

What first? Public transport or houses?

A study on the development timing of public transport in a residential area.

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Abstract

Modern cities are seeking possibilities to create healthy, sustainable and liveable urban environments. Yet these endeavours should not come at the expense of the accessibility of the city. Therefore, many cities try to promote the use of sustainable modes of transportation by developing transit-oriented neighbourhoods. An ongoing debate related to these developments is the development timing of the public transport connection. Even though it is generally assumed that early provision of public transport is favourable, the significance of this notion has not yet been studied, and the considerations of the different parties involved in the decision making process in practice are unclear. Therefore, the aim of this research is to explore what development strategy of public transport in a residential area results in high ridership levels while still being feasible for the different parties involved. This is done through an evaluation of both the influence of development timing on travel behaviour and an evaluation of the development process based on stakeholder interviews. The results suggest that it is indeed beneficial to provide public transport from the moment the first inhabitants start to live in the area. However, the study also revealed that provision in a later stage does not necessarily mean that it is doomed to fail, as the car-ownership levels can slowly decrease in the years after the public transport is provided. The stakeholder interviews show development strategy needs to be tailored to the specific development, as the feasibility of a development strategy and the need for early provision are highly dependent on the location and the budget available for the subsidisation of public transport is limited. Thus, a tailor made solution is required for each location.

Key words: Development timing; Public transport; Travel behaviour; Mode choice.

1 Introduction

The Netherlands is undergoing a population growth that is projected to continue for the coming 50 years (CBS, 2020b). This growth is expected to be the strongest in cities and their surrounding suburbs, which leads to emerging issues such as congestion and environmental pollution experienced by growing cities all around the world (Pan et al., 2017). Therefore, more and more cities are seeking possibilities to solve these issues and create healthy, sustainable and liveable urban environments for today and tomorrow (Ibraeva et al., 2020). Unregulated growth of urban areas will result in a growing number of cars in and around cities. Not only will this lead to more congestion, but it will also contribute to greenhouse emissions (Kuiken, 2016). Therefore, many cities try to promote the use of sustainable modes of transportation within their legislative bounds (Ibraeva et al., 2020). But how does one get people to use sustainable modes of transportation instead of their car?

A planning concept that has become increasingly popular in this endeavour is the integration of land-use and transportation planning. The reason for this interest is the influence both the public transport quality as well as the spatial layout of an area can have on travel behaviour. High quality public transport in a built environment with a spatial layout tailored to the use of sus-

tainable modes of transportation can namely encourage the use of them, hereby serving as a replacement for the car (Faber et al., 2021). In practice, this means a collaboration between different institutions, who all have their own interests and priorities.

One of the ongoing debates in the development of transit-oriented neighbourhoods, is the right development timing of a public transport connection relative to the development of the residential area it serves (Puylaert, 2021). If the public transport connection is provided early, this will result in low ridership levels in the first years of the development, as not all of the intended users live there yet. These low ridership levels are a significant expense for the public transport provider, considering that they need to pay the operating costs even though they ride empty. However, this early provision also has advantages, as residents are more likely to use the offered transit connection when it is provided from the moment they start to live there (Thomas et al., 2016). The reason for this is that people are more likely to change their habits after life events such as moving. Late development on the other hand, might result in the formation of other travel habits such as car travel. As those habits do not easily change (Haggar et al., 2019), the risk may exist that people will not start to use the connection when it is provided in a later stage.

Even though it is generally assumed that early provision of public transport is favourable, the significance of this notion has not yet been studied, and the considerations of the different parties involved in the decision making process in practice are unclear. Therefore, the aim of this research is to explore what development strategy of public transport in a residential area results in high ridership levels while still being feasible for the different parties involved. This is done through an evaluation of both the influence of development timing on travel behaviour and the decision making process around this development timing.

The paper begins with a review of the existing knowledge on the mechanisms influencing travel behaviour in relation to the development timeline, after which the methods and approach used to determine the development strategy are discussed. Then, the results on the influence of development timing and the considerations of the different parties involved in the decision making process in practice are summarised. The paper ends with a conclusion on the development strategy, a discussion on the implications and limitations of the research and recommendations for future research.

2 Literature review

The relation between the built environment and travel behaviour has been the subject of considerable research attention over the past years (Faber et al., 2021). To determine if it matters at what moment people are subjected to such a built environment, it is important to understand the mechanisms that influence the relation, as well as the mechanisms that influence travel behaviour over time. The section starts with a discussion on the relation between travel behaviour and the built environment, after which this relation is linked to mechanisms known to influence peoples travel behaviour over time. The resulting conceptual model is used to form a hypothesis on the influence of development timing on travel behaviour.

2.1 Travel behaviour and the built environment

The built environment consists of buildings, open spaces and transport systems which together form the space we live, work and recreate in (Pacheco-Torgal et al., 2016). The design and spatial-layout of this built environment can have an influence on the travel behaviour of its residents. Neighbourhoods with high densities in areas adjacent to high quality public transport and good walking and cycling infrastructure encourage people to use sustainable modes of transportation, where neighbourhood with large roads and lots of parking facilities encourage car use (Kamruzzaman et al., 2015; Ibraeva et al., 2020). This relation between travel behaviour and the built environment has been recognised in research for several decades (van de Coevering et al., 2015; Wang and Lin, 2019), however the existence of a causal effect of this relation has long been contested using mechanisms that

explain the associating via other variables (Faber et al., 2021; van de Coevering et al., 2016).

One of those mechanisms, residential self-selection, is described as the notion that people choose the place they live based on their travel preferences (Wang and Lin, 2019), which are the result of travel attitude, lifestyle and/or socio-demographics (van Wee and Handy, 2016; van de Coevering et al., 2016). Several studies show that notion weakens the idea that the built environment influences travel behaviour, as people choose an environment due to its favourable characteristics in regard of their preferred way of travel, instead of the other way around (Bruns and Matthes, 2019; De Vos et al., 2018; van Herick and Mokhtarian, 2020; Wolday et al., 2018). However there are also studies that show that residential location choice and travel attitude are only associated to a limited extent (Ettema and Nieuwenhuis, 2017) and that the built environment can also influence travel behaviour after residential self-selection is accounted for (De Vos et al., 2021; Faber et al., 2021; Guan et al., 2020).

Another theory, the reversed causality theory, is that the built environment can influence people’s travel attitudes over time, hereby making them more appreciative for a certain mode of transportation, which in its turn influences their travel behaviour Ramezani et al. (2021). This theory is supported by van de Coevering et al. (2016); Wang and Lin (2019); van Wee et al. (2019), who state that travel attitudes are influenced by the built environment. However, there are also studies that conclude that even after attitudes and transport related location choices are taken into account, there still is an effect of the built environment on travel behaviour (van de Coevering et al., 2016; Faber et al., 2021).

All in all, it can be concluded that both the reversed causality hypotheses and residential self-selection play a role in the relation between the built environment and travel behaviour, but that there also is a causal relation between the two. The conclusions on the mechanisms playing a role in the relation between travel behaviour and the built environment are captured in the conceptual model given in Figure 1.

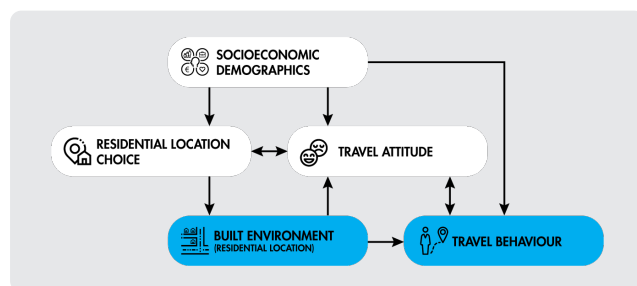


Figure 1. Conceptual model of the relation between travel behaviour and the built environment (adjusted from Faber et al. (2021); van de Coevering et al. (2016))

2.2 When do people change their travel behaviour?

The phrase *Old habits die hard* aptly describes people's travel behaviour, as people do not change their travel habits easily (Haggar et al., 2019; Busch-Geertsema and Lanzendorf, 2017), especially when it involves the car (Daramy-Williams et al., 2019). Even when other influencing factors change, behaviour does not necessarily change accordingly due to habits (Friedrichsmeier et al., 2013). According to Havlíčková and Zámecník (2020) habit is the most important variable that hinders attempts to change travel behaviour. Thus, unveiling what makes people change their habits over time is quite important in the shift towards the use of more sustainable modes of transportation.

Life events have been generally acknowledged as a trigger for people to change their travel behaviour (Janke et al., 2020; Olde Kalter et al., 2021; Clark et al., 2016). They are the moments in someone's life when there is a major change in their situation, such as the birth of a child, moving home, entering the labour market or changing jobs (Olde Kalter et al., 2021). These life events can be seen as windows of opportunity for policies aiming to change travel behaviour, as people are more susceptible for a change in travel behaviour after those events (Janke et al., 2020; Beige and Axhausen, 2017).

All in all, it can be concluded that life events can disrupt habitual behaviour and influence travel behaviour. This influence on travel behaviour is either caused by a change in the socioeconomic demographics such as household composition or employment or a change in built environment. Adding the influence of life events and the relation between habitual behaviour and travel behaviour to Figure 1 gives the conceptual framework as given in Figure 2.

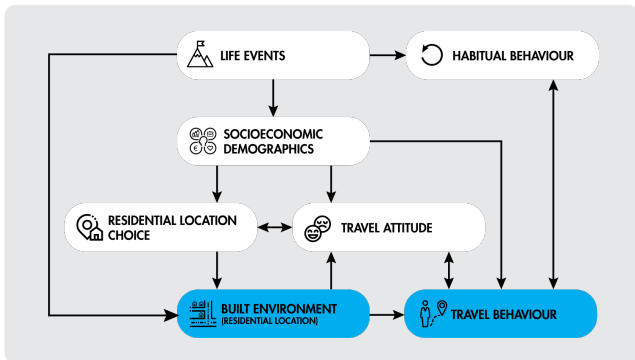


Figure 2. Conceptual model of the mechanisms influencing travel behaviour in respect to the development timeline.

2.3 Hypothesis

The studied literature revealed that people living in an area with a built environment tailored to sustainable modes of transportation, are more likely to use these sustainable modes than people who live in car-oriented

neighbourhoods. Considering that habitual behaviour and life events both influence travel behaviour, there is a certain window of opportunity that people are more susceptible for a change in travel behaviour. Thus, when the built environment is optimised for the use of public transport and people are subjected to this environment during this window of opportunity, theoretically, the chance is greater that they will use it. On the contrary, when people are subjected to good public transport after they have lived at a location for a while, habitual behaviour can reduce the change.

Based on this literature review the following hypothesis is formulated:

"If the public transport connection is developed late, people will have developed other travel habits and the chance they use the public transport when it is provided is diminished."

3 Methodology

This study on development timing of public transport in residential area is based on information obtained from literature, case studies and interviews using the Delphi method. The research is split into two main parts: a part on the influence of development timing on travel behaviour and a part on the development process in practice.

3.1 Influence of development timing

The hypothesis on the influence of development timing on travel behaviour was tested with the help of case studies, in which the effects of three different development timelines on travel behaviour were studied.

For the evaluation of past development strategies, three so called Vinex neighbourhoods were scrutinised. These neighbourhoods are the result of the eponymous policy briefing note originating from the 1990's, which allocated greenfield locations near existing city centres for new-town housing projects. The aim was to catch up on housing construction and reduce travel movements by car to relieve the environment. To accomplish this, the built environment was designed to ensure good accessibility by public transport, cycling and walking (Snellen et al., 2005). These neighbourhoods were chosen, because their aim was to promote public transport usage and they are built following the same vision, which makes them suitable to be compared.

The three cases vary from a place where the public transport connection was developed early in the development, to a developing neighbourhood that obtained access to public transport years after the first inhabitants. The cases are compared based on the success of their public transport connection as well as the car ownership levels. This data is gathered using government documents, ridership levels published by public transport providers, newspaper articles and evaluations of neighbourhoods.

3.2 Development process in practice

A large number of stakeholders are involved in the development process, both governmental institutions - often spread over several departments - and market parties such as developing parties and public transport providers (Rijksoverheid, 2021; Michielsen et al., 2019; Rijksdienst voor Onderneming Nederland, 2021). To determine the feasibility of development strategies in practice, two rounds of semi-structured interviews are held with 7 of those stakeholders.

The participants selected for the interviews are land-use and transportation planners from governmental institutions and transport providers that are involved in the development of public transport in residential areas. The interviewees are from three groups: Municipal government (1), Transport authority (2) and Public transport provider (3). Table 1 gives an overview of the interview participants, their organisation, function and expertise.

These three groups were chosen, because the stakeholders in these three groups have the most power/interest in the development of public transport in a residential area. That is to say, area development is primarily a task of municipalities and the governing transport authority. Together they make decisions on the development vision for the area. From the market parties, the party with the largest interest are the public transport providers, as it is their goal to make a profit from the service they offer. The national government also has a lot of power, as they are the main source of funding (Pojani and Stead, 2014; Rijksoverheid, 2021), however it was decided to exclude them from the research, as they are not involved in the actual planning process.

As the views of those different stakeholders on the development strategy might not align, the Delphi method was applied. The Delphi method is an iterative feedback technique that has been specifically designed to achieve a

consensus from a group of experts (Okoli and Pawlowski, 2004). It uses several rounds of interviews, in which each of the participants is asked to respond to the (anonymous) statements of the other participants until a group consensus is reached (Schmalz et al., 2021). For this research, the technique is applied to explore if there is a consensus on the development strategy that has to be followed. This is done through two round of interviews.

In the first round, the interviewees were asked to give their view on the development strategy they think must be followed and the decision making factors they use to determine this. Furthermore, the participants were asked to validate the identified stakeholders and to state the influence of each of the stakeholders per development phase. The results from this round were analysed using qualitative coding. The encoding scheme for the first round of interviews was created following the steps below, which are inspired by the encoding steps as used by Spruijt (2016); Saldaña (2013).

- (1) Assign structural codes to the interview
Each interviewee was assigned an id code (A - G) and a group code (1-3). The groups correspond to the different types of organisation the participants work for: (1) Municipal government, (2) Transport authority and (3) Public transport provider.
- (2) Assign theme codes
To organise the information retrieved from the interviews, different theme codes were used: travel behaviour influences, decision making factors, stakeholders and development strategy.
- (3) Compose encoding scheme
The coded data was added to the encoding scheme, which gives an overview of the information from the interviews per theme. This way, similarities and differences in the answers could be identified.

From this scheme, statements on the decision making factors and development strategies were selected to

Table 1
Interview participants.

	Organisation	Function and expertise
A1	City of The Hague	Organises and oversees intra organisational collaborations. Expert in the field of the built environment (mobility, land-use, sustainability, housing, economics).
B2	Transport Authority Rotterdam The Hague	Involved in the transportation planning for Vinex-locations around The Hague. Expert in the field of transport planning in relation to the built environment.
C1	City of Almere	Responsible for local bus transit in Almere and regional bus transit between Almere and 't Gooi and Amsterdam.
D1	City of Nijmegen	Advises the mayor and alderman on mobility related projects. Expert in the field of transport planning in relation to the built environment.
E2	Transport Authority Amsterdam	Focuses on medium to long-term developments that impact the regional and national transport system.
F3	GVB (Public transport company of Amsterdam)	Works on short and long-term network development for the municipality of Amsterdam and its surrounding municipalities.
G1	City of Utrecht	Expert in the field of land-use and transport planning. Currently works on long-range public transport connections from and to the city of Utrecht.

present to the interviewees in the second round. This is slightly atypical for a Delphi study, as normally the same questions with the answers given by the other interviewees are presented to determine if people change their mind by seeing the answers of others. However, as the first round of interviews was conducted in a semi-structured form, as this round was also used to obtain information on the process itself, the decision was made not to follow this approach. Both because of the lengthiness answers and because not all topics were related to the goal of the Delphi study, which was to determine what development strategies are feasible in practice. The data retrieved in this round of interviews was compared per interview subject.

The Delphi method has the advantage that the views of a group of experts can be aggregated without the need of a group meeting (Twin, 2021). Furthermore, individuals can express their own opinions in stead of group thinking. However, this also has its disadvantages, as group thinking might help to resolve the points of debate during the discussion. Another disadvantage is that the method can be time consuming and the interviewees need to make a commitment.

Considering that the goal is to identify if there are differences in opinion on the development strategy, it is useful that the views of the different stakeholders are collected separately. By collecting the opinions separately, the opinions of all stakeholders are heard and there are no persons dominating the discussion.

Furthermore, a group discussion could also result in a focus on a specific topic, while other topics are neglected. The differences in opinion that are normally discussed in a group session were instead presented to the participants in the second round. This gave them the opportunity to reconsider their answer based on the opinions of others, while they are not under pressure in the heat of a discussion. As a result, all opinions are heard and the points of debate become clear.

4 Results

4.1 Influence of development timing on travel behaviour

The case studies scrutinised in this research are IJburg, Leidsche Rijn and Ypenburg. Figure 3 gives an overview of the offered level of service of public transport in relation to the number of residents per area. The evaluation of those timelines in terms of the public transport and car ownership levels is given below.

4.1.1 Public transport

All three locations provided some kind of public transport in the early days of development. The difference lies in the quality of the provided public transport. In IJburg, a bus connection was operated for the first residents, and the tram connection started to operate when

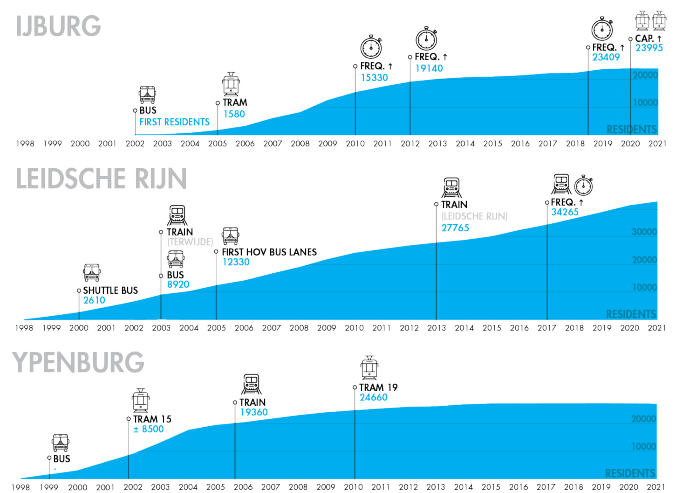


Figure 3. Public transport developments in relation to the number of residents (data on the number of resident per year received from CBS (2013, 2014, 2018, 2019, 2020a, 2021a,b,c,d)).

around 1580 people lived in the neighbourhood. In Leidsche Rijn, the first bus and trains started to operate when around 9000 people lived in the area. Before that, the only option to use public transport was the regular bus service between Utrecht and De Meern, which had a low frequency and a bus stop far away from the neighbourhood. The high-quality bus network was provided from the moment the area had around 12 500 residents and when 27 750 people lived in the area, the train station Utrecht Leidsche Rijn was completed. In Ypenburg, several buses operated in the early days of the development and the first tram connection started to operate when the area had around 8500 residents. The train station was taken into operation when 20 000 people lived in the area and a second tram connection at 25 000 people.

The difference in quality translates to the satisfaction and usage of the passengers. In general, there were a lot of complaints about the lower quality public transport (bus) in both IJburg and Leidsche Rijn. But, as the higher quality public transport (tram) was realised much earlier in IJburg than in Leidsche Rijn (HOV-bus), the residents of IJburg used the tram while the residents of Leidsche Rijn often felt obliged to buy a car as the higher quality public transport was not available.

4.1.2 Car ownership levels

The car ownership levels of each of the neighbourhoods over the years are given in Figure 4. As can be seen, the ownership levels in Leidsche Rijn and Ypenburg are significantly higher than those of IJburg. Leidsche Rijn takes the cake when it comes to the highest ridership levels from 2004 to 2019, however both before and after that time period the ridership levels are similar to or lower than those of Ypenburg, which lie around the nationwide average of about one car per household.

Car ownership per household (2005-2020)

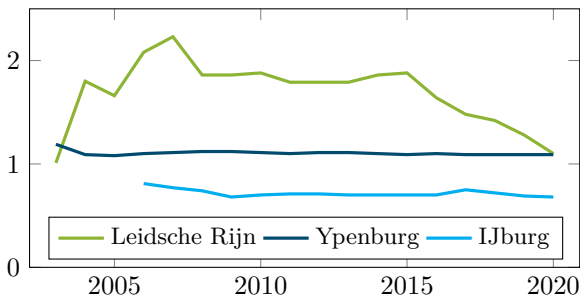


Figure 4. Car-ownership over the years (data retrieved from CBS (2013, 2014, 2018, 2019, 2020a, 2021a,b,c,d))

4.2 Development process in practice

4.2.1 Decision making factors

The decision making factors mentioned in the first round of interviews are the costs, benefits, preconditions of the location, mutual assurance and money availability.

The factors that were mentioned most frequently are the costs and benefits. According to most interviewees, the decisions on the development timing are based on the trade-off between these two. In this trade-off, the investment and operation costs of the provision of public transport are weighed against the benefits of early provision. In the second round of interviews, the interviewees added that governmental institutions use social cost-benefit analyses, while public transport providers base their decisions on the financial costs and benefits, as their goal is to make a profit from the service they offer. Regarding those benefits, most interviewees state that early provision is important, as more people will use the public transport connection when it is provided early. However, it was also argued that this is only partially true, as people will move to another place every ten years on average, and the area will thus be renewed in terms of inhabitants after those ten years. These inhabitants will have public transport available from the first day they live in the area, which means there will be little difference in ridership levels in the long term. In the second round, several arguments were made to undermine this, the main being that no one is average and this statement is only true when you only consider people, but is not true when you consider spatial planning as well.

Another factor that was mentioned frequently, was the location dependency. The interviewees suggested that the influence of this factor could work in two ways, namely as an influence on how early the public transport connection can and must be provided. The 'can' relates to the possibility to feasibly operate public transport at a certain location. An example of this is that provision of public transport in areas with only a few houses scattered across the neighbourhood is not feasible, because many stops would be needed and only few people would

use them. When an area is developed this way, nothing much can be done in terms of public transportation. For developments where the houses are grouped in higher densities on the other hand, the prospects are better, as one stop can provide access for many people. The location dependency is also related to how early public transport 'must' be provided, or in other words, the urgency there is for public transport in an area. If the development concerns an area which has no existing public transport connection nearby or an area that is prone to traffic problems, the early provision of public transport is more urgent than when there already is a high quality connection nearby. However, it is also argued that the early provision of public transport is always important. A counterargument provided against this is that there only is a limited budget to develop several areas, which means that prioritising certain areas is necessary.

The fourth factor that was mentioned multiple times, is the need for mutual assurance between the different parties involved in the development. The interviewees argue that if there is no mutual assurance between parties on a development timeline, there will be a reluctance to start with the development, as there is a risk that this will have financial consequences.

Where all the other decision making factors mentioned above were stated multiple times and were underlined by all the other interviewees, money availability was only mentioned once and not agreed upon. The main argument provided against it was, that it is something one can influence rather than something one has to base one's decision on.

4.2.2 Development strategy

Regarding the development strategy, all interviewees agree that the final quality cannot be provided from day one, as this is not financially feasible. It is argued that it is best to start with a lower quality and/or frequency option and upgrade the connection as the number of inhabitants grows. Some argue that this could, for example, consist of on-demand buses or buses that only operate at peak moments. However, it is also argued that the provided public transport should have a frequency of at least 4 times per hour. Several interviewees also mention that shared mobility and good accessibility to the existing public transport network are also good options when the provision of public transport is not feasible yet. Thus, there is not one clear vision of what should be provided in the early days of development. The only thing that is agreed upon is that something should be provided.

When implementing this transition strategy, it is argued that the final quality should always be kept in mind, as the infrastructure should be suitable for it when there are enough people inhabiting the new neighbourhood. If this is not considered from day one, it might not be possible to fit the desired public transport connection

in the newly-built area. Furthermore, it is also argued that people have to know when the public transport will be provided, as people might show different behaviour when they have a perspective on the time frame in which the public transport will be provided than when there is no perspective at all.

5 Conclusion

The literature, case studies and interviews reveal that there is no unequivocal answer to the question: "What development strategy should be followed to achieve high ridership levels while still being feasible for the different parties involved?"

The literature suggests that public transport should be provided as early as possible, as there is a certain window of opportunity in which people are more susceptible to a change in travel behaviour. This window of opportunity is the result of the interplay between life events and habitual behaviour. Where habitual behaviour keeps people from changing their travel habits, life events, such as moving, are a trigger to change them. This, together with the effect of the built environment on travel behaviour, suggests that the chance that people will use public transport, is greater when they are subjected to it during this window of opportunity, than when they are subjected to it later. The case studies provide a more nuanced view. They do suggest that the early development of public transport results in less car usage in a newly developed residential area, but they also show that the public transport quality and the built environment play a role in this as well. Furthermore, the case studies show that the provision of high-quality public transport in a later stage does not necessarily mean that it is doomed to fail, as car-ownership levels can slowly decrease in the years after public transport is provided.

The interviewed stakeholders argue that provision from day one is not feasible, as the revenues during early implementation are low and the budget available to subsidise public transportation is limited. They stated that a tailor-made solution is required for each location, as the feasibility of the development strategy and the need for early provision highly depend on the location. These tailor-made solutions are often devised using the same approach, being a transition from a basic to the final quality public transport connection as the development of the area progresses. This way, the first inhabitants do have access to public transportation, but the expenses do not skyrocket.

In short, the development strategy needs to be tailored to the specific development, as the feasibility of a development strategy and the need for early provision are highly dependent on the location.

6 Discussion and recommendations

This study has contributed to a better understanding of the influence of development timing on travel behaviour,

and clarification of the challenges of providing public transport in an early stage. Where previous research focused on either the influence of the built environment on travel behaviour, or the moments in time that people are most susceptible for a change in travel behaviour, this research combined the two topics to explore if development timing can influence travel behaviour as well. The research shows promising results of early implementation for a reduction in car ownership levels and increase in public transport usage. This implies that policy measures aimed at the early provision of public transport can increase the use of public transport. The research also identified the different points of view of the stakeholders and unveiled factors that hinder the early provision of public transport.

There are, however, two main limitations to this research. The first is that the case studies might not portray the causal effect of development timing, as the differences between the case studies can also be caused by other factors than a varying development timeline. This, a limited sample size and missing data all mean that the exact effect of early implementation on the ridership levels remains unclear. Future research could address this limitation by applying a longitudinal research design to evaluate the ridership levels over time. The second limitation concerns the areas and stakeholders studied in the research. The stakeholders considered in this research did not include the national government or parties related to heavy-rail transport, but only stakeholders involved in the development and operation of urban public transport such as bus, tram and metro. The inclusion of these parties will result in another set of stakeholders with their own influence on and interest in the development timing, which might result in different or additional opportunities and obstacles for early implementation of public transport.

Furthermore, future research is recommended to determine if the early provision of any type of public transport is beneficial, or if the quality of public transport plays a major role in this as well. Additionally, this topic also relates to a recommendation for practice: careful attention should be paid to the quality of public transport provided from the start, to ensure that people are persuaded to leave their car at home, or better still, at their dealership.

References

- Beige, S. & Axhausen, K. W. (2017). The dynamics of commuting over the life course: Swiss experiences. *Transportation Research Part A: Policy and Practice*, 104, 179–194, <https://doi.org/10.1016/J.TRA.2017.01.015>.
- Bruns, A. & Matthes, G. (2019). Moving into and within cities – Interactions of residential change and the travel behavior and implications for integrated land use and transport planning strategies. *Travel*

- Behaviour and Society*, 17, 46–61, <https://doi.org/10.1016/j.tbs.2019.06.002>.
- Busch-Geertsema, A. & Lanzendorf, M. (2017). From university to work life – Jumping behind the wheel? Explaining mode change of students making the transition to professional life. *Transportation Research Part A: Policy and Practice*, 106, 181–196, <https://doi.org/10.1016/J.TRA.2017.09.016>.
- CBS (2013). Kerncijfers wijken en buurten 1999-2009. <https://opendata.cbs.nl/#/CBS/nl/dataset/80859ned/table?ts=1634652880387>.
- CBS (2014). Kerncijfers wijken en buurten 2009-2012. <https://opendata.cbs.nl/#/CBS/nl/dataset/70904ned/table?ts=1634651459065>.
- CBS (2018). Kerncijfers wijken en buurten 2013-2015. <https://opendata.cbs.nl/#/CBS/nl/dataset/82931NED/table?ts=1634653709367>.
- CBS (2019). Kerncijfers wijken en buurten 2016. <https://opendata.cbs.nl/#/CBS/nl/dataset/83487NED/table?ts=1634724128240>.
- CBS (2020a). Kerncijfers wijken en buurten 2017. <https://opendata.cbs.nl/#/CBS/nl/dataset/83765NED/table?ts=1634653483956>.
- CBS (2020b). Prognose: Bevolking blijft komende 50 jaar groeien. <https://www.cbs.nl/nl-nl/nieuws/2020/51/prognose-bevolking-blijft-komende-50-jaar-groeien>.
- CBS (2021a). Kerncijfers wijken en buurten 2018. <https://opendata.cbs.nl/#/CBS/nl/dataset/84286NED/table?ts=1642758160279>.
- CBS (2021b). Kerncijfers wijken en buurten 2019. <https://opendata.cbs.nl/#/CBS/nl/dataset/84583NED/table?ts=1642758310769>.
- CBS (2021c). Kerncijfers wijken en buurten 2020. <https://opendata.cbs.nl/#/CBS/nl/dataset/84799NED/table?ts=1642758324608>.
- CBS (2021d). Kerncijfers wijken en buurten 2021. <https://opendata.cbs.nl/#/CBS/nl/dataset/85039NED/table?ts=1642758337883>.
- Clark, B., Chatterjee, K., & Melia, S. (2016). Changes to commute mode: The role of life events, spatial context and environmental attitude. *Transportation Research Part A: Policy and Practice*, 89, 89–105, <https://doi.org/10.1016/j.tra.2016.05.005>.
- Daramy-Williams, E., Anable, J., & Grant-Muller, S. (2019). Car use: Intentional, habitual, or both? Insights from anscombe and the mobility biography literature. *Sustainability (Switzerland)*, 11(24), <https://doi.org/10.3390/su11247122>.
- De Vos, J., Ettema, D., & Witlox, F. (2018). Changing travel behaviour and attitudes following a residential relocation. *Journal of Transport Geography*, 73, 131–147, <https://doi.org/10.1016/j.jtrangeo.2018.10.013>.
- De Vos, J., Waygood, E. O. D., Letarte, L., & Cao, M. (2021). Do frequent satisfying trips by public transport impact its intended use in later life? *Transportation 2021*, pages 1–19, <https://doi.org/10.1007/S11116-021-10209-0>. <https://link.springer.com/article/10.1007/s11116-021-10209-0>.
- Ettema, D. & Nieuwenhuis, R. (2017). Residential self-selection and travel behaviour: What are the effects of attitudes, reasons for location choice and the built environment? *Journal of Transport Geography*, 59, 146–155, <https://doi.org/10.1016/J.JTRANGEO.2017.01.009>.
- Faber, R., Merckies, R., Damen, W., Oirbans, L., Massa, D., Kroesen, M., & Molin, E. (2021). The role of travel-related reasons for location choice in residential self-selection. *Travel Behaviour and Society*, 25, 120–132, <https://doi.org/10.1016/j.tbs.2021.07.003>.
- Friedrichsmeier, T., Matthies, E., & Klöckner, C. A. (2013). Explaining stability in travel mode choice: An empirical comparison of two concepts of habit. *Transportation Research Part F: Traffic Psychology and Behaviour*, 16, 1–13, <https://doi.org/10.1016/J.TRF.2012.08.008>.
- Guan, X., Wang, D., & Jason Cao, X. (2020). The role of residential self-selection in land use-travel research: a review of recent findings. *Transport Reviews*, 40(3), 267–287, <https://doi.org/10.1080/01441647.2019.1692965>.
- Haggan, P., Whitmarsh, L., & Skippon, S. M. (2019). Habit discontinuity and student travel mode choice. *Transportation Research Part F: Traffic Psychology and Behaviour*, 64, 1–13, <https://doi.org/10.1016/J.TRF.2019.04.022>.
- Havlicková, D. & Zámečník, P. (2020). Considering habit in research on travel mode choice: A literature review with a two-level methodology. *Transactions on Transport Sciences*, 11(1), 18–32, <https://doi.org/10.5507/TOTS.2020.004>.
- Ibraeva, A., Correia, G. H. A., Silva, C., & Pais Antunes, A. (2020). Transit-oriented development: A review of research achievements and challenges. *Transportation Research Part A: Policy and Practice*, 132(2020), 110–130, <https://doi.org/10.1016/j.tra.2019.10.018>.
- Janke, J., Thigpen, C. G., & Handy, S. (2020). Examining the effect of life course events on modality type and the moderating influence of life stage. *Transportation 2020* 48:2, 48(2), 1089–1124, <https://doi.org/10.1007/S11116-019-10077-9>. <https://link.springer.com/article/10.1007/s11116-019-10077-9>.
- Kamruzzaman, M., Mostafiz Shatu, F., Hine, J., & Turrell, G. (2015). Commuting mode choice in transit oriented development: Disentangling the effects of competitive neighbourhoods, travel attitudes, and self-selection. *Transport Policy*, 42, 187–196, <https://doi.org/10.1016/j.tranpol.2015.06.003>. <http://dx.doi.org/10.1016/j.tranpol.2015.06.003>.
- Kuiken, A. (2016). Verkeer in steden dreigt vast te lopen. <https://www.trouw.nl/nieuws/verkeer-in-steden-dreigt-vast-te-lopen~bec66e87/>.
- Michielsen, T., Groot, S., & Veenstra, J. (2019). Het bouwproces van nieuwe woningen. *CPB boek*. <https://www.cpb.nl/sites/default/files/>

- omnidownload/cpb%20boek%20woningmarkt%20-%20boek%2033.pdf.
- Okoli, C. & Pawlowski, S. D. (2004). The Delphi method as a research tool: an example, design considerations and applications. *Information & Management*, 42(1), 15–29, <https://doi.org/10.1016/J.IM.2003.11.002>. <https://www.sciencedirect.com/science/article/pii/S0378720603001794>.
- Olde Kalter, M. J., La Paix Puello, L., & Geurs, K. T. (2021). Exploring the relationship between life events, mode preferences and mode use of young adults: A 3-year cross-lagged panel analysis in the Netherlands. *Travel Behaviour and Society*, 24, 195–204, <https://doi.org/10.1016/J.TBS.2021.04.004>.
- Pacheco-Torgal, F., Rasmussen, E., Granqvist, C.-G., Ivanov, V., Kaklauskas, A., & Makonin, S. (2016). *Start-Up Creation*. Elsevier, 2016, <https://doi.org/10.1016/C2014-0-04828-9>.
- Pan, H., Li, J., Shen, Q., & Shi, C. (2017). What determines rail transit passenger volume? Implications for transit oriented development planning. *Transportation Research Part D: Transport and Environment*, 57, 52–63, <https://doi.org/10.1016/J.TRD.2017.09.016>.
- Pojani, D. & Stead, D. (2014). Dutch planning policy: The resurgence of TOD. *Land Use Policy*, 41, 357–367, <https://doi.org/10.1016/j.landusepol.2014.06.011>. <http://dx.doi.org/10.1016/j.landusepol.2014.06.011>.
- Puylaert, G. (2021). HTM wil gebiedsontwikkeling aanjagen. *OV-magazine*, pages 6–9. <https://www.ovmagazine.nl/nieuws/htm-wil-gebiedsontwikkeling-aanjagen>.
- Ramezani, S., Hasanzadeh, K., Rinne, T., Kajosaari, A., & Kyttä, M. (2021). Residential relocation and travel behavior change: Investigating the effects of changes in the built environment, activity space dispersion, car and bike ownership, and travel attitudes. *Transportation Research Part A: Policy and Practice*, 147, 28–48, <https://doi.org/10.1016/J.TRA.2021.02.016>.
- Rijksdienst voor Ondernemend Nederland (2021). Dutch public transport concessions. <https://business.gov.nl/regulation/public-transport-concession/>.
- Rijksoverheid (2021). Beleid ruimtelijke ordening. <https://www.rijksoverheid.nl/onderwerpen/ruimtelijke-ordening-en-gebiedsontwikkeling/beleid-ruimtelijke-ordening>.
- Saldaña, J. (2013). *The Coding Manual for Qualitative Researchers*. SAGE Publications, 2 edition, 2013.
- Schmalz, U., Spinler, S., & Ringbeck, J. (2021). Lessons Learned from a Two-Round Delphi-based Scenario Study. *MethodsX*, 8, 101179, <https://doi.org/10.1016/J.MEX.2020.101179>.
- Snellen, D., Hilbers, H., & Hendriks, A. (2005). nieuwbouw in beweging. Technical report, Ruimtelijk Plabureau, Den Haag, 2005. https://www.pbl.nl/sites/default/files/downloads/Nieuwbouw_in_beweging.pdf.
- Spruijt, C. (2016). *Improving the use of traffic models in transport and infrastructure planning Identification of problem issues and explorative research on possible improvements* [Master thesis, Delft University of Technology], TU Delft repository. <https://repository.tudelft.nl/islandora/object/uuid%3A1fb5d1c8-9a9b-40ad-ad48-56e609c26165?collection=education>.
- Thomas, G. O., Poortinga, W., & Sautkina, E. (2016). Habit Discontinuity, Self-Activation, and the Diminishing Influence of Context Change: Evidence from the UK Understanding Society Survey. *Plos ONE*, 11, <https://doi.org/10.1371/journal.pone.0153490>. <http://gtr.rcuk.ac>.
- Twin, A. (2021). Tools for fundamental analysis: Delphi method. <https://www.investopedia.com/terms/d/delphi-method.asp>.
- van de Coevering, P., Maat, K., & van Wee, B. (2015). Multi-period Research Designs for Identifying Causal Effects of Built Environment Characteristics on Travel Behaviour. *Transport Reviews*, 35(4), 512–532, <https://doi.org/10.1080/01441647.2015.1025455>.
- van de Coevering, P., Maat, K., Kroesen, M., & van Wee, B. (2016). Causal effects of built environment characteristics on travel behaviour: A longitudinal approach. *European Journal of Transport and Infrastructure Research*, 16(4), 674–697, <https://doi.org/10.18757/EJTIR.2016.16.4.3165>.
- van Herick, D. & Mokhtarian, P. L. (2020). How much does the method matter? An empirical comparison of ways to quantify the influence of residential self-selection. *Travel Behaviour and Society*, 18, 68–82, <https://doi.org/10.1016/j.tbs.2019.09.002>.
- van Wee, B. & Handy, S. (2016). Key research themes on urban space, scale, and sustainable urban mobility. *International Journal of Sustainable Transportation*, 10(1), 18–24, <https://doi.org/10.1080/15568318.2013.820998>.
- van Wee, B., De Vos, J., & Maat, K. (2019). Impacts of the built environment and travel behaviour on attitudes: Theories underpinning the reverse causality hypothesis. *Journal of Transport Geography*, 80, 102540, <https://doi.org/10.1016/J.JTRANGE.2019.102540>.
- Wang, D. & Lin, T. (2019). Built environment, travel behavior, and residential self-selection: a study based on panel data from Beijing, China. *Transportation*, 46(1), 51–74, <https://doi.org/10.1007/s11116-017-9783-1>.
- Wolday, F., Cao, J., & Næss, P. (2018). Examining factors that keep residents with high transit preference away from transit-rich zones and associated behavior outcomes. *Journal of Transport Geography*, 66, 224–234, <https://doi.org/10.1016/J.JTRANGE.2017.12.009>.