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THE FIRST/LAST MILE PROBLEM AS KEY FACTOR IN PASSENGER TRANSPORT MODAL CHOICE

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Abstract *The first and last mile leg of a journey presents a challenge for the traveller to get to the transportation hub and continue the main leg of their journey. The first and last mile can add up to a significant fraction of one's journey in the matters of duration and costs of travel. This study demonstrates the problem on a real-life journey, which was tracked and analysed. Then three specific cases of short distance, middle distance and long-distance journeys were studied. Journeys were broken down into individual legs and analysed in time and costs aspects. The individual modes are evaluated in total travel costs analysis and present individual options with different approaches to the first and last mile problem. The findings suggest that the fastest option is not always the best in regard to total journey costs. There is a huge difference in car journeys with respects to the amortization of the car and fuel costs only.*

Keywords *first mile, last mile, access, egress, public transport, intercity transport, transportation hub*

1 INTRODUCTION

The main difference between public transport and individual transport is the number of people transported per vehicle. Considering a public transport vehicle, its users will have different origins of their journey and different destinations. That is why public transport vehicles drive along a set route according to a published timetable, stopping at set stops. Passengers group at this stops to use public transport services and get on the vehicle at the most suitable (usually the closest possible) stop and get off at the best stop for their final destination (usually the closest possible).

The problem of getting to the public transport stop and to get to the final destination can be named as the first-last mile problem or access and egress. First-last mile (FLM) is an informal composed-word, widely used to indicate the first and the last leg of each transport movement (Nocera, et al., 2021). Cambridge dictionary defines the last mile as the last stage in a process, especially of a customer buying goods (Cambridge dictionary, 2024). Firstly used in 1974, it originated in telecommunications, where it described the problem of connecting individual end points to the network (Merriam-Webster, 2024).

The "First-Last Mile" problem (FLM) is a relevant transport issue. According to the Green Paper on Urban Mobility, the passenger flows may be a valid approach to promote sustainable, efficient and socially desirable FLM transport (Bruzzone, et al., 2021). Usually, a physical activity is required to overcome the

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first-last mile, thus creating a burden for public transport users. A convenient, short, pleasant and safe FLM trip can facilitate usage of public transport (Ha, et al., 2023).

The FLM problem and lack of good connection between the journey origin or destination might have an undesired consequence of increased usage of individual car transport, creating more congestions and exhaust fumes (Lu, et al., 2024). The FLM problem is unavoidable for the whole transit process, but it is still the weakest part of it.

We can assume that because of the rapid technology advancement, urbanization, demographic changes, globalisation and climate crisis, the FLM is subject to a rapid change in adjacent future (Stam, et al., 2021). We can see the FLM problem also as a spatial accessibility to public transport, which determines to a great extent the modal choice of the traveller for their journey (Kåresdotter, et al., 2022). The journey should be seen as a whole, from origin to destination. The interest in FLM problem has been growing recently, which shows the importance of the quality of solutions to this problem. Its quality can in the end influence the overall perception of the journey for a traveller. Individual quality of transport modes are then not affecting the overall travel experience quality to a large extent, if the rest of the journey is not attractive enough (Venter, 2020).

Although previous studies have examined single-mode travel behaviour, for example subway (Eom, et al., 2023) or bicycle-sharing system problem (Fan, et al., 2019), while other have focused more on build environment (Ha, et al., 2023; Park, et al., 2019), there are only a few studies, which take a view on the problem in intercity travel. For instance Rojas (2017) identified several research gaps in intercity train transit access and egress. The findings suggest that people with smaller distance to the train station are more likely to choose train as their travel mode. Ride-hailing was found to be more popular mode for FLM to airport and train station than to the bus terminal in the case of Yogyakarta, Indonesia (Widiastuti & Irawan, 2024). Ridesharing is also a promising means of the FLM problem providing a solution at a town or neighbourhood level (Ha, et al., 2023). Some studies address the access and egress problem also in air transport (Transportation Research Board, 2008; Neufville, 2006).

The authors believe there is a significant research gap in the role of the FLM for the mode choice and modal split in intercity travel. Various factors and methods can be explored. An interesting question of how would the modal split change, if there was no FLM problem arises and future studies shall examine this point of view to see to which extent can the solutions in FLM contribute to the shift to public transport and mitigate the environmental impact of individual transport.

2 REAL-LIFE DEMONSTRATION OF THE PROBLEM

As stated before, the first/last mile problem is the slowest part of the journey. Let's demonstrate it on an example. One of the authors have recorded their personal journey which shows the individual legs of the journey. The legs of the journey were:

- walk to a tram stop,
- tram ride,
- walk to the train station and waiting for the train,
- train ride,
- transfer to the regional bus,
- regional bus ride,
- walk to the final destination.

The total distance was 152 km, and the average speed was 51 km/h, the average speed on the move was 61 km/h. The average speeds of individual legs based on their timetable are in Tab. 1 (idos.cz, 2024). The average walking speed is neglected.

Tab. 1 : Average speed of individual legs

Journey leg	Travel time	Distance	Average speed	Journey leg
Tram	0:11	4 km	21,82 km/h	Tram
Train	1:29	122 km	82,25 km/h	Train
Regional bus	0:40	23 km	34,5 km/h	Regional bus

From Tab. 1, we can observe that the highest average speed was achieved by train. Fig. 1 show us the speed profile of the journey based on the distance. We can clearly identify the first mile of the journey covered by tram from km 0 to km 4. The last mile was covered by a few hundred meters walk, therefore it is not very visible from the chart.

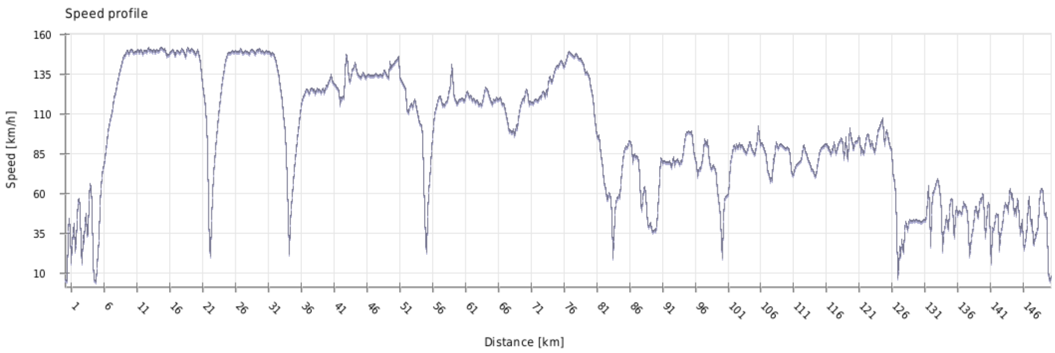

Fig. 1 Distance – speed chart; author

In Fig. 2, we can see the dependency of speed on time. This chart is different to Fig. 1 as the time passes continuously (covered distance does not change during waiting), and waiting times are visible from this chart. The individual legs are also visible from this chart as they are separated by the transfer times from 14:40 to 14:50 and from 16:25 to 16:32. The transfer can be also referred to as the middle-mile problem, when it occurs between 2 parts of the main leg of the journey. In some instances, we may face the need to transfer between 2 hubs using local transport. We can identify the first mile from 14:25 till 14:50 and the last mile from 17:14 to 17:20. The first and the last mile combined hold 22,47% of the journey time.

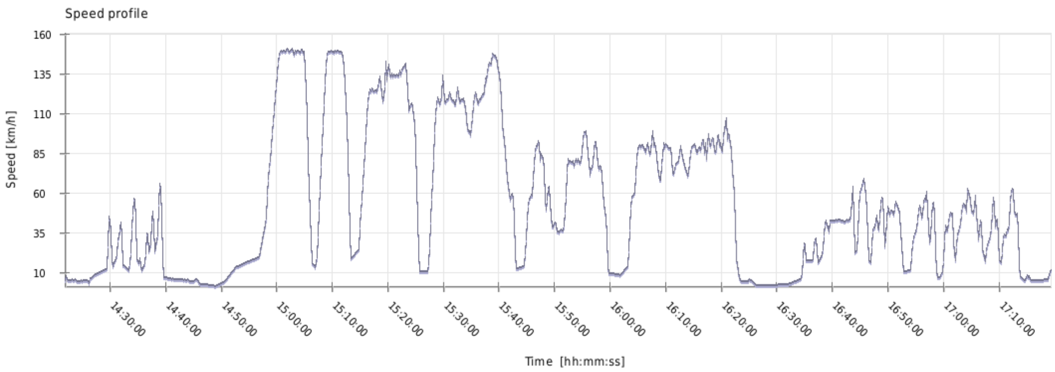

Fig. 2 Time – speed chart; author

In Fig. 3, we can see the dependency of the distance on time.

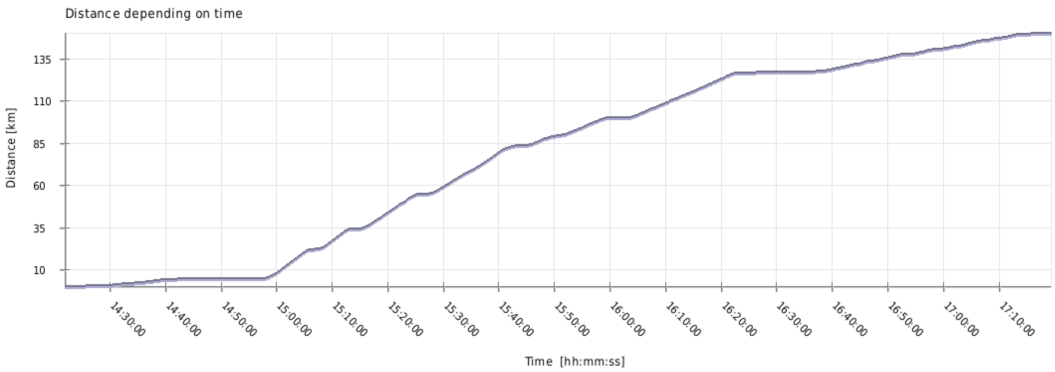

Fig. 3 Time – distance chart; author

From Fig. 3, we can observe when the distance covered in time is not changing, this was the waiting time in a transportation hub, in this case, train stations, or its surroundings.

3 CASE STUDY

For the case study, three cases of a journey are considered. Those are a short distance journey, a middle distance journey and a long distance journey. As a short distance, we consider a journey shorter than 150 km. The obtained times are based on the timetables (idos.cz, 2024) or journey time determined by a navigation tool (mapy.cz, 2024).

Let us make some assumptions for the studied cases. We consider a 5 minute walking time to get to the car (time until we get to a parking spot and get ready) or to get to a public transport stop. We consider a bike parked directly at the origin of our journey. By the TAXI icon, we mean a taxi or alternative services like Uber or Bolt. In this case, we consider an average 5 minute waiting time until the car reaches our location. Graphs are used to analyse the situation and display individual legs and phases of the journey. The main leg is portraited by red edges. The first and the last mile is portraited by the black edges.

3.1 Short distance case

For a short distance journey, we consider a journey between the rectorate of VSB – Technical University of Ostrava and the rectorate of Palacký University in Olomouc. The direct (aerial) distance of these two places is around 70 km. We consider this journey by car, by train and by bus. We construct a graph, where the edges represent the individual parts of the journey. The graph is visualized in Fig. 4.

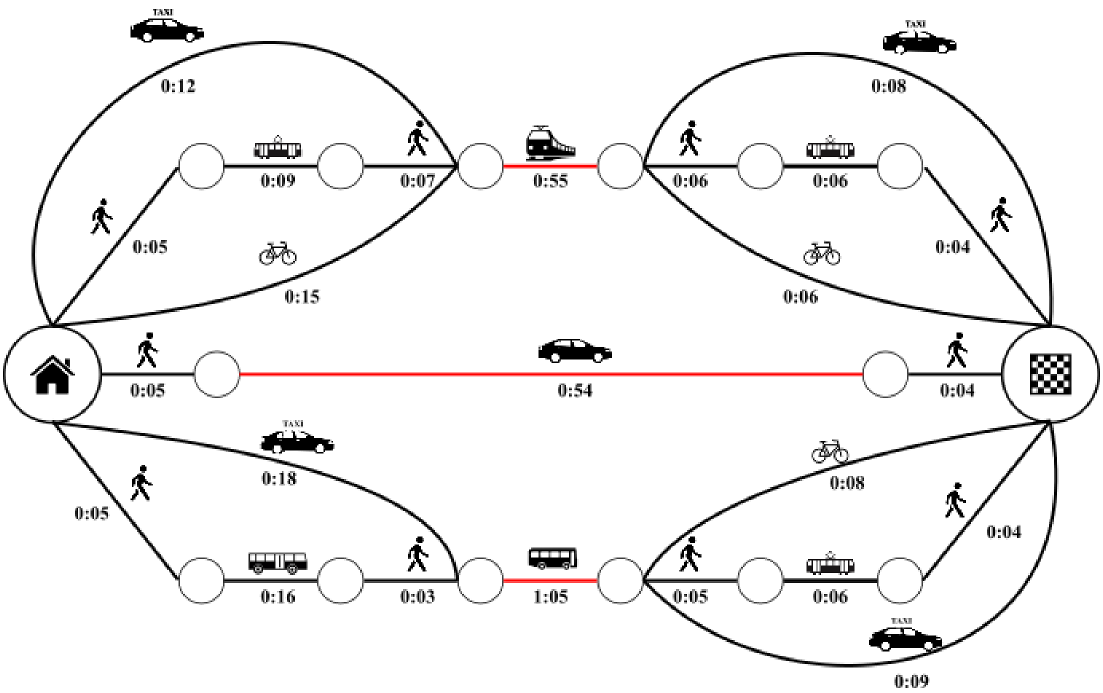

Fig. 4 Short-distance journey graph

Bike option is neglected for the first mile when we consider bus trip on the main leg, as the bus station is 38 minutes by bike from our origin, therefore let us assume that this option is not a rational choice. After the analysis of the graph, considering only the journey time, our best option is a car journey. The main leg in this option is just a minute shorter than the main leg when we take the train. If we would neglect the first/last mile problem. We can travel between the train stations by car in 51 minutes, which is 4 minutes shorter than by a train. We must remember however that our car journey may be affected by traffic jams especially during the peak hours. This depends hugely on a mode choice of other travellers on the route. If too many people choose car as their mode of transport, we will suffer a delay caused by traffic jams (which might affect our bus journey as well). If too many people travel by train, we might suffer a discomfort of an overcrowded train. Trains might be also affected by unforeseen circumstances, such as infrastructure failure or other events.

The second best option is taking a taxi service from our origin to the train station and then using a bike to get to our final destination (we consider using a bike sharing service).

In this case, we consider only the journey time. We can see the summarization of a short-distance trip in Tab. 2. The abbreviation PT represents public transport as a means of covering the first or the last mile respectively.

Tab. 2 : Fraction of a journey time to cover first/last mile for a short distance journey

Journey type	**First/last mile time**	**Main leg time**	**Total journey time**	**Percentage of first+last mile time**
Taxi – train – bike	0:18	0:55	1:13	24,66%
Taxi – train – taxi	0:20	0:55	1:15	26,67%
Bike – train – bike	0:21	0:55	1:16	27,63%
PT – train – PT	0:37	0:55	1:32	40,22%
Car	0:09	0:54	1:03	16,67%
Taxi – bus – taxi	0:27	1:05	1:32	29,34%
PT – bus – PT	0:39	1:05	1:44	37,50%

It is obvious from Tab. 2 that the smallest first/last mile fraction is 16,64% when we use car. This makes sense since it consists only of reaching the parking spot from our orgin and our final destination from the parking spot. The second smallest fraction is 24,66% when using taxi to get to the train station and a bike to get to our final destination. This is the shortest possible time of the entire journey avoiding individual car transit.

We can now add the total cost analysis for the journey. The prices are estimated based on the data of carriers and average price per km by car including and excluding amortization (finance.cz, 2023; České dráhy, 2024; Dopravní podnik Ostrava, 2024; CB Taxi Ostrava, 2024; Black & White Taxi Olomouc, 2024; Dopravní podnik města Olomouce, 2024; Škoda auto, 2024). The cost of journey is presented in Tab. 3.

Tab. 3: Fraction of a journey cost to cover first/last mile for a short distance journey

Journey type	First mile cost	Main leg cost	Last mile cost	Total cost	Percentage of first+last mile cost
Taxi – train – bike	183 CZK	125 CZK	25 CZK	333 CZK	62,46%
Taxi – train – taxi	183 CZK	125 CZK	89 CZK	397 CZK	68,51%
Bike – train – bike	0 CZK	125 CZK	25 CZK	150 CZK	16,67%
PT – train – PT	25 CZK	125 CZK	18 CZK	168 CZK	25,60%
Car*	-	616 CZK	-	616 CZK	-
Car* (without amortization)	-	185 CZK	-	185 CZK	-
Taxi – bus – taxi	183 CZK	129 CZK	89 CZK	401 CZK	67,83%
PT – bus – PT	25 CZK	129 CZK	18 CZK	172 CZK	25,00%

*assuming a single person is in the car, the average fuel consumption for Skoda Octavia

We can now determine the total cost of a journey. We can quantify the time in means of monetary expressions by quantifying one hour as e.g. the average hour salary or a different value of time determined individually. The formula for the total monetary cost would be as follows:

$$C_{Total} = \sum_{i \in I} k_i \cdot (t_i \cdot c_{time} + f_i), \tag{1}$$

Where:

C_{Total} is the total cost of the journey,

k_i is the coefficient of respective means of transport (we can quantify the comfort or discomfort caused by respective means),

t_i is the total travel time for each respective journey in hours,

c_{time} is the value of time in monetary terms,

f_i is the total price (fare) of respective journey.

Let us neglect the comfort coefficient ($k_i = 1$) for this time as it is very subjective and beyond the scope of this paper. Let us assume the time value being 250 CZK/hour. Then we obtain the results as presented in Tab. 4.

Based on the obtained results, we can conclude that the best option with the lowest total costs is travelling by car when we neglect the amortization of the vehicle. It is important to point out that we also do not consider the cost of parking which is free only in certain times or further away from our final destination as well as the price of vignette. If we consider amortization however, the car becomes the worst option for us. Then the second best is using a bike in the origin of our journey to reach the train station and to reach the final destination from the train station.

Tab. 4 : Total costs of the short distance journey

Journey type	Total journey cost
Taxi – train – bike	637.17 CZK
Taxi – train – taxi	709.50 CZK
Bike – train – bike	466.67 CZK
PT – train – PT	551.33 CZK
Car*	878.50 CZK
Car* (without amortization)	447.50 CZK
Taxi – bus – taxi	784.33 CZK
PT – bus – PT	605.33 CZK

3.2 Mid-distance case

For the mid distance journey, let's consider a journey from rectorate of VSB – Technical University of Ostrava to Checkpoint Charlie in Berlin. We will consider the options: plane, train, car and bus for the main leg. In case of plane, we need to define the first and last mile problem.

Let us explain our assumption on an example. Someone tells you that some place is really close, and you can get there in no time. The flight takes just 1 and half hour. That might be the true for sure, but you need to consider the time to get to the airport which is usually further than the train or bus station, the time at the airport needed to undergo the security check and check-in, boarding time and eventually a border control and after landing there is time you need to pick up the luggage, transfer through the airport and get from the airport to your final destination. A ninety-minute flight can become 6 hours travel process. If that is the case, it might happen that by that time, you are already at your final destination when you choose the land means of transport. Therefore, we define as the first mile the whole way to the airport with the time reserve at the airport included, and as the main leg only the flight itself.

The situation of a middle-distance journey (around 445 km of direct distance) is portraited in Fig. 5. We can see that the situation is more complicated now, as there are more steps in the journey. The car journey has the same structure as in the short distance journey, only the times have changed. Note that this is the direct duration, we might also consider some breaks along the car journey. There is a direct night train from Ostrava to Berlin, but let's consider our journey during the day. In this case, we need to change the train once.

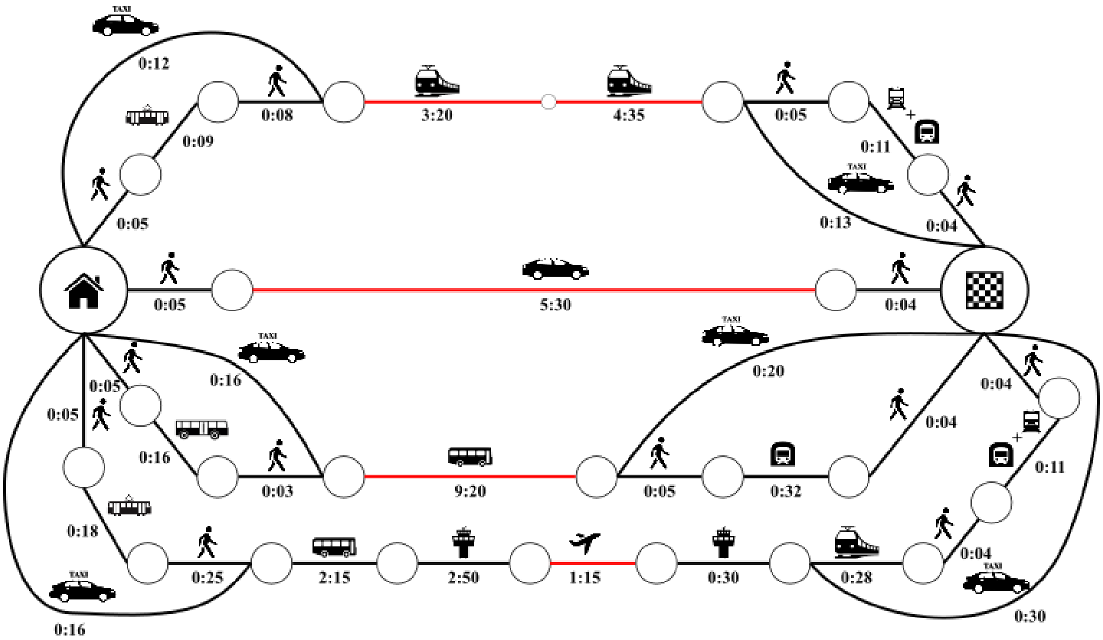

Fig. 5 Mid-distance journey

The bus journey has the same structure as in the short-distance journey. The new journey introduced here is a plane journey. As there is no direct flight from Ostrava to Berlin, the journey is through Krakow airport located in Poland. We can see in Fig. 5, that the main leg is just a very minor part of the journey timewise compared to the other legs of the first and the last mile. Bike is neglected in this case as we consider a longer journey, and we can assume the passenger is carrying some luggage not suitable for biking.

Now we should analyse the journeys and determine what fraction of journey time is needed to cover the first/last mile. The summary is presented in Tab. 5 (idos.cz, 2024; mapy.cz, 2024; finance.cz, 2023; České dráhy, 2024; Škoda auto, 2024; Berliner Verkehrsbetriebe, 2024).

Tab. 5 : Fraction of a journey time to cover first/last mile for a mid-distance journey

Journey type	**First/last mile time**	**Main leg time**	**Total journey time**	**Percentage of first+last mile time**
Taxi – train – taxi	0:25	7:55	8:20	5,00%
PT – train – PT	0:42	7:55	8:37	8,12%
Car	0:09	5:30	5:39	2,73%
Taxi – bus – taxi	0:36	9:20	9:56	6,43%
PT – bus – PT	1:05	9:20	10:25	10,40%
PT – plane – PT	7:10	1:15	8:25	85,15%
Taxi – bus – plane – taxi	6:21	1:15	7:36	83,55%

We can clearly see that in case of plane, the first and last mile adds up to well over 80% of total journey time. This is mainly because the airport is in a different city, and we need some time at the airport for all the procedures. In other cases, the first/last mile takes less than 11% of total journey time. This is because the main leg is long in duration.

The costs of individual modes and their parts for a middle distance journey are shown in Tab. 6.

Tab. 6 : Fraction of a journey time to cover first/last mile for a mid-distance journey

Journey type	First mile cost	Main leg cost	Last mile cost	Total cost	Percentage of first+last mile cost
Taxi – train – taxi	183,00 CZK	897,00 CZK	340,00 CZK	1 420,00 CZK	36,83%
PT – train – PT	25,00 CZK	897,00 CZK	75,00 CZK	997,00 CZK	10,03%
Car	-	4 254,00 CZK	-	4 254,00 CZK	-
Car* (without amortization)	-	1 275,00 CZK	-	1 275,00 CZK	-
Taxi – bus – taxi	380,00 CZK	999,00 CZK	540,00 CZK	1 919,00 CZK	47,94%
PT – bus – PT	25,00 CZK	999,00 CZK	75,00 CZK	1 099,00 CZK	9,10%
PT – plane – PT	235,00	1 000,00	170,00	1 405,00	28,83%
Taxi – bus – plane – taxi	590,00	1 000,00	1 400,00	2 990,00	66,56%

*assuming a single person is in the car, the average fuel consumption for Skoda Octavia

From the cost analysis, we conclude that taxi is the most expensive option for the FLM problem, as taxi services are usually the priciest option. In our case, the cost for a taxi holds 36,83% of journey fare at lowest (using train for the main leg) up to 66,56% when using plane for the main leg. The taxi in this case is not all the way to the airport, but just to the connecting bus. We do not consider a taxi ride to the airport, as it is located in another city and even in a foreign country, where there is a good connection by bus services.

Then the total costs are portraited in Tab. 7.

Tab. 7 : Total costs of the middle-distance journey

Journey type	Total journey cost
Taxi – train – taxi	3 503.33 CZK
PT – train – PT	3 151.17 CZK
Car	5 666.50 CZK
Car* (without amortization)	2 687.50 CZK
Taxi – bus – taxi	4 402.33 CZK
PT – bus – PT	3 703.17 CZK
PT – plane - PT	3 509.17 CZK
Taxi – bus – plane – taxi	4 890.00 CZK

From Tab. 7 we observe that car (neglecting amortization) is the best option for us. With amortization in mind, car becomes the worst option. Again, the vignette and parking price is neglected. Then the best option for us is choosing train and covering the first and the last mile by public transport.

3.3 Long distance case

For the long distance journey, we will consider a journey from Parc Valmer in Marseille, France to the London Transport Museum in London, UK. Our options are shown in Fig. 6. The direct aerial distance is 1 003 km. A journey with a high-speed train connection was selected on purpose.

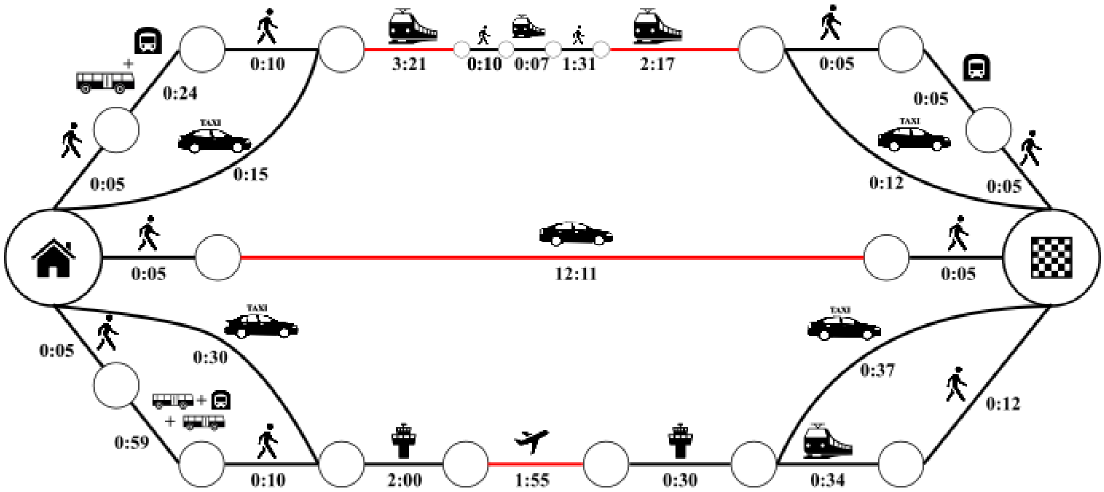

Fig. 6: Long distance journey

On the main leg of the train journey, we can see a long walking phase of 1:31. This is because the service from Paris to London (Eurostar) requires a border control and a security check and it is advised to be at the train station 90 minutes prior to departure.

This takes away one of the biggest advantages of land transport – no need for long security checks when arriving at the station few minutes prior to the scheduled departure is usually sufficient. We can also see the need of transfer between two train stations within a city. We can define this problem as a middle mile problem.

The time analysis of individual means of transport for the journey is in Tab. 8 (mapy.cz, 2024; finance.cz, 2023; Rome2Rio, 2024; Rail Europe, 2024; SNCF, 2024; Moovit, 2024; Transport for London, 2024; Taxi Aix, 2024; RTM, 2024).

Tab. 8 : Fraction of a journey time to cover first/last mile for a long distance journey

Journey type	First/last mile time	Main leg time	Total journey time	Percentage of first+last mile time
Taxi – train – taxi	0:27	7:26	7:53	5,70%
PT – train – PT	0:54	7:26	8:20	10,80%
Car	0:10	12:11	12:21	1,35%
Taxi – plane – taxi	3:37	1:55	5:32	65,36%
PT – plane – PT	4:30	1:55	6:25	70,13%

Here we can see that again the plane journey takes over 65% of total journey time to cover the first and last mile of the journey. We also consider the closest We also consider one of the closest airports to our destination (Heathrow).

The cost analysis of a long distance journey is shown in Tab. 9.

Tab. 9 : Fraction of a journey time to cover first/last mile for a mid-distance journey

Journey type	First mile cost	Main leg cost	Last mile cost	Total cost	Percentage of first+last mile cost
Taxi – train – taxi	936 CZK	4 800 CZK	323 CZK	6 059 CZK	20.78%
PT – train – PT	80 CZK	4 800 CZK	67 CZK	4 947 CZK	2.97%
Car*	-	9 236 CZK	-	9 236 CZK	-
Car* (without amortization)	-	2 767 CZK	-	2 767 CZK	-
Taxi – plane – taxi	1 873 CZK	2 068 CZK	1 618 CZK	5 559 CZK	62.80%
PT – plane – PT	80 CZK	2 068 CZK	150 CZK	2 298 CZK	10.01%

*assuming a single person is in the car, the average fuel consumption for Skoda Octavia

We notice a big difference in the first/last mile price fraction when using public transport and taxi. This is because taxi services are expensive in France and UK compared to the public transport.

The total journey costs for a long distance journey are shown in Tab. 10.

Tab. 10 : Total costs of the middle-distance journey

Journey type	Total journey cost
Taxi – train – taxi	8 029.83 CZK
PT – train – PT	7 030.33 CZK
Car*	12 323.50 CZK
Car* (without amortization)	5 854.50 CZK
Taxi – plane – taxi	6 942.33 CZK
PT – plane – PT	3 902.17 CZK

Here, we notice that the plane is now the best option. It has the best journey time and also the lowest total costs. The international high speed rail tickets are quite expensive and cannot really compete with budget airlines. We must mention that the prices are for the tickets booked weeks in advance when the prices are usually the best. If we decided on spot for such a trip, the tickets would be very expensive for either plane of trains.

4 RESULTS AND DISCUSSION

The results show us a big difference on the total travel costs depending on choosing the first and last mile means of transport. This also affects the time aspect of one's journey and can add up of more than half of the total journey time, especially for air transport and can hold more than half of the fare costs especially when choosing taxi. As the whole trip duration gets longer, the first and last mile time fraction tends to decrease for land transport, as we are usually able to reach the transport hub within 30 minutes.

The results show that a very important factor in individual transport is if we do or do not consider the car amortization. This can be the difference between car being the best and the worst option by the total journey costs respectively. It is also important to stress that we consider only one person travelling. If more people are travelling, the costs for car and taxi are halved per person and on the other hand doubled for public transport (urban and long distance).

The result for presented cases show us the following insights:

4.1.1 Short Distance Journey

For the short-distance journey (aerial distance of 70 km), the main leg was covered by car, train, or bus. The analysis revealed the following:

- Car: Best option when amortization is neglected, with a total journey time of 1:03 hours and an FLM fraction of 16.64%. Total cost without amortization: 447.50 CZK.
- Taxi-Train-Bike: Second-best option when considering the FLM problem, with a total journey time of 1:13 hours and an FLM fraction of 24.66%. Total cost: 637.17 CZK.
- Public Transport: Yields the longest FLM times, resulting in a total journey time of 1:32 hours and an FLM fraction of 40.22%. Total cost: 551.33 CZK.

In terms of total journey costs, the best option is car without amortization (447,50 CZK). If amortization is considered, then the best option is bike – train – bike option with total travel costs of 466.67 CZK. Amortization considered makes the car the worst option with total travel costs of 878.50 CZK.

4.1.2 Mid-Distance Journey

For the mid-distance journey (aerial distance of 445 km), the transportation modes analysed were car, train, bus, and plane:

- Car: Best option when neglecting amortization, with a total journey time of 5:39 hours (without brakes) and an FLM fraction of 2.73%. The total cost without amortization: 2 687.50 CZK.
- Taxi-Train-Taxi: Second-best option regarding the FLM problem, with a total journey time of 8:20 hours and an FLM fraction of 5.00%. The total cost: 3 503.33 CZK.
- Plane: High FLM fraction of 83.55%, making it less efficient despite the shorter main leg. The total cost: 3 509.17 CZK.

The total journey costs analysis shows us as the best option again car without amortization with 2 687 CZK, however being the worst with amortization in total cost of 5 666,50 CZK. Then the best option according to the total journey cost is PT – train – PT with 3 151,17 CZK in total.

4.1.3 Long Distance Journey

For the long-distance journey (aerial distance of 1,003 km), the study considered high speed train, car and plane:

- Train: Preferred option with a total journey time of 7:53 hours and an FLM fraction of 5.70%. Total cost: 8,029.83 CZK.
- Plane: High FLM fraction of 70,13%,which might be perceived by the traveller as inefficient, however making the journey the best option in terms of the total journey costs: 3 902 CZK.
- Car: achieving a low fraction of the FLM, just 1,35% is expected as the main leg is very long (12:11 hours without breaks). The total costs without amortization: 5 854,50 CZK.

In this case, as mentioned before, the best option by the total journey cost is the PT – plane – PT option with the total costs of 3 902,17 CZK, while car with amortization being the worst with 12 323,50 CZK in total.

Needless to say, that the plane ticket price was quite low and booked a long time in advance. Interesting is also the fact that the high-speed train network can be an equal competition to the air transport. The travel time on the main leg of the high-speed trains is 5:38 hours, while the main leg of plane travel is 1:55 hours, the total time with all necessary airport procedures takes up to 4:25 hours. In this case, the Eurostar (Paris – London) train also requires a 90 minute procedure at the train station, however we can see, that in inland transport a well developed high speed train network can be more efficient than the air transport. On the other hand, high-speed train tickets are usually expensive compared to some budget airlines which offer really good prices. There are some budget high-speed train carriers emerging these days, which might have a positive environmental impact on travel customs.

5 CONCLUSIONS

The paper presents the problem of the first and last mile in intercity transport. The first and last mile are the weakest part of the journey and despite being short in time and distance, they can add up to the significant portion of the total travel time and costs.

The case study of a short-distance, middle-distance and long-distance journeys is carried out to analyse the time and cost fractions of first and last mile problem. From the case study it is obvious that it is really important for the case of car if we consider only the cost of fuel or amortization of the car as well. We can conclude from the case study that the public transport seems as the best option to cover the first/last mile of the journey. In the short distance journey, bike was the best option to cover the first/last mile. We can not consider bike as an option for a middle-distance and long-distance journey as we assume that a passenger would carry some luggage which would be impossible to transport on a bike.

The presented cases are very specific and must be studied individually. There are some flight connections, that are very cheap, others that are expensive or require a transfer, which can be up to several hours. Car operation on the other hand carries another costs like beforementioned vignette or parking fees, insurance or sudden breakdowns as well as regular maintenance. Also, a company car can be used, where the amortization costs do not affect the traveller, but the owner of the car. Nowadays, it is also common and usually convenient to work on a train thus we can then subtract the cost of work done from the total costs for the journey.

There are more combinations and factors left to explore, e.g. we can assume that somebody can give us a lift to the train station or the airport which is likely to be faster than public transport and cheaper than a taxi.

The future studies can focus on the technological advancements and emerging transportation services and micro-mobility. A seamless journey is more pleasant for the traveller and they are more likely to choose public transport over individual car transport. The other option is urban planning, spatial accessibility, public transport connectivity, build environment and street walkability and other urban factors. Also passenger preferences can be studied to understand their behaviour, factors affecting mode choice and their customs and whether they are prone to change of their mindset.

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