

Using Cargo Bikes in Personal Logistics – Conditions and Possibilities in the Czech Republic

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Abstract

This paper analyses the possibilities to integrate cargo bikes into personal logistics in the Czech Republic. Cargo bikes for personal use are relatively popular in some European countries, such as Netherlands, Denmark, and Germany, also including sharing systems. In the Czech Republic, this kind of use cargo bikes is sporadic. The most common purpose to use cargo bike, is transport of children and shopping. This paper deals with factors, which can influence the level of the use cargo bikes in various conditions.

On the example of the city of Pardubice, the model of the use of cargo bikes for shopping will be created and the efficiency of this kind of transport will be compared with the use of cars.

KEY WORDS: *cargo bikes; personal logistics,*

1. Introduction

The use of cargo bikes for personal purposes in Europe has been on the rise in recent years. This applies especially to countries where cycling has a long tradition, and the bicycle is perceived by the population as a common means of transport. In addition to private ownership of cargo bikes, bike sharing systems and cargo bike rentals are also becoming increasingly popular.

A survey of 38 truck wheel manufacturers [1] conducted in 2021 shows up to a 66% year-on-year increase in cargo bike sales, mainly in Belgium, Germany, and France. Most cargo bikes were sold in Germany (103,000 in total, 124 per 100,000 inhabitants), while Denmark leads sales per 100,000 inhabitants (25,000 in total, 429 per 100,000 inhabitants). The increasing availability of e-bikes may be one of the important factors in this growth. Manufacturers report up to 92% share of e-bikes in total cargo bike sales in Europe. ZIV reports about 72 % share of sales of electric models within Germany [19]. The COVID-19 pandemic also appears to have had an impact on the increase in cycling traffic in some countries [4, 13], including the use of cargo bikes. Another factor is the possibility of obtaining subsidies related to climate protection for the purchase of cargo bikes in some countries (regions). Sales prices currently start at about 1500 Eur per bike with mechanical drive and about 2000 Eur per bike with electric drive. Buying your own bike may not always be economically advantageous, especially for people who would not use a cargo bike daily, even if they are inclined to bicycle traffic. In this case, there is significant potential for the use of shared cargo bikes [2, 7]. Bike sharing systems are already relatively well established practically throughout Europe. Cargo bike sharing systems are mainly widespread in countries with a traditionally high share of cycling, such as Germany, where these systems operate in more than 150 cities [14].

The analysis shows that there are some regional differences in the sales and use of cargo bikes. The motivation to use a cargo bike is very closely related to the perception of cycling transport in the certain region and to the linked background and support. In the context of current trends in sustainable mobility and reducing environmental burdens (CO₂ emissions), cargo bikes for personal use are important in the micromobility sector. Cargo bikes for commercial use are considered to be an environmentally friendly means of transport, especially for last-mile delivery [18]. The quality of transport infrastructure also has a significant impact on the level of use of cargo bikes [2, 8]. Traditional "cycling-friendly" countries such as Denmark, the Netherlands or Germany support the use of cargo bikes directly, e.g., in the form of subsidies and project financing, but also indirectly, e.g., through transport measures in cities. The bike is a common part of daily activities, such as trips to school, work, shopping, and the level of infrastructure corresponds to this trend. Cargo bike can even be perceived as a symbol of a certain social status, but this also entails negative consequences in the form of a differentiation of opinion in society [3]. In countries strongly focused on individual motoring, such as the US or Australia, the motivation to use bicycles is lower in the adult population. However, studies suggest that even in these communities, cargo bikes have the potential to replace some car trips [5, 12, 17].

2. Analysis of factors influencing private use of cargo bikes

The Czech Republic is quite specific in residents' relation to cargo bikes and cycling in general. The bicycle is perceived here mainly as a means for sports and recreation, although there are some regional differences. Surveys from the period 2020-2021 show that the "pandemic" trend of increasing bicycle traffic has had very little effect in the Czech Republic.[9] Demand for e-bikes has increased, but cargo bikes are still on the fringes of interest. [10]. In 2021, a cargo

bike rental company operated in a test project in the city of Brno. The results of the project indicate that there was interest in this mode of transport in the city of Brno [15]., but it should also be considered that the system was free.

The question is therefore: “What is the potential for the use of cargo bikes in the Czech Republic and what are the possibilities/factors of increasing interest in this mode of transport?”

The main criteria for the transport mode choice can be divided into three basic groups:

- Objective – criteria that can be quantified and can be used to clearly compare different modes of transport – e.g., cost, travel time.
- Subjective – criteria that cannot always be quantified. The user evaluates them himself based on experience (often transferred), possibilities and abilities. Decision-making is often influenced by current feelings or moods.
- Social – e.g., low ecological footprint, low road wear, low externalities, healthier populations.

If the user decides what mode of transport to use before travelling, his subjective criteria may often outweigh the objective criteria in the evaluation. If we would like the user to take more account of the social criteria, it is necessary for him to consider them as his own. Essentially, it is a "relocation" of the criterion from the social group to the subjective group. This is possible only by education, explanation, and ideally from an early age. It is important for children to "embrace" that it is normal to walk, ride a bike, use public transport. If a young person learns to use a bicycle to move from an early age, he/she will also be able to use it, for example, for shopping trips. It is also important to see the bicycle as an equal alternative to the second car in the household.

If we want cargo bikes to be taken into account as an alternative to a car, it must be accepted that the user wants to satisfy his needs:

- immediately and always – it is therefore necessary for the user to have the cargo bike available for 24 hours,
- anywhere,
- with the least possible time required,
- with maximum comfort,
- risk-free,
- with the lowest possible price for transport.

From the user's point of view, it is therefore important to either own the bike or be able to share it in an acceptable availability and at acceptable prices. Furthermore, the quality of the transport infrastructure for cargo bikes is very important (see Section 3).

It is also important to consider the elasticity of demand, i.e., how quickly the demand for cargo bike trips can change in response to a change in entry conditions. Currently, the growth of the price of fuel, respectively price elasticity, may have a positive effect to using a cargo bike. However, other factors also play an important role in transport, most notably travel time. Thus, elasticity manifests itself as cross-shaped elasticity, not its own.

To decide which mode of transport to use, the user must know his possibilities and the resulting utility. The deterministic part of the utility (travel time, charges, fares, etc.) can be described by a linear function. The stochastic part of the utility then reflects the user's personal preferences. From the user's point of view, the utility of choosing a mode of transport is reflected in the so-called user equilibrium, i.e., the state when the user achieves the lowest costs (these costs reflect all the costs associated with the choice of mode of transport).

3. Model example of the use of cargo bikes for shopping in the city of Pardubice

The city of Pardubice lies in a lowland, total area is 83.6 km² and the population was 91,755 in 2021.

A survey of traffic behavior conducted in Pardubice before the coronavirus pandemic [11] confirmed that individual modes of transport are used equally (car transport accounts for 33%, public transport 22%, cycling 14% and pedestrian transport 31%). The city of Pardubice is close to the ideal of a "city of short distances", so the traffic behavior of the city's inhabitants and visitors fulfills the goals of the transport strategies of western European cities.

The survey revealed other important information. More than half (54%) of all journeys is shorter than 3 km and more than half (54%) of journeys up to 3 km is made on foot. At the same time, the inhabitants of the city themselves generate almost half of the car traffic. Switching from a car to a bicycle or public transport for journeys up to 3 km would mean a fifth reduction in the traffic from cars in this distance.

The city of Pardubice still lacks important parts of the infrastructure for car traffic, especially parts of the NE and SE bypasses. The existing system of roads consists of a cross centered in the city center. An important limiting factor in the construction of roads are the rivers that flow through the city. Users of cars must count on delays in queues during rush hours.

The city has a relatively extensive infrastructure for cyclists, which is very often based on the minimum dimensions defined in TP 179 (technical regulation). The dimensions of the dedicated and protective bike lanes and the lanes within the cycle paths thus suit only the cargo bikes of smaller size. It is the infrastructure tailored to the users that will significantly affect the use of certain transport mode. Its integrity, surface quality, etc. are important. However, a feeling of safety, the possibility of comfortable driving, free movement is also very important. For this reason, it is advisable not only to widen the cycling infrastructure with other sections, but also to improve the existing parameters. An example is in the city of Berlin. [16]. The bicycle lines also include protective pillars that separate a sufficiently wide space for cyclists from the area for motor traffic.

Space for cyclists can also be gained at the expense of space for motor transport. The necessary width of the lane is related not only to the size of the vehicle, but also to the speed limit. For a car, a lane width of 2.40 m is required at a speed of 50 km/h (only 2.25 m at a speed of 30 km/h). If buses and small trucks also use the road, they can share the extra space they need (about 0.7 m) with the bicycle space, the so-called shared space.

Especially in cities where there is a lack of space, it is necessary to use the space thoughtfully, economically. It is certainly important to give space to all modes of transport within the city service, to get the individual modes of transport into balance within the modal split. To do this, it is necessary to realize that a car driving at fifty km/h requires the space of 130 m² including spacing distance, while a cyclist takes 3 m², a pedestrian 1 m² and a passenger in a bus or tram 0.5 m². And here is the opportunity to replace a car with a cargo bike, for example, for shopping purposes.

3.1. Origins and destinations

In the city of Pardubice there are six larger shopping zones, mainly in the outskirts, two shopping malls in the city center, several larger supermarkets, and several smaller stores in residential complexes of the city. The 2017/2018 Survey of traffic behavior in Pardubice shows that the most shopping trips in Pardubice are made on foot (45%), by car it is 24%, by bike 16% and by public transport 15% [11]. Virtually there is at least one supermarket and several smaller stores in the walking distance for every residential area in Pardubice where you can buy food and basic consumer goods. For shopping by bike, mainly standard bicycles equipped with a basket are used, only a few private users currently have a cargo bike in Pardubice. It can be assumed that future potential users of cargo bikes would be formed mainly from current users of standard bicycles, pedestrians, and possibly public transport users. But even for a certain part of current users of cars, an interesting argument could be the time availability when using an e-bike, which is "more comfortable" and less demanding on physical exertion than a standard bike. [6] lists up to about 5 km distance (10-20 min) for cargo bikes in commercial use as comparable to cars. If we consider using the bike for private purposes, this distance could be slightly different. According to the survey [11], up to 71% of trips in Pardubice are within 5 km.

To compare the time availability for shopping, we have selected large shopping zones as destinations where it is possible to buy a wider range of goods (food, drugstore, textiles, household and workshop supplies, animal supplies).

3.2. Time availability comparison

To create a model of time availability, we used the GIS software on OpenStreet Maps and CUZK maps. Figure 1 shows the time availability of individual shopping zones when using a bicycle up to a maximum time of 10 minutes, with a resolution of two-minute areas and an average driving speed of 15 km/h. This speed is achievable for most users on a standard bike in local conditions during normal traffic. The situation also considers the possibility of using the existing cycling infrastructure, which is not accessible to motor vehicles.

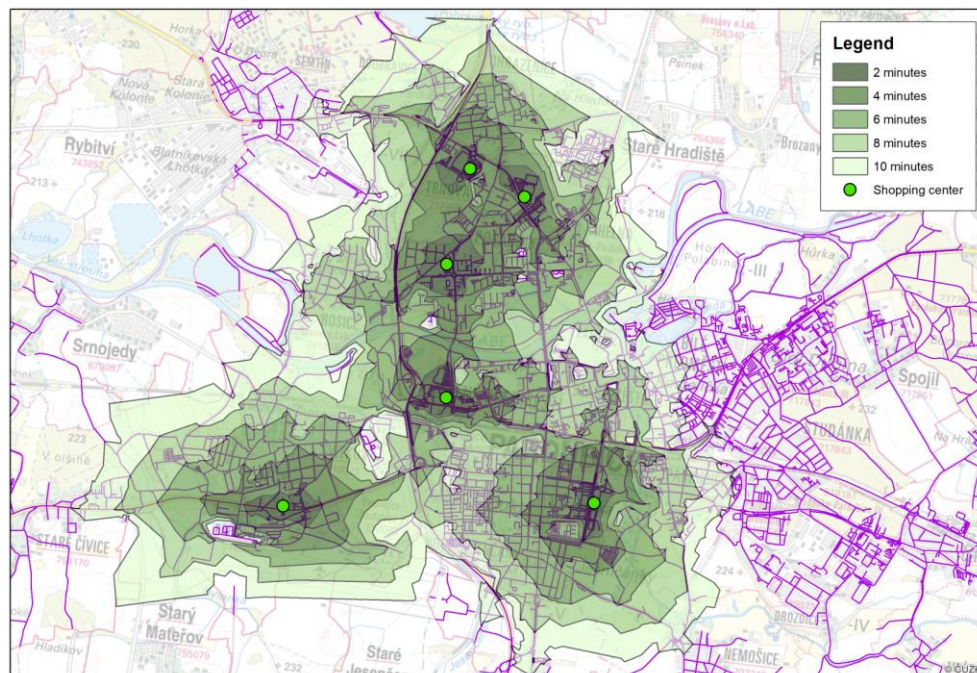


Fig. 1 Time availability of shopping zones using a bicycle

Figure 1 shows that at least one shopping area can be reached by bike from most of the city districts within 10 minutes. A bicycle paths (shared with pedestrian traffic) lead directly to five of the six destinations. The best situation is

in the northwestern part of the city, where there are more shopping zones situated and more than one destination is reachable within 10 minutes. The residential area in the eastern part of the city is the least covered. There are three ordinary supermarkets, but no shopping zone with a wider range of goods. The nearest shopping zone, including the hobby market, can be reached from eastern part of town by bike within about 20 minutes and by car within 11-15 minutes in normal traffic. The advantage of a bike on this route is that 60% of the route are paths shared with pedestrian traffic and the rest are ordinary roads with a maximum driving speed of 30 km/h. All roads along this route also allow the movement of cargo tricycles. In the case of using an e-bike, it can also be considered with a higher average speed and thus with the coverage of a larger area in terms of time availability.

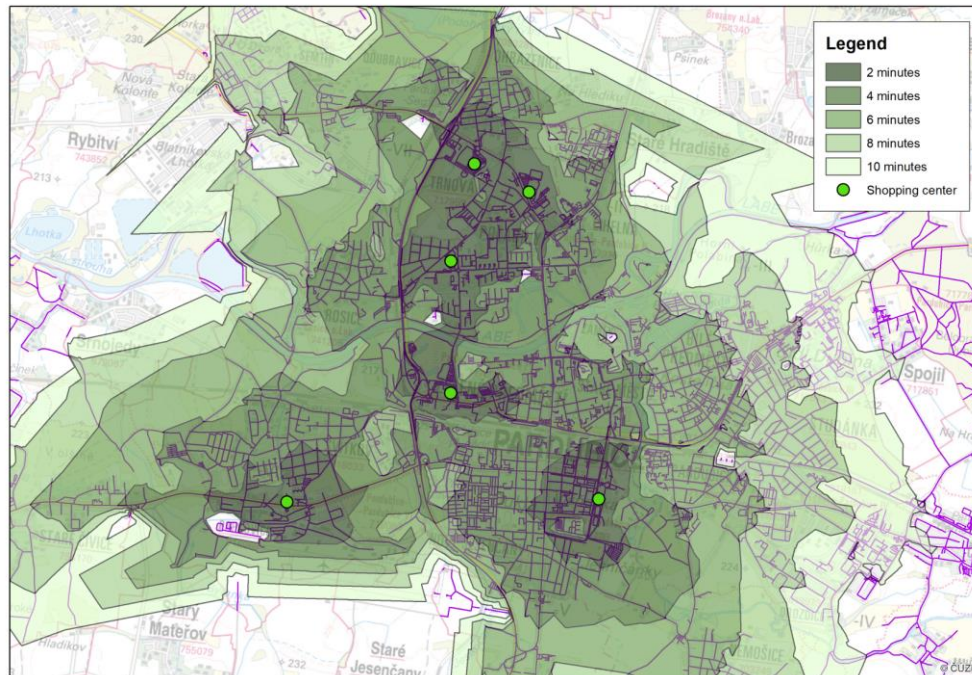


Fig. 2 Time availability of shopping zones using a car

Figure 2 shows a maximum time availability of 10 minutes for the same shopping zones using a car and an average speed of 30 km/h which is achievable in normal (smooth) traffic. The time coverage of individual city districts is larger, although the route by car may be longer. For example, cyclists have more opportunities to cross rivers using roads that are not accessible to motor vehicles. As mentioned at the beginning of Chapter 3, during rush hours, the average speed of a car may decrease due to congestion and the time required to reach a given destination may increase by several minutes. In this case, therefore, the time availability can be comparable with the bike, especially in the case of using an e-bike.

For the sake of completeness, it is also appropriate to mention the time availability when using public transport, which is determined by the routing of individual lines. The public transport stop is located directly at five of the six surveyed destinations, the last one is within walking distance of about 5 minutes. In the case of public transport, the central part of the city is best covered. Five of the six destinations can be reached within 10 minutes by direct connection from city center. From the eastern part of the city, the nearest shopping zone can be reached by direct connection from 16 minutes.

4. Conclusions

The modern cargo bike represents a relatively small and specific market segment, but its potential in the Czech Republic is not yet fully exploited. The use of cargo bikes is influenced both by objective conditions, such as terrain, infrastructure, weather, time availability, and by subjective and social factors. In the Czech Republic, these conditions are characterized by regional differences. The city of Pardubice shows a high level of fulfilment of objective conditions, yet this mode of transport is used here minimally. The results therefore indicate a significant influence of subjective and social factors on which the further work will be focused.

References

1. 2nd European Cargo Bike Industry Survey 2021 [online cit.: 2014-05-22] Available from: http://cyclelogistics.eu/sites/default/files/downloads/2021-09-20_Summary_CCCB_survey_results.pdf
2. **Becker, S.; Clemens, R.** 2018. Exploring the Potential of Free Cargo-Bikesharing for Sustainable Mobility. GAIA

27/1: 156-164.

3. **Boterman, W. R.** 2020. Carrying class and gender: Cargo bikes as symbolic markers of egalitarian gender roles of urban middle classes in Dutch inner cities. *Social and Cultural Geography*, 21 (2): 245-264.
4. Cargo bikes: Safely delivering goods during the COVID-19 crisis and paving the way for a zero-emission freight future. [online cit.: 2014-05-22]. Available from: <https://c40.my.salesforce.com/sfc/p/#36000001Enhz/a/1Q000000gQIE/ZAt015yhRzwwjWVdqyDaU6EyCzIo0qwhSOcHj4pIEEQ>
5. **Dowling, R.; Maalsen, S.** 2020. Familial mobilities beyond the private car: electric bikes and car sharing in Sydney, Australia. *Applied Mobilities*, 5(1): 53-67.
6. **Gruber, J.; Narayanan, S.** 2019. Travel Time Differences Between Cargo Cycles and Cars for Commercial Transport, *Transportation Research Record: Journal of the Transportation Research Board*, 2673(8): 623-637.
7. **Hess, A.N.; Schubert, I.** 2019. Functional perceptions, barriers, and demographics concerning e-cargo bike sharing in Switzerland. *Transportation Research Part D: Transport and Environment*, 71:153-168
8. **Liu, G.; Nello-Deakin, S.; Brömmelstroet, M.; Yamamoto, Y.** 2020. What Makes a Good Cargo Bike Route? Perspectives from Users and Planners. *The American Journal of Economics and Sociology*, 79(3): 941-965.
9. No huge 'corona' gains in the Czech market [online cit.: 2014-05-22]. Available from: <https://www.bike-eu.com/39072/no-huge-corona-gains-in-the-czech-market>.
10. **Prokeš, J.** 2022. Obchodníci čekají boom nákladních elektrokol. Mají významně pomoci kurýrům ve městech [online cit.: 2014-05-22]. Available from: <https://archiv.hn.cz/c1-67037240-obchodnici-ocekavaji-boom-nakladnich-elektrokol-maji-vyznamne-pomoci-kuryrum-ve-mestech>.
11. Průzkum dopravního chování v Pardubicích. [online cit.: 2014-05-22] Available from: <https://pardubice.eu/pruzkum>.
12. **Riggs, W.** 2016. Cargo bikes as a growth area for bicycle vs. auto trips: Exploring the potential for mode substitution behaviour. *Transportation Research Part F: Traffic Psychology and Behaviour*, 43: 48-55.
13. **Sharp, D.; Chan, K.** 2020. Pandemic leads to a bicycle boom, and shortage, around world. [online cit.: 2022-05-22]. Available from: <https://apnews.com/article/technology-lifestyle-business-ap-top-news-europe-39b3691b8e1ea3d74d1280a75e451a36>.
14. Städteliste Cargobike Sharing. [online cit.: 2014-05-22] Available from: <https://www.cargobike.jetzt/tipps/staedteliste-sharing-systeme/#lastenrad-mieten-deutschland>.
15. **Šindelář, M.** 2021. Veřejná půjčovna nákladních kol: vyhodnocení pilotáže a návrh provozního modelu. Brno: Nadace Partnerství. Available from: <https://www.cyclurban.eu/wp-content/uploads/2021/09/kargo-report-v3-final.pdf>.
16. **Šnobl, M.** 2022. Inspirace z Německa: Berlín na kole: Městem na kole. Available from: https://mestemnakole.cz/2022/06/berlin-na-kole/#berlin_na_kole_cykliste19-min-1300x0-c-default
17. **Thomas, A.** 2021. Electric bicycles and cargo bikes—Tools for parents to keep on biking in auto-centric communities? Findings from a US metropolitan area, *International Journal of Sustainable Transportation*, DOI: 10.1080/15568318.2021.1914787.
18. **Vasiutina, H.; Szarata, A.; Rybicki, S.** 2021. Evaluating the Environmental Impact of Using Cargo Bikes in Cities: A Comprehensive Review of Existing Approaches. *Energies*, 14, 6462.
19. Zweirad-Industrie-Verband. Marktdaten Fahrräder und E-bikes 2021. [online cit.: 2014-05-22] Available from https://www.ziv-zweirad.de/fileadmin/redakteure/Downloads/Marktdaten/ZIV_Marktdatenpraesentation_2022_fuer_Geschaftsjahr_2021.pdf