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**The evolution of Hungarian bus procurements and its impact on the
performance of the domestic bus manufacturing industry**

How can domestic manufacturers thrive in the hectic and changing public
transport industry?

**A magyar buszbeszerzések alakulása és hatása a hazai buszgyártás
iparágának teljesítményére**

Avagy hogyan képesek a hazai gyártók előretörni a hektikus és változó
közösségi közlekedés iparágában?

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Abstract

Buses in public transport has always been a vital method of mobility for people in Hungary. This transportation mode has been enabling citizens to get to school, work or essentially anywhere for more than a century. However, to be able to provide these large vehicles for the public, complex public procurement procedures are carried out. In this thesis, the evolution of Hungarian bus procurement tenders will be assessed between 2014 and 2023, especially focusing on the last five years, to evaluate the role and performance of domestic manufacturers of strategic importance. Furthermore, with the help of business professionals the current situation and the future trends will be elaborated on to create a better comprehension on what are the disadvantages of local manufacturers and how they could increase their competitiveness. The findings of this research suggest that as Hungarian bus manufacturers face significant challenges due to competitive pressures and technological changes adaptation is needed. In my research I sought to find the root causes of how manufacturers can thrive in the Hungarian procurements based on possible future alternatives.

Keywords: *Public procurement, Bus manufacturers, Public Transport, Electric buses*

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I. Introduction

Bus transportation has long been a crucial component of mobility, but in today's world, it is ever more important in the fight for providing a sustainable transport alternative. According to Net Zero Scotland in 2024, bus transportation instead of car usage can lead to a significant reduction of 42% in carbon dioxide emissions. However, to offer a more sustainable option for passengers, bus operators and manufacturers need to adapt to the changing regulatory requirements. Thus, this thesis aims to provide a thorough comprehension on the historical and anticipated bus procurement in Hungary. By analysing the different trends producers and operators had to adapt to in the changing environment, one will be able to see which corporations were most successful in providing adequate assets for public transportation use.

The motivation for selecting this topic stems from my professional background and my personal experience of travelling. On one hand, I recently have been working on a project connected to bus manufacturing, and I instantly became interested in the transport sector, especially in the domestic bus production which has a long-standing tradition in Hungary. On the other hand, for over ten years, I have been using buses for my journeys, capitalising on the advantages of public transportation without contemplating on the process by which these substantial vehicles are deployed to transport thousands of individuals on a daily basis. I am interested in understanding the importance of bus transportation and the methods used to ensure bus services are available even in rural areas, thereby facilitating mobility for all residents.

I believe road public transportation is a current topic, which could be relevant for every commuter. Forecasts show that public transportation will be able to provide a more sustainable travel opportunity with the increase of environment-friendly buses, while it will also create an opportunity of mobility optimisation by adapting advanced technologies (KPMG, 2022). Hence, there has been an initial acceleration in the procurement process of low-emission buses. In 2023, the number of electric buses increased by 53%, explaining why experts are anticipating a significant growth and potential in this industry (sustainablebus.com, 2024). These changes, however, initiates producers to change their strategy and adapt to the new regulatory and customer expectations.

In my research, I sought to dive deep to explore the major driving forces of the industry to be able to understand the performance of domestic players. In order to be able to draw quantifiable conclusions, I examined the influence of key stakeholders in the bus manufacturing sector. Thus, in this paper the aspects of bus operators and regulators were mutually assessed.

The research is intended to reveal the trends of public procurement in the road public transportation. For this, I analysed the procured buses which are under the official M3 classification. M3 type vehicles are passenger transportation vehicles consisting of eight or more seats in addition to the driver and with a maximum mass exceeding 5 tons (Economic and Social Council, 2017). While public transportation encompasses several categories, most of the acquired buses fall into this particular area. Moreover, Hungarian producers mostly concentrate their efforts on manufacturing M3 type buses.

My research will begin by evaluating the historical context of public procurement over the previous decade which was issued by the Public Procurement Authority of Hungary (PPA). However, the primary emphasis will be on the last five years, as there have been significant changes in the legislative framework during this period. In addition, interviews were conducted with industry experts, who provided significant information to assess the future possibilities of bus procurement and the operation of public transport.

Following the examination of the public procurement system in Hungary, key findings will be assessed, and the paper will also provide further details regarding the limitations and potential future directions of the research.

II. Literature review

II.1. Importance of bus transportation

Public transportation has consistently played a crucial role in facilitating mobility. Rail, bus, and ship transportation has been serving an important part of assisting efficient travel for passengers, enabling them to reach their destinations within a reasonable timeframe. However, bus transit even distinguishes itself from other modes of transportation when assessing the significance of mobility options as buses are the predominant mode of public transportation in Europe. According to ACEA (2022), over 32 billion passenger journeys were attributed to bus transport in 2022, accounting for 55.7% of all public transport trips.

Bus transportation provides numerous advantages to the overall well-being of the general population. It not only alleviates the issue of transportation within or between cities, but it also offers a more environmentally friendly option for passengers who would normally choose to drive their cars to reach their destination. Thus, the importance of bus transportation is not only unquestionable but could mean the future for a more sustainable mobility (Katsarov, 2022).

Bus transportation, particularly in urban areas, contributes to a safer environment. The passenger capacity of buses allows for the movement of up to 200 individuals, hence greatly facilitating road transit. According to Schmöcker, Lam, and Bell (2003, p. 1-4), the implementation of public transit in a cautious and prudent manner can lead to a notable reduction in traffic congestion inside urban areas. This would benefit cities by not just reducing travel time but also by freeing up a significant amount of space that would otherwise be used for parking of cars.

The other aspect of why bus transport is beneficial is the issue of sustainability. Out of all the motorised transportation modes, buses and coaches have the least amount of carbon emission per passenger (ACEA, 2022). Bus transportation has a significant role in urban areas. This explains why the majority of urban regions are endeavouring to offer additional incentives to encourage residents to refrain from driving and instead utilise the local transportation networks. The significant reliance on automobiles encounters a range of significant challenges, including environmental pollutants encompassing noise, air pollution, and land degradation (Schmöcker, Lam & Bell, 2003, p. 1-4) which would be solved by an efficient public transport system.

II.2. Categorisation of vehicles

According to its definition, a bus is a “*large vehicle in which people are driven from one place to another*” (Cambridge Dictionary, 2024, p. 3). However, this classification is not enough to segment buses based on their use in the transportation. Public transport vehicles can vary as operators are utilising different vehicles for specific purposes. Thus, to understand what is considered as a “bus”, it is crucial to comprehend the vehicle categorisation principles. Vehicle taxonomy is developed by the United Nations under the ECE/TRANS/WP.29/78/Rev.6 (for additional details see Annexes). After their manufacturing, vehicles are classified into eight different categories (Economic and Social Council, 2017).

Category L: Motor-driven vehicles that possess two, three or four wheels and are intended for passenger transportation. This category contains vehicles such as scooters, motorcycles, and even small mopeds. The weight limit for the vehicles is 400 kgs for passenger and 550 kgs for good transportation (MCIA, 2019).

Category M: Vehicles from this category are power driven, with four or more wheels intended for passenger transport. The M category is further subcategorised into *M1*, *M2* and *M3* segments. The *M1* segment comprises of automobiles having not more than eight seats excluding the driver. Typically, M1 vehicles are cars and vans. In the *M2* category, vehicles

have more than eight passenger seats, however their weight is limited to less than five tons. Automotives in this category can be minibuses and campers. Lastly, the *M3* category includes vehicles such as buses and coaches with more than 5 tons of mass (Vehicle Certification Agency, 2024).

Category N: N-type of vehicle are transportation intended automotives. They are further divided into three subcategories based on their weight. However, this classification differentiates between vehicles based on their intended use and manufacturing design (COC Europe, 2023). The category contains automotives such as lorries, trucks and in some cases even vans.

Category O: In this category, trailers and semitrailers are classified into four subsegments based on their maximum weight they can carry. This category is not motor-driven and is usually towed. Moreover, they are sorted by their attachment type to the towed vehicle as well (Vehicle Certification Agency, 2024).

Category T, R, S: In this category agricultural and forestry vehicles are classified. *T-type* of vehicles are motor-driven, operated by driver. They are mostly combine-harvesters and tractors. *R-type* of vehicle are usually complementing units intended for carriage and storage of goods such as forage transport wagons, manure spreaders, and loader wagons. Finally, *Category S* vehicles are towed special purpose units which add to the functionality of the towed vehicle. In this segment seeders, soil preparators balers and wrappers are the most common type of automotives (CEMA, 2019).

Category G: This category contains modified vehicles for off-road purposes. They can be all-terrain vehicles (ATVs), utility tasks vehicles (UTVs), and other *L*, *M* and *N* category automotives that are adapted to off road mobility (Economic and Social Council, 2017).

Although public transport operators utilise vehicles from various categories for their operation, as bus manufacturers are specialised in heavy passenger transportation production, this paper will focus on the *M3* category vehicle procurements, and the trend analysis will be also based on this category.

After understanding the vehicle classification, it is important to segment the different *M3* vehicles based on their attributes, as different bus types serve diverse function in public transport.

In the subsequent analysis, four distinct attributes will be evaluated to illustrate the many options available to producers in terms of manufacturing.

II.2.1. Size classification of buses

In relation to the classification of bus sizes, it is possible to further subdivide M3 category vehicles. Bus sizes can be categorised according to their dimensions, mass, and axle number.

Official category	State of passenger	Bus size	Number of Axles	Length size	Weight
M3/I	Mostly standing	Midi	2 axles	8–12 meters	< 15 tons
		Solo	2 axles	12–13.5 meters	15–18 tons
		Articulated	3 axles	> 18 meter	> 18 tons
M3/II	Seated and standing	Solo	2 axles	12–13.5 meters	15–18 tons
		Solo	3 axles	14–15 meters	16–20 tons
		Articulated	3 axles	> 18 meter	> 18 tons
		Articulated	4 axles	> 18 meter	> 18 tons
M3/III	Seated	Solo coach	2 axles	12–13.5 meters	15–16 tons
		Solo coach	3 axles	14–15 meters	> 16 tons

Table 1: Bus categorisation based on axle number and dimensions (own editing, based on: Economic and Social Council, 2017; Gov.uk, 2016; International Transport Forum, 2019)

M3/I types of buses are specifically designed for the carriage of standing passengers for areas where bus stops are frequent, thus there is a high speed of rotation regarding travellers. Buses in this category can have a shorter length (8-12 meters) and can weigh less than 15 tons. These so-called Midi buses are comprising of two axles and a passenger capacity between 16 and 35 including the driver (Ministry of Transport of South Africa, 2014). In addition, M3/I buses can even have a longer length size and be considered solo or even articulated buses (Gov.uk, 2016).

Through the examination of *M3/II bus types*, it is possible to accommodate various bus proportions within this category. In 2017, the Economic and Social Council stated that these buses are designed to convey standing passengers inside a specific area or gangway that does not exceed the space permitted for two double seats. However, their purpose is also the transport of seated passengers. Buses within this particular category can typically be classified into two distinct kinds, which are determined by the hull structure. Solo buses, in contrast to articulated buses, possess a unified and sturdy structure, and typically range in length from 12 to 13.5 for 2-axle vehicles and 14 to 15 for 3-axle vehicles. According to the International Transport Forum (2019), the passenger carriage of these automobiles has a standing and seated capacity ranging from 60 to 90. Conversely, articulated, or bendy buses consist of many bodies. Articulated vehicles are available in both 3-axle and 4-axle configurations exceeding the length of 18

meters, and the weight of 18 tons. Given their passenger capacity, these buses can accommodate a range of 120 to 200 individuals. Despite being uncommon in Europe and absent in Hungary, there is a distinct category of articulate buses. The so-called bi-articulated vehicles consist of three distinct body components. Their greatest length can exceed 25 meters, and they can accommodate up to 300 passengers (Busworld 2022).

Finally, *M3/III type buses* are intended to accommodate only seated passengers. These vehicles are commonly referred to as coaches. These vehicles are designed to cater to extended travel routes and are equipped with an internal storage compartment. These coaches can be classified into two- or three-axle versions with a length of 12–18 meters, depending on their axle numbers. It is important to mention that three-axle coaches often have a heavier weight, which impacts fuel consumption due to their longer length and higher initial passenger capacity (Gov.uk, 2016). Furthermore, it has been shown that the distribution of gross vehicle mass (GVM) across the three axles is more uniform, leading to a reduced rate of tire wear (Takeuchi, Cristoforo, & Ainsworth, 2019).

II.2.2. Floor type and segment of operation of buses

The floor of buses holds significant importance in the context of bus operation. While individual manufacturers may create buses according to their own standards, the classification of bus floor types is determined by current rules. The assessment will encompass four distinct segments, namely low-floor, low-entry, normal-floor, and raised-floor (or high-floor) types, as per the existing classification.

Urban transit is the primary purpose of *low-floor buses*. This indication arises from the imperative for expeditious passenger movement. Hence, it is common for low-floor buses to possess a higher standing capacity. Typically, bus passengers engage in frequent boarding and disembarking because of the limited amount of travel. In addition, the low entry height also facilitates convenient access for individuals with special needs. However, the cost of constructing these buses might be relatively high because of the necessary modifications required for the suspension and chassis (ITDP, 2006).

Low-entry buses are designed to serve two roles simultaneously. The design of these buses prioritised the requirements of commuters in urban and suburban regions. The front entrance of buses bears resemblance to that of low-floor vehicles, hence facilitating the efficient movement of passengers within urban environments. To cater to the requirements of commuters residing in suburban regions, the rear of these buses is elevated, resulting in variations in the interior

floor height. The proposed design enables the augmentation of seating capacity in the rear section of the buses, while it simultaneously incorporates a compartment for subterranean baggage storage. Therefore, commuting may accommodate both long-distance and short-distance passengers (Solaris, 2024).

Normal-floor buses are predominantly used in interurban transportation when there is no substantial need for convenient access. This bus design exhibits a lower cost compared to low-floor buses, mostly attributed to the comparatively less inventive construction of the chassis and suspension. The advantage of conventional flooring in the context of interurban transit is its ability to tolerate substandard road conditions with suspension support (ITDP, 2006).

Lastly, *raised-floor buses* specifically cater to the requirements of long-haul passengers. In general, the seating capacity of these buses is limited to 2x2 seats per row, excluding the backend row. The elevated floor facilitates the inclusion of a substantial storage compartment located in the lower section of the bus, allowing passengers to conveniently store their personal belongings in this area rather than within the passenger compartment (Thamsuwan et al., 2013, p. 9-17).

Floor category	Entry height (cm)	Description	Segment of operation
Low-floor	< 40	- Frequent circulation of passengers - Intended for standing passenger transport - Easier usage for people with disabilities and elders	<i>Urban areas (City)</i>
Low-entry	< 40	- Intended for medium range transport - Front of the bus for easier entry and exit for short-time travel - Rear of bus for longer travel (higher floor with 2x2 seats per row)	<i>Urban areas, Agglomeration (City)</i>
Normal-floor	40–90	- Intended for interurban and suburban transport passengers - More seats and storage unit	<i>Agglomeration, Interurban areas (Intercity)</i>
Raised-floor	90 >	- Intended for long-haul passengers with baggage - No standing passengers (2x2 seats per row)	<i>Long-haul routes (Intercity)</i>

Table 2: Bus floor types and segment of operation (own editing, based on: ITDP, 2006)

II.2.3. Powertrain

The engine of buses relies on the propulsion system which generates the power for the vehicle. Current propulsion systems can be divided into three distinct classes, which can be further subcategorised.

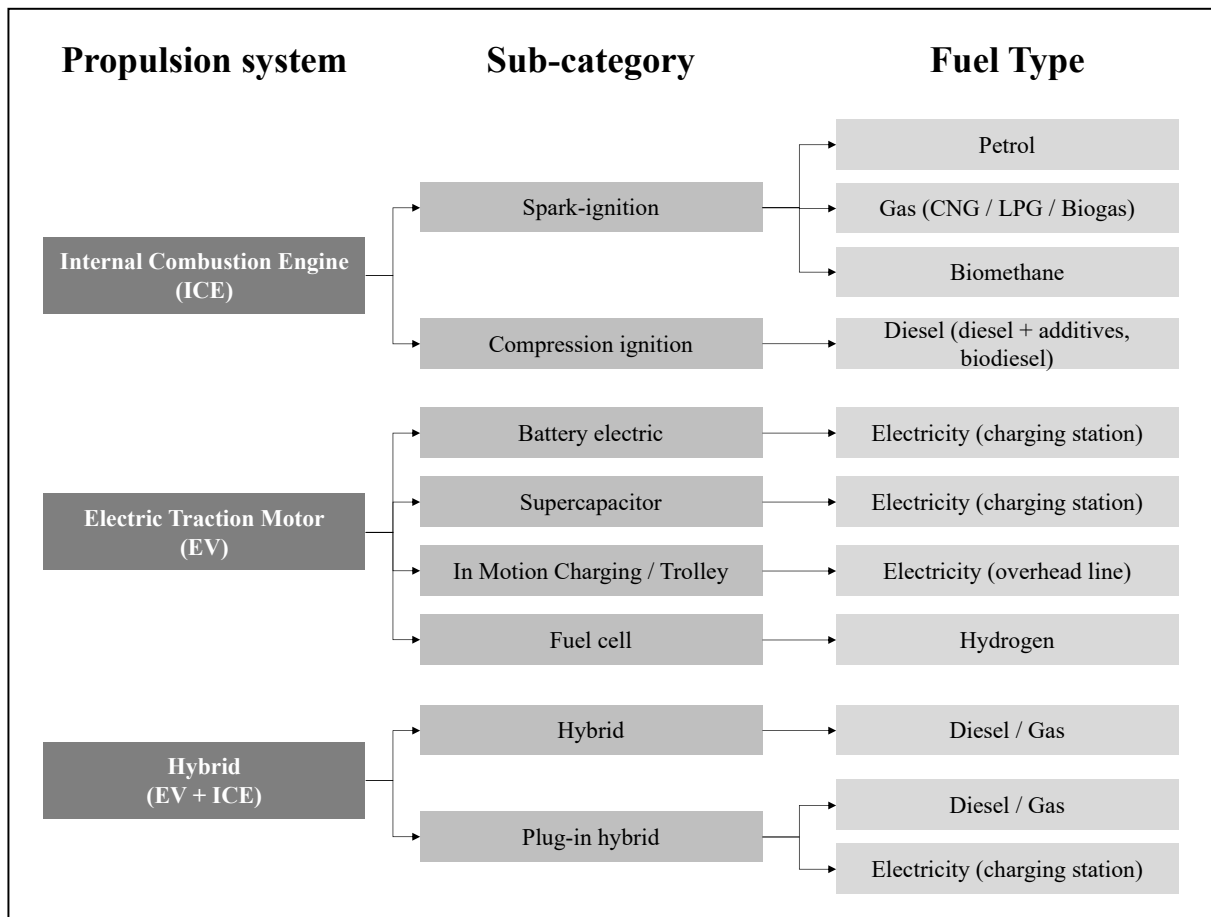


Figure 1: Propulsion systems (own editing, based on: Jain and Draxler, 2023)

The internal combustion engine (ICE) is a widely used propulsion system. ICEs can be classified into two main categories: spark ignition and compression ignition engines. In the context of bus powertrains, diesel-fuelled buses are widely prevalent owing to their notable attributes such as efficiency, durability, and cost-effectiveness. In recent years, there has been a shift in procurement preferences towards alternate propulsion types in some categories, driven by environmental-friendly initiatives, however the diesel buses continued to be dominant overall (Dickens, 2021, p. 20-21). Petrol-powered buses are hardly used due to the high price and the significantly higher consumption of fuel. In 2022, in the whole European Union only three petrol-fuelled buses were sold, compared to diesel buses which covered 67.3% of total bus procurement in the region (ACEA, 2023).

The utilisation of compressed natural gas and liquified natural gas presents a viable and environmentally sustainable alternative to diesel-powered passenger transportation. Furthermore, these buses exhibit a notably reduced level of noise pollution (Milojevic, Grocic & Dragojlovic, 2016, p. 377-382). This technology has the potential to be efficiently utilised in urban transportation, yet the system's drawback lies in the storage of gas. LNG is held at

excessively low temperatures, whereas CNG is stored at elevated pressures. And because of this, the gas needs a lot more space to store one gasoline gallon equivalent (GGE), which shows how energy-dense the fuel is compared to petroleum-based products (OECD, 2019). Thus, although this method can be a viable alternative to conventional propulsion system, the drawbacks of its GGE limits the prospect of usage of these technologies.

EVs are the oldest type of bus propulsion. In the context of in motion charging, this technology has been in use since Thomas Davenport invented trolleybuses in 1834 (Britannica, 2020). Since their inception, trolleybuses have been widely utilised as a means of transportation. Nevertheless, the selection of operating routes was contingent upon the existing infrastructure of overhead lines. The emergence of battery electric and supercapacitor propulsion systems over the past ten years has marked a significant increase in technological advancements in electric vehicles (EVs). According to the article by sustainablebus.com in 2019, it was estimated that the procurement of electric buses would see a compound annual growth rate of 18.5% between the years 2019 and 2024. Nevertheless, in contrast to diesel-powered cars, the primary obstacle to acquiring electric buses is the overall cost of ownership for electric vehicles. Furthermore, electric vehicles are widely recognised as a more environmentally friendly mode of public transportation. However, issues like this technology's constrained range, short battery life, and lack of the necessary charging infrastructure are impeding its rapid growth (Mahmoud et al., 2015, p. 674-677).

Another emerging technology pertains to electric-driven vehicles as well. This unique fuel-cell-powered propulsion system utilises hydrogen as its fuel source. According to Vodovozov, Raud, and Petlenkov (2022, p. 6945), an electrochemical converter is employed to convert chemical potential energy into electrical energy through the reaction between hydrogen and oxygen. Although the technology is still in its early stages, this strategy has significant potential for the future of public transportation. The primary concern revolves around the storage of hydrogen. Hydrogen molecules need to be stored in either a low-temperature (at 20 Kelvins) or high-pressure (up to 10,000 pounds per square inch) environment due to their dimensions and mass. However, despite employing these techniques, it is not possible to completely prevent the leakage of hydrogen from the storage unit (Niaz, Manzoor & Pandith, 2015, p. 457-469). Therefore, establishing a hydrogen-powered sustainable transportation system will require significant research and development efforts as due to current storing methods the price of hydrogen is quite expensive.

Lastly the meaning of hybrid buses can vary based on their type. Hybrid propulsion means that the vehicle possesses more than one propulsion method. However, this means that any combined propulsion system can be categorised as hybrid. The literature distinct two categories, *series hybrid systems* which use an ICE to power an electric generator, while on the other hand *parallel hybrid systems* use ICEs and electric propulsions. There are lots of advantages of hybrid buses, which can be the cost-efficient operation, reduced noise emission and more sustainable environment impact. In fact, hybrid buses operate with a 32–40% energy reduction compared to diesel vehicles (Barrero, Coosemans & Van Mierlo, 2009, p. 299-310).

II.3. The public transport industry

II.3.1. Key stakeholders in public transport

The public transportation is a complex sector, where the joint effort of multiple stakeholders is needed to provide citizens an adequate mobility option. In the following, the essential stakeholders will be introduced.

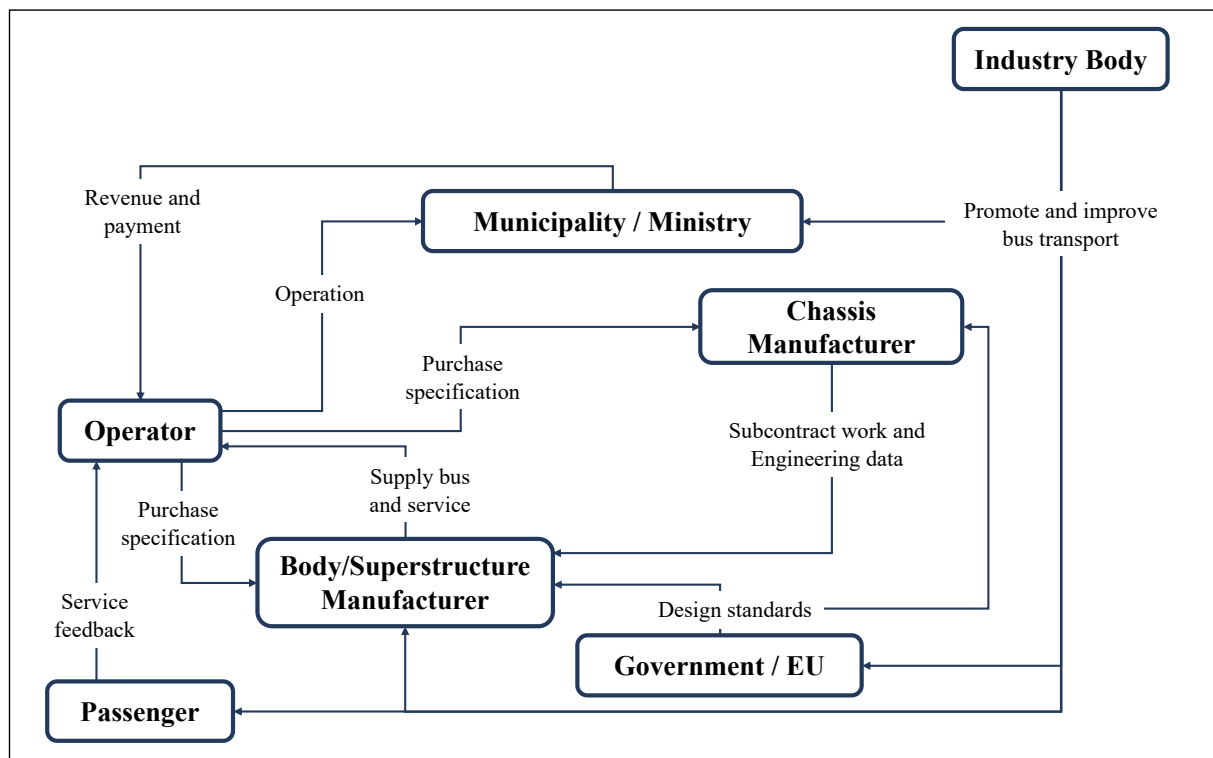


Figure 2: Stakeholders in bus manufacturing and operation (own editing, based on: Napper, 2007)

Bus manufacturers are key stakeholders who are responsible for the assembly of various components of the bus. Concerning the bus configuration, the vehicles generally consist of two primary elements: the body, also known as the superstructure, and the chassis. Manufacturing buses is predominantly a manual and labour-intensive process because of the diverse standards

required and the limited level of automation (Chepkania, Keraita, & Muchiri, 2019). The assembly of the superstructure is considered to have less value added compared to the fabrication of the chassis, as chassis producers are the ones spearheading innovation by developing new propulsion systems and low-floor technology (Napper 2007).

The issuer of the bus transport service is the municipality or the ministry, which appoint the bus operator for a designated region to organise the public transport. Their importance is vital as they finance the public transport (Napper, 2007).

The bus operator's primary goal is to win the transportation tenders by the ministry or municipality to be able to provide transportation services on specific routes. Thus, they are the main customers of manufacturer as they procure buses for the operation. In exchange of their service, they get reimbursed based on the number of kilometres travelled, the fuel expenses, and the requirement to meet specific service quality conditions, such as being on time and maintaining cleanliness (Napper, 2007).

Another significant stakeholder is the regulatory entities such as the EU or the government itself. They want to foster a secure, enduring, and efficient mobility opportunity therefore, their objectives include establishing benchmarks for the excellence of motor fuels, regulating production operations, and offering an affordable transportation option, among various other goals (Viegas and Macario, 1998, p. 204-210).

Finally, the passengers on public transport play a crucial role in the stakeholder network as the ultimate consumers of the service. By excluding them from the integration, there may be significant repercussions, as they have the option to choose alternative modes of transportation. If a transportation organisation is badly planned, the efforts of other stakeholders are rendered futile if passengers are not enthusiastic about using the system (Mrnkova et al., 2017, p. 59-68). Thus, careful inclusion of passengers is needed to ensure an adequate mobility system.

Overall, to make the road public transportation system operational, the requirements of every stakeholder must be thoroughly assessed.

II.3.2. Bus acquisition principles

The procurement of buses is a high-risk investment for the operator, given that a new bus can be quite expensive. Nevertheless, the use of a younger bus fleet is a positive step towards achieving sustainable public passenger transport. It contributes to energy conservation, improves the efficiency of the transport sector, and enhances the safety and security of

passenger road transport (Török, 2012, p. 75-82). Bus purchases in Hungary are primarily dependent on the availability of financial resources, particularly on state and EU funds. To analyse the overall cost of owning a bus, Török (2012, p. 75-82) suggests that it is advisable to concentrate on the complete lifetime cost of the vehicle, encompassing all expenses incurred throughout its lifespan. The proposed lifecycle cost includes acquisition, amortisation, maintenance, and operation costs.

After the useful life of a bus which is about 10 years, the expenses of maintenance start to exceed the costs of amortisation. As a result, during the later stages of the bus's lifespan, the expenses are likely to rise. According to Török in 2012 (p. 75-82), the optimal period for selling a bus is between 9 and 10 years. This statement asserts the rule of thumb, which states that the optimal efficiency of the bus fleet is achieved when the average age of the fleet is around 10 years.

II.4. Unique situation of the Hungarian market

II.4.1. History of Hungarian bus manufacturing and operation

130 years of Hungarian bus manufacturing

The historical origins of Ikarus can be traced back to the year 1895, when Imre Uhry established his enterprise known as Kovács- és Kocsigyártó Üzem in Budapest (Erdélyi, 2016). During the mid-1920s, the elegant, carriage-like buses produced at Uhry's factory became prevalent in numerous cities across Hungary. In the latter part of the 1920s, the company saw a period of economic growth that was disrupted by the Great Depression. However, due to the cohesive nature of the family and the financial backing provided by relatives, Uhry's children successfully revitalised the company, enabling uninterrupted production (Gerle, Kukla & Lovász, 2008). Starting in 1936, scale models were employed to simulate the design of vehicles intended for large-scale production, in addition to the transition from wooden to metal-framed vehicles (Erdélyi, 2016). During the 1940s, the company experienced expansion as a result of investments in mechanisation and other enhancements, driven by the heightened demand for automobiles during the Second World War (Gerle, Kukla & Lovász, 2008).

After the end of the world war, the refurbished company started manufacturing the engines for the bodies produced at the Láng Machine Factory and later, starting from 1950, at the Csepel Car Factory (HVG, 2005). In 1952, Ikarus delivered its 1,000th bus (Ikarus, 2023). Bus manufacturing, however, emerged after the Comecon's decision in 1964 to allow Hungary to focus on the production of buses (HVG, 2005). By the conclusion of the 1970s, the firm had

emerged as the foremost producer in Europe, producing 10,000 units per year (Gerle, Kukla & Lovász, 2008). By the early 1980s, the firm had positioned itself as one of the top five bus manufacturers globally, which was managed by the creation of North American Bus Industries (NABI) to penetrate the US market (Erdélyi, 2016). However, the change of regime significantly disrupted the operation of Ikarus (HVG, 2005). After the dissolution of the former Comecon market and particularly the Soviet Union, the corporation found itself in a state of severe turmoil.

Following an extensive privatisation process and the subsequent financial challenges in 1989, the company was acquired by PV Rt. in 1998 (HVG, 2005). The subsequent period was rather chaotic for Ikarus with multiple acquisitions and sales. By then NABI, the subsidiary of Ikarus, had detached from the firm as well (Erdélyi, 2016). In late 1999, Ikarus was acquired by Irisbus which was the owner of the brand until 2003 (Gerle, Kukla & Lovász, 2008). Regarding, its former affiliate, NABI's success in the beginning of the 2000s was immense, as the US market was booming until its acquisition in 2015 (Erdélyi, 2016). Ikarus's decline continued, but Ikarus Global was able to bring the brand back after the long-running dispute over brand ownership was resolved, and the company is now manufacturing buses for the market (Ikarus, 2023). Parallely during the decline of Ikarus, other manufacturers started to scale their activity such as the Kravtex-Kühne Group, which was capitalising on the infrastructure which was unused by Ikarus (Credobus, 2023). In addition, in the 2010s several smaller bus producers emerged. Amongst others ITK Group and BYD (ITK Holding, 2024; About Hungary, 2017).

Bus operation market since the change of communist regime

The bus operation market in Hungary is highly distinctive. Following the political change, the privatisation of bus operations did not take place due to many factors.

Volán enterprises dominated the intercity bus service industry from the late 1980s until December 31, 2014. During this time frame, apart from minor modifications in the 19 counties of Hungary, there were 24 Volán enterprises in operation (Mándoki and Lakatos, 2018). In early 2015, the Volán enterprises were consolidated into regional transport hubs. The primary goal of the six regional transport hubs and Volánbusz was to manage bus operations for public transportation in the specified territory (Mándoki and Lakatos, 2018). In 2019, as a result of a governmental decision, the six regional hubs and Volánbusz combined their operations and continued their operation under the name of Volánbusz Zrt. The benefits of economies of scale, increased effectiveness, improved service supply, and the impending market liberalisation

supported the consolidation of Hungarian intercity public transportation (Ludányi, 2019). In 2020, a novel endeavour to focus on a certain area arose. Volánbusz Zrt., the dominant intercity bus operator, underwent reorganisation, with MÁV Zrt., a state-owned corporation responsible for railways, assuming ownership of Volánbusz's rights. Although the operational and daily responsibilities were planned to be structured independently (Ludányi, 2020). In 2024, however, the more extensive merger between Volánbusz and MÁV-Start Zrt., the railroad passenger transport subsidiary of MÁV, will result in the cessation of Volánbusz's independent operations (Ludányi, 2024b).

The municipality has the authority to designate the service provider for public transport in the city segment through a power of attorney (Kormányportál, 2010). The organiser of public transport might be a service provider corporation contracted by the municipality, a state-owned service provider like Volánbusz, or even a private entity. For larger cities such as Debrecen, Miskolc, and Pécs, the municipal firm typically handles the provision of transportation services. However, in the case of smaller towns, the responsibility of providing transport services is commonly left to Volánbusz. (Mándoki and Lakatos, 2018). In Budapest, the transportation system is structured in a slightly distinct manner. The Centre for Budapest Transport (BKK) which was formed in 2010 and is fully owned by the city's authorities, has the task of providing transportation for the residents of Budapest. However, the company does not operate the buses rather its contractors BKV and Arriva Hungary manage the operation (BKK, 2024).

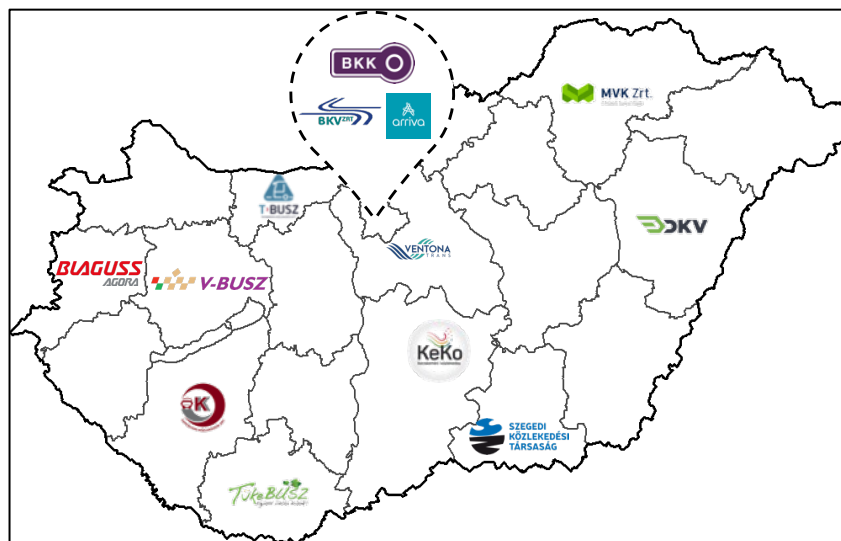


Figure 3: Service providers in the city segment in Hungary (own editing)

In Hungary, the majority of scheduled passenger transport services are provided under public service contracts. However, there are a few exceptions, such as sightseeing buses, nostalgia trains, and other less significant services which are operated privately (Szeri and Ács, 2019).

The concentration remained relatively constant during the succeeding period as well. Arriva Hungary is the sole and substantial private operator that runs bus routes as a contractor of the Centre for Budapest Transport (BKK) (Arriva, 2023). Therefore, complete market liberalisation has not yet fully taken place compared to neighbouring countries where bus operation is done by private players.

II.4.2. Government initiatives

In the past couple of years, multiple government initiative was introduced in the bus manufacturing and operation sector which heavily influenced the bus acquisition processes.

Palkovics (2021), the previous leader of the Ministry of Innovation and Technology (ITM), outlined the government's 2030 strategy for bus manufacturing, which consisted of four key pillars. The suggested strategy aims to achieve a target of domestically manufacturing 70% of public transport buses by 2030. Additionally, it aims to produce all the required buses for school, medical, and military reasons within Hungary. Since the initiation of this incentive in 2021, the government is keen on decreasing the average age of the fleet from 14 to 10 years, as originally suggested by Török in 2012, to create a more adequate, sustainable, and financially vital operation.

However, to achieve a sustainable operation as of January 2022, the government has mandated that only buses with zero emissions can be purchased with government grants in cities with a population of over 25,000 (Palkovics, 2021). This so-called Green Bus Program (Zöld Busz Program) aimed to procure zero-emission urban electric buses and charging infrastructure. A total of HUF 50.7 billion of non-reimbursable EU funding was allocated under the financial envelope of the Recovery and Resilience Instrument. Out of the total financing, a maximum of 80 percent could be used for the acquisition of electric buses, while up to 60 percent could be utilised for the development of charging equipment and charging infrastructure (ITM, 2022). The program, initiated as part of the Climate and Nature Action Plan by providing funding by Recovery and Resilience Facility (RRF), was to swiftly eliminate the buses with the highest levels of pollution, thereby enhancing the quality of urban living (HUMDA, 2022a).

In addition, the Hungarian Mobility Development Agency (HUMDA) presented a novel initiative. The purpose of the Joint Initiative for Hydrogen Vehicles across Europe 2 (JIVE2) is to improve countries' access to hydrogen fuel cell technology. With the help of this new strategy, a more sustainable transportation system will be possible without the limitations of electrification's limited range and charging problems (European Commission, 2023) The

inaugural hydrogen-fuelled bus commenced operations in 2022. Nevertheless, it is anticipated that hydrogen buses will become more prevalent in the 2030s (HUMDA, 2022b). In 2024, Volánbusz introduced its pilot program where citizens of Budapest can travel by a Caetano hydrogen-powered bus in the agglomeration of the city (Patthy, 2024).

II.4.3. Current Hungarian bus manufacturers

In the following four key Hungarian bus manufacturers will be introduced. Some of these industry players have been providing public transport vehicles for decades, others have recently emerged due to the changing trends and requirements of bus transportation.

Credobus (Kravtex-Kühne Group)

The Kravtex-Kühne Group, based in Győr (with a production plant in Mosonmagyaróvár as well), is the leading manufacturer in the Hungarian bus industry. The company was established in 1992, and since then, the company has come a long way, and currently the firm is specialised in producing Credobus-branded vehicles (Credobus, 2023). The group plays a significant role in Hungary's vehicle manufacturing landscape, contributing to the commercial vehicle sector with a focus on innovation and quality in bus production. Credobuses are mostly being developed for the Hungarian market, especially for the main intercity operator, Volánbusz Zrt. Currently Credobuses comprise around 50% of the total number of buses in the fleet of Volánbusz.

The uniqueness of Credobuses lies in the fact that proportional Hungarian value share of the purchase price of buses reaches 70–75%, which is the highest value among any bus manufacturers in Hungary (Credobus, 2023). Following its success, the group expanded its factory in 2022 by 25%, reaching a production facility of more than 20 thousand square meters (Szeghalmi, 2022). The Kravtex-Kühne Group significantly diversified its portfolio in the last couple of years regarding bus manufacturing. Recently, they introduced their articulated model, Econell 18 Next, which is the lightest articulated bus in the world (Credobus, 2023). In addition, with the help of decades of expertise in January of 2024 the company managed to introduce the world's lightest electric bus under the name of Electronell. The novelty of the new vehicle lies in its significantly reduced weight of 11.5 tons, in contrast to the 13-14 tons of a conventional 12-meter e-bus. Consequently, it could achieve the same range while utilising a 25% less battery capacity (Ludányi, 2024a).

ITK Holding (MOL Group)

ITK Holding Zrt. is a prominent Hungarian company involved in various sectors, with a significant focus on the transportation and mobility industry. The company operates through its subsidiaries, covering a wide range of activities such as infrastructure development, information, and communication technology (ICT) services, cooperation with education institutions, real estate management, and vehicle especially buses manufacturing (ITK Holding, 2024). The Budapest-based firm has been acquired by MOL Group in 2018. Subsequently, the company has expanded its operations in the field of bus manufacturing through the collaboration of its subsidiaries, namely Inter Traction Electrics (ITE), ITE Bus and Trucks, and Omnibus Hungária which was acquired in 2022 (Omnibus, 2024; Bucsky, 2018). ITE, the manufacturing affiliate of the organisation is producing the inhouse-developed Mercedes Reform Class minibuses and buses, which is retailed by ITE Bus and Trucks. Although, the construction of the bus superstructure is prepared in Hungary, the higher value-added Mercedes-Benz OC 500 LE chassis is imported from Spain (Patthy, 2022). Thus, not every stage of production is executed internally by the company.

In contrast, the newly acquired Omnibus Hungária, has been a prominent bus and coach trading company before its purchase. The official importer of Mercedes Benz and Setra buses, has been providing operators with vehicles since 2003. The corporate even managed to be the market leader in the category of new procured buses over 8 tons in 2020 and 2022 (Omnibus, 2024).

Ikarus Global Zrt.

Ikarus became a distinguished European bus manufacturer throughout the 1970s and 1980s, producing and selling more than 10,000 units of the well-known 200 series each year. The distribution of Ikarus products encompassed around 50 nations spanning five continents (Ikarus, 2023). However, following the difficulties after the change of regime, the company was split into several parts. After the long ongoing dispute over the rightful ownership of the Ikarus trademark, Ikarus Global emerged triumphant. As a result, Ikarus Járműtechnika Kft., the manufacturing subsidiary of Ikarus Global, began the renovation of the prestigious company's legacy.

In the autumn of 2020, the firm created its first electric bus that was approved for use in Europe, which was built and produced in Hungary (Ikarus, 2023). After pivoting and transitioning the operation towards e-bus manufacturing, the company has expanded its product portfolio through a partnership with the University of Óbuda. Thanks to the partnership, a successful

implementation of the Ikarus 121e and 80e bus and Midi bus models has been accomplished (Patthy, 2023).

BYD Hungary

Chinese electric vehicle manufacturer BYD has successfully established its presence in Hungary through the establishment of its electric bus assembly factory in Komárom in 2016. The investment of 6.2 billion forints was accompanied by a grant of 925 million forints from the Hungarian government (Budapest Business Journal, 2017). The factory with the capability to manufacture 200–400 vehicles per year created approximately 300 employment opportunities. Since its inception in 2017, the company has mostly concentrated on selling electric buses to significant cities in Europe (About Hungary, 2017). In light of their notable achievements primarily in European exports, the firms made the strategic decision in 2020 to augment their production capacity by 500% over the subsequent two years, resulting in an annual production output of approximately 1,000 buses. However, the plans underwent minor modifications as a result of the worldwide pandemic (Patthy, 2020).

In relation to the factory's operations, the personnel at the production facility are responsible for manufacturing both the bus superstructure and the bus chassis of greater value. Even so, the chassis that is produced is commonly distributed to the British plant, where BYD is engaged in a collaborative effort with Alexander Dennis (BYD, 2024). In terms of future prospects, the company intends to expand its operations beyond electric bus manufacturing to include trucks and light commercial vehicles in the near future.

III. Research Methodology

III.1. Introduction to the research and main question

For my research I conducted quantitative and qualitative analyses as well. As my topic is not widely researched, I mainly relied on primary data from publicly accessible databases and the content of expert interviews, and a roundtable talk with business professionals.

The aim of this paper was to create a comprehensive overview on Hungarian public bus procurement trends, thus, in the following the main question of the research will be presented.

Q1: Which public procurement trends have impacted the bus fleet composition of Hungarian operators in recent years?

Q2: How did Hungarian manufacturers performed in the tenders issued by the Public Procurement Authority (PPA) of Hungary?

- *What was the contribution of domestic players to the public procurements?*
- *What is their competitive edge in procurement?*

Q3: Which emerging trends will influence future procurement processes?

- *Which bus attributes will Hungarian operators prioritise in the future?*
- *How can domestic manufacturer adapt to changes and perform better?*

In the following, I will showcase my research methods which consist of three main parts. Firstly, data collection was made of bus public procurements, as the Hungarian public transport operators almost entirely acquire vehicles from tenders issued by the Public Procurement Authority of Hungary. Secondly, a roundtable talk was organised with the help of BKK to have a better understanding of the industry and its current driving. Thirdly, expert interviews were conducted to understand the performance of the domestic manufacturers.

III.2. Data collection and processing

The EU has established a standardised mechanism for public procurement. Most funds are sourced from the EU budget, and mandatory reporting is conducted via the Tenders Electronic Daily (TED) portal. Consequently, I managed to retrieve information from the procurement database using TED while populating the database with data obtained from the Public Procurement Authority of Hungary (PPA). I successfully obtained the precise characteristics of every tender from 2014 to 2023.

Subsequently, I concentrated on the acquisition of M3 category vehicles, excluding minibuses from my research. The reason for excluding minibuses was due to their limited presence in the procurement process and the fact that most manufacturers do not prioritise their production. Furthermore, I did not analyse the procurement of trolleybuses due to their significant disparities in both manufacturing and operational procedures compared to conventional vehicles. Additionally, it is worth noting that Hungarian manufacturers are not currently involved in the production of trolleybuses, thus, conventional bus procurements were emphasised to accurately evaluate the performance of domestic players in tenders.

Following the completion of data gathering, I proceeded to acquire information on the procurements based on the factors of bus type, floor type, powertrain, and segment. It is crucial to mention that, with the assistance of the successful bidder, I was able to gather information

about the brand of the buses that were obtained and the entity responsible for procuring them. The sole concern was the quantity of buses, which I had to collect from diverse sources. Typically, the tender announcement specifies the quantity of buses acquire, however, in certain cases I also had to rely on external sources. The Hungarian website, Magyarbusz.info provided detailed information on every purchase that was announced. Consequently, following the gathering and analysis of data, I constructed a database containing information on public procurement specifically related to buses. Subsequently to the data collection and processing, the objective of the analysis was to categorise the vehicles by the given variables. The variables that I was mainly interested in was the size, the powertrain, the floor-type, and the segment of operation of the procured buses. Consequently, I examined the historical changes of procurement between the period of 2014–2023.

Subsequently to the assessment of historical bus tenders, I analysed the bus prices of bus suppliers by their offered mean prices. In this way, I was able to draw conclusions about the performance of vendors, as in tender processes, the price of the offer comprised the most significant part of the evaluation criteria. To be able to assess the average prices of local players, I also looked at the specific segments where Hungarian bus manufacturers provided buses for operators. With this method, I compared the average prices of newly procured buses, thus seeing the competitive advantages and disadvantages of local manufacturers.

III.3. Roundtable talk

I was able to organise a roundtable talk with the help of the Centre for Budapest Transport (BKK). The participants of this event were from the transport service provider of Budapest (BKK) and its operators (Arriva Hungary and BKV). In the meeting I was able to comprehend the current processes of the industry from the point of view of a privately owned, a publicly owned operator and even the service provider as well in case of Budapest's public bus transport system. Furthermore, the participants debated on the relevance of the different propulsion system and their procurements, highlighting the benefits and the drawbacks of these vehicles. Lastly, we talked about the trends of bus manufacturing, especially highlighting the activity of domestic bus manufacturer and foreign ones.

Thus, I was able to understand the operational challenges, some future trends, and the competitiveness of manufacturers which I implemented in my qualitative research.

III.4. Expert interviews

Based on the key issues and trends that were mentioned in the roundtable talk, I additionally conducted interviews with prominent business experts and an academic to better understand the decision-making in the industry. Below, I will provide a concise overview of their professional background.

Ádám Török, PhD, currently serving as the Vice Dean for Science and International Affairs at the Budapest University of Technology and Economics. In the expert interview we touched upon his recent study, which focused mostly on the electrification of buses. Furthermore, we interpreted on some tendencies that have arisen from the historical background of Hungarian bus production. During the interview we managed to discuss the future trends of the local public procurements.

Dóra Uray, the CEO of Omnibus Hungária Kft., further contributed to identifying and analysing the upcoming trends that she believes will shape the future. We discussed the performance of bus vendors and the unique selling proposition of her organisation, Omnibus Hungária Kft., which supplies Mercedes buses to operators. Moreover, we emphasised the importance of the expansion of electric bus technology besides additional trends.

Péter Takács, PhD, serves as the Deputy Chief Operating Officer for Rail Operations at BKV Zrt., the service provider for BKK. He provided technical views on the future trends in bus operations. We evaluated the potential of electric propulsion technologies, emphasising the significance and existing obstacles of fuel cells, battery charging, and supercapacitor systems.

Through collaboration with *Ferenc Horváth, the Head of Vehicle Development at Volánbusz Zrt.,* the leading operator in Hungary, I acquired valuable knowledge on bus fleet optimisation and the fleet structure of Volánbusz. In addition, we discussed the categorisation of buses, the current tender procedures, and the potential future developments regarding bus acquisitions.

Furthermore, during my discussion with a *senior staff member at Arriva Hungary Zrt.,* I gathered significant insights into the current challenges impeding the company's operations. Additionally, we deliberated about the benefits of maintaining a standardised bus fleet and the potential liberalisation of the market. Moreover, I have been informed about the current tender and supply chain difficulties of operator firms.

With the assistance of these interviews, I was not only able to add to my findings in the historical tender assessment and the analysis of average prices per bus, but I was also able to gain insights

from the perspective of decision-makers into the most intriguing current trends in this industry as well as various future trends that are expected to emerge.

IV. Results of the research

IV.1. General trends by segment of operation in the last decade

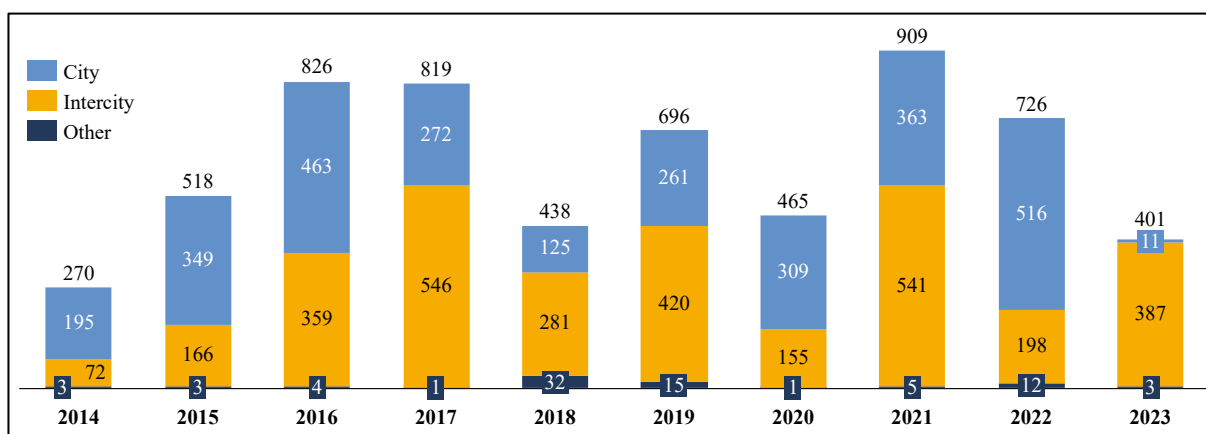


Figure 4: Public bus procurements between 2014 and 2023 by segment of operation (own editing)

In the past ten years, a total of 6,068 buses were acquired in the M3 category by Hungarian entities. This means that bus procurements only in the designated period exceeded 460 billion Hungarian forints in value, which comprise of a significant investment from both the operators and the government (in form of funds and grants) as well.

In order to be able to evaluate these tender procedures, I categorised the quantity of the procured buses based on their operational segment to demonstrate which segment had the highest level of activity.

During this time, most buses were acquired for the intercity sector. In this sector mostly the Volán enterprises, and their successors (the regional public transport hubs which were created in 2015) procured automotives in larger volumes to provide adequate transportation opportunities to citizens. After the cessation and the centralisation of these hubs in 2019, the intercity bus procurements were issued by the main intercity transport provider, Volánbusz Zrt. Regarding the distribution of bus procurements, a total of 3,125 buses were acquired in the intercity sector, accounting for 51.5% of all procurements made between 2014 and 2023.

In contrast, the city sector acquired a total of 2,864 buses, which accounted for 47.2% of all tenders. Procurement procedures in this segment was mostly launched by operators of the capital and the county capitals who were trying to satisfy their own public transportation systems' equipment needs.

Finally, around 80 acquisitions (1% of the total number of procurements) were carried out by organisations or entities that were not associated with public transportation. Typically, these tenders were issued by sports associations, educational facilities, and other institutions for the aim of obtaining private transportation services.

Procurer	Segment	Location	Number of buses	Share of total
Volánbusz Zrt. (and predecessors)	Intercity (+ certain cities)	–	4,253	70%
BKK	City (Capital)	Budapest	1,117	18%
DKV	City (Municipality)	Debrecen	135	2%
Tüke Busz	City (Municipality)	Pécs	121	2%
V-Busz	City (Municipality)	Veszprém	97	2%
MVK	City (Municipality)	Miskolc	91	1%
T-Busz	City (Municipality)	Tatabánya	46	1%
Kaposvári Közlekedési Zrt.	City (Municipality)	Kaposvár	44	1%
Other procurers	–	–	164	3%

Table 3: Bus public procurements by procurer between 2014 and 2023 (own editing)

As previously stated, most procurements were done in the intercity transport sector. The primary operator of the extensively centralised intercity segment was Volánbusz and its predecessors. The company and its antecedents obtained over 4,200 buses in the past ten years, thus, they were responsible for 70% of the public procurements. At second place in this competition was BKK (and its subcontractor BKV). The company acquired approximately 1,100 buses, accounting for 18% of all public procurements during the period of 2014 and 2023. In addition to the large number of procurements that were made by Volánbusz and BKK, several county capitals have also acquired buses, albeit in smaller quantities. In addition, a total of 135 vehicles (9% of all procurements) were obtained by the capital of six counties. These acquisitions varied in number between 44 and 135.

The bus procurements accurately depict the composition and condition of the Hungarian public transport industry. Volánbusz, the primary intercity carrier and the appointed transport operator for 62 cities in 2024, alongside with BKK, the main bus operator of Budapest accounted for approximately 90% of all procurements, highlighting their substantial importance.

The large number of procurements made by Volánbusz could be attributable to multiple factors. *“In the public service contracts (Volánbusz’s contract for the organisation of interurban and*

certain urban public transport), the expectations for the equipment used for public transport are not always, but typically declared. If we approach the technical composition of the fleet, in the contract for interurban public transport, the average age of the fleet is 10 years” (Ferenc Horváth, Head of Vehicle Development at Volánbusz Zrt., 2024). Consequently, the operator has faced and continues to face pressure to get more modern buses to ensure a sufficient transport service for the passengers. This was a challenging issue that required a new resolution. Prior to the consolidation of the regional hubs in 2018, the fleet had an average age of approximately 12 years. Over the past five years, Volánbusz has successfully decreased this figure to about 10 years through these large-scale procurements.

Furthermore, the bus fleet unification played an important role in the procurement strategy of Volánbusz. *“There has been progress in enhancing the disorganised and diverse fleet of various types over the recent period. The technical standard, average age, and type composition have all been made more stringent. Our objective is still to not exclusively utilise a single type of vehicle, nor to identify a type that is universally suitable for all operating environments. However, our goal, was and still is to maintain a relatively homogenised fleet consisting of 5–7 different types of vehicles”* (Ferenc Horváth, Head of Vehicle Development at Volánbusz Zrt., 2024). The benefits of this fleet configuration can be seen in the declining maintenance expenses. Previously, due to the greater variety of buses in the Volánbusz fleet, the procurement of spare parts for individual buses and the maintenance of their conditions posed significant challenges. The route to unification of the fleet structure alleviates this difficulty to a great extent. Additionally, the more standardised fleet configuration simplifies training for maintenance staff and streamlines operational processes, improving overall efficiency. However, the 5-7 vehicle types in the fleet are needed for the firm to offer a versatile operation. In addition, Volánbusz autonomy from the producers as this autonomy also underpins this operation as it allows flexibility in decision-making and reduces reliance on external suppliers, ultimately leading to cost savings.

IV.2. Public procurements based on propulsion system and size

		Diesel	Diesel-Hybrid	CNG / LPG	Electric	TOTAL
Midi	Low-floor	61		6	38	105
Solo 2-axes	Low-floor	551	40	371	251	1,213
	Low-entry	1,807				1,807
	Normal-floor	1,395		6		1,401
	Raised-floor	93				93
Solo 3-axes	Low-floor	8				8
	Low-entry	115				115
	Normal-floor	84				84
Articulated	Low-floor	1,166		76		1,242
TOTAL		5,280	40	459	289	6,068

Table 4: Bus acquisitions by size and powertrain between 2014 and 2023 (own editing)

When looking at the propulsion systems used in recent procurements, it is evident that diesel buses have been the most prevalent. During the period from 2014 to 2023, a total of 5,200 diesel vehicles were acquired. Conversely, the number of vehicles equipped with alternative propulsion was approximately 890 pieces. Among these acquisitions, the highest number of buses purchased were those fuelled by CNG and LPG, totalling up to 459 vehicles. Conversely, the newly developed electric buses ranked second in terms of alternative propulsion systems, with a total of 289 vehicles. Moreover, only 40 diesel-hybrid bus acquisitions took place in the examined period. Additionally, these buses were procured in a batch in 2017, therefore diesel-hybrid buses were not procured publicly in the last 5 years.

With respect to procurements based on size, only four types of buses were purchased in quantities exceeding 1,000 pieces. These four segments encompassed nearly all Solo 2-axle buses, except for the Solo 2-axle raised-floor design, as well as articulated buses. The predominant type of buses acquired were Solo 2-axle low-entry buses in terms of size, with a total procurement count of 1,807 pieces. This might be attributed to the high level of capacity efficiency and experience in the operation of Solo buses. Moreover, these buses were well-suited for intercity transit, which is the most significant sector of operation in Hungary. Followingly, a total of 1,401 Solo 2-axle regular floor buses were acquired. Apart from six buses, all these vehicles were diesel-powered buses designed for intercity transportation. The advantages of these vehicles are even more clear given their significantly lower average acquisition cost, which encouraged the purchase of large volumes. A total of 1,242 articulated buses were acquired throughout this era. The purchase of these buses offered the advantage of

increased passenger capacity, hence, their suitability for urban public transport was the reason behind the increased number of procurements. Furthermore, a vast amount of knowledge has been accumulated in the past regarding the functioning of these buses. The Solo 2-axle low-floor bus design ranked fourth in bus procurement from 2014 to 2023. This segment had a grand total of 1,213 buses procured. In contrast to the higher acquisition costs due to technical difficulties in chassis manufacturing, these buses emerged significantly in the previous couple of years. In urban transportation in most of the cases the low-floor design was a requirement, hence the higher number of purchases. Some of the city operators are only operating low-floor vehicles. The situation is the same in the case of Arriva Hungary: *“Our portfolio is comprised 100% of low-floor vehicles due to regulatory requirements and the ease of operation”* (Senior staff, Arriva Hungary, 2024).

It may be observed that electric buses were exclusively acquired in Midi and Solo sizes. Regarding electric buses, a total of 251 buses were acquired in the Solo 2-axle low-floor size, while 38 buses were acquired in the Midi size. This may be attributed to the operating circumstances. Electric vehicles are used in urban areas, primarily due to environmental considerations. In addition, the required battery capacity for the operation of larger vehicles is substantially bigger, that is why Midi and Solo designs emerged with electric propulsion systems.

Regarding CNG/LPG-powered buses, 377 procured automobiles were acquired in Solo design. Furthermore, 6 of these alternatively powered vehicles were procured in Midi sizes. Moreover, it is notable that a total of 76 compressed natural gas (CNG)-powered articulated buses were obtained throughout the period of 2015 to 2016. Since then, there have been no comparable procurements that have been issued. This is inherent to the operation of articulated buses. These vehicles require substantial power to convey the approximately of 150–200 passengers. As previously stated, the gasoline gallon equivalent (GGE) of compressed natural gas (CNG) is lower compared to diesel buses. Therefore, operators reverted to using vehicles powered by diesel. Particularly, a newly introduced EURO 6 vehicle (manufactured after 2014), known for its smaller nominal carbon emissions, is in competition with the less efficient CNG buses.

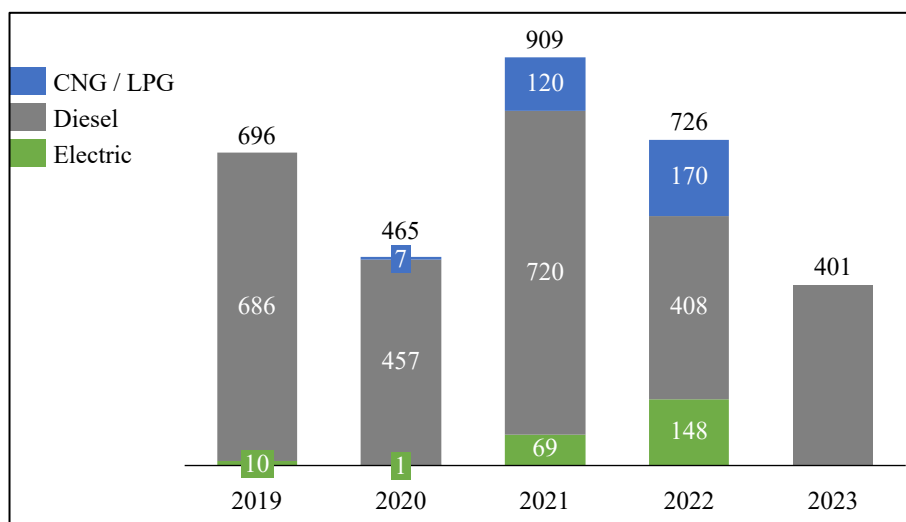


Figure 5: Public procurements based on propulsion system (own editing)

Regarding the propulsion system of the acquired buses, we can see a steep rise since the inauguration of the Green Bus Program (Zöld Bus Program). This increase can certainly be attributable to this initiative which was financed by the Hungarian government through the Recovery and Resiliency Facility of the European Union. According to the initiatives that were implemented by the government, in cities which had a population of more than 25,000 people, it was possible to obtain government support for electric bus procurements. *“In these cases, the government grants amounted for 80% of all costs”* (Senior staff, Arriva Hungary, 2024).

Nevertheless, the sustainability element of electric buses continues to generate numerous inquiries. While e-buses have no local emissions, my interviewee suggested that it is more prudent to consider the carbon footprint of the procured electric buses across their entire lifespan.

My interviewee, Ádám Török, the Vice Dean for Science and International Affairs at the Budapest University of Technology and Economics emphasised the research conducted by him and his colleagues on the lifecycle carbon footprint of electric buses to assess their sustainability. *“For the electricity that e-buses use, we used Hungary's energy mix as a foundation. Our analysis indicates that the carbon footprint of electric buses did not exceed that of EURO 3 cars (produced between 2000 and 2005) over their expected lifespan”*. Showing the problem with the sustainability aspect of electric buses. Although he added: *“This is the case in Hungary, however, this can change regarding the region. For instance, in Norway where 99% of the electricity comes from renewable sources, electric buses can be a more sustainable option even when comparing their lifecycle carbon footprint”*.

Despite taking into account the environmental sustainability of electric buses, the compound annual growth rate from 2019 to 2022 reached an impressive 150%. The procurement of 217 electric buses in 2021 and 2022 demonstrates the forthcoming era of the locally more environmentally friendly transportation mode. Nevertheless, there were no purchases of electric buses in 2023 despite the positive operating experiences with electric buses (as stated in the expert interview with Ferenc Horváth, 2024). The significant reduction can be attributed to the shifting economic circumstances and the disappearance of the main funding for e-bus procurements which came from the RRF. In 2023 the operators faced exacerbated financial challenges as a result of the Ukrainian-Russian war, in addition to the disruption of the supply chain.

IV.3. Average price of new procured buses

Besides the number of procured buses it is interesting to examine the contract value of these purchases. This paper examined the average price of the new procured vehicles. In this sense, the value of the procured buses significantly differed between the city, intercity and the other segment of operation. This was due to the different bus sizes, propulsion systems and specifications. Between 2019 and 2023 the total value of contracts for the procurement of new buses was approximately 127 billion forints (54%) in the city segment, 108 billion forints (46%) in the intercity segment, and 1.2 billion forints (<1%) in the other transport segment. However, due to the different bus type needs the average price of buses differed significantly.

Segment	Value of contracts	Share of total value of contracts	Number of buses procured	Share of total number of buses procured	Average price of a bus
City	127 billion HUF	54%	1,101	40%	116 million HUF
Intercity	108 billion HUF	46%	1,650	59%	66 million HUF
Other	1.2 billion HUF	<1%	29	1%	43 million HUF

Table 5: Average price of new procured buses by segment of operation (2019–2023) (own editing)

During the timeframe spanning from 2019 to 2023, the urban sector had the highest mean cost for a bus, reaching a staggering 116 million forints. Firstly, in urban transportation, there were regular acquisitions of higher-value articulated buses, which contributed to an increase in the average price. Additionally, the mandatory implementation of a low-floor design considerably augmented the cost of buses. Furthermore, in this section, there were acquisitions of vehicles

fuelled by alternate sources. Regarding the manufacturing costs of these CNG/LPG, and electric buses, they were considerably higher compared to the production costs of diesel-powered vehicles. As a result, these specifications have further contributed to the growth in bus pricing. Finally, these acquisitions had a higher value as a result of the demands made by the operators. The implementation of specialised monitoring, surveillance, and route optimisation technologies resulted in an increase in the total average cost of the procured buses as well. According to the interview with Dóra Uray, the CEO of Omnibus Hungária Kft. (2024): *“It is even possible to argue that the proportion between the chassis and body is now 50–50%, given the addition of the expensive components (such as TFT monitors, matrix displays, camera systems, etc.). Previously, the thumb rule was that 60% of the total value represented the chassis and 40% the superstructure”*.

The average price per bus for the intercity segment was 66 million forints. The lower mean price was accountable for the majority of diesel-vehicle purchases. Furthermore, the low-entry and normal-floor design comprised less costs of the total manufacturing expenses, hence the purchase price of these buses were lower. On the other hand, the acquisition of Solo 3-axle vehicles increased the mean price of vehicles in this segment. *“A Solo 3-axle bus is about three meters longer than a Solo 2-axle vehicle, which means that it has more seats and more standing places. I would say that the three-axle bus is more expensive, typically between 10 and 15 million forints, a difference of about 20%”* (Ferenc Horváth, Head of Vehicle Development at Volánbusz Zrt., 2024). Thus, the average price of buses shows an increase for instance compared to the other segment, where the propulsion systems and the floor designs were similar to this segment.

In relation to the other segment, where the involvement of primarily sport associations, institutions, and a few municipalities from smaller towns took place, the average cost of buses amounted to 43 million forints. The lower average price can be correlated with the circumstances surrounding these entities. Typically, all the procurements for this category involved the issuance of requests for Solo 2-axle buses with both normal-floor and raised-floor designs, powered by diesel propulsion systems.

Subsequently to the comparison of average bus prices by the segment of operation, the evolution of bus purchases between 2019 and 2023 was further analysed based on the bus sizes and the propulsion system, to be able to evaluate the possible competitive advantages of domestic manufacturers.

<i>(In thousand HUF, 2019-2023)</i>		Diesel	CNG / LPG	Electric	AVERAGE PRICE BY SIZE
Midi	Low-floor	23,974	51,675	149,450	38,359
Solo 2-axes	Low-floor	83,430	93,436	184,838	125,659
	Low-entry	64,420			64,420
	Normal-floor	64,077			93,060
	Raised-floor	78,134			78,134
Solo 3-axes	Low-entry	83,548			83,548
Articulated	Low-floor	105,734			105,734
AVERAGE PRICE BY PROPULSION SYSTEM		74,197	92,572	184,527	85,163

Table 6: Average price of new procured buses by propulsion system and size (2019–2023) (own editing)

Concerning the Midi buses, it is worth noting that while the average price in this category amounted to 38 million forints, there were significant variations in prices depending on the type of propulsion systems used. The average cost of diesel buses was 24 million forints, whereas the average price of CNG and LPG vehicles was 52 million forints. Conversely, there was a significant surge in the average price of electric Midi buses. The mean cost of an electric bus in this classification was about 150 million forints, indicating an approximate 700% price increase in comparison to diesel buses and a 300% increase in comparison to CNG/LPG buses. Hence, it is evident that the expenses associated with electric buses were substantial, notwithstanding the government subsidy that covers 80% of the overall costs.

When it came to Solo 2-axle buses, it was evident that the inclusion of a low floor design has resulted in higher average vehicle costs compared to other types of floors, all of which were below 80 million forints. The noticeable surge was clear in the context of CNG/LPG and electric vehicles. The mean cost per bus for a Solo 2-axle low-floor CNG/LPG-powered bus amounted to around 93 million forints. The highest average price in this segment was attributable to electric buses. The average price of Solo 2-axle low-floor e-buses was 185 million, making it the segment with the highest average price across all procurement segments.

During the specified time frame, only the low-entry designs of Solo 3-axle vehicles were newly acquired. The mean price of these buses exceeded 83 million forints, indicating the price disparity due to higher capacity compared to 2-axle buses. The price discrepancy was further supported by Ferenc Horváth's assertions which stated the at least 20% higher price compared to the adequate Solo 2-axle category, as discussed in the expert interviews.

In relation to the articulated buses, the mean cost per vehicle nearly approached 106 million forints. The price increase can be accredited to the additional expenses incurred due to the expanded capacity resulting from the larger body and chassis construction.

Although from 2019 to 2023, there were no governmental procurements for hydrogen-powered buses, in 2024, Volánbusz initiated its pilot program for hydrogen buses, thus there are some experiences with the purchase price of this kind of vehicle. According to Ferenc Horváth in 2024, the cost of procuring hydrogen-powered buses is expected to exceed the cost of electric buses: “For instance in case of Solo buses, an electric bus costs approximately 150-200 million Hungarian forints, whereas a hydrogen-powered bus costs 250–300 million forints”. Because of this, the situation regarding the procurements of hydrogen-powered buses can be made even more difficult by the price inequality.

IV.4. Performance of domestic manufacturers in public procurements

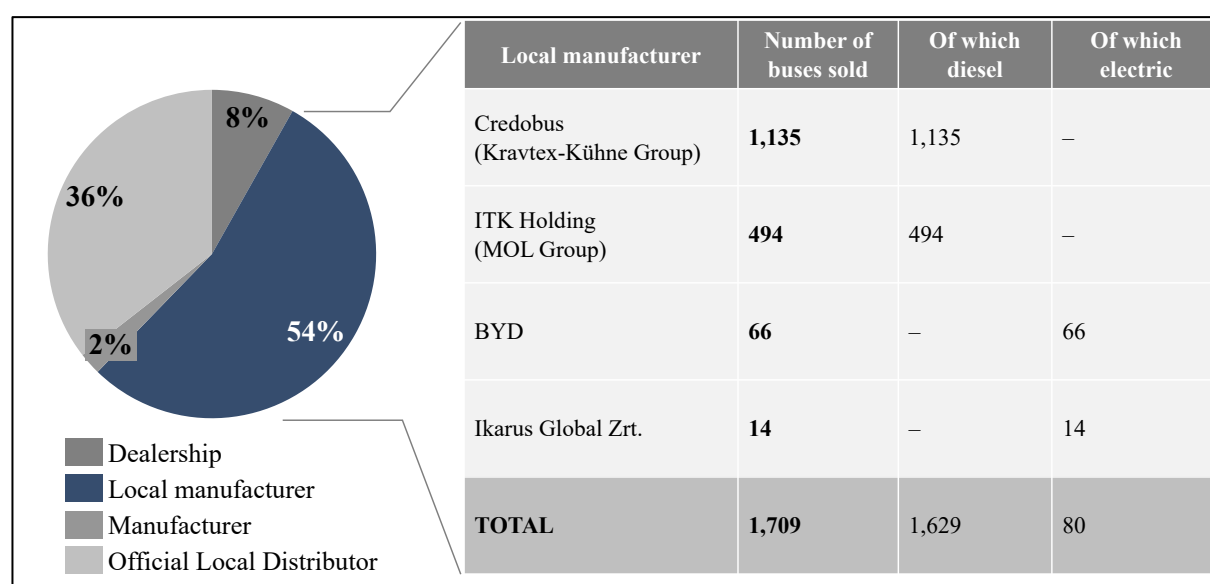


Figure 6: Share of Hungarian manufacturers of total procurements between 2019 and 2023 (own editing)

Over the past five years, Hungarian domestic producers have achieved significant success in the procurement of public buses. During this time frame, the cumulative number of bus acquisitions reached 3,197 vehicles. Regarding the distribution among the successful bidders in the tender, domestic producers manufactured 54% of the total number of buses purchased, which amounted to 1,709 buses overall. These vehicles consisted of Credobuses from Kravtex-Kühne Group, Mercedes buses from ITK Holding, BYD buses from BYD’s factory in Komárom, and Ikarus branded buses from Ikarus Global Zrt.

Regarding the official local distributors, these firms obtained the right to supply a total of 1,222 buses, which accounted for 36% of all procurements. In this segment, MAN Truck and Bus Kft. supplied most vehicles, selling more than 430 buses. Following closely behind were Omnibus Hungária Kft., another subsidiary of MOL Group (the parent firm of ITK Holding), with a sale of more than 250 buses. Third in this ranking was Eco-Tech Vision Kft., the official importer of IVECO buses, as the company managed to sell almost 170 buses.

Concerning the dealerships, these entities supplied the vehicles for 186 tenders, which comprised 8% of the total procurements. In relation to dealerships, there were several successful bidders, primarily specialising in the sale of used or lower cost new buses.

Finally, foreign manufacturing firms contributed 2% of the procurements. Skoda was responsible for all the foreign producer-supplied procurements for new buses. The Czech manufacturers supplied all the 80 vehicles, which were entirely powered by electric propulsion systems.

I was further intrigued by the potential of local producers to achieve success in tenders. Thus, I wanted to understand the factors by which bus suppliers were chosen as tender winner. In the expert interview, Ferenc Horváth (2024) provided a detailed explanation of how procurement procedures operate: *“It is crucial that we cannot issue technological requirements in the tenders as this would limit competition. If we proceeded in this manner, the suppliers would initially raise objections and thereafter would pose questions, thereby indicating that specific criteria impose limitations on the competition. This means that we choose our winners based on their proposed price, warranty, delivery time and the proposed additional equipment. However, the proposed price is the most significant factor for sure”*.

Thus, in the following, besides the evaluation of the performance of Hungarian manufacturers in the performance of procurement tenders, elaborate analysis will be provided on the pricing of domestic producers based on the average sale price of their new buses.

Credobuses by Kravtex-Kühne

Within this period the most successful domestic manufacturer was unquestionably the Kravtex-Kühne Group, with its Credobus brand. The company managed to sell 1,135 buses, from which were all diesel-powered. The main procurer of Credobuses was Volánbusz, the main intercity provider. The total contract value of these procurements amounted to 73 billion forints. Overall, Credobus' sales were the most prominent in the whole period accounting for 36% of total successful procurements.

Credobus (Kravtex-Kühne) <i>(In thousand HUF, 2019-2023)</i>		Diesel	AVERAGE PRICE BY SIZE
Solo 2-axes	Low-entry	63,243	63,243
	Normal-floor	60,286	60,286
Articulated	Low-floor	102,662	102,662
AVERAGE PRICE BY PROPULSION SYSTEM		64,122	64,122

Table 7: Average price of Kravtex-Kühne's Credobuses between 2019 and 2023 (own editing)

The average prices of Credobus' vehicles were below the mean price in the appropriate category. In the Solo 2-axle low entry segment, Credobus had an average selling price of 63 million forints per bus. As a result, the cost of these buses was lower than that of their competitors. Furthermore, the lower purchase price could also be observed when it compared to the mean price of a bus in this category. The average price per bus was one million forints below the mean price of the Solo 2-axle low-floor segment. In the Solo 2-axle normal-floor category, Credobus' average price was \$60 million. Although one dealership provided a lower price for buses for procurement, it is worth mentioning that the specific tender only included 4 buses, compared to the 264 buses delivered by Credobus in this particular segment. Lastly, in the articulated segment of the market, yet again Credobus had the lowest average price of 102 million for one bus, outperforming its competitors, ITK Holding and MAN Truck and Bus Kft.

Mercedes buses by ITK Holding

During the period from 2019 to 2023, the manufacturing subsidiary of ITK Holding, known as Inter Traction Electrics (ITE), accomplished a moderate performance. In this period, the producer of the Mercedes Reform buses provided a total of 494 vehicles, which accounted for 15% of the overall procurements. The acquisitions were valued at about 35 billion forints, highlighting the importance of this company.

Mercedes (ITK Holding) <i>(In thousand HUF, 2019-2023)</i>		Diesel	AVERAGE PRICE BY SIZE
Solo 2-axes	Low-floor	83,430	83,430
	Low-entry	71,988	71,988
	Normal-floor	62,274	62,274
Articulated	Low-floor	106,227	106,227
AVERAGE PRICE BY PROPULSION SYSTEM		118,382	118,382

Table 8: Average price of ITK Holding's Mercedes buses between 2019 and 2023 (own editing)

The average price of Mercedes buses in the Solo 2-axle low-floor segment was the same as the average price of all the vehicles procured in this category. This can be attributable to the fact that between 2019 and 2023, only ITK Holding provided vehicles with diesel-fuelled propulsion systems in this segment, totalling up to 100 buses. In contrast, the Solo-2 axle low-entry version of Mercedes buses of the firm exhibited the highest average price in comparison to competitors. This may be the reason why the volume of sales of Credobuses manufactured by Kravtex-Kühne and IVECO buses manufactured by Eco-Tech Vision Kft. was higher. In comparison to the 80 new buses that were sold by ITK Holding, about 800 new Credobuses and 160 new IVECO buses were acquired between 2019 and 2023. Lastly, the company had the poorest performance in the Solo 2-axle normal-floor segment. The company sold only 5 buses at an average price of 62 million forint, which regardless of being below the average price of the segment could not compete with the price offered by Credobus.

BYD buses by BYD's factory in Komárom

The BYD factory in Komárom successfully produced 66 buses with a value of 10 billion forints for passenger transportation from 2019 to 2023. This represented a minimal 2% of the overall acquisitions. However, it should be noted that other buses with the BYD brand were acquired during that period, but those vehicles were not produced within the country. Although the smaller quantity could be attributed to the plant being in its early stages of development, the production of buses at the facility has significantly grown in the past few years. The primary determinant rather was that the BYD production factory was manufacturing buses for international markets, as the price provided for the vehicles were significantly higher outside of the country. Furthermore, the demand from international operators resulted in a constant sales pipeline for manufacturing factory which also tied up the capacities of the factory. This huge demand could be attributed to the positive experience gained from using BYD buses. Several of my interviewees emphasised the advantages of these vehicles. Ferenc Horváth in the interview conducted in 2024 highlighted: *“When it comes to newer types of electric buses, the battery capacity is larger, which means that they can travel more than 200–250 kilometres on a single charge”*. Furthermore, the senior employee from Arriva emphasised in the expert interview in 2024: *“In my opinion, the BYD bus offers excellent cost-effectiveness. After conducting tests on various bus models, I believe the battery pack is of excellent quality”*.

BYD (In thousand HUF, 2019-2023)		Electric	AVERAGE PRICE BY SIZE
Solo 2-axes	Low-floor	154,210	154,210
AVERAGE PRICE BY PROPULSION SYSTEM		154,210	154,210

Table 9: Average price of BYD buses between 2019 and 2023 (own editing)

Upon the evaluation of the activity of BYD, it was evident that the manufacturer exclusively offered Solo 2-axle low-floor e-buses. Despite the fact that the average price of the 66 vehicles sold was 154 million forints, a larger mean price per bus compared to the price offerings of Ikarus and other competitors, BYD performed second best after Skoda. This higher mean price figure however was not perceived critically by operators as BYD buses possessed higher battery capacity, hence higher range.

Ikarus buses by Ikarus Global Zrt.

The performance of Ikarus Global Zrt. Was the least prosperous among all domestic manufacturers. The company sold only 14 buses, which was a marginal portion of total procurements issued between 2019 and 2023. The total contract value for these vehicles amounted to only 2 billion forints. This low figure can be explained by the firm's previous issues and limited production capability.

Ikarus (Ikarus Global Zrt.) (In thousand HUF, 2019-2023)		Electric	AVERAGE PRICE BY SIZE
Solo 2-axes	Low-floor	148,000	148,000
AVERAGE PRICE BY PROPULSION SYSTEM		148,000	148,000

Table 10: Average price of Ikarus buses between 2019 and 2023 (own editing)

When evaluating the pricing of Ikarus buses, the company had the lowest average price per vehicle in the Solo 2-axle low-floor electric bus class, showing a relatively decent prospect. The average cost of 148 million per bus was lower than the price offered by every other competitor (BYD, Skoda, MAN Truck, and Bus Kft.). Nevertheless, the company's performance was hindered by its restricted production capacity.

IV.5. Possible future trends of bus public procurements in Hungary

Subsequently to the analysis of the performance of domestic manufacturers based on the number of provided vehicles and the proposed prices per bus, I wanted to draw conclusions from the possible future trends that were mentioned by the experts during the conducted

interviews. By understanding these trends, the possible competitiveness of manufacturers can be assessed in the subsequent period.

Name of interviewee	Firm	Possible future trends mentioned
Ferenc Horváth	Volánbusz Zrt.	• Homogenisation of bus fleet • Expansion of electric buses • Appearance of hydrogen-powered buses • Extensive use of Midi buses
Péter Takács, PhD	BKV Zrt.	• Expansion of electric bus • Appearance of hydrogen-powered buses
Ádám Török, PhD	Budapest University of Technology and Economics	• Expansion of electric bus • Appearance of hydrogen-powered buses • Homogenisation of bus fleet • Possibilities of market liberalisation
Dóra Uray	Omnibusz Hungária Kft.	• Expansion of electric buses • Extensive use of Midi buses • Possibilities of market liberalisation
Senior Staff	Arriva Hungary Zrt.	• Extensive use of Midi buses • Expansion of electric buses • Possibilities of market liberalisation

Table 11: Future trends mentioned in the conducted expert interviews (own editing)

In the following, I will evaluate and demonstrate the specifics of five most recurring future trends that were brought up by the individuals who were taken part in the expert interviews.

Homogenisation of bus fleet

Operators in the upcoming period are expected to further homogenise their fleet composition. This tendency has already begun as Volánbusz has initiated the process of consolidating its bus fleet, which privately held corporations such as Arriva have already accomplished. The continuation of this trend is highly probable, particularly for operators with diverse fleet configuration, as there is potential for cost reduction through fleet standardisation. Several respondents referenced the importance of this initiative: *“By homogenising the fleet, we can lower the costs of equipment, the training of the technical staff, the maintenance, and the possible substitution of buses, thus we can operate this much more efficiently”* (Senior staff, Arriva Hungary). *“We managed to homogenise the fleet structure. Our goal was and still is to maintain a fleet consisting of preferably 5–7 different types of vehicles”* (Ferenc Horváth, Head of Vehicle Development at Volánbusz Zrt., 2024).

Extensive use of Midi buses

Midi buses are expected to become more prevalent in the future. Conversely to their lowered purchase price these vehicles can completely fulfil the needs of travelling passengers in smaller towns and the agglomeration. Dóra Uray even added in the conducted interview in 2024: *“We*

urge the utilisation of Midi buses as they would provide a more sustainable alternative for smaller towns where there is less need for 12-metre-long buses. This method is already a best practise in Western Europe". This trend has already commenced, as Volánbusz is in the procurement process of acquiring smaller Midi buses for this purpose. *"We will see how the maintenance and operational costs will look like. We are curious about the effectiveness of this method"* added Ferenc Horváth in the expert interview in 2024.

Possibilities of market liberalisation

In the past years there were attempts of market liberalisation. In mainly the city segment the appearance of private operators have already taken place. On the other hand, this was not the case in the intercity segment, where Volánbusz Zrt. is considered to be the sole operator. This, however, can change in the future. According to the senior staff of Arriva with whom I conducted an expert interview: *"There is a plan that this market liberalisation will begin in 2025 alongside the lines where the separated regional hubs used to operate, and then private operators will be able to come in. This is the plan that has been developed but nothing is sure yet"*.

Expansion of electric buses

The emergence of electric buses is unquestionable. According to Péter Takács in the expert interview (2024): *"Electric vehicles are currently receiving a great deal of attention in the European Union, and the plan is to purchase electric buses in accordance with an existing regulation that specifies how many vehicles must have zero emissions"*. The anticipated increase can further be enunciated by the fact that according to Clean Vehicle Directive issued by the European Union 75% of all vehicles must have an electric propulsion system, explained the senior employee of Arriva. Moreover, in the expert interview with Dóra Uray in 2024, the industry professional further added that: *"I expect a growth in electric bus procurements in the future. This is due to the generous 80% subsidies provided for vehicles in cities with populations over 25,000. However, it is important to note that there is currently no assistance from the European Union, which has temporarily hindered progress. Nevertheless, there are plans to reintroduce support in the future, which would greatly benefit and assist cities"*.

Appearance of hydrogen-powered vehicles

The appearance of hydrogen-powered vehicles can significantly form the public procurements in the future. Although the operational cost of these vehicles is posing substantial problems currently, still this transportation alternative can mean a more sustainable option for passengers

compared to diesel-powered vehicles in longer-haul routes. In contrast of the higher costs, according to the interview with Péter Takács in 2024, the technology could be at service currently as well. However, the main issue is the high magnitude of possible accidents that makes operator immensely precautious. Furthermore, according to Ádám Török the storage of hydrogen is still highly expensive further hardening the expansion of hydrogen-powered buses. Thus, currently electric vehicles possess greater chance compared to hydrogen buses. This view was further shared with the senior staff of Arriva in the expert interview (2024): *“Numerous analyses were undertaken by our company to ascertain the cost of hydrogen fuel, however, our research indicated that electric vehicles remain considerably more affordable than buses equipped with hydrogen propulsion systems”*.

The future of bus procurement in Hungary will be significantly influenced by these mentioned trends. Consequently, domestic manufacturers are required to adjust their production methods to accommodate these indicators and tendencies if they want to advance on the market.

V. Conclusions

V.1. Key findings

In my research, I sought to find the answers to the questions of what kind of public procurement trends influenced the fleet composition and the acquisition of operators, to assess which tender types were most frequent. I also wanted to know the performance of Hungarian manufacturers in these tenders to comprehend their competitiveness and contribution to domestic bus procurements. Lastly, I was curious about the emerging trends that could influence manufacturers. By assessing the possible future requirements of operators, one will be shown how producers can adapt to changes.

Q1: Which public procurement trends have impacted the bus fleet composition of Hungarian operators in recent years?

Regarding the public procurement trends, operators seem to prefer the procurement of diesel buses, as operational costs of these vehicles are significantly lower than the cost of alternatively powered vehicles. According to my interviews, although electric buses started to emerge due to their viewed sustainability, there are many concerns with their day-to-day operation and lifecycle carbon footprint. However, as regulatory requirements urged operators to procure these types of buses the volume of e-buses increased in the previous years.

Another trend which was essential is the expansion of the low-floor buses in urban transport as this design made it easier for passengers (even with special needs to embark and disembark quickly). Thus, in urban procurement tenders bus manufacturers without this vehicle design could not compete essentially.

Furthermore, the homogenisation of fleet could also be observed as procurers were trying to obtain buses of the same type due to lower maintenance and operation costs which resulted in tenders with larger bus volumes. Manufacturers regardless of longer delivery time, wanted to tie up greater capacities to ensure the supply for their procurement needs.

Q2: How did Hungarian manufacturers performed in the tenders issued by the Public Procurement Authority (PPA) of Hungary?

The performance of Hungarian manufacturers varied significantly in the previous years. In contrast of Credobus and to an extent BYD, other domestic producers such as ITK Holding, Ikarus Global did not contribute immensely to the procurements of operators. Credobus was and still is stable bus provider for Volánbusz in the intercity segment, even though that its production capacity is smaller than big foreign manufacturers' (Solaris, MAN, Mercedes, etc.). Regarding BYD, the firm in its target segment's procurements (in the electric bus tenders) performed moderately well, even though its smaller impact on total procurements. On the other hand, the other two companies did not manage to contribute significantly which could be attributed to their considerably smaller production capacity and longer promised delivery time. This issue was further intensified by the lack of financing opportunity and the lack of grants which bigger firms could provide for procurers.

Concerning local manufacturers, in the roundtable talk and the conducted interviews the increasing competitiveness of Credobus was mutually highlighted, which is also observable in their innovative design solutions. However, as the firm's production capacity is fully tied up by Volánbusz, other procurers need to find the vehicles of other manufacturers. Regarding BYD, the firm is one of the most innovative e-bus manufacturers in the globe. In this case, not the lack of competitiveness of the firm resulted in fewer procurement, rather it was due to lack of capacity and the still limited tender volumes. On the other hand, the competitiveness of ITK Holding and Ikarus was drastically lower. These firms were trying to offer viable tender offers even with lowered prices however, they faced immense competition from foreign producers whose stable supply, reliability, and faster delivery times were unmatched for domestic firms. Thus, it can be stated that (apart from Credobus) in most segments Hungarian manufacturers

need to develop their business to be able to compete with foreign producers even in the home market.

Q3: Which emerging trends will influence future procurement processes?

Regarding the trends of the future, five topics were elaborated on based on the interviews of business professionals.

Firstly, the homogenisation of the fleet was mentioned. This trend has already started, but it will continue in the future for operators who do not have the optimal fleet structure. This issue is especially actual for Volánbusz, as although the firm has already started to unify its fleet the operator is still far from the optimal operation. Consequently, in the subsequent years, manufacturer who provided vehicles in the past for the company, can be in advantageous position if they can continue to offer buses with reasonable prices. This can be extremely beneficial to Credobus which already has a great relation with Volánbusz. On contrary, manufacturers such as Ikarus Global or ITK Holding could face greater challenge in tenders, which could hinder the development of these domestic companies.

Secondly, an initiative was revealed by the interviewees that suggested the use of Midi buses in urban and peri-urban regions. Although this trend can be more sustainable for smaller cities, operators have just started to experiment with these buses. Thus, there is little knowledge of the benefits of this operation. However, if this trend emerges, manufacturer who want to supply buses for urban operators must develop their own Midi bus designs. This could be advantageous for BYD and Ikarus Global, as these firms already have Midi models.

Thirdly, market liberalisation was highlighted, which is an ongoing debate in the industry. The liberalisation would create greater competition, therefore unburdening the state, which funds procurement at its own cost. However, this way, the opportunity of providing inexpensive public transport would fade away. In the next few years, therefore, the state's strategic decision to liberalise can change the industry and the business of manufacturers. In the case of market liberalisation, many operators would enter, which would result in an immense increase in bus procurements as private companies would create fleets comprising brand-new buses. This could be worrying for local manufacturers, as larger private operators are likely to procure from the same producers as before to optimise their fleet structure. On the other hand, even if the current form remains, the competitiveness of local manufacturers could decline without governmental grants which further shows the vulnerability of this industry. Thus, government support is needed for these firms to advance.

Fourthly, regarding the propulsion system of the vehicles, in previous years, e-bus procurements increased with the funding of RRF. However, due to the economic and political situation, these funds currently cannot be called for by operators. Thus, the lack of funding can set back the expansion of e-buses which shows how future of electric bus procurement is in jeopardy. This would immensely decrease the competitiveness of Ikarus Global and BYD as these firms only manufacture e-buses. Furthermore, although e-bus vendors are still optimistic about e-buses, operators are less so. After considerable knowledge of the functioning of these vehicles, operators now see the major challenges of operating e-buses. Still, to meet the regulatory requirements, operators need to continue the procurements of eco-friendly buses if funding enables it. In this case Ikarus, BYD, and even Credobus (with its new model) can be in an advantageous position.

Lastly, the appearance of hydrogen buses was assessed. After the discussion with business professionals, it can be highlighted that procurements for these vehicles are not likely to emerge in the subsequent years. Although, hydrogen-powered buses could offer a more environmentally friendly solution compared to diesel vehicles, the safety risks, the high cost of acquisition and operation hinder the expansion of this vehicle type. This enables local manufacturers to focus on other strategic alternatives rather than investing in the development of this technology.

V.2. Limitation of the research

In my research the analysis of public procurements was under investigation, however, these tenders did not include the procurements of private operators, thus this limitation made it difficult to draw definitive conclusions about bus purchases. Private operators do not necessarily reveal their present fleet size or planned bus procurements due to the sensitive nature of the information.

Another factor that hindered this research is the divergence of opinions among experts concerning propulsion systems. Despite the long-standing presence of electric buses, numerous technological inquiries remain unresolved. That is the reason why experts are uncertain about the potential prospects of electric bus transportation. In addition, the usage of hydrogen technology contributes to the existing uncertainty, as the implementation of this relatively novel technology in public transportation is now being tested.

Ultimately, the future trajectory of public procurements is significantly shaped by the accessibility of financial prospects. The reliance on government initiatives and the restricted

availability of EU funding further may hinder the forecast of future trends and opportunities for bus procurement. Therefore, predicting bus procurement trends is a challenging task.

V.3. Future prospects

V.3.1. Applicability of results

The content of this research could also provide valuable insights into the competitive landscape and performance of players in the Hungarian procurement tenders. Understanding the major drivers of public procurement procedures for the different types of buses can help companies tailor their product offerings to better meet the needs of various markets.

Furthermore, the analysis of the prices offered by bus, segment, and propulsion systems and the assessment of current trends can provide insights for bus manufacturers to thrive on the market in the upcoming years.

V.3.2. Future research proposals

One potential area for future research is to analyse the technological benefits and obstacles associated with the acquired buses to gain a deeper knowledge of the distinctive features that make bus brands stand out. Furthermore, this study could entail a more intricate evaluation of manufacturers and distributors, focusing on their production and operation costs.

On the other hand, it could be useful to evaluate the export performance of Hungarian manufacturers (especially in the case of BYD) to gain a comprehensive understanding of their success in international markets. As the offered purchase price for buses in foreign markets is higher, exporting buses can enhance the opportunities for the firm. Thus, analysing the export capabilities as well could shed light on the overall performance of domestic producers.

In addition, the incorporation of minibuses and trolleybuses in the public procurement analysis might contribute to a more thorough comprehension of the Hungarian public transport industry. By conducting this investigation that incorporates these specific vehicle types, it would be possible to assess the performance of suppliers more accurately in public tenders.

V.4. Summary

To summarise, this thesis discussed the evolution of bus procurements in Hungary and their impact on the performance of the domestic bus manufacturing industry. In addition, possible future trends were assessed to showcase what Hungarian manufacturers may need to adapt to in the public transport sector.

After analysing the historical public procurements, it can be observed that domestic manufacturers face fierce competition. Regarding the local firms, it seems that currently only Credobus can provide for operators on larger scales. Others, such as BYD, ITK Holding, and Ikarus Global, further need improvements to gain procurement tenders in the country.

The research further identified significant trends that meaningfully influence the future of procurement. These trends were concerning the spread of electric, hydrogen-powered, and Midi buses, the possibility of market liberalisation, and the homogenisation of the fleet structure, to which local manufacturers need to adapt if they want to increase their competitiveness.

Lastly, at the end of the thesis, the limitations of the research were assessed, while the applicability and future prospects were also elaborated on.

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VII. Annexes

VII.1. Vehicle categorisation details

Categorisation	Classification	Examples
Category L (passenger or goods transport vehicles)	Motor vehicles less than 550 kg	<i>Mopeds, Motorcycles, Quads, Minicars</i>
Category M (passenger transport vehicles)	Power-driven vehicles having at least four wheels and used for the carriage of passengers	<i>Cars, Minivans, Campers, Minibuses, Buses, Coaches, Trolleybuses</i>
Category N (goods transport vehicles)	Power-driven vehicles having at least four wheels and used for the carriage of goods	<i>Vans, Pick-up trucks, Lorries, Trucks</i>
Category O (passenger or goods transport vehicles)	Trailers, towed by another vehicle	<i>Trailers, Semi-trailers</i>
Category T (agricultural vehicles)	Agricultural or forestry vehicle with a minimum of two axles and a maximum design speed of 6 km/h	<i>Tractors, Combine harvesters</i>
Category R (agricultural vehicles)	Designed primarily for towing by a tractor, intended mainly to carry loads and process materials	<i>Forage transport wagons, Manure spreaders, Loader wagons</i>
Category S (agricultural vehicles)	Interchangeable towed equipment that adds to the functions of the towing vehicle	<i>Seeders, Soil preparators, Round balers, Bale wrappers</i>
Category G (passenger or goods transport vehicles)	M and N type vehicles with specific modification for off-road transportation	<i>Specialised off-road vehicles, Dirt bikes, Dune buggies, Sandrails</i>

Vehicle categorisation (own editing, based on: CEMA, 2019; Economic and Social Council, 2017)

VII.2. Glossary

ACEA – European Automobile Manufacturers Association

ATV – all-terrain vehicle

BKK – Budapesti Közlekedési Központ (Centre for Budapest Transport)

BKV – Budapest Közlekedési Zrt. (Budapest Transit PLC)

CNG – compressed natural gas

DKV – DKV Debreceni Közlekedési Zrt. (DKV Debrecen Transit PLC)

EU – European Union

EV – electric vehicle

GGE – gasoline gallon equivalent

GVM – gross vehicle mass

HUF – Hungarian Forints

HUMDA – Hungarian Mobility Development Agency

ICE – internal combustion engine

ICT – information and communication technology

ITM – Innovációs és Technológia Minisztérium (Ministry of Innovation and Technology)

LNG – liquified natural gas

MÁV – MÁV-VOLÁN Group

MVK – Miskolc Városi Közlekedési Zrt. (Miskolc Transit PLC)

NABI – North American Bus Industries

PPA – Közbeszerzési Hatóság (Public Procurement Authority of Hungary)

PP – public procurement

RRF – Recovery and Resilience Facility

TED – Tenders Electronic Daily

TFT – thin film transistor

UTV – Utility-task vehicles

VII.3. Interview questions

Interview questions for manufacturers

- In which specific public transport segment are you currently concentrating your efforts to expand on the market?
 - Domestic or export market
 - Production and sales of buses that are specifically designed for use in public transportation (focus tendency on electric and hybrid buses)
- How are supplier and partner relationships effectively managed to provide a solid supply chain for production?
- What strategies are you using to enhance the company's agility in adapting to shifting market conditions, such as regulatory modifications and funding alternatives?
- What strategies do you employ to distinguish their products from competitors in the market?
- What is your current primary obstacle?
 - The emergence and growth of China's bus manufacturers?

- Characteristics of Hungarian bus operations?
- Rising competition in the manufacturing and sales?

Interview questions for manufacturers

- What qualities are desirable when procuring buses?
 - Categorisation by bus size (including mini, midi, two-axle, three-axle, and articulated buses)
 - Floor type alternatives (low-floor, low-entry, normal-floor, and raised-floor)
 - Propulsion system (electric, diesel, hybrid, hydrogen)
- Which fleet optimization techniques is your company currently implementing?
 - Choice between a heterogenous or homogenous fleet
 - Acquisition of used or new vehicles
- What are the procedures for bus procurement tenders?
 - Bus procurement tender frequency
 - Bus procurement tender volumes
- What are the benefits and drawbacks of purchasing buses from domestic and international bus manufacturers?
- What are the challenges you face in their day-to-day operations?
 - Regulatory initiatives and modifications to rules
 - Collaboration with manufacturers
 - Procurement financing
- What are the anticipated trends in the acquisition and manufacturing of buses in the future?