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The Transport Network of Budapest and its Agglomeration: Current Situation and Future Vision

1. Historical introduction: The legacy of decades past

A metropolis and its agglomeration zone are the scene of simultaneous operation of multiple transport sectors, where the most important criteria for the smooth flow of traffic across various networks are safety, continuity, and co-ordination. Throughout the historical processes of Budapest's urban development, the expansion of the transport network also sought to keep pace with the growth of the population and the increase in the city's area. From the 1960s for nearly three decades, the development plans for public and individual transport in the capital and its agglomeration adhered to the so-called socialist urban planning and development principles. Until the 1970s, elements of the transport network that formed the basis of the system were built and expanded according to these principles, complemented by smaller sub-networks (such as trolleybus lines and Danube ferries) and specialised transport modes (such as the cogwheel railway and the Millennium Underground). The passenger connections between the municipalities of the agglomeration and the capital city were served by the Hungarian State Railways lines, as well as light railway lines and local bus services operated by the Volán companies in the surrounding areas.

The opening of the first metro line section (the M2 line between Keleti Railway Station and Deák Square in 1970) and its subsequent extensions in several stages resulted in significant changes to the transport network. It marked the beginning of the reduction and fragmentation of previously long surface routes, the relocation of numerous tram and bus terminal stops to metro stations, effectively establishing these services as 'feeders' to the metro. Concurrently, the expansion of the metro network (lines M3 and M4) led to a decrease in the significance of public transport and an increase in the number of road lanes supporting passenger car traffic (Rákóczi Road, Váci Road, Bajcsy-Zsilinszky Road, and Üllői Road). However, the metro network thus created did not become an efficient means of connecting distant urban transport nodes (e.g. Pestszentlőrinc–Békásmegyer or Budafok–Rákospalota), but rather replaced surface transport in the inner areas. Its development was essentially limited to the inner third of Budapest.

Starting in the 1990s, long-term transport development planning adopted similar principles,[1] focusing on transforming metro stations in the capital's transitional zone into key transport hubs for seamless mode changes. From these hubs, commuters arriving from the agglomeration by suburban train, train, bus, or car would continue their journey

[1] Arató et al. 1997: 122.

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by metro to their workplaces or to commercial and service facilities located in the inner city districts. However, despite being touted as 'passenger-friendly', and incorporating rational transport and traffic technology solutions, this system failed to consider Budapest and its agglomeration as an integrated territorial entity. This meant that it did not aim to plan a comprehensive, multifaceted transport network on the scale of the agglomeration, thus making the development projects based on the aforementioned forced mode changes redundant.

In the last decade of the 20th century, Budapest experienced a surge in urban transport conflicts, primarily driven by a sharp increase in private vehicles. This situation necessitated a fundamental shift and renewal in transport policy. To address this, it is crucial to conduct a comprehensive analysis of the factors contributing to traffic conflicts in metropolitan areas, which are becoming more severe due to increasing pressure on the transport network. Understanding these factors and their constraints *(Figure 1)* has proven essential throughout the development of new network planning approaches.

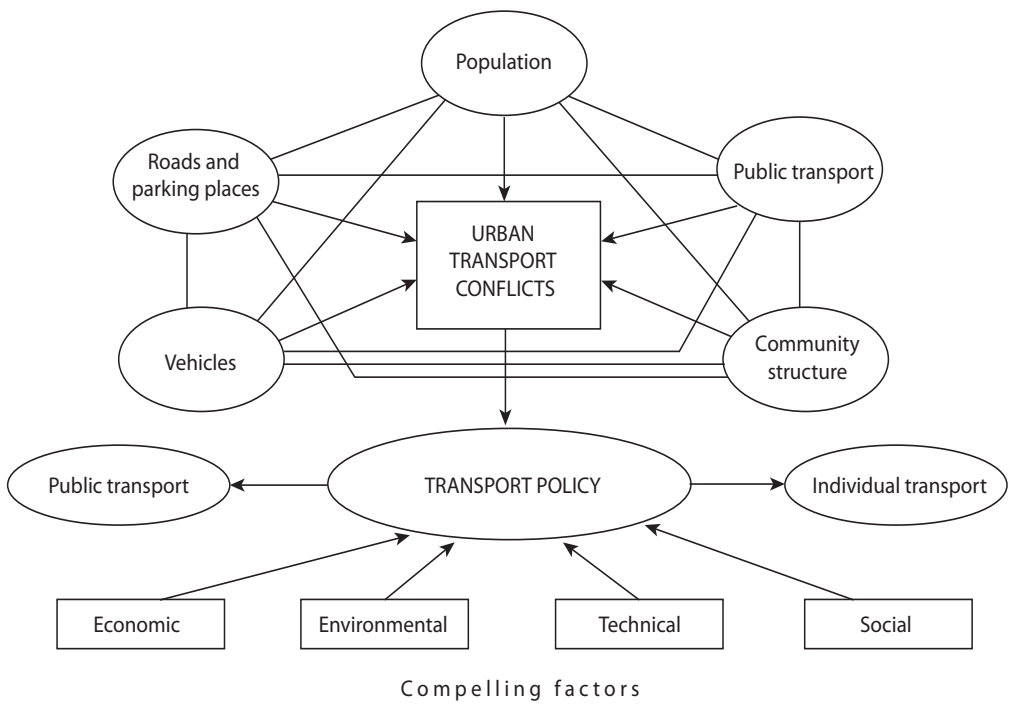

Figure 1: Simplified causal model of metropolitan transport conflicts
Source: compiled by the author

At the beginning of the 2000s, there was finally a conceptual shift in the planning of transport development in the Hungarian capital, which had long been lacking according to many transport experts and urban planners. This shift brought sustainability to the forefront,[2] as well as the necessity to expand co-operation with suburban municipalities.[3] This recognition also appeared in the long-term development concept. Specifically, it already included the so-called S-Bahn concept[4] for suburban rail transport, meaning that by connecting the 11 railway lines converging on Budapest through the terminal stations, a railway ring around the capital could gradually be developed. Thus, suburban trains – through their scheduled, timetable-based operation – could become part of the capital's internal transport network, raising the quality of public transport[5] in the Hungarian metropolis.

However, for a long time, Budapest also adhered to the practice of transport development planning typical of major Western European cities, aimed at catering to the growing demand for individual motorisation. This practice led to changes in residential location preferences and transport habits. In the case of the ring-radial urban public transport network, no plans were made to replace the congested downtown sections, as the 1980s projections for the 2000s anticipated traffic volumes significantly smaller than those of today, which were expected to be manageable by increasing the capacity of the roads passing through the city centre. This planning approach has had a major influence on the practice of designing urban spaces and the placement of pedestrian crossings. In the latter area, the emphasis was on the separation of pedestrian and car traffic at the same level, which manifested in the design and construction of an increasing number of underpasses and road overpasses.

The shift in transport planning priorities reflects how the previous approach gradually transformed in the newer transport development plans for Budapest; it shows how the essential transport aspects of the 'liveable city' concept began to be incorporated at a strategic level. The new concepts developed after 2000 emphasised the increase in the number of pedestrian zones, the networking of cycle paths, the creation of zones with reduced motor vehicle traffic, the designation of bus lanes, and the restoration of long bus routes, etc. All of this served to prioritise public transport over the needs of individual objectives and the growing demand for personal vehicle traffic. Simultaneously, Budapest's transport planners were faced with the need to regulate car and lorry traffic in the capital and to set up a public transport tariff community. Despite the positive efforts evident in the changes to planning practice, the transport infrastructure of our capital still retains, in many places, remnants of the previous approach that can be regarded as a negative legacy.

[2] Tánczos 2000: 10.
[3] FŐMTERV 2001.
[4] FŐMTERV 2007.
[5] FKT Urb Konzorcium 2008.

2. Current transport network issues in Budapest and its suburbs

In the three decades since the political-economic system change, transport development plans for the Hungarian capital and its agglomeration zone have not been able to follow the real urbanistic processes with sufficient flexibility, despite all professional efforts and renewal efforts. This has been a particular problem in the outer districts of the capital and in the agglomeration municipalities, where very intensive changes have taken place during the period (e.g. significant population growth and housing construction), while car use still dominates in the urban areas concerned. This problem, which affects the entire city of Budapest, has led to increased road congestion even in areas well-served by the public transport network. Since Budapest's radial-ring road network has been fully developed in the inner areas only, the consequence of the aforementioned suburban processes has been that the spatial development of Budapest and the expansion of built-up areas have not been accompanied by significant road network development in the outer districts. The appropriately sized and quality diagonal road and rail connections have not been fully established; the existing network elements are incomplete, and in some parts of the city, they are fragmented. There are no continuous, transversal connections between the outer districts of Budapest, either at the level of road or public transport networks, and as a result, an increasing share of road traffic not destined for the city centre is routed through the narrow street network of the inner districts, built almost a century and a half ago, and through the Danube bridges in the city centre.

Until recently, surface routes operating in the inner parts of Budapest – aside from a few cases – had no connections with the lines serving the outer districts. In this respect, the gradual development of the interconnected tram network has brought about positive changes. While the public transport network can handle the demands of the city's size and the travel needs of its population, the fixed-route network suffers from outdated infrastructure, which imposes constraints that lead to longer travel times, reduced schedule reliability, and diminished overall performance.

Up until the mid-2010s, transport development in the capital and its suburbs ignored the increasing popularity and significance of environmentally friendly cycling. Cycling was treated as a nearly 'insignificant' factor, separate from motorised transport. This approach is reflected in the current structure of the city's road network and the fragmentation of the existing cycle path network.

The most pressing transport-related issues in Budapest and its suburbs are largely rooted in urban structural factors, which can be summarised as follows:

a) The so-called modernisation urban planning practices, modelled on Western European examples, have led to a network and transport spaces serving the needs of individual car use in the Hungarian capital. The distorted urban structure, sprawling urban functions, and the avoidance of the optimal utilisation of areas previously used for industrial purposes force surface transport into unnecessary excess performance. The increasing use of metropolitan spaces for functions other than their original purposes is leading to mounting tensions, while many developments focus on addressing symptoms

rather than the underlying structural problems. Transport development ideas that do not fit into the system and are extracted from their urban structural context inevitably generate new issues. This situation is perpetuated by planning based solely on projects, lacking well-considered strategic objectives.

b) Instead of analysing the diverse and influential factors of transport and their interrelationships affecting urban development, outdated concepts or often foreign models, which are not adaptable due to the unique features of the Hungarian capital, have been implemented (e.g. traffic lane expansions and the planning of parking garages in areas intended for traffic calming). This has led to persistent, long-term issues, particularly exacerbated by the acceleration of suburbanisation processes. Interventions based on outdated models of responses to the challenges of the evolving metropolitan and suburban lifestyle only serve to worsen problems in Budapest and its suburban area, further increasing transport-related environmental impacts.

c) The significant structural deficiencies of the transport network at the metropolitan scale are currently largely hindering the development of a more modern traffic management system. The overemphasis on the importance of developments and the praise of expected outcomes have not resulted in the elimination of network deficiencies, which is a comprehensive conceptual problem. In Budapest's transport modernisation plans, radial network development has consistently enjoyed a lasting advantage over diagonal directions, as well as private vehicle transport over public transport. Due to the excessive financing of metro construction, there has been a lack of CapEx projects to support the development of surface public transport.

d) The fragmented regulation that hinders comprehensive transport development solutions further impedes the implementation of modern, environmentally friendly developments. Another issue is that the legal, institutional, and regulatory framework, which influences the entire planning environment, does not support rational co-operation. In the case of Budapest, this also manifests in the functional separation of local and interurban (agglomeration) transport development, ultimately leading to the failure of multi-party collaborations due to conflicting interests.

e) Another issue is the stubborn persistence of sectoral thinking and the lack of willingness to co-operate among different transport sectors. Both phenomena are evident in the transport system of the Budapest agglomeration, posing a serious obstacle to integrated transport development. Intra-sectoral routines, outdated habits, and practices persistently hinder modern solutions. This includes the exaggeration of technological and operational problems and the prioritisation of the operator's perspective over the service role of transport. The prioritisation of operational considerations over passenger comfort, or the rigid separation of fixed-track systems, both degrade the quality of service; procuring vehicles that only fit the existing network perpetuates these problems for decades to come.

f) Since the mid-2010s, both transport infrastructure and vehicle fleets have been increasingly plagued by a growing backlog of maintenance neglect, resulting from the persistent lack of upkeep and the absence of periodic renewals. This has led to significant technical deterioration that at times threatens the daily operation of the network.

To address the listed issues, it is necessary to determine the correct directions for transport development. Special attention must therefore be given to sectoral and regional integration, as well as to aligning urban transport policy with other sectoral policies. To this end, raising the level of co-ordination and establishing effective co-operation between sub-sectors must be treated as a priority task. This is in line with the principles of modern mobility planning and the requirements arising from international experiences and the need for an integrated urban development approach. Additionally, integrating vehicle and road and track maintenance, operations, and development is crucial for improving the functioning of Budapest's currently problematic transport system. However, securing and properly monitoring the use of financial resources dedicated to these goals is essential.

In addressing transport issues, it is important not to forget that the sector is a significant city-shaping force, an economic development driver, and an environmental factor, forming an integral part of urban development policy. The development goals aimed at eliminating unfavourable conditions have already reflected the joint interests of Budapest and its agglomeration in the city development concept[6] adopted by the capital in the 2010s, in accordance with valid urban development principles. These principles are intended to ensure that transport measures are not implemented as isolated, ad-hoc interventions, but rather as part of a coordinated, comprehensive context. To achieve this, it is necessary to simultaneously consider the content of various metropolitan and national development documents, as each has comprehensive and sectoral transport development implications (such as national, Pest County, and Budapest area development concepts, and various scales of transport infrastructure development strategies). The developments must align with Budapest's current integrated urban development strategy and the city's spatial structure plan, as well as with various thematic development programs. Additionally, the transport development goals of national and metropolitan environmental protection programs must also be taken into account.

The planning aimed at modernising the agglomeration's transport network is supported by the fact that Budapest and Pest County's area development concepts have also formulated joint proposals for the development of the capital's region, which are prominently addressed in the objectives of the transport development plan.

A key professional requirement is that in Budapest's forward-looking urban development concept up to 2030, and in the capital's zoning regulations, transport conditions should be designed in accordance with the functions of these zones. Accordingly, the city's long-term transport development plan distinguishes between the following three main territorial units:

1. *Inner zone, including the Danube riverside and the central city areas:* Priority must be given to pedestrian, bicycle, and public transport, while personal vehicle traffic and through traffic that can be diverted elsewhere should be reduced. (These are the so-called environmentally sensitive and densely built-up areas.)

[6] Municipal Government of Budapest 2013.

2. *Suburban and hilly zone:* In this territorial unit, public transport must provide reliable basic services, but personal vehicle traffic can also be significantly present. (These areas represent the loosely built-up regions.)

3. *Transitional zone:* This is the territorial unit where the coexistence of the two previous mobility preferences can be implemented. In addition to tram and bus lines crossing the area, the infrastructure for intermodal transport and the development of cross-directional connections will also play a role. (These areas can be considered transitional with significant development potential.)

3. The future vision of the capital's transport network

3.1. Strategic objectives for network development

The future of Budapest's transport network is fundamentally dependent on the vision outlined in the capital's general development concept extending to 2030, which is being pursued with determined effort. According to this vision, in just 10 years, Budapest will become a liveable, attractive European capital with a distinctive character, seamlessly fitting into the modern European city network as an innovative economic and cultural centre for the country and the agglomeration. In my view, to ensure favourable development for Budapest, it is worth pursuing the following transport-specific strategic objectives:

a) Network development to promote a liveable urban environment. The adverse aspects of the capital's transport network, which are attributable to urban structural reasons, as well as the inadequate connections between Budapest and the agglomeration municipalities, need to be transformed through integrated transport development. This involves favourably influencing transport needs and mode choice, reducing the environmental impact, and enhancing equal opportunities. Functional transport spaces must be integrated into urban public areas in a way that meets actual mobility and travel needs as an inherent part of the urban environment, while appropriately adapting to the area's characteristics. To achieve a desirable urban space and mobility, there is a need for transport infrastructure built with environmental consciousness, following the principles of compact city design and balanced urban structural development. Therefore, less environmentally damaging transport options must be made easily accessible, and their networks should be suitably shaped to support the everyday use of pedestrian, bicycle, and public transport.

b) Safe, predictable, and integrated transport networks. To ensure that the travelling public can reach their destinations daily, a safe transport environment and a unified, predictable, and reliable transport network are required. To ensure smooth and predictable operation of both public transport and private vehicle traffic, stable funding for transport must be secured, along with cost-effective development, maintenance, and operational interventions. This includes ensuring the integration of different transport modes, proper network connections, increased co-operation between services and providers, and the environment-specific application of sectoral division of labour. As the declining accident

rates observed in the early 2010s plateaued by the early 2020s, road safety must be given a prominent role in network development. Ensuring equal access to both Budapest's and the agglomeration's transport networks is also a crucial aspect of both network development and operation, as it is fundamental to providing safe and predictable travel for everyone.

c) Establishment of regional connections to deepen co-operation. The implementation of the regional integration of Budapest and its agglomeration cannot be imagined without the development of a transport network that also strengthens economic competitiveness. The Hungarian capital is located at the intersection of European, national, and regional transport networks, which ensures the creation of an economically competitive area on an international level from a transport perspective as well. Our capital and its agglomeration can provide an environment that supports a wide range of activities as a unified urbanised area. However, for properly coordinated economic co-operation, it is essential to organise different levels of transport networks into an integrated system and continuously improve their connections. The presence of macro-regional and international transport networks requires effective connections between incoming rail, road, water, and air networks and the proper linkage of these networks to regional and local networks.[7] To achieve the long-term development goals of the Hungarian capital, priority must be given to the principle – consistent with the aspirations of the European Union – that transport network development strategies should be integrated beyond administrative borders. Therefore, among the strategic objectives, there must be an emphasis on expanding regional transport network connections, establishing interoperable systems, developing intermodal transfer points, and ensuring the appropriate and adequately regulated institutional background for related services.

In the development the transport network of Budapest and its agglomeration area, there are additional supplementary and remedial tasks that need to be addressed. On the one hand, there is a need to provide public transport services that are still lacking in several newly developed urban areas over the past three decades (such as various residential developments on the Buda side). On the other hand, it is necessary to harmonise the current and future public and private transport needs of areas affected by future construction projects. In the outer districts and the agglomeration municipalities they interact with, the deficiencies in diagonal road and rail connections must be addressed. The aim is to prevent vehicle traffic from being routed through the inner Pest districts and across the Danube bridges. Additionally, reducing the fragmentation of the radial structured fixed-track transport network elements and, in the long term, eliminating it entirely is essential. The integrated planning and development of the core public transport network, covering the most important surface and underground connections, is of paramount importance. These high-capacity network elements (such as the metro, the suburban rail, the express bus services, etc.) must ensure high-level accessibility between agglomeration municipalities. To achieve this, a comprehensive approach to public space planning that prioritises the needs of pedestrians and cyclists is also necessary, particularly to enhance the liveability of the capital's public areas.

[7] Fleischer 2010: 220.

3.2. Realistic operational objectives and the means to achieve them

To enhance the quality of transport infrastructure within the diverse transport network systems, it is necessary for Budapest and its agglomeration to establish operational objectives that: a) integrate public and private transport into the complex urban development process; b) facilitate the integration of various modes of transport; and c) support the regional integration of urban development processes occurring in the agglomeration. To achieve this, the following three main operational objectives can be outlined:

a) Integrated network development for smart urban connections. To achieve this objective, the following tasks will arise:

- A qualitative expansion of the network of public transport lines providing direct connections should be implemented, making them more competitive with private car transport. This requires the integration of urban and suburban rail networks.
- The existing fixed-track network lines need modernisation, which involves updating and replacing worn-out elements of both surface and underground track networks. Particularly important in this context is the prompt commissioning of sections of the metro network with high passenger-carrying capacity that are currently under renovation.
- The currently disconnected areas on the Buda and Pest sides must be linked, by creating new Danube crossings and eliminating at-grade railway and road crossings (through the construction of road underpasses and overpasses).
- A unified cycle route network must be established to support the further expansion of this environmentally friendly mode of transport, avoiding travel through traffic lanes on major roads that pose safety risks. To achieve this, the current fragmentation of the cycle route network connecting the districts of Budapest and establishing agglomeration and regional connections must be addressed.
- The network for water transport, which has been inappropriately overlooked and undervalued, needs to be expanded with the construction of suitable ports (particularly in the Danube riverside agglomeration towns), thereby establishing the infrastructural conditions for regional river navigation.

b) The creation of liveable public spaces free from the harmful environmental impacts of transport in Budapest and the agglomeration towns. This second operational goal can be achieved through the implementation of the following network development tasks:

- Developing a versatile system of sidewalks, pedestrian streets, and public space usage that considers urban structural characteristics. This task is fulfilled when safe pedestrian and bicycle traffic can be integrated into a unified network, especially in Budapest's inner city areas, which are overloaded from this perspective.
- Ensuring transport equality for people with various mobility restrictions by increasing the number of accessible pedestrian and passenger facilities (such as replacing stairs with ramps, building elevators, operating low-floor vehicles, etc.), with particular emphasis on the physical accessibility of metro stations and the availability of numerous underpasses in Budapest.

- Network developments that enhance the safety of public and private vehicle traffic, as well as pedestrian traffic, by modernising technical infrastructure elements that contribute to accident prevention.
- Increasing the quantity, length, and area of traffic-calmed or restricted vehicle traffic sections within the inner city road network. This means that, to improve the safety level for pedestrian and bicycle traffic, the system of speed-restricted zones in Budapest should be extended to cover all locally significant elements of the inner zone road network.

c) Development of an interconnected transport network with optimal interchange points. The key to achieving this third operational goal is the execution of the following tasks:

- Increasing the connectivity of different fixed-track network elements. Particularly, the railway sections crossing Budapest need to play a significantly larger role in passenger traffic within the city and between the towns of the agglomeration area. In line with this, the placement of railway stops should also be adapted to the city's traffic needs.
- Expanding and improving the quality of transfer connections that facilitate mode changes within the network. There is a great need to improve such connections at the current intersections of bus, tram, metro, suburban railway, and long-distance railway networks.
- Integrating the national main road network's sections leading to Budapest and bypassing the capital into the internal main road network. Such developments will enable a more rational and territorially balanced load on the road network within the metropolitan agglomeration and reduce or replace the overloading of the secondary road network serving residential areas.
- Expanding and enhancing the quality of the cycle track network in the capital and its agglomeration. The core bicycle route network forms a cohesive system in Budapest and in the Duna riverbank municipalities of the agglomeration that are significant from a tourism perspective. However, further development is needed in the northeastern and southeastern parts of the agglomeration, which have considerable green space potential.
- Integrating passenger shipping into the public transport system of the capital and its agglomeration. Increasing the availability of passenger shipping services in Budapest and the Duna-facing settlements of the agglomeration, as well as utilising the ports as intermodal transfer points, could significantly reduce vehicle traffic in central Budapest and along the embankments, while passenger ships could provide a new, environmentally friendly alternative in the urban transport network.
- Raising the accessibility of Liszt Ferenc International Airport (LFNR) in Budapest to a higher quality level. For this centrally important airport in Central Europe, the rail-based public transport connections to the airport offer a modern alternative to the current expressway. The railway service for LFNR should be efficiently

integrated with the long-distance and suburban transport network through a dedicated railway station.
- Developing intermodal hubs that effectively facilitate passenger transport mode changes. In establishing a unified transport network for the capital and the agglomeration, it is essential to create hubs that offer simple, quick, clear, user-friendly, safe, and comfortable transfers for passengers.
- Building a network of high-capacity Park-and-Ride (P+R) facilities and Bike-and-Ride (B+R) bike storage in Budapest and larger cities within the agglomeration. To create a liveable urban environment, it is important to direct motorised traffic from the agglomeration to the nearest P+R and B+R facilities next to suburban railway stations, thus reducing traffic entering the capital.

4. Specific network development programmes to be implemented by 2030

The strategic and operational transport network development goals outlined for Budapest and its surrounding agglomeration are supported by specific programmes. The successful implementation of these programmes will substantiate the vision for the future of transport in the metropolis and the region.[8] These large-scale development projects, implemented under the direction of the Budapest Development Centre and with financial support from the European Union, cover both the administrative area of the capital and the surrounding agglomeration.[9] Their common goal is to ensure the unified and harmonious future development of the transport network in these symbiotic urban areas.

4.1. Public transport development projects in the capital

In the next 8–10 years, developments will focus on rail networks, particularly *the modernisation of the tram network* in Budapest. Within this framework, three key development tasks have been highlighted.

a) Extension of the 3-line tram ring towards Angyalföld: This extension will create a connection with the tram line running along Lehel Street. The project includes the construction of a new road overpass, as well as the establishment of cycle tracks and sidewalks alongside the tram tracks. This new transport infrastructure will significantly improve rail transport connections between the areas of Angyalföld and Zugló.

b) Expansion of the Buda tram network to Budafoki Road: The successful development of the capital's network in recent decades continues southwards along the Danube. The new line will connect the university quarter and the Infopark with the heart of Buda and provide a link to the new residential and office district near the Lágymányosi Bridge.

[8] Budapest Közlekedési Központ 2020.
[9] Budapest Fejlesztési Központ 2019.

According to the plans, most tram services will connect with several metro stations on the Pest side, while a smaller portion will create a rail link along the Buda embankment towards Batthyány Square, complemented by a cycle track. As a result of the expansion, the northern part of the Lágymányosi area will shift from car-dominated surfaces to areas dominated by pedestrians, cyclists, public transport, and green spaces.

In line with the ongoing expansion concept, a multi-branching, north–south oriented rail axis will be established on the right bank of the Danube. Although the current project only extends the tram line beyond the Rákóczi Bridge, further extensions towards the rapidly growing parts of Újbuda should also be considered.

c) Construction of a new tram line between Kelenföld and outer Ferencváros: This new tram line will cross the new Danube bridges currently under construction in Csepel, the southern part of Budapest. The new public road bridges over the Danube at the northern end of the Csepel Peninsula and the access roads to these bridges will be equipped with tram tracks, providing a new connectivity alternative between the tram networks of Buda and Pest. The new track section will feature accessible stops with transfer options to the suburban railway lines.

4.2. Transport projects with a complex urban development impact

A substantial portion of the long-term transport development projects for Budapest will be realised as part of significant urban development activities. Each of these projects will enable a qualitative renewal of metropolitan life and public space use, thereby playing a crucial role in shaping the future vision of Budapest. Among these strategic programmes, the following have a direct impact on the transport network.

a) Renovation of the lower Pest embankment, thereby restoring the connection between the city centre and the Danube. The renovation includes expanding green spaces in the city centre, improving conditions for pedestrians and cyclists, and implementing measures to reduce road traffic. As a result of the project, the Pest embankment will transform into a flexible and representative waterfront area, ideal for hosting larger events. It will also be adaptable into a recreational waterfront area in case of temporary closures to vehicle traffic. By eliminating parking and storage functions on the embankment, a much wider, greened pedestrian promenade will be created. The entire length of the embankment will be made accessible, with road and pedestrian surfaces at the same level and uniform paving. Additional traffic safety and traffic management interventions will significantly enhance the usability of the area. However, the project is not popular among regular car users of the embankment, who would be deprived of an important central route. Their opposition has already been voiced in various press outlets.

Figure 2: Plan of the future new Danube bridge (Galvani Bridge) to provide a transport link between south Buda and the Csepel Peninsula
Source: Nemzeti Közlekedési Központ 2022c

b) Construction of new Danube bridges in the south of Budapest. On the southern 10-km section of the Danube in Budapest, which currently lacks bridges, two new independent Danube bridges will be built, connecting the southern part of Buda to the Pest side via Csepel, with a sophisticated architectural design *(Figure 2).* By connecting the new bridges to the capital's road network, it is estimated that the congestion in the city centre could be reduced by an average of 50,000 vehicles per day (including planned traffic calming measures), as the new infrastructure elements will take over part of the traffic that is forced to use the inner Danube bridges. The aforementioned improvements to the fixed-route transport network will include tramways, wide pavements and cycle paths on bridges, and the associated road network will be enhanced with tree-lined streets and green strips. The two new bridges will improve connections between the southeast and southwest of Budapest and will also help revitalise the former industrial areas. The new bridges will bring tram transport to the island and provide the Csepel district with a direct link to the southern part of Buda.

c) Construction of an intermodal public transport hub in Kelenföld. This development project will allow suburban buses to reach the newly built bus terminal in Kelenföld on the Őrmező side without detours, unlike the current terminus at Etele Square. The hub will also facilitate the creation of a significant number of P+R parking spaces. Passengers will benefit from higher quality services in the new building, while the current terminus area will be freed up for other uses. The project includes the comprehensive functional development of the Kelenföld hub, including ensuring accessibility to the nearby planned South Buda Centre Hospital by tram.

d) Comprehensive reconstruction of road access to Budapest Liszt Ferenc International Airport. Although traffic forecast studies indicate that it is not justified to connect Hungary's primary airport with the city centre by metro line, the current two-lane expressway leading to the airport is no longer suitable for providing road access to this major air traffic hub at a 21st-century standard. It is also inadequate for serving as both the M4 motorway and the main route of Road No. 4. The worn-out expressway is hazardous and highly prone to congestion. Reconstruction will involve the construction of a modern urban main road, eliminating at-grade railway crossings, incorporating separate bus lanes on certain sections, pedestrian and cycle connections, and green areas along the road. Modernising the road to the airport is also an important urban development task that will improve transport options for residents of the southern Pest districts and enhance cross connections between neighbouring areas. The project will also place a strong emphasis on prioritising public transport and significantly improving traffic safety in the affected areas.

e) Expansion of the capital's cycle route network towards the suburban municipalities bordering Budapest. During the execution of the development task named 'cycling garden suburbs', residents of municipalities within the inner ring of the agglomeration will be able to safely reach the nearest railway and bus stations, as well as several suburban railway stops by bicycle. An accessible cycling route between Budapest and their locality will be a realistic alternative, as the agglomeration's cycle route network will be seamlessly integrated with the city's network. The infrastructure supporting environmentally friendly cycling will be further developed, including improvements in storage and maintenance conditions *(Figure 3).* The project will not only facilitate a comfortable and easy mode of transport change but will also promote climate protection goals and encourage an active and healthy lifestyle.

Figure 3: Modern covered bicycle storage at the Pilisvörösvár railway station
Source: Nemzeti Közlekedési Központ 2022b

f) Establishing bus lanes on Budakeszi Road. On Budakeszi Road, where traffic well exceeds its current capacity, bus lanes with intelligent traffic lights at intersections will provide an attractive alternative for daily commuters compared to private cars. Buses moving faster and given priority at intersections will make bus travel more appealing. Parking spaces and bicycle storage at bus terminals will facilitate switching modes of transport. The use of dedicated bus lanes can also address traffic congestion for Budakeszi and neighbouring settlements in the Zsámbék Basin, as it will reduce delays by promoting public transport. Although the Budapest Development Centre supports rail-based public transport wherever possible, there is currently no realistic alternative to constructing dedicated bus lanes towards Budakeszi, mainly due to topographical conditions.

g) Alternative use of unused urban railway stations. Two significant projects in this area stand out as particularly important for promoting comprehensive urban development programs. The first is the redevelopment of the former *Rákosrendező railway yard's* operational area for urban development purposes. The state-owned former sorting yard area located in the transitional zone between the city centre and the outer districts has excellent urban development potential. In the case of Rákosrendező, the exploration of the large area's possibilities and defining its future development will be undertaken in the near future, taking into account sustainability, environmental consciousness, and effective economic development, with the goal of creating a liveable modern urban district and new green spaces on the site of the former railway operational area. Market players need to be involved in the development of this well-prepared area in a regulated manner. Additionally, alongside the development of the Nyugati Railway Station and its connecting lines, the railway traffic needs for the newly functional urban district must also be accommodated.

The second significant project with similar content is the redevelopment of the former *Józsefváros railway station* site. Located along Kőbányai Road, one of Budapest's most important traditional urban axes, the state-owned Józsefváros railway station will be a key site for a comprehensive urban development initiative. Numerous cultural and sports investments in the surrounding area will support the renewal of the former railway station site at its centre. With the transformation of the current railway 'brownfield' site *(Figure 4),* a multifunctional urban district can be created that will include cultural and sports functions, new residential spaces, workplaces, and establish connections between surrounding areas. Ensuring internal accessibility within the area, as well as strengthening pedestrian and cycling connections between neighbouring districts, is also a crucial transport development task.

Figure 4: Aerial view of the former Józsefváros railway station site before its functional transformation
Source: Nemzeti Közlekedési Központ 2022a

h) Creation of a car-free Városliget. The Budapest Development Centre considers it a key development task to establish a pedestrian- and cyclist-friendly function for Kós Károly Promenade and, secondly, to 'stop' the vehicle traffic arriving in Budapest on the M3 motorway at the P+R parking facilities being built at Mexikói Road. The aim is to encourage drivers to continue their journey into the inner city using public transport. By creating pedestrian connections between surrounding neighbourhoods and large-capacity P+R parking facilities, one of the 'lungs and green islands' of the city will be freed from significant volumes of through traffic after half a century. A car-free Városliget will become an attractive, nationwide significant public park, appealing not only to the residents of Budapest but also to visitors and foreign tourists, becoming a true green oasis on the Pest side, enticing for relaxation, rejuvenation, recreation, and sports.

4.3. Railway developments in Budapest and the agglomeration

In the future urban rail transport of our capital city, the modern railway network will play a prominent role, emerging as a key element in shaping the city's development processes over the next decade. The most significant railway developments will extend both to the districts and railway facilities within the administrative area of the capital, as well as to the agglomeration zone and its settlements.

4.3.1. Railway development tasks within the administrative area of Budapest

The most significant infrastructure developments related to rail networks in the capital city encompass various types of tasks (such as railway tunnel construction, station reconstructions, capacity expansions on certain line sections, track modernisations, etc.). Among these, the following are the most notable:

a) Reconstruction of the Nyugati Railway Station and its surroundings. A 21st-century requirement is that Hungary's busiest railway station should be able to accommodate significantly more trains and provide high-quality services suited to contemporary standards. This means that both the Nyugati Railway Station and its surroundings need comprehensive modernisation from technical, passenger comfort, and urbanistic perspectives. The project began in 2021. Included in this initiative is the construction of an underground station beneath and behind the existing hall, which, with its platforms and hidden approach tracks, will increase the station's train reception capacity by approximately 50% compared to the current setup. The reason for the underground construction is that this part of the station will serve as the receiving station for the future Danube river railway tunnel. Thus, the facility will transform into a through station, as a significant portion of the arriving trains will continue towards Buda, i.e. heading towards Széll Kálmán Square, Kelenföld, South Buda, and the western sector of the agglomeration, thereby creating numerous new direct railway connections.

b) Expansion of the southern circular railway's transport capacity. The two-track railway section connecting the Kelenföld and Ferencváros stations, which is serviced by the southern connecting railway bridge, is currently a bottleneck in suburban rail traffic. This railway section also handles significant volumes of domestic long-distance and international rail traffic. Therefore, during its development, a third track will be built alongside the existing tracks, and in some sections, a fourth track will be added. This will allow for increased train frequency (suburban trains running every 6–8 minutes). As part of the upgrade to the transport environment, new pedestrian and bicycle crossings will be created under the railway embankment, and a pedestrian and bicycle green corridor extending from Budaörsi Road to the Danube will be constructed. This project, the first major railway investment in decades within the capital, will improve transport comfort not only for daily commuters to Budapest but also for city residents with its new stops and increased train frequencies.

c) Modernisation of the Kőbánya-Felső – Rákos-Rákosliget railway line section. This project involves the construction of a third railway track between Keleti Railway Station and Kőbánya-Felső station on the shared introductory section of the main lines leading to the towns of Hatvan and Újszász. Additionally, the entire railway section passing through the eastern sector of the agglomeration, between Rákos and Hatvan stations, will be technically renewed. These developments will significantly improve Budapest's railway accessibility from the affected settlements in the metropolitan agglomeration, which will positively impact commuting conditions.

d) Construction of a railway tunnel between Kelenföld and Nyugati Railway Station. Among the various railway network developments in Hungary, this project stands out significantly due to its scale, cost, and technical solutions. The primary reason for its implementation is that the 19th-century terminal stations inherited by Budapest are no longer capable of accommodating many more trains daily in the modern era. More trains could only run on the suburban lines entering Budapest if the capacity of the three terminal stations could be significantly increased. Given the current railway technical conditions, this is not feasible, so the optimal solution might be to establish a through station system. This solution would enable the development of a new railway connection within the city, allowing trains arriving from one direction to leave Budapest via another line. The underground connection between Nyugati Railway Station and Kelenföld would not only address the capacity issues by relieving the terminal stations as traffic constraints but also create entirely new connections within the agglomeration zone's transport network. The development of Budapest's railway network is also a crucial urban development task, as the construction of the railway tunnel would free up substantial surface areas currently occupied by railway operations, making these valuable urban spaces available.

e) Development of a modern, accessible passenger centre at Keleti Railway Station. In the spring of 2021, the construction of a new passenger centre began at Budapest's largest railway station, which serves nearly 11 million passengers annually. According to the construction schedule, by the summer of 2022, a newly renovated, multifunctional passenger service facility will be available to travellers. The new centre will offer services for ticket purchases and handling matters related to domestic and international travel all in one location. The station area will be accessible in an accessible format (via escalator or lift) between the underpass level and the platform hall. The accessible, well-designed passenger centre will be developed below the platform level, through a complete redevelopment of the area previously occupied by ticket counters. The spacious passenger service area will include ticket offices and customer service counters, one of which will be accessible.

The railway network infrastructure development tasks within the administrative area of Budapest, as described above, require additional supplementary CapEx projects. These include the construction of missing stops within the city, as the absence of properly located railway stops often prevents transfers from the railway to the metro lines or trams. Even though trains with favourable service frequency will serve densely populated residential areas, residents will be unable to use the railway for their intra-city travel due to the lack of railway stops.

4.3.2. Railway line developments affecting suburban municipalities

It is well-recognised among transport professionals that the root of the most pressing urban transport problems in Budapest can be traced to the unhealthy increase in personal vehicle use originating from the suburban municipalities. For decades, the population of

suburban municipalities around Budapest has been steadily rising, with the majority of residents working in Budapest. As a result, many people commute between their homes and workplaces on workdays. Two-thirds of daily commuters use their own cars for this purpose, and the traffic generated by these vehicles overwhelms not only the main roads leading into the city but also the much larger-capacity highway entrances. The solution lies in the significant development and modernisation of suburban railway lines and the suburban railway network, which could absorb a substantial portion of the current car commuters. The specific tasks are outlined in a railway development document for the capital's agglomeration, prepared under the direction of the Budapest Development Centre, which covers long-term planning.[10] The railway, particularly in the western, northeastern, and southeastern sectors of the agglomeration, needs to become more competitive with congested roadways as soon as possible. Therefore, the following development tasks are prioritised in the ranking of these tasks.

a) Track expansion between Kelenföld and Törökbálint. The section of the Budapest–Győr–Hegyeshalom double-track electrified railway line that runs within the agglomeration area is already so congested that train frequency cannot be increased any further. Since this section will also be part of the high-speed rail route connecting Budapest with the nearest Eastern and Central European capitals (Vienna, Bratislava, Prague, and Warsaw), there is an urgent need for additional tracks. Therefore, planning has begun for the expansion of the railway section between Kelenföld and Törökbálint, with the construction of a 9-kilometer third and fourth track on the most congested inner section of the railway.

b) Increasing the transport capacity of the Budapest–Veresegyháza–Vác railway line. Similar to other suburban lines around Budapest, this railway line also requires significant expansion of its capacity, as it must offer a real alternative to commuting by personal vehicle for the population of the agglomeration municipalities it serves. This requires the construction of a second track, which will allow for increased train frequency and average travel speed. According to model studies of the Budapest Agglomeration Railway Strategy, the planned capacity expansion could triple the number of weekday passengers on this line. Additional developments (such as making stations accessible, covering railway platforms, and providing bicycle storage and car parking facilities) could further enhance the attractiveness of using the railway line.

c) Upgrading of the Budapest–Lajosmizse–Kecskemét diesel railway line. The single-track suburban railway line running through the southeastern sector of the agglomeration is highly utilised even in its current neglected state, indicating its significant future development potential. Due to outdated track infrastructure, trains can only operate at low speeds and are often overcrowded due to low service frequency. Modernising the line would not only provide a competitive alternative for the affected parts of Budapest (Kispest, Pestszentimre, and Pestszentlőrinc), as well as the neighbouring towns of Gyál and Dabas, but also for numerous other communities along the agglomeration ring.

[10] Budapest Development Centre 2022.

4.3.3. Upgrading and integration of the suburban railway lines into a unified network

Traditional railway lines have distinct characteristics, but local railways serving Budapest and its agglomeration, which differ from traditional railways in many aspects, yet share similar technical features with other fixed-track transport systems, play a crucial role in public transport. Due to significant population growth in the municipalities affected by the agglomeration zone, their average daily passenger traffic reaches up to 200,000. The Budapest Agglomeration Railway Strategy rightly focuses on the development of the five suburban railway lines, particularly the Csepel (H7) and Ráckeve (H6) lines. While the Szentendre (H5), Gödöllő (H8), and Csömör (H9) suburban railway lines' termini in Budapest (at Batthyány Square and Örs vezér Square, respectively) are directly connected to the metro network, the termini of the Csepel and Ráckeve lines (Boráros Square and Közvágóhíd) are not. Although the two termini are relatively close to each other (just 1.5 km apart), the lines do not form a continuous network. Therefore, in this project, an important task will be to extend both the H6 and H7 lines from Közvágóhíd terminus through a new railway tunnel to connect directly with the metro network at Kálvin Square. This will enable passengers from Ráckeve and Csepel, as well as intermediate stations, to reach the city centre without transferring and connect directly to metro lines M3 and M4 at Kálvin Square.

Large-scale developments are expected to begin in 2026. The first phase will involve extending the suburban railway line in Csepel southwards to Erdősor Street, where a new terminus will be constructed. Simultaneously, the entire track will undergo technical modernisation. The second phase will involve connecting the Ráckeve and Csepel lines and extending the shared track to Kálvin Square in the form of an 'underground suburban railway line'. The planned start year for this project is 2027. As a result of these developments, fixed-track suburban transport could become competitive with passenger car traffic and help reduce transport-related emissions in the affected urban areas. During the modernisation of the suburban railway lines, track renovations will eliminate current speed restrictions and allow for increased operating speeds. The upgrades will also include the reconstruction and accessibility improvements of stops, enhancement of station environments (including increased green areas), renewal of passenger information systems, and the establishment of P+R and B+R parking facilities.

Long-term development plans include the conversion of the Gödöllő and Csömör suburban railway lines into metro lines. Development plans for the Szentendre suburban railway are still in the pre-planning stage.

The extensive network development for fixed-track transport, which will cover both the capital city and the municipalities in the agglomeration zone, will require additional ancillary developments at approximately 50 railway stations and suburban railway stops. These developments will include the *construction of numerous P+R parking spaces and bike storage* facilities. According to surveys by the Budapest Development Centre, it is necessary to expand storage capacity at railway and suburban railway stops in the outer districts of Budapest and the agglomeration municipalities by installing approximately 10,000 car parking spaces and around 8,000 bicycle storage units.

Summary

In the shaping of Budapest as a metropolis, a key role has been played by the multi-stage development of the capital's transport network. This process, spanning a century and a half, has been characterised by the continuous expansion of the network and the adaptation of its spatial structure to changing travel demands. Concurrently, a significant network development task was the establishment of multifaceted passenger transport connections between the capital and the increasingly expanding municipalities of the agglomeration zone, which required the expansion of various fixed-track and road transport networks.

The future vision for the transport of Budapest and its agglomeration is shaped by the short- and long-term developments of each networks of the transport sector. The process, coordinated and directed by the Budapest Development Centre, is carried out based on strategic and operational development goals, using tools that serve these objectives. The most important of these goals are: 1. Creating a safe, predictable, and integrated urban transport system; 2. Deepening and diversifying cooperation in the transport spatial connections within the agglomeration; 3. Promoting intelligent forms of integrated network development (energy-efficient, non-polluting, and quiet).

Achieving optimum ratios between motor vehicle traffic and pedestrian traffic in the use of public spaces in Budapest, in order to minimise conflict situations.

Expanding and passenger-centred development of intermodal public transport connections. This includes linking Budapest and suburban fixed-track transport networks (tram, suburban railway, and railway lines), integrating the sections of the main road network bypassing Budapest and entering the city with the inner-city road network, incorporating Danube navigation into the capital's and agglomeration's transport, improving access to Budapest Liszt Ferenc International Airport, and expanding the agglomeration connections of the recreational and tourism-oriented bicycle network.

The outcome of long-term network developments will be the realisation of a modern, environmentally friendly, and passenger-friendly transport network in Budapest, offering a wide range of services to travellers, and a highly integrated agglomeration transport network within the capital's transport system. Of course, this requires the continuous provision of all European Union and domestic resources to the capital and agglomeration zone to make such a vision a reality.

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