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TRADITIONAL AND LIGHT COMMERCIAL VEHICLES SHARING TRANSPORT IN THE CITY –COST ASSESSMENT

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Abstract

The article is devoted to the assessment of the cost-effectiveness of using light commercial vehicles sharing (LCV-sharing) method in urban transport. The fast growing population of the world (7.6 bn), the increasing urbanization exemplified by the increasing number of cities over one million inhabitants and megacities with over ten million inhabitants (33) results in growing number of cars and congestion, emission and concentration of GHG, noise and air pollution are becoming global concerns. Due to the assumption of sharing economy, progressive congestion and air pollution in the city of Poznań, the authors decided to look at the LCV-sharing possibilities in that city. Simulation of transport costs, as a main method used in this paper, was adopted in the conditions of purchasing own fleet of vehicles (for cash or leased) in comparison to using shared vehicles. Research results indicate that self-transport is profitable after exceeding a certain scale and frequency of freight transport. Authors drew the attention to the problem of advertising this type of sharing possibilities in the society, especially between entrepreneurs, and the problem of the cost of LCV-sharing.

Keywords: City logistics, LCV sharing, transport feasibility study, cargo transport in the city.

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1. Introduction

Currently, it is developing dynamically, and even can be said - it becomes fashionable, shared transport. There are many reasons for this, among which one of the most important is the protection of the natural environment. From an economic point of view, the first question arises whether the so-called LCV-sharing (light commercial vehicles sharing) is profitable. This question is the central problem of this study. The method of simulating transport costs was adopted in the conditions of purchasing own fleet of vehicles in comparison to using shared vehicles. The simulation was carried out on the basis of real investment and price rates in the city of Poznań.

To avoid misunderstanding of terminology for this article, it was assumed that LCV is a commercial vehicle with a gross vehicle weight, but no more than 3.5 tonnes.

The study consists of three parts. The first one is devoted to the identification and characterization of LCV-sharing reasons. The second part is the presentation of the assumptions of the sharing economy as justification for LCV-sharing. The third part presents the results of simulation analysis.

2. Literature Review and Theoretical Framework

2.1. The essence and causes of LCV-sharing

There are more than 7.6 billion people living all over the world nowadays, out of which 55% live in cities. Not only do new cities keep emerging, but the existing ones grow larger. Between 2000 and 2018 the number of cities exceeding a million of inhabitants grew from 371 to 548, and the number of those exceeding 10 million grew from 16 to 33. These changes are mostly visible in Asia and Africa where urbanization processes are the fastest (UN, 2018). Large city areas such as the Chinese Shenzhen founded in 1978 and now totaling 12 million inhabitants (by the way, partner city of Poznań) can serve as an example. Already at the end of 2017, as the world's first mega-city it operated exclusively electrical city buses (16 thousand in total, the majority of them being battery electric vehicles – BEVs) and taxis, out of which nearly 99% (almost 22 thousand cars) are purely electric. There are 30 more Chinese cities wishing to implement similar solutions with respect to city buses already in 2020 (Keegan, 2018). Shenzhen residents also benefit of a very well developed underground network (launched in 2004) consisting of 8 lines and ca. 300 km, which keeps growing fast (Shenzhen Metro, 2019). Despite all this, motorization rate keeps growing. The increase can be observed in all vehicle categories, but mostly in passenger cars, trucks and lorries. In the last decades, all over China the number of registered cars grew three times from 76 to 240 million (Statista, 2019). Despite numerous restrictions, already in 2015 in Shenzhen alone there were ca. 300 passenger cars per 1000 inhabitants approaching fast the motorization rates of European cities (Manz, 2017, p.16). Despite enormous expenses in the development of road transport infrastructure, the supply does not meet the snowballing demand especially during rush hours, which inevitable leads to traffic congestion.

Traffic congestion is a problem with which the majority of cities struggle nowadays, but it mostly touches the largest, the most active and highly motorized ones. The most significant costs of traffic congestion includes time loss and losses resulting from its changeable character and unpredictability. According to INRIX that in 2018 researched more than 200 largest cities in Europe and both Americas

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(unfortunately there is no data for Asian cities), mean time lost per driver of a passenger car exclusively in the rush hours reached as many as 272 hours yearly in Bogota. Rome (254 h), Paris (237 h), London (227h) or Warsaw (173 h) did not fare much better than that. With such high levels of traffic congestion, mean driving speed in city centre drops to just a dozen or so km/h (e.g. 11 km/h in London). As a consequence, inhabitants of these cities in fact loose large amounts of money. Yearly costs of time lost as a result of traffic congestion in Great Britain are estimated at 7.9 billion pounds a year i.e. ca. 1300 pounds per driver (INRIX, 2019, p. 4-15). Increased car operation costs, especially fuel consumption and thus additional emissions should be added to this. Low efficiency of supplies in the cities, with largely increasing e-commerce volumes, force among others courier companies to invest in new vehicles and staff operating them. This in turn additionally increases congestion levels because of poorly developed (un)loading infrastructure in many cities which causes delivery trucks to block road lanes. Traffic congestion also increases stress levels and decreases psychophysical capacities of transport users and other inhabitants of the city, thus lowering the quality of life. As a result many move to the suburbs. This in turn, increases demand for transport, changing its mode from public to individual transport, which in consequence increases congestion levels even more as jobs migrate slower and less than the inhabitants do (OECD, 2018).

Of course the list of unfavourable transport's external effects is far from exclusive. Transport constitutes one of the most significant sources of air pollution, especially in developed countries where the number and emissions from other sources keep falling gradually. Particulate matters, nitrogen oxides, the carcinogenic benzo(a)pyrene and other count among the most dangerous substances for city inhabitants. London can serve as an excellent example as according to expert calculations commissioned by Transport for London, 9400 people yearly die prematurely with transport being the largest contributor to these deaths (TfL, 2019). According to EEA estimates, in 2015 in the whole EU as many as 470 thousand people died, including ca. 46 thousand in Poland, just due to two pollutants: particulate matters and nitrogen oxides (EEA, 2018, p. 64).

City transport also constitutes a significant source of noise that negatively influences our comfort, makes relaxation difficult, contributes to loss in work efficiency and to health damage in long-term perspective. Increased noise levels also contribute to loss in real-estate value.

Finally, transport is a significant emitter of greenhouse gases. Dependency of this industry on oil-derivative fuels is estimated at 95% worldwide, which translates into ca. 1/4 of total CO_2 emissions from fossil fuels. In developed countries this percentage is even higher. Regardless of location, road transport has the largest share in these emissions e.g. in 2016 in the EU it reached nearly 72% (EU, 2018, p. 151). Anthropogenic emissions of CO_2 constitute a real civilization threat as they lead to an increase in mean temperatures, which in turn results in rising the frequency of natural calamities (e.g. droughts, floors, cyclones), shifting climate zones, increased extinction rates of species and raising see levels (Masson-Delmotte, 2018, p. 183-271). It is especially the last process that is of key importance for nearly half of the world's population living in seaside areas, especially for the inhabitants of 13 of the 20 largest cities located directly at the seaside. The above-mentioned processes keep accelerating with respect to observations done just a couple of decades ago, but the real increase in their dynamics is forecasted once CO_2 concentration in the atmosphere exceeds 450 ppm (parts per million). With this level, mean global temperature will increase by ca. 1.5°C when compared to pre-industry era and according to the majority

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of experts this is the maximum level allowing for stabilizing the climate and saving the world from a global catastrophe. However, to do this, greenhouse gas emissions need to be immediately limited. This task is extremely difficult because of the fact that emissions keep growing steadily and in December 2018 global mean CO_2 concentration reached 409.4 ppm (NOAA, 2019). With this growth rate recorded in the 21st century and the ever-growing emissions, there are just a couple of years left before reaching the 450 ppm threshold. Therefore, intense actions towards reduction in emissions need to be taken now, especially in transport, with one of the solutions with best perspectives being vehicle sharing.

2.2. LCV - sharing as the element of the sharing economy

According to English Oxford Living Dictionaries, sharing economy is „An economic system in which assets or services are shared between private individuals, either free or for a fee, typically by means of the Internet" (Oxford dictionaries, 2016). This system consists in starting goods recirculation, increasing the use of assets, exchanging services and sharing production potentials (Schor, 2016). An example of recirculation of goods may be so-called bookcrossing box, that is, public wardrobes or bookshelves that anyone can put books on (sometimes a specific genre for which the bookshelf is dedicated) and take away books placed by another person. The book is not stored in a private library, but is read by subsequent users. An example of increasing the use of assets is the joint use of vehicles (carsharing), primarily passenger cars, to move from their place of residence usually to the workplace. It is a kind of a neighborly agreement to use only one vehicle instead of several for individual passengers. It is also possible to take financial advantage of group travel for a longer distance. Then, the most common mating of passengers takes place using social media platforms. Mutual exchange of services usually takes place in the form of so-called time banks. For example, in free time, someone washes a window at another person, and this one, in a way, repays this service in his free time by giving a child a private tuition. Finally, sharing production potential can consist of paid or free permission to use tools or machines for anyone who wants to do some work, usually not necessarily for their own needs. These are, of course, only examples whose list could undoubtedly be significantly extended. He points out that sharing economy projects can be both commercial and non-commercial. In the first case, they can rely either on the intermediation of transactions between their parties and the remuneration is then the commission (example of Airbnb), or on the direct conclusion of contracts at a fixed price (Zipcar example). If the sharing economy projects are non-commercial, they rely either on barter and direct exchange of goods or services (for example, time banks), or on creating opportunities for such exchange (example of a cross-box) (Schor, 2016).

The report prepared by the consulting company Ernst and Young gives the following factors as reasons and benefits of the dynamic development of the sharing economy (The rise…, 2015):

- More use of available resources. Opening the business potential of various institutions to ideas and use by innovative and motivated people allows for better adjustment of supply offers to effective demand. Thanks to this, also unprofitable stocks of finished products are liquidated.
- Creating new jobs. In particular, enterprises can react much faster to changes in demand, which allows for more intensive use of live work, including more frequent employment of employees. Job opportunities appear even in regions where employment has so far been difficult to find.

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- Increasing social mobility. Opening the possibility of using the existing business potential triggers entrepreneurship and innovation of many people. In this way, a large group of micro-entrepreneurs emerge who start their own business activity on the basis of self employment.
- Support for competence development. Professional and economic activation creates opportunities for gathering experience and motivates people to improve their skills through education and professional training.
- Creation of more favorable conditions for business. It is easier for entrepreneurs to change their ideas for finished products. In turn, customers have the opportunity to find an offer that meets their requirements easier.
- Construction of transparent business activity and financial settlements. Contractual transactions and barter exchanges take place under conditions of full disclosure and none of the contract's throne is in a privileged position vis-a-vis the other.

The sharing economy undoubtedly allows for the implementation of many socially positive effects. You can include them (Schor, 2016):

- Reduction of demand for new products thanks to the dynamic development of secondary markets. Many products can be re-used by subsequent users, thanks to which the costs of obtaining them decrease, ie products become available to a much larger number of consumers. The secondary market can also facilitate the recycling of manufactured goods and the recovery of valuable resources for re-use.
- Greater care for the environment. Extending the life cycle of products results in a reduction in the scale of their production. The natural result is the reduction of greenhouse gases and all substances harmful to the natural environment. The consumption of non-renewable resources is also decreasing.
- Strengthening social capital, thanks to the creation of opportunities and the need to cooperate with people sometimes geographically distant from each other. Communities become more integrated, which triggers inclusion processes and eliminates the conditions for excluding some people or entire social groups.
- It encourages the use of information and communication technologies, which are necessary to establish information links between individual people and their communities. Facilitation of mutual agreement directly affects the reduction of transaction costs in the course of establishing economic cooperation between people and enterprises.
- It allows the emergence of innovative businesses that turn out to be fairer and more democratic. These businesses also have greater ease in cheap and fast adaptation to the changing demand requirements in the markets.

The above statement quite unequivocally suggests that the sharing economy can be an effective way of realizing the values promoted by the concept of sustainable development and taking account of social responsibility by business.

It is noted, however, that along with the practices of the sharing economy there are a number of problems that need to be resolved, namely (Malhotra & Van Alstyne, 2014):

- Potential conflict between short-term and long-term users. The result may be a reduction in investment growth in capital-intensive assets, the financial return of which requires long

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periods. Price drops may lead to the lack of interest in financing such investments by traditional investors. The logic of sharing economy activities leads to price setting at the level that covers the marginal costs of consumption of the offered goods and services. Potential solutions may be crowdfunding. Investors can settle for the title of joint ownership or the right of free use of the generated assets.

- Potential conflict between primary producers and users from the secondary market. Although products prolong their life cycle thanks to sharing, their original producers lose the possibility of acquiring new customers, which means they lose potential sales revenues. This forces them to constantly improve the product, only that the financing of research and development is low.
- Easiness of formulating false opinions on the Internet. It's both positive and negative. Both categories of reviews may not be truthful.
- The ability to provide certain services or the production of certain goods by individuals or companies that do not have the right to do so. This applies to those products that require special certification or inspection.
- Decreasing possibilities of financing state or regional budgets. The distribution of barter transactions prevents the fiscal registration of transactions. As a consequence, there may be a problem with financing public expenditure.

A review of these few potential difficulties generated by the sharing economy practices leads to the conclusion that the entire organization of social life should ultimately be redesigned. The fiscal system and methods of budgeting state or local government expenditures must also adapt to the new economic model.

The inevitable character of the changes that will have to take place results from the growth rate of the sharing economy. According to the PwC report, these activities in 2013 were worth USD 15 billion globally, forecasts show that by 2025 it will be 335 billion (The sharing…, 2016).

Against this background, it becomes understandable why the sharing of goods transport has positive development prospects. According to research in Europe and the USA, about 25% of trucks drive unloaded, and those with a load usually use only 50% of their payload (The Sharing economy, 2016). A simple bill proves that over 60% of trucks are available for use. As a consequence, you can expect a smaller number of cars on the road, less congestion, less pollution, and due to less demand for cars - generally a smaller ecological footprint.

3. Research Method

The sharing economy is becoming more and more important not only in the sphere of satisfying the needs of the consumer, but now it is also important for the supplier of products or services. Changes in the consumption model will force changes in the way companies are run, adapting them to the requirements of the modern consumption model, in which the concept of ownership is rejected and replaced with the concept of use. When observing market trends, it can be noticed that business representatives point to the sharing economy as one of the factors which will lead to the creation of new services or will significantly affect the enterprises themselves (DHL 2018/19, p. 15, PWC 2019, p. 4)

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One of the paradigms of the sharing economy is the change in the structure of assets on the part of the consumer, and increasingly on the part of the producer or distributor. In the traditional approach, enterprises and consumers were the owners of assets (they were asset heavy), whereas the principle of the sharing economy is their use - access to them on an asset-as-a-service basis (being asset light). The idea of cargo sharing is a response to the challenges of the new approach to owning assets. The analysis was aimed at answering whether it is profitable in the long-term perspective.

A comparison of the costs of using a shared vehicle purchased for cash and one obtained under a leasing contract is possible only if a common denominator has been found. For the purpose of this study, the common denominator that was chosen is the cost of using the vehicle for one day and it is dependent on the number of travelled kilometers. Due to the cost of a shared vehicle based on the time of use, i.e. the first fifty kilometers free of charge within the time of use, and additional charge for a higher number of kilometers travelled, it was necessary to calculate the cost of use per kilometer. For this purpose, it was assumed that the average speed in the city of Poznań is 41 [km/h] (Korkowo, 2017). The following assumptions were adopted to determine the costs of using a purchased vehicle: the depreciation period of the fixed asset - three years, insurance, one set of winter tires and obligatory services in the authorized service station. In the case of purchase of a fixed asset, no expenses related to the replacement of, for instance, brake pads or the need to replenish the consumable fluids were taken into account.

Data preparation was related to the choice of the provider of the LCV sharing solution on the Poznań market and the analysis of its fleet and the price list. Two traditional forms of obtaining assets from the market were chosen as a reference point. The purchase for cash and the leasing of the means of transport were selected. Analysis of the CityBee offer (2019) consisted in the analysis of the price list and the offered vehicles. The vehicle selected for the purpose of the analysis was a Fiat Ducato van L4H2 2.3 MJ II 130 HP, wheelbase 4035 [mm] equipped with a rear view camera and rear parking sensors, with the following cargo space parameters (h x w x d): 1932 x 1870 (1422) x 3705 [mm], the total capacity of the cargo compartment is 13 [m3]. In order to obtain the vehicle price and a leasing offer, an interview with a Fiat dealer was conducted.

4. Findings

The idea behind LCV sharing is sharing assets with other users so it must be limited in time. In the case of daily transport needs limited by time below than 3 hours and 51 minutes, and travelling less than 145 km during that time, it is economically justified (Figure 01) as the cost will be lower than for the use of the purchased means of transport. The need to use the vehicle for more than the above-mentioned 3 hours and 51 minutes justifies the purchase of the means of transport. It is worth mentioning that the analysis was carried out taking into account the maximum use of the rented means of transport.

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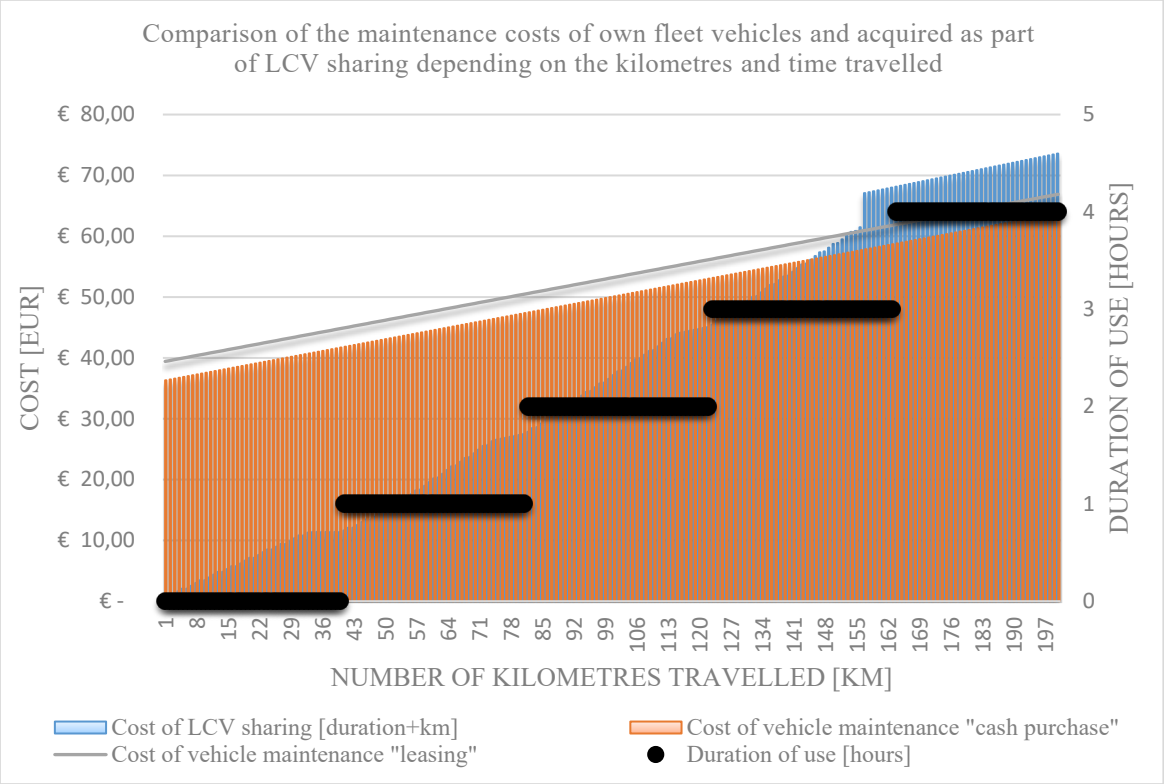

Figure 01. Comparison of the maintenance costs of own fleet vehicles and obtained as part of LCV sharing depending on the kilometres and time travelled.

LCV sharing consists in sharing assets, which is clearly indicated by the analysis of the costs of obtaining a vehicle and it is possible with a short period of use per day. Estimation of costs in the long term - a month - showed that the cost of this form of obtaining a means of transport will be higher than in the case of purchase of a vehicle (Figure 02). Estimated cost of using the vehicle, assuming that every day we can drive 50 kilometres included in price, it about EUR 1200,01. For comparison, the cost of using a vehicle purchased for cash or leasing, assuming additional costs to cover 50 kilometres a day and full depreciation over a period of 3 years, is respectively EUR 930,64 and EUR 993,69 per month.

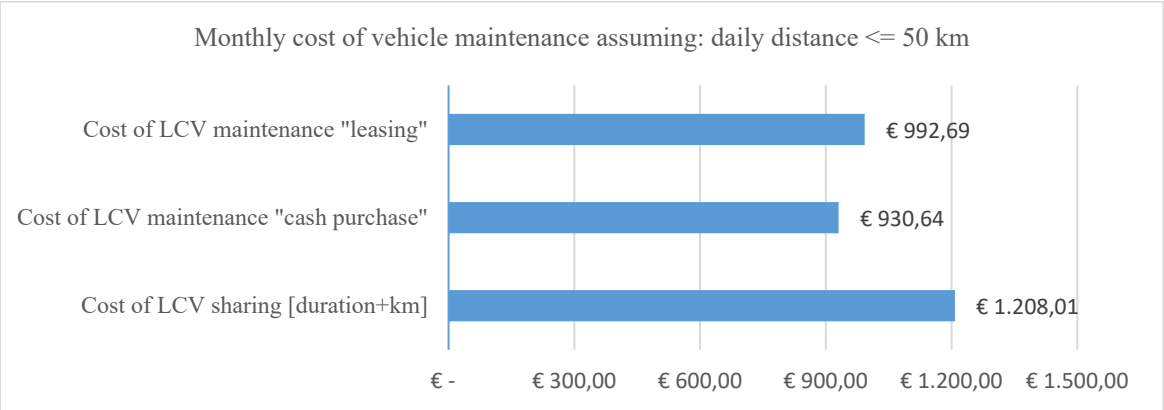

Figure 02. Monthly cost of vehicle maintenance assuming: daily distance = 50 [km]

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The calculations indicate that the economic operator who would like to gain access to the delivery vehicle in this way should conduct a detailed analysis in the scope of:

- transport needs, the type of required vehicle,
- the time of use of the means of transport,
- structure of the working week (is the vehicle required on all days),
- the number of kilometres travelled per a day.

After building the appropriate mathematical model and after calculations, this will allow for taking the most advantageous decision.

5. Conclusion and Discussions

As you can see from the above simulation analysis, LCV-sharing is not a universal recipe for the civilization and ecological problems of modern cities. From an economic point of view, LCV-sharing becomes profitable for the enterprise only if the transportation needs are limited. Taking the assumptions the sharing economy principals, the price should much more lower. Perhaps the price could be lower when more entrepreneurs will use LCV-sharing.

One can of course ask a question about the directions of transport policy of cities and entire countries, to create such conditions that will modify today's parameters of cost calculation in enterprises. This is probably another task to do.

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