussions on the conflicts between tram and road infrastructure, resulting in several comparative studies on the need and possibility of substituting trams for a non-railway mode of transport such as buses and trolleybuses. The main method of resolving conflicts was the separation (vertical or horizontal) in order to provide rapid circulation. While vertical separation may have often been a preferable tool, its realisation was not always possible due to economic issues and sometimes due to the geographical characteristics of the location. The horizontal separation of urban traffic was more accessible and quicker in its construction and this method was supported by the possibility of extending the territory of streets which were state property, as well as by the reconstruction of the bombed cities after WWII. These horizontal separation decisions needed careful consideration as to urban design in order to arrive at solutions which were both economically and functionally effective.

On the other hand, the advantage of tram transport was its versatility and adaptability to urban situations and to the objectives of planners and politicians. As R. J. Buckey noted in his book "A history of tramways: from horse to rapid transit" (1975, p. 119): "The tramway is more flexible among all modes of urban transport, it can pass virtually anywhere, up, down, beside and on the

street". Such flexibility was important in resolving spatial conflicts that increasingly varied according to the objectives, preferences and characteristics of the urban situation.

It should be noted that within these solutions there was no situation when the balance or a decision with equal effects between motorised transport and tramways was achieved. However, there were cases when one mode of transport received more priority than the other. The role of the tramway traffic, in most cases, was lower compared to that of motorised and pedestrian traffic. This can possibly be explained by the specific needs of the tramway transport organisation such as the need to have a big turning radius in the intersections or, the difficulties in modifying the direction of its track guided route, etc., and these aspects were thought to be responsible for the delay in the circulation of road traffic. However, within these ideas there was a difference between the idea that the tramway could be maintained and modernised in the future, and the idea that its network had to be minimised and left only in the most traffic loaded directions. The understanding of these preferences will help to understand not only the tramway system planning, but also all urban transport planning in both countries.

The main hypothesis of the article is based on the idea that in the GDR, tramway planning had higher priority than in the USSR. This can be explained in the GDR by the long traditions in tramway planning, with an understanding of the social effect and role in the functioning of all urban traffic. Whereas, in the USSR, the tram was not always so important, and this is possibly due to a late development in cities and an exclusively rational orientation based on rapid economic profit. This difference between the two communist countries resulted in important variances in the posterior development of the tram network.

The main objective of this paper is to understand the reasons for actions in tramway planning in the USSR and the GDR, as well as the evolution of ideas for solutions to spatial conflicts in the 1950s and 1960s. The aim is not to explain all of the conflicts and urban solutions, but to explain the general logic of the urban actions in both countries, highlighting the ideas related to the priorities and solutions of the conflicts between the tram and motorised transport. The article has been developed in the following way: the first chapter is devoted to the development of trams in the USSR and the GDR up to WWII which will make it possible to understand the dynamics of the development of tramway systems; the second chapter is dedicated to the post-war period which coincided with the reconstruction of cities and the beginning of the ideas for the rationalisation of urban traffic; the third chapter relates to the radical change in urban planning with the development of ideas about motorised transport as the universal mode of

transport in cities in the 1960s; and finally a chapter will be devoted to the solutions of the conflicts between tramway and motorised transport.

II. THE DEVELOPMENT OF TRAMS IN THE USSR AND GERMANY BEFORE WWII

The development of trams as a means of mass transport took place from 1890, coinciding with the processes of industrialisation and urbanisation (McKay, 1976, p. 6). Its economic advantage was widely accepted from the beginning of the 20th century when with the extensive electrification trams became the main mode of urban public transport. The development of the tramway network reached also the small villages resulting in an extensive transport network on a suburban scale. In parallel there was the process of development of buses, trolleybuses and the metro therefore, the monopoly of trams in cities began to be questioned (Schmucki, 2010, p. 12). J. Stübben, for example, in his 1924 work "Der Städtebau" had already mentioned the limits of tramway application in the city, highlighting the difficulty of tramway operation in narrow streets and the problems of speeds between them along the road and at intersections. Stübben saw one of the main solutions to this problem in the reserved tram platforms (1924, p. 249-250).

The main objective for European countries and the USSR was to compare the technical and economic characteristics of the three modes of public land transport: bus, tram and trolley bus, in order to choose the main mode of transport. In this period different projects appeared intending to highlight the most comfortable and economical urban transport mode. In most European countries, buses were considered as a suitable solution to replace the tramway due to the developments in comfort and technical characteristics. In Germany and the USSR this issue was not yet resolved in a defined way because the road infrastructure was not very developed[1]. In Germany, this was explained also by the promotion of its electricity industry with the preference for the use of electrified transport (Yago, 1984, p. 20) and by the orientation of politicians towards a compact and concentrated suburban development (Capuzzo, 2003, p. 47). In the USSR this could be explained by the change in political status, the delay in urbanisation

[1] On the importance of the construction of urban road infrastructure and the construction of interurban roads with military objective in the USSR based on the Stalinist strategy of modernisation, as well as the state policy on the development of the automobile industry in the 1930s and its problems, see the works of Lewis H. Siegelbaum (2008) "Cars for Comrades: The life of the soviet Automobile", New York., (2008) "Cars for Comrades: The life of the soviet Automobile", New York, Cornell University Press, as well as "Roadlessness and the 'path to communism': Building roads and highways in Stalinist Russia" (2008), Journal of Transport History,29, №.2.

and road infrastructure construction and the difficulties in the industry of motorised transport production.

In Germany in the years 1910-1920, trams played a key role in the development of cities, mainly due to the extensive municipalisation of tramway companies when almost half of the private companies became social agencies (Kreschnak, 1981, p. 56). During the period of reconstruction and rationalisation policy in urban planning after WWI, the German state was focused on improving the country's economy and at the same time on extending its power in urban planning decisions to create a good image for the workers. The tram lines that were considered the main mode of public service provision were based on a policy of providing comfortable and short connections between all city main locations and new residential areas. Therefore, it could be said that in that period the idea of integration between the tramway network and land use planning appeared and this was an idea which was supported by state - centralised regulation.

Despite having the development of motorised transport as the main strategy during the Nazi regime in Germany, the tram did not lose its importance as the means of urban transport that transported workers and provided effectiveness in urban functioning. Tram lines were almost not changed and were complemented by buses which had not yet entered the phase of competition. In O. Blum's, H. Potthoff., C. Risch book "Strassenbahn und Omnibus im Stadtinnern" published in 1942, authors argued that the "new" type of traffic (motorised traffic) should not influence the existing tram traffic, stressing that the tram should receive the maximum possible support because it is efficient and therefore had to take advantage of narrow streets (1942, p. 6-7). These ideas had the possibility to be maintained later, for example, Professor H. Potthoff in 1954 was appointed dean of the Hochschule für Verkehrswesen in Dresden, developing his ideas in the reconstruction of the GDR cities.

The main idea of this book was based on a careful comparison of the advantages and disadvantages of both trams and buses. Both modes of transport were first evaluated from a technical point of view with criteria such as passenger capacity, speed, road surface efficiency, traffic fluidity, etc. where both modes of transport presented similar characteristics, leading to a conclusion that theoretically trams could be replaced by buses. However, this was not so important for the authors and the comparison was followed by an evaluation of the social and economic benefits of the two modes of transport. Within the social evaluation, the tram had more advantages for creating a reliable public transport system with fixed tracks; operational safety; being free of oscillating movements and clear of other traffic and; comfortable for

passengers, etc. (1942, p. 49). The main idea of the authors was that the tram had an infrastructure independent of the unstable motorised traffic and its infrastructure. Buses and trolleybuses presented ambiguity and insecurity in their functioning due to the fact that they shared their infrastructure with motorised traffic and, for this reason, they could not be considered as the main mode of public transport.

Apart from the social aspects, the important economic point in the comparison of the two modes of transport was considered to be the long-term investments made in the tramway infrastructure, which was expensive to build and cheap in functioning (1942, p. 51). Therefore, for the authors it was logical to take advantage of this investment in relation to the long-term city development plans. These economic and social criteria were decisive for continuing with the development of trams and not replacing them with buses.

As for the development of the tramway system in the USSR, the years 1910-1920 were politically unstable which resulted in the decline of tramway transport. Additionally, this period was characterised by the development of utopian concepts of the socialist city based on multiple discussions between planners and politicians. Therefore, in this period the planning of tramway networks in Soviet cities was characterised by a lack of clarity of their future development. From Stalin's period and his urgent policy of industrialisation of the country, began the rapid process of urbanisation and support for tramway development with its extensive electrification. This process took place precisely between 1932-1937, when the tram network projects were implemented in industrial cities such as Magnitogorsk (1935), Chelyabinsk (1932), Zaporozhie (1933), etc. It should be noted that because it was a short period of development of the tramway system in Soviet cities, its planning was not completed, often remaining in the form of projects and plans, which in most cases did not receive their development after WWII.

In parallel to tram transport development, the question was raised about the main mode of public transport for the future development of Soviet cities. Professor A. K. Zilbertal was one of the few developers who supported the idea of extensive use of the tram[2] as the main means of public transport. In his work "Problemy gorodskogo passajirskogo transporta" published in 1937, he proposed the exceptional use of buses only for cities between 50,000 and 80,000 inhabitants. For other cities with a population of between 80,000 to 1 million inhabitants the main method

[2] A. H. Zil'bertal was one of the first theorists in the 1930s to devote his works to the problems of public urban transport choice and tramway transport development issues in Soviet cities. Among his works see "Problemy gorodskogo passajirskogo transporta", 1937, "Tramvainoe hozyastvo", 1932, both published in Moskva-Leningrad, Gosudarstvennoe transportnoe izdatel'stvo.

of public transport had to be the tram (1937, p. 234). Despite his numerous works into this matter and the support of the state for the development of trams, by the end of 1930 the tram began to be considered as something obsolete and old; which would in the future deteriorate rapid circulation of road traffic. This change can possibly be explained by the numerous translations of Western European planners who were oriented to organise the city in relation to automobile traffic, where the tram no longer had a future for development. Thus, for example, the translation of Henry Watson's book in 1938 into Russian was important because it was dedicated to the evaluation of trams, their conflicts with motorised transport and the possibility of substitution with buses. The author, in spite of trying to underline the advantages of trams over buses, continued with ideas similar to those held at that time in the Western Bloc where the planning of the tramway infrastructure should be reconsidered in relation to the new urban traffic conditions. The use of trams was not advantageous in the central locations, in narrow streets and at intersections, and it had the priority only in directions with huge amounts of traffic in the peripheries (Watson, 1938, p. 14).

Possibly, following the ideas of Western planners, the ideas of public transport planning in the USSR were also changing. Some of the first ideas on the rationalisation of the tramway network were written by the Soviet planners V. K. Petrov and V. G. Sosyantz in their book "Urban Transport", published in 1939. According to them, after WWII it was necessary to think about the elimination of the tram lines in the centre of Moscow, replacing them with an intensive operation of buses and trolleybuses. The tram had a limited function in urban transport such as connecting peripheral areas with the periphery of the central zone, improving connectivity between peripheral areas, connecting suburban areas with the urban transport system, especially with the final metro station (1939. p. 16-17).

In general, in this period both in GDR and the USSR, along with the development of tram networks, the concern about the development of automobile traffic in the future can be noted. Despite having the tram as a priority in urban functioning, spatial conflicts were widely discussed and studied. However, the first steps in finding solutions to this issue were taken during urban reconstruction in the post-war period.

III. COMPETITION IN THE TECHNOLOGICAL DEVELOPMENT OF TRAMS, BUSES AND TROLLEYBUSES: CONDITIONAL RECOGNITION OF TRAMWAYS

The post-war period can be considered as an important stage in the development of public transport in Europe and the USSR. There was a powerful initiative to develop the technical characteristics of different modes of public land transport such as speed, acceleration and deceleration time, passenger capacity, comfort, noise minimisation, etc. As a result, countries came up with similar results for trams, trolleybuses and buses. The difference was in the decisions on the application of certain type of public land transport and the development of the necessary infrastructure. In some Western European countries such as West Germany, Italy, Belgium, etc., the post-war period started with the reconstruction and modernisation of existing tramway infrastructure, characterised by an improvement to the technological characteristics of tram wagons. This was accompanied by the development of tram infrastructure such as an improvement of track conditions and separation on reserved platforms. The technological advance of trams was mainly related to the increase in design speed, passenger capacities, dynamic characteristics such as the acceleration and deceleration that reached automobile level; deceleration characteristics were twice as good as the automobile´s (2.5 - 3 m/sec2 vs. 5 - 6 m/sec2).

Within the speed criteria, the conventional tram with speeds of circulation of 15-16 km/h followed buses and trolleybuses 18-20km/h. Therefore, the conventional tram had two solutions: maintenance of the existing tram infrastructure with improvements to its effectiveness with larger capacities, or its replacement with buses and trolleybuses.

In the case of speed characteristics, conventional trams did not have the possibility of gaining priority; in the case of capacity with time it was possible to develop greater characteristics. The ability to transport large quantity of passengers in one journey was one of the characteristics that gave economic priority to public transport. The 1950s were characterised by the intentions of increasing tramway capacity based on the idea of adding a second wagon. This development was very slow in the USSR and Socialist Europe, only at the end of 1950 were trams with two wagons experimented with. Despite this tram development, in the late 1950s and early 1960s, tramways, trolleybus and buses capacities ran at a similar rate of 75-90 people. This development of capacities continued with the production of articulated trams, with 157 people in Tatra T-3 in 1962 followed by the articulated bus, Ikarus - 180 and Ikarus - 280 with a capacity of 170-180. In parallel, in the USSR, with the idea of developing mainly the road transport infrastructure the

concept of trolleybus-train[3] was developed, with the capacity of 190 people. In the GDR trolleybuses did not find mass development, possibly because the transport planners did not see the important technological difference between buses and trolleybuses, as well as between trolleybuses and trams. With this rapid technological development of buses and trolleybuses in the 1950s and 1960s, influenced the priority of non-rail public transport and the development of infrastructure for it.

However, by the end of 1960, it became obvious that the capacity of buses and trolleybuses would not be able to accommodate traffic of between 15,000-25,000 people which had started to be considered normal for growing cities. In the USSR problems began with travel time being raised to 50-70 min (Gol'tz, 1974, p. 4). Trolleybuses and buses could not respond to the mobility needs of people with the most important urban focuses like the city centre and industrial zones. While in the GDR, although there was also no public transport with higher speeds, they had the infrastructure for the articulated tramway and the possibility of accommodating greater passenger capacities, which ultimately helped to maintain reasonable travel time in the cities. From this, we can understand that apart from the problem related to speeds; problems with delays of buses and trolleybuses had also started to appear. Additionally, the development of the capacities of these modes of public transport had reached its limit, and there was an urgent need to transport the largest flows of passengers. Meanwhile, the tram had the opportunity to grow in passenger capacity, with the solutions of articulating three tram cars improving the capacity up to 300-450 people and reaching up to 30,000-35,000 people every hour. The recognition of these problems with buses and trolleybuses in the conditions of increasing urban traffic and the need for urban extension in the late 1960s gave new impetus to the development of both rapid tramway technology and infrastructure with new solutions in urban structure and design.

However, until reaching these conclusions, both in the GDR and in the USSR within the process of choosing the main mode of public land transport, two decades were spent in discussions and research trying to find solutions to the spatial conflicts between rail and non-rail public transport.

IV. THE GROWING CAR TRAFFIC: THE FIRST IDEAS ABOUT TRAMWAY CONFLICTS WITH ROAD TRAFFIC IN THE POST-WAR PERIOD

[3] One of the first ideas about the trolleybus-train appeared in Kiev, realized by Soviet engineer V. Veklich. See more in his work V. F. Veklich (1967) "Poezd iz trolleibusov MTB-82", Ukraina, Gorodskoe hozyastvo.

In the post-war period, there was a difference in urban public transport policy in the USSR and the GDR, which could be explained by the absence of the agreed principles between the two countries. Each country continued with the ideas from the previous period which affected the different development of the tramway networks. In the USSR the transport planning policy was based mainly on developing road infrastructure and with the selective replacement of trams by buses and trolleybuses. The substitution was carried out mainly in large cities such as Moscow, Leningrad, etc., as well as with the solutions of exclusion of trams in the planning of new industrial cities. Meanwhile, in medium-sized cities, the reconstruction and development of tram networks continued. In the GDR in the post-war period the tram preserved its priority as the main mode of public transport in all cities. The explanation can possibly be found in Germany's general resistance to the development of motorised transport for ideological reasons which were related to the act against Nazi motorisation policy (Schmucki, 2010, p. 5-24), as well as the impossibility of quickly building road infrastructure due to post-war economic problems. In order to meet the needs of the people movement in the city, tram lines and old wagons were rebuilt. The importance of trams in the GDR can also be seen in urban transport policy: the tram was proposed optionally for cities with between 50,000-150,000 inhabitants and was the main mode of transport for cities between 150,000 and 700,000 people (Deutsche Bauacademie, 1954, p. 163).[4]

While, in the USSR, the planning of the use of the conventional tram tended to be avoided, and in literature only the solution of fast tram for cities with between 600,000-800,000 inhabitants was mentioned (Stramentov., Fishelson, 1963, p. 32). This may be explained by the idea of avoiding the use of trams in the cities; although there was some passenger traffic that was identified as tram traffic of 5,000-15,000 people/hour, for this volume of traffic the intensive use of buses and trolleybuses was planned.

To better understand the priorities in urban transport development in the post-war period in the USSR and GDR, it is interesting to compare the report for CIAM in Moscow in 1958 on the experience in urban reconstruction and construction 1945-1958. In this report in the answers on urban transport solutions in the GDR, for example, the tram was named as the main mode of

[4] In "Handbuch für architekten" (1954) the explanation was given that neither buses nor trolleybuses could replace the tram, clearly defining the role of buses as the means of transport for weak traffic with the possibility only to function on the city periphery or to connect the centre with suburbs. The trolleybus was defined as a mode of transport for medium flows in cities up to 150,000 inhabitants. While the tram was considered as the main public transport mode (Grundverkehrsmittel) that managed a very large proportion of total traffic, due to the profitability of its functioning, high performance and passenger load capacity (1954, p. 163-165).

public transport with the use of conventional tram for cities of 80,000-300,000 inhabitants, and for cities of 300,000-750,000 inhabitants were proposed the need of fast tram (Abrosimov, 1958, p. 12). While in the text of the USSR experience, there was no clarity in the criteria for the use of different modes of urban transport. Instead, the advantages of trolleybuses with their greater manoeuvrability compared to trams, the importance of the use of railway lines in the city, as well as the reduction in tram use from 85.6% in 1940 to 43.6% in 1956, with bus use growing to 35.4% (Abrosimov, 1958, p. 28-29) were mentioned. From this comparison, one can see the weak role of trams in urban transport planning in Soviet cities in the post-war period, as opposed to the extensive reconstruction of trams in GDR cities.

The other aspect of the comparison of transport policy between the two countries may be the volume of passengers which was a determining criterion in the selection of urban transport. In the GDR tram use started with a number below 5000 passengers/hour and was followed by 5,000-14,000 passengers where the tram was the main urban transport (Kruger, Richter, Stuhr, 1961, p. 212). Whereas in the USSR in directions below 5000 passengers/hour only buses and trolleybuses were used; between 5,000 and 15,000 people/hour articulated buses and trolleybuses and in case of 15,000 - 25,000 people/hour - fast trams.

On the other hand, in the post-war period in the USSR due to the urgency in urban reconstruction there were other much more important problems than improving rapid transit infrastructure and there was not a critical need for this infrastructure improvement as cities were not growing so rapidly. For this reason, first of all there was preoccupation for construction and improvement of road infrastructure which was in a very bad condition. It was possibly viewed as economically irrational to develop both road and tram infrastructure, therefore, road infrastructure was selected due to the advantage of combining both individual and public transport traffic.

The second problem was related to the reduction of delays in road infrastructure, with special interest in traffic improvement in intersections. This was highlighted by A. A. Polyakov in his pioneering book on urban traffic in the USSR "Organizatziya dvijeniya i planirovka ulitc" published in 1953 (p. 169). This was proposed to be done through a series of actions such as: the replacement of tram lines by bus or trolleybus; the planning of the tram line in a direct direction; the absence of turns at intersections and; connections from the tram stops with buses and trolleybuses lines (Polyakov, 1953, p. 235-236). As a result, these solutions to improve traffic flow backwards seriously worsened the level of service for passengers and direct connectivity between different urban points.

The difference in public urban transport policy between two countries can be explained by the difference in the selection criteria of public transport modes, explained in the book of A. E. Stramentov and M. S. Fishelson "Gorodskoe dvijenie", in 1963. The authors evaluating the German public transport policy in GDR and FRG based on the concept of the “tram-bus combination”, summarised that "in the case of the USSR it is not necessary to blindly follow the concepts established as "tram-bus", it is necessary to combine the modes of transport in order to arrive at rational and sequential solutions. Therefore, solutions should depend on the following principles: Firstly, the capacity of the flows should be related to the transport capacity; the transport speed in the main directions should depend on the shape and size of the city (the duration of the journey should not exceed 30-40 minutes); and during the choice between 2 or 3 competitive modes of transport, the mode that is most economical and *has the least influence on the existing urban situation should be chosen*" (1963, p. 76).

From this, we can conclude that, in the case of the USSR, there was no firm policy on the development of public transport. There was a concern about the economic efficiency and urgency of the implementation of public transport planning, or on the contrary there was an intention to develop public transport modes that were utopian and not possible to be realised in the near future.

V. THE GROWING PUSH OF MOTORISED TRANSPORT IN THE EARLY 1960s AND THE DEVELOPMENT OF IDEAS ON THE REPLACEMENT OF TRAMS

The radical change in both urban planning and urban transport since the early 1960s can mainly be explained by the development of the political-economic objectives of the socialist regime. The socialist five-year plans of the 1950s were designed to bring order to the many public projects that had to be carried out, an order that also required coordination between administrations. In the post-war period, the urgency of needs gave clear priority to sectoral projects and plans. The country's development was linked to large productive projects and the provision of housing, so "separate planning" predominated and centralised planning did not ensure the integration of vertical policies. In the 1960s, there was time for another form of planning due to political changes, academic and technical progress, and because urgency was no longer the justification for everything. Transport was a very powerful instrument in the improvement of the economic conditions of the socialist system, but it had to be interrelated not only with the centres of

production and consumption of the territories, but also with the functionality of the urban space. This was an important issue that needed to be improved urgently. The socialist economy ideology of division of labour and the ambiguous concept of a socialist city in terms of the coherence of urban growth meant that an entity had to be planned in the form of an integrated system, where city planning, and transport had to converge. Interurban transport and urban transport should complement each other and the specialisation of the functions of the means of transport and the coordination of their functioning should be defined.

Within these changes and the importance of strengthening the urban public transport system, in parallel the idea of development of road infrastructure and motorised transport existed. It was a hidden idea in the form of an image that represented the level of modernity of cities, so it was always in the minds of both planners and politicians. Possibly, one of the solutions to this conflict in the paradigms was to be able to combine the development of the road infrastructure with the possibility of developing fast public transport, which was to be done through the planning of an extensive and intensive system of buses and trolleybuses, in coexistence with a car traffic whose growth was expected. To understand the development of tram networks, it is necessary to understand why motorised transport and road infrastructure were important in urban planning in Socialist Europe and the USSR. There are several reasons for this:

- The large and complex road infrastructures created part of the imagery of the communist party as a symbol of progressivity and modernity. Competition with the Western Bloc for world domination required the representation of technological advances, which were implemented spatially in large and complex road infrastructure constructions.

- Another reason could be the importance of traffic planners in urban planning. Traffic planners were treated as people who could address the complexity of traffic planning with mathematical calculations and models. In doing so, they were seen as the people who could provide the rationalisation of the urban structure. They therefore had the decisive voice in urban planning. The logic of urban planning based on the engineering concern to provide maximum road infrastructure capacity for future traffic became the fundamental principle not only for urban transport infrastructure planning, but also for the whole urban planning. The principle was “more is better” based on the idea that when road traffic grew, which was expected to occur in any case following the example of the Western countries, the road infrastructure of socialist cities would be prepared for that.

- On the other hand, there was a concern of the socialist regime for rapid traffic and accessibility to ensure the efficiency of the functioning of cities and the economy in general. In the post-war period most cities did not have a classified and functionally specialised street structure, the solution to this issue became the main preoccupation of the authorities. If the reconstruction of road infrastructure would not be realised according to fluid road traffic criteria, rush hours and delays could happen, which would mean a reduction of economic benefits for industry oriented socialist cities. This also meant the decline of the socialist city's main advantage – a city free from road traffic congestion.

In the USSR transport planning theory, buses were seen as the secondary transport system that had to complement the tramway system. In practice, however, buses replaced trams both in the narrow streets of the city centre and in the new directions to connect with new residential areas. Although flexibility in movement as the main criterion of buses was emphasized, in short, the importance resided on the idea of combining their infrastructure with the automobile infrastructure, thus creating homogeneous transport traffic, which was without delays, fluid and faster. The reduction of trams in the USSR in this period was from 85.5% in 1940 to 37.5% in 1960, it was estimated that the reduction could be in 1980 approximate to 18-20%, and the growth of buses was from 6.5% in 1940 to 41.4% in 1960 (Stramentov., Fishelson, 1963, p. 31-32). As for RDA, this change was not so dramatic, the passenger traffic in tramways reduced by 10, 1% between 1955-1970 (Statistische Jahrbuch der DDR, 1972, p. 244).

In relation to the ideas of the extensive use of buses in the USSR, a large collective piece of work published by the Central Institute of Urban Research and Planning could be mentioned where, for the first time, new urban planning principles were announced. Within this work the chapter dedicated to urban public transport development principles is especially interesting. First, it could be emphasised that this chapter did not include any possibility of conventional tramway development in Soviet cities, instead, it explained the incompatibility of tram traffic with intensive traffic in narrow streets (1966, p. 316).

Within the section dedicated to fast public transport, the authors began with the idea that high speeds in urban traffic could be achieved with both rail and non-rail type of public transport, supporting it with the idea that passenger transport was to be carried out by non-rail transport (TSNIIP, 1966, p. 318). The explanation of the priority of buses was mainly based on the possibility of quickly organising passenger transport with minimal investments. As for the modes of fast public transport, the future possibility of using fast tramway was mentioned, however, in the

explanations the cases of use of other modes of transport such as metro, urban rail and monorail rather prevailed. According to the authors, trolleybuses were not comfortable because of their suspended electrical contact cables that cluttered the urban space (TSNIIP, 1966, p. 328). The conclusion of this chapter was based on the ideas of the advantages and possibilities of using express buses, as well as the need to combine buses with electric transport characteristics and introduce electric buses in the future.

In the GDR cities of between 50,000 and 700,000 inhabitants, there had to be a combination of trams and buses (Deutsche Bauacademie, 1967, p. 84). Despite this priority of trams, the general trend of rationalising urban traffic by limiting the delays caused by the tram was also present. On this occasion, studies were carried out to evaluate different modes of public transport. Within this, the metro, due to economic issues and, monorail, due to difficulties in implementation, were not successful in their widespread application. The planners tried to look for other solutions for the replacement of trams. The idea of replacing trams by urban rail came up in "The Conference on the Construction of Cities" in 1967. The idea was discussed that with proper planning of the Deutsche Reichsbahn tracks, all GDR cities could in future function without the tram system. After discussion and analysis, it was admitted that railway lines could meet urban traffic needs only in some cities such as Halle, Magdeburg, Berlin, as the other cities did not have such a developed railway system. The elimination of the tram and the lack of adaptation of S-bahn to perform urban traffic could result in the release of undesirable flows to different modes of public transport during rush hours (Rüger, 1968, p. 171).

It should be noted that this idea of replacing the tram with rail in the case of the USSR was practically impossible, because a developed network of railway lines did not exist in their cities. The railway lines were located on the periphery of cities without having sufficient relations with the urban structure. Apart from these complexities, there was a lack of understanding of the use of existing possibilities in rail transport that did not allow the use of existing possibilities (Shabarova, 1986).

Explaining this idea of replacing trams by rail, it is worth noting that the idea of homogenising the three types of rail transport such as metro, rail and tram and combining the use of their infrastructures to limit the networks of their infrastructures within the urban transport network was one of the old ideas of the 1930s. In order to do this, there were important criteria to keep in mind such as; having railway lines related to the urban structure; having the possibility of organising passenger traffic flows separated from freight traffic; and having the capacity of the

lines for regional and suburban passenger traffic as well as for urban traffic. Apart from these problems there was also the important problem of the construction of the additional lines and the low density of the railway lines that complicated the accessibility of the passengers and lengthened the general time of trip. Recognising these problems both the GDR and the USSR also recognised the impossibility of this idea and the need to temporarily maintain tram lines in cities.

Thus, in the numerous studies on the alternative to the tram in both the GDR and the USSR at the end of 1960, it was concluded that there was no viable solution for larger volumes of traffic than the tramway system. The difference here was in the possibility of continuing with the conventional tram. In the case of the USSR, conventional trams were still the undesired modes of transport and therefore, in the literature only buses and trolleybuses for between 9,000 and 10,000 passengers/hour were mentioned, and for flows between 10,000 - 20,000 passengers/hour the fast tram was mentioned (Sheinyuk, 1971, p. 4). In the case of the RDA, generally conventional tram infrastructure was maintained, and if it had to be replaced, this could be done with other modes of rapid and massive transport such as fast tram and fast train, and only in exceptional circumstances with the bus (Glissmeyer, 1970, p. 68-69).

VI. THE VARIOUS SOLUTIONS TO THE CONFLICTS: THE ROLE OF TRAMWAYS IN URBAN STRUCTURE AND DESIGN

In order to better understand the conflicts and priorities between tram and urban planning we looked at the solutions to the conflict points in the GDR and the USSR in urban planning. The conflictive places were usually considered to be the places of interaction between motorised and tram transport that caused the delay in the circulation of urban traffic flows. Among the most conflictive places were considered: the centre of the city with narrow streets, the intersections and, roads with the intensive load of motorised traffic. By comparing ideas and solutions for these conflict zones in the GDR and the USSR, an attempt was made to understand the priorities in tramway planning.

- *Intersections and vertical-horizontal separation of urban traffic.* Intersections were the most conflictive places in cities. It was considered in both countries that the separation of transport flows had a great effect on the capacity of urban traffic circulation. The problem was especially tram transport which needed the additional time and space to make turns, therefore this mode of transport was considered to cause delays in motorised traffic. These intersections were

referred to as "intersections with heterogeneous traffic" (Polyakov, 1965, p. 81). Solving this problem was considered to be very difficult. In some discussions, planners even made proposals for radical solutions such as eliminating tram lines, replacing them with motorised public transport, moving the line to parallel streets, or moving the intersection of tram lines elsewhere (Polyakov, 1965, p. 161).

In general, two types of solutions were applied: the vertical or horizontal separation of tram traffic and motorised traffic. Vertical separation was applied in exceptional occasions when there was a large volume of traffic. Intersections at different levels were not applied for the conventional tram, or express buses, but rather for the fast tram lines and located on the main roads.

Therefore, in both the GDR and the USSR there were more solutions with horizontal separation of motorised and tram transport. Horizontal separation at intersections led to the need to think about urban design, in order to place the tram in urban space according to the needs of modern traffic (Keul, 1969, p. 267). In the case of roads without a high load of motorised traffic, the intersections of tram lines were combined with motorised traffic; in the case of high motorised traffic, the main task was to avoid the intersections with tram transport as much as possible and at the same time avoid vertical separation solutions. To this end, the intersections of tram lines were moved from motorised transport intersections, or 1-2 tram lines were eliminated in order to avoid the crossing of four directions that would complicate the traffic flow at intersections.

One of the exemplary solutions can be found in the case of Dresden where the horizontal separation of tram lines from the main roads through an asymmetrical composition was applied (Fig. 1). The main idea of this solution was to alleviate the problem of delays at the numerous intersections in the ring around the city centre where urban traffic was accumulating. This solution was accompanied by the idea of *classifying tram traffic*[5] *before entering the motorised transport intersection*, through the bifurcation of the tramway lines that were preferably located in places free from motorised traffic circulation.

Despite the intention to limit the influence of tram infrastructure planning, the tram continued to present its demands on the organisation of space at intersections. One of the key necessities

[5] According to Richtlinie fur Stadtstrassen, Versuchs und Entwicklungsstelle des Strassenwesens, Deutsche Bauinformation, Berlin, 1969: "The arrangement of a tram sorting system can increase the permeability of intersections. Classifying allows several trams to pass through the intersection simultaneously or independently. Tram crossings on the road which at rush - hour reach the value of 70 % of the programmed number of periods, require sorting systems".

was a turning radius of 30-50m which increased requirements for space dimension in order to provide space visibility for all types of urban traffic. These issues were aggravated by the prospect of future automobile development with its demands of road widths up to 100-120m. All this increased the dimension of space at intersections and with it the distances for pedestrian crossing.

- *The tram in the city centre: substitution versus maintenance*. Conflicts between the city centre and urban traffic were present from the 1920s when the extensive use of motorised transport began. The solutions were based mainly on the idea of choosing certain modes of urban transport for circulation in narrow city centre streets. In this choice the tram played an inferior role than motorised transport. This led to the solutions of eliminating tram lines and moving them to the periphery of the centre and replacing them with buses and trolleybuses that should provide accessibility to the centre through tram transfers (Polyakov, 1953, p. 52). This decision began to be applied on a larger scale from the 1960s with the idea of the pedestrianisation of the urban centre.

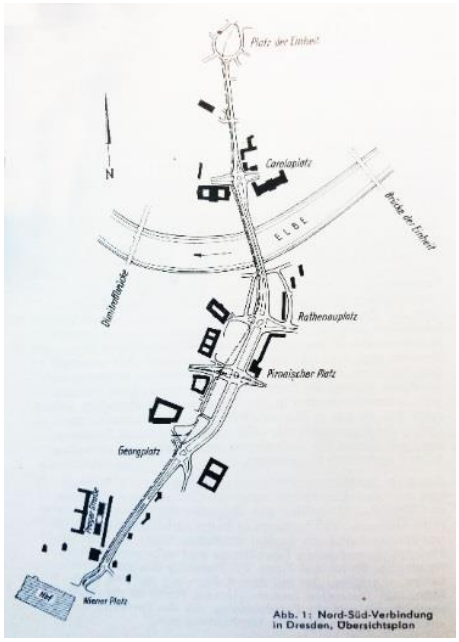

Fig. 1: The North-South connection in Dresden, general plan. Source: R. Peschel, Die Strasse, 7, 1971. p. 208. The lateral location of the tram line was explained with the intention of creating the conditions for rapid motorised transport passage, comfort and accessibility of the centre for pedestrians. A generalised solution in both the GDR and the USSR, showing the adaptation of tram lines to urban traffic.

On the other hand, there were solutions when the planners wanted to maintain tram transport, understanding its importance in terms of transporting greater flows of passengers to the city centre and the discomfort of transfers. In this case it was proposed to use the underground tram

or to maintain the combination of the pedestrian zones with the tram. Although the underground tram was a solution for cities with more than 500,000 people, in practice it was applied only in the case of cities with more than 1 million people, thus, leaving large pedestrian areas without mass public transport.

Despite the extension of the idea that the city centre has to be free of any mode of urban transport, in the GDR in this period there were discussions about the importance of running trams[6] not only to provide connections with the rest of the city, but also to provide service within the city centre (Deutsche Bauacademie, 1967, p. 83-84). One of the temporary solutions in medium-sized cities where there was still no heavy traffic was to keep the tram in the centre. For example, in in the centre of Magdeburg and Erfurt tram lines were kept, albeit with the idea of their later reconstruction into underground tramway. Compared to this practice in the centres of medium-sized cities in the USSR, trams were often replaced by buses and trolleybuses.

To better understand the tramway development priorities in both countries, the two cities Magdeburg and Oryol were compared. They were of a similar size, with between 240,000 and 270,000 inhabitants; both cities were bombed during WWII and the urban transport infrastructure was in need of reconstruction in both locations. In the case of Magdeburg, the preservation and reconstruction of the entire tramway network in the post-war period can be highlighted. There were changes in the tram network in the central part of the city in the 1960s. One of them was the elimination of a tram line that went from the train station to the residential areas in the north part of the city. However, in this case, there was another line that duplicated that connection, therefore, these residential areas were not left without tram access to the train station (Fig. 2). The other action was the rectification of the two tram lines in the central part which improved the flow of tram traffic. This tram network was maintained in Magdeburg at the end of the 1960s, stressing that the tram, despite having a physically worn infrastructure, could not be replaced either by buses or by urban rail because they cannot solve the massive traffic in the city (Michalk, 1969, p. 52).

[6] W. Weigel in his book "Verkehr in der Modernen Stadt" stressed the importance of trams in the centre: "We must reject our repeated call for the elimination of urban rail transport, even in the centre with its replacement by buses. If we expect this to relieve the traffic load on the roads, we will inevitably overlook the fact that three buses would have to be used instead of a modern high-capacity tram, which would make even greater use of the road surface" (1962, p. 97).

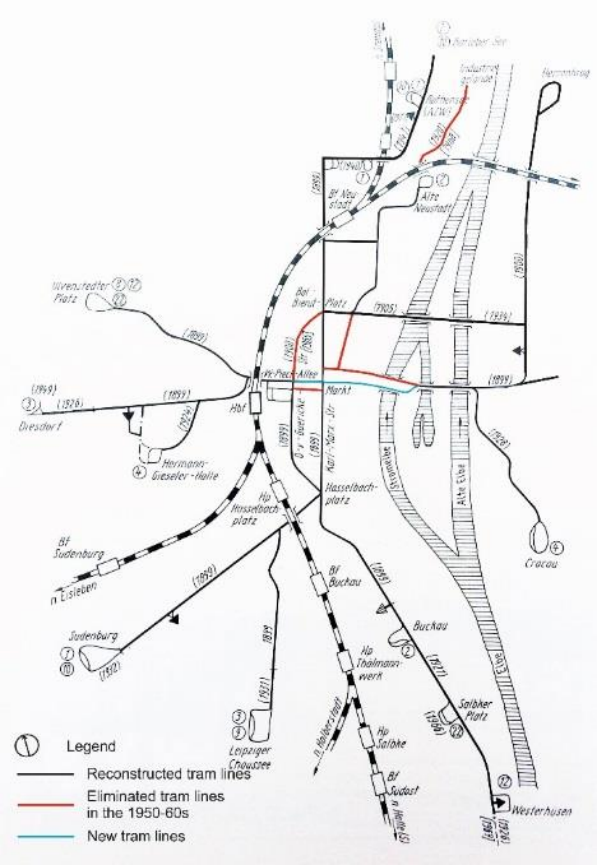

Fig. 2: The change of tram lines in Magdeburg in the 1950s-1960s. Source: Magdeburg Strassenbahn, 1998, p. 122. The reconstruction of the lines in the post-war period, followed by the elimination and rectification of some lines in the city centre in the 1960s. Elaboration of the author based on the superimposition of the plans of Magdeburg tram networks of 1941 and 1981.

In the city of Oryol tramway lines were also rebuilt during the post-war period but lost their importance in the 1960s (Fig. 3). In the post-war period apart from the reconstruction of tram networks, there was an important development of the tram system in the 1953 plan with the development of several tram lines in radial and circular directions to improve the accessibility of new residential areas and the connectivity between them. However, from the early 1960s, the process of tramway replacement by trolleybuses began (Tarkhov, 1998, p. 184-185).

The first action in 1961 was related to the elimination of the tram line in the city centre, which was an unjustified solution for a city of only 240,000 inhabitants. This continued with the elimination of lines in the north and northeast, limiting the use of trams in residential areas. As a result, there was only one tram line with two branches that distributed the passenger flows to the stops of the new trolleybus and bus lines. Thus, even though in the post-war period the entire tramway network was rebuilt, and the extension of the tramway network was foreseen, these

ideas changed rapidly at the beginning of 1960, when the period of extensive development of motorisation and rationalisation of urban traffic began.

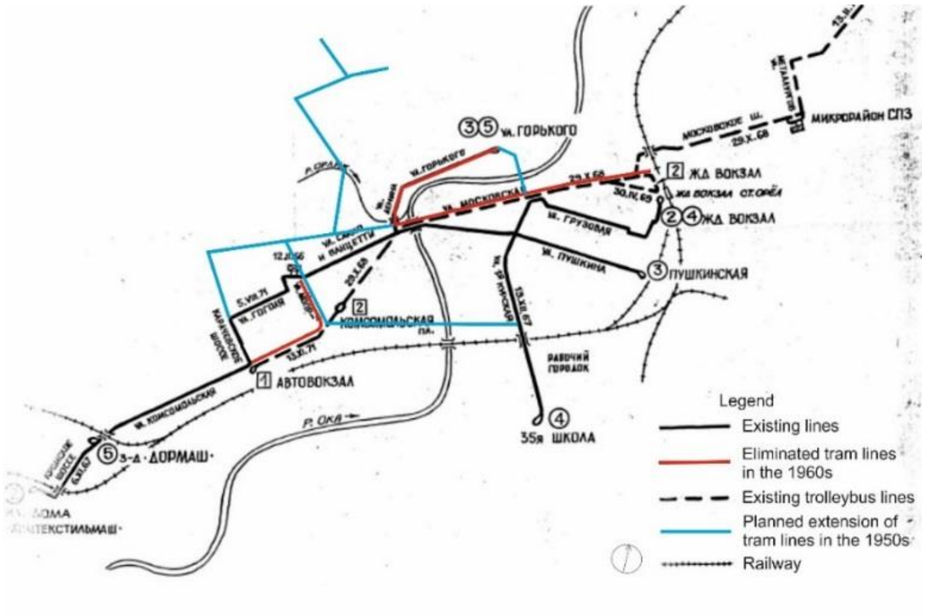

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Fig. 3: The change of tramway lines in the city of Oryol in the years 1950-1960. Source: S. A. Tarkhov, "Istoriya Orlovskogo tramwaya", Oryol, 1998. The reconstruction and development of the lines in the post-war period, followed by the elimination and replacement of tram lines by trolleybuses. Elaborated by the author based on the tramway network plans: 1941, 1953, 1962 and 1971.

Comparing these two cases, it can be seen that in case of Oryol, the tram lines were removed from the important passenger traffic directions. The eliminations of the lines within the city created discomfort, limiting the direct connections with the main points of activity such as the train station and the bus station. The residential area in the northern part was left without connections to the industrial zone. In comparison, important connections were preserved in Magdeburg to provide accessibility both between urban centres and between residential areas. From these two cases, it can also be seen that in the GDR, despite the similarities in the technical characteristics of trams and buses, a hierarchy was maintained in urban transport where the main public transport was the tram supported by a consolidated tram network, and the bus had a complementary and secondary transport role. While, in the USSR, the role of the tram was not as strong as that in the GDR, the similarities of the technical characteristics not only equalled the importance of both modes of urban transport but converted the tram to an inferior mode of transport in comparison to the bus or trolleybus.

VII. CONCLUSIONS: SECONDARY PRIORITIES AND UNIDIRECTIONAL CONFLICTS

The period between 1950s and 1960s can be characterised by an instability in the reconstruction, maintenance and development decisions in tramway transport and infrastructure. In both the GDR and the USSR, the role of the tramway in relation to the conditions of motorised traffic was questioned several times. Despite this, there were differences in tramway development between the USSR and the GDR. In the USSR this was related to the possibilities of easy replacement of trams by buses and trolleybuses, leaving tram lines only in directions with very intensive traffic, thereby limiting the connectivity and comfort of the whole urban public transport system. While in GDR the idea of preserving an extensive and coherent tramway system prevailed, trying to avoid interruptions of their itinerary with the transfers and maintain the level of service for passengers.

One of the reasons to explain this difference can possibly be the different dynamics of tramway development before WWII. In Germany there was a better development of tram networks which can be explained by the industrialisation and early urbanisation of cities which resulted in the formation of a consolidated tram network. This tramway development process was shorter in the USSR and was therefore characterised by the instability of tramway planning principles and criteria. As a result, the tram did not reach its extensive use in Soviet cities and its development in relation to the urban structure.

This difference influenced the subsequent solutions to spatial conflicts between tram and motorised transport. A careful approach on the part of the GDR regarding displacement, vertical separation of urban traffic and any other change of tram lines can be highlighted, as it was exemplified in the case of Magdeburg. In the USSR, changes to the tramway network and its adaptation to the requirements of motorised traffic were more easily carried out. First in large and new cities, and later in the 1960s in medium-sized cities, becoming generalised solutions for improving urban traffic circulation.

In both countries the period of the 1960s can be evaluated as the period when the tram reached its greatest abandonment. In the case of the GDR this was characterised by maintenance and selective tram replacement in secondary directions and in the city centre. In the case of the USSR, tram lines were replaced by trolleybuses and buses on a large scale, leaving the most heavily loaded lines only on the periphery, with directions to industrial zones, usually creating a network of 2-3 lines, thus breaking the tram network system. With this, we can conclude that the main

reason for these differences between the two countries was the criterion related to the choice of public transport modes. In the USSR the criteria were based on technical as well as economic characteristics which aimed to reduce the amount of initial costs for the organisation of public transport infrastructure. In the case of the RDA, apart from these criteria, which were also important, social issues of public transport, such as the level of service, were considered. Furthermore, the assessment of the economic aspects was also related to the importance of the cheap functioning of the existing tramway infrastructure.

In both countries, after failures in theory and urban practice to replace the tram system, and poor functioning of buses and trolleybuses, the role of tramways in urban public transport functioning was recognised. After almost 20 years of resistance to the development of tramways systems, in the late 1960s the fast tram was chosen as a temporary solution. As a result, in the development of public transport in the 1970s and 1980s the tram played a stronger role than before, but despite this, it continued to have conditions for its existence and difficulties in its realisation, possibly due to the spatial conflicts which it still created for motorised transport.

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