Well-being Indicators for Car-Free Policies

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Well-being Indicators for Car-Free Policies

A study into the selection and operationalisation of well-being indicators for representing local stakeholder interests in the ex-ante evaluation of car-free policies

by

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Graduation committee

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Preface

After almost six and a half years of studying, this thesis marks the end of a very inspiring time in Delft. I would like to express my gratitude to the members of my graduation committee for their great support. Thank you, Maaike, for shaping the topic with me when I was still overwhelmed by all the interesting topics out there, and for initiating my internship at TNO. Marian, thank you for your practical feedback and your instant enthusiasm about my double degree thesis topic. Yirang and Adam, thank you for your availability - sometimes on quite short notice - for discussing my progress and thank you for thinking along with me and always giving interesting suggestions for overcoming challenges. Thank you, Marjolein, for our frequent check-ins and your down-to-earth feedback on my work. Our check-ins often made me put my struggles into perspective and gave me motivation to continue working on them.

I am also grateful for the welcoming and inspiring environment that I got to experience at TNO. It was nice to get to know everyone and the interesting projects that are being done at SUMS. A big thanks to everyone who took time out of their day to help me with setting up Urban Strategy and with any issues I faced. Also to the other interns at SUMS, thank you for the (sometimes much-needed) coffee breaks and nice conversations.

Furthermore, I want to thank all other students in the thesis room, for the good discussions about thesis topics and about anything else. Thanks as well for providing me with the necessary distractions from thesis work every once in a while. This made my time in the thesis room not always very productive, but at least always enjoyable. The same holds for my roommates and other friends, you provided me with much-appreciated distractions from my thesis and have made me maintain a good work-life balance.

Lastly, I want to thank my family and my girlfriend for their endless support - not only during my thesis but during my whole academic career. They really encouraged me to seize opportunities and make the most out of my time at TU Delft. This motivated me to pursue both academic and personal growth by joining several committees and boards, going on exchange to Trondheim, and applying for a double degree master. I could not have done this all without you.

Especially this last step of pursuing the double degree of Transport & Planning and Construction Management and Engineering shaped this thesis and provided me with interesting insights from both fields. I hope that by combining these fields of research, this thesis can provide a valuable contribution to the role of well-being in policy evaluation so that hopefully, this could lead to better mobility policies and more liveable cities.

R. C. Verbeeke
Delft, January 2024

Summary

Ongoing population growth and urbanisation worldwide increase the pressure on urban transportation systems. This often results in an increase in the use of private cars, which has a significant impact on (among other things) air pollution, noise pollution and traffic safety. To combat these issues, governments worldwide are planning car-free policies to maintain and increase the livability of cities. However, car-free policies often face opposition from local stakeholders, and policy-makers often lack relevant model indicators to represent all stakeholder interests in their ex-ante car-free policy evaluations. Well-being (Dutch: Brede Welvaart) indicators can be more relevant for the various stakeholder interests in car-free policies than conventional indicators. While conventional indicators are often technical or economical, well-being indicators in the context of mobility can cover aspects in the domains of living environment, accessibility, safety and health as can be seen in figure 1 (Vonk Noordegraaf et al., 2021).

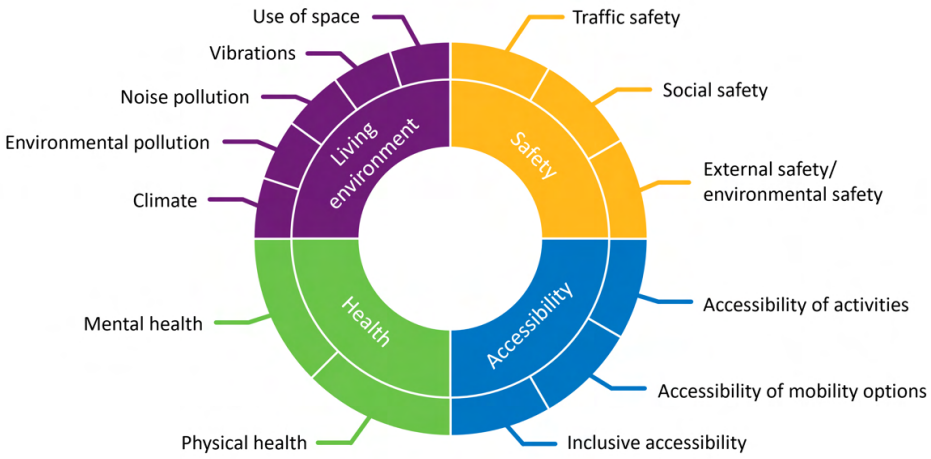


Figure 1: Four domains of well-being related to the mobility system, and their corresponding aspects for indicators (adapted from Vonk Noordegraaf et al. (2021)).

Considering well-being in policy evaluation is a hot topic in the Netherlands, but it is often still conceptual. Existing literature, such as the study by Vonk Noordegraaf et al. (2021), do propose well-being indicators. However, not much research has been conducted in operationalising these indicators in practice. On top of that, when well-being indicators would be operational, one would still have to select relevant indicators for representing the stakeholder interests from the broad spectrum of well-being indicators. This thesis investigates these two research gaps with the following research question:

> How can relevant well-being indicators be selected and operationalised in the planning process of car-free policies to represent stakeholders' interests in ex-ante evaluations?

The goal of this thesis is to contribute to a better representation of local stakeholder interests in car-free policy evaluation and eventually to better local stakeholder support for these policies.

Methodology

To answer the research question, a well-being indicator selection process was developed and applied to a case study in the Oude Westen neighbourhood in Rotterdam. To start, literature research and a stakeholder analysis were conducted to select the most relevant stakeholder groups for participation in this process for the Oude Westen case. Then thirteen semi-structured interviews were conducted with interviewees from these stakeholder groups. The interview transcripts were coded and the results were first analysed on the level of well-being aspects to get insights into which domains and aspects of well-being were found to be important to specific stakeholders. These results were combined with

literature findings to create an average weighted ranking of the importance of the domains and aspects of well-being. The second level of analysis was more nuanced and looked specifically at the different codes within the most important aspects of well-being, giving the context in which the aspects were mentioned. This served as a good base to select relevant indicators for the aspects of well-being. From the proposed indicators by Vonk Noordegraaf et al. (2021), a shortlist of relevant indicators was selected based on these contexts.

A further selection of the relevant indicators was made based on the objectivity of the indicator (for quantification in a model), the relevance for the stakeholders, the representation of different domains of well-being, and the availability of data and resources for the operationalisation. For the selected indicators, a four-step operationalisation process was followed. This included literature research into existing quantification approaches for similar indicators, the determination of the indicator purpose and specification, the development of a quantification approach, and the interpretation and verification of the results.

The indicators were operationalised with TNO's Urban Strategy tool. This is an interactive tool which acts as a digital twin for cities and regions by allowing users to implement interventions after which the model is run to update the results. It includes several modules, ranging from transport-related modules such as mode choice or traffic assignment, to modules related to the environment, such as noise and air pollution. In this thesis, the first two types of modules were used: the New Mobility Modeller (NMM) for mode choice, and the Traffic+ module for the traffic assignment.

As a last step in this thesis, the results of the well-being indicator selection process and the operationalised indicators were validated and the applicability of the process was assessed. This was done in two ways. First, the operationalised indicators were applied to the case study in Oude Westen and evaluated for several scenarios to assess their applicability and relevancy. Secondly, two validation interviews were conducted with involved stakeholders - one with two local neighbourhood council members and one with a policy-maker of the municipality. These interviews served as member checks to validate the results of the process for the Oude Westen case, and also as expert interviews to assess the applicability of this process in practice.

Results

For the Oude Westen case, the stakeholder groups of local residents, local business owners, and the municipality were selected as the most relevant stakeholder groups to be involved in this participation process. They were considered to be the most interested in, and affected by, the car-free policies. The stakeholder interviews revealed stakeholders to be mainly interested in the living environment domain, followed by accessibility and safety. The health domain was not often mentioned by stakeholders. Findings in existing literature about stakeholder involvement in car-free policies showed a similar ranking.

In terms of well-being aspects, stakeholders mentioned most often the use of space, traffic safety, and the accessibility of both mobility options and activities. Literature findings showed more attention to environmental and noise pollution, and to financial consequences for business owners (which did not fall under one of the four specified domains). Combining the findings of these two sources resulted in the ranking of importance of well-being aspects that can be seen on the left side of figure 2.

The second level of analysis yielded the relevant indicators for the most relevant aspects of well-being. These results can be seen in figure 2. The context of stakeholder interests in literature was, in most cases, in line with the case study findings. Often, at least one of the indicators proposed by Vonk Noordegraaf et al. (2021) was relevant for the context in which stakeholders mentioned the specific aspect of well-being. For some aspects, however, the proposed indicators were not on the same level as the stakeholders' experiences. For example, the proposed indicators for physical health were abstract and on a high level (e.g. measuring the outcome or impact in the number of accidents or Disability Adjusted Life Years), while the stakeholders mentioned their interests based on their experiences in daily life (e.g. dangerous mix of different transport modes on the street). In such cases, a new indicator was developed that better reflected the stakeholder interests and was more relatable for the stakeholders. Other times, adding a new specification to the proposed indicator could be sufficient to make the indicator represent the stakeholder interests (e.g. adding a quality aspect to the number of mobility options indicator).

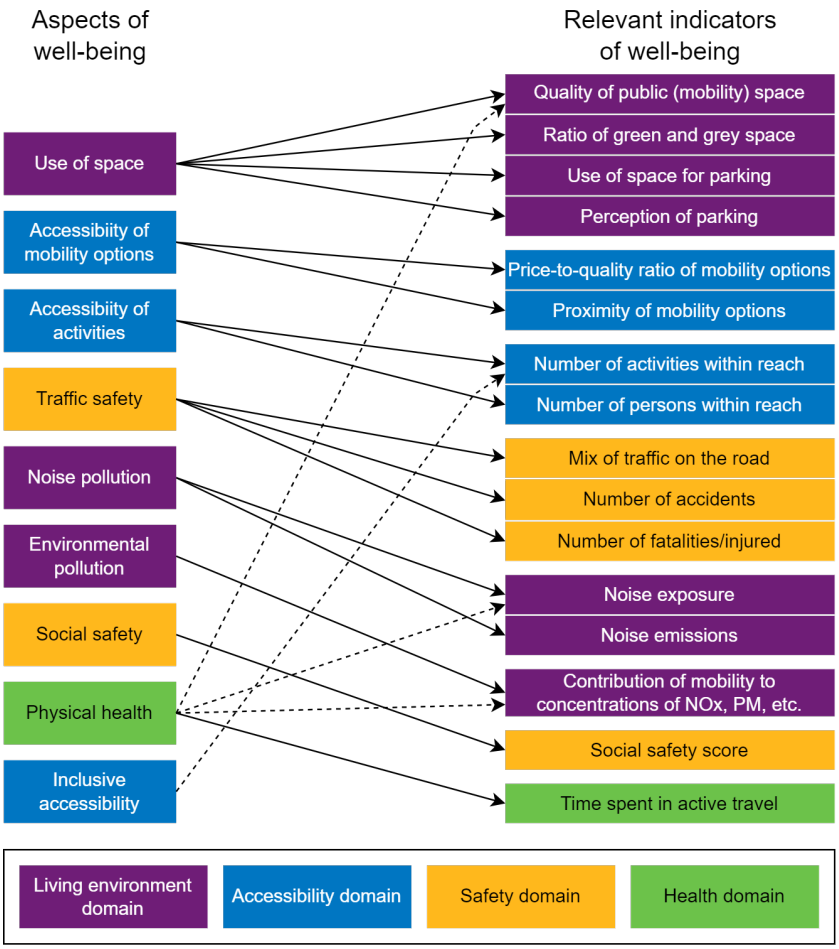


Figure 2: Overview of relevant indicators of well-being and the aspects of well-being that are represented by them - from most important on top, to less important on the bottom. Arrows indicate direct links between aspects of well-being and relevant indicators which Vonk Noordegraaf et al. (2021) also proposed for that aspect of well-being. Dashed arrows indicate a link between an aspect of well-being and a relevant indicator that was originally proposed by Vonk Noordegraaf et al. (2021) for a different aspect of well-being.

From the shortlist of relevant indicators in figure 2, a final selection was made to get to three indicators to operationalise. This included the indicators for the use of space for car parking, the number of mobility options, and the traffic mix on the road.

The use of space for car parking indicator was operationalised to show per zone the area that was allocated to car parking, and the area that was used for car parking after the simulation period (07:00h-09:00h). It also specifies the type of parking and can thus filter for parking spaces in public space. The implementation of this indicator in Urban Strategy resulted in unrealistic results for the modal split (car trips only accounted for 15% instead of the more realistic 37%). Further research should investigate whether this can be solved with (re-)calibration of the mode choice model of the NMM or the parking function of Traffic+, or the data about available parking spaces or car ownership might be flawed.

The number of mobility options indicator determines the number of options people have to take public transport (PT) within a reasonable walking distance from their house. As a quality aspect of the PT stops, the service frequency is summed. This yields for every residency, the cumulative service frequency of all stops within the threshold distance from their home. This indicator can be relevant for assessing whether an area has enough alternative transport means for the car. By varying the threshold distance, this indicator could also be used with user group specifications, or specifically for assessing inclusive accessibility by reducing the maximum walking distance to 100 metres for example.

The traffic mix warning level indicator was designed to indicate road sections where the cycling infrastructure is not suitable for the combination of the speed limit, bike intensity and car intensity. CROW guidelines were used to determine the threshold values for the intensities per type of cycling

infrastructure (e.g. mixed traffic, cycle lane, or cycle path). For each road section, the speed limit and the bike and car intensities in the model are checked. When one of those is not in line with the guidelines, the traffic mix warning level for the road section is high. Due to technical challenges and limited resources, this indicator was not implemented yet in Urban Strategy, but manual samples showed that it could be applied in practice.

After operationalisation, the indicators were applied to the case study area and their relevance was assessed using different scenarios (the implementation of changes to the tram network, the removal of on-street parking spaces in specific zones, the implementation of one-way traffic in busy streets, and the combination of the parking measure and the one-way traffic). This showed that the number of mobility options indicator was mainly relevant in the earlier stage of the policy planning process to determine whether an area satisfies the car-free requirement of enough alternative transport means. Combining this indicator with a modal split indicator could be valuable to add information about whether these mobility options are also used.

While the use of space for car parking indicator could not fully be implemented due to the technical challenges mentioned above, an adjusted approach without the mode choice model could already show the dispersion of parking cars to neighbouring zones in the scenario that removed parking spaces. However, when planning policies that do not directly target parking spaces, it can be valuable to complement this indicator with a conventional traffic intensity indicator. This is more relevant for the one-way traffic scenario.

Overall, it could be concluded that these indicators can be relevant in practice, but it depends on the type of policy that is being evaluated. Also, conventional indicators can be relevant to complement these well-being indicators and clarify observed changes. Since the traffic mix warning level was not implemented yet, this was not used for the case study. However, one could argue that changes in traffic intensities could also be visible in this indicator, making this indicator relevant for some policies as well.

As the last step of this thesis, the validation interviews assessed the validity of the results for the case study, and the applicability of the process in practice. In general, the validation interview results showed that the well-being indicator selection process can yield relevant results. The ranking of well-being aspects was confirmed to be relevant, validating the results of the well-being indicator selection process. Regarding the operationalised indicators, the validation interviews showed that the stakeholders deemed these indicators relevant for the corresponding stakeholder interests - although their relevance could still be increased by implementing some recommended future developments (e.g. increasing the resolution of the parking indicator from zones to streets). The stakeholders claimed that the well-being indicator selection process could be applied in participation processes and could contribute to reducing participation fatigue, which seems to be in line with literature. However, confirming this causal relationship would require further validation. The expert interviewees added recommendations for the implementation in practice. These included the need for clarity for the participants regarding the procedure of the participation process, the need for the indicator selection process to be able to actually influence the policy evaluation and decision-making, and the need for participants to understand the spectrum of well-being they can consider when stating their interests in the policy.

Additionally to these stakeholder recommendations, the recommendation can be made to add this validation step to all well-being indicator selection processes. This can serve as a final check of the list of operationalised indicators before the policy evaluation and can give stakeholders even more feeling of ownership of the indicators. This additional step results in the recommended implementation of the process as shown in figure 3.

Discussion

The results showed that the well-being indicator selection process can yield relevant results. There are, however, some limitations of this study to take into account. These can serve as directions for future research. First, following the well-being indicator selection process with different stakeholders might yield different results. For example, the visitors of the area were not taken into account in this case study because it was a large, heterogeneous group and thus difficult to involve in this process, but they can be an important stakeholder group that could impact the results. Secondly, since the sample size of the interviews was small, the case-study-specific results (e.g. the ranking of importance of well-being aspects) can not be generalised to other cases. It can, however, be argued that one should never

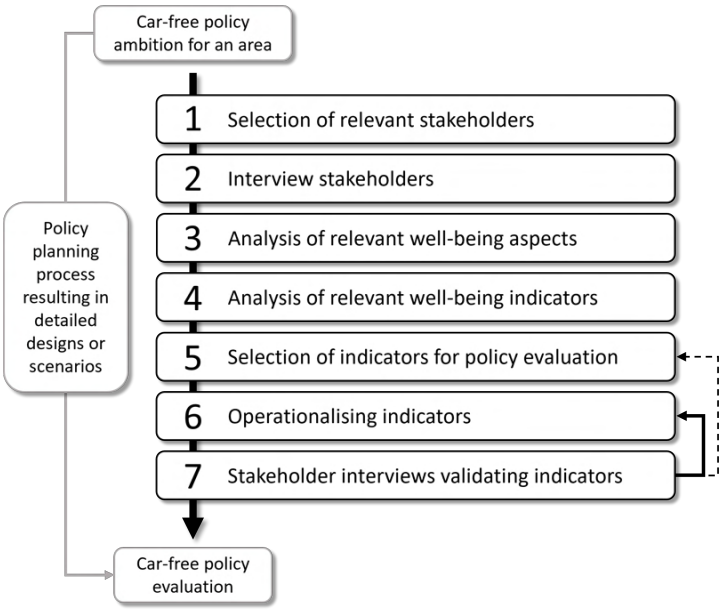


Figure 3: Recommended steps of the well-being indicator selection process in practice. In grey, the embedded context of the policy planning process is shown.

only use generalised indicators since this might oversee important local contexts. Thirdly, this thesis heavily depends on the domains, aspects and indicators of well-being as defined by Vonk Noordegraaf et al. (2021) and using different definitions and indicators could yield different results. However, one could argue that this is not a problem since the selected indicators are merely a means to get to better representation of stakeholder interests in the policy evaluation. As long as the policy-maker is open to adding new aspects or indicators when necessary, the interests can still be represented.

Further validation of the process is required to confirm the generalisability to other cases. However, the expert's claims about the applicability of the process and the potential benefits (e.g. combating participation fatigue and increasing buy-in of stakeholders in the evaluated policies) seem to be in line with existing literature about stakeholder involvement. When the recommended future developments for the operationalised indicators are implemented and the technical challenges are overcome, these can also be applied to other cases. However, it is recommended to validate the indicator outcomes with empirical data before using it in policy evaluation.

Conclusion

This thesis showed that well-being indicators can be very relevant for representing (local) stakeholders' interests in car-free policy evaluations, although this relevance can depend on the type of policy and the stage of the planning process. Selecting relevant indicators requires involving the stakeholders early in the process, analysing their interests, selecting and operationalising relevant indicators, and validating the indicators with the stakeholders. Developing the indicators in cooperation with the stakeholders enables discussions about the evaluation results to focus on the effects of proposed policies rather than the evaluation criteria or the policies themselves. The well-being indicators can represent stakeholder interests at the same level as they are experienced and therefore enhance the relatability of the indicators for stakeholders and provide policy evaluation results that are more relevant for the stakeholders.

Future research could provide more consensus about the used domains and aspects of well-being, leading to a standard set to be used in these well-being indicator selection processes. Secondly, it could investigate the validity of the developed process with other involved stakeholders and for different cases. Lastly, future research could investigate the effects of the use of well-being indicators in policy evaluations and trade-offs between these indicators that might occur.

Since this thesis was one of the first to investigate the relevance of well-being indicators for (local) stakeholders, the developed indicator selection process can be valuable for the application of well-being

in car-free policy evaluation. The three well-being indicators that were operationalised in this thesis provide a first step into turning conceptual well-being indicators into operational indicators and can now be applied in other cases as well. The developed method for operationalising (well-being) indicators can serve as a basis for operationalising other well-being indicators in the future. In these ways, this thesis contributed to solving the problem of a lack of suitable indicators for car-free policy evaluation. With contributions to better stakeholder interest representation and increased buy-in of stakeholders in evaluated policies, this thesis could contribute to increased support of local stakeholders for car-free policies worldwide.

Contents

1

Introduction

Over the previous 70 years, the world has seen a major population increase. From an estimated 2.5 billion people in 1950, the population grew to about 6.1 billion people in the year 2000 and is expected to grow to 9.7 billion people in the year 2050 (United Nations, 2022). At the same time, the population share living in cities[1] has increased between 1950 and 2000 from 25% to about 45% This share is expected to further increase to 58% in 2050 (UN Habitat, 2022). A quick calculation combining these statistics shows that where in the year 1950, about 625 million people were living in cities, this number had already grown to 2.75 billion in the year 2000. In the year 2050, an estimated 5.6 billion people will live in a city.

These 5.6 billion people will not only live in cities, but they will also need to go to work, get groceries, or visit the doctor every once in a while. Their kids will need to go to school, and they might want to be able to go visit family in the next town. All these activities represent movements in and through cities. Therefore, the trend of growing cities does not only come with a challenge to house all inhabitants but also with a significant challenge to accommodate all transport movements in urban areas. These movements can be made with different modes of transport. While the impact of an increase in the number of people walking in the city might be limited, the impact of more people driving their private cars into the cities can be significant. They need extensive infrastructure and since cars are parked for up to 96% of the time, they still take up (often public) space when they are not being used. In the Netherlands, this results in up to 50% of public space in cities being dedicated to cars (Zijlstra et al., 2022).

This impact of cars in cities is not only a future problem, it is already present in the current situation. With their 'Global Outlook on Walking and Cycling' (2016), the United Nations Environment Programme showed other present-day issues with the widespread usage of cars; from global impacts such as increased emission of greenhouse gasses, to more local impacts such as air pollution and traffic safety issues. This does not imply that private cars are the sole cause of these issues. Cars share their infrastructure (not their parking spaces) for example with buses, and partly with cyclists. However, as the classic photo in figure 1.1 shows, cars take up a significantly higher amount of space per person on the road. Of course, this is a simplified picture with some obvious flaws (e.g. buses hardly operate at full capacity, so you need more to transport 69 people). However, it still nicely illustrates the need for more road space per person for cars compared to buses and bicycles. Besides that, compared to the bus, the 60 cars also present 59 more drivers on the road, and 59 more potentially polluting vehicles. This impacts both safety and air quality.

Incidentally, these last two factors are some of the aspects of urban life that have seen an increase in attention over the last years. During the Covid-19 pandemic, people spent more time at home and in their own communities. Partly forced by social distancing regulations and partly as a result of increased attention to mental health, people went outside and searched for more space for their (social) activities.

[1] Cities are defined by the UN Habitat (2022) as "settlements of at least 50,000 inhabitants in a high-density cluster of grid cells (greater than 1,500 inhabitants per sq. km)"

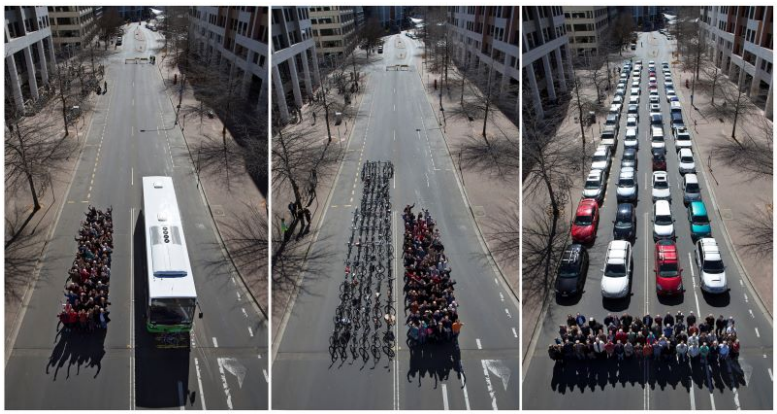


Figure 1.1: Pictures showing the road space needed to transport 69 people in 1 city bus, on 69 bikes, or in 60 cars (We Ride Australia, 2018).

This movement increased the importance of, and attention to, the use of public space, both in green and blue spaces and in streets and plazas (Mouratidis, 2021). Local and regional authorities often facilitated this quest for a high quality of life in local communities. The Covid-19 pandemic proved to be a window of opportunity to implement (often temporary) policies regarding public space allocation to active mode travel and social functions. This resulted in many examples of so-called 'tactical urbanism': simple, small-scale interventions in public spaces that can be implemented in the short-term, often with local community support, and can eventually grow into larger, more permanent and long-term changes (Mould, 2014; Tactical Urbanist Guide, n.d.). Major cities all over the world (a.o. Berlin, Vancouver, Mexico City, and Bogota) turned kilometres of car lanes in existing urban areas into (temporarily) pop-up cycle lanes (Connolly, 2020; Daly et al., 2020). These temporary measures were often very much appreciated by bike-riding local residents. Many local governments aimed to make those pop-up bike lanes permanent after the pandemic ended, but some also faced heavy opposition from car advocates (Cantrill, 2020; The Royal Borough of Kensington and Chelsea, 2020). It seems that for those kinds of policies to become permanent, more support is needed for the policies and more different stakeholders have to be taken into account.

1.1. Problem definition

The example mentioned above illustrates the controversy that is still involved with policies that restrict car usage. Policy-makers often need to make a strong case for the implementation of those measures since they can face strong opposition from affected stakeholders (Nieuwenhuijsen et al., 2018). It is therefore important to identify those relevant stakeholders and take them into account in the process of designing and planning car-free policies. Only then will they be able to buy into the proposals and will the policies be able to gain the widespread support that many policy-makers aim for (Banister, 2008). Including these stakeholders in the planning process, means that their interests should be taken into account in the ex-ante evaluation of policies during the planning process.

In ex-ante evaluations of transport-related policies, decision-makers often work with indicators from models in which the policy is implemented. Traffic-related indicators, such as the demand and potential delays on specific routes, are common outputs of models. However, the many different stakeholder interests related to these car-free policies can lead to the need for different indicators. Examples can be factors related to the liveability of urban areas, (local) air pollution, and available public space. These example indicators might also better support policy-makers in their goals with car-free policies. However, the challenge is to identify the indicators that are needed for these types of policies and to quantify these indicators that might not be commonly available as model outputs yet. Therefore, this thesis aims to contribute to solving the problem that is formulated as:

> Car-free policies are being proposed in existing urban areas worldwide, but they often face opposition from different stakeholders. In supporting their policies, both to the public and to the political decision-makers within their own organisations, policy-makers currently lack model indicators that are relevant to the different interests of the stakeholders who will be affected by the policies.

1.2. Research objectives and scope

In order to overcome the problem stated in the previous section, this research aims to provide policy-makers with a method to quantify a set of indicators that can be used in ex-ante evaluation to represent the relevant stakeholders' interests in car-free policies. When applied in practice, this could ultimately contribute to better aligning the policies to the interests of the affected stakeholders. For achieving this, this thesis has three main objectives:

1. Identify relevant indicators for stakeholders affected by car-free policies in existing urban areas.
2. Develop a method to quantify these indicators in a transport model.
3. Validate the method and results and provide recommendations for application in practice.

These three objectives all focus on the process of planning car-free policies. Which types of policies exactly are included in this thesis is discussed in section 2.1.1. The scope of this thesis is limited to the planning process for these policies. It does not consider the outcomes of the planning process and therefore does not aim to assess the effects of specific policies.

Spatially, the scope of this thesis is limited to policies planned in existing urban areas. This is in line with the problem of densification of existing cities that was described earlier.

Regarding the stakeholders, the scope of this thesis is not limited to one specific stakeholder: the goal is to include the most relevant and affected stakeholders. The stakeholders were selected based on a combination of literature research and stakeholder analysis for a case study (see sections 4.2 and 4.2.2). This combination reduces the risk of arbitrary or case-specific choices in the included stakeholders.

1.3. Research questions

The research objectives described above lead to the following main research question:

> How can relevant well-being indicators be selected and operationalised in the planning process of car-free policies to represent stakeholders' interests in ex-ante evaluations?

This main research question will be answered with the help of four sub-questions. The answers to these sub-questions (SQs) will build towards the answer to the main research question. The following sub-questions are defined:

1. Which stakeholders are, or should be, involved in participation for planning car-free policies and what are their interests in these policies?
2. What are relevant well-being indicators for representing stakeholder interests in the planning process of car-free policies?
3. How can relevant well-being indicators be operationalised in an existing transport model?
4. To what extent can the used methodology yield relevant results and be applied in practice?

1.4. Research context

This thesis research was conducted as part of a double degree programme combining the master programmes of 'Construction, Management and Engineering' (CME) and 'Transport and Planning' (TP, a track of the Civil Engineering master programme). The thesis topic is at the crossroads of these two disciplines and therefore combines the expertise of both programmes. The first two sub-questions combine expertise about transportation policies and model indicators (TP-related) with expertise about stakeholder management (CME-related). For the third sub-question, the more technical transport modelling knowledge of TP is most relevant. Lastly, the fourth sub-question capitalises on the practical side of CME and adds more knowledge on application in practice. Appendix J discusses the contributions of the two master programmes to the different parts of the thesis in more detail. The added value of this double degree is the resulting integrality of this research. By combining qualitative and quantitative research, this thesis provides an integral solution that includes stakeholder involvement, technical indicator development, and practical application recommendations.

This thesis is part of the XCARCITY research programme (xcarcity.nl). With a consortium of public organisations, knowledge institutes, and private parties, XCARCITY aims to develop digital twins for car-free areas within cities. By doing this, they want to support (local) governments, project developers, and transport operators in making decisions about policies for sustainable and clean cities (TU Delft, 2022). Both TU Delft and TNO are part of the XCARCITY consortium. This thesis contributes to

XCARCITY workpackage four by working on indicators for integrated transport models. Meanwhile, it also contributes to workpackage seven - where the knowledge is utilised in practice - by developing an indicator selection method that enables well-being indicators to be applied in practice. The results of this thesis can be used in the research that will be conducted in these workpackages of the XCARCITY programme.

1.5. Report outline

The remainder of this thesis is structured as follows. Chapter 2 contains a literature review of car-free policies in general, the planning process of these policies, and model indicators. This chapter identifies the research gaps that are addressed in this thesis. The 3rd chapter discusses the methods used for the different parts of this research. In chapter 4, an analysis is made of stakeholders and their interests in car-free policies for the case study area, as well as for existing literature related to car-free policies. The next chapter (chapter 5) reports on the resulting relevant indicators for well-being aspects that were found in chapter 4. In chapter 6, a final indicator selection is made and these indicators are operationalised. Chapter 7 discusses the applicability and validity of (the results of) the proposed well-being indicator selection process and the operationalised indicators and gives recommendations for implementing this process in practice. In chapter 8, the results and limitations of this research are discussed. Lastly, the answers to the research questions, the contributions of this thesis, and the recommendations for future research can be found in the conclusion of this thesis in chapter 9.

2

Literature review

As shown in chapter 1, policies related to restrictions on car usage are popular among policy-makers in cities worldwide. Scientific literature seems to confirm the positive effects that cities aim for when implementing car-free initiatives. Meanwhile, there is also (mainly grey) literature available confirming the controversy around implementing such policies. This has led to a small body of knowledge that has been created regarding the planning and implementation process of these policies. However, this often resorts to best practices and qualitative recommendations.

In this chapter, a literature review is conducted on the topic of the implementation of car-free policies in urban areas. The main focus lies on the role, involvement, and representation of stakeholders in the implementation of car-free policies. Since attention in scientific literature has mainly been focused on the concept of car-free initiatives and their effects, sources focusing on the implementation are more limited. Therefore, this literature review uses a combination of peer-reviewed literature and grey literature, such as master theses, conference proceedings, and governmental reports.

Search engines Google Scholar and Scopus are used with a combination of keywords such as *car-free, car-lite, low-traffic* and *stakeholder involvement, stakeholder engagement, community engagement*. This was sometimes complemented with additional keywords such as *policy*, *implementation*, or *indicator*. Specific combinations of these keywords and search operators (such as searching only in titles or abstracts) have delivered an initial list of literature, which could be complemented by using snowballing techniques on this initial literature.

The literature review first goes into detail about car-free policies themselves, their definition, their effects, and their occurrence worldwide. Then, the focus will shift towards the planning process. Section 2.2 looks at literature related to the planning of car-free policies and stakeholder involvement. Lastly, section 2.3 shows what is known about model indicators that measure broader aspects than only economic or traffic-flow aspects.

2.1. What are car-free policies?

Since the second half of the 20th century, the private car has become ubiquitous in society. Many cities have become car-dependent, while the negative effects of this dependency on and ubiquity of cars are significant (Nieuwenhuijsen et al., 2018). Already in the 1960s, the Dutch city of Delft created a 'Woonerf', a residential street where car speeds are restricted and cars equally share the road with cyclists and pedestrians. This turned out to be the foundation of present-day traffic-calming policies (Wright, 2005). From the 1970s, many Dutch cities started to pedestrianise their city centres and ban private cars to improve the quality of life in the city centre (Nederveen et al., 1999). Initially, this car-free movement was sparked by the oil crisis in the 1970s, which also led to the first car-free days in Denmark, Switzerland, The Netherlands, and West-Berlin in 1973 (Badiozamani, 2003; Whitney, 1973). Two decades later, car-free days began to surface again, now with the goal of nudging people's behaviour away from private cars. This eventually resulted in an annual EU car-free day on the 22nd of September (later internationalised to World Car-Free Day) (Badiozamani, 2003; UNEP, 2018). As predicted by

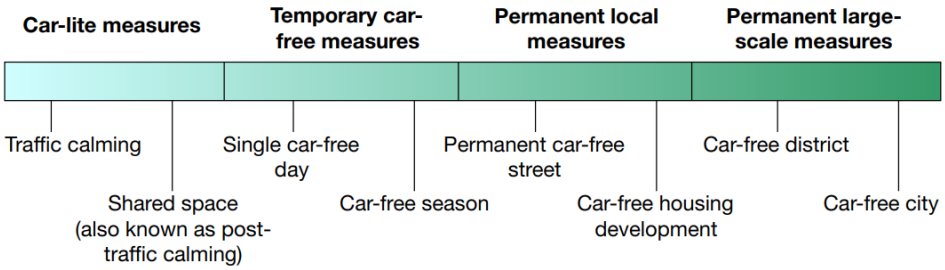


Figure 2.1: Spectrum of car-free measures as defined by Wright (2005).

Badiozamani (2003), the widespread participation in car-free days did (among other developments) seem to have sparked more (participatory) sustainable urban planning.

2.1.1. Definition of car-free policies

The term 'car-free policies' can comprise many different types of policies and initiatives. Terms such as car-free, car-lite, low-car, and low-traffic are sometimes used interchangeably in literature. Melia et al. (2011) assume this is because all variants of car-free development still have to allow some car usage (e.g. mobility impaired, craftsmen, emergency services), resulting in a grey area between car-free and low-car/traffic. This is also stated by Nieuwenhuijsen et al. (2018) who define car-free cities as "a city without private cars but one that may still have buses, lorries, taxis, emergency vehicles, motor-bikes or even shared cars as necessary to move goods and people." (p.200)

Wright (2005) defines an entire spectrum of car-free measures. As can be seen in figure 2.1, this spectrum differentiates measures by temporal scope, spatial scope, and restrictiveness. On this spectrum, most policies that are described in literature fall between the car-lite measures and the permanent local measures, while still being permanent. Though focused solely on mixed-use and residential development (limited spatial scope), Melia et al. (2011) does define the spectrum of car-free and car-lite measures with fixed temporal scope by developing the following definitions:

- "Car-free development: A residential or mixed-use development which normally provides a traffic-free immediate environment; offers no or limited parking, separated from residences; and is designed to enable residents to live without owning a car." (p.28)
- "Low-car development: A residential or mixed-use development which offers limited parking, and is designed to reduce car use by the residents." (p.29)

These two definitions provide a spectrum of permanent car-free development that better fits the examples of policies found in literature. In this thesis, the term 'car-free policies' will be used as an umbrella term that covers all policies that aim to realise development on this spectrum between the two definitions stated by Melia et al. (2011). This includes policies that are traditionally defined as 'low-car' or 'low-traffic' and thus could mean different levels of restrictions on cars. These restrictions would mainly be limited to private cars, and would not fully restrict public cars (emergency services, public buses, delivery vehicles on designated roads, and shared vehicles) as defined by Loo (2018). In the end, all these policies are focused on an increase in car-free transport, whether that is by completely banning private cars, or by merely disincentivizing car usage. Therefore, they all fall under the umbrella term of car-free policies.

2.1.2. Goals, approaches, and target groups of car-free policies

The private car has played a large role in facilitating movements and allowing people to participate in society. However, the disadvantages of the car dependency of large parts of society often affect non-car users by adding barriers to cities, decreasing traffic safety, polluting the air, and decreasing accessibility of car-dependent locations for people without a car (Nieuwenhuijsen et al., 2018). These negative effects of private cars have moved many cities across the world to implement car-free policies. Aims of these policies are often a reduction of car usage in the city and an increase of the share of more sustainable transport modes such as active modes (walking and cycling) and public transit (Nieuwenhuijsen et al., 2018). Policy objectives focused on quality of life and accessibility have been added to traditional traffic-flow-related objectives (Lindenau & Böhler-Baedeker, 2014). By doing this,

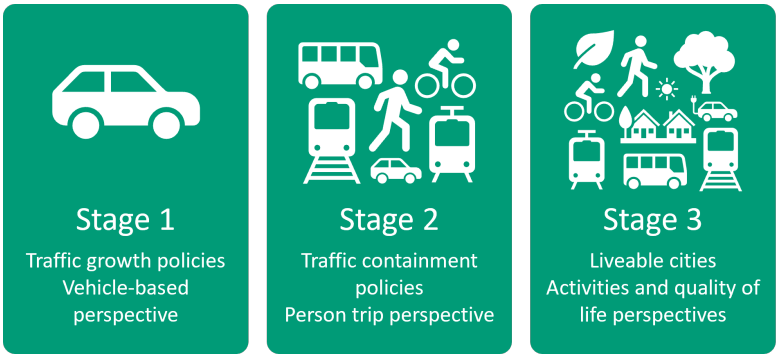


Figure 2.2: Three stages of the evolution of transport policies (adapted from Jones (2014)).

cities move their policies further along the policy evolution defined by Jones (2014) that is shown in figure 2.2. Car-free policies that fall in stages 2 and 3 of figure 2.2 are often implemented to move a city (back) towards being a 'walking/cycling/transit-city' as opposed to a 'car-city' (Ortegon-Sanchez et al., 2017). The perspective of liveable cities and quality of life that the third stage of figure 2.2 uses also comes forward in objectives of increased public health - often one of the drivers of car-free policies. This is often supported by arguments of reduced air pollution and traffic noise, and an increase in physical activity among citizens (Nieuwenhuijsen & Khreis, 2016).

There have been many examples of car-free policies worldwide. By analysing 200 different car-free initiatives, Ortegon-Sanchez et al. (2017) found the four most common rationales behind these policies:

1. **Increasing the attractiveness and convenience of more sustainable transport modes** (e.g. increasing quality of bicycle and pedestrian infrastructure and providing bicycle sharing schemes, or increasing public transport service levels)
2. **Making the use of private cars more expensive and less convenient** (e.g. congestion charges to enter city centres, restricting car access to streets, or regulating parking)
3. **Bring back the social functions of streets** (e.g. closing roads for a day to give space for walking, skating and cycling; turning highways into (semi-)permanent public parks; or removing elevated urban highways)
4. **Developing sustainable residential areas** (e.g. developing car-free residential areas to reduce car-dependencies)

Several approaches mentioned above are targeted at the citizens of cities. Mainly for approach number 4, it is clear that this is targeted mainly at (future) residents of the developed areas. However, if policies are introduced in mixed-use areas or city centres, as opposed to strictly residential areas, the targeted stakeholders can be different. In these areas, a mix of different stakeholders (a.o. consisting of residents, employees of local businesses, and visitors/customers) is the most likely targeted group. For example, Hagen and Tennøy (2018) identified employees working in the city centre of Oslo, who live in other parts of the city, as one of the stakeholders that were affected by the municipality of Oslo's plans to reduce car access and remove parking spaces in the city centre. In the same case of Oslo, Wylie (2019) focused his research on local business owners and commercial property owners as other affected stakeholders.

2.1.3. Results of car-free policies

The aim of car-free policies is to create a more liveable city. The reduction of car traffic is not the objective itself, but it is a means to contribute to more liveable cities (Modijefsky, 2021). When Oslo implemented large-scale car-free policies in their city centre, no significant modal shift was recorded in surveys among commuters into the city centre (Hagen et al., 2020). The authors blamed this on the share of car users already being very low in this group. Overall, however, traffic data showed that the car traffic in the city centre reduced by over 25% between 2016 and 2019 (Modijefsky, 2021). In Madrid, restrictions on parking and the implementation of a Low-Emission Zone (LEZ) resulted in a reduction in private car ownership among citizens in the zones where the policies were implemented (Gonzalez et al., 2021). A similar effect was seen in car-free developments in Vienna (Austria) and Freiburg (Germany) where private car usage and car ownership were at very low levels, much lower

than in other districts in the cities (Späth & Ornetzeder, 2017). It should be noted, however, that in the case of Vienna, the residents were contractually prohibited from owning a car.

Environmental impact of car-free policies

Nieuwenhuijsen and Khreis (2016) reviewed (grey) literature and concluded that car-free policies that actually reduce car traffic could contribute positively to reducing air pollution, reducing noise, and reducing the temperature in cities. However, it should be noted that they also state that for the latter effect, no studies into any causal relation with car-free policies have been conducted. Also, for the other two factors, the extent to which car-free policies would contribute to these effects largely depends on factors such as city layout, traffic density, and active transport provisions. This is also shown in the research by Glazener et al. (2022), who found in their literature review that studies on the effects of car-free days generally find reductions in air pollution and in noise, but that the results do vary significantly per situation. Nieuwenhuijsen and Khreis (2016) further state that when these reductions in pollution (air and noise) materialise, they could lead to reduced premature mortality and morbidity in the affected areas. Globally, car-free policies could, when implemented on a large scale and effective in reducing car traffic, contribute to reducing the emission of greenhouse gases, and thus to mitigation of climate change (Nieuwenhuijsen & Khreis, 2016).

Spatial and social impact of car-free policies

By reducing the usage of cars in cities, also the need for space for cars is reduced. Infrastructure for cars occupies up to 50% of the public space in the Netherlands (Zijlstra et al., 2022). The public space that becomes available after car usage has decreased in cities, can be reallocated to the people. Green spaces and attractive walking and cycling infrastructure can contribute positively to public health, both physical (more physical activity in active transport) and mental (positive effect of green space on mental health) (Nieuwenhuijsen & Khreis, 2016). Other possibilities for the reallocation of public space are towards public squares, markets, and other social functions. This would fall under the approach of bringing back the social functions of streets as defined by Ortegon-Sanchez et al. (2017), which contributes to liveable cities and the quality of life in cities (see stage 3 of figure 2.2 (Jones, 2014)). The reallocation of space was also mentioned by locals as the cause of increased social interaction and emerged meeting spaces for people of all walks of life in Oslo (England & Eriksson, 2020).

2.2. Planning process of car-free policies

Literature about the implementation of car-free cities is more limited than literature about the concept itself and its effects. However, several case studies have been conducted into the planning process of car-free policies implemented around the world. Also, some studies have reviewed these case studies and based on these, concluded some best practices for the implementation of car-free policies. On sustainable transport planning in general, more literature is available.

Cascetta et al. (2015) define a decision-making model for transportation planning by combining three aspects of the planning process: policy decision-making, quantitative analysis, and stakeholder involvement. As can be seen in figure 2.3, the three aspects are parallel to each other and interact throughout the entire decision-making process. The combination of the three aspects is said to improve the planning process of transportation systems by adding more transparency and open communication of the decision-making and the technical analyses (Cascetta et al., 2015).

2.2.1. Stakeholder involvement in policy planning

Stakeholders can be defined as ”people and organizations who hold a stake in a particular issue, even though they have no formal role in the decision-making process” (Cascetta et al., 2015 (p.28)). These stakeholders have some kind of interest in the planned policy. This interest can be sparked by the degree to which the policy affects their living environment or economic situation, or by the stakeholders’ professional or institutional interest (Cascetta et al., 2015).

The importance of the participation of stakeholders in the planning of sustainable urban mobility is generally endorsed in literature (Banister, 2008; Esztergár-Kiss & Tettamanti, 2019; Lindenau & Böhler-Baedeker, 2014; Nieuwenhuijsen et al., 2018; Wright, 2005). Banister (2008) defines ’involvement and communication’ as one of the seven key elements of increasing acceptance of sustainable mobility policies. He argues that stakeholder involvement is essential to make stakeholders buy into

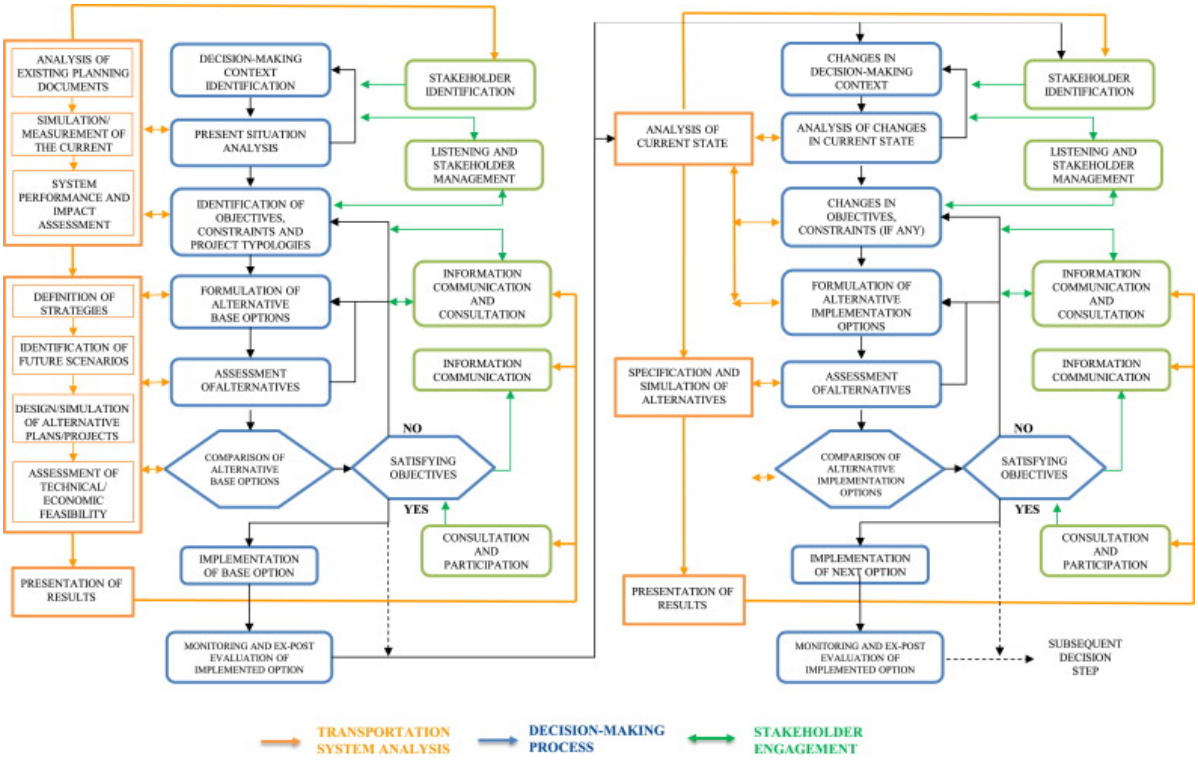


Figure 2.3: Transportation decision-making model based on cognitive rational decision-making, quantitative analysis, and stakeholder engagement (Cascetta et al., 2015).

policies and to gain widespread support for them. Lindenau and Böhler-Baedeker (2014) confirm this statement after researching several sustainable mobility plans in European cities. Although it cannot give any guarantees, they do state that involvement in the process can encourage stakeholders and the general public to take ownership of the concept of sustainable mobility and related policies. They also emphasize that the local expertise that stakeholders can bring could help to reach a consensus sooner. The differentiation between stakeholders and the general public that was made by Lindenau and Böhler-Baedeker (2014) is also used by Fernandez-Heredia and Fernandez-Sanchez (2020), who state that involvement should take place on different levels: among stakeholders (interest groups and organised individuals) and also among the less organised rest of society. Policy-makers might often forget to involve the average person in the planning process, which makes the proposed policy more of a change from the top down instead of a change supported from the bottom as well. This latter situation can often result in change actually taking place, emphasizing the importance of public support (Wright, 2005).

2.2.2. Stakeholder involvement in planning car-free policies

As mentioned in the chapter 1, many parties can be affected by the implementation of car-free policies, and many different interests play a role. Already in the first large-scale pedestrianisation of city centres in the Netherlands, differences in attitude towards the policy could be seen between different stakeholder groups. For downtown residents, the disadvantages of higher parking costs were offset by the advantages of a better quality of life and higher property values in the centre. Residents of neighbouring areas, however, saw more illegal parking in their neighbourhoods, which was not offset by an increase in quality of life (Nederveen et al., 1999).

In a review of many car-free policies, Kuss and Nicholas (2022) found that the majority of the interventions were led by one stakeholder: the local government. They also found that collaboration with other stakeholders was important for the support for the intervention - in 20 out of 26 cases, the leading stakeholder involved one or more other stakeholders in the planning process. The stakeholders that were most often involved were private parties ((local) businesses), followed by public transport operators and the civil society (Kuss & Nicholas, 2022).

Doheim et al. (2020) also analysed cases where car-free policies were implemented. They confirm that support for policies is greater when the public is involved and they show examples where information campaigns and adapting the policies on the input from local stakeholders have seen positive results. Doheim et al. (2020) stress that awareness of the public of the positive effects of car-free policies should be raised. However, this does seem like a one-way type of public involvement and the adaptations to the policies in the examples they show were only done after implementation. Therefore, these examples do not seem to show actual stakeholder involvement in the planning process, but merely public information campaigns.

Wright (2005) gives a broad overview of all stakeholders that can potentially be affected by car-free policies in developing cities. Since this was written in a handbook for developing cities, Wright (2005) produced a very extensive list of potential stakeholders that can be anyone from sewer companies to the insurance industry. This does, however, make the list very general and examples of cases where all these stakeholders were actually involved were not shown. The book does give cities some basic tools to involve communities in the planning process.

2.2.3. Best practices for planning and implementing car-free policies

In literature, various authors have reviewed cases of car-free policies being planned and implemented to find the best practices for these policies to be effective. They often conclude with a list of 'essential steps' to take to set your policy up for success.

Doheim et al. (2020), for example, conclude their review of several cases of car-free policies with three pillars with recommendations for car-free policy implementation: Planning, Policy, and People. First, there is the need for effective planning of transport and infrastructure that provides people with alternatives to using the private car. Secondly, an effective and complementing range of policies is needed with a focus on encouraging and rewarding, rather than on punishing and prohibiting. Lastly, Doheim et al. (2020) recommend in the first two pillars to put the people first and combine that with encouraging public participation and raising awareness.

Glazener et al. (2022) give several recommendations for organising car-free days and events. They stress the need for strong political will and for effective management of the events among all government departments and other involved stakeholders. Thirdly, they mention the need for public involvement and support from citizens and private sector parties (Glazener et al., 2022). While specified for car-free events and not necessarily for car-free policies in general, these three requirements closely resemble the three pillars that were defined by Doheim et al. (2020). An important requirement for the successful implementation of car-free events (and also for car-free policies in general) that is added by Glazener et al. (2022) is the accessibility of the car-free event and destinations in the car-free areas. If not realised, accessibility can create a barrier for people to participate in the event or to support the policy.

In their book chapter, Nieuwenhuijsen et al. (2018) suggest nine prerequisites for a more successful transition to car-free cities. Although still often based on empirical examples, most of these prerequisites are also supported by extensive literature. In figure 2.4, the nine prerequisites are divided into four categories and the relations between the prerequisites and categories are shown. The governance prerequisites are essential to realising the needed infrastructure prerequisites for alternative transport means and the necessary funding (Nieuwenhuijsen et al., 2018). The alternative transport means are in turn necessary for stakeholder support (Doheim et al., 2020). Lastly, some two-way interactions are shown in figure 2.4. The detailed planning is interacting with stakeholder involvement as this is essential in the planning process (as described in section 2.2.1). Evaluation also interacts with detailed planning as pre- and post-implementation evaluation can improve and adjust policy plans. This evaluation in turn also interacts with stakeholder involvement since criteria for the evaluation of alternatives should ideally be (partly) based on stakeholder involvement to ensure policies are suited to the involved stakeholders.

2.3. Indicators in transport policy planning

In planning transport policies, policy-makers often make use of indicators. Indicators are defined by Gudmundsson and Sørensen (2013) as "variables that are constructed and selected to operationally represent properties of entities of interest." (p.44) When these indicators are compared over different scenarios, or with a benchmark value, policies can be evaluated. In combination with models and

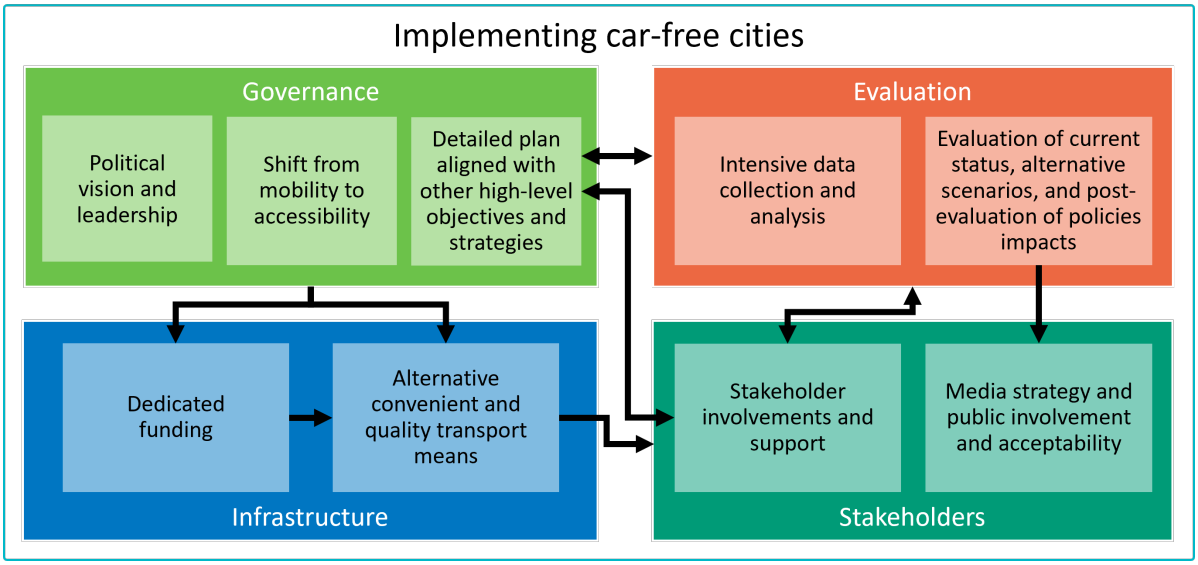


Figure 2.4: Nine prerequisites for the implementation of car-free cities (adapted from Nieuwenhuijsen et al. (2018)) divided into four categories. The black arrows show the influential relations between the prerequisites and/or the categories.

scenarios, indicators can be very useful for ex-ante evaluation of policy (Gudmundsson & Sørensen, 2013). Tuominen et al. (2008) add to this that the indicators that are used, and transport policy research in general, should be 'fit-for-purpose' in order to be used to support decision-making in transport policy planning. This implies that the indicators should fit the purpose of the policy, and thus should be relevant to the intended goals of the policy and the involved stakeholders. For car-free policies, this means that there is a need for indicators that represent broader interests than just traffic-flow-related aspects. Looking back at Jones's (2014) stages of policy evolution in figure 2.2, car-free policies would mainly fall under stages 2 and 3 (Ortegon-Sanchez et al., 2017). This would mean that indicators should be used that represent the perspectives of these stages, resulting in some traffic-related indicators, but also indicators with a focus on liveability and quality of life.

2.3.1. The definition of measuring beyond GDP

The need for indicators that look at social and environmental aspects has become a topic of attention outside the domain of mobility as well. The European Commission (2009) published a report in which they emphasised the need for indicators that fit the challenges of today's world. They suggest the development and use of environmental indicators such as air pollution and its impact on public health, and social indicators such as well-being and quality of life. This report was part of the 'Beyond GDP[1]' initiative that aims to develop "indicators that are as clear and appealing as GDP, but more inclusive of environmental and social aspects of progress" (European Commission, n.d.). In the Netherlands, the Netherlands Bureau for Economic Policy Analysis (CPB), the Netherlands Institute for Social Research (SCP), and the Netherlands Environmental Assessment Agency (PBL) also decided to include more indicators in their policy analyses that go beyond the GDP (CPB, 2021).

These indicators that go beyond the GDP and include more social and environmental aspects of welfare fall under the Dutch term 'Brede Welvaart', or 'Broad Prosperity'. Although 'Brede Welvaart' seems to be an established term in Dutch literature, there does not seem to be a full consensus on the English term yet. In international literature, terms such as 'Beyond GDP' or 'Welfare Beyond GDP' are also used (see European Commission, n.d.). In the context of the Netherlands, governmental organisations use the English terms '(Broad) Well-being' (e.g. PBL (2022), IenW (2022) and CBS: Van Sandijk (2018)), 'General Welfare' (e.g. CPB (n.d.)), and 'Broad Prosperity' (e.g. CBS (2020)). The English term 'well-being' seems to be used the most by official organisations, and also covers best the social and environmental (or quality-of-life) aspects that are considered in the next section (Aitken, 2019). Therefore, this term will be used in this thesis for indicators beyond GDP, and as a translation of the Dutch term 'brede welvaart'.

[1] GDP stands for Gross Domestic Product and is an economic indicator that is often used for measuring macro-economic development in countries (European Commission, 2009)

2.3.2. Indicators of well-being in the mobility domain

Well-being (Dutch: Brede welvaart) is defined by the Dutch national statistics office CBS (2020) as "the quality of life here and now and the extent to which this will not negatively influence the quality of life of generations to come and/or of people elsewhere in the world" (translated from CBS (2020), p.26). This definition mentions multiple aspects of well-being: here and now, later, and elsewhere. These three dimensions of well-being all cover certain themes, as is shown in table 2.1. The goals of car-free policies (as explained in section 2.1.2) mainly correspond with the well-being dimension of here and now. However, mainly in light of the aim to reduce global greenhouse gas emissions, also the other two dimensions can be relevant.

Table 2.1: Dimensions of well-being with the corresponding themes (adapted from CBS (2020)).

Dimension of well-being	Themes	
Here and now	- Subjective well-being - Material welfare - Labour and leisure - Environment	- Residence - Society - Safety - Health
Later	- Economic capital - Natural capital	- Human capital - Social capital
Elsewhere	- Trade - Development aid	- Environment - Natural resources

In their contribution to the CVS conference, Wilmink et al. (2021) plead for the use of well-being indicators in mobility policies. They state that policies are often evaluated on a limited set of indicators and that the use of well-being indicators could improve policy evaluations. Besides this, using well-being indicators could also justify innovations in mobility because of the attention to effects that go beyond only the mobility system. They do note, however, that the choice of which indicators to include could significantly impact the outcome of evaluations (Wilmink et al., 2021). The positive message about using well-being indicators was also endorsed by the Dutch Council for the Environment and Infrastructure (Rli) which states that well-being should be taken into account in all future spatial planning challenges (Rli, 2021).

The Netherlands Institute for Transport Policy Analysis (KiM) supports this attention to well-being in mobility policies by explaining that the effects of mobility policies are not only seen in the accessibility-related indicators but also in a broader definition of well-being (Visser & Wortelboer-van Donselaar, 2021). Increased accessibility of an area can negatively affect accessibility for other areas through (new) spatial barriers; it can affect liveability through changes in social safety, traffic safety, or air pollution; and it can affect nature, ecosystems, and climate. If these factors are affected by the policies, they should also be taken into consideration in ex-ante policy evaluation (Visser & Wortelboer-van Donselaar, 2021). The Netherlands Environmental Assessment Agency (PBL) adds that this attention to these factors of well-being in turn requires operational indicators and tools that can be used for policy evaluation in practice (Snellen et al., 2021).

Commissioned by the Dutch Ministry of Infrastructure and Water Management, the Dutch research organisation TNO (2021) published a report that aimed to identify indicators of well-being for use in the mobility domain. A total of 42 potential indicators were identified in the report. These indicators were divided into four domains of well-being in a mobility context: living environment, safety, accessibility, and health (the same domains as suggested by Snellen et al. (2021)) (Vonk Noordegraaf et al., 2021). Within each domain, several aspects are defined that split up the domain of well-being and cover all the underlying indicators. These domains and aspects can be seen in figure 2.5. A full overview of the four domains, the underlying aspects and the proposed indicators that fall in these aspects is given in appendix A.

This TNO report was presented as a 'quick scan' into the world of well-being indicators in the mobility domain. This means that the proposed indicators are discussed with varying degrees of elaboration. Some indicators came with proposed units and a suggested method to define them. An example of such an indicator is 'CO_2 emissions' (in the 'climate' aspect of the 'living environment' domain), which was suggested to be measured as kilograms of emitted CO_2 (optionally per kilometre), measured per

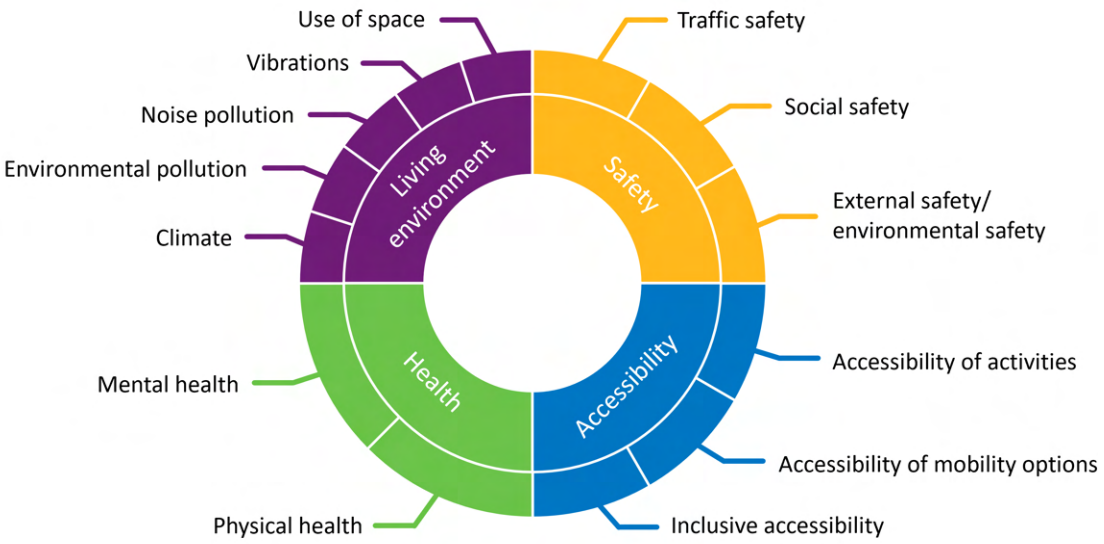


Figure 2.5: Four domains of well-being in relation to the mobility system, and their corresponding aspects for indicators (adapted from Vonk Noordegraaf et al. (2021)).

vehicle (type), per individual trip, or for all trips in the network (Vonk Noordegraaf et al., 2021). Other indicators however, such as the fragmentation of green spaces (in the category 'use of space' of the 'living environment' dimension), did not yet come with an elaboration of calculation method and unit. Irrespective of the degree of elaboration on the indicators, all of them are still conceptual in this report. The report concludes the operationalisation of indicators as one of the topics of attention for future research (Vonk Noordegraaf et al., 2021).

2.4. Concluding research gaps and conceptual framework

This literature review aimed to investigate existing literature and knowledge on all aspects of the topic of this thesis. This thesis aims to contribute to the problem of lacking indicators of well-being for ex-ante car-free policy evaluation. By defining car-free policies, their goals, effects, and results in section 2.1, the car-free context of this thesis is established. The problem as stated in section 1.1 specifically occurs in the planning process of car-free policies. The transport policy decision-making model by Cascetta et al. (2015) (figure 2.3) provides a relevant overview of this process and can serve as a basis for the conceptual model of the context of this thesis. In this model, the emphasis is on the interaction between decision-making, quantitative analysis, and stakeholder involvement. A similar interaction can be found in the relations between the nine prerequisites for the implementation of car-free policies by Nieuwenhuijsen et al. (2018) (see figure 2.4). This adds the specific context of car-free policies to the general transport policy decision-making model. Combining these two sources with insights gained from the literature review yields a conceptual framework (figure 2.6) that shows the interactions in the planning process of car-free policies. This conceptual framework shows the planning process of car-free policies and gives an overview of the context of this thesis. The scope of the thesis is shown by the green area in figure 2.6.

The main elements of this conceptual framework (political will, investments in transport system, detailed planning, stakeholder involvement, policy evaluation, and media strategy) are adapted from the prerequisites defined by Nieuwenhuijsen et al. (2018). The decision-making model of Cascetta et al. (2015) formed the inspiration for the two-way interaction between decision-making and evaluation and between decision-making and stakeholder involvement. Although the two-way interaction between stakeholder involvement and quantitative evaluation was not made explicit in the original decision-making model, the conceptual model below merely makes explicit what was already implicitly defined by Cascetta et al. (2015) through the interaction between stakeholder involvement and the identification of objectives or assessment of alternatives. The interactions connected to stakeholder support for policies were explained in section 2.2.1 about stakeholder involvement in policy planning in general.

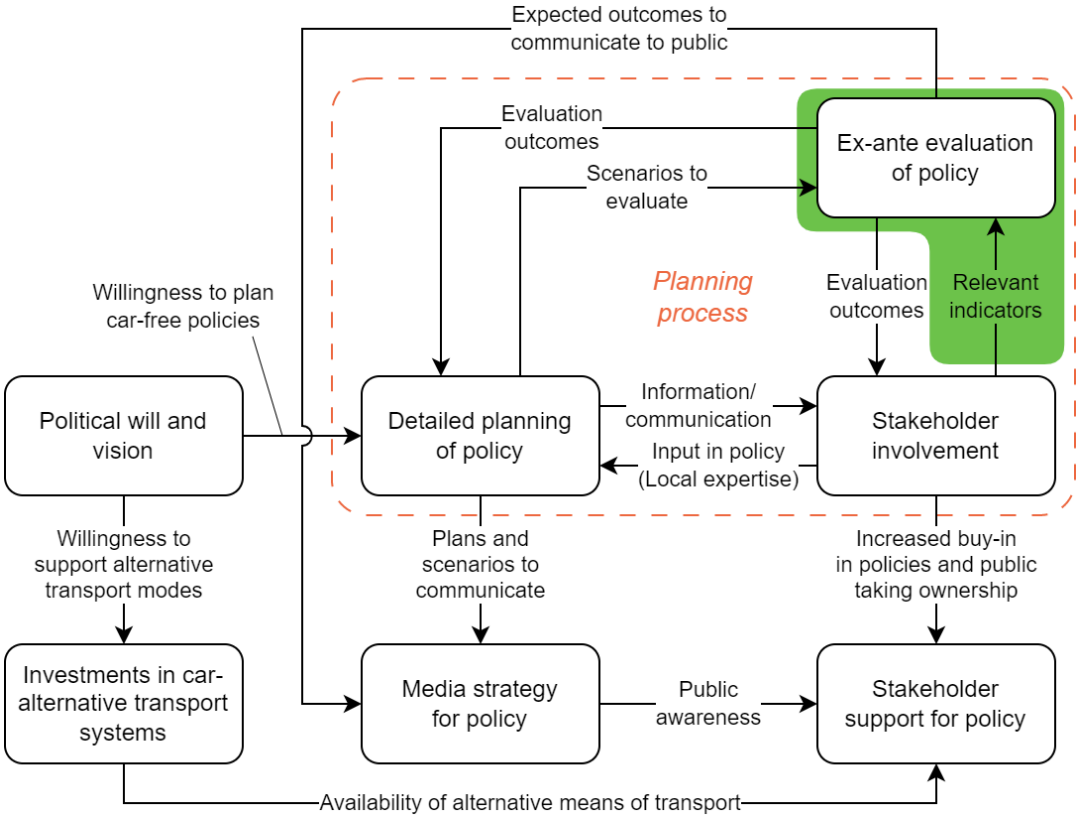


Figure 2.6: Conceptual framework based on literature review (interactions inspired by Cascetta et al. (2015), elements inspired by Nieuwenhuijsen et al. (2018)). The green area highlights the scope of this thesis.

Regarding stakeholder involvement in the planning process of transport policies, there is existing literature available that covers this. Much of this literature elaborates on either the effects that stakeholder involvement can have on the support for the policies, or on the process of getting these stakeholders involved in the first place, often giving practical recommendations and best practices (see section 2.2.1). However, this mainly concerns general cases, often not specified to car-free policies. Although for example Cascetta et al. (2015) did identify where in the process stakeholder involvement could take place, these and other existing studies also do not go into detail about this specific interaction from stakeholders to the quantitative ex-ante evaluation of policies and do not provide details on how stakeholders could be involved in this step of the process. This makes the 'relevant indicators' arrow from stakeholder involvement to quantitative ex-ante evaluation in figure 2.6 the first research gap that this thesis is focused on.

Secondly, since gathering these relevant indicators for this context of car-free policies has not been done in earlier research, not much is known about how these indicators can be used in the quantitative ex-ante evaluation of policies. Quantitative ex-ante evaluation of policies, in general, is nothing new in planning transport policies (e.g. the interaction between planning policies and evaluating them with quantitative analysis was already described by Cascetta et al. (2015)). However, as described in section 2.3.2, car-free policies would require different indicators during the ex-ante evaluation. Such indicators are only proposed in conceptual terms (Vonk Noordegraaf et al., 2021), but they are not operationalised yet. This operationalisation of these well-being indicators in ex-ante car-free policy evaluation is the second research gap that is explored in this thesis.

3

Methodology

This chapter describes the methodologies used in this thesis. First, a general framework of the research is presented. This describes all the steps that are taken in the research. Secondly, the case study area and the method of selection are shown. This is followed by section 3.3 which describes the method for gathering stakeholder interests through interviews. Lastly, section 3.4 shows the methodology of quantifying the indicators in a transport model.

3.1. Research setup

In the previous chapter, a conceptual framework of the context of this thesis was presented (figure 2.6). Zooming in on the green area in this conceptual framework gives the scope of this thesis. Figure 3.2 gives a more detailed framework for the actual research scope of this thesis. This research framework starts at the bottom left with an area where car-free policies are being planned. It ends in the second circle with a method for selecting and operationalising relevant indicators. By going through the framework from start to end, all objectives and all four sub-questions are addressed. In this thesis, a case study area is chosen to apply the whole process to a real case. For the validation of the results, the last step in figure 3.2 (bottom centre) is performed to address sub-question four.

Figure 3.1 shows the intended results of this research, specified per research question. These sub-results are obtained sequentially through the research framework. Sub-question one is answered in chapter 4. In chapter 5, sub-question two is answered. Chapter 6 answers sub-question three. The last sub-question is answered in chapter 7. As can be seen in both the research framework and the intended results, the main intended outcome is a method to select and operationalise indicators of well-being. The case study is a means to explore and apply this process.

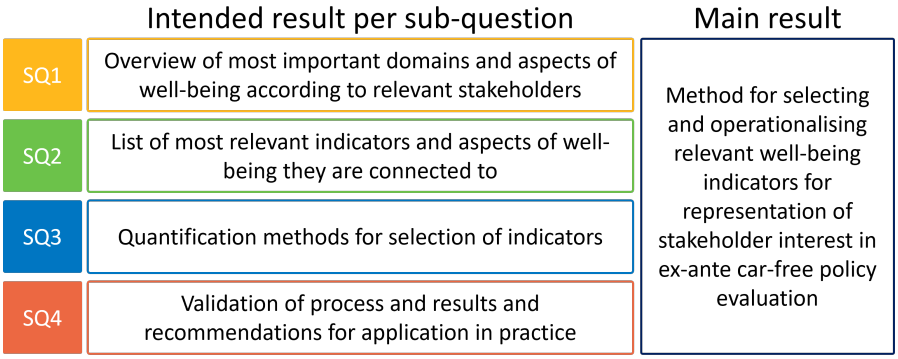


Figure 3.1: Intended results of this research, divided over the four sub-questions.

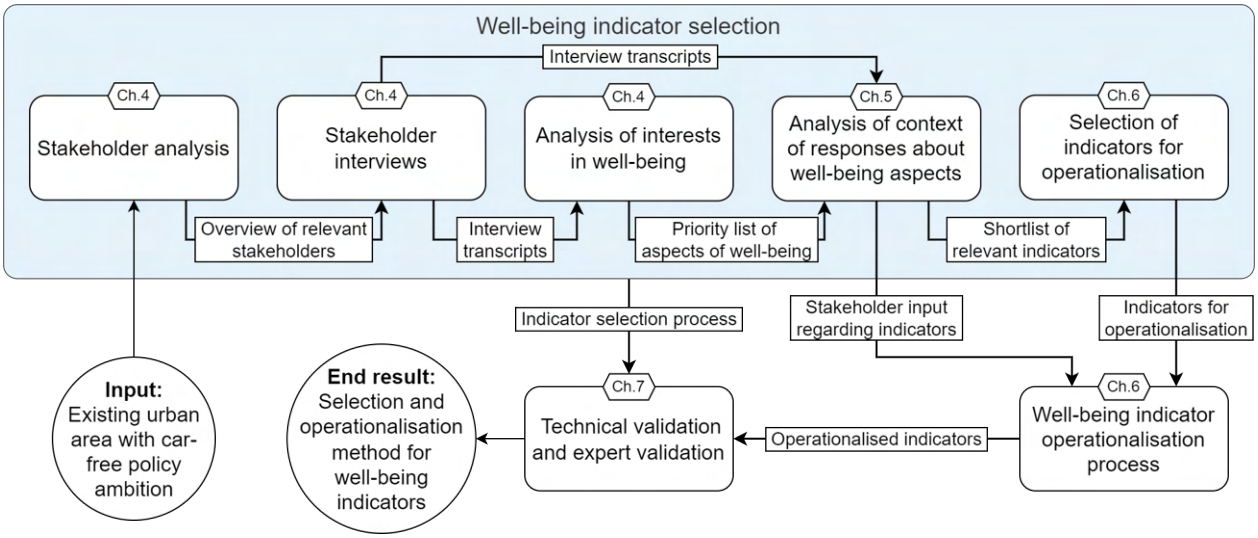


Figure 3.2: Research framework with the start and end of this research project noted in the bottom-left circles. The rounded squares state the methods used in the research step, with on the top the chapter in which this can be found, and the arrows represent the intermediate research outputs that are fed into the next research step.

3.2. Case study area selection

For the selection of the case study area, both practical requirements and representation considerations were taken into account. Practically, the area should be within the scope of the XCARCITY research programme. This scope consists of the Pampus neighbourhood development in Almere (NL), the municipality of Amsterdam (NL), and the Metropolitan Region Rotterdam The Hague (MRDH) (NL). Next, to quantify the indicators in an existing transport model, the case study area should be within the scope of TNO's Urban Strategy model (see section 3.4.1). In theory, new areas could be added to the model, but this would not be feasible within the time and resource constraints of this thesis. Therefore, out of the three earlier mentioned areas, this leaves the cities of Amsterdam, Delft, and Rotterdam.

Several aspects of an area can be considered in order to select a case study that suits the research purpose. The scope of this thesis is focused on existing urban areas (see section 1.2). To ensure the presence of a diverse group of stakeholders, the case study area should be an existing neighbourhood with a mix of different land uses. This ensures the inclusion of different (potentially opposing) stakeholder interests. Also, dense urban areas often have a mixed land-use pattern, so a case study area with this same pattern increases the generalisability of results. Again in the pursuit of generalisability of results, the population of the area should be heterogeneous in terms of age and ethnicity and should as much as possible reflect the overall population of the city.

Lastly, Nieuwenhuijsen et al. (2018) stated nine prerequisites for car-free policies to be implemented. Two of them are also used as criteria for the case study area selection: political will and alternative transport means. These criteria (among other factors) ensure the feasibility of the implementation of car-free policies in the area. As a last criterion, the proximity of dwellings in the area to facilities is taken into account as many facilities in close proximity reduces car dependency and increases the potential of car-free transportation. A full overview of all criteria can be found in table 3.1.

3.2.1. Selection process

The practical requirements leave the cities of Amsterdam, Delft, and Rotterdam available. Another study involving stakeholders in car-free policies in Amsterdam was planned to overlap with this research. In order to let that study complement this thesis rather than conflict with it by involving similar stakeholders, the choice was made not to select an area in Amsterdam. Due to its larger size, the city of Rotterdam provided more potential case study areas than Delft. In the coalition agreement of 2022, the municipality of Rotterdam expresses the aim to turn four neighbourhoods into low-car areas: Oude Noorden, Oude Westen, Middelland and Nieuwe Westen (Gemeente Rotterdam, 2022).

These four areas all have political will to implement car-free policies. Therefore, they are assessed

Table 3.1: Selection criteria for the case study area.

Aspect	Criterion	Consideration
Practical requirements	Scope of XCARCITY	In case study areas of XCARCITY programme
	Scope of Urban Strategy	Urban Strategy model is operational in area
Development type	Existing urban area	New developments are not in the scope
Area size	Neighbourhood	Policies can be planned for entire area at once
		Feasible number of stakeholders to involve
Land-use	Mixed land-use	Diverse stakeholder types involved in area
Population	Age	Heterogeneous population including kids and elderly; representative of city population
	Ethnicity	Heterogeneous population of native Dutch, western migrants, and non-western migrants; representative of city population
Existing plans for car-free policies	Political will required	Prerequisite for car-free policies (Nieuwenhuijsen et al., 2018)
Existing alternative transport means	Several other transport means within area	Prerequisite for car-free policies (Nieuwenhuijsen et al., 2018)
Proximity to facilities	Close proximity to supermarkets, schools, childcare and healthcare	Reduces car-dependency; increases potential for car-free transportation

on the other criteria to make a selection. The full assessment of the areas on the criteria can be found in appendix B. The Oude Westen neighbourhood was found to be the most suitable for the case study area of this thesis. Due to its centrality, this neighbourhood scored particularly well on proximity to facilities and the presence of alternative transport means - multiple tram lines cross the area and the train station can be reached in a 10-15 minute walk.

3.2.2. Oude Westen - Rotterdam

Oude Westen is a mixed-use residential neighbourhood in Rotterdam that was partly rebuilt after the bombing of Rotterdam in the Second World War. Over the years, the neighbourhood has had a diverse population of native Dutch people and migrants from all over the world (Mini World Rotterdam, 2013). From the seventies, the neighbourhood got a bad reputation with high crime rates and drug abuse. However, over the past decades, multiple initiatives from residents and local businesses have successfully worked on improving the area (Mini World Rotterdam, 2013). The housing association Woonstad is continuously working on renovating and rebuilding several residential blocks in the neighbourhood to offer residents more diverse types of housing (Gemeente Rotterdam, n.d.-b).

The neighbourhood is home to just over 9,500 people in roughly 5,500 households (Gemeente Rotterdam, n.d.-f). The ratio of workplaces/residents is 0.38, meaning there are 38 jobs in the neighbourhood per 100 working residents. Of the total area, 63% of the buildings fulfil a residential function, leaving 37% for other functions (Gemeente Rotterdam, n.d.-b). These statistics show the mixed land use of the neighbourhood. They also indicate the need for commuting out of the neighbourhood - as there are not enough jobs for all residents - as well as into the neighbourhood since most likely not all jobs are fulfilled by the area's own residents.

The Oude Westen neighbourhood is located in the centre of Rotterdam, close to the Rotterdam Central Station (see figure 3.3). There are multiple metro stations around the neighbourhood (Rotterdam Centraal, Eendrachtsplein and Dijkzigt) and trams run through both main shopping streets (West-

Figure 3.3: Map of the Oude Westen neighbourhood with the two main shopping streets, the neighbourhood park, the three schools, the medical centre, and all transport options.

Kruiskade and Nieuwe Binnenweg[1]). Various facilities are located within the neighbourhood: shops, restaurants, cafes, schools, a medical centre, and multiple community centres.

3.3. Stakeholders

This section describes the methodology that was used for answering the first two sub-questions. The first sub-question aimed to get an overview of the relevant stakeholders in car-free policies in the case study area. Secondly, the interests of the relevant stakeholders in car-free policies needed to be determined. For this sub-question, a stakeholder analysis was used to determine the relevant stakeholders, who were then interviewed to determine their interests in the car-free policies.

The goal for the second sub-question was to take the results of sub-question one and translate the interests of stakeholders in specific aspects into corresponding relevant indicators of well-being. This sub-question is based on the same interviews as sub-question one and uses a second level of analysis (see section 3.3.3).

3.3.1. Stakeholder analysis

The relevant stakeholders in the case study area were identified through a stakeholder analysis. First, literature was scanned to find the stakeholder types that were involved in earlier studies into car-free or closely related policies. These stakeholder types served as a guideline for which stakeholders to include in the analysis in the case study area. In the stakeholder analysis, the stakeholders were

[1]There are plans to shorten the tram lines that run on the Nieuwe Binnenweg and remove trams from this street. These are part of long-term plans for the entire tram network in the region of Rotterdam (MRDH, 2023). The plan sparked significant protests among residents and local business owners - even resulting in several petitions to keep the trams in certain areas (OPEN Rotterdam, 2023a, 2023b; Visscher, 2023). The municipality did in the end vote for the plan to go through - be it with some changes from the originally proposed plan by MRDH. This would result in fewer available alternative transport means in the Oude Westen neighbourhood. However, even without trams on the Nieuwe Binnenweg, the Oude Westen neighbourhood would still be the area with the most alternative transport means and the most suitable case study area.

identified and described. Also, their power and interest in local car-free policies were assessed. The stakeholders were then categorised into the four quadrants on the power versus interest grid (PI-grid). This stakeholder analysis was based on public sources.

Based on the stakeholder analysis and the categorisation of the stakeholders, the most important stakeholders were selected to be included in the interviews. The choice was made to focus on the stakeholders in the high-power, high-interest quadrant of the PI grid. This focus matches existing stakeholder management theory that names these stakeholders as the most important to manage (e.g. Ackermann and Eden (2011) and Bryson (2004)). Besides this, the focus on one quadrant also limited the number of interviews to a feasible amount within the time constraints of this research. The interviewees were found through the network of the researcher and the supervisors, through other interviewees, and through local community centres.

3.3.2. Interviews

Semi-structured interviews were conducted with 13 relevant stakeholders. This interview style provides freedom for the interviewee to elaborate on everything they find important, and for the interviewer to probe for more elaboration on new aspects that come up during the interview (Doody & Noonan, 2013). Simultaneously, the semi-structured interview also provides a structure for the interviewer to follow to ensure consistency between interviews. For this reason, all interviews were conducted with one of the interview guides in appendix E. The first interview guide was made specifically for an interview with a policymaker. Since this interviewee was experienced with the topic, this interview took an hour and explored not only his/her interests in car-free policies but also the municipality's experience with using well-being in policy evaluation and involving stakeholders in the policy planning process.

The second interview guide was used for the interviews with local stakeholders who are potentially affected by the car-free policies. Within this second guide, some specific questions were altered to apply to the specific stakeholder type that was interviewed. Because of the limited expertise of these interviewees on the topic, and in order to keep the barrier of participation low, these interviews took on average 15 to 20 minutes.

The shorter, less technical interviews with stakeholders were complemented by two interviews with residents who were also on the local neighbourhood council. These two interviews were more in-depth and longer (roughly an hour) than the other affected stakeholder interviews because of more probing and more follow-up questions being used. Through these interviewees' networking roles in the neighbourhood, these interviews aimed to provide more generalisation and validation to the other interview results.

Both interview guides were structured in five parts. Below, you find an overview of the five parts of the interviews with affected stakeholders. For each part, the specific content for the interview with a policymaker or a neighbourhood council member is shown in italics.

1. **Introduction** - Introduction of the interviewer, interviewee, and the research project. Consent for interview and recording was asked.
2. **Personal questions** - Stakeholder type-specific questions about the interviewee and his/her travel behaviour.
    - *For the policy-maker, questions were focused on his/her role within the municipality.*
    - *The two neighbourhood council members were also asked about their roles.*
3. **Car-free policies** - Introduction of car-free policies including examples. Exploration of the interviewee's initial interests in the policies.
    - *The policy-maker was asked here about the municipality's vision on car-free neighbourhoods and its concrete plans for the Oude Westen.*
    - *The neighbourhood council members were asked about their experience of the general interests of residents and business owners in the neighbourhood.*
4. **Well-being** - The concept of well-being is introduced and the interviewee is probed to think about his/her interests in car-free policies given the broad spectrum of well-being.
    - *The policy-maker was also asked about the municipality's main goals in car-free policies when shown on the whole spectrum of well-being.*

- *The neighbourhood council members were also asked about their experience of the general interests of residents and business owners in the neighbourhood.*

5. **Closing remarks** - Space for the interviewee to give some final comments and, if applicable, recommendations of other people who might be relevant to interview.

The interview guides ensured a clear storyline in the interviews and provided the interviewer with a set of questions that covered all aspects that should be covered in all interviews. Since the nature of the interviews was semi-structured, most questions were open and aimed to get a conversation started. The guide also provided potential follow-up questions in specific directions in case certain topics were not sufficiently covered in the initial interviewee response.

Local resident interviewees were mainly recruited in community centres in the neighbourhood. The local business owners were recruited in person in their stores for an interview on the spot or at a later time. The local council members and the policy-maker were approached by email after referral by other interviewees or the researcher's network.

The interviews were recorded with consent from the interviewee. This recording was then transcribed and summarised, and personal information was removed from the summary before it was included in appendix F. The interviews were conducted in Dutch since this is the native language of most interviewees and the interviewer - this means that the transcripts/summaries are also in Dutch.

3.3.3. Data analysis

The data was processed before analysis. For this data processing, the main steps of the method described by Burnard (1991) were adapted to be used for digital transcripts. The resulting five-step process is shown in figure 3.4. First, the transcripts of the interviews are read through and almost all parts of the transcripts get assigned a category. This is the open coding. Secondly, all categories are gathered and similar categories are grouped. For the top-level division of categories, the domains and aspects of well-being (see section 2.3.2) are used.[2] The resulting list of codes is then checked again, similar codes are removed, and the full list of codes is compared to the full transcripts to check if all aspects are still covered. After this, the transcripts are re-read and the final list of codes is used to code all sections of the interviews.

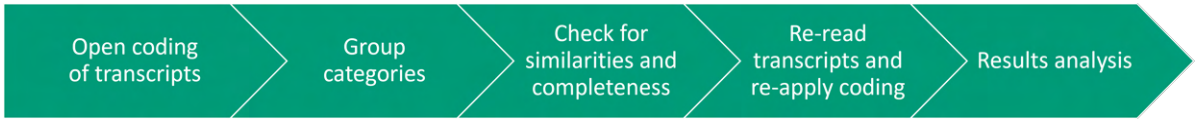


Figure 3.4: Main steps in coding of interview transcripts (adapted from Burnard (1991)).

This process was done after the first batch of interviews was conducted. This batch included interviews with all stakeholders that were to be interviewed. Later interviews were coded with the codes that were found in the first batch. If no code fitted the answer, a new code was added. The full list of codes used can be found in appendix G. After all coding of all interviews was done, the data could be analysed.

The analysis was done on two levels. First, in section 4.3, the results were analysed on an aggregated level per aspect and domain to get insights into which domains and aspects of well-being were found to be important to specific stakeholders. In this first level, most attention was paid to the numeric codes per aspect to get the aggregated results. However, the letters of the codes (and thus the description given by stakeholders) were sometimes also mentioned to be able to determine overarching trends in the results. This first level of analysis aimed to answer sub-question one and provide a ranking of the importance of the well-being aspects.

The second level of analysis happens in chapter 5. Here, a more nuanced analysis was done by looking specifically at the different codes within the most important aspects of well-being - thus specifically looking at the letters of the codes. This analysis level provided a clearer understanding of why stakeholders found certain aspects important and resulted in a good base to select relevant

[2] Every aspect contains codes starting with an odd or an even number - odd meaning this code is positive about the importance of the aspect, and even meaning this code is negative about the importance of this aspect. Each number is followed by a letter which is used to distinguish between the different contexts in which this aspect was mentioned.

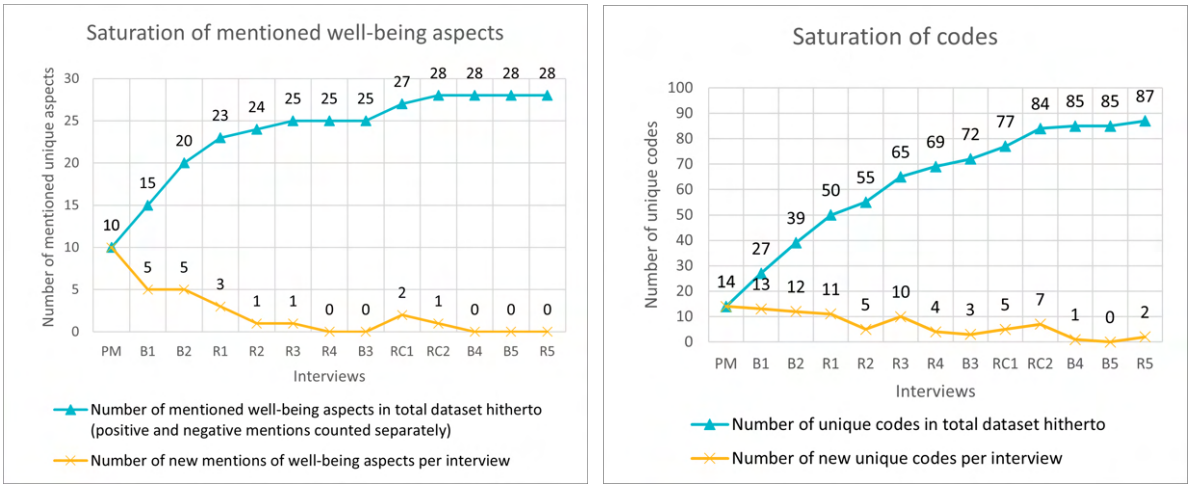
indicators. With this selection of indicators, this analysis level aimed to answer sub-question two and yield the intended end result of a shortlist of relevant indicators.

3.3.4. Sample size and data saturation

In total, 13 interviews were conducted. This section shows the sufficiency of this sample size by demonstrating the data saturation that occurred. Getting a rough estimation of data saturation was already possible during the data collection due to this taking place simultaneously with the coding of transcripts and the analysis of data, which both started after the first five interviews were conducted.

Looking at the first analysis level - aggregated per well-being aspect - figure 3.5a shows the number of newly mentioned aspects of well-being per interview. It can be seen that except for the longer interviews with the local council members, no new aspects of well-being were mentioned in the last seven stakeholder interviews. Even the interviews with the local council members did not yield many new insights. This indicates that saturation is reached in the data on an aggregated level, according to the high-order grouping approach as defined by Hennink and Kaiser (2022).

However, as opinions about well-being aspects were mentioned in different contexts (as analysed in the second level of analysis, the higher-order code saturation does not necessarily mean all nuances and contexts of these opinions are fully explored - at which point meaning saturation is reached (Hennink et al., 2017). The meaning saturation is assessed in figure 3.5b, which shows the number of new unique codes per interview on the disaggregated level (second level of analysis). Here it can be seen that although the last interview does provide two new unique codes, a downward trend in the number of new unique codes can be seen after the sixth interview, and only a few (if any) new codes are identified in each next interview. The interviews with local council members (RC1 & RC2) do not completely follow that trend. This can be explained by them having more expertise on the topic and representing all residents in their interviews. Considering this represented group and the longer interview duration, the number of new unique codes in these interviews is still low. This code frequency count approach (as defined by Hennink and Kaiser (2022)) indicates (near) saturation of the data on the disaggregated level as well.



(a) Number of unique opinions about the importance of aspects of well-being after each interview.

(b) Number of unique contexts in which opinions about the importance of well-being aspects are mentioned.

Figure 3.5: Saturation of data based on two analysis levels. The x-axes display the interviews in chronological order.

A different order of the interview could have resulted in reaching data saturation earlier. When the interviews with the local council members (RC1 & RC2) would have been the second and third interviews in the list, a saturation of mentioned well-being aspects would have been reached after seven interviews - resulting in six interviews with no new aspect being mentioned, one more than in the original order. Also for the code saturation, this new order resulted in a clearer downward trend of new codes per interview. Analysing aspect saturation for 10,000 random orders of the interviews resulted in a maximum of six interviews with no newly mentioned aspects of well-being. This indicates that saturation of the well-being aspects could have been reached no sooner than after seven interviews.

For the code saturation, this maximum number of interviews without new codes was one - indicating that in order to reach (near) saturation on this dis-aggregated level, at least 12 interviews were necessary.

3.4. Operationalisation of indicators

This section describes the methodology of the second part of this thesis, which aims to answer the third sub-question. In chapter 6, all indicator quantification and modelling steps that were shown in the research framework (figure 3.2) are performed. The shortlist of indicators that was the result of sub-question two serves as input for this chapter. The intended result of this chapter is a quantification method for a selection of indicators from this shortlist and an implementation of them in the *Urban Strategy* model.

3.4.1. Urban Strategy

Urban Strategy is a tool developed by TNO to support (a.o.) planners and policy-makers. It interactively visualises information and acts as a digital twin for cities and regions by allowing users to implement interventions after which the model is run to update the results (TNO, 2023). The tool consists of several modules which all have their specific model purpose - e.g. related to transport, such as mode choice or route choice, or related to the environment, such as noise and air pollution. These modules can interact as output data of one can serve as input data for the other. In this study, two modules are used: the New Mobility Modeller (NMM) and the Traffic+ module.

The first module (NMM) is used to model the impact of changes in the model (such as differences in travel times, parking costs, or different available transport modes) on the mode choice that was determined for the base scenario. It uses population data that includes many characteristics (bike/car ownership, driver's license, public transport car, etc.). For each population group, a logit model is then used to determine the utility of different transport modes - which then determines the mode choice (Heezen et al., 2022).

Traffic+ performs the assignment of car, truck and bike traffic on the network. It takes the Origin-Destination matrices (OD-matrices) for the different modes and assigns these trips using one of two methods: All Or Nothing (AON) or Volume Averaging (VA) algorithm. The AON assignment is used for bikes and trucks. It assumes these modes always take the fastest route - and that all travellers making this trip take the same fastest route. The VA algorithm, on the other hand, takes into account the volume of traffic on roads and lets this impact the expected travel time (Heezen et al., 2022). By taking this into account, the fastest route will become less appealing when more vehicles are assigned to this route. Therefore, others might divert to another route. This assignment algorithm requires iterations to assign traffic, take into account the traffic volume on routes, and re-assign the traffic with the updated travel times. This assignment algorithm is used for car traffic in this model.

As a basis, *Urban Strategy* uses an existing, validated transport model. In this case, the same *Urban Strategy* setup is used as in the study by Heezen et al. (2022). This setup is based on the regional transport model of the metropolitan region of Rotterdam and Den Haag (Metropoolregio Rotterdam-Den Haag, MRDH): the V-MRDH model. The V-MRDH model is an OmniTRANS[3] model that can be used by the MRDH, municipalities and the province to perform all kinds of transport and traffic studies (MRDH, n.d.-b). A cut-out of this regional model is made for the municipality of Rotterdam to reduce the size of the model and decrease computation time. From the V-MRDH model, the network and the OD-matrix are imported in *Urban Strategy* (Heezen et al., 2022). The base scenario is for the year 2030 - which means that for example the large infrastructural project of the *A16 Rotterdam*[4] is already completed and is a part of the network.

3.4.2. Selecting specific indicators to operationalise

To get from the shortlist of relevant indicators to a final choice of indicators to quantify, a final selection is necessary. First, the shortlist is narrowed down based on some general selection criteria. After this, a final selection is made from the remaining indicators. This final selection is based on the general

[3] https://www.goudappel.nl/nl/expertises/data-en-it-oplossingen/verkeersmodelleringssoftware-omnitrans-expert

[4] The *A16 Rotterdam* is a large infrastructure project that creates a new, 11km-long highway connecting the A16/A20 with the A13 on the north side of Rotterdam-The Hague Airport (De Groene Boog, n.d.).

criteria and some additional, more case-specific criteria. There are five general criteria for narrowing down the shortlist:

- **Objectivity** - Since the use case for these indicators is ex-ante policy evaluation, objective indicators are most relevant. Subjective indicators are more difficult to quantify in models and often require data that can hardly be gathered before the implementation of the policy.
- **Representation** - As discussed in section 2.3.1, the concept of measuring and assessing well-being involves considering a wide spectrum of domains and aspects. Selected indicators should therefore ideally represent multiple domains of well-being.
- **Relevance** - The result of the previous research steps is a shortlist of indicators that are relevant for this case. This ranking of relevance can be used in this final selection to select the most relevant indicators.
- **Availability of data** - Open or commonly available data ensure that indicators are generally operationalisable and are therefore required.
- **Availability of resources** - The quantification and operationalisation of indicators can take significant time and effort. Since these resources are limited, both in this research and in practice, only a limited number of indicators can be operationalised.

More case-specific criteria are also applicable. In this case, these are specific for this study.

- **Scope of research** - The scope of this research is limited, allowing only three indicators to be operationalised. The development of additional models on top of the existing Urban Strategy modules would not fall within the scope.
- **Current state of the art** - This research is meant to contribute to the current state of the art. That is why it is important to assess what is already implemented in the Urban Strategy model and which indicators can still be added to this.

Section 6.1 discusses these seven criteria in more detail and applies them to make a final selection of indicators.

3.4.3. Quantification methods

The operationalisation process of the selected indicators consists of four main steps. First, literature research is conducted to determine which approaches to quantify or operationalise similar indicators have been used in the past. Secondly, the purpose that the indicator should have is determined based on the input of stakeholders and literature. This ensures the relevancy of the indicator. Some potential specifications of the indicator are also determined here. The third step is to design a quantification approach. This determines how the indicator can actually be quantified and computed. Finally, in the fourth step, the results of the indicator are shown and the possible interpretation of those is determined. This step also includes a verification of the operationalised indicator against the determined purpose and specification from step two. Section 6.1.3 describes all these steps in more detail. The rest of that chapter applies this process for three selected well-being indicators.

3.5. Validation of methodology and results

In the last part of this thesis, the indicator selection process and the operationalised indicators are validated. This is done to answer the last sub-question: To what extent can the used methodology yield relevant results and be applied in practice? The validation consists of two independent parts: a technical validation of the operationalised indicators, and validation interviews to evaluate the validity and applicability of the indicator selection process and its case study results.

3.5.1. Technical validation of operationalised indicators

In this technical validation, the operationalised indicators are implemented in the Urban Strategy model for the case study area. The different indicators are calculated for four different scenarios. The results are then discussed and compared to the base scenario. In this way, the relevancy of the indicators for different types of car-free policies can be assessed.

The modelled scenarios are the implementation of the plans for the future tram network, a policy to remove all on-street parking spaces within 500 meters of a large parking garage, one-way traffic on the

Nieuwe Binnenweg and West-Kruiskade, and a combination of the reduced parking policy and one-way traffic. Section 7.1 describes the scenarios and their implementation in Urban Strategy in more detail and also discusses the results of the technical validation.

3.5.2. Validation of results through expert interviews

This part of the validation was done by conducting interviews. These interviews had two main goals.

- First, **content validity** was evaluated. The goal of evaluating this type of validity is to determine whether the indicator selection process covers all relevant aspects of well-being (Elias, 2023). The question of whether the operationalised indicators represent the relevant stakeholder interests could also be considered a part of this type of validity.
- Secondly, the **applicability** of the results of this research was assessed. This evaluated the practical side of the operationalised indicators and the indicator selection process and explored the barriers and opportunities to apply these in practice.

The interviews served both as member checks and expert interviews. The member-checking method originally involved sharing interview transcripts with participants to check the accuracy of the transcripts. However, several studies have proposed or analysed member check approaches in which synthesised findings were presented to participants instead of 'raw' transcripts (e.g. the 'structured member check approach' by McKim (2023); or the 'Member Check of Synthesized Analyzed Data' as mentioned by Birt et al. (2016)). These approaches were adapted in the validation interviews, validating the outcomes of the analysis of the stakeholder interview data and the relevance of the operationalised indicators for the collected stakeholder interest data. Therefore, the interviews evaluated to what extent the well-being indicator selection process covered all relevant aspects and to what extent it yielded relevant results in this case. In this way, these interviews contribute to the first validity goal mentioned above. The practical expertise of the interviewees became relevant for the second validation goal mentioned above. The applicability of the process in practice was evaluated based on the interviewees' expertise on the topic of stakeholder participation in mobility policy planning.

The first interviewee was the policy-maker who was also interviewed earlier in this thesis (see section 3.3.2). As a policy-maker in the mobility department of Rotterdam, this expert has experience from practice and he can assess the applicability from the policy-maker side of the process. As one of the interviewed stakeholders in the indicator selection process, this interview also served as a member check as described above. The second interview was conducted with the two neighbourhood council members who were also interviewed in the earlier steps of this research. Since they were interviewed in the earlier phase of this research as well and they represent the local stakeholders, they were relevant interviewees for a member check. However, as the connection between the local stakeholders and the municipality, they also have expertise in stakeholder participation and can assess the applicability of the process from the stakeholder perspective.

The interviews took roughly one hour. Before the interview, the interviewees received a hand-out with an introduction to this research, describing the problem and the goal, and an initial overview of the indicator selection process. This was done to ensure a basic understanding of the context of the interview and the research in general before the start of the interview.

The validation interviews were conducted using a semi-structured method. They followed the interview guide that can be found in appendix E.3. In general, the interviews followed the following structure:

1. Introduction and recap of conducted research.
2. Indicator selection process - Starts with a presentation about the process applied to the Oude Westen case.
    - Validation of resulting ranking of importance of well-being aspects - are these aspects of well-being indeed the most relevant for the local stakeholders?
    - Validation of the indicator selection process - can this process in general lead to relevant outcomes?
    - Applicability of the indicator selection process - is this applicable in practice?
3. Operationalised indicators - Starts with a presentation about the operationalised indicators for this Oude Westen case.

- Validation of operationalised indicators - are these indeed relevant for the corresponding aspect of well-being?
- Applicability of operationalised indicators - can these indicators provide relevant insights for the evaluation of car-free policies?

4. Closing remarks

The summarised transcripts of the interviews can be found in appendix F. These transcripts are used to perform the analysis in chapter 7. Since this research step involved only two interviews, no transcript coding was performed. Instead, the input from the neighbourhood council members and the policy-maker was directly analysed and used to answer the last sub-question.

4

Relevant stakeholder interests in aspects of well-being

In this chapter, the relevant stakeholders for the well-being indicator selection process are determined. The first section discusses the stakeholders that are involved in car-free policy planning in literature. Section 4.2 then describes the performed stakeholder analysis for the case study area and makes the selection of which stakeholders to include in the interviews. After that, the resulting interests in car-free policies of the interviewed stakeholders are described. In section 4.4, these results are compared with stakeholder interests from literature. Lastly, section 4.5 determines the final ranking of the importance of the well-being aspects for stakeholders. More information about the used methodology for the interviews and the data analysis can be found in section 3.3.

4.1. Existing literature discussing stakeholders of car-free policies

Chapter 2 discusses the existing literature on stakeholders in car-free policies. In general, these policies are often targeted to benefit people using the areas - mainly local residents, but also visitors and potentially local business owners - by aiming for a better quality of life and increased liveability (see 2.1.2). However, more parties can be affected by the policies. One could think of public transport operators, real estate owners, or schools for example.

Only limited existing literature actually involves different stakeholders and assesses their interests in car-free policies. Thirteen different sources (both academic and grey literature) - that to some extent involved stakeholders in their research - were analysed on which stakeholders were involved. Table 4.1 shows an overview of the number of times each stakeholder was mentioned. This gives an insight into the attention that is paid to this stakeholder in existing literature.

As can be seen in table 4.1, the most often mentioned stakeholders are the *local government*, *hospitality and tourism industry*, *residents of the affected area*, and the *retail industry*. These (local) stakeholders can all be found within the scope of the case study area in this thesis. Since the scope of the case study area is limited to a neighbourhood in an urban area, and thus the car-free policies in this case study will be municipal policies, some other stakeholders might be less relevant. From table 4.1, the stakeholders *national government* and *regional government* are less relevant. Also, *consultancy firms* are not considered to be relevant stakeholders to further involve in the case study. The interest of the consultancy firm is not of major importance since they are not the ones affected by the policies, nor are they the ones whose (political) will is necessary to implement the policies.

The literature that was used in this section also discussed the specific interests of different stakeholders. In appendix C, a full overview of these stakeholder interests can be found, categorised into the different domains of well-being that were defined by Vonk Noordegraaf et al. (2021): living environment, safety, accessibility, and health (see section 2.3.2). Note that not for all stakeholders mentioned above, specific interests were discussed in the existing literature. Some sources merely mentioned the involvement of certain stakeholders, without going into detail about interests. This is why not all stakeholders in table 4.1 are also present in appendix C. Also, the stakeholders left out of the scope of the case study (see section 4.1) are left out of the table in the appendix.

Table 4.1: Stakeholders consulted in existing literature regarding car-free policies.

Category	Stakeholders	Number of mentions	Sources
Government	Local government	7	B,C,D,E,G,K,L
	National Government	2	D,L
	Regional government	1	D
Local business	Hospitality and tourism industry	6	A,B,E,G,I,J
	Retail industry	5	A,B,E,G,I
	Offices/business parks	3	G,I,L
	Craftsmen	2	A,G
Civil society	Residents affected area	6	A,F,H,J,L,M
	Interest groups (NGOs/community organisations)	4	D,G,K,M
	Travelers/visitors (car drivers and cyclists)	3	A,G,I
	Residents neighbouring areas	2	F,H
	Association for disabled people	2	A,G
Transport organisations	Public transport / shared mobility operator	4	A,D,K,L
	Logistics companies	3	A,G,I
Experts	Engineering/architect/consultancy firm*	4	C,D,K,M
Other corporations	Landowners/real estate/housing corporation	3	G,K,M
	Parking provider	1	A
	Public services (e.g. schools, universities and hospitals)	1	G

[A](Rydningen et al., 2017) [B](Wylie, 2019) [C](England & Eriksson, 2020) [D](Kuss & Nicholas, 2022) [E](Bjerkan et al., 2014) [F](Nederveen et al., 1999) [G](Wright, 2005) [H](Glazener et al., 2022) [I](Szarata et al., 2017) [J](Loo, 2018) [K](Selzer & Lanzendorf, 2019) [L](Hesselgren & Hasselqvist, 2016) [M](Selzer, 2021)

*Consultancy firms were often involved, but they represented the policy goals as opposed to their own company's interests.

Figure 4.1 shows a brief overview of the different stakeholder groups and their interests that were mentioned in literature. The main takeaway from this overview and the more detailed appendix C is that aspects in the domains of living environment and accessibility are mentioned most when discussing stakeholder interests - significantly more than the other two domains. For the residents, their mentioned interests were found to cover the most different domains - all but the domain of health. The interests of their stakeholder group, civil society, were most extensively covered in existing literature. This included the quality of life, cleanliness and reduction of pollution within the living environment domain; traffic safety within the safety domain; public transport accessibility and affordability within the accessibility domain; and play opportunities for children within the health domain.

The interests of local business owners were mainly found in the accessibility domain - accessibility to deliveries, and accessibility for customers - and they were mainly supported by the overarching interest in maintaining their financial turnover - which falls in the 'other' domain.

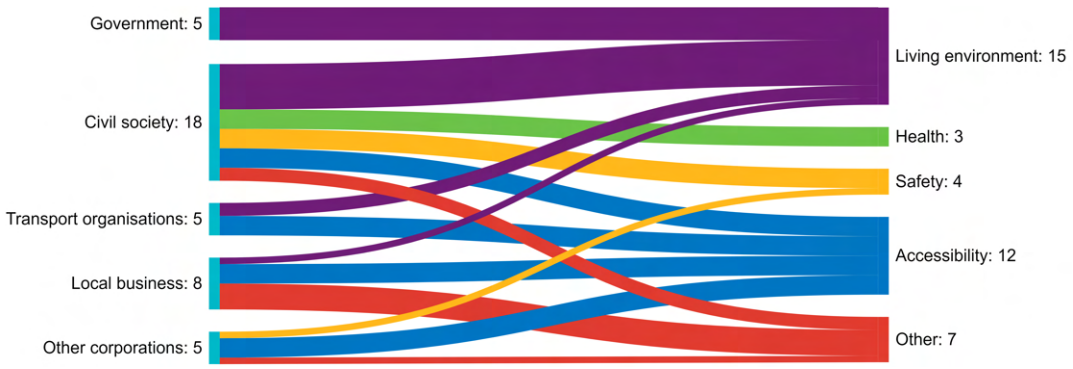


Figure 4.1: Diagram of different stakeholder groups (left) and the number of interests mentioned in literature categorised into the four domains of well-being (right)

Remarkably, for the municipality, the mentioned interests only covered the living environment domain. This included the attractiveness of public spaces, the minimisation of the negative effects of transport (e.g. noise and air pollution), and the densification of residential areas. The fact that these interests are only in the living environment domain goes against the expectation that municipalities would have a diverse palette of policy goals/interests. However, it should be noted that these municipal interests are only based on three different scientific papers. Next to this, the focus of this literature review was on car-free policies. These policies are often aimed at increasing the liveability of areas (see section 2.1.2) and thus the literature covering those policies can be biased towards the living environment domain. In general, the interests of municipalities cover more domains - specifically the accessibility domain - and municipalities have many other policies that have different goals than only within the living environment domain.

4.2. Stakeholder analysis and interviewee selection in Oude Westen

The section above found the stakeholders of car-free policies that were mentioned in existing literature and selected the ones relevant to the scope of this case study of one neighbourhood. For the relevant stakeholders within the scope, the corresponding local stakeholders in the Oude Westen neighbourhood were identified. Table D.1 in appendix D shows an overview of all relevant local stakeholders for car-free policies in Oude Westen. This table also contains information about the power the stakeholders have over the to-be-implemented car-free policies and their interests in them. This interest is meant to be political interest in the car-free policies, not only general curiosity in the topic (Bryson, 2004).

4.2.1. Categorising the stakeholders

Based on this full stakeholder analysis in appendix D, the different local stakeholders were placed in the power versus interest grid (PI-grid) in figure 4.2. This PI-grid shows four quadrants with stakeholders divided into having either high or low interest in, and high or low power over the car-free policies. This grid helps to identify which stakeholders' interests must be considered in planning the policies. The *players* have both a high interest in the car-free policies and the power to influence the policies that are being implemented. These are the stakeholders whose buy-in is required for the policy to succeed (Bryson, 2004). The other quadrants contain stakeholders who either only have high interest but lack the power to influence (*subjects*), or those who have the power to influence the policies, but lack the interest in this specific policy (*context setters*). Lastly, there is the *crowd* with stakeholders who have little interest or power.

The other three quadrants should not need the same kind of attention as the *players* (Ackermann & Eden, 2011). However, *subjects* could form coalitions to increase their power and become a *player*. The same goes for *context setters*, who can get increased interest and move up to the *players* quadrant (Ackermann & Eden, 2011). This means that these two quadrants should get some attention as well in order for the stakeholders in them to not turn into a powerful, opposing *player* later on. The *context setters* need to be kept satisfied, and the *subjects* should be kept informed at least.

In this thesis, the choice was made to further include only the stakeholders in the *players* quadrant. However, when more time and resources are available for a more extensive study, one could also include stakeholders in the *context setters* and *subjects* quadrants. The local government and the municipal mobility department belong to the *players* quadrant because they have a strong interest in car-free policies - they often initiate the planning of them - and their power is also high since they serve as policy-makers and decision-makers in the policy planning process. The local residents and local business owners stakeholders in the *players* quadrant were placed there because they are some of the groups that are most affected by the policies, making their interest in them very high. Their power depends on the extensiveness of the participation process, but their protest power should also be considered and is usually quite high. The full explanation of the power and interest of all stakeholders can be found in appendix D.

Note that the visitors of the area are not included in this overview. Since the visitors are a very heterogeneous group, it is complex to define them as one stakeholder and to involve them in this research. Their input can be relevant in policy evaluations as well, but a different research method might be needed to involve them - a survey with a large sample size could for example contribute to representing the heterogeneousness of the group. In this interview-based research, however, they are not further taken into account.

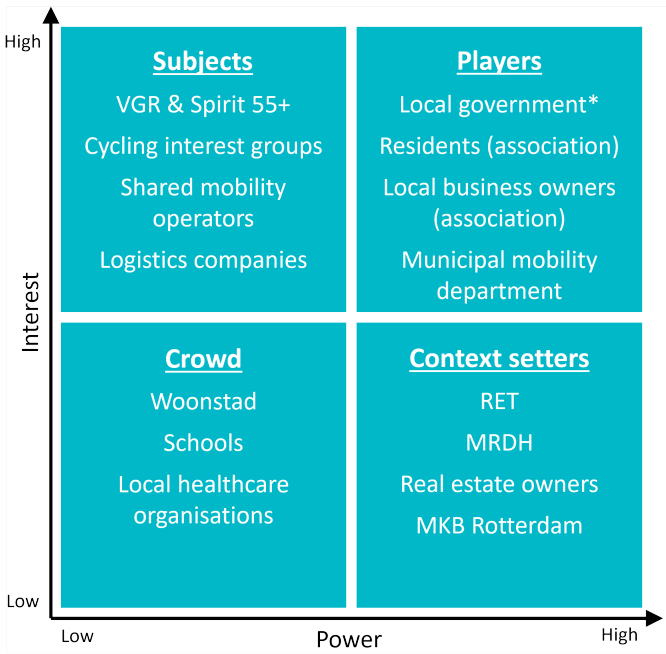


Figure 4.2: Stakeholders divided into four quadrants in a power-interest grid. *Local government includes all mentioned political actors within the municipality: the Municipal Council, the Municipal Executive Board, and the Wijkraad Dijkzicht Oude Westen.

4.2.2. Interviewee selection for case study

As described in section 3.3.1, all *players* in the PI-grid of figure 4.2 were selected for interviews. An overview of all interviewees can be found in table 4.2.

Table 4.2: Overview of interviewees for stakeholder interviews

Stakeholder	Interviewees	ID
Local government and municipal mobility department	Policy-maker at municipal mobility department	PM1
Residents	Resident & neighbourhood council member	RC1 & RC2
	Senior resident	R1, R2 & R3
	Young adult resident	R4
	Middle aged resident	R5
Local business owners	Local store owner	B1, B2 & B3
	Local store/restaurant owners	B4 & B5

For the local government and the municipal mobility department, an interview with a strategic policy-maker (PM1) at the municipal mobility department was conducted. This interviewee takes the decisions made by the political actors of the municipality and turns these into a more detailed vision. Therefore, this policy-maker represents the interests of the political decision-makers (because he is responsible for making a full vision document for their rough plans), as well as representing the municipal mobility department (in terms of their interests, their policy planning process, and the indicators they use for this).

For the residents, five different local residents were interviewed. Three (R1, R2 & R3) were seniors and living with a grown-up kid or a spouse. The other interviewed residents included a young adult (R4) and a middle aged resident with young kids (R5). The number of interviews per age group does not match the share of these age groups in the overall population in the Oude Westen neighbourhood (see appendix B). The over-representation of senior residents in the interviews can be explained by

the recruitment of the interviewees which took place for a large part in different neighbourhood centres - locations where senior residents are over-represented.

However, next to these residents, two members of the local neighbourhood council Dijkzicht-Oude Westen were interviewed (RC1 & RC2). They are residents of the Oude Westen neighbourhood, as well as elected representatives of all residents in the neighbourhoods of Oude Westen and Dijkzicht - a neighbouring area south of the Oude Westen. In this role, they can answer as residents in the interviews, but they can also talk on behalf of the larger group of residents in the neighbourhood. In this way, their answers can be used to verify the findings in the other interviews with residents - which compensates to some extent the skewed representation of the different age groups in the interviews. While not necessarily being elected by the local business owners, these neighbourhood council members still talk to a lot of business owners in the neighbourhood and can thus also give some more general insights into the interests of the local business owners.

The interviews with local business owners were conducted with three store owners (B1, B2 & B3) and two owners of eating establishments or shops with a coffee corner (B4 & B5). These businesses were all located on the West-Kruiskade and the Nieuwe Binnenweg, the two main shopping streets in the Oude Westen neighbourhood.

4.3. Stakeholders' interests in Oude Westen case study

In this section, the results of the interviews with stakeholders are discussed. As described in section 3.3.3, the interviews were coded to analyse the responses. An overview of all codes can be found in appendix G.

4.3.1. Municipality

The coalition agreement of 2022 was the first time the municipal executive board of Rotterdam has written down the ambition to make specific neighbourhoods more car-free (Gemeente Rotterdam, 2022). However, the municipality was already working on allocating more space to other transport modes, just not under the name of 'car-free policies' (interview PM1 in appendix F). For these policies, three main goals were taken into account:

1. Traffic safety in a busy city with many fast-moving different modalities.
2. Accessibility for all transport modes.
3. Making space for the changing city - for green spaces, or for (reducing nuisance for) new residential development.

Now for the new car-free policies, the concrete goals are still being developed, but they are related to the three main goals mentioned above. Concrete measures that will be taken should according to PM1 be on three aspects: the design of the road/public space, the speed, and the intensity.

Currently, the focus in policy planning and evaluation seems to be mainly on the accessibility domain. The broader spectrum of well-being is known, and talks about integrating the other aspects more in policy-making have been taking place for years, but in the end, not all the domains are taken into account. The political parties currently in charge want to be able to explain their decisions towards their supporters, and then they often resort to talking about accessibility.

> "They will never say that it is not important, but you see aspects like air quality, health, and being able to move around freely [...] fading to the background. So this is still not established, even though we have been working for 10/15 years to make that part of the discussion. - *Interview PM1*"

Even though well-being is not taken into account explicitly in mobility policy planning, the municipality does consider some domains to be important. Accessibility is (as mentioned above) often the most important domain in mobility policy-making. As the municipality has the ambition that everyone should be able to participate in society, inclusive accessibility and spatial accessibility of mobility options are two very important aspects. However, the spatial accessibility of activities is the measuring tool that is more often used for evaluating plans. On a local level, this is often most important.

The living environment domain - mainly the aspects of noise, climate, environmental pollution, air pollution, and vibrations - is tied to many (inter)national regulations that force the municipality to think

about this. It is therefore not a question whether these norms should be taken into account. A question for local politicians is, however, which benchmarks to set for these aspects. The use of space is implicitly important for the municipality as well, especially the focus on green and blue spaces. This can be seen in the third of the three main goals in mobility policies that were described above.

In the same three main mobility policy goals, the municipality mentions traffic safety. Currently, they are working on improving both traffic safety and social safety by decreasing the anti-social behaviour in the streets - mainly cars accelerating unnecessarily, speeding, and making noise (music and popping exhausts) (Gemeente Rotterdam, n.d.-c). In general, traffic safety is considered to be very important, especially in an ever-growing city where traffic is busy, fast, and a diverse mix of transport modes.

Health is the domain that is least considered in policy evaluation within the municipality. There could be major health benefits to car-free policies (R5). However, the health benefits are hardly ever attributed to infrastructure or policies in their evaluation. This is (partly) why the health domain is considered as 'nice to have', but is not decisive in decision-making.

4.3.2. Residents

In their initial reactions to car-free policies, almost all residents mentioned the use of space in the neighbourhood as an important aspect. For some (R1, R3 & R5), this had to do with the lack of parking in the neighbourhood or the use of underground parking. However, also more green and wider sidewalks were mentioned. Besides the use of space, multiple arguments were given for the importance of accessibility of activities and mobility options (R2, R4). Other aspects that were mentioned were traffic safety and social safety. These views were confirmed by the interviews with the neighbourhood council members who mentioned also mentioned most the use of space, followed by accessibility (activities and mobility options) and traffic safety (RC1, RC2). In all residents' responses, across the domains of living environment, safety, and health, the issue of anti-social behaviour of people speeding and accelerating unnecessarily - causing noise and air pollution, and reduced safety.

When the whole spectrum of well-being was introduced, the responses were more evenly divided over the four domains. Especially the safety domain was mentioned more often, with equal attention to traffic safety and social safety. Over the total interviews, the safety domain was the third mentioned domain with again equal attention to traffic safety and social safety.

> "I have two kids, but the one-way traffic is not always respected and there are no speed bumps. My kids walk to school on their own, they should be able to do so safely without someone coming racing around the corner. - *Interview R5*"

According to how much the aspects are mentioned, accessibility is considered by the interviewed residents to be the second most important domain of well-being. Mainly the accessibility of mobility options was mentioned by residents, followed by accessibility of activities and inclusive accessibility. The importance of accessibility is mainly shown in wanting to maintain the status quo (e.g. not closing tram lines) since many interviewees are relatively happy with the current accessibility in the Oude Westen neighbourhood. This is similar to the views of the local council members, although they show a bit more focus on the importance of inclusive mobility.

Health is by most not considered an important domain to consider in transport policies - one person even explicitly stated that you should not want to try to combine health improvements with mobility policies (R5). The few times health aspects were mentioned, it was mainly because of the positive physical health impacts of active mobility and the negative impacts of air pollution. Mental health was mentioned only twice.

The living environment is the domain which is mentioned most often in the interviews with residents. Both the residents and the local council members mentioned the use of space aspect the most often. Remarkably, half of the mentions of the use of space by the residents were somewhat related to the parking of cars. Opinions of interviewees regarding parking were polarised and included both the need for more parking spaces (close to dwellings) and the wish for fewer on-street parking spaces - often emphasising the availability of parking garages nearby. The other half of the mentions of the use of space was mainly focused on the wish for more green spaces in the neighbourhood. A similar trend

could be seen in the responses of the neighbourhood council members. The use of space was followed in importance by environmental pollution and noise pollution.

> Aesthetics of streets can also be included in mobility. A greener and more beautiful street invites you to take more time to go there and to not just race through it. This gives a better spatial experience. - *Interview R4*

When asked which domain was most important, residents answered diversely. All domains were mentioned at least once, but with three mentions, the living environment was mentioned the most. This result matches the number of mentions of the individual aspects during the interviews since living environment aspects were discussed most often. It must be noted that the only time that accessibility and health were mentioned as the most important aspects, was in an interview where the interviewee found all domains important.

The council members named safety and living environment as the most important domains. One council member also emphasised the advantage of prioritising the safety domain.

> This can also allow for an objective or neutral discussion with proponents and opponents [of car-free policies] as occasional and personal arguments are disregarded. - *Interview RC1*

This is something that was also seen in the interviews, both with residents and with local business owners. Regardless of their opinions about car-free policies, they all acknowledge the importance of safety and the unsafety of the current situation.

4.3.3. Local business owners

Amongst the local business owners, the opinions about car-free policies are mixed. This was visible in the interviews with business owners and was confirmed by the neighbourhood council members in their interviews (RC1 & RC2). For some business owners, their initial reaction to hearing about proposed car-free policies was negative. They were worried about losing turnover when they are harder to reach by car. For some interviewees (B1 & B2), this negative reaction was accompanied by general discontent with, and lack of trust in, the municipal government.

> The shopping street is totally thriving, there are very little unoccupied buildings, it is running well, so I don't understand why they now want to turn this into some kind of promenade for pedestrians. [...] I feel like the municipality doesn't get it. - *Interview B1*

Other business owners are less negative. The owners of businesses where people buy more and heavier goods mainly mentioned accessibility by car as the most important aspect in their initial reaction. The other business owners also mentioned traffic safety, social safety, and the need for more policing or enforcement of (parking) regulations.

When presented with the domains and aspects of well-being, the interviewed business owners tended to focus on a wider spectrum of aspects. Within safety, traffic safety and social safety are mentioned. Both proponents and opponents of car-free policies acknowledge the unsafe traffic situation. They complain about speeding cars that tend to ignore pedestrian crossings, and about the unsafe situation when cyclists have to squeeze in between cars and trams.

> Cars driving here is not a problem, but the way they do is the problem. It is too much of a nuisance. You have to be very careful when you cross the road because it is really dangerous. - *Interview B5*

Accessibility is considered to be very important. Some business owners mainly focus on accessibility by car, while others mention the importance of accessibility of transport modes in general. The former group mainly contained the owners of stores selling bigger goods. Business owners whose

clients more regularly came by other modes of transport than the car seemed less focused on accessibility by car. They did, however, raise concerns about how deliveries of goods to their businesses by car or truck should remain possible.

The health domain was not often mentioned. The impact of constant nuisance on mental health, and nuisance and poor air quality on physical health was mentioned a handful of times. However, it was also considered to be the individual's responsibility and part of life in a city. Also, electrification of vehicles was mentioned as potentially mitigating many of the health effects.

For the living environment domain, most comments were concerning the use of space - they mainly considered the wish for more green and the availability of parking. Also environmental and noise pollution were mentioned by business owners as points of attention. However, both aspects were also mentioned as not needing much attention because the business owner either did not see the issue with cars in the context of pollution or deemed the noise part of life in the city. This matches the initial observation of mixed opinions among business owners.

When asked about which domain should get priority in decision-making, safety was mentioned more than accessibility. However, aspects of accessibility were mentioned more often than aspects of safety. This could mean that the interviewees regarded safety as important, but were more outspoken and passionate about accessibility. Living environment aspects were also mentioned to be important. However, the mixed opinions about this domain, and the fact that the many mentions of this were in the context of parking (and thus accessibility), do not qualify this domain to be considered most important among the local business owners. The most important domains of well-being, accessibility and safety, also match indirectly with the two other aspects that were often mentioned: the potential loss of turnover and the need for more policing. The loss of turnover is, according to business owners, connected to accessibility, while the need for more policing connects to the safety domain.

4.3.4. Concluding interests of stakeholders in Oude Westen

In summary of the results mentioned above, the most important domains of well-being can be determined in two ways. First, one could look at the responses to the direct question in the interview about which domain was deemed most important. Secondly, one could check how many times all aspects of well-being were mentioned in the interviews, and which domains these aspects belong to.

The first method yields diverse results. The domains of safety, accessibility and living environment were all mentioned equally as being the most important domain in policy evaluation. Two times, it was mentioned that all domains were important. The health domain was only mentioned once as the most important domain.

When looking at the number of mentions of the different aspects, some more distinct results can be seen. Figure 4.3 shows an overview of the number of times all aspects were mentioned to be important, divided over the different domains of well-being and for the different stakeholders. Overall, the residents rated the living environment as the most important domain, both when answering that direct question, but also in terms of the number of living environment aspects that were mentioned. The local business owners mentioned mostly aspects from the accessibility domain, followed closely by the living environment. The policy-maker from the municipality mentioned living environment aspects the most. This results in living environment being the most important domain in general, followed by accessibility and safety. It should be noted, however, that the safety domain was disproportionately often mentioned to be the most important domain when compared to how many times aspects within the domain were mentioned. Also, part of the reason living environment aspects were mentioned this often was that there are simply more aspects included in the living environment domain than in other domains. However, this does not make the conclusion of living environment domain being the most important invalid, since more included important aspects only contribute to the domain being important.

Within the living environment, the use of space is considered to be the most important aspect. For accessibility, this is the accessibility of mobility options. For the safety domain, the most important aspect is considered to be traffic safety. Within the health domain, physical health is mentioned to be the most important aspect.

Some stakeholders also expressed negative reactions to certain aspects of well-being. This indicated that they actively thought that this aspect should not be important in the policy evaluation. The

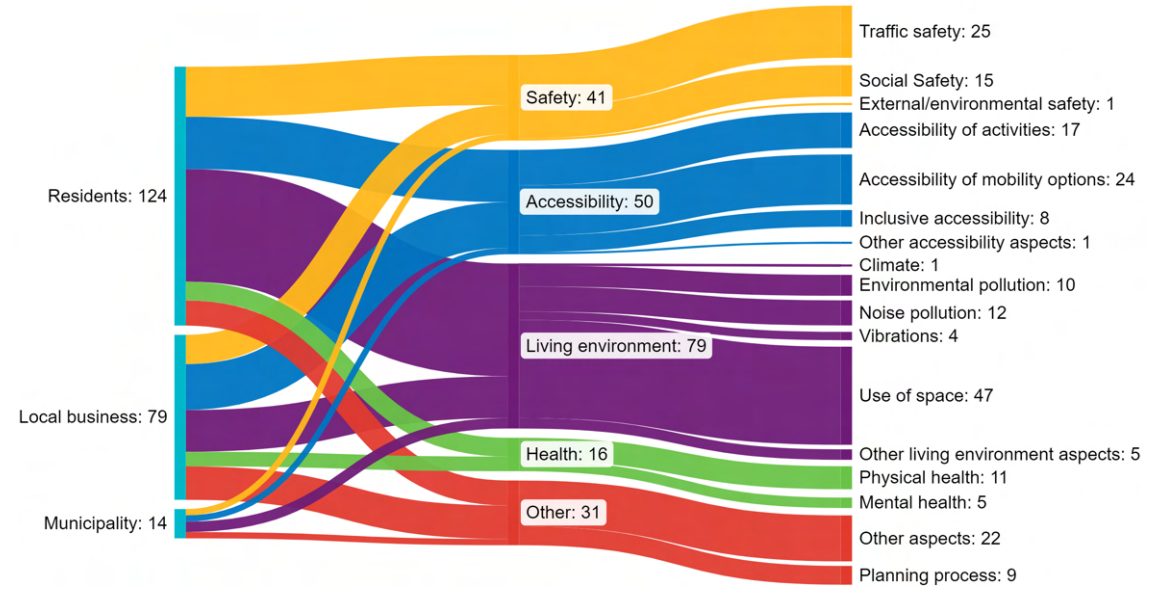


Figure 4.3: Sankey diagram of the positively mentioned aspects of well-being for the different stakeholders.

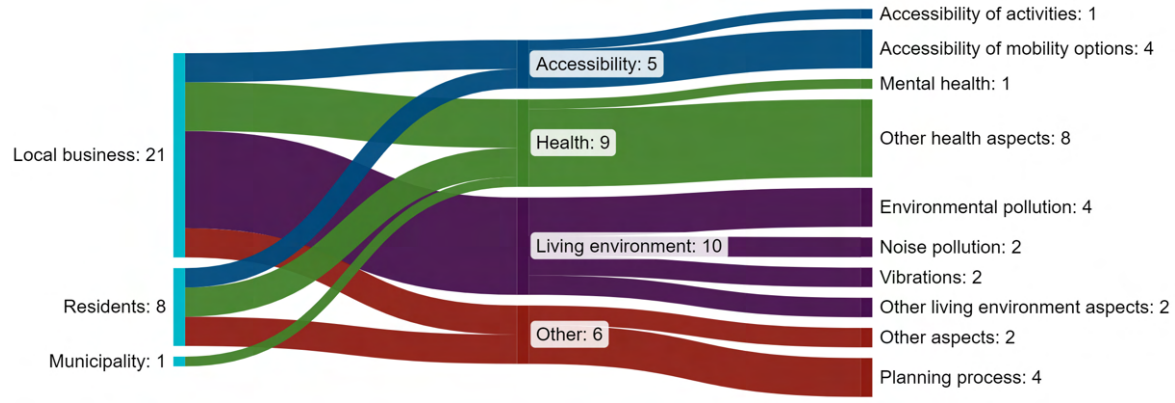


Figure 4.4: Sankey diagram of negatively mentioned aspects of well-being for the different stakeholders.

negative responses are shown in figure 4.4. When these negative responses are subtracted from the positive responses, the same domains and aspects remain the most important overall.

4.4. Comparison of case study and literature findings

Since these empirical findings are more of an exploratory case study than statistically significant results, it is important to compare the empirical findings in this study with findings in other case studies in literature. These literature findings were presented in section 4.1, and figure 4.5 shows an overview of these findings filtered to only include the stakeholders that were mentioned in the case study above. For all three stakeholders, this section compares the empirically found interests from this case study with interests found in literature.

Municipality

The (local) governments' interests found in literature mainly considered the living environment domain. The results found in the interviews, however, show that the municipality has diverse interests in the accessibility, safety, and living environment domains. This difference with literature could be caused by the lack of policy documents in the discussed literature. Also, in the context of car-free policies, it is more likely that literature discusses the municipal goals on the living environment domain since these goals are often-seen policy goals for car-free policies. Municipal goals on traffic safety and accessibility might be seen as more trivial or might fall under other policy contexts - which are not discussed in literature focused on car-free policies.

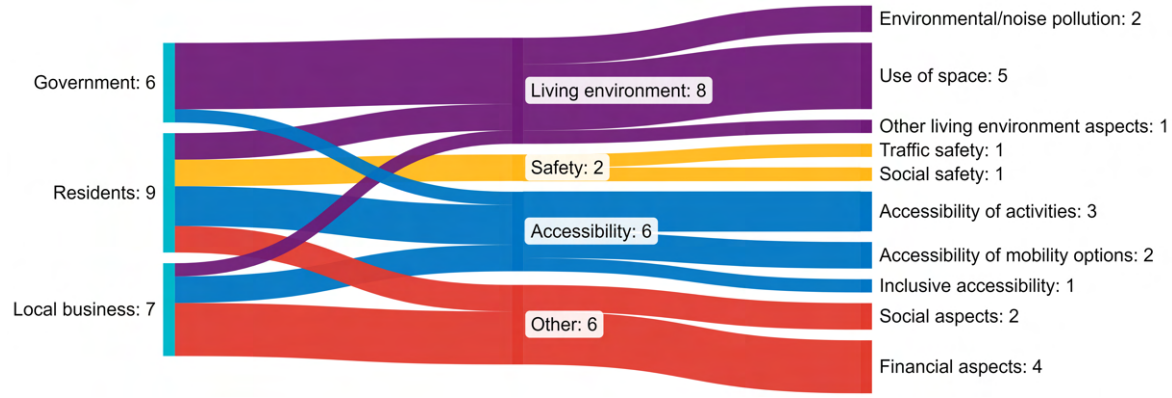


Figure 4.5: Stakeholder interests found in literature filtered to stakeholders included in the case study.

Residents

The stakeholder group 'Civil Society' in section 4.1 did not only include residents, but also interest groups, visitors, and residents of neighbouring areas. Figure 4.5 shows the literature findings filtered specifically for the residents. In the empirical findings, the residents mentioned interests in the living environment domain significantly more often than interests in any other domain (see figure 4.3). In literature, such a distinct importance of the living environment domain was not found among the residents' interests.

In the empirical findings, the shares of residents' interests belonging to the safety and accessibility domains are lower than in the literature findings. However, the observation that the interests of residents are mainly spread over the living environment, safety and accessibility domains, can be made for both empirical and literature findings. In both results, the health domain contains little or no interests of residents. The other aspects mentioned in literature are related to social cohesion in neighbourhoods - something that did not occur in the empirical findings. In the empirical findings, the other mentioned aspects were more varied and were mainly related to potential solutions or enforcement of rules.

Local business owners

In literature, the interests of local business owners were mainly considered to be in the accessibility domain. This matches the empirical findings in this research. The minor interest of local business owners in the living environment domain and the very low interest in the health domain were both visible in the empirical findings as well as in existing literature. The worries about loss of turnover that were mentioned in the interviews (which fall under the 'other aspects' category in figure 4.3) were also present in literature (in the 'financial aspects' category in figure 4.5).

The stated importance of safety was something that was found in the case study interviews, but not in literature. This could mean that just like in the case study, safety aspects were not extensively discussed by local business owners during interviews in other studies. A reason for the fact that the safety domain was stated to be important in the empirical findings of this research, can be that the interviewees were explicitly questioned about which domain should be dominant in decision-making - a question that might avoid personal arguments and bias as was mentioned in interview RC1.

4.5. Weighted importance of well-being domains and aspects

In general, the importance of the domains of well-being is ranked similarly for the findings in literature and the findings in this case - living environment being the most important, followed by accessibility and safety. Table 4.3 shows these rankings - which are based on the number of times a stakeholder interest in this domain was mentioned. The stakeholder interests mentioned in literature were also mostly related to similar aspects of well-being as those found to be important in the case study - at least the top 8 of the most mentioned aspects contained many similar aspects.

Both data sources have their strengths and limitations. The literature findings for these three stakeholder types were based on 10 different sources, covering several different case studies (Bjerkan et al., 2014; Glazener et al., 2022; Loo, 2018; Nederveen et al., 1999; Rydningen et al., 2017; Selzer, 2021;

Selzer & Lanzendorf, 2019; Szarata et al., 2017; Wright, 2005; Wylie, 2019). However, the stakeholder interests in figure 4.5 were often only mentioned in one source, and most sources only mentioned a handful of interests for a limited number of stakeholder types. The literature-based ranking in table 4.3 is therefore based on a limited number of stated stakeholder interests (and sources). The empirical findings are concluded from a case study and, although the data reached (near) saturation (see section 3.3.4), the sample size was limited while the stakeholder groups were quite heterogeneous. However, this data did give insights into interests for all three stakeholder types in one single case study, while existing literature did often not cover all three stakeholder types in one case study area.

The two different data sources can complement each other. One is based on a select number of findings from a wider range of case studies, while the other gives a complete (and more detailed) view for these three stakeholder types for one case study area. Also, this case study's results can add important local context to existing knowledge, which is necessary for a case-specific selection of indicators. This is why the rankings of the importance of domains and aspects for both empirical findings and literature findings in table 4.3 can be combined to create a weighted overall ranking of the importance of the domains and aspects of well-being in the context of car-free policies. Due to the complementary strengths of the two data sources and the fact that both have their limitations, the decision was made to weigh both rankings equally. This resulted in the final rankings in the right column of table 4.3.

Note that the rest domain (other) - which contains other stakeholder interests that do not fit the four domains of well-being as used by Vonk Noordegraaf et al. (2021) - is on a tied third place in the weighted ranking of well-being domains. This indicates that all stakeholder interests outside of the existing four domains of well-being were collectively mentioned more often than interests in the health domain. However, this rest domain contains a wide variety of stakeholder interests and thus it is difficult to name one defined group or aspect of it that was found to be very important. This can be seen in the weighted ranking of well-being aspects, where the three aspects in places 6 and 9 belong to the rest domain. Where the 'financial aspects' and 'social aspects' found in literature are quite distinct groups, the 'other aspects' from the case study findings are a very heterogeneous group of stakeholder interests. It is difficult to identify relevant indicators for such heterogeneous groups of interests. In the next chapter, the relevant indicators are further explored. Specifically section 5.1.5 discusses the aspects in this rest domain.

Table 4.3: Comparison of rankings of domains of well-being and aspects of well-being based on literature findings and case study findings. The last column contains a weighted average ranking based equally on literature and case study findings.

	Literature findings	**Case study findings**	**Overall ranking**
Domains	1. Living environment 2. Accessibility –. Other 4. Safety	1. Living environment 2. Accessibility 3. Safety 4. Other 5. Health	1. Living environment 2. Accessibility 3. Safety –. Other 5. Health
Aspects	1. Use of space 2. Financial aspects (other) 3. Acc. of activities 4. Env./ noise pollution –. Acc. of mobility options –. Social aspects (other) 7. Traffic safety –. Social safety –. Inclusive accessibility –. Other environmental aspect	1. Use of space 2. Traffic safety 3. Acc. of mobility options 4. Other aspects (other) 5. Acc. of activities 6. Social safety 7. Noise pollution 8. Physical health 9. Env. pollution	1. Use of space 2. Acc. of mobility options 3. Acc. of activities 4. Traffic safety 5. Noise pollution 6. Financial aspects (other) 7. Environmental pollution –. Social safety 9. Social aspects (other) –. Other aspects (other) 11. Inclusive accessibility 12. Physical health

5

Relevant indicators of well-being

This chapter aims to answer the second sub-question and deliver a list of the most relevant indicators of well-being for the evaluation of car-free policies. The ranking of importance of domains and aspects of well-being that was determined in the previous chapter is used as a guideline for which aspects of well-being to cover in this chapter. The first section discusses the empirical findings from the case study interviews. The next section compares these empirical findings with what was found in existing literature.

5.1. Case study results for relevant indicators of well-being

In this section, the second level analysis of the data gathered in the case study interviews is performed (see section 3.3.3 for the methodological background). The aspects of well-being that were found to be the most important are discussed in further detail to see in which context they were mentioned. Then a selection is made of indicators that best match these contexts.

5.1.1. Living environment domain

Within the living environment domain, the most important aspect was found to be the use of space, followed by noise pollution and environmental pollution. Since living environment was also found to be the most important domain by the number of times the corresponding aspects were mentioned, all three of these aspects are discussed here (instead of already making a smaller selection).

Use of space

The use of space was mentioned by interviewees in two main contexts. First, it was often mentioned in the context of car parking. Secondly, it was mentioned in the context of the importance of more green and blue space and wider sidewalks in the neighbourhood.

In the context of parking, many interviewees mentioned that the parking garages should be used more instead of the busy on-street parking. Some explicitly mentioned that there should be less parking on the streets, while some mainly mentioned the need for enough parking in general - which some interviewees split up into the need for enough on-street parking for residents and the need for more garage parking for visitors.

In the context of alternative use of space, most interviewees mentioned the importance of green space both in the streets and in the neighbourhood in general. In this same context, interviewees mentioned the potential benefits of more green space (e.g. mental and physical health). Wide sidewalks were also mentioned, which was often related to the inclusive accessibility aspect in terms of accessibility of the sidewalk, also when using a walking aid.

The following indicators were proposed for the use of space aspect (Vonk Noordegraaf et al., 2021).

- Use of space for infrastructure - for moving vehicles.
- Use of space for parking - for storage of stationary vehicles or vessels.
- Perception of parking for different transport modes.

- Ratio of green and grey space.
- Fragmentation of green space.
- Quality of public (mobility) space.
- Commercial use of public space.

For the first context in which the use of space was mentioned - the parking - the second and third indicators could be relevant. The use of space for parking could be split into on-street parking and parking in a parking garage, and also in parking for residents and parking for visitors. With this split, the indicator can be relevant to the interests of all interviewed stakeholders. Some interviewees mentioned the unsafety of parking garages (R5, RC2) and the lack of proper bike parking space (RC2). Therefore, the indicator about the perception of parking for different transport modes can also be relevant.

In the second context mentioned for use of space, the green space and wide sidewalks are key. The indicator of the ratio of green and grey space is a very relevant indicator for these stakeholder interests. The quality of public (mobility) space can be related to the wide sidewalks in this context. This can also be relevant for the call for more seating spaces in the streets, which was mentioned in the context of physical health (B2).

Noise pollution

The aspect of noise pollution was mentioned in two contexts. The most-mentioned context was noise pollution by anti-social behaviour of car drivers (e.g. unnecessarily acceleration, revving[1], speeding, honking). The second context was the general noise of the traffic on the busy roads in the Oude Westen area. The proposed indicators for this aspect were: noise emissions and noise exposure.

The first context is related to the noise emissions indicator. This measures the noise levels that are emitted and are therefore relevant for single events of noise emission such as those that occur due to anti-social car drivers.

For the second context, the noise exposure indicator is more relevant. This indicator would measure the longer-term average exposure of building facades to noise and could be split into different levels for noise during the day and during the night (Vonk Noordegraaf et al., 2021).

Environmental pollution

Environmental pollution was mentioned in two general contexts. The first context contains mentions of air pollution by cars in general. However, it also contains mentions of air pollution specifically due to speeding and revving[1] cars, and a mention of air pollution due to idling vehicles. The second context in which environmental pollution was mentioned was littering in the streets.

The indicators proposed by Vonk Noordegraaf et al. (2021) for the environmental pollution aspect of well-being were:

- Emissions of NOx, PM, etc.
- (Contribution of mobility to) concentrations NOx, PM, etc.
- (Contribution of mobility to) nitrogen deposition.
- (Contribution of mobility to) water quality (no concrete indicator defined yet).
- Total material use or total materials saved by avoided use.
- Total materials saved by recycling.

The first context of the environmental pollution aspect was related to air pollution. This leaves the first two indicators. Both can be relevant to the interests of stakeholders. However, the second indicator shows a relative contribution of mobility to this air pollution, which can be more intuitive than merely absolute numbers of emissions. Also, some interviewees mentioned that there were heavier polluters than 'just some cars'. For them, the clear indicator of the contribution of mobility to air pollution can be very relevant.

In the second context of littering, no proposed indicator matches this interest. It can also be debated how much of a relationship there is between mobility and littering. Since this connection is not clear at the moment, this context and interest are disregarded.

[1] Revving is increasing the running speed of the engine while the clutch is disengaged, resulting in more engine noise without moving the car.

5.1.2. Accessibility domain

Within the domain of accessibility, the aspects of accessibility of mobility options and accessibility of activities were found to be the most important aspects.

Accessibility of mobility options

The accessibility of mobility options was mainly mentioned in two different contexts. The first context was the affordability of mobility options around the Oude Westen neighbourhood. This ranged from the cost of parking on the street to the affordability of alternatives to on-street parking. Most interviewees mentioned supporting using nearby parking (garages) as opposed to on-street parking, or indicated support for alternatives such as parking at a park-and-ride (P+R) location and travelling the last part by tram or bus. However, all mentions of these alternatives were accompanied by highlighting the importance of the affordability of those solutions.

The second context of the accessibility of mobility options was the presence of many different mobility options, among which a good cycling network and a good public transport network. Interviewees mentioned the importance of the - currently very strong - public transport network and how this should remain as available as it is now - with always a stop in close proximity. The importance of a good cycling network was also mentioned. A few times, people also mentioned the importance of having delivery vehicles being able to deliver goods in the streets.

For the accessibility of mobility options, the proposed indicators by Vonk Noordegraaf et al. (2021) were:

- Share of mobility expenditure to household budget.
- Price-to-quality ratio.
- Distance to boarding point, frequency, transfers, comfort (related to public transport).
- Quantity of mobility options.
- Reliability of availability.

In the first context this aspect was named, the first two potential indicators are relevant. The context indicated a slight acceptance of alternatives to the car. This could mean that the quality of the alternative mobility option is important - people would be okay with parking in parking garages, given that it is not too expensive (R1), not too far from their house (R5), and the quality of the parking garage is good (e.g. having surveillance system) (R5, RC2). Given the importance of both affordability and quality of the mobility options, the price-to-quality ratio could be a good indicator.

Given the emphasis on the presence of mobility options in the second context, the indicator of quantity of mobility options is a good option. The distance to the boarding point can also be a relevant indicator. However, since the emphasis is on many mobility options, this indicator could be a bit expanded to distance to the nearest boarding point for all mobility options - e.g. distance to the nearest train station, nearest tram stop, nearest bus stop, nearest car parking, and nearest shared car/scooter/bike.

Accessibility of activities

The accessibility of activities was mentioned both in terms of accessibility by car, as well as in terms of accessibility by all transport modes in general. It was also once mentioned in the context of providing equal accessibility to all, so all residents can participate in society (PM1).

The indicators for accessibility of activities proposed by Vonk Noordegraaf et al. (2021) were:

- The number of activities (of a certain type) reachable within a certain travel time, by a certain mode of transport, from a house or person.
- The number of households or persons reachable by a certain mode of transport, within a certain time, from an activity or business.

For the local business owners, the second indicator seems relevant given that all the conditions (e.g. chosen mode and chosen acceptable travel time) are explained well. For the residents, the first indicator seems relevant - again given that it is well explained.

5.1.3. Safety domain

The domain of safety was not found to be the most important domain of well-being according to the interviewees. However, many interviewees named traffic safety as an important issue in the neighbourhood.

Traffic safety

The context in which this aspect was mentioned could be divided into two categories. The first context was the general importance of traffic safety in the current situation with busy mixed traffic on the main shopping streets - a mix of cyclists, cars, and trams, with several pedestrian crossings. The second context was specifically focused on the high numbers of speeding cars and scooters in the streets. This context is more related to anti-social behaviour that was mentioned in relation to all domains of well-being.

The two potential indicators for traffic safety defined by Vonk Noordegraaf et al. (2021) were the number of accidents and the number of fatalities/severely injured/minorly injured (see appendix A). However, the interviewees mainly mentioned unsafe situations and near misses, not actual accidents. The context in which traffic safety was mentioned had much to do with the environment (for the first context) and with the behaviour of people (in the second context), and less with the actual outcomes (number of accidents). If these proposed indicators were used, the question is if the effects would also be visible in the unsafe situations and near-misses that the local stakeholders notice and talk about. Therefore, it can be questioned whether these proposed indicators would match the exact interests of the stakeholders. The mixed use of the road, where cyclists mix with busy car traffic and trams, was mentioned often (R4, RC1, RC2, B2, B4). An indicator related to the mix of traffic on the roads could therefore be relevant for the context in which stakeholders think of traffic safety.

Social safety

For the second most important aspect of safety, social safety, the context in which it was mentioned was twofold as well. The first context was related to the general feeling of safety on the streets - some during the night, some when confronting others with their behaviour, and some when encountering beggars or confused people. This had not always a direct link with the proposed mobility policies, but given how much it was mentioned, it is an issue that the neighbourhood is dealing with. The second context was again the anti-social behaviour by (mostly young) car users who cause nuisance with playing loud music, honking, smoking, and harassing women.

The proposed indicator for social safety was the social safety score (Vonk Noordegraaf et al., 2021). This could fit the contexts in which social safety was mentioned as it covers a wider spectrum than only mobility-related issues. However, as mentioned by a neighbourhood council member (RC2), information about the (impact of) policies should be communicated with residents in a way that they understand, and policy-makers should steer clear from professional jargon. This means that an indicator such as the social safety score should be explainable to the non-expert residents.

5.1.4. Health domain

Health was not the most important domain found in the interviews. However, for completeness, the most important aspect of this domain is still discussed here since it was mentioned over ten times.

Physical health

The importance of physical health was mentioned in two contexts. The first context was the importance of walking and cycling for staying healthy. In this same context, the need for seating spaces in the streets was also mentioned as a way to enable elderly or physically challenged people to stay active (B2).

The second context physical health was mentioned in, was the impact that stress, long-term nuisance and air pollution can have on people's physical health. This context is closely related to the aspects of noise pollution and environmental pollution within the living environment domain.

The proposed indicators for this aspect were the Disability Adjusted Life Years (DALY)[2], Quality Adjusted Life Years (QALY)[3], and the use of active modes of transport (Vonk Noordegraaf et al., 2021). Within the first context of physical health, the last proposed indicator seems to be the most relevant for stakeholders. In terms of physical activity, especially the time spent on active modes per person per day or week could be relevant.

[2]The difference between DALY and the average expected number of life years is how many healthy life years are lost due to premature death and diseases (as a result of the living environment). This is impacted through exposure to unsafety and negative effects of the living environment (e.g. accidents, pollutants, noise pollution).

[3]Life years weighted by the experienced quality of life. This is impacted by the same living environmental effects as the DALY.

For the second context, the DALY and QALY seem relevant. However, here it is again important that the indicator can be explained to stakeholders. These indicators specifically measure the longer-term impact of policies/measures, while the context in which this aspect was mentioned was more outcome related[4]. This context of physical health was closely related to the aspects of noise pollution and environmental pollution within the living environment domain. Therefore, it might be more relevant to take outcome-related indicators for these aspects and use them to communicate about physical health in this context as well. This might better cover the direct interests of stakeholders in physical health.

5.1.5. Other aspects

The rest category - for interests that did not fit into one of the four defined domains of well-being - had quite some mentions in the case study interviews as well. These mentions were diverse and often of a practical nature. They can be split up into two categories: related to the effects of the policies and related to the planning process of the policies. This rest domain was mentioned in most interviews. However, because of the diversity of aspects that were mentioned, it is difficult to group these mentions into a context which is mentioned often enough to be considered one of the important aspects of well-being.

Other responses related to the effects of policies

Within the mentions related to the effects of the policies, most mentions were about the importance of more policing and enforcement of rules (e.g. against double parking and speeding). This is an aspect that can be taken into account when planning the new policies and when communicating them to the stakeholders. Satisfying this stakeholder interest could be a good extra measure to take that addresses not only this explicit interest but also indirectly addresses other mentioned interests that were related to the anti-social behaviour of some car drivers.

Secondly, the importance of maintaining the income of local businesses was often mentioned. This issue was often mentioned in the context of the accessibility of businesses. Since it might not be possible to have a direct indicator for local business income, an accessibility indicator might be more feasible to use for this aspect.

Other responses related to the policy-making process

The mentions in this category were very diverse. Since they were all related to the policy-making process itself, they will not be represented by any relevant indicators. However, they can still be relevant for policy-makers to take into account when planning new car-free policies.

Almost half of the mentions were in the context of the importance of listening to the local stakeholders and finding out the underlying problems behind people's arguments. This endorses the importance of this process of talking to local stakeholders and involving them in policy-making. The importance of listening to local stakeholders also relates to the need for case- and neighbourhood-specific approaches for car-free policies - which was also one of the responses from interviewees in the context of the policy-making process. Other mentions of the policy-making process were more related to general discontent about, and lack of trust in, the policy-making process of the municipality. Since these topics are outside the scope of this thesis, they are not further taken into account.

5.2. Comparison of case study findings and existing literature

Since the case study results discussed above are based on one case only, it is important to compare them with the findings in existing literature. The stakeholder interests found in literature were not always mentioned in as much detail as in the interviews in this case study. Also, the context in which the interests were mentioned was not always very clear, which makes it more difficult to identify relevant indicators. The relevant data that was found is discussed below for each domain of well-being.

[4] Methorst et al. (2010) defined four possible levels of monitoring: input, output, outcome, and impact. Inputs can comprise policy input (e.g. political will and actual plans and policies.). Outputs are the direct outputs of policies or measures (e.g. removed parking spaces and widened sidewalks). Outcomes are the directly observable effects of the outputs (e.g. less accidents). Impacts are the longer-term, secondary outcomes and benefits, which are often harder to measure (e.g. DALY or QALY).

5.2.1. Living environment domain

Within the living environment domain, interests both in literature and in this case study were mainly found in the use of space aspect, the noise pollution aspect, and the environmental pollution aspect.

Use of space

The use of space aspect was most often found in the context of the quality of the space. The attractiveness of the public space and the human-friendliness of the space - both for residents and visitors - were found to be important for the local government (Bjerkan et al., 2014; Selzer, 2021; Selzer & Lanzendorf, 2019). Another interest of the local government in the use of space was related to the densification of residential areas - areas could be more densely populated if there was less need for extensive car infrastructure for the generated traffic (Selzer & Lanzendorf, 2019). Lastly, the local business owners were found to be interested in more public space being available for restaurants (Wright, 2005).

For the use of space, the case study findings discussed more indicators related to parking. This interest did not occur as much in literature - only among local business owners (Wylie, 2019) and among residents in neighbouring areas to the car-free area (Nederveen et al., 1999). Therefore, these parking-related indicators are relevant, but not the most relevant indicators for this aspect when weighted with the literature findings - and thus they will not be on the top of the list of relevant indicators.

The quality of public space was found to be important both in literature and in the case study - in the latter, this was specifically focused on the presence of green spaces and wide sidewalks. Therefore, the quality of the public (mobility) space is a very relevant indicator, as well as the ratio of green and grey spaces.

The commercial use of public space might be a somewhat relevant indicator according to the literature findings. However, since this aspect was hardly mentioned in the case study findings, this indicator is not very relevant when considering both data sources.

Environmental and noise pollution

The environmental pollution aspect was mainly mentioned by residents in the context of the cleanliness of the neighbourhood (Loo, 2018). This can be interpreted as relating to air pollution, but also to littering. Therefore, it is difficult to give a distinct context for this interest.

A more clear interest in this aspect was found to be from the local government, which has an interest in minimising the negative external effects of transport (Bjerkan et al., 2014; Russo & Comi, 2010). The main negative external effects that were mentioned were related to air pollution and noise pollution (Russo & Comi, 2010).

The interest in noise pollution in literature was mentioned in the context of traffic noise in general, not regarding specific anti-social driving behaviour - as was found in the case study. Therefore, when combining the findings in literature and the case study, the indicator of noise exposure is the most relevant indicator. The noise emissions indicator can still be relevant for this local issue of anti-social driving behaviour in Oude Westen, but it might be less generalisable to other cases.

According to the empirical findings, the contributions of mobility to concentrations of NOx, PM, etc. are relevant indicators for the environmental pollution aspect of well-being. This is in line with the literature findings, where emissions and air pollution were found to be important, which increases the relevance of this indicator. Note that the interest in emissions found in literature could also relate to the climate aspect of well-being. However, since this was not found to be important in the empirical findings, this aspect is not further taken into consideration.

Other environmental aspect

The general interest in 'quality of life' was mentioned by residents (Nederveen et al., 1999). Since this was not further explained with more context, it is not possible to link this interest to a relevant indicator - it could be anything from noise exposure to air quality or share of green public space. Therefore, this general interest can not explicitly be taken into account in the selection of indicators. However, there might be an overlap with other interests, so the shortlist of selected indicators could still end up containing indicators that are also relevant to this general interest of 'quality of life'.

5.2.2. Accessibility domain

Within the domain of accessibility, interests in the aspects of accessibility of activities, accessibility of mobility options, and inclusive accessibility were found in literature.

Accessibility of activities

Local business owners were found to be interested in the accessibility of their business by private car (Rydningen et al., 2017) and by delivery vehicle (Bjerkan et al., 2014) within opening hours. For residents, interests were found in having many amenities nearby (Nederveen et al., 1999).

The indicators that were found to be relevant in the empirical findings in this study also apply to these literature findings. Again, the number of activities reachable within a certain travel time by a certain mode is relevant for the residents - and for the business owners in the context of delivery companies that can be reached. The number of households that can be reached within a certain travel time (by car specifically or by different modes) is relevant for the business owners in the context of the potential customers.

Accessibility of mobility options

The accessibility of mobility options was mentioned by residents in existing literature in the context of the availability of public transport as an alternative mode of transport (Rydningen et al., 2017). Also, residents stated to be concerned about the accessibility of mobility for low-income households (Glazener et al., 2022).

These interests from literature are largely in line with the empirical findings in this case study. The price-to-quality ratio is a relevant indicator for the context of affordability that was found both in literature and in the case study.

In the case study findings, the indicator for the distance to the nearest boarding point was generalised to all modes of transport. If the public transport aspects of this indicator - frequency, transfers and comfort were also included by Vonk Noordegraaf et al. (2021) - are maintained and included, this indicator is also relevant for the literature findings that emphasise the importance of public transport availability.

Inclusive accessibility

England and Eriksson (2020) mention the interest of the local government in the inclusive accessibility aspect of well-being. For example, the interviewees in that study mentioned the accessibility for people with disabilities and the need for amenities nearby.

The inclusive accessibility aspect was not one of the more often mentioned aspects in the case study and was therefore not considered in this chapter about relevant indicators. The indicators that Vonk Noordegraaf et al. (2021) proposed for this aspect were:

- Proportion of users finding it difficult to use a transport option.
- Number of actions required to make a certain trip.
- Complexity of actions required to make a certain trip.

No specific indicator can be determined to be most relevant due to the limited context found in literature. However, since accessibility for people with disabilities was only mentioned in general, and also the nearby amenities and public transport options were mentioned in this context, another option to create relevant indicators is to split the proposed indicators for accessibility of activities and accessibility of mobility options into user groups and include user groups such as people with disabilities or elderly.

5.2.3. Safety domain

Within the safety domain, two stakeholder interests were found in literature: social cohesion and traffic safety. The first interest falls under the social safety aspect and explains this in the context of community cohesion and solidarity (Loo, 2018). The second interest is mentioned in the context of the safety issues expected by residents when cars would return to their car-free community in Hong Kong (Loo, 2018). This can be explained in terms of traffic safety and social safety and thus makes both aspects - and the related indicators - relevant.

According to the empirical findings in this research, the relevant indicator for social safety was the social safety score. Also in the context of social cohesion - how the social safety aspect was mentioned

in literature - this indicator could be relevant to some extent. The indicator might not directly represent social cohesion, but social cohesion can contribute to a higher social safety score when viewed in the context of the community looking out for each other - making the indicator somewhat relevant at least.

The traffic safety interests found in literature were mentioned generically, without a very specific context. This means that the proposed traffic safety indicators (both the longer-term outcome indicators and the short-term output indicators) can all be relevant to the interests found in literature.

5.2.4. Health domain

For the health domain, no specific stakeholder interests were found in literature. Therefore, in this domain, the relevant indicators are solely based on the empirical findings from this research.

5.2.5. Other aspects

Within the rest domain of other stakeholder interests that were found in literature, the two main aspects were financial aspects and social aspects. The financial aspects consist of local business owners being concerned about maintaining their financial turnover when car-free policies are implemented (Rydningen et al., 2017; Szarata et al., 2017; Wright, 2005; Wylie, 2019). These findings are in line with findings in the case study where this interest was categorised under 'Other responses related to the effects of policies' (see section 5.1.5). Here the argument was made that this concern was often related to the accessibility of the business - something that was also found in literature (Rydningen et al., 2017; Wright, 2005). This means that the accessibility indicators that were relevant for local business owners are also relevant for this aspect.

The social aspects found in literature were the social cohesion - that was already mentioned in section 5.2.3 - and the environmental awareness of residents (Loo, 2018). The latter aspect was mentioned in a similar context to the social cohesion mentioned in section 5.2.3. Residents appreciated the common environmental awareness in their community. This is more of a characteristic of the community than a relevant interest to consider when determining relevant indicators for car-free policy evaluation. Therefore, this last aspect is not further taken into account.

5.3. Concluding relevant indicators of well-being

When considering the resulting priority list of domains and aspects of well-being (section 4.3), the findings of relevant indicators in the case study (section 5.1) and the comparison of these empirical findings with literature findings (section 5.2), one overview can be made of the most relevant indicators for car-free policy evaluation. Figure 5.1 shows this overview, which can be seen as a shortlist of relevant indicators from which a final selection can be made. On the left, the aspects of well-being that were found to be important are arranged from top to bottom in descending order of importance. These aspects can all be evaluated by the relevant proposed indicators that are displayed on the right. As the aspects are displayed in order of importance, this list of indicators can also be seen as a priority list of relevant indicators. However, some indicators can be used for multiple aspects of well-being - e.g. noise exposure can be used to evaluate noise pollution, but also indirectly for physical health. When fulfilling a double function like that, indicators can get a higher priority since they are relevant for multiple aspects of well-being and thus for multiple stakeholder interests.

Note that most indicators on this shortlist are not yet clearly defined and specific indicators. Exactly these, definition and specification, are essential for indicators to provide clear measurements that can be interpreted and incorporated in policy-making. Therefore, the indicators on this shortlist should be considered as conceptual indicators which still have to be operationalised in order to be used in practice. The next chapter discusses the operationalisation process of a selection of these conceptual indicators.

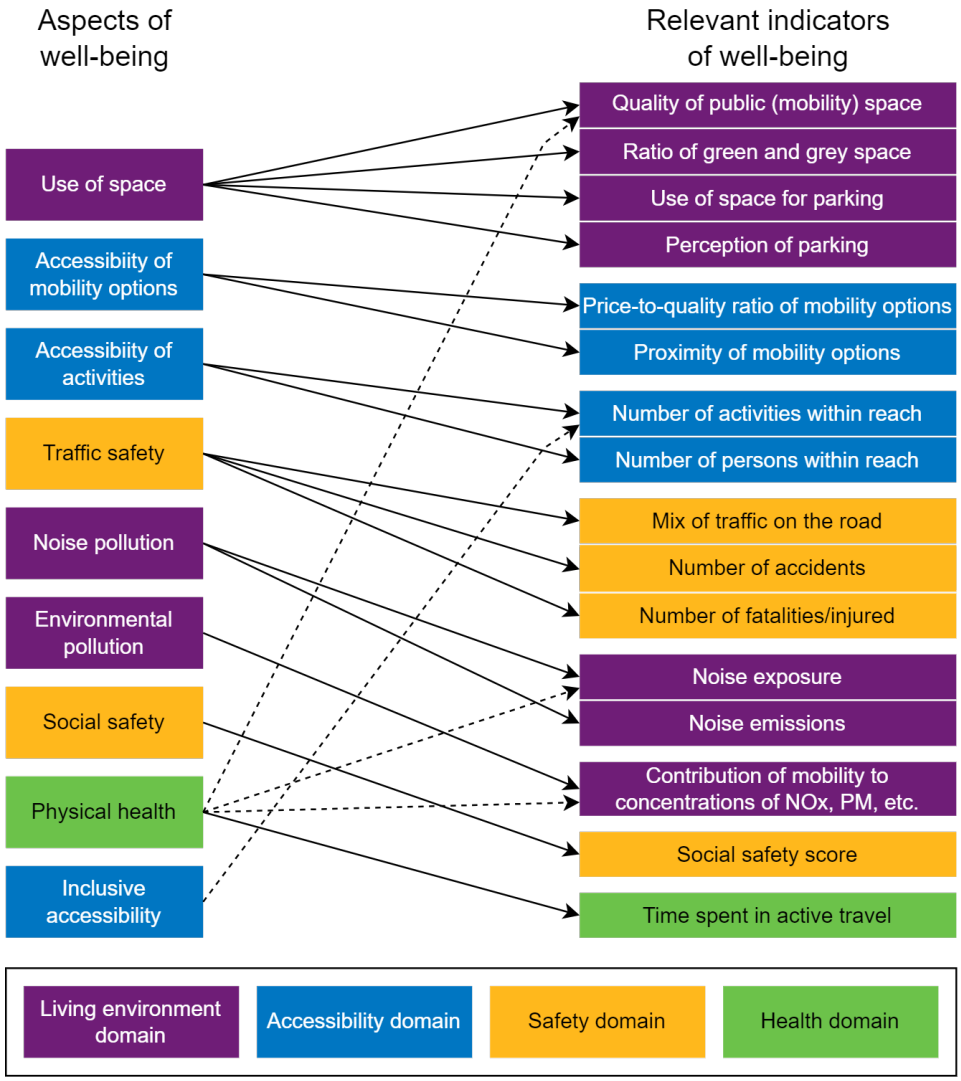


Figure 5.1: Overview of relevant indicators of well-being and the aspects of well-being that are represented by them - from most important on top, to less important on the bottom. Arrows indicate direct links between aspects of well-being and relevant indicators which Vonk Noordegraaf et al. (2021) also proposed for that aspect of well-being. Dashed arrows indicate a link between an aspect of well-being and a relevant indicator that was originally proposed by Vonk Noordegraaf et al. (2021) for a different aspect of well-being.

6

Operationalisation of well-being indicators

This chapter discusses the operationalisation of indicators. Given the determined shortlist of 16 relevant - but still conceptual - indicators that was concluded in the previous chapter, this chapter makes a final selection of three conceptual indicators to operationalise. The first section describes the approach that is taken for the selection and operationalisation of the indicators. Sections 6.2, 6.3 and 6.4 then respectively discuss the operationalisation of the selected indicators of the use of space for parking, the proximity of mobility options, and the mix of traffic on the road. In these sections, the operationalisation steps described in section 6.1.3 are walked through for the specific indicator.

6.1. General approach to selecting and operationalising indicators

This section describes the general approach that should be taken to operationalise conceptual indicators. First, it discusses how to narrow down the shortlist of chapter 5 to operationalisable indicators. This part is not case-specific but approaches the shortlist from a general point of view, and is therefore applicable to other cases as well. Then, the case-specific considerations and final indicator selection for this study are presented. Lastly, the steps necessary to get to an operational indicator are discussed.

6.1.1. Narrowing down the shortlist

From the short-list of 16 conceptual indicators that was found at the end of chapter 5, not all are suitable to be operationalised for ex-ante policy evaluation. Also, a policy-maker might need to make a smaller selection since quantifying and communicating 16 different indicators might be infeasible and ineffective. Therefore, the shortlist of relevant indicators is narrowed down by applying methodological selection criteria for indicators to be used in ex-ante evaluations. These criteria are briefly described in the methodology chapter (section 3.4.2) and are shown here in more detail.

- **Objectivity** - For quantification in a transport model to be used in ex-ante evaluation, objective indicators are most relevant. Although they can be very insightful and relevant, subjective indicators are more complex to quantify. This is especially true when looking at ex-ante evaluations since it is difficult to collect data on factors such as stakeholder perception and satisfaction before the policy is implemented.
- **Representation** - The concept of well-being (as discussed in section 2.3.1) focuses on considering a wide spectrum of domains, aspects, and indicators for policy evaluation. This calls for selecting indicators that represent different aspects and domains of well-being as opposed to focusing solely on one specific domain.
- **Relevance for stakeholders**[1] - In general, policy-makers should aim for indicators that are relevant for the stakeholders in their cases. When following the methodology of this study, policy-

[1] Although being related to the case, this selection criterion is not case-specific. The criterion is important for all cases. However, how this criterion is applied could differ per case (e.g. with ranks as in this case, or with a simple check whether or not it is relevant).

makers will have a shortlist of indicators that are deemed relevant based on the stakeholder input (as was established in this study in chapter 5). This shortlist can be seen as a ranking of the relevance of the indicators. The higher ranked indicators can be considered most important and relevant to operationalise - which should be taken into account in the selection.

- **Availability of data** - The indicators should be operationalisable for (almost) every case a policy-maker is working on. Therefore, it is important that the necessary data is openly available - or that the data is commonly and easily available for the policy-makers.
- **Availability of resources** - In general, policy-makers often experience restraints on the available resources. This means that they often cannot have a too big selection of indicators to operationalise, and have to be selective with indicators that require complex (additional) models that would require more resources.

Table 6.1 gives an overview of the shortlist of indicators. The table shows the domains and aspects of well-being that the indicator is relevant for - which is important for the representation criterion. Next, it shows some characteristics related to the other selection criteria: the rank of relevancy the indicator got on the shortlist in chapter 5 and whether the indicator is objective. These characteristics cover the criteria of relevance and objectivity. Then, the technical needs for the indicator regarding models and data are shown. This covers the criteria of availability of data and resources - assuming complex, or new-to-be-implemented models would require more resources than available. The last two columns correspond to case-specific selection criteria. A full and more detailed description of all these characteristics of the indicators can be found in appendix H.

Based on the general selection criteria described above, the not-objective indicators are deselected. The other criteria mentioned above are less black-and-white and do not automatically (de-)select certain indicators. They are taken into account in the final selection in the next section when also the case-specific criteria are considered.

6.1.2. Case-specific indicator selection for this research

Selecting the indicators to operationalise is not only a general matter but also needs case-specific criteria. When these case-specific criteria are applied together with the general criteria, a policy-maker could come to a well-balanced selection of indicators to operationalise.

- **Scope of research** - In this research, the available time and resources - and thus the feasible scope - are limited. Therefore, it is important to select indicators for which operationalisation might be feasible within the available resources. This can result in selecting indicators that could work with the existing Urban Strategy model and not selecting indicators that would require complex additional models. The number of selected indicators also depends on this criterion.
- **Contribution to the current state of the art** - This criterion is specific to this study. The goal is to contribute to the state of the art. Therefore, indicators are selected that are not yet operational and widely available in the Urban Strategy model that is used. In applied cases in practice, it might be the other way around. Policy-makers might not aim to contribute to the state of the art but rather see what is already available to them (without putting in too much extra effort).

In table 6.1, the column 'present in US?' describes whether this indicator is already implemented in the Urban Strategy model that is used in this study, or if the indicator is very easily operationalisable in the model. This is related to the current state-of-the-art criteria. Indicators that are already implemented in the model, or those that can potentially be implemented very easily - are deselected. Selecting these indicators would not result in a significant contribution of this research to the state of the art of the Urban Strategy model.

This leaves the grey and blue rows in table 6.1. These indicators are not yet deselected by any criterion, so from this sub-list, a selection can be made based on the non-black-and-white criteria. The criterion of the limited scope of this research project limits the indicator selection to two or three indicators. Adhering to the general representation criterion would call for selecting those two/three indicators from two/three different domains of well-being. The relevance criterion focuses attention on the top of the list - the highest relevancy ranks. This is where the health-related 'time spent in active travel' is deselected due to being not as relevant as other indicators higher on the list. This results in selecting either 'ratio green/grey space' or 'use of space for parking' for the living environment domain,

the 'proximity of mobility options' for accessibility, and either 'mix of traffic', 'Number of accidents', or 'Number of fatalities/injured' for safety. The choice between the first two is made by checking the available resources and the contribution to the current state of the art. The required model(s) for the use of space for parking matches best with the existing macroscopic transport model (Urban Strategy), and the interaction of this indicator with the transport model results in a more interesting contribution to the state of the art than the ratio of green/grey space would. Therefore, the use of space for parking is chosen in this domain. For the safety domain, the mix of traffic matches the available transport model, while the other two indicators would require more additional modelling. Also, the mix of traffic was found to be more relevant for stakeholders. Therefore based on the research scope criterion and the relevance criterion, the choice was made for the mix of traffic indicator. This makes the final selection of indicators: use of space for parking, proximity of mobility options, and mix of traffic on the road. For all three, the required data can potentially be obtained from open data or internally available data within TNO or the Urban Strategy model. Together, they represent three of the four domains of well-being.

Table 6.1: Overview of relevant conceptual indicators and their characteristics. (Full explanations can be found in appendix H.) The blue rows are the indicators that are selected for operationalisation. Grey rows were not immediately disregarded but were not selected as final indicators to operationalise.

Conceptual indicator	Well-being domain	Well-being aspect(s)	Rank[1]	Objective	Required model(s)	Required data	Present in US?[2]
Quality of public space	Living environment	Use of space, Physical health	1	No	Geographic data model	GIS-data, subjective input regarding quality criteria	No
Ratio green and grey space	Living environment	Use of space	2	Yes	Geographic data model	GIS-data	No
Use of space for parking	Living environment	Use of space	3	Yes	Macroscopic, or large-scale microscopic transport model	GIS-data, Zonal data, Trip data	No
Perception of parking	Living environment	Use of space	4	No		GIS-data, subjective input regarding perception	No
Price-to-quality ratio of mobility options	Accessibility	Accessibility of mobility options	5	No	Depends on specification	Travel costs per mode, subjective input regarding quality	No
Proximity of mobility options	Accessibility	Accessibility of mobility options	6	Yes	Depends on specification	GIS-data, Network data, Locations of PT stops/hubs/parking	No
Number of activities within reach	Accessibility	Accessibility of activities, Inclusive accessibility	7	Yes	Macroscopic transport model	Zonal data (residents and activities), Travel time data	Potentially
Number of persons within reach	Accessibility	Accessibility of activities	8	Yes	Macroscopic transport model	Zonal data (residents and activities), Travel time data	Potentially
Mix of traffic	Safety	Traffic safety	9	Yes	Macroscopic transport model	Traffic intensities, Network-data (infrastructure separation)	No
Number of accidents	Safety	Traffic safety	10	Yes	Macroscopic transport model and statistical analysis model, or Microscopic transport model	GIS-data, Traffic intensities, Historic accident data	No
Number of fatalities/injured	Safety	Traffic safety	11	Yes	Macroscopic transport model and statistical analysis model, or Microscopic transport model	GIS-data, Traffic intensities, Historic accident data	No
Noise exposure	Living environment	Noise pollution, Physical health	12	Yes	Macroscopic transport model, Noise exposure model (CNOSSOS, dutch standards SRM)	GIS-data (infrastructure and built environment), Traffic intensities, Vehicle data	Potentially
Noise emissions	Living environment	Noise pollution	13	Yes	Macroscopic transport model, Noise emissions model	GIS-data (infrastructure), Traffic intensities, Vehicle data	Yes

Indicator	Well-being domain	Well-being aspect(s)	Rank[1]	Objective	Required model(s)	Required data	Present in US?[2]
Contribution of mobility to concentrations of NOx, PM, etc.	Living environment	Environmental pollution, Physical health	14	Yes	Macroscopic transport model, Air quality model	GIS-data (infrastructure and built environment), Traffic intensities, Congestion data, Vehicle data	Yes for NO2
Social safety score	Safety	Social safety	15	No	Depends on considered factors	Subjective input data regarding safety factors, Relevant other input data	No
Time spent in active travel	Health	Physical health	16	Yes	Macroscopic transport model	Modal split, Trip data (travel times)	No

[1] Rank of the importance of the indicator based on the shortlist determined in chapter 5.
[2] Urban Strategy (US), the model used at for this case study (as described in section 3.4.1).

6.1.3. Necessary steps to operationalise indicators

This section describes the steps that are undertaken in the following sections to operationalise the three selected indicators. All three of the following sections follow this approach.

First, exploratory research is conducted on what has already been done with this indicator. Finding existing literature (both scientific and grey) with different approaches that have been suggested is considered important to gain knowledge about the possible specifications of the indicator that could be chosen. In this step, one should already reflect on the differences between the existing approaches, or the lack of existing approaches.

The second step is to refer back to the input from local stakeholders regarding this indicator to determine the relevant purpose and specification of the indicator. Determining these gives direction for the operationalisation approach and enables the verification of the operationalisation of the indicator later in the process. The specification is based on the input from stakeholders and on the existing approaches for quantifying this indicator that were found in literature.

Thirdly, the approach to operationalise the indicator is designed. This step first involves determining the data (preparation) that is needed to put into the model. Next. the interaction with the model and the processing of the relevant model output is described. These two parts together explain how the indicator is quantified. The last part of this step is the overview of data that is needed as input, the parameters that can be set by the policy-maker, and the assumptions that were made in the indicator quantification. This part functions as an essential step towards operationalisation since this shows how the indicator could be applied in other cases and what policy-makers could potentially tweak.

The last step in the operationalisation approach of the indicators is the results and interpretation. First, the quantification results of the indicator are shown for the case study of this thesis (Oude Westen). Then, the interpretation of these results is discussed, as well as the potential limitations of the indicator. The purpose and specification that were determined earlier are relevant to these discussions.

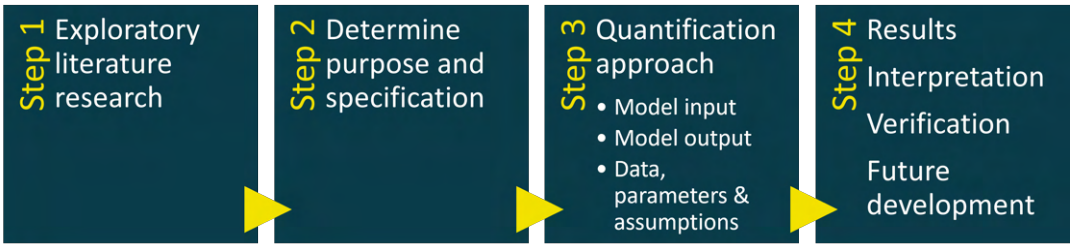


Figure 6.1: Operationalisation steps taken for each selected indicator

6.2. Operationalising indicator one: Use of space for parking

This section discusses the indicator of the use of space for parking. All four steps in the operationalisation process (that was defined in figure 6.1) are discussed in the following subsections.

6.2.1. Existing literature on the use of space for parking

Vonk Noordegraaf et al. (2021) defined potential specifications of the indicator such as specification per mode, with or without charging infrastructure, for specific target groups, with different parking fees. What seems to be missing in this report is a clear definition of what is meant by 'use of space' - there are two different definitions possible. Use of space can reflect on the amount of space that is allocated to something (in this case to parking), meaning the land that is allocated to parking infrastructure. This is a permanent use of space and disregards the actual occupation of spaces - and thus is not dependent on any transport model, but solely on geographic data about the infrastructure. The second possible definition is the extent to which space is actually used for parking. This is a quantification of the occupation of space for parking which should naturally include a temporal element - meaning it needs a transport model to model the production and attraction of zones.

Space allocation

There are multiple approaches for determining the space allocated to (car) parking. First, there are (local) governments that keep databases with all parking spaces in their area. For example, Gemeente Amsterdam (n.d.) offers a public dataset containing most parking spaces in the municipality. They also added specifications regarding reserved parking spaces for special vehicles/permit holders, pricing, and EV charging infrastructure. When such data sets are not available, one relies on estimation techniques to determine the allocated space for parking. Such estimation studies are often conducted using a combination of different data sources. For example, Li et al. (2022) use a combination of parking codes and assessor databases to determine the number of off-street parking spaces. For on-street parking, they used parking restrictions combined with OpenStreetMap (OSM) data. At TNO, Snelder et al. (2021) took a similar approach by combining OSM data with the National Roads Database (NWB, dutch: Nationaal Wegenbestand) for on-street parking. For off-street parking estimation, they combined four different geographical databases containing public space data, land-use data, real estate data, and infrastructure data.

Based on this existing literature on space allocation to parking, the following remarks can be made.

1. The use of space for parking indicator is specifically aimed at public space since the proposed use case is public policy evaluation. Therefore, the main focus should be on parking in public space instead of parking on private property (which Li et al. (2022) and Snelder et al. (2021) also take into account). However, do note that private parking can still be relevant when space occupation is taken into account (see below) since it reduces pressure on public parking. Also, commercial parking garages should be included at all times. Even though these are technically private property, they do serve as public parking.
2. Note that the mentioned sources focused mainly on the estimation of car parking spaces. Some existing literature also takes into account other modes such as buses and bikes. However, these are often based on rough averages of vehicle sizes and do not specify concrete public space allocation for this mode's parking.

Space occupation

The second definition is used by Nicolas et al. (2003), who add a temporal element to the indicator. They define the individual space consumption by parking (C) as shown below.

Definition by Nicolas et al. (2003)

$$Cs_i = s_i * h_i / n_i$$

where s_i is the surface of one parking spot in m^2, h_i the duration of the parking in h, and n_i the number of people using in the car.

This results in an indicator for the use of public space specified per person with the unit $m^2 h$ (Nicolas et al., 2003). This indicator would require data regarding parking duration (could be derived from travel time during the day) and the number of people sharing a car.

Will et al. (2020) also include the temporal aspect, but they use transport model outputs (OD matrix per mode) as input for this calculation. They define the following equation for space-time used for parking by cars for pendular commuting.

Definition by Will et al. (2020)

$$A_I^x = S_x * N_{I\rightarrow}^x * T_{origin}^x + S_x * N_{\rightarrow I}^x * T_{destination}^x$$

where A_I^x is the space-time used for parking by mode x in zone I, S_x is the space occupied by one parked vehicle of mode x, T_{home}^x and $T_{destination}^x$ are the average daily time a vehicle of mode x is parked at respectively the origin and (primary) destination location, and $N_{I\rightarrow}^x$ and $N_{\rightarrow I}^x$ respectively the number of vehicles of mode x travelling from and to zone I on a day, determined by summing the number of vehicles travelling between OD-pairs (N_{ab}^x):

$$N_{I\rightarrow}^x = \Sigma_{a\in I, b\notin I} N_{ab}^x, \qquad N_{\rightarrow I}^x = \Sigma_{b\in I, a\notin I} N_{ab}^x$$

This approach assumes a pendular commute with only one destination. Also, it uses the average times a vehicle is parked at its origin or destination. Therefore, this data is needed as separate input and is not based on the transport model output (e.g. full simulation time minus the travel times).

Lastly, Gonzales (2011) defines the minimum parking space required per trip in m^2h, with the temporal element based on the total time the vehicle is in use, minus the travel time. This is calculated using the following equation.

Definition by Gonzales (2011)

$$\bar{R}_p = \left(\psi - \frac{d}{v_m}\right) r_p$$

where ψ is the vehicle hours in a trip (combined in use and while parked), d is the distance travelled in a trip, v_m is the average speed of the vehicle, and r_p is the area of a parking space plus the space needed to get in and out of the space.

Since this indicator uses travel times and trip distances, it does use input from a transport model.

Based on these existing approaches for the occupation of space for parking, the following remarks can be made.

1. The approaches by Gonzales (2011) and Nicolas et al. (2003) lack specification of location and do not make a distinction between origin and destination parking. This would be very relevant for the application of this indicator in a macroscopic transport model with different zones.
2. While Will et al. (2020) do take into account locations of parking, they use average parking times per mode. Since different trip purposes can cause different parking times, and different zones can attract trips with different purposes, it could be relevant to specify these parking times per trip purpose or per individual trip. This can be based on both purpose and travel time (which influences the parking time at the origin location) and becomes especially relevant when parking costs are related to parking duration - which is often the case.
3. Gonzales (2011) base parking time on the total of vehicle hours that the vehicle is in use. This is difficult to define in a trip-based transport model since it should include parking time as well - does vehicle use end at the start of the following trip with the vehicle? It implies the need to work with some tour-based or activity-based model since one could then assess total vehicle hours in use from leaving till arriving home.
4. The approach by Will et al. (2020) does work with trips, but they assume only pendular commutes without trip chaining. Since in reality more trips would be chained, or a vehicle could make multiple trips within the simulated period, this assumption reduces the accuracy of the estimation.

6.2.2. Indicator purpose and specification

To define the purpose and specification of the indicator, two aspects are taken into account: the context in which it was mentioned by stakeholders in the interviews, and the policy goals of the policy-makers. The first aspect is important because it ensures the indicator is relevant to the stakeholder's interests. The second aspect should be taken into account to make sure the indicator is useful for the policy-maker and can be used to communicate the policy objectives to the stakeholders.

As was discussed in section 5.1.1, the use of space for parking indicator was concluded to be relevant for stakeholders based on the following contexts:

- There was either too much or too little on-street parking available (opinions are polarised).
- Parking garages are for some a suitable alternative to on-street parking, but this capacity is often not fully utilised while on-street parking often reaches capacity.
- Removal of on-street parking spaces in the past resulted in some more green space and wider sidewalks, which was seen as a positive result.

Related to this indicator, there are some policy objectives in the case of Oude Westen in Rotterdam. The local government aims to redivide space for infrastructure with more priority for walking, cycling and public transport (and less for cars) (Gemeente Rotterdam, 2020). Also, regarding parking the local government aims to move people to park at the edge of the city at one of the P+R locations (Gemeente Rotterdam, 2023). This implies an aim for a reduction (or limited growth) of parking in the city itself.

Based on these two aspects - stakeholder interests and policy objectives - the purpose of this indicator needs to be to assess how much public space is actually being used specifically for car parking, both in terms of allocation and utilisation of the space. This purpose implies a specification on the car as the mode of transport. Secondly, it is relevant to include an aspect of (expected) utilisation of parking - which could be split into utilisation by the user groups residents and visitors. Another potential specification of this indicator can be in the categories of on-street and garage parking. Lastly, when the use of space for parking is decreased (or increased) with a new policy, it is relevant for the stakeholders to know what the new (or previous) function of that space is.

6.2.3. Indicator quantification approach

This indicator is quantified on zonal level and specified only for cars, not for other transport modes (think: bike parking or shared vehicle parking). For each zone, the number of parking spaces is determined. Then, the first step(s) of the macroscopic transport model (Urban Strategy in this case) is run to determine the production of car trips for each zone. With this data (the number of departing cars), combined with data on car ownership in the zone, the number of cars already parked in the zone can be estimated. This is then used to adjust the available parking capacity for each zone, after which the traffic assignment step in the transport model is run. This determines the parking intensities per zone, but also new travel times between zones including added time for parking which changes the production of car trips from the zones. This enables doing some iterations between determining the new model split and car trip production, determining the updated free parking capacity, and running the traffic assignment again to get the new, adjusted parking intensities and travel times. Figure 6.2 visualises all the steps in this quantification approach. The approach is discussed in more detail in the next paragraphs.

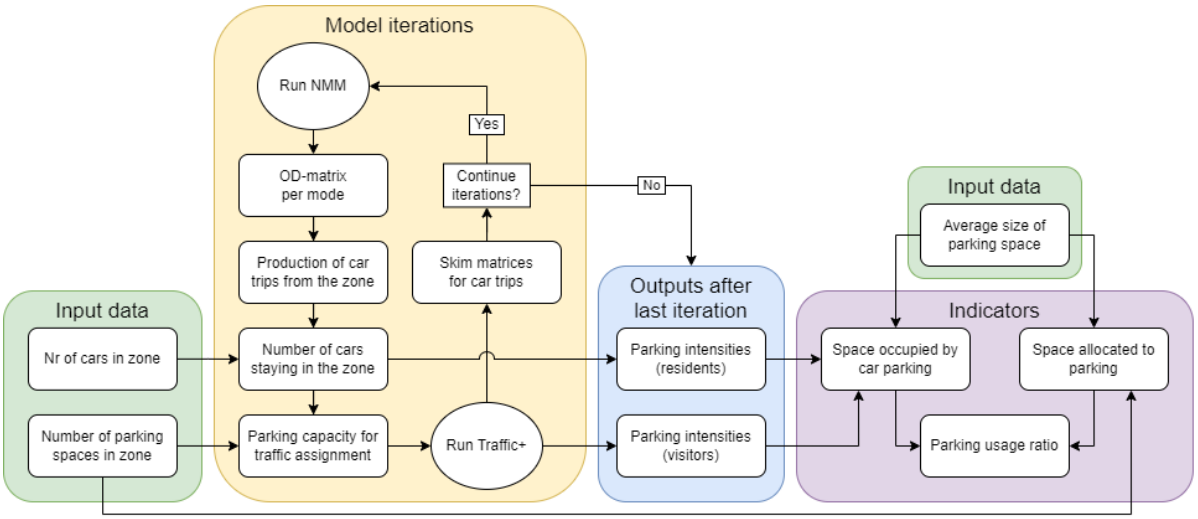


Figure 6.2: Flowchart of quantification approach for Use of Space for Parking.

Model input

Next to a working macroscopic transport model, this indicator requires data. First of all, one needs a data set containing the parking spaces in the area. This should ideally be split into different types of parking spaces, so one can make the distinction between private and public parking (the focus of the indicator is on public space), and between on-street and garage parking.

Given a data set P_t with parking spaces p of type t, one first needs to find out which zone z they belong to. This is done by determining the closest zone. The parking spaces of each type t are summed per zone z. This can be expressed in equations 6.1 and 6.2.

$$\text{zone}(p) = \begin{cases} \text{argmin}_{z' \in Z} \, \text{distance}\,(z', p) & \text{if } \text{argmin}_{z' \in Z} \, \text{distance}\,(z', p) \leq d \\ \text{None} & \text{otherwise} \end{cases} \tag{6.1}$$

where:

- $zone(p)$ is the zone to which parking space p belongs.
- $\text{argmin}_{z' \in Z} \, \text{distance}\,(z', p)$ determines the closest zone z' to parking space p based on distance as the crow flies, with $z' \in Z$ and $p \in P_t$.
- Z is a set containing all zones in the model.
- P_t is a set containing all parking spaces of type t in the study area.
- t is the type of parking space, with $t \in T$ and for this case:

$$T = \{\text{Private, Parking bay, On-street, Parking garage}\}$$

- Parking space p belongs to the closest zone z' if the minimum distance between p and z' is less than or equal to cut-off distance d. Otherwise, p does not belong to any zone in the model.

$$PS(t, z) = u_{t,z} * \sum_{p \in P_t} [\text{zone}(p) = z] \tag{6.2}$$

where:

- $PS(t, z)$ is the number of parking spaces of type t in zone z.
- $[\text{zone}(p) = z]$ results in 1 if the zone of parking space p is the same as the zone z.
- $u_{t,z}$ is the urbanisation correction factor for parking space type t in zone z, which is based on the degree of urbanisation of the zone.

As can be seen, equation 6.2 uses an urbanisation degree factor. This factor is used to adjust the estimations of the number of parking spaces to the degree of urbanisation of the zone. Since higher degrees of urbanisation often come with less available parking due to stricter local regulations on on-street parking or more narrow streets where street parking is not possible on both sides, this correction factor is needed to adjust for these aspects that are not taken into account in the initial estimation of the number of parking spaces. Note that this correction factor is only necessary in case estimations of the number of parking spaces are used. When actual data on these parking spaces is available, the assumption can be made that this is already accurate data and no correction is necessary.

With the number of parking spaces per type per zone, one can set parking capacities as input for the transport model. These parking capacities are used in the Traffic+ module[2] of Urban Strategy to simulate the impact of limited parking. It can simulate people parking in neighbouring zones and walking to their destination zone whenever parking capacity in their destination zone is (almost) reached. Using a BPR function, the time to search for a parking space in a crowded zone is simulated, resulting in a potentially higher travel time than parking in a less-crowded neighbouring zone and walking to the destination. These additional travel times are then added to skim matrices with the total average travel times between zones for the transport mode car.

For simplicity, the transport model currently does not distinguish between parking space types - although this could be a very relevant future implementation. Therefore, all parking space types are summed per zone. Before this is put in the model as parking capacity, however, it needs to be adjusted for how many cars might already be parked in the zone. For this, one first needs some data from the steps in the transport model that take place before the traffic assignment.

[2]The model step that does the traffic assignment on the network.

Model output

As output of the earlier steps of the transport model, one needs the production of car trips per zone and the number of cars that the inhabitants of the zones have[3]. This data is then used to determine the actual number of available parking spaces per zone considering some cars do not leave their origin zone and stay parked there.

First, the production of each zone is compared to the number of cars in the zone. This indicates how many cars were not used and are thus left in the zone. The assumption is made that these cars are all parked in the zone itself and mostly parked in private parking spaces. Therefore, the number of occupied spaces by cars that did not leave the zone is first subtracted from the private parking capacity. Only when more cars stay in the zone than there is private parking, the rest is evenly divided over the other, public parking capacities.

$$FC(t,z) = \begin{cases} \max((PS(t,z) - SC(z)), 0) & \text{if } t = private \\ PS(t,z) - \frac{\max((SC(z) - PS(private,z)),0)}{|T \backslash \{t_{private}\}|} & \text{if } t \neq private \end{cases} \tag{6.3}$$

$$SC(z) = \text{numberofcars}(z) - \text{carproduction}(z) \tag{6.4}$$

where:

- $FC(t,z)$ is the Free Capacity of parking spaces of type t in zone z.
- $SC(z)$ is the number of Stationary Cars in zone z, defined by the difference between the number of cars that are owned in the zone and the production of cars out of the zone during the simulation time.
- $|T \backslash \{t_{private}\}|$ is the size of set T when the private parking type $t_{private}$ is not counted. It represents the number of public parking types that are included.

Now the actual available parking capacity is determined, this capacity can be put into the model to run the traffic assignment (Traffic+ module). This then updates the intensities on all roads, the parking intensities in the zones, and the travel times between zones. After this is done, the modal split and the origin-destination matrix can be determined again based on the new travel times. With this new production of car trips per zone, the updated available parking spaces can be determined using equation 6.3. This process can be repeated for a set number of iterations or until an equilibrium has been reached.

When this process of iterations is finished, the final parking intensities per zone are taken as model output (from the traffic assignment). These parking cars are then split equally over the different types of public parking spaces. This assumption is further discussed in the next subsection with assumptions.

Three specifications are then relevant for this indicator:

- The **passive use of space for car parking** (space allocation) is the total number of available parking spaces. This can be the total area or specifically the public space. The public space use includes in this case on-street parking and parking bays. It does not include private parking since this is not in public space. Also, it does not include parking garages because in the case study area, most of these are underground or in (commercial) buildings and therefore do not directly take up public space.
- The **active use of space for car parking** (space occupation) is the total area of the parking spaces used in a zone. Again, this can be the total area or only the area in public space. In the public space specification, only the parking types of on-street parking and parking bays are taken into account.
- The **occupation rate of parking spaces** is the ratio between space occupation and space allocation for parking per zone. This can also be specified for the total numbers or specifically in public space.

[3]Note that this is not technically a model output, but more of a model input since it is used as input zonal data for the transport model. However, in this use case, the data was already in the model and was taken from the model to quantify the indicator. Therefore it is discussed in this section about model output.

The parking intensities that are determined by the transport model are in the Passenger Car Unit (PCU), which means that these parked cars are assumed to be normal-sized passenger cars. Therefore, it can be assumed that these cars take up normal-sized parking spaces. The first two above-mentioned specifications can therefore be quantified by multiplying the number of spaces by the average size of a parking space. This average size of parking spaces in the Netherlands is 12.5m^2 (VEXPAN, 2021).

Data, parameters and assumptions

Next to a working macroscopic transport model with the standard necessary zonal data, this indicator requires some potentially additional input data.

- **Parking spaces** - This data is often available at (local) governments. However, it can also be derived from open data that is available for the entire Netherlands - as was done by Snelder et al. (2021). In this case, the data for on-street parking and parking bays was obtained from the municipality of Rotterdam. The data for private parking and parking garages was obtained from the data set put together by Snelder et al. (2021). Data for the smaller municipal parking garages that are spread out over the case study area could not be obtained in time for this study. However, this is very relevant data to obtain for future studies.
- **Degree of urbanisation per zone** - This data is necessary to determine the correction factor for the number of parking spaces that should be applied per zone. This data can be obtained from the CBS (as was done by Snelder et al. (2021) in appendix A).

This indicator can be tuned to the case and needs of policy-makers by adjusting some parameters. Note that these are parameters specifically used in the quantification of the indicator. There can of course be significantly more tunable parameters in the transport model. However, these are considered to be out of the scope of this indicator description and tuning all model parameters to the specific case study is assumed to be preparatory work before quantifying this indicator.

- **Parking space types** - First of all, the inclusion of different types of parking spaces can be changed. In this case, the private parking spaces, on-street parking, parking bays and parking garages are taken into account.
- **Number of iterations** - The number of iterations that are taken in the process of quantifying the indicator for the use of space for parking can be adjusted. It can be based on the values reaching a situation of not changing much after each iteration. However, the total number of iterations can also be set arbitrarily (based on expert judgement).
- **Correction factor for urbanisation degree** - This correction factor that is applied to the number of parking spaces based on the degree of urbanisation of the zone can be tweaked by the policy-maker. This parameter should be calibrated on the situation in the case study area. Note that this factor only needs to be applied to the number of parking spaces when this number is obtained through high-level estimation as done by Snelder et al. (2021). When accurate parking space data is obtained from the local government, this factor does not have to be applied.

In the quantification of this indicator, several important assumptions are made. First, the indicator is based on the assumption that there is a moment when all cars that move during the simulation period are at their destination zone at the same time. The transport model simulates the morning peak period (07:00-09:00), which is assumed to be the peak pressure on the network. Therefore, the parking intensity after the morning peak period - considering all travellers during the morning peak period stay in their destination zone until the end of the simulation - can be considered the peak parking intensity over the day.

Secondly, regarding the cars that are owned in a zone, the assumption is made that these are all parked in their own zone at the start of the simulation and that these are mainly parked on private property. Only when there is not enough private parking, these cars are distributed over the public parking spaces as well. In reality, people can park their cars in neighbouring zones, or they could have left earlier than the simulated period.

Thirdly, the assumption is made that the cars arriving in a zone are all visiting and thus use public parking spaces. This could be slightly inaccurate since visitors could also park in private parking spaces at the location they visit. However, in the high-density urban area where the case study area is located,

the share of private parking spaces is not very high, so the share of visitors that could park in private parking spaces is assumed to be low. In more rural areas, this assumption might need reconsideration.

The fourth assumption is that the visiting cars are equally divided over the public parking space types. This is a simplification of reality for two reasons. First, in reality, the exact location of the parking space and the destination have an impact on the choice of parking spaces. This level of detail is lost because a macroscopic transport model is used with data aggregated on zonal level. Secondly, the spread over parking spaces is a simplification because it does not account for attributes of the parking spaces - such as the need for a parking permit, the parking costs, and the maximum parking duration - which could all have an impact on the choice of parking. Adding these details and an additional parking type choice model might increase the realism of the indicator, but does add another layer of complexity that is not feasible within the scope of this study.

The fifth assumption that is made regards the fact that only the public parking spaces on the ground level and outside are included in the use of public space for car parking. Parking garages are also public parking, and they could also take up some public space for parking. However, this is difficult to quantify since they often have multiple floors, meaning one cannot easily determine the ground space used based on the number of parking spaces in use. One could theoretically look at the ground area used by the garage - although this would only work for the parking allocation indicator, not for the occupation indicator. In this case study, the parking garages included are all underground. This would also be a reason to not include them in the calculation of the use of public space - given the assumption that only space on ground level is included in this calculation.

The final assumption made in this process is that on-street parking is considered to be public space used specifically for parking - even though these spaces are on public space allocated to road infrastructure. The assumption is that when on-street parking is possible and allowed, this road space is not strictly required for the road infrastructure and could thus be considered to be space allocated specifically for parking (since for infrastructure it was not required).

6.2.4. Indicator results, interpretation, verification and further development

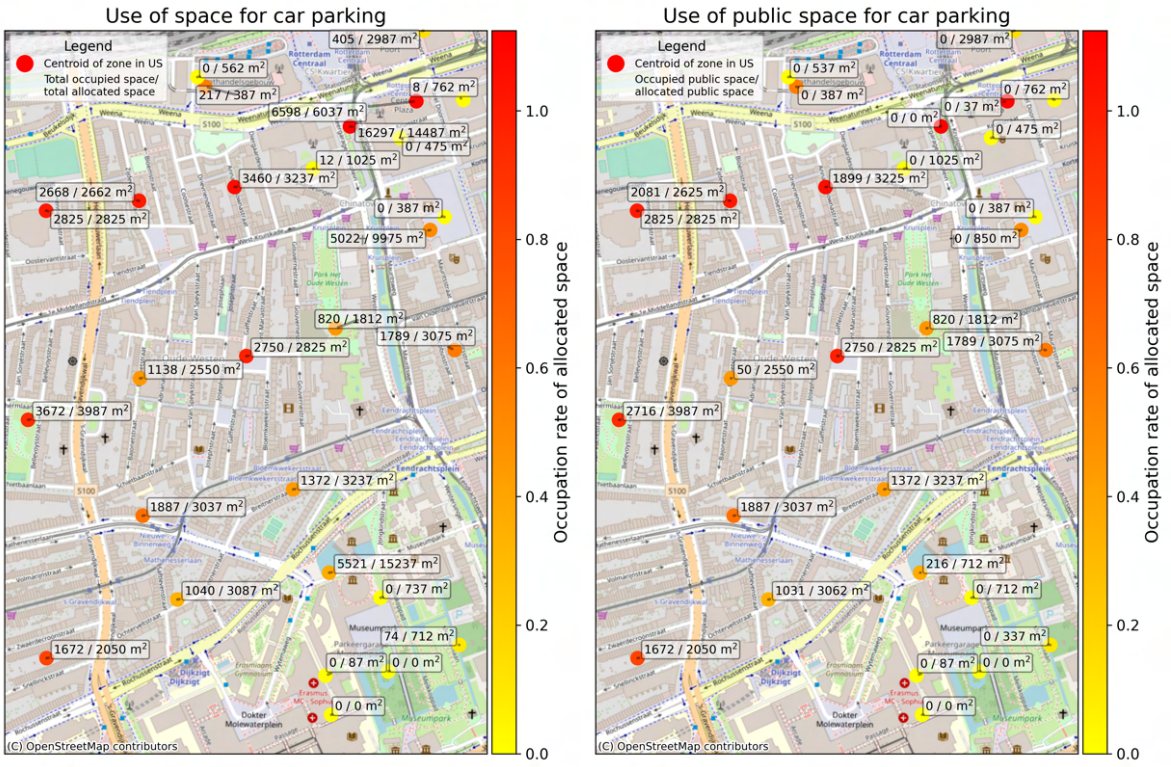
The results of the use of space for car parking can be visualised as done in figures 6.3a and 6.3b. The results are specified per zone and include the two specifications that were mentioned above: passive and active use of public space for car parking. Figure 6.3a shows the total occupied space compared to the total allocated space for car parking per zone. The colours of the centroids of the zones indicate the occupation rate of the total allocated space for parking. In figure 6.3b, the total allocated space is corrected for the amount of space that is actually part of public space and thus excludes parking garages (as discussed in section 6.2.3). The occupied space in this figure is also corrected for the parking in public space. In line with the assumption mentioned above that parking visitors are equally divided over the three types of public parking, only the share of parking in public space is included in figure 6.3b.

Interpretation of results

The operationalised indicators of space allocation and occupation give an insight into the (public) space that is set aside for car parking and the (public) space that is actually used for parking after the simulation period. When combined, these two indicators determine the occupation rate of the car parking spaces in a zone. Visualisations such as in figure 6.3 can be used to determine whether there is over-capacity of parking spaces and thus if less public space could be allocated towards car parking.

Another way in which extra insights can be gained from these indicators is by combining them with the attraction of car trips per zone (which can be a model output). This allows a policy-maker to evaluate how many of these car trips could park in the destination zone, and how many had to divert to other zones. This can shine more light on potential parking issues going on in zones. Within the scope of this thesis, this option was not further explored, but it could be relevant for applications in future cases.

Overall, these operational indicators could be used to evaluate the effects of all kinds of policies on the need for parking in zones. Measures can impact both the space allocation (e.g. infrastructural redesigns) and the space occupation (e.g. measures impacting car traffic volumes). Therefore, it can be very relevant in the context of ex-ante evaluation of all kinds of car-free policies.



(a) Total occupied space by parked cars versus the total allocated space for car parking per zone.

(b) Occupied public space by parked cars versus the allocated public space for car parking per zone. These areas do not consider parking garages and private parking (see assumptions in section 6.2.3).

Figure 6.3: Use of space for car parking indicator per zone. Colours illustrate the car parking occupancy rate of the zone.

Verification of the operationalised indicator

The purpose of this indicator was to determine how much public space was actually used specifically for car parking, both in allocation and occupation. The operationalised indicators do fulfil this purpose. In section 6.2.2, the following specifications were proposed for this indicator:

- Specification per user group (visitors versus residents).
- Specification per parking type (on-street parking and parking bays versus parking garages).
- A specification of the future use of the public space when a policy would take away parking.

The first specification is partially implemented. Figure 6.2 shows that the parking intensity is determined separately for residents and visitors. However, this is not reflected in the final indicators. The stakeholders also mentioned more interest in the different spread of residents and visitors over the various parking types. This relates to the second proposed specification: specification per parking type. The current operational indicators for the use of public space for car parking do not have a sophisticated specification of parking per parking type - parking intensities are just split evenly over the different types, as is mentioned in the assumptions above. Therefore, the indicators do not provide valuable insights in this specification. This is also the reason why there is no specification per user group regarding the type of parking spaces they use most. The last proposed specification is more of a recommendation to the policy-maker to communicate the future function of the space they take away from car parking. This was therefore not relevant to include in the quantification approach of this operationalised indicator, but should be taken into account when using the indicators in practice.

Implementation issues for the indicator in Urban Strategy

The implementation of the indicator in Urban Strategy using the quantification approach described above resulted in some unrealistic results. Figures 6.3a and 6.3b showed occupation rates above one. This parking pressure resulted in extremely high travel times. When running the NMM, these high travel times for car trips impacted the modal split and reduced the share of car trips to merely 15% while the base scenario of the same model in the study by Heezen et al. (2022) yielded a 37% share of car trips.

This low share of car trips was not only not in line with the earlier study using this model, but it was also not in line with reality. Gemeente Rotterdam (2016) showed a modal share of 37% for cars in the year 2015. Even though a modal shift could take place in the simulated year of 2030, a shift from 37% to 15% would not be realistic.

Several attempts were made to produce more realistic results, but they did not succeed in solving the issue. The remaining issues could potentially be caused by two factors. First, the parking capacities could be lower than in reality. This could be due to incomplete parking space data (e.g. missing data about municipal parking garages), or due to an overestimation of car ownership in a zone (and thus an overestimation of the occupied spaces and an underestimation of the free capacity). Secondly, there could be a need for (re-)calibration of the NMM or (the parking aspect of) the Traffic+ module. The NMM could, for example, give a lower weight to parking time than to travel time. For the Traffic+ module, the parameters of the BPR function could potentially be (re-)calibrated. The combination of using the NMM and Traffic+ including parking should then ideally be validated with empirical data.

Since the scope of this thesis was limited to developing a first approach to operationalising well-being indicators, solving the two above-mentioned potential causes was outside the scope of this thesis. Appendix I describes the implementation issue, the potential causes, and the attempted fixes with more (technical) details. This might be used in future work on the implementation of this indicator.

Potential future developments of the operationalised indicators

Since this is the first approach for the operationalisation of this indicator, there is space for future development. It would be recommended to start improving this indicator by improving the quality of the parking space data that is used. The current case study misses data about the municipal parking garages, while these are a major part of the parking space supply in high-density urban areas. When this step is made, it is important to validate the results with empirical data and re-calibrate the model where needed. This is a step that was outside the scope of this thesis, but one that is detrimental to the relevance of this indicator.

If this improvement does not solve the issues of the unrealistic results that were mentioned above, the next future development would be to check the calibrations of both the New Mobility Modeller and (the parking aspect of) the Traffic+ module. These modules should be validated with empirical data to ensure realistic results after the implementation of the indicator.

A next potential future development would be the addition of a parking space type choice model. This would improve the added value of the indicators by adding a more accurate specification per parking type and thereby abandon the simplification of spreading the visiting cars equally over the public parking types. To enable this, more attributes need to be gathered in the parking space data - think of cost, maximum duration, maximum height, or the need for a parking permit. Since these attributes often differentiate between parking spaces - even within zones - a higher level of detail of the indicator might also be necessary.

This development and more detailed choice for parking type would also open the door for specification per user group and/or trip purpose. Each trip purpose could be allocated to specific parking types or user groups could be allocated to parking types of which the attributes match their personal attributes - such as income level, possession of a parking permit, or disabilities. This parking type and user group specification could also benefit other indicators on the shortlist such as the accessibility of activities since the characteristics of parking near activities can be taken into account.

The last proposed future development of the indicator would be to add a temporal aspect to the parking. As seen in the literature about this indicator (see section 6.2.1), adding a temporal element to the parking would enable one to see the usage of parking spaces in time. This could add interesting insights since it can show how much of the day the parking space is used, at which times and by which user group. This could open up opportunities for dynamic use of this space - dynamically split over parking and another land use. In combination with using more parking space attributes, this development could enable the use of actual parking costs (cost per hour times the parking duration) instead of an average parking cost. However, note that adding a temporal element might not be possible when using the current model (Urban Strategy) since this is a macroscopic trip-based model that simulates only the morning peak period. A more microscopic/agent-based model would be more suitable for this application since this can add detail about how long an agent stays at a location - and thus about parking duration.

6.3. Operationalising indicator two: Proximity of mobility options

This section discusses the operationalisation of the indicator of proximity of mobility options. All four steps in the operationalisation process (that was defined in figure 6.1) are discussed in the following subsections.

6.3.1. Existing literature on the proximity of mobility options

The proposed indicator for the proximity of mobility options was focused on public transport (PT) - the distance to the nearest PT stop (Vonk Noordegraaf et al., 2021). Next to this, an indicator was proposed for the number of mobility options within a certain distance - which looked at different modes, different sub-options within modes, or certain aspects of modes such as the need for a credit card or a driver's license (Vonk Noordegraaf et al., 2021).

These two options are both mentioned in other literature: indicators related to the distance to the nearest stop/parking of different modes of transport, and indicators related to the number of mobility options within a certain distance - although the latter is not mentioned frequently.

One of the few studies that defined an indicator focused on the quantity of transport options was conducted by Ali et al. (2021). They define the indicator as the number of different transport modes that are available between two zones. Kyriakou et al. (2019) defined this indicator in more general terms - the number of available transport modes. However, they do not provide more specifications and disregard the indicator in the rest of their study.

More often mentioned are indicators that measure how many people live within a certain distance of a public transport stop. Gillis et al. (2015) for example determine their indicator for access to mobility services as the percentage of the population living within 400 meters from a public transport stop. They increased this threshold to 800 meters for rail transport. Other studies have determined the same indicator, but have opted for different threshold values for this indicator. Table 6.2 shows an overview of these threshold values. Note that all references still use the same definition for the indicator, except for Stantchev et al. (2018), Currie (2010) and Shiau and Liu (2013).

Table 6.2: Threshold values for indicators for population shares living within a certain distance from a public transport stop

References	Thresholds per mode			
	Bus	**Tram**	**Train**	**Ferry**
Badland et al., 2015	400m	600m	800m	800m
Zito and Salvo, 2011[1]; Jiang et al., 2013[1]; Stantchev et al., 2018[1]	300m	300m	300m	300m
Campos et al., 2009[1]	500m	500m	500m	500m
Currie, 2010[2]; Gillis et al., 2015[2]	400m	400m	800m	-
Shiau and Liu, 2013[3]	500m	1000m	1000m	-

[1]No specification per mode
[2]The 800m distance was specified for rail stations. Since the tram falls under light rail, these stops were categorised as regular public transport stops and not as rail stations.
[3]The 500m threshold was specified for the bus and the 1km for Mass Rapid Transit - which was therefore assumed to include trams.

Both Stantchev et al. (2018) and Currie (2010) add more detail in their indicator regarding the public transport service level. The former sets frequency as an extra threshold by only including public transport stops that see at least hourly service. The latter defined the supply of public transport in an area (zone) with the following supply index (SI_{zone}).

Definition by Currie (2010)

$$SI_{zone} = \sum N \left(\frac{Area_{B_n}}{Area_{zone}} * SL_{B_n} \right)$$

where N is the number of public transport stops which are within the threshold distance from

the selected zone, $Area_{B_n}$ is the area within the threshold distance from stop n that falls in the zone [km^2], $Area_{zone}$ is the area of the zone [km^2], SL_{B_n} is the service level for stop n [number of bus/tram/train vehicle arrivals per week].

Shiau and Liu (2013) define their indicator not as the share of the population that lives within this threshold distance from public transport stops, but as the percentage of land area that is accessible by public transport when considering these threshold distances.

The following remarks can be made based on the discussed literature:

- By taking into account more public transport aspects (such as done by Currie (2010)), this indicator also to some extent considers the usefulness and relevance of a public transport stop - assuming a high service frequency increases the usefulness of a stop. This also better matches the importance of the availability of public transport as a suitable alternative transport mode that was found in literature (see section 5.2.2).
- The indicator definition by Shiau and Liu (2013) removes the population aspect from the indicator and therefore does not take into account population density differences between areas - which are implicitly taken into account by indicators focused on population shares.
- Literature about indicators regarding the quantity of different available transport modes (within a certain distance) is scarce and these indicators are not specified in much detail.

6.3.2. Indicator purpose and specification

This section determines the purpose and specification of the new indicator based on the context in which this topic was mentioned by stakeholders in the interviews and on the policy goals of the policy-makers. In this way, both the relevancy of the indicator for the stakeholders and for the policy-makers is ensured.

The indicator of the proximity of mobility options was concluded in section 5.1.2 to be relevant for stakeholders based on the following contexts:

- In general, residents and local business owners were keen on the significant number of different transport modes that are available nearby (train, tram, metro, car (parking), bike (infrastructure)).
- In particular, the high-quality public transport network with many stops - always a stop nearby - was seen as a very positive aspect of the transport system. Also in literature (section 5.2.2), the quality and usefulness of public transport as an alternative to the car was found to be important when considering proximate public transport stops.
- A good cycling network was also found to be important.

In the case study of Oude Westen in Rotterdam, some policy objectives could be related to this indicator. The local government aims to increase the accessibility of public transport stops by foot and to make (public) transport more inclusive (Gemeente Rotterdam, 2020). Meanwhile, they also aim to increase the number of mobility options available to people (Gemeente Rotterdam, 2023).

Considering these two aspects, it seems the purpose of the indicator proximity of mobility options needs to be the assessment of the freedom to choose from a multitude of mobility options within a feasible range from home - or a feasible range from destinations such as local businesses. The indicator should include the multitude of mobility options (relevant for local stakeholders and policy-makers) and an aspect of service quality of the public transport stops (mainly relevant for local stakeholders). Since its purpose is to assess people's freedom to choose from different transport modes, the indicator needs to be specified to individual (housing) locations.

6.3.3. Indicator quantification approach

This indicator does not require specific data preparation for the input of the model. There is therefore no 'model input' section in the quantification approach. However, the indicator does require some data that can come from the model, or that needs to be obtained from other sources. Since the indicator is defined for individual housing locations, the street addresses and their locations are needed. For simplification of this quantification approach - to keep the process feasible within the available resources

- currently, only public transport modes are included. Therefore, the public transport stop locations and their service frequencies are required data. These data sets can come from the model as model output. If they are not initially in the model, they need to be obtained from a different source.

Model output

The indicator is quantified for each street address. For each address location, the public transport stops of each included public transport mode that are within the set threshold distance for accessing this transport mode are added to a set $S_{l,m}$.

$$S_{l,m} = \{s_m \in S \mid \text{distance}(l, s_m) \leq t_m \; and \; \text{mode}(s_m) = m\} \tag{6.5}$$

where:

- S is the set of all public transport stops s in the model network
- l is the location of the address the indicator is defined for
- m is the transport mode, with $m \in M$ and M is the set of all included public transport modes
- distance(l, s) represents the distance between location l and stop s
- mode(s) is the transport mode that is serving stop s

With this set $S_{l,m}$ for each address location, the number of transport options for each location can be determined. This is done by adding the service frequencies of the stops in this set. The sum of those frequencies is considered the number of public transport options that are within reach of a location within an hour. The indicator is calculated for each location using the following equation:

$$O_{PT}(l) = \sum_{m \in M} \sum_{s_m \in S_{l,m}} F(s_m, m) \tag{6.6}$$

where:

- $O_{PT}(l)$ is the number of public transport options for location l, expressed in services per hour
- and $F(s_m, m)$ is the frequency by which stop s_m of mode m is served per day.

Data, parameters and assumptions

This method of quantifying this indicator is specified only for public transport modes. Therefore, the assumption is made that the quality of the proximate stops is determined by the service frequency.

The basic data that should be available in a transport model for this indicator are:

- **Location dataset** - This can be a dataset with addresses (and geographic location information attached to them) as was used in this case study. However, these can also be a dataset with shapes and locations of buildings, as then the indicator can be quantified per building.
- **Public transport stops dataset** - A dataset containing all locations of public transport stops in the case study area. This should include the transport mode that serves this stop and the service frequency.

The following parameters are used in the quantification of this indicator:

- **Threshold distances** - A set of threshold distances within which the stops are considered proximate to a certain location. These distances can differ per mode and can be altered by policy-makers based on their policy objectives. Based on literature, average values of $390m$, $475m$, and $600m$ are proposed for respectively bus stops, tram stops and train stops. The explored literature did not cover threshold distances for metro stops. Therefore, the threshold distance of $540m$ is proposed by interpolating between the distances for tram and train.
- **Included transport modes** - Policy-makers should consider which transport modes should be taken into account in the indicator. For this specific approach to quantifying this indicator, this parameter is limited to include transport modes that have a service in a certain frequency. In the case study, the modes of bus, tram, metro, and train are included since these are all present in the vicinity of the case study area.

In this quantification approach, assumptions are made and some aspects are decided to not be taken into account. First, the indicator is based on the assumption that the total frequency of public transport is a relevant indicator for the number of (PT) mobility options a person or household has. This does not take into account the route of the PT line and the destination. It takes an average frequency per hour for the simulation period (morning peak period in this case) and is therefore not representative for the rest of the day - in which the frequencies are usually lower.

Secondly, the distance from a location to a PT stop is taken as the crow flies, and not on the network. Therefore, these distances might in reality be longer than measured in this indicator, which could exclude stops for certain locations that are now included. Natural barriers such as bodies of water or highways are also not taken into consideration. This leads to a possible overestimation of the mobility options around those locations. These phenomena can best be seen in the results in figure 6.4 when looking at the island in the bottom-right corner. The number of mobility options on the island is influenced by the metro stop on the other side of the water, even though this is in reality not within walking distance. Around large barriers, it could be possible to mitigate this issue by manually adjusting the inclusion of PT stops opposite the barrier. However, due to limited available resources, this is currently not done. Therefore, policy-makers should take this into consideration when applying the indicator.

Thirdly, the exact proximity of PT stops is not taken into consideration - the indicator merely counts the stops within the threshold distance. In reality, there can be a difference between the experienced acceptable mobility options between PT stops around the threshold distance and PT stops only 50 meters from a location. A weight factor with the actual distance to the PT stop could therefore be relevant. However, this aspect of exact proximity was not added to the indicator to increase the explainability of the indicator to stakeholders. The assumption was made that adding a factor of proximity to the service level (besides frequency) would decrease the transparency of the indicator and make it more difficult for all stakeholders to understand.

6.3.4. Indicator results, interpretation, verification and further development

For implementation of the proximity of mobility options indicator for the case study of Oude Westen, the dataset of individual addresses was obtained from the Registration of Addresses and Buildings (BAG, or Basisregistratie Adressen en Gebouwen in Dutch) (Kadaster, 2023). The modes that are included are train, metro, tram, and bus - which use threshold distances of respectively 600m, 540m, 475m and 390m. Figure 6.4 shows the indicator for the entire city of Rotterdam. It can be seen that the available frequency of public transport options is significantly greater in the central area and is most severely influenced by train and metro stops. This can be explained by the greater threshold distances that are considered for these modes, and by the on average higher frequency that these stations get served at than bus and tram stops.

Figure 6.5a shows a more detailed map with the number of mobility options for the Oude Westen neighbourhood. This is again with the set threshold distances that were based on literature. It can be seen that the whole neighbourhood has at least over 100 different mobility options per hour during the morning peak period - with locations more towards the Rotterdam Central train and metro station peaking at around 600 mobility options per hour. This should be interpreted as the summed service frequency of all PT stops within the set threshold distance from any location in Oude Westen being over 100 times per hour during the morning peak period (the simulation period, 07:00-09:00). Therefore, this indicator shows the supply of mobility options to the population.

Note that this could also include a bus line stopping at two consecutive stops that are both within the threshold distance from a location. Therefore, this single bus is counted twice. However, it can be argued that this is accurate since getting on that bus at one stop is technically a different mobility option than getting on that bus at the other stop at a slightly different time.

It was not explicitly mentioned in the context of the proximity of mobility options, but in chapter 5, some stakeholders did associate inclusive accessibility with the proximity of mobility options. This would require applying this indicator in such a way that it could also be relevant for that aspect. Figure 6.5b shows the indicator specified for a uniform threshold distance of 150 meters. The assumption was made that this walking distance was more applicable to people with reduced mobility. This is currently

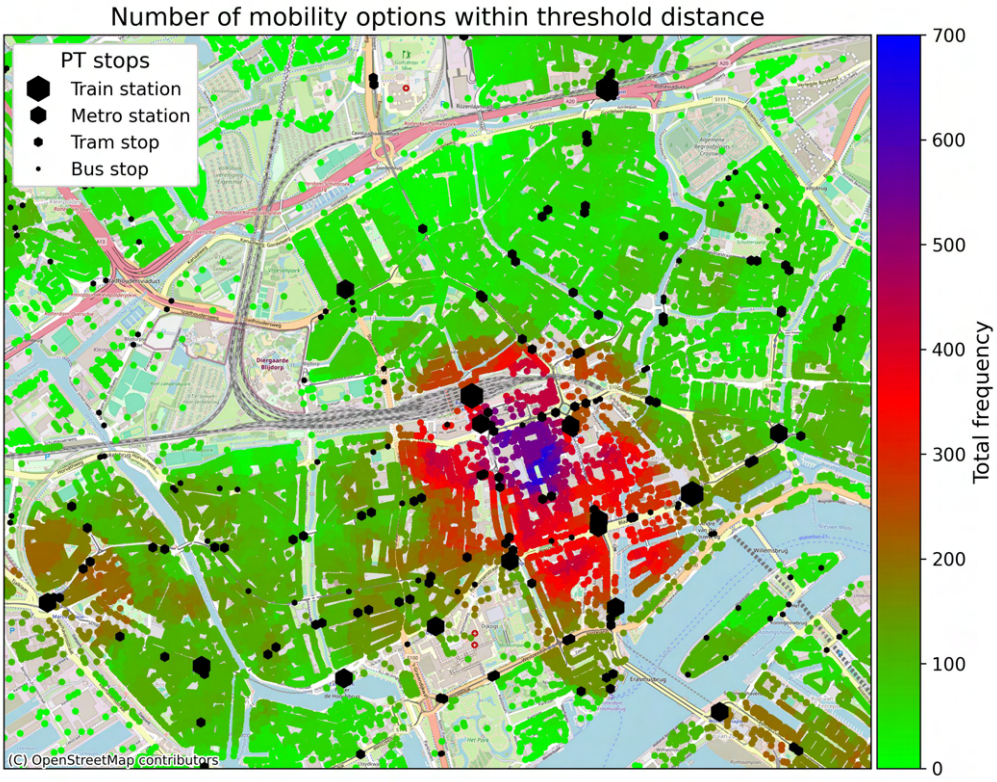
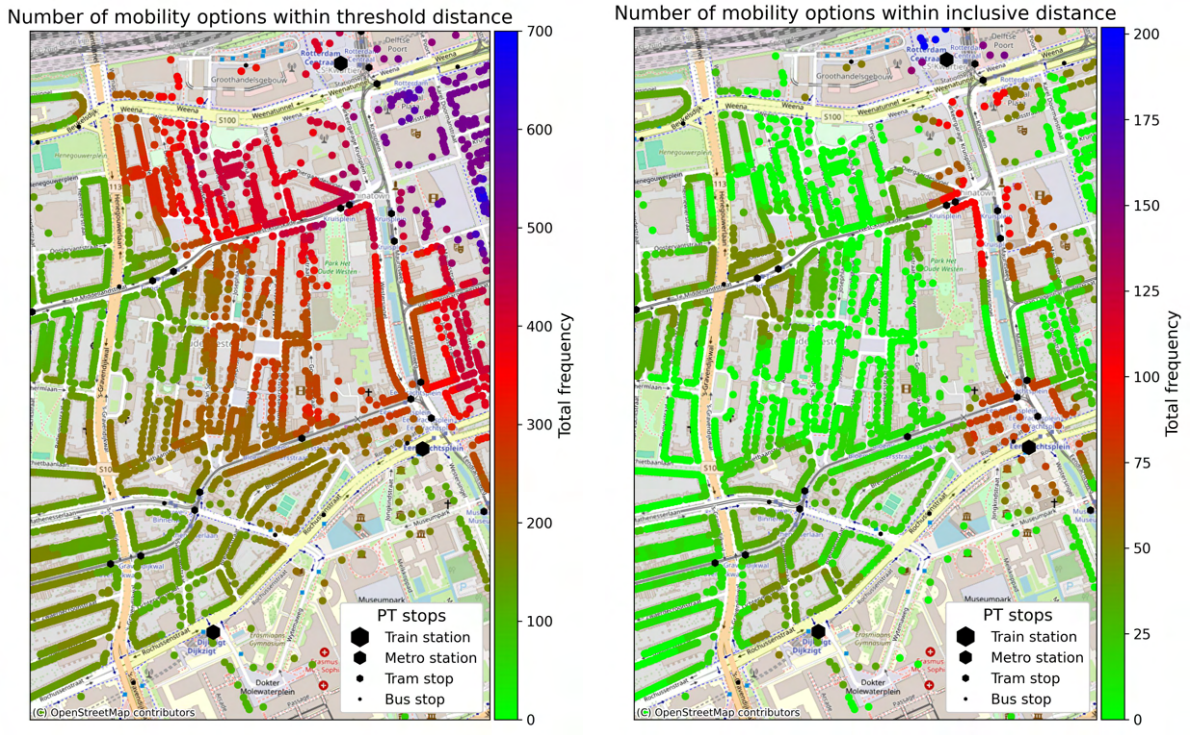


Figure 6.4: Number of mobility options for addresses in Rotterdam considering public transport modes.



(a) Number of mobility options in Oude Westen considering public transport modes and normal threshold distances based on the literature averages.

(b) Number of mobility options in Oude Westen considering public transport modes and an inclusive threshold distance of 150 meters for every mode.

Figure 6.5: Numbers of mobility options for addresses in case study area Oude Westen

still a proposed extra use-case for the indicator, but it shows how this could theoretically be applied to specific target groups as well by adjusting the threshold distance.

Verification

The operationalised indicator does match the determined purpose and specification quite well. It does assess the freedom for people to choose different mobility options. However, it is currently still limited to public transport modes, so it does not yet represent the full choice set of mobility options.

Regarding the specification, the indicator is correctly specified per housing location. It also adds the quality element of public transport by assessing the service frequency. However, it could be questioned if this is sufficient consideration of quality elements, or that other elements - such as comfort levels or availability of seating - should still be added.

In the current visualisation, the multitude of mobility options is shown for all PT modes combined. This is something that could be split into the different transport modes if deemed relevant. However, this was not specified in the determined specifications of the indicator and therefore, the current operationalised indicator is still in compliance with the specifications.

Potential future development of the operationalised indicator

Further development of this indicator could go in three directions. First, the set of included transport modes could be expanded. This would require one to rethink how to evaluate the 'quality aspect' which is currently included as service frequency. It might be complex to compare this with modes that do not run on a specific frequency (most non-PT modes). Therefore, it is also an option to separate the modes that are too different to compare and make separate indicators. The current operationalisation could then remain for PT modes, but a different operationalisation process could then be completed for other modes such as private car, bike, or shared mobility.

A second further development direction is in the specification per user group. As mentioned earlier in this section, this indicator could also be tuned to specific user groups. Currently, this can be done by changing the threshold distances. Future developments could involve adjusting the mode availability per user group based on user group characteristics such as having a driver's license, having a public transport card, being able to bike, etc. This becomes even more relevant when more different modes are included. Expanding the indicator customisability in this direction would allow the indicator to be used more for the aspect of inclusive accessibility as well.

The third possibility for further development is the application to different location types. The indicators Vonk Noordegraaf et al. (2021) proposed for the well-being aspect of accessibility of activities were directed from people to activities and also vice-versa. Currently, this operationalised indicator of the number of mobility options is not specified for people or activities, but for all locations in general. However, just like the indicators in the other aspect of accessibility, this could be split. The number of mobility options can be specified for residential locations, directing the indicator from people to their mobility options - which allows them to travel to activities. This is then specified to be relevant for the residential stakeholders. This can also be turned around when information is needed from the perspective of local business owners or other organisations. The number of mobility options could then be specified from activity locations to mobility options to assess the options people have to reach this activity location.

6.4. Operationalising indicator three: Mix of traffic on the road

This section discusses the indicator of the mix of traffic on the road. All four steps in the operationalisation process (that was defined in figure 6.1) are discussed in the following subsections.

6.4.1. Existing literature on the mix of traffic on the road

Traffic safety risk can be split into multiple components. Rumar (1999) defines three aspects that influence the size of traffic safety problems: exposure, accident rate, and injury risk. This proposed indicator of the mix of traffic on the road is related to traffic volumes and thus related to the exposure component.

Asadi et al. (2022) found that exposure variables - in their case vehicle kilometres travelled and bike kilometres travelled - contribute significantly to the the frequency and probability of accidents. Traffic

volume - another exposure variable - also has a link with crash risk. This link is not proportional, and findings on this link differ, but in general, this link is found to be strong (SWOV, 2022).

Hakkert and Braimaister (2000) also mention the link between traffic volumes and accidents. Although detailed estimations of the number of accidents require more complex safety performance functions, a simple method using traffic volumes and an average accident rate could already provide rough estimates.

The link between safety and traffic volumes (exposure) is also present in practice. When looking at the guidelines for cycling infrastructure in the Netherlands, CROW (2016) stated in their handbook for road design that the traffic volumes of bikes and motor vehicles determine the type of bicycle infrastructure that is needed - whether it can be mixed traffic, an on-road cycle lane, or a separated cycle path (see table 6.3).

Table 6.3: Guidelines for cycling infrastructure (translated from Dutch) (CROW, 2016)

<table>
<tr><th rowspan="2">Road category</th><th colspan="2" rowspan="2">Max speed motor vehicles (km/h)</th><th rowspan="2">Intensity motor vehicles (veh/day)</th><th colspan="3">Cycle network category</th></tr>
<tr><th>Base network (Intensity<750 cyclists/day)</th><th>Primary cycling network (Intensity 500-2500 cyclists/day)</th><th>Fast cycle route (Intensity>2000 cyclists/day)</th></tr>
<tr><td rowspan="3">Access road</td><td colspan="2" rowspan="3">Walking speed or 30</td><td><2500</td><td rowspan="2">Mixed traffic</td><td>Mixed traffic or cycle street</td><td>Cycle street (with priority)</td></tr>
<tr><td>2000-5000</td><td>Mixed traffic or cycle lane</td><td rowspan="2">Cycle path or cycle lane (with priority)</td></tr>
<tr><td>>4000</td><td colspan="2">Cycle lane or cycle path</td></tr>
<tr><td rowspan="3">Distributor road</td><td>50</td><td>2x1 lane</td><td>All</td><td colspan="3" rowspan="2"></td></tr>
<tr><td>50</td><td>2x2 lanes</td><td>All</td><td colspan="3">Cycle path</td></tr>
<tr><td>70</td><td>-</td><td>All</td><td colspan="3">Bicycle and moped path</td></tr>
</table>

Some remarks that can be made based on the found literature:

- Exact relations between traffic volumes and numbers of accidents are not easy to determine (SWOV, 2022). For these detailed estimations of the number of accidents, more complex methods are needed (Hakkert & Braimaister, 2000). However, an indicator does not necessarily have to provide detailed estimations for it to be a useful and relevant indicator, as long as it can give an indication of the phenomenon it is meant to describe. Therefore, these more complex methods might not be strictly necessary.
- Since the indicators are determined with input from stakeholders, the explainability and clarity of the indicators are very important. This would call for a simple and understandable calculation method and would disregard the use of more complex safety performance functions.
- In practice, the traffic volumes for bikes and cars, and the speed limit on the roads are used to determine what is safe cycling infrastructure (CROW, 2016). These values can be useful when determining threshold values for this indicator.

6.4.2. Indicator purpose and specification

As done for the first two indicators, the purpose and specification of this indicator are determined by looking at two aspects: the context in which the stakeholders mentioned this aspect, and the objectives of policy-makers related to this indicator.

Traffic safety was mentioned by stakeholders in the context of experiencing busy mixed traffic in the main shopping streets in the neighbourhood (see section 5.1.3). In particular, the combination of cyclists, cars, trams and multiple pedestrian crossings was perceived as unsafe for cyclists.

In the case study area of Oude Westen in Rotterdam, the local government has the policy objective to decrease the speed and intensity of car traffic on the lower level roads (Gemeente Rotterdam, 2023). This policy is aimed at (among other things) improving the traffic safety on those roads and specifically mentions the Nieuwe Binnenweg (shopping street in Oude Westen).

Considering the above-mentioned aspects, the purpose of this indicator needs to be to evaluate traffic safety by assessing the traffic mix on the road. Existing literature compares traffic volumes of different modes. Given the discussed stakeholder interests, the specifications of the indicator can be a comparison of traffic volumes of cyclists and cars (and/or trams), or traffic volumes of pedestrians and cars, cyclists, and/or trams. Because of the different threshold values for different types of infrastructure (see table 6.3), this indicator needs to be defined for each road segment.

6.4.3. Indicator quantification approach

The purpose of the indicator is to evaluate the traffic safety of a road by assessing the intensities of the different modes on the road. For evaluating traffic safety based on these intensities, the infrastructure type needs to be known. Every infrastructure type has different safety threshold values for the intensities. For the combination of bikes and cars, the CROW (2016) has the infrastructure guidelines as shown in table 6.3. These can be transformed to high and low threshold values per infrastructure type as can be seen in table 6.4. Note that contrary to often used units of vehicles per hour, these threshold values are in vehicles per day - it considers the total traffic on a road on a full day. Crossing the high threshold values is more alarming than crossing the low threshold values since the high threshold values mean that there are either more bikes or more cars than the bike infrastructure was designed for (according to the guidelines). Since these are guidelines for safe cycling infrastructure, the assumption is made that crossing these high threshold values might impose traffic safety risks and require a more close inspection.

Table 6.4: Infrastructure dependent thresholds for safe cycling infrastructure (adapted from CROW (2016)). The speed limit column indicates the speed limit [km/h] for cars on the road to which the cycling infrastructure belongs (so in the last row, the bicycle and moped path is separated from a car road with a 70km/h speed limit). The threshold intensities are in veh/day.

		Car intensity thresholds		**Bike intensity thresholds**	
Cycling infrastructure type	**Speed limit**	**Low**	**High**	**Low**	**High**
Mixed traffic	30	0	5000	0	2500
Cycle street	30	0	2500	500	2500
Cycle street (with priority)	30	0	2500	2000	∞
Cycle lane (medium I_{car})	30	2000	5000	500	2500
Cycle lane (high I_{car})	30	4000	∞	0	2500
Cycle lane (high SL, 2x1 lane)	50	-	-	0	750
Cycle lane (with priority)	30	2000	∞	2000	∞
Cycle path	30	4000	∞	0	2500
Cycle path (with priority)	30	2000	∞	2000	∞
Cycle path (high SL, 2x1 lane)	50	-	-	500	∞
Cycle path (high SL, 2x2 lane)	50	-	-	0	∞
Bicycle and moped path	70	-	-	0	∞

Model input

This indicator does not necessarily require specific model input to enable the quantification of the indicator. It requires a macroscopic transport model that can output intensities of different modes for each road (in this case at least intensities for bikes and cars). If one would want to quantify the indicator within the model, one also needs to input the rest of the required data. This concerns infrastructural data about the current cycling infrastructure type (ranging from mixed traffic to separated cycle paths as seen in table 6.4). This needs to be determined for every link in the model network. The speed limit of the road needs to be added to this infrastructural data as well.

Some transport models might have separate networks for cars and bikes. This results in the need for a method to link the car links to the cycling links that run alongside these car links. Only when this link is made, the intensities and the infrastructure type are structured around one link and the indicator

can be quantified. In the Urban Strategy model used for the case study, this separation of networks was the case. The linking process between those networks did not end up being feasible within the available time and with the available resources in this study. This is why no results can be shown for this indicator, only a manual demonstration. The rest of this section discusses a potential approach for the operationalisation of the indicator.

Model output

From the transport model, a data set containing all the road links is exported. This is then filtered to only include links that can be used by both cars and bikes. This data set should include the infrastructural data that was mentioned in the previous paragraph.

The type of cycling infrastructure of road segment r, with $r \in R$ and R is a set of all road segments open to bikes and cars, is referred to as $CI(r)$. The first aspect of the CROW guidelines that needs to be checked is whether the speed limit matches the type of cycling infrastructure type. This yields a warning level for the speed limit.

$$WL_{SL}(r) = \begin{cases} 2 & \text{if } SL_r > ASL_{CI(r)} \\ 0 & \text{if } SL_r = ASL_{CI(r)} \\ -1 & \text{if } SL_r < ASL_{CI(r)} \end{cases} \tag{6.7}$$

where:

- $WL_{SL}(r)$ is the traffic mix warning level regarding the speed limit SL for road segment r.
- SL_r is the speed limit in effect on road segment r.
- $ASL_{CI(r)}$ is the Advised Speed Limit for the cycling infrastructure CI of road segment r.

This traffic mix warning level is positive (2) if the speed limit on the road segment is higher than the advised speed limit for the type of cycling infrastructure, and neutral if the speed limit is as advised. When the speed limit is lower than the advised speed limit for this type of cycling infrastructure, the warning level is negative (-1). This indicates that the speed limit could be higher for this type of infrastructure and the guidelines would still be respected.

The next check is whether the traffic intensities for bikes and cars (I_b and I_c) are within the threshold values for the type of cycling infrastructure. The traffic mix warning levels for bike and car intensities have four options. A warning level of 2 means that an intensity is greater than the high threshold value, while a level of -1 means that the intensity is lower than the low threshold value. For the other two options, there is an extra parameter: the warning factor wf. This can be set to a fraction which serves as the threshold for a soft warning about almost exceeded threshold values. The warning level of 0 occurs when the intensity is between the lower threshold value and the warning threshold (a fraction of the high threshold). The warning level of 1 occurs when an intensity is higher than the warning threshold, but still lower than the high threshold value from the guidelines.

$$WL_m(r) = \begin{cases} 2 & \text{if } I_{m,r} > t_{h,m,CI(r)} \\ 1 & \text{if } wf * t_{h,m,CI(r)} < I_{m,r} \leq t_{h,m,CI(r)} \\ 0 & \text{if } t_{l,m,CI(r)} < I_{m,r} \leq wf * t_{h,m,CI(r)} \\ -1 & \text{if } I_{m,r} \leq t_{l,m,CI(r)} \end{cases} \tag{6.8}$$

where:

- $WL_m(r)$ is the traffic mix warning level regarding the intensity of mode m for road segment r, with $m \in M$ and $r \in R$.
- $M = \{\text{bike, car}\}$ is the set of compared modes in this case.
- $I_{m,r}$ is the traffic intensity I of mode m on road segment r over a full day.
- $t_{h,m,CI(r)}$ is the high threshold value t_h for mode m on cycling infrastructure type CI of road segment r.
- wf is the arbitrary warning factor above which fraction of the high threshold t_h a warning is given for a road segment.

- $t_{l,m,CI(r)}$ is the lower threshold t_h for mode m on cycling infrastructure type CI of road segment r.

Note that for this indicator, the intensities for a full day are required. The Urban Strategy setup used in this case study simulates only the morning peak period (07:00h-09:00h). Therefore, the intensities in the model should be converted to full-day intensities by expert judgement (e.g. using a rule of thumb), or the other parts of the day should also be simulated.

Now there are warnings for when the speed limit, the intensity of bikes and the intensity of cars do not match the cycling infrastructure design of the road segment. However, to get to one operational indicator, these three warning levels can be combined into one traffic mix warning level for each road segment. Since it concerns a traffic safety indicator, the most severe warning level must be the normative overall warning level. Therefore, when one of the three sub-indicators gives the highest warning level, the overall warning level should be the highest as well. The same holds for the soft warning level of 1. When this is the highest warning level of the three, the overall warning level should also be this level. However, when no warning level is higher than 0, there are no traffic safety warnings, so the overall warning level should be 0 or -1. It will be -1 if there is no positive traffic safety warning and any of the three sub-indicators gives a warning level of -1. Mathematically, this gives the following definition of overall traffic mix warning level $WL(r)$ of road segment r:

$$WL(r) = \begin{cases} \max(WL_{bike}(r), WL_{car}(r), WL_{SL}(r)) & \text{if } \max(WL_{bike}(r), WL_{car}(r), WL_{SL}(r)) > 0 \\ \min(WL_{bike}(r), WL_{car}(r), WL_{SL}(r)) & \text{if } \max(WL_{bike}(r), WL_{car}(r), WL_{SL}(r)) \leq 0 \end{cases} \tag{6.9}$$

Data, parameters and assumptions

For the quantification of this indicator of traffic safety, the following data is required:

- **Speed limit** - The speed limit of the roads in the network is often known in macroscopic transport models since this also influences travel times. If this is not in the model yet, this data could be gathered by the road manager (often local government in urban contexts).
- **Cycling infrastructure** - The cycling infrastructure type needs to be known for each network link (road segment in the model) where both cars and bikes are allowed to go. This means information about the separation of the cyclists from the cars and about the priority that cyclists might have (see table 6.4 for the different types that CROW uses).

  This data can be already in the model that is used. However, if this is not the case, it might be possible to obtain it from the road manager (often local government in urban contexts). When this is also not available, the infrastructure type could be determined using OpenStreetMap (OSM) data. This open, crowd-sourced data often contains information about the type of road infrastructure (e.g. specification of whether there is a separate cycle path or a cycle lane on the road). Using this data does require matching OSM network links with network links in the used transport model. This could be a complex task.

In this indicator quantification approach, there are a few parameters that policy-makers could tweak for their cases.

- **Included modes** - In this example, the traffic safety warning is given for the combination of bikes and cars. However, this indicator could be determined for other combinations of modes as well. One might think about cycling and walking, or cars and trams. A requirement for the selection of the modes is that there are guidelines or research outcomes that could be used as threshold values.
- **Threshold values** - The threshold values, in this case, are based on CROW guidelines for safe cycling infrastructure. Other threshold values could be used as well. These could be based on different guidelines or research outcomes (for other mode combinations for example). However, they could also be based on the policy objectives of a (local) government. E.g. For a bike intensity of 2000 bikes per day, the policy is to use cycle streets.
- **Warning factor** - The warning factor is the most easily adjustable parameter of this indicator since it can be set based on personal or organisational preferences. Proposed is a warning factor of

0.85. This takes into account that the intensities are model outputs, often for a forecasted year, which brings a certain uncertainty to the output values. The real intensity could be higher than the model estimation, leading to more severe traffic safety risks than the model estimated. Therefore, it is advised to not bring this warning factor too close to 1 to ensure a soft warning is shown well before an intensity reaches the threshold value.

During the quantification of this indicator, some important assumptions are made. First of all and most importantly, this indicator is based on the assumption that there is a higher traffic safety risk when the intensities are higher than the threshold values for the specific cycling infrastructure. This is based on the literature findings in section 6.4.1 and on the fact that the CROW guidelines for cycling infrastructure were directed towards facilitating safe cycling infrastructure. To apply this assumption and turn the CROW guidelines into operational threshold levels, the assumption is also made that these guidelines can be interpreted the other way around. This means that instead of the intensities determining what is safe cycling infrastructure, the type of cycling infrastructure can also determine what are safe speed limits and intensities to be on that infrastructure.

Secondly, and related to the first assumption, the assumption is made that a traffic safety warning due to an intensity higher than the threshold of the mode is not necessarily compensated by the intensity of the other mode being lower than the low threshold value. For example: on a road with a cycle street with priority, a car intensity of more than 2500 vehicles per day and a bike intensity of less than 2000 bikes per day, the lower bike intensity does not compensate for the too-high car intensity. In this example, the cycling infrastructure type is still not in compliance with the guidelines.

6.4.4. Indicator interpretation, verification and further development

As mentioned earlier, in the case study model, it was not feasible to merge the infrastructural data and the intensities of single road segments within the available time and resources. Therefore, this section discusses the conceptual visualisation of the results and the recommended interpretation of those.

The results of this traffic mix warning level can be visualised on a map where all road segments get a colour based on their traffic mix warning level. For all road segments with the highest warning level, policy-makers could investigate the intensities of bikes and cars and determine which aspect gave the warning. The determined specific traffic mix warning can be interpreted in different ways:

- **High warning for speed limit** - This indicates that the speed limit does not match the cycling infrastructure. This is a serious warning which might require action. This can be in the form of adjusting the speed limit or altering the cycling infrastructure.
- **High warning for bike/car intensity** - A high warning on bike or car intensity indicates that the intensity is too high for the type of cycling infrastructure. This can be interpreted in two ways. First, it can motivate the policy-maker to implement measures to reduce the (expected) intensity on the road segment. Secondly, if bringing down the intensity is not possible, or not desired, the warning level can also be a motivation to alter the infrastructure to a different type of cycling infrastructure.
- **Soft warning for bike/car intensity** - A soft warning can be interpreted as the intensity of the bikes or cars being close to the threshold value. In these cases, the policy-maker knows the cycling infrastructure type only just adheres to the threshold values, so traffic safety issues might occur. Especially since this indicator is based on model outputs, this comes with the uncertainty that is inherent to using models - especially when looking at a forecast for a future year. Therefore, policy-makers should take into account that due to model uncertainty, a soft warning indicates that in reality thresholds might be crossed.
- **No warning for bike/car intensity or speed limit** - According to the model outputs, the road segment has the correct cycling infrastructure type for considered traffic intensities and has the correct speed limit.
- **Negative warning level for bike/car intensity or speed limit** - When a negative traffic mix warning occurs, it indicates that in theory, the cycling infrastructure is over-designed for the actual traffic intensities (or the speed limit) on the road segment. This could indicate that there is 'spare' capacity that could still be used - for example by rerouting traffic to this road. Otherwise, it could also indicate that the infrastructure could be redesigned to a less-separated type. How-

ever, please note that this warning does not necessarily require action[4] This also holds for a 'too low' speed limit. This does not necessarily require action as this can also be an intentional policy effect.

To demonstrate these warning levels, the indicator is manually evaluated for two locations in the network. As mentioned in the quantification approach above, for this indicator one would need the traffic intensities for a full day. However, since this Urban Strategy setup only simulates the morning peak period, these examples use the total intensity for the peak period (07:00h-09:00h) as the intensity for the full day. They should therefore not be interpreted as valid results for the chosen road segments, but merely as demonstrations of how the application of this indicator would work.

The first test location is the most eastern part of the Nieuwe Binnenweg, in the eastbound direction. The cycling infrastructure in this location is a cycle lane, and the speed limit is 50 kilometres per hour. The car traffic intensity is almost 2800 vehicles per day and the bike intensity is roughly 400 bikes per day. With these statistics, this location would fall in the category of cycle lanes with a high speed limit for cars (Cycle lane (high SL, 2x1 lane) in table 6.4). No thresholds are exceeded and none is a close call, so even with a conservative warning factor (e.g. 0.65), no (soft) warning will be given for this location.

The second location is the Wytemaweg in the southbound direction. This road has a cycle lane and a speed limit of 50 kilometres per hour. The car intensity is 2540 vehicles per day and the bike intensity is 1160 bikes per day. These statistics place this road segment in the same category as the previous example. However, since the bike intensity on this road is higher, it exceeds the threshold value of 750 bikes per day. This results in a warning level for bike intensity and an overall high warning level for this road segment. To mitigate the traffic safety risks, the speed limit could be reduced - placing the road segment in a different category that allows higher bike volumes - or the bike intensity could be reduced (e.g. by providing alternative routes).

These examples demonstrate how this indicator could be applied in practice. Even though the intensities in these examples were not full-day intensities, already a threshold value was exceeded. This shows that this indicator can identify locations where the CROW standards for safe cycling infrastructure are not met. By using the traffic mix warning indicator, policy-makers can evaluate all kinds of policy plans. First, it could be used to evaluate traffic safety in general and to inspect potential locations where new cycling infrastructure or other measures are needed. Secondly, it could be used to evaluate plans for redesigning infrastructure to check if, in a future situation, the new infrastructure would still comply with the guidelines. Lastly, in the context of car-free policies, it could indicate where too high car intensities might influence traffic safety, possibly resulting in arguments for taking action. However, it could also reveal potential negative traffic safety effects elsewhere when new policies are implemented.

Verification

The purpose of this indicator was to evaluate the traffic safety of a road by assessing the traffic mix on the road. Possible specifications were the mix of bikes, cars and potentially trams, or the inclusion of pedestrians as well. The current operationalisation of the indicator resulted in the traffic mix warning indicator. This does assess traffic safety by evaluating the mix of traffic on the road. Even though it does inspect the separate intensities of the included modes and not directly the mix, it does take the relation of the intensities into account by selecting corresponding threshold values.

The modes that are included are currently only bikes and cars. Therefore, it does not yet meet all specifications - the tram is not included for example. However, the quantification approach could apply to other modes as well, given that the necessary data (infrastructural data and guidelines/thresholds) is available.

Potential future development of the traffic mix warning level

As mentioned above, further development of the indicator could be going in the direction of including other infrastructure types and other modes. This could make the indicator more applicable to all different

[4] Different arguments could be given for different situations. E.g. a road with a cycle lane where the intensity of cyclists is lower than the threshold might result in more traffic safety issues due to cars not expecting cyclists there anymore and not leaving much space - even though theoretically, the road is 'over-designed' for the number of cyclists. Further investigation and/or expert judgement might be needed on a case-by-case basis.

types of roads. Developments such as including more infrastructural design details or adding more modes can make the indicator also more realistic as it takes more aspects of the real world into account. One could think of adding a factor for the width of cycle paths/lanes, or the presence of pedestrian crossings (which also opens up the possibility to include pedestrians in the indicator together with cars and trams).

To get a more realistic and detailed indicator for traffic mix warning, it can be relevant to not only include the model outputs (intensities) and the expert knowledge (guidelines/thresholds) but also local knowledge from stakeholders. This local knowledge can include information such as double parking that happens often (and forces cyclists to the car lane), cars often driving too fast, or bad visibility at exits towards major roads. The interviews in chapter 4 did offer such local knowledge, including the first two examples given above. When these additional insights could be incorporated into the indicator, the indicator also accounts for aspects of traffic safety that the model and the expert knowledge do not, possibly resulting in a more realistic indicator. In the first example given above - the Nieuwe Binnenweg - the indicator did not give a high warning level. However, the local context would show that there is also a tram running on that street, which can make the situation more unsafe. Also, speeding issues are present on that street, again increasing the traffic safety issues. This exemplifies why this local context can be important.

6.5. Discussion of operationalised indicators for car-free policies

The relevancy of the operationalised indicators can vary for different stakeholders and different steps in the car-free policy planning process. This is discussed in the first part of this section. Afterwards, the relations of the three operationalised indicators to other well-being indicators on the shortlist, and to other indicators in Urban Strategy are discussed.

6.5.1. Relevancy of operationalised indicators for stakeholders

Based on the interviews conducted in chapter 4, the use of space for car parking indicator seems most relevant for the local residents since they mentioned issues with parking (both in the context of too much parking and too little parking) most often. For local business owners, this indicator could be relevant as well, although their opinions were more focused on one side of the discussion - the need for enough parking nearby. The municipality also focuses on the use of space in general in their mobility policy evaluation (see section 4.3). In the context of car-free policies, they specifically mention the use of space as one of their three main challenges (Gemeente Rotterdam, 2023), making this indicator also relevant for the municipality. The indicator is most relevant for the evaluation of policies or interventions that involve parking spaces - e.g. removing parking spaces or reallocating them to other modes. However, it can also be useful in the evaluation of policies impacting the car demand in general as this can impact the parking intensities in zones. The use of space for car parking is therefore relevant in the whole planning phase of a policy or intervention.

The indicator for the number of mobility options was found to be most relevant for local residents. They emphasised the importance of the quality of the option (see section 5.1.2) - which is currently represented by the service frequency in this operationalised indicator. For local business owners, this indicator could also be relevant, albeit more implicitly. Local business owners did not mention this context as often as the residents, but their responses were focused mainly on accessibility in general. Since this indicator can be used to assess the number of mobility options (even potentially specified to business locations), the indicator could contribute to evaluating accessibility. In the planning process, this indicator can be especially relevant in the early stage when locations for interventions are still being determined. The availability of suitable alternative transport means is one of the prerequisites for car-free policies (see figure 2.4). The indicator of the number of mobility options can contribute to assessing this by determining areas where the public transport availability is high enough to serve as an alternative to cars. Besides this relevance of the indicator in the early stage of the policy planning process, it can also contribute to policy evaluation in a later stage. It can show the impact of policies and interventions on the number of public transport options for individual household locations. This high level of detail can contribute to representing the interests of the stakeholders on a very local level.

The mix of traffic on the road indicator is relevant to all involved stakeholders to some extent. For the municipality, it is one of their main goals in making mobility policies - even explicitly mentioning their

attention to dealing with diverse mixes of transport modes on the roads and increasing speeds of modes such as light electric vehicles (see section 4.3). Local business owners mentioned the unsafe situations for cyclists as well. However, because this is not their most important interest and literature findings do not show this interest either (see section 4.4), the indicator seems to be only slightly relevant to them. For the residents, traffic safety was found to be a bit more important than for the local business owners - also the busy mix of traffic on some roads was mentioned. This makes the indicator very relevant for the residents.

6.5.2. Relation to other indicators

The three operationalised indicators have significant differences in terms of quantification approach. The use of space for car parking is the only operationalised indicator that involves iterations with a transport model. This makes this indicator more complex to integrate with existing tools than the other operationalised indicators that only use output data of a transport model (traffic mix warning level) or those that do not require transport model outputs, merely the input data (number of mobility options).

This section compares the operationalised indicators to other well-being indicators on the shortlist and to existing indicators in the Urban Strategy model. This gives insights into the potential operationalisation of other well-being indicators. Additionally, it also gives insights into how these indicators compare to existing indicators and how they could complement each other.

Comparison to other well-being indicators on the shortlist

When comparing the operationalised indicators to the other, not-operationalised indicators on the shortlist in chapter 5, one can see that the majority of the indicators seem to be more on the level of the traffic mix warning level and the number of mobility options: they are not likely to require interaction and iterations with a transport model. For many indicators, transport model output data, or even just GIS data would suffice. The first category includes indicators such as noise exposure, contribution of mobility to air pollution, or number of accidents. The second category includes indicators such as the ratio of green and grey space and the quality of public space.

What stands out is that these last two mentioned indicators are both from the well-being domain of living environment, which is also the domain with the most indicators that do not necessarily require a transport model to be quantified. The assumption can be made that these are therefore less complex to operationalise since they do not depend on integration with an existing model.

For the other well-being domains, almost all relevant indicators require output data from a transport model. Most do not seem to require iterative interaction with this model, which keeps the expected complexity of operationalisation lower than for the use of space for parking indicator. However, it should be noted that based on the overview in table 6.1, the indicator for the use of space for car parking does not seem to require integration with the transport model either, only the output data. Only in the operationalisation, while determining specifications and a quantification approach, the required interaction and integration with the transport model were determined. Therefore, it cannot be stated with certainty that the operationalisation of other indicators will not also unveil a need for more complex interaction with the transport model.

Comparison to other indicators in Urban Strategy

Existing indicators in Urban Strategy are all mobility-related or related to noise or air pollution. On the well-being spectrum, some existing indicators would fall under the living environment domain (e.g. noise and air pollution). However, most would not fall under any well-being domain. These indicators are more traffic-related (e.g. intensities, intensity/capacity ratio, modal splits).

These traffic-related indicators are all not directly relevant to the interests of local stakeholders that were defined in chapter 4. The three operationalised indicators in this chapter are more relevant for representing the interests of local stakeholders and cover more domains of well-being. The existing traffic-related indicators can, however, still be useful to clarify the effects of policies. The traffic intensity on a road can for example help clarify why a traffic mix warning level (operationalised well-being indicator) changes and is also input data for this well-being indicator. For the indicator of the use of space for parking, the intensities on roads in an area can also be a useful insight in addition to a change in parking space occupation. In both these examples, the conventional, traffic-related indicator has an

explanatory role - it can help to explain why the well-being indicator changes - and would not serve as the main indicator to be used in policy evaluation since it does not directly represent stakeholder interests.

In terms of the complexity of operationalisation, the conventional, traffic-related indicators are usually already operational in existing transport models. Operationalising well-being indicators is therefore intrinsically more resource-intensive than using conventional traffic-related indicators. Within the list of well-being indicators, the ones that require more complex models on top of the transport model (e.g. environmental models for noise and air pollution or statistical models for the number of accidents) require more complex and/or resource-intensive quantification approaches than the conventional traffic-related indicators. Other well-being indicators that are based on (GIS) data without the involvement of a transport model might be less complex and resource-intensive to quantify than the conventional indicators.

7

Relevant well-being indicators in practice

This chapter discusses the validity of the results of the indicator selection process, and the applicability of this process and the operationalised indicators in practice. The first section shows several scenarios for the case study of Oude Westen in which the operationalised indicators can be used for policy evaluation. It aims to assess the indicators by discussing the effects of the different scenarios on the indicators. The second section discusses validation interviews that were conducted. This section aims to evaluate the validity of the results of the well-being indicator selection process and the applicability of the process in practice. The last section combines the findings of the case study and the validation interviews in recommendations for the implementation of this process.

7.1. Technical feasibility of indicators: A case study in Oude Westen

To assess the technical feasibility of the operationalised indicators and their potential use cases in practice, the indicators are calculated for several model scenarios. They are complemented by existing indicators of Urban Strategy, which can contribute to explaining changes in the well-being indicators (see section 6.5.2).

Operationalised indicators in the case study

As described in the previous chapter (section 6.4.4), due to the technical challenges in operationalising the traffic mix warning indicator, and the limited available time and resources, it was not feasible to fully operationalise this indicator for this case study. The indicator of the number of mobility options was fully operationalised and is used in this case study.

The operationalised use of space for car parking indicator was found to have implementation issues in Urban Strategy (see section 6.2.4 and appendix I). Therefore, the quantification approach was adjusted for this case study. The iterations with the New Mobility Modeller (NMM: the mode choice module) were omitted from the approach, meaning that the indicator only shows first-order effects of parking capacities (e.g. parking in neighbouring zones) modelled by the traffic assignment module. Second-order effects such as a modal shift away from cars are not modelled in this adjusted approach since the mode choice model is not included (see figure 7.1).

In this case study, the above-mentioned operationalised indicators are assessed for different scenarios. This is done to demonstrate and assess the applicability of the indicators. Evaluating the policies and determining an optimal solution considering trade-offs between the indicators is not part of this case study since this is not the main focus of this thesis. Also, a proper policy evaluation would be based on a balanced mix of operational indicators, while the selection for this case study is limited. Investigating trade-offs between indicators and using them to evaluate policies are interesting topics for further research.

Case study scenarios

The four different scenarios in this case study are shown below. They all relate to car-free policies (the definition of what is included in this is discussed in section 2.1.1). In the first scenario, the number

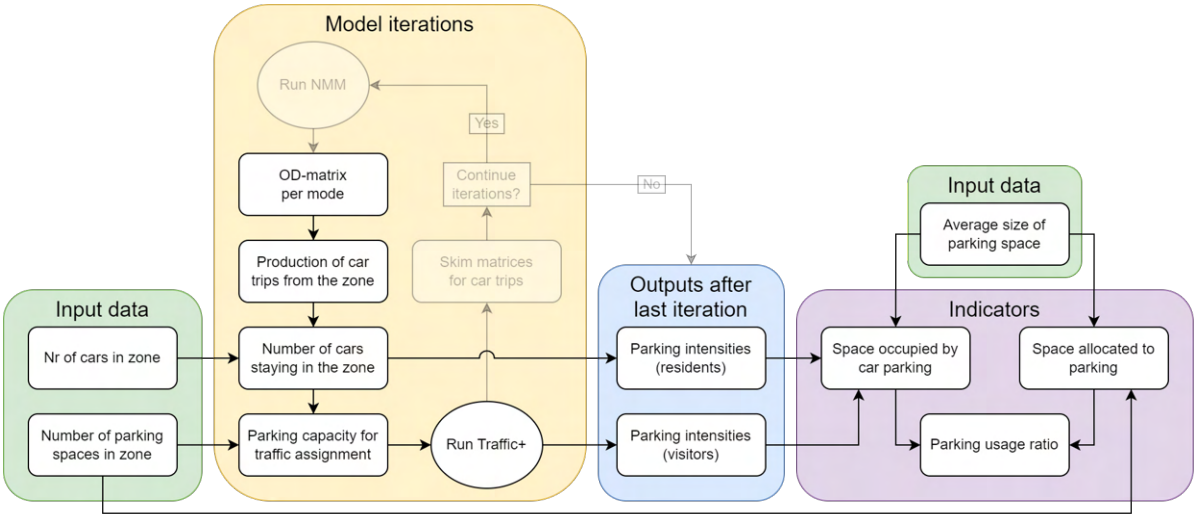


Figure 7.1: Adjusted quantification approach for use of space for car parking indicator.

of mobility options indicator is most relevant to show the impact of the scenario. For the last three scenarios, the use of space for car parking indicator is more relevant. All scenarios are based on and compared to a base scenario. This is the standard model scenario for the year 2030 - which is based on the V-MRDH model as described in section 3.4.1.

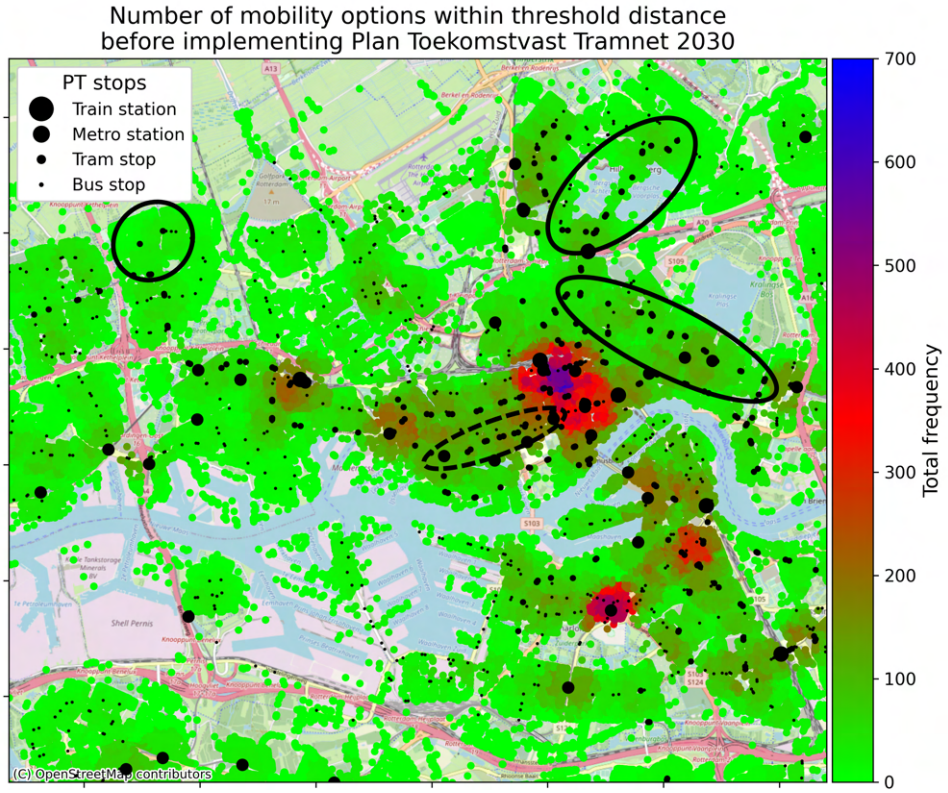
1. **Future-proof tram network scenario** - This scenario contains the changes to the tram network in Rotterdam as proposed by the MRDH in their plan for a more resilient tram network in 2030 (MRDH, 2023).
2. **Reduction of parking spaces** - In this scenario, as a demonstration of potential car-free policies, several car parking spaces are transformed into green spaces, terraces, or bike parking.
3. **One-way traffic** - Another potential car-free policy can be to transform streets into one-way streets for cars. This scenario explores the possibility of reducing car traffic by applying these policies to the main streets of Oude Westen: Nieuwe Binnenweg and West-Kruiskade.
4. **One-way traffic and reduction of parking spaces** - In this scenario, scenarios two and three are combined to assess their combined impact.

7.1.1. Scenario one: Future-proof tram network

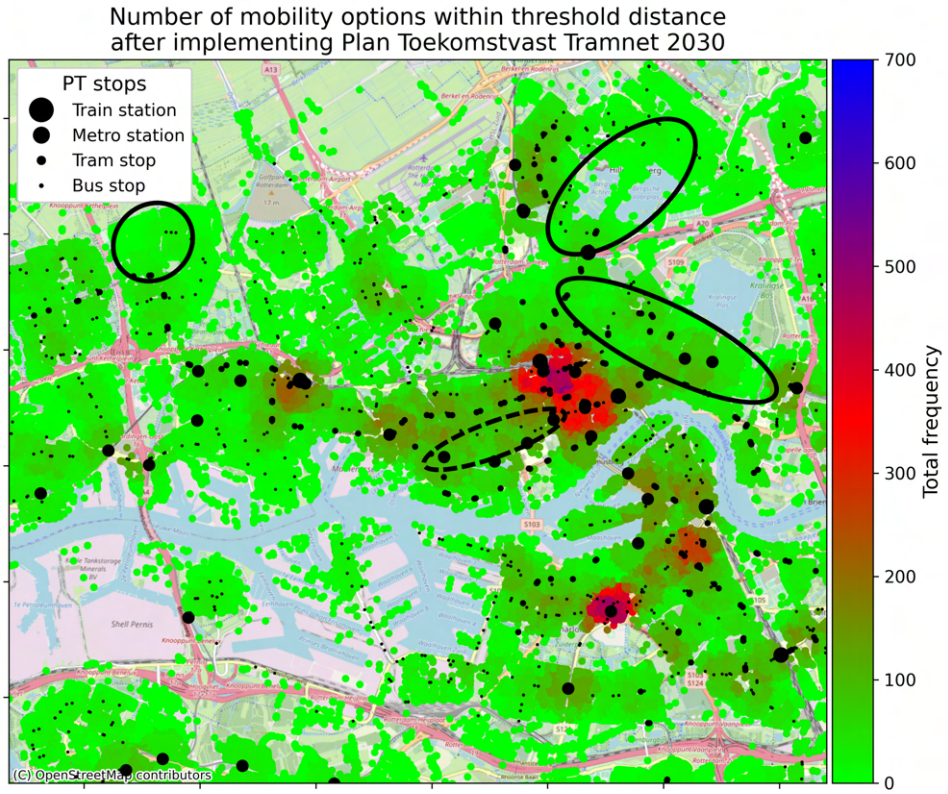
In the plan for the future-proof tram network by MRDH (2023), measures are proposed to increase the robustness of the network. This is done by eliminating some tram lines and increasing frequencies on others. This can affect the number of mobility options people have. In the context of car-free policies, the number of mobility options for public transport contributes to the presence of alternative transport means in the area - which is one of the prerequisites for the implementation of car-free policies (see figure 2.4).

In this scenario, the tramlines that were (partly) eliminated were removed from the stops that they will no longer serve when this plan is implemented. By doing this, their frequency would no longer count towards the number of mobility options. The planned increase of frequencies at other lines was not yet quantified by MRDH (2023), so this could not yet be implemented in this scenario. Therefore, the results for this scenario might not be representative of the full plan for the future-proof tram network, but only for the part of the plan responsible for the elimination of tramlines.

Figure 7.2 shows the graphs of the number of mobility options for the base scenario (a) and scenario one (b). At first glance, the two graphs in figure 7.2 might not seem to show much difference. When taking a closer look, however, one can see the impact of the future-proof tram network scenario, especially in the neighbourhoods Hillegersberg-Schiebroek (north-east) and Kralingen (east) in Rotterdam and Kethel (north-west) in Schiedam (all solid ellipses in figure 7.2). In these neighbourhoods, the number of mobility options is already lower than in the centre of Rotterdam. Therefore, a reduction in



(a) Number of mobility options before implementation of the plan for a future-proof tram network. (Base scenario)



(b) Number of mobility options after implementation of the plan for a future-proof tram network. (Scenario one)

Figure 7.2: Comparison of the number of mobility options in the future-proof tram network scenario and the base scenario.

the frequencies or elimination of tramlines altogether has a bigger impact on the remaining number of mobility options.

In the city centre of Rotterdam, also a whole tram line was eliminated (in the Nieuwe Binnenweg in Oude Westen, the dotted ellipse in figure 7.2), but since the number of mobility options in that area is already high, this change does not seem to have a major impact on the overall number of mobility options in that area. Since the density of public transport stops and lines in the centre is higher than in the outskirts of Rotterdam, a loss in mobility options due to the elimination of a tram line would also be more easily compensated when the increases in frequencies of other lines are implemented as well (which was not the case in this scenario). In the outskirts of the city, there are simply fewer stops within the threshold distance, resulting in fewer stops that can compensate for a decrease in service frequency elsewhere.

7.1.2. Scenario two: Reduction of parking spaces

A common car-free policy is removing parking spaces from the streets, or relocating them to parking garages or P+R locations. The goal of such a policy would be to stimulate the use of parking garages instead of on-street parking and free up public space for other uses (e.g. wider sidewalks or green/blue space). This scenario simulates the implementation of such a policy. The large parking garages in and around the Oude Westen neighbourhood - Schouwburgplein 1, Schouwburgplein 2, Central Plaza and Museumpark - all have a low occupancy rate in the base scenario. This spare capacity can be used by cars currently parking in parking bays or on the streets.

In this scenario, parking spaces in the public space (on-street parking and parking bays) within walking distance from those garages, are removed. The maximum acceptable walking distance is set to 500 meters, about the same threshold as is used for tram stops in the indicator for the number of mobility options (see section 6.3). This measure is applied to all zones in and directly surrounding the Oude Westen area and resulted in parking spaces being taken away in 25 zones.

Figure 7.3 shows the results for the use of space for car parking indicator for this scenario. The allocation of public space for car parking in the zones where the parking measure was implemented decreased from over 32,000m^2 to zero. this is space that could be reallocated to other uses. The occupation of public space in those zones decreased from over 16,500m^2 to zero - this also includes zones with parking garages since this figure concerns the public space, which does not account for (often underground) parking garages. It can be seen that the parking intensity in several zones outside of the measure implementation area has increased. However, this increase is often not more than 100m^2 and therefore does not cover the total decrease in space occupation that was seen in the no-public-parking zones. The majority of the cars that had to be parked elsewhere, were relocated to the large parking garages shown in figure 7.3. Since these parking garages were not considered public space, these relocated parked cars no longer occupy public space and these changes are not shown in figure 7.3 which shows the use of public space for car parking.

Note that the occupancy rate for several zones exceeds 100%. This can be explained by the parking capacity not being an actual maximum in the Traffic+ module. The capacity is used as input for a BPR function, which yields the travel time on a link (in this case parking in a zone) based on the (parking) intensity on that link. Therefore, it does not cap the parking intensity, but it does increase the additional travel time for parking exponentially when the capacity is exceeded. This means that trips to zones with an occupancy rate larger than one have significant travel time increases. However, apparently parking in that overfull zone still results in lower travel times than parking in neighbouring zones. This can indicate that the parking capacities overall are too low, which could be caused by the missing data on residents' parking garages (as mentioned in section 6.2.3), or that the car ownership in the zone (and thus the number of occupied spaces) was over-estimated. In reality, such significant travel time increases and parking occupancy rates far above one would not occur since people would park in neighbouring zones, choose another mode of transport, choose another destination, or cancel their trip. The last three options are not possible in this adjusted operationalisation approach of the use of space for car parking indicator (as described in section 7.1). Therefore, this is a limitation of the current state of the operationalisation of this indicator.

When comparing the results with other indicators in Urban Strategy, one can see the rerouting of cars towards the parking garages or other zones in the traffic intensities as well. Local roads in Oude

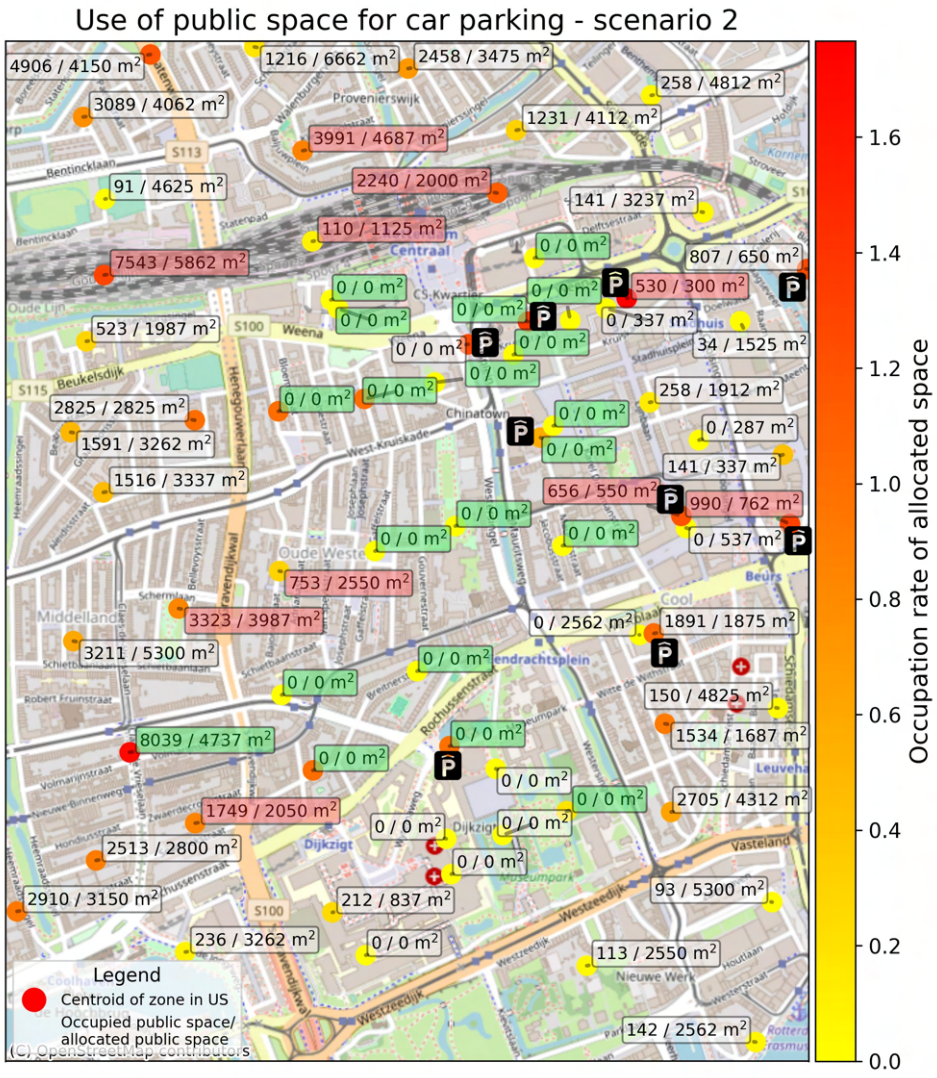


Figure 7.3: Use of public space for car parking in scenario 2. For each zone, the public space occupation is compared with the public space allocation. Red data labels indicate an increase in public space occupation of at least one car ($12m^2$) in comparison with the base scenario, while a green data label indicates a decrease in public space occupation of at least one car.

Westen experience a slight decrease in car intensity, while roads to zones with parking garages see a slight increase. On the Henegouwerlaan (the larger road west of Oude Westen) one also sees a small increase of traffic on the through-traffic lanes, and a small decrease of traffic on the parallel local access roads - indicating a little less traffic directed towards the local zones in the neighbourhood.

7.1.3. Scenario three: One-way traffic

In this scenario, another common car-traffic-reducing measure is taken. The two main (shopping) streets in Oude Westen - Nieuwe Binnenweg and West-Kruiskade - are turned into one-way streets. The West-Kruiskade is open for cars from west to east, while the Nieuwe Binnenweg is open from east to west. The goal of these measures is to reduce car traffic in the neighbourhood of Oude Westen and divert through-traffic to larger roads outside the neighbourhood. The measures were implemented in Urban Strategy by reducing the speed and capacity of cars on the roads in the blocked direction to zero. These routes then get an infinite travel time and therefore, no traffic will be assigned to them.

In figure 7.4 can be seen that there is little change in the use of space for car parking when comparing this scenario to the base scenario. For most zones that did see some changes, the change was only a handful of parked cars, and this only got up to about 15 cars. These differences could be related to changes in car traffic intensities caused by the implemented measures. For example, around the

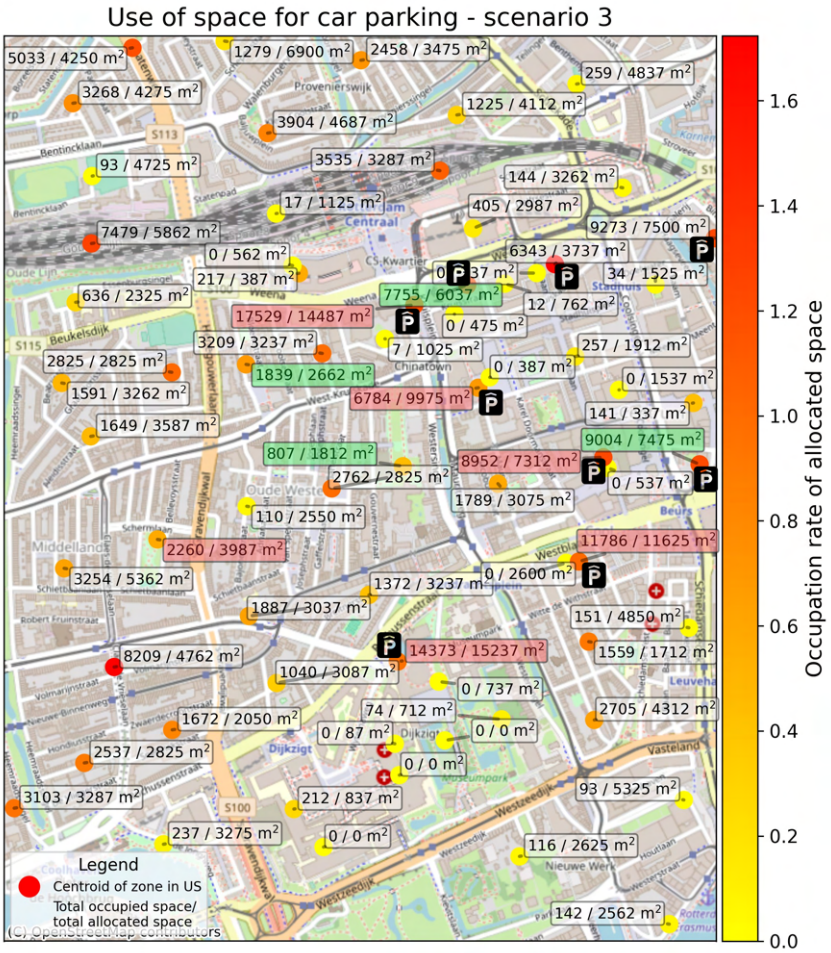


Figure 7.4: Use of space for car parking in scenario 3. For each zone, the space occupation is compared with the space allocation. Red data labels indicate an increase in space occupation of at least one car ($12m^2$) in comparison with the base scenario, while a green data label indicates a decrease in space occupation of at least one car.

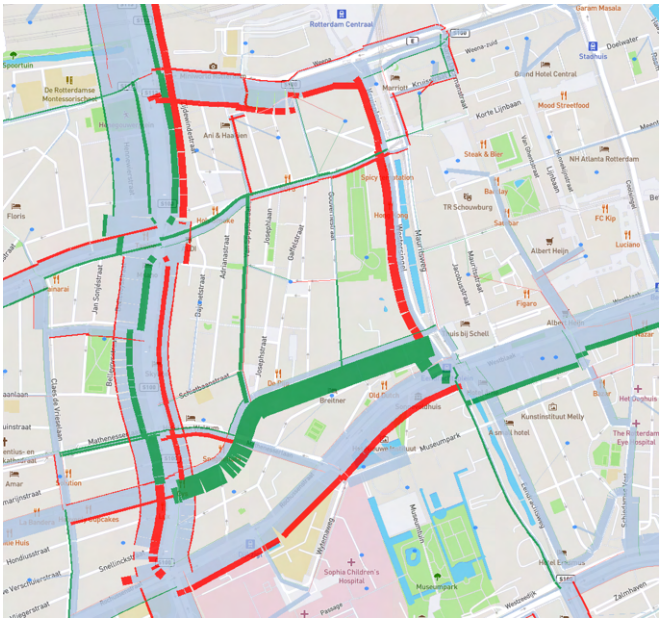


Figure 7.5: Change in car traffic intensity on roads when comparing scenario three to the base scenario. Red means the intensity increased, while green indicates that the intensity decreased. Note that this does not include freight traffic.

parking garage where the parking intensity decreased (green data label close to Rotterdam central station), the traffic intensities increased, also increasing the travel time, and making parking in this zone less convenient. Overall, the impact of this scenario on the use of space for car parking in Oude Westen is not high. When looking at the traffic intensities, however, the impact is significantly higher. As can be seen in figure 7.5, the biggest impact of the measures was the reduction of traffic on the Nieuwe Binnenweg (to zero, due to the one-way measures), and the diversion of this traffic to the north and east of Oude Westen (Weena and Westersingel) and the south of Oude Westen (Westblaak). Although the mix of traffic on the road indicator cannot be calculated in this case, it can be reasoned that on the busy roads where this measure is implemented, such a decrease in car traffic has a significant impact on the traffic mix on the road and can therefore have a positive impact on traffic safety.

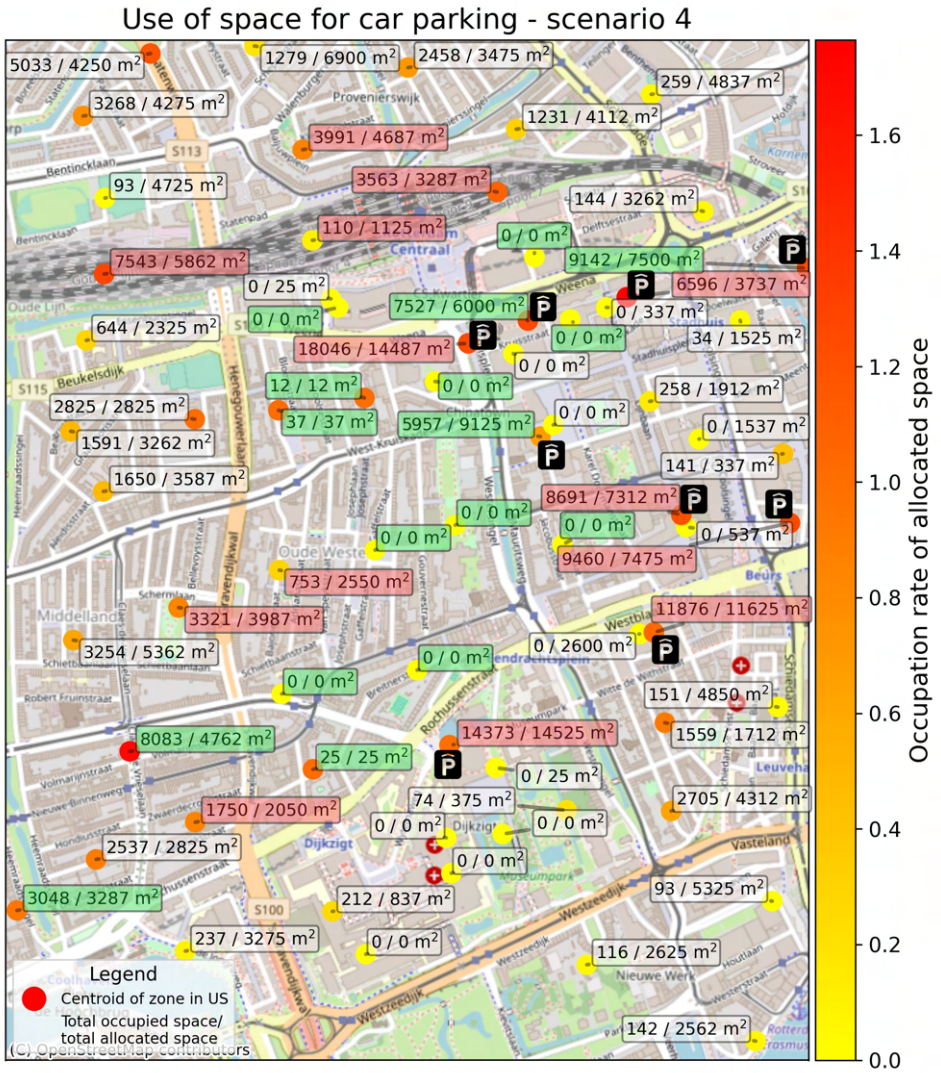


Figure 7.6: Use of space for car parking in scenario 4 compared to the base scenario. For each zone, the public space occupation is compared with the public space allocation. Red data labels indicate an increase in space occupation of at least one car (12m²) in comparison with the base scenario, while a green data label indicates a decrease in space occupation of at least one car.

7.1.4. Scenario four: One-way traffic and reduction of parking spaces

In this last scenario, a combination of the previous two scenarios is tested. This means that both the one-way streets and the reduction of parking spaces are implemented. In figure 7.6, it can be seen that a similar parking relocation effect can be seen in the zones north and west of Oude Westen as was seen in scenario two - where a share of the parked cars in Oude Westen was relocated to (public) spaces in those neighbouring zones. Also similar to scenario two is the parking intensity increase in

parking garages since the public spaces in zones around Oude Westen cannot handle all the increase in parking intensity. However, these parking garages are also where this scenario yields different results than scenario two.

In scenario two, the increase in parking intensity in most parking garages was higher than in scenario four. This can be caused by the changes in traffic intensities due to the implementation of one-way streets. This is a similar effect as was seen in scenario three, where the changes in traffic intensities on the roads actually decreased the parking intensities in some parking garages. For example, the two parking garages in the south see an increased parking space occupation when compared to scenario two (see figure 7.7), which was also the case in scenario three (figure 7.4). Similarly, the occupation of parking space in the parking garage Central Plaza (close to Weena, with 7527m^2 of occupied space) has decreased in comparison with scenario two. This can be caused by increased car traffic and travel times on surrounding roads, as the car traffic intensity plot is very similar to the one in scenario three.

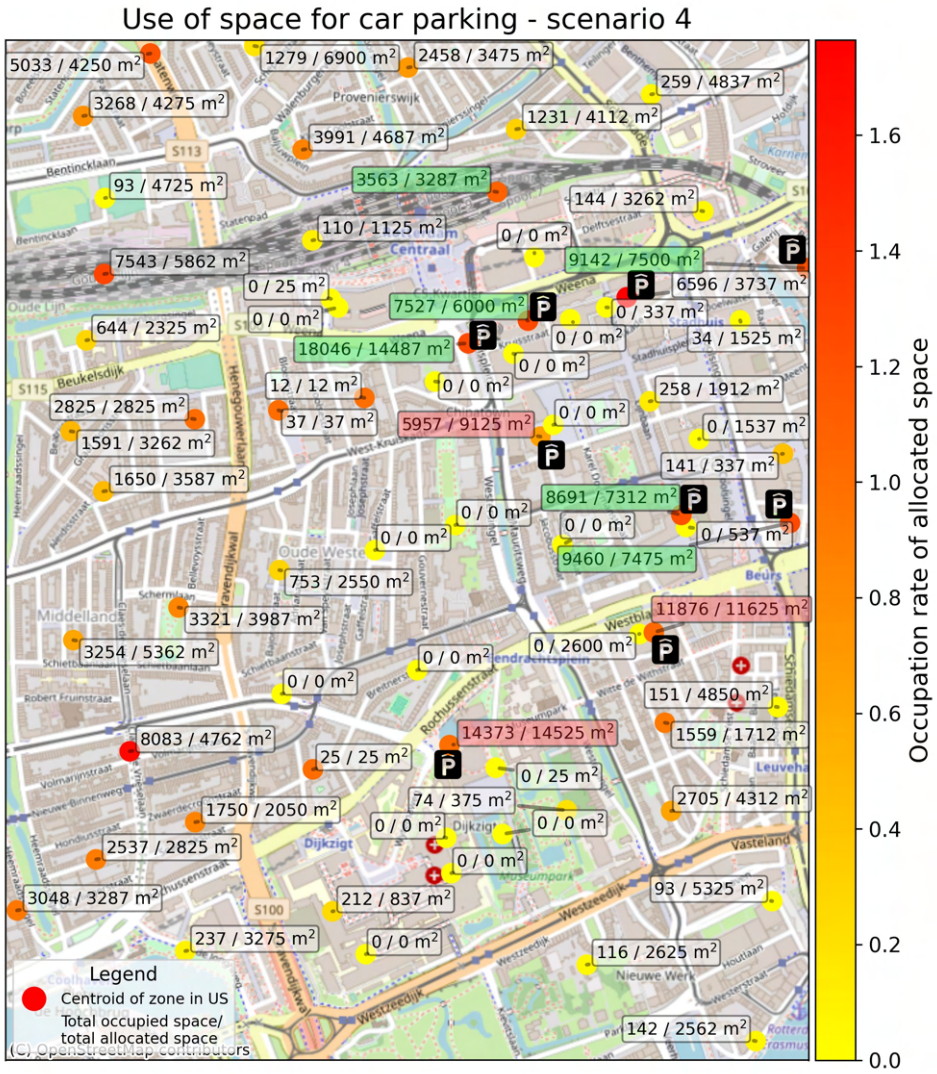


Figure 7.7: Use of space for car parking in scenario 4 compared to scenario 2 (reduction of parking spaces in Oude Westen). For each zone, the public space occupation is compared with the public space allocation. Red data labels indicate an increase in space occupation of at least one car (12m^2) in comparison with scenario 2, while a green data label indicates a decrease in space occupation of at least one car.

7.1.5. Discussion of case study results

Scenario one showed that the operationalised indicator of the number of mobility options can visualise the impact of changes in the public transport network and service levels. This impact was more easily visible in areas with a low public transport stop density since one stop more or less has a relatively

higher impact there than in an area where the number of mobility options and the public transport stop density is already high. Note that this is an output indicator which shows the direct effect of policies on the available (public) transport options. A combination with existing modal split indicators could be valuable to add information about the outcome of a policy by indicating whether this change in the number of mobility options also had an impact on the share of trips made by public transport.

In scenario two, it could be seen that the use of space for car parking indicator was suitable for showing the effect of the parking space reduction policy. It showed the trivial results of less space use for parking in zones where the measure was implemented, but it also showed the parking dispersion towards other zones. This can be a valuable insight in policy evaluation. In terms of well-being, the indicator showed the space that became available for other uses (e.g. sidewalks or green space), and to what extent this goes at the expense of space in other zones.

The use of space for parking indicator was less relevant in scenario three where a conventional indicator such as the traffic intensity was better able to show the impact of the measure. This was to be expected since the measure taken was targeting traffic flow and not car parking. However, if the majority of cars parking in Oude Westen would have had a destination outside of Oude Westen, such a diversion of traffic could have had more impact on the use of space for car parking in Oude Westen, making this indicator more relevant. In such a case only cars with a destination in Oude Westen would have been parking there. Cars with different destinations would be likely to park in other zones since parking in Oude Westen would not be convenient anymore for cars that do not have to be at a destination in Oude Westen due to travel times increasing because of the measures. In terms of well-being, the parking space indicator could not demonstrate a clear impact. However, since the traffic intensities changed, other well-being indicators that use these intensities as input (e.g. indicators related to noise or air pollution) could become relevant for demonstrating the impact on well-being.

In scenario four, a combination of the results of scenarios two and three could be seen. The use of space for parking indicator showed relevant results for this scenario - mainly because this scenario involved a measure targeted at parking space (which is in line with the reflection about the applicability of the indicator in section 6.5.1). However, the combination with the more conventional traffic intensity indicator was necessary to provide a more complete picture of the impact since also the traffic flow targeted measure of one-way traffic was implemented.

Overall, it can be concluded that both operationalised indicators can provide relevant results in this case study. It can also be concluded that the combination of these indicators with other existing indicators can provide a more complete picture of the effects of a scenario. Also, the relevancy of the indicator depends on the type of policy that is being evaluated and what aspect is targeted by the policy (e.g. traffic flow or parking spaces). The indicators can show the impact of measures on well-being. However, this does sometimes require interpretation of the results in the context of well-being. For example, a decrease in the space used for car parking could be viewed as an opportunity for alternative uses of that space - which clarifies the potential impact on well-being.

Three important things should be noted. Firstly, the results of the use of space for parking indicator in this case study showed multiple occupation rates above one, which is realistically not possible (except for illegal parking). This is partly because the second-order effect of parking capacities - the modal shift that can take place - was not modelled in this case study (see the start of this section 7.1). If the full quantification approach as designed in section 6.2.3 was used, the share of car trips would most likely go down due to the high parking intensities, decreasing the parking occupation rate of zones. However, as discussed in scenario two (section 7.1.2), other realistic consequences of high parking pressure - such as choosing another destination, or cancelling a trip - could still not be simulated in the full operationalisation of the indicator.

Secondly, the results in this section do not show all the potential impacts of the interventions. The results only include the Oude Westen area, where the measures are implemented, and some neighbouring roads and zones. Therefore, it does include some dispersion effects, but potential city-wide impacts are not shown. For actual policy evaluation, the indicators should be evaluated for a (much) wider area to identify potential unexpected and unwanted effects elsewhere in the city. However, the current study area suffices for showing the local impact of the scenarios on the indicators.

Lastly, the differences between the results of indicators for different scenarios are not always very large. The differences between the use of space for car parking, for example, are sometimes only

a few square meters. This does not even correspond to one car. Especially considering that these are model indicators - and both the model and the input data come with a certain uncertainty - such small differences should not be considered to set two scenarios apart. They should therefore not weigh heavily in policy evaluation. Larger differences, however, should still be taken into account in policy evaluation. For example, a decrease of multiple hundred square meters of the space used for car parking could be considered a relevant difference between two scenarios.

7.2. Validation of research results and applicability of the process

In this section, the results from chapters 4 and 5 and 6 are validated by involved stakeholders and the applicability of the indicator selection process is assessed. As described in the methodology chapter (section 3.5.2), the local neighbourhood council members and the policy-maker who were interviewed before, were interviewed again to evaluate the validity of the results and applicability of this process. This did not include the results of the technical case study in the previous section. To perform these interviews, the indicator selection process was summarised in a visualisation of the process (see figure 7.8). This flowchart was based on the process that was used in this research and thus on the blue area in the research framework (figure 3.2). Figure 7.8 is the process that was discussed with the interviewees in this section.

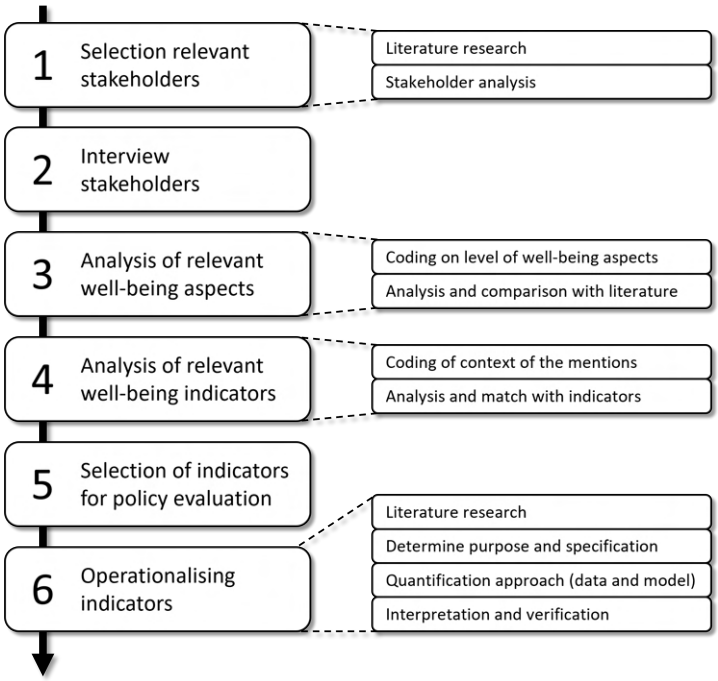


Figure 7.8: Flowchart summarising the indicator selection process that was used in this research.

7.2.1. Validation of research results for the Oude Westen case

The ranking of importance of well-being domains and aspects that was concluded at the end of chapter 4 (table 4.3) was the first topic of the validation. Being presented with the top five domains and aspects of well-being, the local neighbourhood council members (CM for Council Members) could agree with most of the ranking. Only the low ranking of the health domain was found to be surprising. They reasoned that interviewees might not associate health with the context of mobility policies and questioned whether this context would create a tunnel vision obstructing interviewees from thinking broader and also considering health aspects. Council member RC1 added the importance of probing interviewees to think about aspects they would not have associated with the context themselves (such as health in this case) (CM). The policy-maker (PM) shared this remark about the low position of the health domain and also suspected an effect of the mobility context of the interviews. He added that health usually is considered more important in research into similar topics in Rotterdam. All interviewees agreed with

the interviewer that some aspects related to health are a part of the living environment domain (think of air pollution or noise pollution) and thus some more important aspects are also indirectly related to health. Regarding the ranking of well-being aspects, the policy-maker concluded that these results confirmed that although policy-makers are often focusing on air pollution due to the strict norms on this topic, local stakeholders experience noise pollution more directly and view this as having a bigger impact on their daily life. A last remark made by the neighbourhood council members was the fact that visitors of the area were not taken into account in this research - something that is also discussed in section 4.2. They confirmed the complexity of capturing the views of this heterogeneous group and endorsed the need for a different research approach for incorporating the visitors' views in the research (CM).

In the interviews, the interviewees were also presented with a brief overview of the setup and results of the three operationalised indicators. In general, the policy-maker raised questions about the availability of the required data on neighbourhood level and the ability of models to show results when quantifying the indicators on neighbourhood level (PM). The availability of data was also mentioned by neighbourhood council member RC1 (CM). This emphasises the importance of setting the right criteria when selecting the indicator to operationalise in step 5 of figure 7.8 (or in section 3.4.2).

Specifically about the use of space for parking indicator, the policy-maker remarked that the resolution of the indicator on zone level could result in missing local contexts - one street might be full of cars, while another might be only 40% occupied. He added that this might complicate communication with stakeholders since the indicator might not reflect their personal experience. This means that one should be careful with what kind of stakeholders one discusses this indicator with and for what kind of policy or intervention (PM). Further development of the indicator towards more details on the different parking types could help solve this (PM). The interviewed neighbourhood council members had similar remarks regarding the potential of the indicator when a split in different parking types would be added - especially with a split in user groups as well, enabling the use of trip purpose and thus parking duration (CM). Council member RC2 also advocated for customisation on a higher level of detail (e.g. per street), agreeing on this with the policy-maker (CM, PM). Next to this, the time or moment for which this indicator is calculated was mentioned to be important - is the policy designed for peaks around events (as was done for paid parking elsewhere in Rotterdam), or for regular morning peaks (CM)?

The number of mobility options indicator was appreciated by the local council members. They stated that it added quantification and visualisation to the often-mentioned argument that the Oude Westen neighbourhood already has enough alternative mobility options (CM). A limitation of the indicator that was also mentioned in section 6.3.4 - the need for more specification in user groups - was also mentioned by the interviewed policy-maker (PM). He added the importance of distinguishing between trip purposes and potentially needed connections in the number of mobility options people have.

The traffic mix on the road indicator did not raise many questions. The policy-maker confirmed the relevancy of the indicator, especially the fact that it considers the cycling intensity as well - currently the car intensity is often modelled and intensities of other modes are estimated. He did, however, expect warning levels on many roads since Rotterdam is a busy city, but then still the indicator could be useful to identify focus areas where the situation is more severe than in other areas (PM). The neighbourhood council members indicated missing a human behaviour aspect in this indicator - stating examples of double parking or speeding that also influence traffic safety (CM). Similar to the parking indicator, the time aspect was mentioned to be relevant: the peak intensity can be a bit too high for the road, while during the rest of the day, the infrastructure suffices (CM).

7.2.2. Applicability of the selection process

Both the policy-maker and the neighbourhood council members confirmed the relevance of the indicator selection process. Council member RC1 stated that the structure this process provides can contribute to structuring the feedback on the impact of their input on the resulting policy decisions to participants. Similarly, the municipal policy-maker mentioned that determining the importance of well-being aspects early in the planning process would allow for structured discussion of the policy evaluation later in the process since one can refer back to what was considered important earlier (PM). Being involved in determining the evaluation criteria could contribute to a feeling of ownership of the final policy decision among the stakeholders - something that is especially important if difficult choices have to be made

(CM). This could also contribute to shifting from discussions about potential solution options (outputs) to discussions about the effects (outcomes) of policies or interventions (PM).

By enabling clearer feedback to stakeholders throughout the participation process and increasing ownership of the process and the outcomes, this indicator selection process could contribute to combating participation fatigue[1] (CM). This participation fatigue was also mentioned by the policy-maker who added that there are several municipal departments that all have their separate participation processes in neighbourhoods, and often involve similar stakeholders. He also shared the ambition to work towards an integral neighbourhood approach where there are pre-selected stakeholders who can be involved in these processes (PM). In theory, given the broad spectrum of well-being indicators, the results of such an integral process could be applied to several different domains, reducing the need for separate participation processes for each department or domain.

In general, the interviewees were positive about the selection process, but they also gave several preconditions and recommendations that should be taken into account when applying this process in practice.

- The scale of the policy or intervention to which this process is applicable is important to consider. City-wide high-level vision documents are too abstract and too generalised for this process to be applied (PM). Meanwhile, applying this process to small projects of individual streets is infeasible due to limited available funds and time (PM). Neighbourhood level seems to be a suitable scale of policies and interventions to apply this process (CM, PM). The process must be applied at a level where there are enough time and resources to properly organise the participation process and satisfy all preconditions (CM).
- There should be multiple possible solutions or outcomes in terms of policies or interventions - the decision should not already have been made by political decision-makers (CM). This ensures that the input of participants could still influence the decision-making. Due to the often limited available time, it can be a good idea to reduce the potential solution space to a few options before starting the participation process (CM).
- Connecting to the previous precondition, it should always be clear for the participants what the boundary conditions are within which they can think. This can prevent the disappointment of participants later in the process (CM).
- It should be clear to the participants what the goal of the participation process is, what the process will look like, and how the results will be used (CM). Similarly to the previous precondition, this can prevent disappointment of participants later on.

The local council members stressed that the above-mentioned preconditions are all important to prevent the disappointment of the involved stakeholders and resentment against the government (CM). This resentment against the (local) government and participation processes was also experienced during the recruitment of interviewees for the stakeholder interviews in chapter 4.

7.2.3. Discussion of validation interview results

In general, the validation interview results showed that the well-being indicator selection process can yield relevant results. The ranking of well-being aspects was confirmed to be relevant. This confirmation validates that the well-being indicator selection process can yield relevant results for this case. However, the low position of health was found remarkable, but that yielded the recommendation to probe stakeholders during the interviews to think about all aspects of well-being and explain the potential link to the planned policy.

Regarding the operationalised indicators, the validation interviews showed that the stakeholders deemed these indicators relevant for the corresponding stakeholder interests - although their relevance could still be increased by implementing some above-mentioned recommended future developments. However, note that these three indicators were not presented as an exhaustive list of indicators to represent the stakeholder interests - the choice for which indicators to operationalise was limited by the scope of this thesis after all. Therefore, the conducted validation interviews can not be used to validate

[1] Participation fatigue is the negative attitude of stakeholders towards participation in government and policy-making often caused by experiences from previous participation processes where they felt unheard or ignored.

the completeness of the list of the operationalised indicators and their ability to represent all stakeholder interests. In practice, agreeing on a complete list of indicators for the actual policy evaluation would be an important step in a participation process since this is where involved stakeholders would have to agree or disagree with how their interests are represented in the policy evaluation.

The validation interviews showed that the indicator selection process is expected to be relevant in participation processes. The stakeholder's claims that this process would contribute to reducing participation fatigue do sound like logical reasoning and seem to be in line with literature (as is further discussed in section 8.4). However, confirming an actual causal relationship between this process and a reduction of participation fatigue would require further validation.

The stated preconditions for the implementation of the process in practice seem to be general preconditions for participation processes. They are not specific for this case, the ex-ante evaluation of car-free policies, or the selection of well-being indicators. An additional precondition specifically for selecting well-being indicators would be that it should be clear to participants how the planned policy relates to the different domains and aspects of well-being. Secondly, agreeing with the stakeholders on a final list of indicators to include in the policy evaluation (as mentioned above) should also be a precondition for applying this process in practice.

7.3. Implementation of the indicator selection process in practice

In this section, the conclusions from the case study and the validation interviews are used to give some general recommendations for the implementation of the well-being indicator selection process and the operationalised indicators in practice.

In the first section of this chapter, the case study with the operationalised indicators showed that the indicators can be relevant, but that it depends on the type of policy. This calls for expert judgement in the selection of the indicators and a fit-for-purpose selection depending on the type of policy under evaluation. Also, it can be recommended based on this case study to make use of conventional indicators (e.g. traffic intensity or modal split) when the results of the well-being indicators need to be clarified.

Figure 7.9 shows the well-being indicator selection process in practice. It can to some extent be done parallel to the policy planning process. However, since it differs per indicator in which phase of the planning process they are most relevant, at least the first steps of the well-being indicator selection process should be applied at the beginning of a policy planning process, even when only the ambition for car-free policies in an area is known. This ensures that even in the early phases of the policy planning process, relevant stakeholder interests can already be taken into account and relevant indicators could potentially be used while designing the scenarios.

Based on the experience from the validation interviews in this thesis, and the discussion of the results of those validation interviews above, an additional step in the well-being indicator selection process is recommended. As can be seen in figure 7.9, a validation interview step is added after the operationalisation of the indicators. This allows for the check of the final list of indicators by stakeholders as mentioned in the discussion above (section 7.2.3) before the policy evaluation. From this seventh step, there are two potential feedback loops. Most likely is the continuous arrow, which indicates that feedback in the validation interviews was mainly targeted at the operationalisation of the indicators and might require a policy-maker to make adjustments here (e.g. change the resolution or specification). This type of feedback was seen most in the validation interviews in this thesis. Secondly, there is the dotted arrow. This represents a feedback loop that would occur if the results of the validation interviews were critical of the final selection of the indicators (e.g. not all most relevant interests are represented). When this occurs, one has to go back to step five to adjust the selection of the indicators and then operationalise them again. One could argue for a validation step between steps five and six to prevent unnecessary work on the operationalisation of indicators that are later deselected. However, since the relevance of the indicator can depend significantly on factors of the operationalisation step (e.g. specification and resolution), it might be difficult for the stakeholders to validate a list of not-yet-operationalised indicators. Also, one could argue against this extra validation step by claiming it could contribute to participation fatigue.

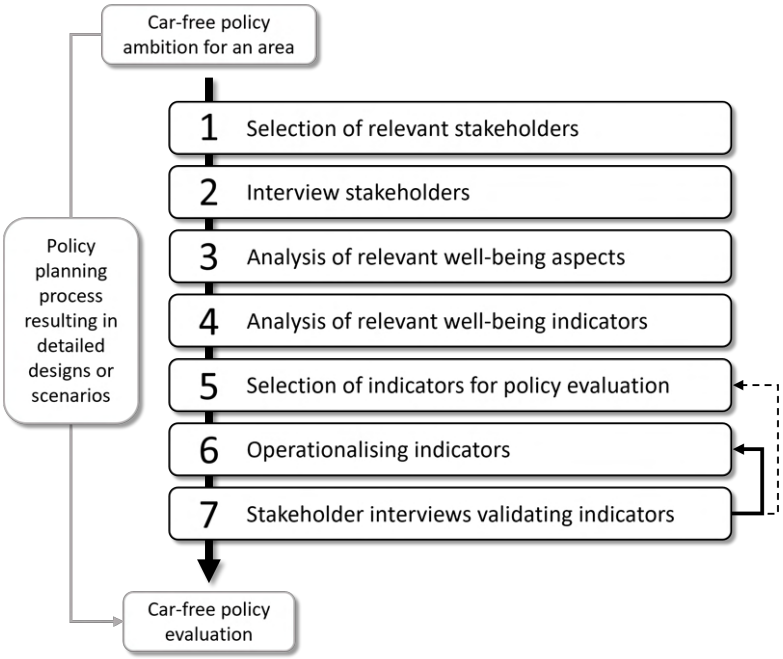


Figure 7.9: Recommended steps of the well-being indicator selection process in practice. In grey, the embedded context of the policy planning process is shown.

8

Discussion

The results of this thesis are twofold. First, there are the results of applying the well-being indicator selection process to the case of Oude Westen, including the operationalised indicators. Secondly, there is the developed well-being indicator selection process itself. In this chapter, both parts are discussed separately. Afterwards, the limitations of this research are discussed and recommendations for future research are made.

8.1. Discussion of results for the Oude Westen case

In this research, the designed indicator selection process was applied to the case of car-free policies in the Oude Westen neighbourhood in Rotterdam. The first results were presented in chapter 4: a list of the most relevant aspects and domains of well-being for stakeholders. In chapter 5, the next step was made by matching the interests with relevant indicators. A selection of these relevant indicators was then operationalised in chapter 6.

8.1.1. Stakeholder interests and relevant indicators

This list of relevant domains and aspects of well-being consisted of a weighting of empirical results from this case study and findings in existing literature. The combination with literature findings ensured that the empirical findings from this case study were checked with existing knowledge on stakeholder interests in other cases. Because of this, the impact of potential outliers in the sample of the case study findings is limited, while still safeguarding the local input in the selection process.

Overall, the empirical findings in this study matched the literature findings relatively well. The stakeholders in Rotterdam found the domain of safety, and the traffic safety aspect in particular, more important than what was found in literature. This could be caused by the fact that almost all interviewees were currently not satisfied with the (traffic) safety in the neighbourhood (see last questions of the interview transcripts in appendix F). Specifically for the municipality, this stakeholder was found to have a more balanced interest in the different domains of well-being than the strong living environment focus that was found in literature. In section 4.4, this was already discussed to be potentially caused by the focus on car-free policies in the included literature and the often living-environment-focused targets of these policies. The findings in this case study confirm that the focus of the municipality is wider than this one domain and one cannot focus merely on one domain of well-being since interventions often have effects on multiple domains - which is in line with the whole idea of well-being indicators investigating more than only one domain that was discussed in section 2.3. This position of the municipality is in line with the prerequisite for the implementation of car-free policies that requires alignment of the car-free plan with other high-level plans and objectives (Nieuwenhuijsen et al., 2018).

The answer to the question of which domain was most important got a variety of responses, resulting in a draw between three domains and only the health domain being mentioned less often. However, looking at the number of times the aspects of a certain domain were mentioned seemed to provide a clearer insight into the importance of the domains. The question can be raised which of these approaches leads to the most relevant results: the answer to a direct question or the analysis of the

mentioned underlying aspects. In this research, the assumption was made that the analysis of the mentioned underlying aspects would represent the intrinsic interests of a stakeholder the best since it cannot be ensured that the interviewees understand the exact definitions of the domains of well-being and their underlying aspects. The answers to a direct question could therefore not be guaranteed to yield the intrinsic interest of the stakeholders.

The resulting ranking of the importance of the well-being domains was found to be living environment - accessibility - safety - health. This ranking seems to be valid for this case study, although the municipal policy-maker and the local neighbourhood council members were surprised about the low position of health in this ranking. Also in the ranking of well-being aspects, the first health aspect is only in 12th place. The interviewees in the validation phase attributed this to stakeholders not seeing a clear link between health and the context of mobility policies. This effect was indeed experienced during the stakeholder interviews in chapter 4 and this could potentially explain another remark from the validation interviews as well. The policy-maker noticed that the aspect of noise pollution got a higher priority than air pollution, while air pollution is actually a bigger focus within policy-making due to strict guidelines. It seems like noise pollution is higher in the ranking because this is more noticeable in the daily lives of stakeholders. In this trend, it also makes sense that the domain of health scored lowest - the link between mobility and the other domains is more clearly noticeable in the daily lives of stakeholders than the link with the health domain.

In line with this noticeability criterion, in the next step of finding relevant indicators, the proposed indicators for traffic safety - number of accidents and number of fatalities - were less relevant for the context in which stakeholders mentioned traffic safety. They mentioned the unsafe situations on the road, not necessarily the outcomes in the number of accidents. Here the stakeholders again valued aspects that were noticeable in their daily lives. This led to the creation of the indicator for the mix of traffic on the road - an output indicator as opposed to the proposed impact or outcome indicators. Also in the physical health aspect of well-being, the proposed indicators - DALY and QALY (see section 5.1.4) - were considered to be too abstract impact indicators and not matching the more output/outcome-related context that stakeholders mentioned for this aspect. Even though these indicators can be relevant when evaluating policies on a high, strategic level, they do not match the context in which stakeholders mentioned this aspect and might therefore not resonate with their experiences in daily life - they lack a certain relatability. When this relatability is ensured with carefully selected (well-being) indicators, the participation might be more valuable and in case of positive results of those indicators in the policy evaluation, stakeholder support might increase due to the positive results of the policy being relatable to a positive change in the stakeholder's daily life.

8.1.2. Operationalised indicators

This section discusses the operationalised indicators of well-being. During the operationalisation process in chapter 6, the name of the indicators changed slightly to cover better the specification that was used. The use of space for parking was operationalised as the use of (public) space for car parking. The proximity of mobility options was operationalised as the number of mobility options. The mix of traffic on the road was operationalised as the traffic mix safety warning. While the initial names and the operationalised names can be used interchangeably, the operationalised names are more specific and are therefore used in this discussion.

Use of (public) space for car parking

For the use of space for car parking, the difference between space allocation and space occupation was an important distinction and the indicator contains both. The designed quantification approach allowed for interaction with the transport model and thus for an approximation of the actual free parking capacity of parking spaces in a zone - something that was not found in existing quantification approaches. The implementation of this indicator did raise some challenges that are further discussed in the limitations section below (section 8.3).

Using a modified approach, however, the case study in chapter 7 did show that this indicator can already yield relevant results regarding the dispersion of traffic to other zones (only first-order effect, no modal shift). It can therefore already be relevant for the evaluation of policies or interventions, mainly those related to parking spaces.

The verification of this indicator showed that in the current quantification approach, the specifications of user groups and parking type are realised only to some extent. Ideally, future development of this indicator would result in a better specification of the different types of parking spaces. This would replace the current assumption of equal split over the different public parking types with a parking type choice model which can incorporate characteristics of the parking space (e.g. cost, permit requirements, time windows, etc.). With these characteristics, a specification per user group would also be more relevant since personal characteristics or trip purposes could then also be considered.

Number of mobility options

The number of mobility options proved to be especially relevant in the early phases of the process of planning car-free policies. It can help identify areas that satisfy one of the prerequisites for car-free policies as defined by Nieuwenhuijsen et al. (2018): the availability of alternative transport means. The use of service frequency as a service quality indicator was an important aspect of evaluating this prerequisite. However, the case study in chapter 7 also showed that this resulted in the impact of interventions being more easily recognisable in areas with a low density of public transport stops. In areas with a high density of stops, such as the Oude Westen neighbourhood, this indicator might be less relevant since the relative impact of an intervention is small and harder to see. This indicator is an output indicator. Combining it with an outcome indicator such as the modal split could make the indicator also more relevant for areas with a higher density of public transport stops.

The verification of this indicator showed that the number of mobility options is currently not indicating all mobility options people have, but is limited to public transport options. A future development should be to include other modes (such as private car, bike, or shared mobility) in this indicator, or to design similar indicators for other (groups of) transport modes.

Traffic mix safety warning

The traffic mix safety warning was not feasible to implement and calculate within this research. However, this was due to the model containing separate networks for bikes and cars. In a model setup that has only one integrated network, this could have been feasible. Therefore, the general quantification approach taken in section 6.4 is still relevant.

Literature does link traffic intensity to traffic safety but the exact relation is complex to estimate, which would result in a less explainable indicator. Quantifying this exact relation is therefore not part of this indicator and the indicator merely checks whether the infrastructure would be considered safe for the traffic intensities. The warning levels that this indicator gives are based on CROW design guidelines (CROW, 2016) and the assumption is made that these threshold values therefore represent the limits of safe cycling infrastructure. This indicator thus serves as a proxy indicator for traffic safety, one that is more on the output level than on the outcome or impact level. Due to this, the indicator is more in line with the context in which stakeholders mentioned traffic safety and the indicator could be more relatable.

The interpretation of this indicator requires some nuance. A warning would indicate an intervention is needed for the aspect that triggered the warning level (speed limit, car intensity or bike intensity). However, expert judgement and involvement are always required since the intervention would need to be adjusted to the local context, which might differ from the general guidelines. This local context was also mentioned by local council members to be important as this additional information (local knowledge like frequent double parking or speeding) could yield a more accurate evaluation of traffic safety.

Currently, this indicator is still limited to the mix of cars and cyclists on a road. However, urban areas such as Oude Westen often have a highly diverse traffic mix. Expanding this indicator to include other modes - or developing similar indicators for other mode combinations - would help provide a more complete overview of the traffic mix and potential safety issues that arise from this. Clear guidelines should be available for these other combinations of transport modes to provide the threshold values for the traffic mix safety warning.

8.2. Discussion of the well-being indicator selection process

The selection process for well-being indicators for ex-ante policy evaluation that was developed in this thesis consists of seven recommended steps (see figure 7.9). In the first step, the stakeholder selection,

the comparison with existing literature on car-free policies was made. This ensures a wide range of stakeholder groups as a basis for selecting the relevant stakeholders for the case area. The relevance of always performing a full stakeholder analysis was endorsed by a local council member (CM), opposing an emerging strategy of the municipality to have more fixed contact persons in the neighbourhoods (PM). Both opinions could have their strengths: always performing a stakeholder analysis could prevent bias in the invited stakeholders, while having a few known contact persons for certain topics could contribute to preventing participation fatigue by reducing the number of calls for participation among the general group of local stakeholders. A combination could be possible: performing a stakeholder analysis and then linking to known contact persons in the selected stakeholder groups.

During the second step, conducting stakeholder interviews, it was found to be important to clearly instruct participants to consider the whole spectrum of well-being as defined by Vonk Noordegraaf et al. (2021). This would reduce the risk of participants not seeing the link between an aspect of well-being and the context of mobility policies and therefore not expressing their interests in this aspect (as was seen for the health domain). In the validation interviews, this was also mentioned as a recommendation: clearly stating the space a participant is allowed to think in.

The third step was the first level of analysis for important domains and aspects of well-being. As mentioned above in section 8.1.1, the assumption was made that selecting the most important domain based on an analysis of the mentioned well-being aspects was the least prone to participants not fully understanding the definitions and concepts of all domains, and thus not expressing their actual interest.

The second level of analysis was performed in the fourth step, which concluded with a shortlist of relevant indicators. It can be concluded that it is possible to make a selection of relevant indicators based on the context in which an aspect of well-being was mentioned. However, where this research took the indicator set defined by Vonk Noordegraaf et al. (2021) as a basis, a different base set could yield different relevant indicators and it could even occur that the base set does not contain any relevant indicators for the context of the well-being aspect. Therefore, it is important to allow for the creation of new (specifications of) indicators when the indicators of the base set do not suffice. This can be a specification that was not in the original set of indicators or even a different type of indicator. Sometimes the context calls for an output indicator while the proposed indicators are outcome or impact indicators. This is what induced the creation of the indicator for the traffic mix warning level. The idea behind using well-being indicators is that there is a possibility to make fit-for-purpose indicators that go broader than economic or traffic-related indicators (see section 2.3). If the proposed indicators do not match the context of the stakeholder interest, they would not be fit-for-purpose and therefore less relatable and relevant - which would induce the development of a new, better fit-for-purpose indicator.

From the shortlist, a further selection is made of indicators to operationalise: step five. The key criterion in this final selection was the objectivity of the indicator (see section 6.1). This criterion is important because the context of the research is ex-ante evaluation using model indicators, and subjective indicators are difficult to quantify in a model, let alone before a policy is implemented. However, the subjective indicators that are disregarded by this criterion could also be very relevant for the policy evaluation. With a combination of expert judgement and qualitative reasoning, these indicators could still be used in the evaluation when this is deemed necessary. As was discussed above in section 8.1.1, the relevancy for the stakeholders is another important criterion. Only when these indicators are relevant and relatable for the stakeholders, can this process contribute to the goal of better representing the stakeholder interests in policy evaluation and potentially increasing stakeholder support for car-free policies. A more practical criterion in this selection was the availability of resources and data for the operationalisation of the indicator. During the validation interviews, the policy-maker noted that this should not get the upper hand in the selection. If the indicator is relevant, one should at least investigate whether it is possible to invest in the development of the indicator before disregarding it because of a lack of resources. However, as the operationalisation of the use of space indicator showed, the unavailability of data could potentially lead to unrealistic results. Therefore, this criterion should be thoroughly considered.

After the selection of the indicators, they need to be operationalised in step six. This thesis showed that in general, it is possible to derive an indicator purpose and specification from the context in which the corresponding well-being aspect was mentioned. However, when this context is limited, it also becomes difficult to determine and define a clear indicator purpose and specification. This would also make the verification step more difficult and less relevant.

The last step is the validation of the operationalised indicators with the involved stakeholders. This step should determine the final set of indicators that will be used in the policy evaluation. The number of validation interviews that should be conducted depends on the composition of the group of interviewed stakeholders in the earlier steps, on their roles (e.g. do some stakeholders represent bigger groups?), and on expert judgement. Therefore, this number could be differentiated on a case-by-case basis. However, it should always be the aim to represent all stakeholders in this validation step. When this step is implemented and proper validation is done, there might be a feeling of ownership of the selected indicators among the stakeholders. This provides a good basis for the policy evaluation and limits the space for discussion about the used indicators later in the process.

8.3. Limitations of this research

This section discusses the limitations of this thesis. It is again split into two parts: limitations related to the operationalised indicators and limitations related to the indicator selection process.

8.3.1. Limitations of operationalised indicators

Since this thesis is exploratory research into the operationalisation of these well-being indicators, the three operationalised indicators all still have their limitations. Further research can be done into each operationalised indicator to further develop them into more generally relevant indicators. This section describes the main limitations that would require further research.

The biggest limitation of the use of space for car parking indicator is that the quantification approach proposed in figure 6.2 did yield an unrealistically low share of car trips to the Oude Westen neighbourhood. The drop in the share of car trips after running the mode choice model could be caused by unreasonably high travel times for cars. In the results of the case study in chapter 7, one can see occupation rates above one, which can result in those high travel times. The adjusted quantification approach of figure 7.1, however, does not take into account the modal shift effects of high parking pressure. Therefore, this indicator currently only shows the first-order effects of parking capacities: dispersion of traffic to neighbouring zones. Further research into this indicator and the Urban Strategy model would be necessary to mitigate this limitation. The Urban Strategy model, with this parking indicator and realistic capacity implemented, should be checked for a need for recalibration of specifically the parking aspect of the Traffic+ module and/or the mode choice model of the New Mobility Modeller (see section 6.2.4 and appendix I). When using a different model, this quantification approach of the free parking capacity and the use of space for car parking indicator should also be implemented and validated before using the indicator results.

Another limitation of the use of space for car parking indicator is the fact that it is aggregated per zone. As mentioned by the policy-maker in the validation interviews, the parking pressure can vary per street and an aggregated value per zone could differ from local stakeholder's experiences (PM). This could severely limit the relatability of the indicator and make it less relevant for the local stakeholders. Specifying the indicator on street level could mitigate this, as long as it is validated with empirical data. Otherwise, the indicator values could still be not relatable for local stakeholders.

A limitation of the operationalisation of the number of mobility options is the lack of detail in the mobility options. The choice was made to keep the indicator explainable to the involved stakeholders and maintain the low complexity of the indicator. This is why it merely counts the (public transport) mobility options. However, this means other potentially important factors are not taken into account. This could be factors related to the direction and destination of mobility options, the potential connections, or the actual distance to the stop. During the validation interview, the policy-maker added the potential of using user group specification and trip purpose for determining the number of mobility options (PM). This could include trip characteristics such as costs, reliability and comfort, and personal characteristics such as income, driving ability or the availability of a public transport card. Further research could explore these possibilities and their effects on the explainability of the indicator.

8.3.2. Limitations of indicator selection process

In the application of the indicator selection process in this thesis, the stakeholder group of visitors of the area was not taken into account. It was already argued in section 4.2 that the group of visitors was difficult to include in this research due to being a large and very heterogeneous group. However, this is still an important stakeholder group who might use the infrastructure in the area for their commute

or who might be customers of businesses in the area. Also in a validation interview, the importance of this group was stressed (CM). Including this group might have an impact on the ranking of well-being aspects and domains. The visitors might for example value accessibility more than the living environment since they do not have to live in the area. Therefore, this can be an important group to consult, but how to best incorporate their interests and how to weigh their interests with the interests of local stakeholders living or working in the area, is a topic for further research.

Another limitation of this research is related to the data collection. The sample size (number of conducted interviews) is not representative of the whole population in the area. Section 3.3.4 showed the data reaching (near) saturation - this was most apparent for the mentioned well-being aspects and slightly less for the context in which these aspects were mentioned. However, even though (near) data saturation was shown, the results cannot necessarily be generalised to the whole population in the case study area, let alone urban areas in general, due to the small sample size. The interviews with local neighbourhood council members did somewhat mitigate this limitation as they represent the local residents and to some extent also the local business owners. Besides this, however, this thesis is an exploratory research into the topic of selecting and operationalising well-being indicators. Therefore, providing generalisable rankings of the importance of well-being aspects and domains was not the intended result and thus the results should not be interpreted as such.

The last limitation related to the process is the fact that both the considered domains and aspects of well-being and the proposed list of indicators were based solely on the work by Vonk Noordegraaf et al. (2021). Especially considering that the stakeholders all needed clarification of the used domains and aspects of well-being to formulate their answers, the used definitions did have a defining role in the responses from stakeholders. Therefore, using differently defined domains and aspects of well-being could yield different results from the stakeholder interviews. However, for the domains and aspects of well-being related mobility policies, the work by Vonk Noordegraaf et al. (2021) was the most advanced and detailed work that was done in the context of the Netherlands, and the only study that added an extensive list of potential indicators. This was the reason for using this work as the basis for this research. Consequently, the proposed indicators could be used as a base list to select relevant indicators from. Using different work as a basis would therefore also yield different relevant indicators. However, the goal of this selection of well-being indicators is not to find the overall best indicators, but the indicators that are best fit-for-purpose (section 2.3 and Tuominen et al., 2008). On top of that, these fit-for-purpose indicators are still only a means to reach the main goal of better representation of stakeholder interests in ex-ante car-free policy evaluation and potentially more support for these policies. Therefore, the consequences of this limitation are minor, as long as the indicators suffice to represent the context in which the well-being aspects are mentioned. This limitation can further be mitigated by developing new, custom indicators when the indicators on the base list would not suffice. Then, the base list of indicators does not have a major impact on the relevancy of the results of this selection process.

8.4. Generalisation and application of the results

The sections above discussed that the well-being indicator selection process seems to be able to yield relevant results. As mentioned in the validation interviews, this process is expected to be able to create a feeling of ownership of the process for the involved stakeholders (CM). This is an effect of stakeholder participation that was also found in literature (Banister, 2008; Lindenau and Böhler-Baedeker, 2014; and section 2.2.1). Furthermore, Fernandez-Heredia and Fernandez-Sanchez (2020) stressed that by involving the average person in the process, support for the policy can be gained from the bottom up. This would argue, in agreement with this thesis, for the involvement of local stakeholder groups in the well-being indicator selection process to increase support for the to-be-implemented policies. Meanwhile, the local stakeholder involvement can be beneficial for the speed of the process as well since local expertise that was also mentioned earlier (e.g. as extra input for the traffic mix safety indicator) could help to reach consensus sooner (Lindenau & Böhler-Baedeker, 2014). These agreements and similarities with findings in literature seem to argue that this well-being indicator selection process is generalisable to other cases. This is in line with a validation interview where it was argued by the policy-maker that this process could also be applied to other neighbourhoods and cities that deal with similar challenges as the Oude Westen (PM). However, further validation of the indicator selection process in other cases is required to confirm these claims and prove the generalisability of the process to other cases.

A generalisable indicator selection process does also not necessarily mean that the resulting ranking of well-being domains and aspects or the relevant indicators can be generalised to other cases. As mentioned in the limitations, the sample size does not allow for a generalisation to a whole population. Also, to get fit-for-purpose indicators, the local context of other cases should also be taken into account and therefore the selection process also needs to be applied there. For the application of the well-being indicator selection process, four recommendations can be made based on the process and results of this thesis:

- The scale of the intervention should be suitable for this process. Not only should the resulting indicators be fit for the purpose of evaluating the intervention (as stated by Tuominen et al. (2008)), but also the intervention should be fit for the purpose of being evaluated by indicators selected using this process.
- There should be clarity for the participants about the procedural details of the process - e.g. duration, structure, planned use of the results - as well as about the spectrum of well-being they can consider in expressing their interests. The first point of clarity could contribute to preventing disappointment and participation fatigue. The second point of clarity could contribute to the quality of the results by ensuring stakeholders fully understand the potential links between the policy and their interests in all domains of well-being.
- When the results of the validation step require an iteration of the selection or operationalisation of indicators, another validation step has to be performed afterwards before continuing to the policy evaluation. Only when the stakeholders agree with the selected indicators, will the indicator selection process actually provide added value for the policy evaluation. In case of minor changes to the operationalisation of indicators, the stakeholders can conditionally agree to the final list and these minor changes do not need to be validated in another validation step.
- The policy planning process should be parallel to, and interconnected with, the indicator selection process. The relevant indicators should actually come from stakeholder input and the decision-makers should actually consider the evaluation outcome - two interactions that were also shown in the conceptual framework in figure 2.6. This means that there should be multiple potential designs or policy scenarios for the policy evaluation at the end of the indicator selection process.

The indicators that were operationalised in this thesis can be generalised to other cases. In these other cases, the required (local) data sets need to be acquired to allow for the calculation of the indicator. The availability of this data might differ per case (PM). However, if the data would not be available, the indicator would not be selected in step five of the indicator selection process. This is an important consideration because incomplete data can lead to implementation issues and/or unrealistic results, as was seen for the use of space for car parking indicator (see section 6.2.4).

If the indicator is selected, the quantification approaches developed in this thesis can be applied in the new case as well, while taking into account the given remarks and discussed limitations. When a different type of transport model is used, the indicators would need some customisation to make this work. However, the number of mobility options and the traffic mix safety warning both do not interact with the model and merely use some common model output data, implementing these indicators should not lead to major issues. The use of space for car parking depends largely on the parking functionality of the Traffic+ module of Urban Strategy and would be more difficult to implement in a different transport model.

9 Conclusion

This thesis investigated how well-being indicators could be operationalised to represent stakeholder interests in the ex-ante evaluation of car-free policies. By combining qualitative and quantitative research, a well-being indicator selection process could be developed and applied to a case study in the Oude Westen neighbourhood in Rotterdam. The results of the well-being indicator selection process were validated using the case study and validation interviews. In this chapter, the conclusions of this research are presented. First, the research questions of this thesis are answered. This is followed by the recommendations for future research and the contributions of this thesis to the field of well-being indicators and car-free policies.

9.1. Answers to the research questions

To answer the main research question of this thesis, the four sub-questions are answered first.

Sub-question 1: Which stakeholders are, or should be, involved in participation for planning car-free policies and what are their interests in these policies?

The municipality, local residents and local business owners should participate in the planning process of car-free policies. These groups are most invested in and affected by car-free policies. While other, larger stakeholders often have a formal role in the planning process, the latter two stakeholder groups depend on involvement in these participation processes. Meanwhile, these stakeholder groups are among the groups that experience the impact of interventions the most in their daily life. Involving the local residents and business owners could yield more bottom-up support for car-free policies, making their involvement important.

The interests of stakeholders were derived from analysing which well-being aspects were mentioned the most. For the case study of Oude Westen, the interests of the stakeholders were primarily in the living environment domain, followed closely by the accessibility domain and the safety domain. The health domain sparked the least interest from the stakeholders. In terms of well-being aspects, the most stakeholder interests were found in the use of space, accessibility of mobility options, accessibility of activities, traffic safety, and noise pollution.

Sub-question 2: What are relevant well-being indicators for representing stakeholder interests in the planning process of car-free policies?

Relevant indicators were found to be indicators that match the context in which stakeholders mentioned the specific aspect of well-being. In particular, the type of indicator (output, outcome, or impact) should match with the context that was given by the stakeholders. This can enhance the relatability of the indicator to the stakeholders' experiences.

The indicators were selected from a list of proposed indicators for each well-being aspect. For the use of space, the most relevant indicators included the quality of public space, the ratio between green and grey space, the use of space for parking, and the perception of parking. For the accessibility of mobility options, these were the price-to-quality ratio of mobility options and the proximity of mobility

options. The relevant indicators for accessibility of mobility options are the number of activities and persons within reach. For traffic safety, these were the mix of traffic on the road and the number of accidents or fatalities/injuries.

Sub-question 3: How can relevant well-being indicators be operationalised in an existing transport model?

The operationalisation steps taken in this thesis started with literature research into existing quantification approaches for similar indicators. Based on these approaches and the stakeholder interests, the purpose and potential specifications of the indicator were determined. This was followed by developing a quantification approach for each indicator. Lastly, the operationalised indicator was verified with the purpose and specification determined above and the results were interpreted.

In this thesis, three indicators were operationalised: the use of space for car parking, the number of mobility options, and the traffic mix safety warning. The complexity of the operationalisation of these indicators varied, as did the expected complexity of the operationalisation of other indicators on the shortlist. Where the number of mobility options merely required static input data to be quantified, the traffic mix safety warning indicator required the output data of a transport model (the traffic intensities). The operationalisation of the use of space for car parking indicator even involved more complex interaction with the existing transport model that was used - which was also required to have a parking capacity feature. Depending on the (type of) indicator to be operationalised, the required data and models can vary significantly.

Sub-question 4: To what extent can the used methodology yield relevant results and be applied in practice?

The application of the well-being indicator selection process in the Oude Westen case proved that this method did yield relevant rankings of well-being aspects and relevant operationalised indicators. This was shown in the feedback of the results to the stakeholders. However, the difficulty of interviewees in linking mobility policies to effects in the health domain seemed to have caused a lower ranking of health-related well-being aspects than expected. This could also occur in other domains of well-being.

The well-being indicator selection process can be applied in practice as part of a participation process for policy planning. However, four recommendations for this process should be considered to reduce the risk of participation fatigue and increase stakeholders' investment in the process.

1. The scale of the planned policy should be on neighbourhood level, where the policies are concrete enough to discuss with stakeholders and budgets are sufficient for a full participation process.
2. The participants should have a clear understanding of the procedures of the participation process - e.g. duration and planned use of results - and the spectrum of well-being they can consider in expressing their interests. Especially the link between the planned policy and the domains and aspects of well-being should be clear.
3. The final list of selected and operationalised indicators should be validated by the stakeholders before proceeding to the policy evaluation. When this validation requires changes in the selection or operationalisation of the indicators, the adjusted list should again be validated.
4. The indicator selection process should be parallel and interconnected with the policy planning process. The stakeholder input should be considered throughout the planning process and the evaluation of different policy scenarios or designs using the selected indicators should be considered in the final policy decision.

Main research question: How can relevant well-being indicators be selected and operationalised in the planning process of car-free policies to represent stakeholders' interests in ex-ante evaluations?

This thesis showed that well-being indicators can be very relevant for representing (local) stakeholders' interests in car-free policy evaluations. Operationalising these indicators requires interviewing stakeholders to determine the interests they have in the policies, given the wide spectrum of well-being aspects they could consider. Matching the responses of stakeholders to aspects of well-being yields a list of relevant well-being aspects. Matching the contexts in which these aspects were mentioned to potential indicators then yields a shortlist of relevant indicators. From this shortlist, a final selection

can then be made on the criteria of objectivity and relevance of the indicator, and representation of different well-being domains. The selected indicators are then to be operationalised for the existing (transport) model that is used. This requires conducting research into existing similar indicators, determining relevant indicator purpose and specifications, developing a quantification approach, interpreting the results of the indicator, and verifying this with the purpose and specifications that were determined. Lastly, the selected and operationalised indicators are validated by involved stakeholders to check if they do indeed represent their interests.

The relevance of well-being indicators can depend on the specific type of policy under evaluation and on the specific stage of the planning process. In many cases, conventional (traffic-related) model indicators can be used to clarify or explain changes in well-being indicators. The well-being indicator selection process can provide a structure to the policy planning process through which stakeholders can become more invested early in the process. The stakeholders' interests are used as input for the operationalised well-being indicators that can be used throughout the planning process. By combining qualitative stakeholder interests and quantitative model indicators in this one process, it is possible to iterate between stakeholder input and (adjustments in) how these are represented in models. This could ensure that stakeholders' interests are taken into account throughout the process, not only at the final ex-ante evaluation. Also, these well-being indicators developed in cooperation with the stakeholders enable discussions about the evaluation results to focus on the effects of proposed policies rather than the evaluation criteria or the policies themselves.

Well-being indicators can represent stakeholder interests at the same level as they are experienced, such as using output indicators for interests experienced at the output level and outcome indicators for interests experienced at the outcome level. Using these indicators could therefore enhance the relatability of the indicators for stakeholders and provide policy evaluation results that are more relevant for the stakeholders - for example traffic safety results expressed in the dangerousness of the mix of traffic on the road instead of high-level savings of quality-adjusted life years. This could potentially increase stakeholder support for the planned policy.

9.2. Contributions to the field and recommended future research

This thesis is an exploratory research into the field of well-being indicators in car-free policy evaluation. Therefore, there are some opportunities for future research. First of all, future research could provide more consensus about the domains and aspects of well-being that are considered relevant for mobility policies. A standardised and widely accepted set of domains and aspects would result in a standardisation of the interpretation of stakeholder interests on the well-being spectrum and enhance the comparability of different case studies. Another topic for future research would be to perform a more representative study into relevant well-being aspects for stakeholders. This could be done using a large-scale data collection method (e.g. survey or Participatory Value Evaluation). A representative set of indicators could provide relevant well-being indicators even in policy planning processes where an indicator selection process with involved stakeholders would not be possible. Lastly, future research could investigate the validity of the results of the indicator selection process when different stakeholders (e.g. visitors) are involved and for different cases (e.g. other types of policies or car-free policies in other areas).

For the three indicators that were operationalised in this thesis, some recommendations for future research can be made as well. The use of space indicator requires more research into the calibration and validation of the (interaction between) the parking capacity and the mode choice model. Only when this is done, can the impact of parking space allocation on the modal split be modelled and taken into account in policy evaluation. For the number of mobility options indicator, future research is recommended to be focused on expanding this indicator to include other transport modes besides public transport and include a specification for user groups. This would increase the relevance of this indicator as a representation of the actual number of mobility options people have. In the XCARCITY context, these last recommendations for future research can be very relevant for work package four which looks into impact assessment and optimisation models. This work package could also further explore the evaluation of policies using these indicators and the trade-offs between indicators that could occur.

Despite these opportunities for future research, this thesis already made a first step into the field

of using well-being indicators for car-free policy evaluation. It contributed to the two research gaps identified in chapter 2: the selection of relevant well-being indicators and the operationalisation of well-being indicators for ex-ante evaluation of car-free policies. Therefore, it also yielded relevant initial results for the XCARCITY project to build upon - potentially in all work packages involving stakeholder involvement, policy assessment, and model indicators. Since this thesis was one of the first to investigate the relevance of well-being indicators for (local) stakeholders, the developed indicator selection process can be valuable for the application of well-being in car-free policy evaluation. After further validation of the generalisability to other cases, this could potentially also be valuable for the evaluation of other types of policies, making the contribution potentially go beyond the context of car-free policies. The operationalisation of well-being indicators was another field in which little research had been done. The three well-being indicators that were operationalised in this thesis provide a first step into turning conceptual well-being indicators into operational indicators and can now be applied in other cases as well. The developed method for operationalising (well-being) indicators can serve as a basis for operationalising other well-being indicators in the future.

This thesis contributed to solving the problem of a lack of suitable indicators for car-free policy evaluation (as defined in chapter 1) by developing a well-being indicator selection process and an operationalisation method for these indicators. These fit-for-purpose well-being indicators could contribute to a better representation of local stakeholders' interests in car-free policy evaluation. Combined with stakeholder participation early in the policy planning process, facilitated by the developed indicator selection process, this could lead to more buy-in of stakeholders in the planned policies. Therefore, this thesis could contribute to increased support of local stakeholders for car-free policies worldwide.

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A

Proposed indicators of well-being for use in the mobility domain

Table A.1: Proposed indicators of well-being in the mobility domain divided over the four dimensions and their categories (adapted from Vonk Noordegraaf et al. (2021))

Dimension	Category	Indicators [unit (if already defined)]
Living Environment	Climate	CO2 emissions [g]
		Greenhouse gas emissions [g]
		Required propulsion energy [Joule]
		Required energy for construction and maintenance of infrastructure and vehicles [Joule]
		Number or share of vulnerable locations in the transport system
	Environmental pollution	Emissions of NOx, PM, etc. [g]
		(Contribution of mobility to) concentrations NOx, PM, etc. [mcg/m3]
		(Contribution of mobility to) nitrogen deposition [mol/ha]
		(Contribution of mobility to) water quality (no indicator defined yet)
		Total material use or total materials saved - avoided use [g]
		Total materials saved - recycling [g]
	Noise pollution	Noise emissions [dB]
		Noise exposure [Lden, Lnight]
	Vibrations	Nuisance for residents living near roads, railways, and waterways
	Use of space	Use of space for infrastructure - for moving vehicles [m2]
		Use of space for parking - for stationary vehicles or vessels (storage) [m2]
		Perception of parking for different transport modes
		Ratio of green and grey space [shares in percentages]
		Fragmentation of green space
		Quality of public (mobility) space
		Commercial use of public space [m2]

Dimension	Category	Indicators [unit (if already defined)]
Safety	Traffic safety	Number of accidents Number of fatalities, severely injured, and minorly injured
	Social Safety	Social safety score
	External safety / environmental safety	Location-based risk (probability per year) Group risk
Accessibility	Spatial accessibility of activities	Number of reachable activities/activity centres of a given category within x minutes from a person, household or business [#] Number of reachable persons/households/businesses that can be reached from an activity centre within x minutes [#]
	Spatial accessibility of mobility options	Share of mobility expenditure to household budget [%] Price-to-quality ratio Distance to boarding point [m], frequency [#/hour], transfers [#], comfort [experience] Quantity of mobility options [#] Reliability of availability [number of times per unit of time that the option is (unplanned) unavailable, per user]
	Accessibility	Proportion of users finding it difficult to use this option [#] Number of actions required to make trip [#] Complexity of actions required to make journey (perception)
Health	Physical health	Disability Adjusted Life Years DALY [# year] Quality Adjusted Life Years QALY [# year] Share of active modes in modal split [%]
	Mental health	Perceived freedom of choice in mobility options (perception) Experienced emotions while travelling (perception) DALY/QALY

B

Assessment of potential case study areas

Table B.1: Assessment of potential case study areas. Supporting data is made available by Gemeente Rotterdam (n.d.-f)

Aspect	Description	Oude Westen	Nieuwe Westen	Middelland	Oude Noorden
Area	Neighbourhood or city district	Neighbourhood	Neighbourhood	Neighbourhood	Neighbourhood
XCARCITY & Urban Strategy	Within scope of both	Yes	Yes	Yes	Yes
Heterogeneous land-use	Diverse stakeholder types	Mixed-use	Mixed-use	Mixed-use	
Proximity to facilities	Average proximity to closest supermarket, school, and healthcare and childcare centre	0.275 m	0.3 m	0.3 m	0.325 m
Heterogeneous population	Generalizability to other cases; representation of general population				
Age	Compared to city of Rotterdam as a whole	Slightly less kids, slightly more young adults	Slightly more young adults, 5 percentage point less elderly	Slightly less kids, 5-6 percentage point mode young adults, 6 percentage point less elderly	Slightly more young adults, 4 percentage point less elderly
Cultural background	Compared to city of Rotterdam as a whole	16% less Dutch, 16% more non-western migration background	14% less Dutch, 14% more non-western migration background	4% less Dutch, 1% more non-western migration background, 3% more western migration background	10% less Dutch, 12% more non-western migration background, 1% less western migration background
Base level of alternative transport	Prerequisite for car-free policies	Multiple tram and bus lines crossing, bordering metro at one side and train station at the other side. Train station is 10 minute walk	Multiple tram and bus lines crossing, bordering metro at one side. Train station is 20-25 minute walk	Multiple tram and bus lines crossing, bordering metro at one side. Train station is 15-20 minute walk	Two tram lines in area, train station is 22 min walk
Existing plans for car-free policies	Political will (prerequisite) and governmental confidence in suitability of area for car-free policy	Ambition for low-car neighbourhood; Two traffic-calming experiments have been conducted	Ambition for low-car neighbourhood	Ambition for low-car neighbourhood	Ambition for low-car neighbourhood
Existing parking spaces per household	Shows current presence of cars in area	0.73	0.96	0.78	0.87
Number of cars per household	City-wide level is 0.7	0.4	0.5	0.5	0.5

C

Overview of stakeholder interests in literature

This appendix contains a full overview of the stakeholder interests in car-free policies that were found in literature. In table C.1 below, the stakeholders are divided into multiple categories. For each stakeholder, their interests are categorised as much as possible in the four domains of well-being as defined by Vonk Noordegraaf et al. (2021). Other interests that do not fall under one of these four domains, are placed in the last column of the table.

Table C.1: Overview of stakeholder interests found in literature about car-free policies (part 1)

	Interests				
Stakeholder	**Living environment**	**Safety**	**Accessibility**	**Health**	**Other**
Civil society					
Residents	Quality of life[B] Cleanliness[D]	Social cohesion[D] Safety[D]	Public transport availability[A] Accessibility low-income residents[C] Amenities nearby[B]		Social cohesion[D] Environmental awareness[D]
Interest groups	Reduction of pollution[E] Play-opportunities for children[E] Aesthetics[E]	Traffic safety[E]		Play-opportunities for children[E]	
Interest groups for disabled citizens				Accessible streets[A] Accessible public transport[A]	
Travelers / Visitors	Cycling possibilities[A] Quality/ human-friendliness of public space[F]				
Local business					
Local business owners (retail and hospitality)	Public space for commercial use[E]		Accessibility to deliveries in office hours[H] Car accessibility for customers[A]		Financial turn-over[A,E,F,G]
Craftsmen			Accessibility of project locations[A]		

[A](Rydningen et al., 2017) [B](Nederveen et al., 1999) [C](Glazener et al., 2022) [D](Loo, 2018) [E](Wright, 2005) [F](Szarata et al., 2017) [G](Wylie, 2019) [H](Bjerkan et al., 2014) [I](England & Eriksson, 2020) [J](Selzer & Lanzendorf, 2019) [K](Selzer, 2021)

Table C.2: Overview of stakeholder interests found in literature about car-free policies (part 2)

	Interests				
Stakeholder	**Living environment**	**Safety**	**Accessibility**	**Health**	**Other**
Government					
Municipality	Attractive public space for residents/visitors[H] Minimize negative impact of transport[H] Densification of residential areas[J] Human-friendliness of public space[J,K]		Inclusive accessibility[I]		
Transport companies					
Public transport operators	Sustainable public transport[A]		Accessibility for PT vehicles[A]		
Logistics companies	Unoccupied loading areas[A]		Accessibility of delivery destinations[A] Low cost of transport[H]		
Other corporations					
Real estate & Housing			Parking available close to dwellings[J,K]		Land/real estate value increase[E]
Schools		Traffic safety[E]	Accessibility to students[E]		

[A](Rydningen et al., 2017) [B](Nederveen et al., 1999) [C](Glazener et al., 2022) [D](Loo, 2018) [E](Wright, 2005) [F](Szarata et al., 2017) [G](Wylie, 2019) [H](Bjerkan et al., 2014) [I](England & Eriksson, 2020) [J](Selzer & Lanzendorf, 2019) [K](Selzer, 2021)

D

Stakeholder analysis for Oude Westen

Table D.1: Stakeholders in the Oude Westen neighbourhood described with their power and interest in car-free policies.

Stakeholder	Power	Interest
Governmental organisations		
Municipal Executive Board ('College van B&W') - The executive board of the municipality consists of the mayor and 9 aldermen. They are the day-to-day administration of the city. Vincent Karremans is currently the alderman responsible for both mobility and public space (Gemeente Rotterdam, n.d.-d).	The mayor and aldermen are responsible for carrying out the general policies as decided upon in the city council. In the way they carry out those policies, aldermen have significant power. However, they are checked and held responsible when necessary by the city council.	In the coalition agreement, the four biggest governing political parties present in the executive board agreed upon the goal of reducing car-traffic as much as possible in Oude Westen. They even announced a 'low-car'-fund of €20M to fund the transition to low-car neighbourhoods (Gemeente Rotterdam, 2022).
Gemeenteraad Rotterdam - Directly elected municipal council of Rotterdam. The 45 members vote for local ordinances and budgets and they check the municipal executive committee.	The municipal council is the decision-maker in the municipality. The members have the power to (among other things) vote for policies, propose changes, and investigate proposed policies (Gemeente Rotterdam, n.d.-a). Their power in the planning process of car-free policies is thus significant.	The municipal council aims to represent all citizens in decision-making. Therefore, the different political groups might have different interests. Their general interest in the policies is high since all members aim to represent their supporters vision in decisions that are made regarding these policies.
Wijkraad Dijkzicht Oude Westen - Elected council of local residents, tasked with connecting the different networks in the neighbourhood and representing the neighbourhoods towards the municipal council (Gemeente Rotterdam, 2021).	Can give solicited and unsolicited advice to municipal council and can thus have influence on the municipal council decision-making (Gemeente Rotterdam, 2021). The wijkraad itself has limited decision-making power.	The wijkraad aims to cooperate with municipality and the neighbourhoods to contribute to improving the neighbourhood (Gemeente Rotterdam, n.d.-e). The wijkraad is also tasked with motivating participation of residents in challenges regarding a.o. accessibility and (traffic) safety (Gemeente Rotterdam, 2021).
Mobility department Gemeente Rotterdam - The municipal department responsible for mobility policies and infrastructure projects.	Policy-makers for the municipality. The department does not have final decision-making power.	Interested in optimizing mobility in the municipality. Interests might be limited by the interests of the political decision-maker that the department reports to.

Stakeholder	Power	Interest
MRDH - The Metropolitan Region Rotterdam The Hague is a cooperation between 21 municipalities around (and including) Rotterdam and The Hague. MRDH is also the transport authority for this region.	MRDH provides subsidies for a variety of projects related to a.o. traffic safety, public transport, or influencing travel behaviour (MRDH, n.d.-a).	MRDH aims to contribute to economic development in the region. It also aims to improve accessibility of the region given the further urban densification that is expected (MRDH, n.d.-c).
Civil society		
Aktiegroep Het Oude Westen - Association of local residents, headquartered in the middle of the neighbourhood. The association is involved in all kinds of residents' initiatives and is the connecting factor between all residents and organisations in the neighbourhood (Aktiegroep Het Oude Westen, n.d.).	The association does not have legal power in policy planning. They do have a big group of active volunteers, a big reach in the neighbourhood with their own local newspaper, and a long history of uniting residents and pressuring local government (Aktiegroep Het Oude Westen, n.d.).	The association strives for continuous improvement of the Oude Westen neighbourhood (e.g. increasing greenery in the streets). It aims to connect people and provide support (financially and in connecting with organisations) for residents' initiatives (Aktiegroep Het Oude Westen, n.d.).
Vereniging van Gehandicaptenorganisaties Rotterdam (VGR) - The association of disability organisations in Rotterdam unites several organisations related to mentally and/or physically disabled or chronically ill residents of Rotterdam (VGR, n.d.).	The association has no legal power in policy-making and decision-making. However, it does represent over 25 different organisations and thus can have a substantial support base.	The member associations share the aim of providing equal opportunities for disabled people. As part of this mission, they aim to improve inclusiveness and accessibility of (a.o.) facilities and public space (VGR, n.d.).
Stichting Spirit 55+ - Interest group that represents senior citizens (55+) in the centre of Rotterdam (including Oude Westen) and organises activities. (Spirit55+, n.d.).	Has no legal power in policy-making and decision-making. Not very substantial support base.	Represents members' interests in living, healthcare, and well-being.
Local business		
BIZ Nieuwe Binnenweg and BIZ Gebruikers West Kruiskade e.o. - Local business owners associations for the two main shopping streets in Oude Westen. Members collectively invest in their surrounding environment (Ondernemen010, n.d.)	Represents all local business owners in these streets. Legal power is low, but unites many individual business owners who collectively have a significant voice.	Associations aim to increase attractiveness and accessibility of the shopping areas. The interest of the business owners is to attract customers and increase revenue.
BIZ eigenaren Nieuwe Binnenweg and BIZ Eigenaren West Kruiskade e.o. - Associations of commercial real estate owners in the main shopping streets of Oude Westen. Members collectively invest in the environment surrounding their properties (BIZ West-Kruiskade/ 1e Middellandstraat, n.d.).	Association represents all real estate owners in the corresponding streets. Legal power is low, but it unites many real estate investors who collectively have a stronger voice.	Associations aim to improve the surrounding environment. Real estate owners are mainly interested in their property's value and thus in the attractiveness of these commercial locations.

Stakeholder	Power	Interest
MKB Rotterdam Rijnmond - Interest group for small and medium-sized companies in Rotterdam and its surrounding region. Regional branch of national association.	No legal power, but represents over 800 members and reaches 15,000 businesses in the region (MKB Rotterdam, n.d.).	Representing interests for many businesses, not fully focused on this local policy.
Transport organisations		
RET - Public transport operator. In Oude Westen, RET operates four tram lines (W. Kruiskade & Nieuwe Binnenweg) and a bus line (Mathenesserlaan). On the area's borders, there is are RET metro lines in the south and more buslines in the north.	RET does not hold legal power in mobility policies, but they are involved in agreements and close contact with MRDH and the municipality which increases their potential influence.	RET would mainly be interested in the accessibility of specific streets for their vehicles (buses and trams) and in minimum delays due to congestion.
Felyx, Check, GoSharing, etc. - Shared micro-mobility operators operating in Rotterdam	No legal power in policy decision-making.	Interested in policies promoting the use of alternative modes of transport.
Mywheels & Greenwheels - Car-sharing companies operating in Rotterdam.	No legal power in policy planning. Can have some power in their importance for offering alternatives to private cars.	Interested in all policies that restrict private car usage, but allows for shared cars
Rotterdamse Fietsalliantie; Rotterdam op die fiets; Fietsersbond Rotterdam - Interest groups promoting cycling in Rotterdam.	No legal power in policy planning. Combined, these interest groups might have an influence on agenda-setting.	These groups are interested in promoting the use of the bike, and in policies facilitating this (increasing traffic safety and attractiveness of cycling routes).
PostNL, DHL, UPS, etc. - Logistics companies delivering in the area.	As major delivery companies, they might have some influence. However, they do not have any legal power.	These companies are interested in accessibility of areas to their vehicles and available loading spaces near major delivery locations.
Other organisations		
Woonstad Rotterdam - Housing association that owns over 50,000 (mostly social) housing units in Rotterdam. In Oude Westen, Woonstad owns over 2500 social housing units - roughly 60% of all dwellings in the neighbourhood (Dagblad010, 2021; Gemeente Rotterdam, n.d.-f)	As a major residential real estate owner in the area, and in the entire city, Woonstad has some influence. However, it does not have direct legal power in the planning of car-free policies.	Woonstad is a non-profit organisation interested in providing affordable housing in Rotterdam, improving the neighbourhoods, in a sustainable way (Woonstad Rotterdam, n.d.).
Schools - Three primary schools and one secondary school are located in Oude Westen.	No legal power in mobility policies. Might be capable of organising some opposition.	Interested in traffic safety around the schools. Possibly also in accessibility for certain modes.
Healthcare - Several GPs, medical centres, and dental care centres are located in Oude Westen.	No legal power in mobility policy planning.	No major interest in the policies, as long as accessibility remains sufficient for everyone.

E

Interview guides

This appendix contains the interview guides for the stakeholder interviews conducted in this thesis. The first section shows the interview guide used for the interview with a policy-making stakeholder. Section E.2 contains the interview guide for the interviews with stakeholders affected by the policies. The last section show the interview guide used in the validation interviews for chapter 7.

E.1. Interview guide policy-making stakeholder(s)

This interview guide is used for the interview with a policy-maker from the municipality of Rotterdam. The guide differs from the interview guide for stakeholders who are affected by the policies since the goal of these two interview types is different. The goal of this interview is to gather data about the municipality's plans for car-free policies in the Oude Westen neighbourhood and the municipality's policy planning process. Especially important is the topic of representation of stakeholder interests in policy evaluation.

The interview consists of 5 sections and follows the following structure:

1. The interview start with an informal introduction of the interviewer, interviewee, and the research project.
2. The second section of the interview contains some personal questions for the interviewee about their role in the municipality and their experience with the Oude Westen neighbourhood.
3. This section covers the ambition of the municipality regarding car-free policies in the city.
4. In the fourth section, the interview then focuses on the planning process of these car-free policies and on the ex-ante evaluation of policies.
5. The interview is ended with some space for the interviewee to give some final comments and, if applicable, recommendations of other people that might be relevant to interview.

Introduction

The interview starts with an introduction of the interviewer, interviewee, and the research project.

a. **Introduction of interviewer** - *Mention study programmes, the graduation phase, and the affiliation with TU Delft and TNO.*
b. **Introduction of research project** - *Briefly introduce the context of the project (relevance for society and thus the interviewee). Give the definition of car-free policies that is used in this thesis. Introduce the goal of the project and the focus of this first phase with interviews.*
c. **Ask for recording consent** - *Ask for consent to record the interview and to include a transcript of the interview in the final thesis that will be published publicly in the TU Delft repository. Mention that the transcript will be send to the interviewee to check before it is published in the thesis.*

Personal questions

This section of the interview aims to collect some data about the interviewee. This includes his/her relation to the area and to potential car-free policies in the area, his/her current travel behaviour, and his/her involvement in policy planning.

d. **Introduction of interviewee** - Can you briefly introduce yourself?

e. **Role in the policy-making** - Can you tell me about your role in the mobility policy-making within the city of Rotterdam?

f. **Affinity with Oude Westen** - What is or has been your involvement with the Oude Westen neighbourhood?

Car-free policy plans

This section of the interview goes into detail about the plans of the municipality to implement car-free policies.

g. **General car-free vision of municipality** - *Mention car-free ambitions in coalition agreement.*
Can you tell me about the municipal vision for car-free neighbourhoods in the long-term?
Ask for a time horizon for that vision.

h. **Concrete policy plans** - Given that long-term vision, what are more concrete policies that are being considered on neighbourhood level, for example at in the Oude Westen neighbourhood?

Policy planning process

This section aims to gather data about how the municipality plans their policies and how they perform ex-ante evaluation of policies.

i. **Mobility policy planning process** - Can you describe what the policy planning process looks like in the mobility department of the municipality of Rotterdam?

   Follow-up questions:

   i.1. To what extent are stakeholders involved or represented in this process?

   i.2. Who are these involved stakeholders?

   i.3. Are there stakeholders who are currently not involved or represented of which you think that they could be important to also involve or represent?

j. **Well-being in policy evaluation in Rotterdam** - *Mention the trend of well-being being used more often in policy evaluation*
How does the municipality of Rotterdam evaluate their planned policies before implementation?

   Follow-up questions:

   j.1. What type(s) of models are used in this evaluation?

   j.2. What indicators are often used in the ex-ante evaluation?

   j.3. How is decided upon which indicators to be considered?

Closing questions

In this final section of the interview, the interviewee gets the opportunity to give some final comments and share any ideas he/she has for the car-free policies, this research, or the interviews.

k. **Other important aspects for car-free policies** - Is there anything else that you want to share with me regarding for example the Oude Westen neighbourhood, car-free policies, or important considerations in these policies?

l. **Interview recommendations** - Do you have any recommendations for other people to interview who might give additional valuable insights in this research?
Do you have existing contacts with relevant stakeholders in Oude Westen?
Give a list of stakeholder types that are to be interviewed.

m. **Final remarks** - Do you have any final remarks regarding this research project?

n. **Final version of this thesis** - You will get a copy of the transcript of this interview for you to check before this thesis is published. Do you also want to receive the final thesis report after publication?

E.2. Interview guide affected stakeholders

This interview guide is used for the interviews with stakeholders that are affected by the car-free policies. The goal of this interview is to gather data about the interests of these stakeholders in car-free policies in their neighbourhood. All interviews with these affected stakeholders use this interview guide and thus follow the same general structure consisting of five sections:

1. Introduction of the interviewer and the research project.
2. Personal questions about the interviewee and his/her behaviour.
3. Introducing the topic of car-free policies and exploring the interviewee's initial interests in this.

4. Introducing the concept of well-being and probing the interviewee to think about his/her interests over the broad spectrum of well-being.
5. Final comments and, if applicable, recommendations of other people to interview.

Below, the full interview guide is worked out in detail. For some questions, there are specific versions for specific stakeholder types. These are indicated by a number following the letter of the question.

Introduction

The interview starts with an introduction of the interviewer and the research project.

a. **Introduction of interviewer and research project**
b. **Ask for recording consent** - *Ask for consent to record the interview and to include a summary of the interview in the final thesis that will be published publicly in the TU Delft repository.*

Personal questions

This section of the interview aims to collect some data about the interviewee.

c. **Introduction of interviewee** - Can you briefly introduce yourself?
d. **Stakeholder specific follow-up questions**
   d.1. **Residents** - How long have you been living here? What does your household look like? Do you have a driver license? Does your household own a car?
   d.2. **Local business** - What does your customer-base look like (e.g. in terms of age, social groups, or where they live)? How long do clients usually spend in your business?
e. **Travel behaviour**
   e.1. **Residents** - How do you usually travel through the Oude Westen area? Are there specific trips or trip purposes that require you to use a specific mode of transport?
   e.2. **Local business** - How do your customers usually travel to your shop? How do you usually get your goods delivered? Do you have a business vehicle that you depend on?

Stakeholder's interests in car-free policies

In this section, the interests of the stakeholder in car-free policies are investigated. Here, the broad spectrum of well-being is explicitly not mentioned yet to ensure the initial thoughts of the interviewee are captured and he/she is not steered into any direction.

f. **Introduction car-free policies** - More and more municipalities are looking at car-free or low-traffic neighbourhoods. The municipality of Rotterdam also has the aim of making Oude Westen more low-traffic. Concrete measures are not known yet, but one could think of measures such as removing on-street parking, making streets one-way streets, narrowing streets for cars, or even closing streets for cars.
g. **Stakeholder's initial interest in car-free policies** - When the municipality is thinking of implementing some sort of car-free policy in your neighbourhood Oude Westen, what are aspects that you find important for them to consider?

   Follow-up questions:
   g.1. Can you tell me what effects you hope that such a policy would have? When could you be convinced of supporting the policy?
   g.2. What kind of negative effect of such a policy might move you to oppose the policy?

Interests on well-being spectrum

In this section, the theory of well-being is introduced and the interviewee is shown the entire spectrum of well-being (indicators) that could be considered in policy evaluation when well-being is taken into account. Given this spectrum of potential interests, the interviewee is again asked about his/her interests in the car-free policies.

h. **Introduction of well-being spectrum** - Over the last years, governments have increased focus on well-being in policy-making. Where they first focused mainly on economic and material results, well-being is broader than that. Well-being considers the quality of life here and now, and the extent to which that impacts the quality of life later or elsewhere in the world.
   Mobility can have an impact on well-being. This is why four domains where defined in which mobility and transport have an impact on well-being. These are safety, accessibility, health and living environment. Within these domains, there are different aspects, which can be seen on the hand-out. For all these aspects, a municipality could use different measurement tools to measure the effects of their (proposed) policies.

i. **Stakeholder's response to the well-being spectrum** - Given that you can think about the broad spectrum of well-being that was just introduced, are there any other things you find important for the municipality to consider when making new policies for a car-free Oude Westen?

Follow-up questions:

i.1. **Stakeholder interests in different well-being domains** - *Ask for each domain:* Within this specific domain of well-being, what aspect(s) do you find most important? What do you think about when thinking of this aspect? How could a policy impact this according to you?

i.2. **Stakeholder's priority for well-being domains** - Which domain(s) of well-being do you think the municipality should consider to be the most important?

Closing questions

In this final section of the interview, the interviewee gets the opportunity to give some final comments and share any ideas he/she has for the car-free policies, this research, or the interviews.

j. **Starting point** - Can you rate the current situation in the Oude Westen neighbourhood on all four domains? Use the scale –/-/0/+/++ (from very unhappy to very happy).

k. **Final remarks** - Is there anything else that you want to share with me regarding this topic or this research?

l. **Interview recommendations** - Do you have any recommendations for other people to interview who might give additional valuable insights in this research?

m. **Final version of this thesis** - Do you want to receive the final thesis report after publication?

E.3. Expert validation interviews

This interview guide is used for the expert validation interviews described in chapter 7. The interviews consist of four parts: introduction, discussion about the indicator selection process, discussion about the operationalised indicators, and closing remarks. These interviews were also semi-structured, but less structured than the stakeholder interviews shown above. Also, the interviewees for the validation interviews were already known by the interviewer from earlier stakeholder interviews and they were already familiar with the concepts of car-free policies and well-being. Therefore, this interview guide is less elaborate than the interview guides above.

- **Introduction and recap of conducted research.**
  a. Brief introduction of the research
  b. Ask for consent for recording the interview
- **Indicator selection process**
  c. Presentation about the indicator selection process applied to the Oude Westen case.
  d. Validating the resulting ranking of importance of well-being aspects. Potential questions:
    d.1. Are these aspects of well-being the most relevant for the local stakeholders?
    d.2. Do these outcomes match your experience of important well-being aspects in the neighbourhood?
  e. Validating the indicator selection process. Potential questions:
    e.1. Do you think that this process in general lead to relevant outcomes?
    e.2. Do you think the indicator selection process investigates all the relevant aspects?
  f. Applicability of the indicator selection process. Potential questions:
    f.1. Is this selection process applicable in practice?
    f.2. For the evaluation of what kind of policies could this process be used?
    f.3. Do you have any other remarks regarding the applicability of this process?
- **Operationalised indicators**
  g. Presentation about the operationalised indicators for the Oude Westen case.
  h. Validating the operationalised indicators. Potential questions:
    h.1. Are these indeed relevant for the corresponding aspects of well-being?
    h.2. Are these indicators relevant to the stakeholders?
  i. Applicability of the operationalised indicators. Potential questions:
    i.1. Can these indicators provide relevant insights for the evaluation of car-free policies?
    i.2. Are these indicator specifications relevant for the policy evaluation?
    i.3. Would it be possible to represent the stakeholder interests through these indicators?
- **Closing remarks**
  j. Do you have any other remarks regarding the indicator selection process or the operationalised indicators?
  k. Do you have any other remarks regarding this research?

F

Transcripts of interviews

F.1. Interview policy-maker

This interview took place on 23-05-2023. It took around one hour. The transcript is based on the audio recording of the interview and was not validated with the interviewee afterwards.

Interviewer: *Wat is uw rol binnen de mobiliteitsafdeling van gemeente Rotterdam?*

PM: Wij houden ons bezig met het maken van lange termijn visie, maar ook met het doorvertalen daarvan naar de korte termijn. Mijn focus zit voornamelijk op inrichtingsvraagstukken of verdeelvraagstukken van de ruimte.

Interviewer: *Wat is uw affiniteit met autovrij of autoluw beleid? Ter verduidelijking: Ik gebruik 'autovrij beleid' als een overkoepelende term voor al het beleid van autoluw tot compleet autovrij. Natuurlijk wordt het nooit 100% autovrij, want je hebt altijd services als hulpdiensten die er nog langs moeten. Maar autovrij beleid is voor mij dus een overkoepelende term, ook voor autoluwe maatregelen.*

PM: Mijn passie ligt in stedelijke ontwikkeling en het inzetten van mobiliteit voor een veranderende stad. Het huidige college introduceerde nu de term "autoluw", en mijn taak is om dit beleid concreet vorm te geven. Rotterdam investeerde al langere tijd in aantrekkelijkheid van de stad, waarbij kwaliteit centraal staat. Echter ondanks deze langetermijnvisie blijft het een strijd om kwaliteit bij elk project te handhaven, zelfs bij kleine ingrepen zoals ruimteherverdeling tussen auto's, fietsers en voetgangers.

De mobiliteitstransitie is urgenter dan ooit, met thema's als gezondheid, klimaat en resiliency, waar Europese normen aan verbonden zijn. Het halen van deze normen is noodzakelijk, maar als stad willen we ook vooruitstrevend zijn. Dit roept de politieke vraag op: hoe snel willen we stappen zetten in deze transitie?

Interviewer: *In het coalitieakkoord staat dat het Oude Noorden, Nieuwe Westen, Middelland en het Oude Westen zijn bestemd als wijken die autoluwer moeten worden, en er wordt zelfs een fonds voor autoluwe maatregelen van 20 miljoen vrijgemaakt. Dat klinkt nog niet als een volledige visie van hoe dat dan moet worden. Is daar al een meer uitgewerkte visie van hoe bijvoorbeeld een wijk als het Oude Westen er erover [...] 30 jaar uit moet zien?*

PM: Voor komende zomer wordt onze aanpak publiek gemaakt. We zijn nu nog procesmatig aan het nadenken wat 'autoluwer' betekent en wanneer we tevreden zijn. In tegenstelling tot Amsterdam, waar de focus ligt op wijken autoluwer maken, hebben wij al lang keuzes gemaakt die minder ruimte voor auto's betekenen, hoewel dat autoluwe niet centraal staat. Onze doelen richten zich op verkeersveiligheid, doorstroming/bereikbaarheid, en ruimte maken voor groen, water en nieuwe bouwprojecten (ook bijvoorbeeld omgevingseffecten reduceren).

De uitdaging is nu om vast te stellen wanneer het autoluw genoeg is. We zoeken geschikte indicatoren om concrete plannen te beoordelen. Deze uitdagingen spelen niet alleen in de binnenstad, maar ook in heel Rotterdam. We zullen moeten werken met plangebieden, impactgebieden en studiegebieden om te kunnen bekijken hoe maatregelen buiten een specifiek gebied bijdragen aan de autoluwe visie.

Interviewer: *Hebben jullie al specifieke gedachten van wat nu eerste beleidsmaatregelen zouden kunnen zijn op wijkniveau, op lokaal niveau?*

PM: Ik spreek snel over mobiliteit, maar het draait niet alleen daarom. Bijvoorbeeld, het Hofplein-project richt zich op verblijven en bevat een verkeersaanpassing, terwijl het eigenlijk een groenproject is. Mobiliteitsprojecten hebben een bredere scope dan alleen mobiliteit en dragen bij aan een veranderende stad.

Echte systeemkeuzes zijn al gemaakt, zoals de koppeling tussen verdichting en OV in de omgevingsvisie 2040. Dit zijn hoog niveau keuzes die wel de mobiliteitsvraag in de stad bepalen.

Binnen mobiliteit zijn diverse benaderingen mogelijk, waarbij ik vaak onderscheid maak tussen fysiek sturen, sturen op mensen, dwingen, en verleiden. Voor snelle impact met een beperkt budget kiezen we vaak voor communicatie, nudging en zachtere maatregelen, zoals fietsstimulering en bevordering van wandelen.

In het kader van de autoluwe opgave zien we de behoefte aan meer sturende maatregelen. Zo werken we aan een nieuw circulatieplan en onderzoeken we de invoering van een maximumsnelheid van 30 km/uur in de hele stad. Een balans vinden tussen langetermijndoelen en geloofwaardige eerste stappen blijft een uitdaging.

Interviewer: *Hebben jullie bijvoorbeeld specifiek voor een wijk als Oude Westen al wel aan specifieke ingrepen gedacht die meer slaan op het sturen en minder op het verleiden?*

PM: Experimenten en interventies creëren vroegtijdig impact en stimuleren discussies met vakmensen en belanghebbenden door een mogelijke toekomstige wereld zichtbaar te maken. Voorbeelden zijn interventies op het Eendrachtsplein en Kruisplein, waar de gemeenteraad positief op reageerde en om verdere implementatie vroeg.

In het Oude Westen zie ik de buurt als een systeem met lange lijnen, zoals de Nieuwe Binnenweg, West-Kruiskade en Middelland. Urgentie voor ingrijpen is groot vanwege verkeersveiligheid, gevoelens van onveiligheid en economische aandachtspunten. Bewoners hebben behoefte aan verandering en hebben concrete maatregelen, zoals eenrichtingsverkeer, besproken in participatietrajecten. Het definiëren van wensen, zoals ”meer groen”, is cruciaal omdat deze beelden heel bepalend zijn.

Dit jaar moeten we een verkeerscirculatieplan opstellen, waar het Oude Westen deel van uitmaakt. Mobiliteit omvat technisch gezien wegontwerp, snelheid en verkeersintensiteit. Actie op alle drie fronten is nodig, hoewel sommigen denken dat het wegnemen van parkeerplaatsen genoeg is. Het bespreekbaar maken en consensus bereiken voor moeilijke keuzes is uitdagend, hoewel dit niet mijn verantwoordelijkheid is als ambtenaar, maar die van de stad.

Dit is waar brede welvaart belanrgijk is. Iedereen wil groener, mooier, veiliger en gezonder, maar concrete invulling is een andere discussie. Dit is vergelijkbaar met iedereen die ijsberen op smeltende ijsschotsen zielig vindt, maar...

Interviewer:*Maar als je dan geen vlees mag eten, dan is het ineens anders.*

PM: Ja, dat zie je sterk terug op straatniveau. De huidige coalitie wil echt stappen maken, maar het kunnen uitleggen en verantwoorden is ook erg belangrijk.

Interviewer: *Voor hun eigen achterban?*

PM: Ja, en ook voor zichzelf. Ze vallen dan gauw terug op de basis van mobiliteit: bereikbaarheid. Luchtkwaliteit, gezondheid en bewegingsvrijheid voor kinderen of ouderen blijken dan toch nog niet goed verankerd, ondanks inspanningen van 10/15 jaar om dit bespreekbaar te maken.

Interviewer: *Dus als het moeilijk wordt, zakt dat toch weer naar de achtergrond.*

PM: Ja, absoluut. Dit geldt binnen de stad en op landelijk niveau. Veel kaders zijn landelijk bepaald, zoals snelheidsregimes en ontwerprichtlijnen. Samenwerking met grote steden, overheden en belangenpartijen, zoals bijvoorbeeld ook de ANWB, is essentieel. Die waardebepaling en het bepalen van indicatoren moet je niet alleen doen, anders landt het niet.

Interviewer: *Om daar op in te haken ben ik nog wel benieuwd naar hoe dat proces van het maken van concreet beleid voor bijvoorbeeld het verkeerscirculatieplan dan loopt hier [bij de gemeente]. Als daar plannen voor worden afgewogen, wie zit er dan aan tafel qua betrokken stakeholders of andere partijen waarmee jullie in gesprek gaan?*

PM: Participatie varieert per maatregel en plan. Het is gebruikelijk bij omgevingsvisies en grote stedelijke beleidsplannen, vaak via wijkraden, belangenpartijen en overleg met grote stakeholders. Op lager niveau, zoals bij verkeerslichtaanpassingen, informeert men meestal achteraf omdat daar minder interesse in is. Het tussenliggende niveau, straatinrichting en verdeelvraagstukken, is waar men graag meepraat.

De uitdaging is dat projecten soms niet alleen lokale, maar ook stedelijke impact hebben. Naar wie luister je dan? Als ambtenaren moeten we mensen gehoord laten worden, en uiteindelijk maakt de politiek de afwegingen.

Vaak willen belanghebbenden niet alleen over voorgestelde oplossingen worden bevraagd, maar ook betrokken worden bij het bepalen van de uitdagingen en oplossingen. Echter blijven voorgestelde oplossingen dan vaak oppervlakkig, vooral in groepsprocessen waar men voorzichtig blijft, terwijl op systeemniveau keuzes moeten worden gemaakt. Belangrijke beslissingen zoals het afsluiten van wegen komen zelden concreet aan bod tijdens buurtparticipatie. Als ambtenaren hebben we de verantwoordelijkheid om dit onderwerp te bespreken in de gesprekken met belanghebbenden.

Interviewer: *In het mobiliteitsdomein zijn vier domeinen van brede welvaart gedefinieerd. Dat zijn bereikbaarheid, veiligheid, leefomgeving en gezondheid. Daarbinnen zijn dan weer allerlei aspecten gedefinieerd. Dit was echt om een opzetje te maken om tot indicatoren van brede welvaart te komen. Komt dit overzicht toevallig bekend voor?*

PM: Ja, herkenbaar inderdaad. Ik merk dat het nog niet gemeengoed is om dit erbij te pakken als je een project begint en dan per item te kijken: 'wat doen we wel of niet op dit vlak?'.

Interviewer: *Wordt er nu echt bij het maken van plannen op meer tactisch niveau, bijvoorbeeld dat verkeerscirculatieplan, dan ook al brede welvaart meegenomen?*

PM: De term "Brede welvaart" komt vaak niet voor in stedelijke plannen. Bij het vertalen van autoluw naar doelen proberen we de termen meer te laten vallen, maar het is vaak nog niet zo verdeeld over domeinen. We neigen snel naar bereikbaarheid en leefomgeving, terwijl gezondheidsaspecten als 'nice-to-have' worden beschouwd.

Elk project heeft een andere dynamiek. Bijvoorbeeld, de herstructurering van het tramnetwerk in Rotterdam vereist opheffing van lijnen om andere te versterken. Dit kan lastig zijn vanwege impact op specifieke gebieden zoals het Oude Westen. Eigenlijk zou je dan alle brede welvaart aspecten moeten overwegen voor de hele stad en alle schaalniveaus. De dynamiek van het tramverhaal verschilt sterk van andere projecten zoals straatherinrichting of gebiedsontwikkeling, daar zit frictie in.

Interviewer: *Ja want dan wordt dit nog niet zo toegepast, maar het is ook lastiger om toe te passen.*

PM: Ja

Interviewer: *En als je op elke lokale ingreep dit goed wil toepassen, dan zal je voor elke minimale ingreep moeten gaan kijken naar de impact op grote schaal, en dat is wellicht niet echt te doen?*

PM: Ja, de projectleider ziet me al aankomen, die heeft net een budget van 2 ton bij elkaar gesprokkeld en dan kom ik daar met een hele onderzoeksvraag.

Interviewer: *Dus nu ligt voornamelijk de focus in dit soort beleid nog op de bereikbaarheid en de leefomgeving?*

PM: Ja toch weer de drie aspecten zoals verkeersveiligheid, bereikbaarheid (met meerdere dimensies, zoals alternatieve routes en vervoerswijzen), en ooktoegankelijkheid voor bewoners en ondernemers.

In het Oude Westen hebben we ooit een 'Rotterdamse super block' verkend, zonder auto's en met stallingen aan de randen. Het onderzoek naar gezondheidsbaten was veelbelovend, maar het toekennen van gezondheidsbaten aan infrastructuur blijft een uitdaging in besluitvorming. Op rijksniveau gebeurde dit al wel eens bij de A2-ondertunneling in Maastricht, met positieve resultaten.

Interviewer: *Ik wil nu kijken naar waar vanuit de gemeente de prioriteiten liggen als je naar de cirkel [met brede welvaart aspecten] kijkt. Is dit misschien nog een lastige vraag omdat het niet helemaal is waar de prioriteiten nu liggen, maar waar ze idealiter zouden liggen?*

PM: Men richt zich al op specifieke gebieden om impact te maken, niet op de hele stad. Dit krijgt vorm door globale doelen als verkeersveiligheid en bereikbaarheid, maar de nuance zit in de indicatoren waarmee plannen worden getoetst. Eerder lag de focus op targets zoals een gemiddelde snelheid behalen van 25 km/uur, wat ten koste ging van andere aspecten. Gelukkig zijn deze targets verdwenen. De vraag naar nieuwe, gebiedsspecifieke indicatoren groeit, waardoor de schaal lijkt te verschuiven naar een meer gebiedsgerichte aanpak.

Interviewer: *Stel nou we kijken naar de wijk Oude Westen - of desnoods naar het hele blok Oude Westen, Middelland en Nieuwe Westen - dan staan die drie aspecten (verkeersveiligheid, bereikbaarheid en het ruimte maken voor de groei van de stad) ook wel grotendeels op de cirkel van brede welvaart. Bijvoorbeeld binnen bereikbaarheid, waar zou dan de focus van de gemeente liggen als je uit deze 3 aspecten zou moeten kiezen?*

PM: Op stedelijk niveau richten we ons op inclusie, met focus op toegankelijkheid en bereikbaarheid. Op Zuid zijn er minder alternatieven dan op Noord. Op buurtniveau gaat het om concrete zaken zoals parkeren voor de deur en bereikbaarheid per vrachtwagen, en dit scoort momenteel hoog bij het toetsen van plannen. Bij verkeersveiligheid wordt asociaal gedrag nu als grootste probleem ervaren, daar ligt ook onze focus. Handhaving is lastig, maar de politieke zet hier wel op in. Externe veiligheid focust op gevaarlijk vervoer, zoals spoorlijnen en autosnelwegen dwars door de stad. Discussies over elektrisch laden en benzinestations staan momenteel los van het autoluw verhaal.

Interviewer: *Als je bij de leefomgeving kijkt, dan zijn klimaat, milieuvervuiling, geluidsoverlast, dingen waar inderdaad meer normen voor zijn.*

PM: Trillingen zijn een zorg: bij snelheidsverlaging naar 30 km/uur moet overal drempels komen, wat verplicht trillingsonderzoek betekent. Dit is een hot item. Voor geluidsoverlast berekenden we dat heel Rotterdam naar 30

km/uur brengen 7000 minder ernstig gehinderden zou opleveren. Het vertalen van aangescherpte geluidsnormen naar besluitvorming is nog wel een grote stap. Voor klimaataspecten zijn er verder gewoon harde doelstellingen.

Interviewer: *Dan hebben we de bereikbaarheid van activiteiten waar veel focus op ligt, de sociale veiligheid waar nu veel focus op ligt, en bij de leefomgeving is dat dan voor alle aspecten eigenlijk?*

PM: Ja.

Interviewer: *Er liggen onder die bereikbaarheid nog wel verschillende indicatoren die mogelijk zijn. Is bijvoorbeeld een van deze twee indicatoren iets wat jullie dan gebruiken of zouden willen gebruiken?*

PM: We gebruiken modellen [met de indicator van bereikbaarheid van activiteiten] veel voor grote projecten, zoals een nieuwe brug of beleidsvisie. Voor kleine projecten is het minder effectief in het laten zien van tastbare resultaten, maar het helpt wel om zaken op de agenda te zetten, zoals bij het nationaal programma Rotterdam Zuid. Het is minder geschikt voor concrete plannen.

Modellen worden steeds meer uitgebreid met gebiedsspecifieke kenmerken, maar het aanpassen aan doelgroepen is arbeidsintensief en kennis ontbreekt soms. Opschalen van individuele ervaringen naar grotere gebieden is risicovol en generalisatie over een gebied op basis van één casus ligt op de loer. Dit tegengaan is een uitdaging, maar wel noodzakelijk.

Interviewer: *Ja, en dat zal bij meerdere van dit soort indicatoren voor de kleinere verkeersingrepen soms lastig te definiëren zijn.*

PM: Als je zo'n schaal gaat gebruiken voor projecten, en je wil dat gebiedsgericht doen, dan kom je misschien [meer verschillen tegen]. Zo zou je misschien de Tarwewijk en Oud-Charlois, die op het eerste gezicht erg op elkaar lijken, allebei een hele andere waarderingsindex geven. Met dat bewustwordingsproces bezig zijn en dat met elkaar bespreken, daar nemen we niet of onvoldoende de tijd voor.

Interviewer: *Dus dat zou je idealiter wel nog toe willen voegen?*

PM: Ja dat dat iets meer gemeengoed wordt in ons handelen. En dit is ook al jarenlang een gespreksonderwerp, dus dat heeft niks met onwil te maken, maar puur met de vraag: 'hoe dan?'

En we krijgen dat ook soms vanuit de politiek het verwijt dat we trends uit één gebied op de hele stad plakken, alsof in een nieuwe gebiedsontwikkeling dezelfde mensen gaan wonen als in de binnenstad of in Prins Alexander. Dus we moeten flinke stappen zetten in meer gebiedsgericht en doelgroepgericht verhalen opbouwen, en van daaruit ook vinden wat belangrijk is.

Interviewer: *Ja.*

PM: Heel interessant is ook dat je bijvoorbeeld voor Oude Westen iets hebt wat je top down belangrijk vindt voor een buurt, of voor bewoners, terwijl dit soms verschilt van wat mensen zelf zouden aangeven wat zij belangrijk vinden. En beide is waar.

Interviewer: *Heb je verder nog iets over of autovrij beleid, of brede welvaart, of mijn onderzoek, wat je nog kwijt zou willen?*

PM: Heel goed dat er iets gebeurt. Er zijn al meerdere studies in deze hoek gedaan, maar er is ook nog veel nodig. Het is voor ons waardevol, want Rotterdam is erop gebrand om binnen de komende 4 jaar al een verschil te maken. En dat gaat misschien wat ruwer of wat klassieker dan brede welvaart zou veronderstellen. Maar dan is het denk ik altijd goed om dan achteraf nog eens een keer terug te kijken: 'had het anders moeten gaan, of kan je toch lijnen doortrekken daarin?'

F.2. Residents interviews

The interviews with residents took place between 05-06-2023 and 14-06-2023 and they took on average 20 minutes. These transcripts were based on notes taken during the interviews and the audio recordings of the interviews. The transcripts were not validated by the interviewees afterwards.

Resident 1

Introductie

a. **Over de geïnterviewde**
   - Woont 40 jaar in Oude Westen, nu samen met zoon van 25
   - Heeft een rijbewijs, zoon ook.
   - Zoon heeft een auto, zelf niet ivm medische redenen.

b. **Reisgedrag**

- Reis voornamelijk met OV, laat zich soms rijden
- Grote boodschappen gebeuren met de auto, andere dingen zijn vaak op loopafstand of met het OV bereikbaar.

Autovrij beleid

c. **Wanneer de gemeente dit beleid aan het maken is, waar moeten ze dan volgens u op letten?**
   - Genoeg parkeerplaatsen voor bewoners. 's Avonds vaak geen parkeerplaats beschikbaar in eigen en omliggende straten.
   - Wachtlijst voor parkeergarages. Deze garages moeten ook aantrekkelijker. Garagevergunning betekent betalen als je eens op straat parkeert, dat zijn hoge tarieven.

d. **Wat voor effect hoopt u dat dit beleid heeft? Wanneer zou u hier voorstander van kunnen worden?**
   - Eerder waren parkeervakken weggehaald. Hier kwamen brede stoepen en geveltuinen voor terug. Meer groen is wel fijn en gezellig.

e. **Door wat voor negatieve effecten zou u tegen het beleid zijn?**
   - Het is tweestrijdig. Brede stoepen en tuinen zijn fijn en gezellig, maar er moet ook gedacht worden aan mensen met auto's.
   - Garages zijn ook goed, maar moeten wel betaalbaar zijn. Sommige mensen kunnen dat meer betalen dan anderen. Ook parkeren er veel mensen uit andere straten. Eigen straat moet voorrang krijgen en het combineren met garageparkeren moet soepeler.

Brede Welvaart in mobiliteit

f. **Als u nu dit hele spectrum van brede welvaart ziet, zijn er dan aspecten waarvan u vindt dat de gemeente dit ook moet meenemen?**
   - Alle aspecten zijn belangrijk. Zelf vind ik gezondheid belangrijk, want ik ben door medische redenen afhankelijk van het OV, en dat wordt soms geschrapt nu.

g. **Binnen de verschillende domeinen, welke aspecten vindt u dan het meest belangrijk?**
   - Leefomgeving:
     - Trillingen zijn belangrijk. Verzakking komt hier ook veel voor.
     - Milieuvervuiling is ook belangrijk met alle fijnstoffen.
     - Klimaat is ook belangrijk, daar moeten we ook verder mee.
   - Gezondheid: geluidsoverlast was er altijd al, dus daar ben ik aan gewend.
   - Bereikbaarheid is wel goed, al moet je wel een stukje lopen, maar daarmee blijf je juist in beweging. Op sommige routes is dat wel lastig. De toegankelijkheid is wel goed.

h. **Als u moet kiezen tussen deze vier domeinen, welke vindt u het meest belangrijk? Bij welke zou de prioriteit van de gemeente moeten liggen?**
   - Eigenlijk zijn alle vier belangrijk.
   - Veiligheid: ik voel me redelijk veilig al, behalve 's avonds laat alleen op stap.
   - Bereikbaarheid is ook belangrijk, want je wil niet afhankelijk zijn van anderen.
   - Gezondheid is misschien wel het belangrijkste want dat heb je nodig om de andere domeinen te ervaren.
   - Leefomgeving is ook belangrijk, want het is belangrijk dat je je fijn voelt in je omgeving.

Afsluitend

i. **Vertrekpunt - Kunt u aangeven hoe u de huidige situatie in het Oude Westen zou beoordelen voor deze vier domeinen?**
   - Veiligheid - Over het algemeen tevreden, wel vraagtekens bij sociale veiligheid, zeker nu de zomer nadert.
   - Bereikbaarheid - Redelijk tevreden, minder tramlijnen maken sommige activiteiten nu moeilijker te bereiken dan vroeger.
   - Gezondheid - Zorgelijk [ontevreden], laatste tijd veel verwarde mensen op straat die schelden en schreeuwen.
   - Leefomgeving - Kan beter met ruimte voor parkeren, wel genoeg ruimte voor groen en fietsen. [tevreden]

Resident 2

Introductie

a. **Over de geïnterviewde**
   - Woont al 25 jaar in het Oude Westen, volwassen zoon woont met haar.
   - Geen rijbewijs, ook geen auto.

b. **Reisgedrag**

- Voornamelijk het OV en lopen.

Autovrij beleid

c. **Wanneer de gemeente dit beleid aan het maken is, waar moeten ze dan volgens u op letten?**
   - Er worden al een aantal straten 's nachts afgesloten deze zomer. [Dit is deel van het zomer-offensief van de gemeente Rotterdam om aso-overlast tegen te gaan.]

d. **Wat voor effect hoopt u dat dit beleid heeft? Wanneer zou u hier voorstander van kunnen worden?**
   - Overlast verplaatst bij maatregelen. Als het hier afgesloten wordt, dan gaan ze wel naar de Nieuwe Binnenweg.
   - Zelf niet erge overlast, want woont niet bij die straten in de buurt.

e. **Door wat voor negatieve effecten zou u tegen het beleid zijn?**
   - Je moet wel overal kunnen komen met de auto, maar dat moet kunnen als je maar een aantal straten sluit.

Brede Welvaart in mobiliteit

f. **Als u nu dit hele spectrum van brede welvaart ziet, zijn er dan aspecten waarvan u vindt dat de gemeente dit ook moet meenemen?**
   - Sociale veiligheid: rond eigen woning valt het mee, maar meer richting centrum zijn veel junks en bedelaars. Dit wordt ook steeds erger.
   - Milieuvervuiling: veel afval op straat.
   - Bereikbaarheid: plannen om tramlijnen op te heffen zijn belachelijk.
   - Fysieke gezondheid: stress en veel overlast heeft impact op fysieke gezondheid.

g. **Binnen de verschillende domeinen, welke aspecten vindt u dan het meest belangrijk?**
   - [Zie bovenstaande]

h. **Als u moet kiezen tussen deze vier domeinen, welke vindt u het meest belangrijk? Bij welke zou de prioriteit van de gemeente moeten liggen?**
   - Veiligheid
   - Leefomgeving

Afsluitend

i. **Vertrekpunt - Kunt u aangeven hoe u de huidige situatie in het Oude Westen zou beoordelen voor deze vier domeinen?**
   - Oude Westen wordt nog steeds bestempeld als achterstandswijk.
   - Veiligheid - ontevreden
   - Bereikbaarheid - tevreden
   - Gezondheid - neutraal (veel stress werkt op de gezondheid)
   - Leefomgeving - tevreden op locatie, maar verderop in de wijk is het slechter.

Resident 3

Introductie

a. **Over de geïnterviewde**
   - Woont al 55 jaar in het Oude Westen, nu samen met vrouw.
   - Heeft een rijbewijs, heeft beschikking over een deelauto met buren (tweede auto van buurtbewoner die beschikbaar is voor buren). Auto is bijna altijd beschikbaar, nooit problemen mee.

b. **Reisgedrag**
   - Binnen de wijk lopen en fietsen, verder vooral OV. Buiten de stad zoveel mogelijk OV.
   - Voor specifieke trips kan de auto nodig zijn, bijvoorbeeld trips naar het tuincentrum of voor vakantie.

Autovrij beleid

c. **Wanneer de gemeente dit beleid aan het maken is, waar moeten ze dan volgens u op letten?**
   - Eenrichtingsverkeer is er al veel, maar wordt te weinig gehandhaafd (er wordt enorm veel tegen het verkeer in gereden). Als er niet gehandhaafd wordt, heeft het geen zin.
   - Bezoekers zijn bang om vijf meter te lopen, dus die parkeren vlak voor de winkel waar ze moeten zijn.
   - Er is een enorme garage onder het Kruisplein, maar niemand staat erin.

d. **Wat voor effect hoopt u dat dit beleid heeft? Wanneer zou u hier voorstander van kunnen worden?**
   - Mensen moeten in de garage parkeren en niet op de straat-parkeerplekken die amper te vinden zijn.
   - Veel straten hebben al parkeren slechts aan één kant, dat levert al fijne brede stoepen op.
   - Het effect is wel dat bewoners en bezoekers uren rondrijden om een parkeerplek te vinden.
   - Als bewoner betaal je een laag bedrag voor een parkeervergunning. Visite betaalt wel veel, maar misschien nog niet genoeg. Ze moeten het zo duur maken dat mensen vanzelf naar de garage rijden.

e. **Door wat voor negatieve effecten zou u tegen het beleid zijn?**
   - Zolang het niet leidt tot minder parkeerders van buiten het Oude Westen, heeft het geen zin. Het heeft alleen zin om maatregelen te nemen die echt werken.

Brede Welvaart in mobiliteit

f. **Als u nu dit hele spectrum van brede welvaart ziet, zijn er dan aspecten waarvan u vindt dat de gemeente dit ook moet meenemen?**
   - Leefomgeving is één van de belangrijkste aspecten.
   - Er was ooit het plan om de tunneltraverse ['s-Gravendijkwal/Henegouwenlaan] verdiept te maken en zo lokaal verkeer helemaal van doorgaand verkeer te scheiden. Dan zouden er veel minder mensen door het Oude Westen gaan ook.
   - De geplande snelle buslijn door de Maastunnel is gepland om over de secundaire weg [ventweg] te rijden [op de Henegouwenlaan]. Dit gaat een enorm probleem worden, want ze willen daar meer fietspad maken, maar ook een snelle bus erover. Bewoners hadden een alternatief voorgesteld in de gemeenteraad, maar worden niet gehoord hierover.

g. **Binnen de verschillende domeinen, welke aspecten vindt u dan het meest belangrijk?**
   - Leefomgeving - Geluidsoverlast en milieuvervuiling liggen dicht bij elkaar. Ik woon dicht bij de West-Kruiskade, als je dan hoort hoe idioot mensen door de straat rijden, dan heb je het over allebei.
   - Veiligheid - Verkeersveiligheid gaat over hetzelfde probleem van hardrijders.
   - Bereikbaarheid - Garage is leeg terwijl straten overvol zijn. OV bereikbaarheid is goed.
   - Gezondheid - Persoonlijk voel ik me goed.

h. **Als u moet kiezen tussen deze vier domeinen, welke vindt u het meest belangrijk? Bij welke zou de prioriteit van de gemeente moeten liggen?**
   - In het Oude Westen zijn veel ouderen, die zijn misschien niet zo goed ter been en dan is de mentale gezondheid belangrijk.
   - Dit zie je terug in afstanden die mensen moeten afleggen naar OV en dergelijken. Voorzieningen zijn vaak dichtbij en goed bereikbaar hier, maar in sommige straten is nog steeds aan twee kanten auto-parkeren. Hierdoor zijn de stoepen nog smal, wat lastig is voor mensen die lopen met een hulpmiddel. Dit komt ook terug als er op straathoeken geparkeerd wordt waardoor mensen met een rolstoel er niet meer langs kunnen.
   - Leefomgeving is belangrijk voor mezelf, ik ervaar dat er dingen gebeuren die niet normaal zijn [bijv:idioot rijden].
   - Bereikbaarheid - Alles in het Oude Westen is dichtbij, dus bereikbaarheid is goed.
   - Veiligheid - sociale veiligheid op straat is niet hoog genoeg om in te grijpen als je iets ziet gebeuren. Dit deed ik vroeger wel, maar nu lig je voor je het weet op de grond.

Afsluitend

i. **Vertrekpunt - Kunt u aangeven hoe u de huidige situatie in het Oude Westen zou beoordelen voor deze vier domeinen?**
   - [Op te maken uit bovenstaande antwoorden:]
   - [Veiligheid - ontevreden]
   - [Bereikbaarheid - tevreden]
   - [Gezondheid - tevreden]
   - [Leefomgeving - ontevreden]

Resident 4

Introductie

a. **Over de geïnterviewde**
   - Woont sinds een half jaar in het Oude Westen, samen met twee huisgenoten. Heeft hiervoor elders in Rotterdam gewoond.
   - Heeft geen rijbewijs. Huisgenoten hebben wel een rijbewijs, maar geen auto.

b. **Reisgedrag**
   - Reist normaal met de fiets of met een skateboard. Met gratis studenten-OV werd wel meer de combinatie skateboard en OV gebruikt. Nu vaker de fiets ivm hoge kosten OV.
   - Werk is vlak naast huis, wel wekelijkse trip naar Kralingse plas. Dit gebeurt met de fiets ivm slechte OV verbinding.

Autovrij beleid

c. **Wanneer de gemeente dit beleid aan het maken is, waar moeten ze dan volgens u op letten?**
   - Maatregelen om autoverkeer op de West-Kruiskade te ontmoedigen kunnen erg helpen. Hier rijden veel mensen door de straat voor het rijden en sich, de West-Kruiskade is een soort paradestraat. Soms staan er hele rijen auto's in een file die de hele tijd toeteren.
   - Helemaal weghalen van autoverkeer lijkt wel lastig want het is een belangrijke verkeersader in de stad.

d. **Wat voor effect hoopt u dat dit beleid heeft? Wanneer zou u hier voorstander van kunnen worden?**
   - Minder overlast door inperken van autoverkeer.

- Minder parkeervakken zal wel lastig zijn voor de ondernemers ivm ruimte voor laden/lossen. Wellicht moeten zij dan persoonlijke parkeervakken krijgen.
- Er is weinig ruimte voor fietsers op de West-Kruiskade. De ruimte tussen geparkeerde en rijdende auto's is soms heel klein.
- Ook qua sociale veiligheid is er veel overlast door ongewenst aanspreken van vrouwen vanuit auto's.

e. **Door wat voor negatieve effecten zou u tegen het beleid zijn?**
   - Ik moet me dan verplaatsen in een autobezitter, want ik heb zelf niet de ambitie om een auto te kopen. Mijn vader heeft bijvoorbeeld een bedrijfsbusje die binnenkort niet meer overal in de stad mag komen. Als ondernemer heb je soms je auto echt nodig, terwijl je recreationeel makkelijk een ander vervoersmiddel kan pakken. Je klusspullen neem je niet zo makkelijk mee in de metro.

Brede Welvaart in mobiliteit

f. **Als u nu dit hele spectrum van brede welvaart ziet, zijn er dan aspecten waarvan u vindt dat de gemeente dit ook moet meenemen?**
   - Esthetiek van straten kan ook meegenomen worden in mobiliteit. Een groenere en mooiere straat nodigt uit om meer tijd te nemen om erheen te gaan en minder alleen door te racen. Er is dan meer ruimtelijke beleving.
   - Sociale veiligheid is belangrijk.
   - Mentale gezondheid heeft onbewust veel effect. Zelf niet veel last van geluid behalve bij grote overlast soms. Wel valt de stilte erg op als je eens op een echt stille plek bent.

g. **Binnen de verschillende domeinen, welke aspecten vindt u dan het meest belangrijk?**
   - Gezondheid - zowel mentaal en fysiek is belangrijk. Vaak zie je jonge kinderen op elektrische fietsen/scooters, terwijl het juist ook belangrijk is om te bewegen.
   - Dit is ook een deel veiligheid want jonge kinderen op snelle elektrische vervoersmiddelen is gevaarlijk.
   - Leefomgeving - alle aspecten zijn wel belangrijk. Vooral klimaat, milieuvervuiling en ruimtegebruik.
   - Veiligheid - specifiek sociale veiligheid is hier belangrijk.
   - Bereikbaarheid - Bereikbaarheid van activiteiten is belangrijk. Denk aan transferiumpunten waar je op verschillende vervoerswijzen kan overstappen.

h. **Als u moet kiezen tussen deze vier domeinen, welke vindt u het meest belangrijk? Bij welke zou de prioriteit van de gemeente moeten liggen?**
   - Leefomgeving, vooral klimaat en milieuvervuiling.

Afsluitend

i. **Vertrekpunt - Kunt u aangeven hoe u de huidige situatie in het Oude Westen zou beoordelen voor deze vier domeinen?**
   - Bereikbaarheid - zeer tevreden
   - Gezondheid - neutraal
   - Leefomgeving - ontevreden
   - Veiligheid - ontevreden

Resident 5

Introductie

a. **Over de geïnterviewde**
   - Woont samen met vriend en twee dochters van 8 en 13, op de basisschool en de middelbare school.
   - Beide volwassenen hebben een rijbewijs. Hebben twee auto's, één parkeervergunning voor in de straat.

b. **Reisgedrag**
   - Reist meestal met de auto, naar de snelweg naar werk.
   - Ook boodschappen doen met de auto, want houdt niet van sjouwen.
   - Soms niet met de auto naar het winkelcentrum, ook al geldt daar ook de vergunning (dus gratis parkeren), uit angst dat dan de parkeerplek in de eigen straat kwijt is.

Autovrij beleid

c. **Wanneer de gemeente dit beleid aan het maken is, waar moeten ze dan volgens u op letten?**
   - Minder parkeren zou ik niet zeggen, er staan al genoeg mensen op de stoep. Er zijn ook veel paaltjes op hele brede en lege stoepen om wildparkeren tegen te gaan.
   - Er moet onderzoek gedaan worden of mensen hun auto nodig hebben voor werk. Dan alleen een parkeervergunning geven als de auto nodig is voor werk, maar niet voor onnodige (tweede) auto's. Er zijn genoeg auto's in de straat die maar 1 of 2 keer per week gebruikt worden.

d. **Wat voor effect hoopt u dat dit beleid heeft? Wanneer zou u hier voorstander van kunnen worden?**
   - Meer ruimte voor groen is wel belangrijk. Er zijn teveel auto's in de straat en te weinig groen.

- Het is ook goed om meer te controleren op eenrichtingsverkeer. Er gaan er genoeg tegen de richting in, en mijn kinderen lopen dan naar school en kijken alleen naar waar auto's vandaan horen te komen.
- Zelfs als er kentekens worden doorgegeven van auto's die vaak tegen verkeer in rijden, wordt er niks mee gedaan.

e. **Door wat voor negatieve effecten zou u tegen het beleid zijn?**
   - Bij minder parkeerplaatsen moet je lang zoeken na een lange werkdag. Soms is er dan in alle straten hier geen parkeerplaats te vinden.
   - Zou elke bewoner misschien een vaste parkeerplaats kunnen krijgen na werktijd? Ik zou best een paar tientjes in de maand willen betalen voor een vaste plek in de straat voor mijn deur.

Brede Welvaart in mobiliteit

f. **Als u nu dit hele spectrum van brede welvaart ziet, zijn er dan aspecten waarvan u vindt dat de gemeente dit ook moet meenemen?**
   - De motor van auto's moet wel uit als ze stilstaan. Bij mij voor de deur was een kinderopvang waarvan het busje een half uur met draaiende motor stilstond. In mijn woonkamer rook je dan de vieze motor.
   - Meer groen is goed voor de fysieke gezondheid. Overal in de wijk een beetje, alle kleine beetjes helpen al.
   - Van trillingen heb ik geen last, wel rijdt de vuilniswagen soms tegen het verkeer in.
   - Bereikbaarheid - toegankelijkheid is allemaal redelijk goed.

g. **Binnen de verschillende domeinen, welke aspecten vindt u dan het meest belangrijk?**
   - Leefomgeving - ruimtegebruik - ruimte moet optimaal gebruikt worden. Er zijn parkeergarages maar die zijn duur, en er is niet eens toezicht. Deze worden niet optimaal gebruikt, want mensen parkeren dan liever op straat ivm kosten en meer toezicht.
   - Sociale veiligheid - ik heb twee kinderen, maar het eenrichtingsverkeer wordt niet altijd nageleefd en er zijn geen drempels. Kinderen lopen alleen naar school, dat moet wel veilig kunnen zonder dat iemand de bocht om komt scheuren. Het is ook vaak één type die dit doet.
   - Toegankelijkheid - voor mensen met bijvoorbeeld een rolstoel is het niet toegankelijk als er op de stoep geparkeerd wordt.
   - Voor fysieke gezondheid ben je zelf verantwoordelijk. Mentaal draai ik wel door als ik zo lang moet zoeken naar een parkeerplek.

h. **Als u moet kiezen tussen deze vier domeinen, welke vindt u het meest belangrijk? Bij welke zou de prioriteit van de gemeente moeten liggen?**
   - Veiligheid en ruimtegebruik.
   - In het verkeer kan je niet gezondheid mengen, dat staat los daarvan. Je moet accepteren dat gezondheid niet lukt als je verkeer wil.
   - Leefomgeving - je moet niet alleen maar auto's zien als je naar buiten kijkt.

Afsluitend

i. **Vertrekpunt - Kunt u aangeven hoe u de huidige situatie in het Oude Westen zou beoordelen voor deze vier domeinen?**
   - [Op te maken uit bovenstaande]

F.3. Local neighbourhood council members

The interviews with residents took on average 50 minutes. These transcripts were based on notes taken during the interviews and the audio recordings of the interviews. The transcripts were not validated by the interviewees afterwards.

Resident and neighbourhood council member 1

Introductie

a. **Over de geïnterviewde**
   - Wijkraadslid in Dijkzicht-Oude Westen.
   - Woont nu twee jaar in Oude Westen, samen met partner.
   - Als wijkraadslid gekozen op persoonlijke titel, niet namens politieke partij. Zit dus ook niet vast aan partijprogramma of coalitieakkoord.
   - Wijkraad is de oren en ogen van de gemeenteraad. Weinig directe politieke macht, maar wel lobby mogelijk bij gemeenteraad. Plannen en participatie trajecten hoeven niet verplicht eerst langs wijkraad, maar wijkraad wordt vaak pas tegelijk met bewoners ingelicht over participatie.

b. **Reisgedrag**
   - Heeft geen rijbewijs. Partner wel, maar geen eigen auto.
   - Reist voornamelijk te voet in de wijk, of anders met het OV door de stad.
   - Visite komt meestal ook met OV of parkeert op de P+R buiten de stad.

Autovrij beleid

c. **Wanneer de gemeente dit beleid aan het maken is, waar moeten ze dan volgens u op letten?**
   - Vanuit de wijkraad hoor je soms dat er beleidsontwikkeling gaande is die impact kan hebben op je wijk. Je moet dan gaan kijken hoe het impact heeft en of het gewenst is.

d. **Wat voor effect hoopt u dat dit beleid heeft? Wanneer zou u hier voorstander van kunnen worden?**
   - Dit is afhankelijk van de bewoners. Algemeen gezien is de luchtkwaliteit hier slecht, en auto's hebben daar een belangrijke rol in.
   - De wijk is onveilig op het gebied van verkeersveiligheid. Meerdere black spots, en meerdere wegen met dubbele functies - auto, tram en fiets bij elkaar - wat negatief is voor de verkeersveiligheid.
   - Een tekort aan parkeerplaatsen.
   - Veel auto's gebruiken de wijk als afsnijdroute.
   - Veel soorten overlast: jongeren parkeren op straat met harde muziek en een joint; veel auto-inbraken; mensen hebben een onveilig gevoel door vele brommers en scooters op straat.
   - Verder veel persoonlijke voorkeuren van mensen. Sommigen zeggen: 'weg met de auto, niet door onze wijk rijden', en willen vergroening en brede stoepen. Anderen willen voor de deur parkeren en willen wel vergroening en brede stoepen, maar niet voor hun deur.
   - Ook bij de discussie over de toekomst van de tram (tram weg van Nieuwe Binnenweg en versterkt op West-Kruiskade) hadden sommigen geen principieel bezwaar zolang er maar iets van OV is in de wijk. Anderen waren vaak tegen omdat ze deze specifieke tram vaak gebruikten.
   - Het is belangrijk om uit te zoeken waarom mensen tegen zijn. Dan vindt je de onderliggende redenen en problemen die misschien ook aangepakt moeten worden. Dit kost wel veel tijd en energie. Op een participatie avond zijn het vaak de sterke meningen die je hoort, maar een grote groep komt niet opdagen.

e. **Door wat voor negatieve effecten zou u tegen het beleid zijn?**
   - Het nuanceren van meningen is belangrijk, dan worden vaak de onderliggende problemen gevonden. Willen mensen niet veranderen, of kunnen ze dat niet (door bijvoorbeeld een wachtlijst voor de parkeergarage)?
   - Bezoek moet nog steeds kunnen komen, maar bij mij gebeurt dat met de fiets of met het OV.
   - De combinatie P+R en tram is vaak goedkoper dan hier parkeren, alleen vergt dit een extra stap. Bezoek komt vaak bewust op de fiets in plaats van met de auto, omdat dit gewoon sneller is.
   - Met grote gezinnen is de metro vanaf de P+R misschien toch wel duur, is er dan een financiële barrière? Is het onpraktisch? Moet je omrijden? Iedereen heeft zo zijn persoonlijke redenen. Soms is dit het gemak van een optie, en soms zelfs al het [al dan niet terechte] gevoel van gemak.
   - Mensen klagen vaak eerst [na invoering van maatregelen], maar vinden na een tijdje de groene straat [die ze ervoor terug kregen] toch wel erg mooi. Anderen blijven boos.
   - Mensen weten de parkeergarages vaak niet te vinden terwijl die vaak goedkoper zijn.
   - We moeten anders naar autobezit kijken, zeker met de vele korte ritjes in Rotterdam, is de auto dan wel noodzakelijk?

f. **Hoe ligt dit in de wijk (bij bewoners en ondernemers) in het algemeen?**
   - Grofweg zijn de meesten onder de 40 voorstander van minder auto's. Daarboven wil men vaak de auto voor de deur hebben staan. Het is vaak de gewoonte dat de auto altijd beschikbaar is, terwijl de jongere generatie vaak als student en dus als fiets- en OV-gebruiker in Rotterdam is gesetteld (en wellicht soms een deel- of leenauto gebruikt).
   - Binnen de ondernemers is een groep die verwacht dat mensen niet meer komen als ze met het OV moeten komen. Een andere groep denkt juist dat de verwachte toename in voetverkeer met een auto-luwe straat goed is voor de zaken. (Dit is ook in bijvoorbeeld het autoluwe centrum van Gent gezien.)
   - Er is geen hard standpunt in te nemen namens het collectief door de aanwezigheid van veel voor- en tegenstanders.

Brede Welvaart in mobiliteit

g. **Als u nu dit hele spectrum van brede welvaart ziet, zijn er dan aspecten waarvan u vindt dat de gemeente dit ook moet meenemen?**
   - Bereikbaarheid is al goed met het OV en het feit dat je alles kan lopen in deze kleine wijk. Bereikbaarheid ligt dus aan je gewoontes.
   - Gezondheid - Rotterdam heeft een lagere levensverwachting dan andere delen van NL, ten dele door slechte luchtkwaliteit en deels door weinig bewegen. Dit zou pleiten voor het weghalen van de auto, maar dat kan ook slecht werken voor mensen die afhankelijk zijn van een auto (bijvoorbeeld ivm slecht ter been zijn).
   - Je moet echt voor alles kijken op wie dit impact heeft.
   - Persoonlijk zou ik bij het zien van deze cirkel [van brede welvaart aspecten] voor autoluw zijn:
     - De toegankelijkheid is al goed.

  - Op verschillende vormen van veiligheid scoort het Oude Westen laag (verkeersveiligheid en veilig voelen op straat).
  - Leefomgeving - milieuvervuiling en geluidsoverlast is er zeker door auto's.
  - Tekort aan fietsnietjes, en daarvan passen er veel op een autoparkeerplaats.
- Het ligt eraan hoe de lokale overheid verder wil met dit beleid. Vaak is zij gevoelig voor wat het hardst geroepen wordt, zo komt bereikbaarheid vaak hoger op de ladder dan de andere domeinen.

h. **Binnen de verschillende domeinen, welke aspecten vindt u dan het meest belangrijk?**
- Dit is lastig, we moeten dan de meningen van de bewoners vinden. Milieuvervuiling hebben we wel harde cijfers over, maar we moeten juist kijken naar wat bewoners willen.
- Generaliserend, ongeacht de positie tegenover autoluw speelt er wel het volgende:
  - De meeste zorgen zijn over verkeersveiligheid, zowel bij voor- als tegenstanders van autoluw.
  - Ook zorgen over vervuiling, geluidsoverlast en trillingen door vrachtwagens worden gedeeld door beide kampen.
  - Leefomgeving en veiligheid zijn vaak ook wel belangrijk voor tegenstanders van autoluw, maar dan niet in de eigen straat.
  - Mensen die voor autoluw zijn, kijken vaak breder. Er is dus een verschil tussen het wijkbrede niveau en persoonlijke ervaringen.
  - De wijk staat wat betreft gezondheid ook op allerlei lijstjes van wijken die gezonder kunnen worden. Heeft ook te maken met levensstijlen, maar het is ook een welvaartskwestie: mensen kunnen zich soms ook geen sport veroorloven. Initiatieven voor gesubsidieerde yoga bijvoorbeeld worden ook wisselend bezocht.
  - Ook onder de yuppen zijn er twee kampen, sommigen laten alles bezorgen en komen hun huis niet eens uit. Dit levert ook weer overlast op door alle bezorgers, terwijl er veel opties ook op loopafstand liggen. Onder deze groep zijn ook mensen die de auto niet nodig vinden, maar wel alles thuis laat bezorgen, dan is de vraag of dit niet juist nog meer impact heeft dan een eigen auto.

i. **Als u moet kiezen tussen deze vier domeinen, welke vindt u het meest belangrijk? Bij welke zou de prioriteit van de gemeente moeten liggen?**
- Veiligheid. Hierbij kan met voor- en tegenstanders ook een objectieve/neutrale discussie ontstaan omdat dan de gelegenheidsargumenten en persoonlijke argumenten weg worden gehaald.

Betrokkenheid van de wijk

j. **Hoe zou de wijk volgens u het beste betrokken kunnen worden in de evaluatie van dit beleid?**
- Dit heeft te maken met hoe je als overheid naar participatie kijkt. Participatie moet nu vaak verplicht plaatsvinden voor bepaalde plannen. Vaak komen er dan late uitnodiging voor participatie-avonden met starre plannen waar geen ruimte is voor input van bewoners.
- Het kan wel beter - marktplein in Delfshaven - daar is in een lang traject echt met bewoners en architecten op straat gelopen. Hier is heel veel met mensen gepuzzeld en is er uiteindelijk meer gerealiseerd dan mogelijk werd geacht.
- Je moet duidelijk en eerlijk zijn in participatie over wat je aan het doen bent. Liever participeren in de inrichting van de plannen, niet alleen achteraf voor de vorm participeren op de details. Ook bij een PWE gebeurt dit, daar heeft participatie echt impact op het plan en wordt gekeken naar wat mensen collectief van waarde vinden.
- Soms is het antwoord ook dat er zo erg contrasterende meningen zijn, dat er niet een meerderheid voor een plan gevonden kan worden. Dan worden meningen en de argumenten opgehaald, en is het aan de raad om de afweging te maken. Zij wegen ook meer stadsbrede belangen mee.

Afsluitend

k. **Vertrekpunt - Kunt u aangeven hoe u de huidige situatie in het Oude Westen zou beoordelen voor deze vier domeinen?**
- Bereikbaarheid - zeer goed, alleen toegankelijkheid is wel minder (geen geleide lijnen, geen veilige oversteekplekken). Maar er zijn verder weinig plekken in NL zo bereikbaar als het Oude Westen.
- Veiligheid is onvoldoende. Verkeersveiligheid en sociale veiligheid is niet goed. Overlast van middelengebruikers, dak- en thuislozen en verwarde mensen. Veel jonge kinderen met scherpe voorwerpen op straat. Objectieve cijfers zeggen ook niet alles, omdat meldingsbereidheid laag is. Subjectieve cijfers zijn belangrijker. Uiteraard woon je wel midden in de stad, maar zelfs voor die verwachting gaat het achteruit.
- Leefomgeving - ruimtegebruik, geluidsoverlast is voor velen wel aanwezig. Deels komt dit door het in het centrum liggen, deels door auto's, feestjes, festivals. Bijvoorbeeld bij de bierfiets kan dat leuk zijn voor bezoekers, maar bewoners komen er slecht van af zo. Leefomgeving kan beter, maar je krijgt het nooit stil zo centraal in de stad, en er is altijd een ruimtevraagstuk - dus neutraal. Het delen van de kleine beschikbare ruimte moet misschien stadsbreed worden aangepakt, maar nu wordt het onder het mom van de woon-crisis vooral volgebouwd.
- Gezondheid - lastiger om een inschatting te maken. Alle monitoring geeft wel aan dat de wijk echt beter kan. De wijk krijgt dan een zesje, niet enorm slecht, maar zeker ruimte voor verbetering.

Resident and neighbourhood council member 2

Introductie

a. **Over de geïnterviewde**
   - Wijkraadslid in Dijkzicht-Oude Westen, hiernaast ook ondernemer.
   - Woont samen met partner in Oude Westen.
   - Als wijkraadslid ben je volksvertegenwoordiger en je bent er voor de bewoners, en een beetje voor de ondernemers. Je hebt geen programma van een politieke partij, maar bewoners maken de agenda.

b. **Reisgedrag**
   - Zowel de geïnterviewde als de partner hebben een rijbewijs, en ze hebben één auto.
   - Reist voornamelijk lopend en met de fiets in de wijk. Buiten de wijk zoveel mogelijk fiets en OV. Soms voor bereikbaarheid of vervoer van spullen wel met de auto.
   - Boodschappen soms met de auto (als gekozen wordt voor niet bezorgen). De auto heeft een jaar in het buitenland gestaan, ook dan red je je prima met o.a. het bezorgen van boodschappen of een leenauto.

Autovrij beleid

c. **Wanneer de gemeente dit beleid aan het maken is, waar moeten ze dan volgens u op letten?**
   - Meningen van zowel bewoners als ondernemers zijn gemengd. De ene ondernemer zal de zaak sluiten, de ander vindt het juist mooi. Wel zijn er zorgen over bevoorrading.
   - Als je bezwaren en voorkeuren vergelijkt met de situatie nu, dan moet er in ieder geval iets gebeuren. Er wordt veel dubbel geparkeerd (door auto's en vrachtwagens), wat erg irritant en link is voor fietsers.
   - Ook liggen er kansen om met autoluw het park bij de Coolhaven te verbinden met het Euromast park en zo een mooier gebied te creëren.

d. **Wat voor effect hoopt u dat dit beleid heeft? Wanneer zou u hier voorstander van kunnen worden?**
   - Deze straten [rondom Nieuwe Binnenweg/Mathenesserlaan] zijn net heringericht. Autoluw was toen ook onderwerp van gesprek. Toen was een kleine meerderheid voor het behoud van alle parkeerplaatsen. Ik heb toen voorgesteld om inrichting op maat te doen, dus op sommige plekken wel parkeren, en op sommige plekken niet, aan de hand van voorkeuren van bewoners. Sommige bewoners zouden dan (bijvoorbeeld door slecht er been zijn) nog steeds de auto voor de deur willen, terwijl anderen het niet erg vinden om een stukje te lopen naar de parkeergarage. Dan kan je al de helft van de parkeerplaatsen weghalen.
   - Dit zou dan drukte weghalen uit de wijk en geeft dan meer ruimte voor groen en voor buitenspelen.

e. **Door wat voor negatieve effecten zou u tegen het beleid zijn?**
   - Bij herinrichting vielen de grote hoeveelheden invalidenparkeerplaatsen op. Het zou erg zijn als mensen door nieuw beleid minder mobiel worden.

f. **Hoe ligt dit in de wijk (bij bewoners en ondernemers) in het algemeen?**
   - Bijna de helft van de bewoners wil minder auto's (rond de Nieuwe Binnenweg).
   - In het oude Oude Westen zijn parkeergarages maar daar staan weinig auto's in. Ik weet niet zo waarom mensen auto's voor de deur willen. De parkeergarages worden wel al jaren als onveilig ervaren voor personen en voor auto's.
   - Hoe meet je bezetting van een parkeergarage? Er moet ruimte zijn voor het aantal aangevraagde plaatsen, maar toch is er veel leegstand. Is dit de verkeerde rekeneenheid dan?

Brede Welvaart in mobiliteit

g. **Als u nu dit hele spectrum van brede welvaart ziet, zijn er dan aspecten waarvan u vindt dat de gemeente dit ook moet meenemen?**
   - Veiligheid is het lastigste, hier zit een objectieve en subjectieve norm in.
   - Verkeersveiligheid - een straat wordt veiliger als je er minder vervoerswijzen op zet.
   - Sociale veiligheid - sommige mensen zijn bang in het donker en willen dus geen grote afstand tussen hun auto en voordeur.
   - Externe veiligheid geldt vooral bij bevoorraden met vrachtwagens. Soms ook een bijzondere mix van functies, zoals een opslag van een meubelwinkel midden in de woonwijk.
   - Daarnaast is er nog het asogedrag op de weg, dit valt deels onder verkeersveiligheid, deels onder sociale veiligheid, of onder mentale gezondheid en geluidsoverlast. Sommige mensen liëren hun mannelijkheid aan het volume van hun auto's, dat is onhandig en irritant, en het helpt niet.

h. **Binnen de verschillende domeinen, welke aspecten vindt u dan het meest belangrijk?**
   - Bereikbaarheid geldt alleen voor mensen die slecht ter been zijn als auto's verder weg staan. Verder is bereikbaarheid goed, alles is dichtbij OV lijnen. Als die weggehaald worden, tegelijk met het invoeren van autoluw, dan verandert er wel veel tegelijk. Heel veel activiteiten spelen zich ook wel af in het centrum. [Toegankelijkheid voor iedereen is dus het belangrijkste om in de gaten te houden.]
   - Gezondheid - je wordt blijer van het kijken naar groen dan naar auto's, maar of dat ook echt met onderzoek is aangetoond weet ik niet. Ik vind het wel mooier.

- Als je te vroeg een winkelstraat autoluw maakt, dan kan je weleens een rare leegte krijgen. Bijvoorbeeld als West-Kruiskade ineens autoluw is, daar is zo'n gewoonte om met de auto te komen, hoe krijg je dan nog de klanten op de West-Kruiskade? Ondernemers (zoals de grote Chinese supermarkt) hebben klanten in heel Nederland, die zeggen dat klanten niet meer komen als ze niet met de auto mogen komen. Dit kan waar of niet waar zijn, of het is eerst gewoon wennen. Als je zomaar auto's overal weghaalt krijg je misschien een saaie boel. [Dit pleit voor een meer gefaseerde aanpak] en alleen gezellige auto's.
- Ruimtegebruik is binnen leefomgeving heel belangrijk - je moet keuzes maken. Bijvoorbeeld een oude discussie over het aantal fietsnietjes/-stallingen in de straat. Ontwerper wilde niet meer fietsnietjes voor esthetische reden, maar er waren veel meer fietsen. Tekenaar had geen goed antwoord op het bezwaar hierover van bewoners.
- Met metingen op mijn dak zag je wel verbetering in de luchtkwaliteit met nieuwe verkeersmaatregelen.
- Ruimte gebruik is wel het belangrijkste bij leefomgeving, ook onder bewoners en ondernemers.
- Binnen veiligheid is verkeersveiligheid het belangrijkste - echt keuzes maken voor scheiding van vervoerswijzen.
- In de brede welvaart cirkel staat niets over hoe mensen zich gedragen. In auto gedraag je je anders en wordt je ongeduldiger, zeker met de drukte in de grote straten in het Oude Westen.

i. **Als u moet kiezen tussen deze vier domeinen, welke vindt u het meest belangrijk? Bij welke zou de prioriteit van de gemeente moeten liggen?**
   - Leefomgeving.

Betrokkenheid van de wijk

j. **Hoe zou de wijk volgens u het beste betrokken kunnen worden in de evaluatie van dit beleid?**
   - De mobiliteitsaanpak moet werken met leesbare kaarten zodat je het ook echt aan bewoners kan voorleggen. Graag alle dimensies [van brede welvaart] terugzien op verschillende kaarten.
   - De MRA heeft nu vooral kleine kaartjes waar je geen goede details kan zien. Bijvoorbeeld bij een black spot voor veiligheid, moet je wel duidelijk kunnen wat er dan precies bedoelt wordt, zodat dit ook aan de bewoners uitgelegd kan worden.
   - Wijkraden moeten de tools krijgen om zonder 'verheven deskundigheid' de informatie uit te kunnen leggen aan de bewoners.

Afsluitend

k. **Vertrekpunt - Kunt u aangeven hoe u de huidige situatie in het Oude Westen zou beoordelen voor deze vier domeinen?**
   - In het algemeen scoort volgens mij het Oude Westen heel hoog. Ik zou niet ergens anders willen wonen, dus ik vind het ook leuk om hier volksvertegenwoordiger te zijn. De hectiek van hoe alles hier bij elkaar komt (bezoekers, ondernemers, bewoners), dat staat me het meest aan van wonen in de stad.
   - Ondertussen is er wel veel aan de hand, bijvoorbeeld op gebied van veiligheid. Er is veel overlast van drugsgebruikers en daklozen die het wijkpark door hun aanwezigheid onbereikbaar maken voor andere mensen die van het park willen genieten. Hier speelt de auto geen rol in.
   - Qua bereikbaarheid zit je hier op zijn best. Alles is op zijn minst op drie manieren te bereiken. Hier ben ik zeer tevreden mee.
     - Bij het verzet tegen het verdwijnen van tram 4 zijn de meeste overwegingen nostalgisch want men zit dan zelf weinig echt in de tram.
   - Qua gezondheid heb ik makkelijker praten dan de mensen die in de echt kleinere woningen wonen in het Oude Westen. Dit geldt ook voor stenigheid. Het centrum is heel stenig, al zijn er veel dingen al verbeterd. Ik heb de niet bewezen overtuiging dat wanneer je je eigenaar voelt van je omgeving (bijvoorbeeld door een geveltuintje), dat dat goed is voor je en dat je je daar comfortabel en verantwoordelijk door voelt.
     - In het Oude Westen zijn geen sportverenigingen, alleen een dans- en boksschool. Dit is te weinig capaciteit en te weinig divers, dus er wordt te weinig bewogen.
     - Ook gezondheids-initiatieven worden beperkt bezocht nadat hier toch iets van geld voor gevraagd wordt. Mensen kunnen het dan niet betalen - dit is dan waar of niet waar, want soms is het keuzes maken, maar veel mensen hebben ook echt een kleine portemonnee.
     - Mentale gezondheid is lastig. Problematieken als armoede hebben invloed op gezondheid.
     - Als je naar bewoners-initiatieven kijkt, is het vaak 'zitten en eten', weinig sport.
   - Leefomgeving - Ik heb tegengestelde gedachten hierover. Jammer dat technologie zo langzaam gaat dat men nog steeds denkt dat we met kleine, persoonlijke maatregelen helpen tegen klimaatverandering, terwijl technologische ontwikkelingen veel meer impact kunnen hebben. Calvinisme helpt het klimaat niet, maar we denken dat het helpt omdat we ons best doen.

  - Typisch Rotterdams: 'Het is onze eigen rotomgeving, dus hij is perfect.'

l. **Heeft u nog dingen die u nog zou willen delen over dit onderwerp of over mijn onderzoek?**
   - Het percentage dat je als privé persoon kan doen aan klimaatverbetering is superklein. Ik vind het hard dat de nadruk daar wel op komt te liggen. Er is technisch al veel meer mogelijk dan dat we nu doen, maar er zijn andere redenen (zoals verdienmodellen) om dat nog niet tot uitvoering te brengen.
   - Je moet beleid goed kunnen uitleggen aan mensen in gewone-mensen-taal. Als je dit niet kan, dan kan je inspraak niet serieus nemen. Ook kan je alleen dan een gedragsverandering krijgen.
   - Bijvoorbeeld het initiatief van bewoners voor een alternatieve route voor een buslijn, daar hadden bewoners het ver uitgezocht, maar de gemeente nam het niet serieus in overweging. Juist dan moet je met mensen om tafel gaan zitten, dat is mooie participatie.

F.4. Interviews with local business owners

The interviews with local business owners took place between 05-06-2023 and 14-06-2023 and they took on average 15-20 minutes. These transcripts were based on notes taken during the interviews and the audio recordings of the interviews. The transcripts were not validated by the interviewees afterwards.

Local business owner 1

Introductie

a. **Klanten**
   - Klanten komen uit heel Zuid-Holland. Uit de wijk komt maar zo'n 15% van de klanten, verder ook veel van buiten de stad.
   - Klanten blijven soms veel inkopen, die zijn er dan maximaal een half uurtje. Combineren vaak met andere winkels bezoeken op de Kruiskade.

b. **Reisgedrag**
   - Klanten komen veel met OV, maar ook wel met de auto.
   - Bedrijf heeft zelf een bestelauto.
   - Leveringen komen wel 4/5 keer per dag aan de zijkant van de winkel met een vrachtwagen.

Autovrij beleid

c. **Wanneer de gemeente dit beleid aan het maken is, waar moeten ze dan volgens u op letten?**
   - Autoluw snap ik wel, maar twee jaar geleden was het Kruisplein afgesloten, en dat was een ramp voor de omzet. Als ze dat gaan doen, dan zijn we binnen een jaar weg.
   - Mensen kopen hele tassen vol goederen kopen, dus die willen in de buurt parkeren, we moeten bereikbaar zijn. Ook de tram is belangrijk, maar ook de auto.
   - Mensen zeggen al dat ze niet komen omdat de stad moeilijk bereikbaar zijn.

d. **Wat voor effect hoopt u dat dit beleid heeft? Wanneer zou u hier voorstander van kunnen worden?**

e. **Door wat voor negatieve effecten zou u tegen het beleid zijn?**
   - Alleen de tram is niet genoeg voor ons. Bij een juwelier of kledingwinkel kan dat, maar hier doen mensen echt boodschappen.
   - De winkelstraat floreert helemaal, er staat weinig leeg, het loopt goed, dus ik snap niet dat ze hier nu een soort promenade voor voetgangers van willen maken.
   - Heb het idee dat de gemeente er niks van snapt.
   - Tijdens onderhoud toen de straat open lag en mensen niet meer met de auto konden komen, scheelde dat de helft van de omzet.
   - Mensen parkeren nu meestal in de buurt ergens, in zijstraten, terwijl de parkeergarage onder het Kruisplein bijna leeg is. Hier wordt te weinig bekendheid aan gegeven.

Brede Welvaart in mobiliteit

f. **Als u nu dit hele spectrum van brede welvaart ziet, zijn er dan aspecten waarvan u vindt dat de gemeente dit ook moet meenemen?**
   - (Verkeers)veiligheid is ook belangrijk.
   - Milieuvervuiling vind ik onzin, over vijf jaar is toch alles elektrisch, en ten opzichte van de cruiseboten in de haven maken die paar auto's in de stad geen verschil.
   - Gezondheid: Als mensen geen overlast willen, moet je niet in de grote stad gaan wonen.

g. **Binnen de verschillende domeinen, welke aspecten vindt u dan het meest belangrijk?**
   - Bereikbaarheid van activiteiten is het belangrijkste.
   - Bereikbaarheid van wonen in de wijk is niet erg belangrijk, de meeste klanten komen van verder weg.
   - Er moet goed over nagedacht worden: misschien moet de tram nog frequenter rijden. Ze moeten goed aangeven dat er verderop geparkeerd kan worden en dat je dan makkelijk met een trein, bus of tram, of shuttlebus verder kan reizen. Dan ben je veel drukte kwijt, en voor de mensen is het ook fijn om zonder stress te winkelen, zonder dat je dubbel moet parkeren of veel rondjes rijden om een plek te vinden. Er moet verder gedacht worden dan alleen auto's blocken.

- Laten we zorgen dat de mensen die erover gaan er wel verstand van hebben, of dat er anders iemand ingehuurd wordt, en dat er gekeken wordt naar hoe andere steden dit doen.

h. **Als u moet kiezen tussen deze vier domeinen, welke vindt u het meest belangrijk? Bij welke zou de prioriteit van de gemeente moeten liggen?**
   - Zakelijk gezien is bereikbaarheid het belangrijkste.
   - Privé gezien vond ik het te druk hier, en kon ik mijn auto niet kwijt, daarom woon ik hier niet meer.

Afsluitend

i. **Vertrekpunt - Kunt u aangeven hoe u de huidige situatie in het Oude Westen zou beoordelen voor deze vier domeinen?**
   - Veiligheid - zeer ontevreden - er wordt veel geracet, voor sommige mensen is het echt wel onveilig. Ik snap dat je als bewoner je niet veilig voelt.
   - Bereikbaarheid - ontevreden
   - Gezondheid - neutraal, weinig mening over
   - Leefomgeving - tevreden (over ruimtegebruik).

j. **Heeft u nog dingen die u nog zou willen delen over dit onderwerp of over mijn onderzoek?**
   - Denk goed na en denk outside the box.
   - Probeer een oplossing te vinden die voor iedereen van toevoeging kan zijn. Vaak is het star beleid van 'auto's weg, auto's weg, auto's weg, geen parkeerplaatsen', maar ik weet niet of dat nu alleen de oplossing is.

Local business owner 2

Introductie

a. **Klanten**
   - Klanten komen veel lopend of fietsend uit de wijk, soms wel van verder naar deze specifieke winkel.
   - Klanten blijven gemiddeld 15 minuten.

b. **Reisgedrag**
   - Klanten komen veel met de auto of de trein (station dichtbij). Parkeren is wel lastig, de hoofdstraat is meestal vol, dus de meeste kans is in de zijstraten.
   - Bedrijf heeft zelf een bedrijfsauto.
   - Leveringen worden zelf gehaald met bedrijfsauto of worden geleverd door vrachtwagens voor de deur. Laad/los-zones staan vaak vol met particuliere auto's, hierop wordt niet gehandhaafd.

Autovrij beleid

c. **Wanneer de gemeente dit beleid aan het maken is, waar moeten ze dan volgens u op letten?**
   - Geen particulieren op laad/los-zones, gelijk hoog beboeten, want als vrachtwagens niet dubbel hoeven te parkeren, dan verhoogt dat de veiligheid.
   - Laden/lossen aan de weg moet voor klanten ook kunnen, dat is handig voor zware dingen kopen en inladen.
   - Iedereen moet door de winkelstraat kunnen, dus maximaal eenrichtingsverkeer, zolang het maar wel open blijft.
   - Plaats liever plantenbakken als versmalling om hard rijden tegen te gaan, dan vergroent het ook gelijk en hoef je niet direct de hele straat af te sluiten.

d. **Wat voor effect hoopt u dat dit beleid heeft? Wanneer zou u hier voorstander van kunnen worden?**
   - Het is een goed idee om de auto te laten. Autoluw is niet erg, maar de huidige partijen in de gemeenteraad zijn echt autohaters. Ze moeten geen auto's haten, maar gewoon anders inrichten. Auto's blijven komen en gaan, en iedereen wil toch de steden in rijden met hun auto, dus zorg dat mensen het niet moeilijk gemaakt wordt maar dat ze op een andere manier toch welkom zijn.
   - Maak misschien meer ondergrondse parkeergarages, dan kunnen de parkeerplaatsen op straat wel weg.
   - De prijs van de parkeergarage en de trein moet wel omlaag, want anders komen mensen niet meer als toch de auto's weg moeten. Dus OV gratis of goedkoper.

e. **Door wat voor negatieve effecten zou u tegen het beleid zijn?**

Brede Welvaart in mobiliteit

f. **Als u nu dit hele spectrum van brede welvaart ziet, zijn er dan aspecten waarvan u vindt dat de gemeente dit ook moet meenemen?**
   - Groen en vergroening is belangrijk. Ik vraag al jaren om groen in de straat, maar niemand van de gemeente biedt een plantje of grasmatje aan. Als je één tegel weghaalt heb je al een probleem.
   - Als je vindt dat er teveel uitlaatgassen, geluidsoverlast, of trillingen zijn, dan moet je maar buiten de stad gaan wonen.

g. **Binnen de verschillende domeinen, welke aspecten vindt u dan het meest belangrijk?**

- Verkeersveiligheid voor te hard rijdende auto's. Vaste ruime fietspaden met duidelijke lijnen waar je als auto niet overheen mag. Al moet je wel als auto ook de vrijheid hebben.
- Sociale veiligheid: er was de afgelopen jaren te weinig politie, daarom heb je nu die aanslagen. Nu is er daardoor ineens wel politie.
- Sociale veiligheid: goeie ondernemers die op elkaar letten en elkaar helpen, zorg dat die blijven zitten.
- Veiligheid: er zijn ook veel bedrijven die witwassen en niks bijdragen aan de straat.
- Bereikbaarheid: betere fietspaden in het centrum, dat is er in het Oude Westen en daar omheen nog niet.
- Bereikbaarheid: grote, betaalbare parkeergarages, waarom niet gewoon 1 euro per uur? Waarom niet gewoon gratis tram? Dan komen er minder mensen met de auto. Als de gemeente niet auto's pest, maar zorgen dat het OV gratis is of er goede fietspaden zijn, dan is iedereen blij en gelukkig ermee.
- Leefomgeving: Ik heb daar een beetje maling aan. Ik gun iedereen zijn plekje, en het is leuk om in de stad te wonen, maar dan heb je wel herrie, trillingen en uitlaatgassen. Als je dat niet wil, dan ga je buiten het centrum wonen.
- Gezondheid: elektrische auto's goedkoper maken. Voor de burger en ondernemer wordt wel alles duurder gemaakt en die worden gepest door de overheid, maar ze doen er zelf niks aan.
- Fysieke gezondheid: ik heb altijd plantjes en bloemetjes buiten staan en iedereen vindt dat leuk. Mensen kunnen hier ook even zitten, terwijl er geen enkel bankje verder is in de straat, dat is wel belangrijk. Als je slecht ter been bent of je hebt long- of hartklachten, dan kan je hier niet heen want er is geen bankje om te rusten.

h. **Als u moet kiezen tussen deze vier domeinen, welke vindt u het meest belangrijk? Bij welke zou de prioriteit van de gemeente moeten liggen?**
   - Als ondernemer is bereikbaarheid het belangrijkste.
   - Als bewoner is dit zeker de veiligheid, als je hier loopt met familie, dan wil je veiligheid. En dan kies je zelf ervoor of je hier gaat wonen met kinderen in de toekomst.

Afsluitend

i. **Vertrekpunt - Kunt u aangeven hoe u de huidige situatie in het Oude Westen zou beoordelen voor deze vier domeinen?**
   - Veiligheid - zeer ontevreden.
   - Bereikbaarheid - zeer tevreden
   - Gezondheid - neutraal, ik snap dat er veel uitlaatgassen zijn en er zijn veel met zwervers en bedelaars, dat is moeilijk en eng voor mensen. Het kan dus beter.
   - Leefomgeving - er is geluid, er zijn aso-rijders, er zijn trillingen. Voor bewoners is dat een minpunt, voor mij als ondernemer is dat niet zo erg - neutraal.

j. **Heeft u nog dingen die u nog zou willen delen over dit onderwerp of over mijn onderzoek?**
   - Heel belangrijk: heel veel groen, veel zitplekken, en elektrische auto's. De gemeente moet bij zichzelf beginnen met simpele oplossingen (goedkoop parkeren, OV gratis) en geen automobilistje pesten.

Local business owner 3

Introductie

a. **Klanten**
   - 30-40% van de klanten komt uit Rotterdam, dus ook veel van buiten de stad.
   - Klanten blijven gemiddeld zo'n 10-20 minuten. Soms loopt dit uit tot een uur.

b. **Reisgedrag**
   - Klanten komen voornamelijk met de auto, anders soms met het OV. 90% van de klanten klaagt over te weinig parkeergelegenheid.
   - Bedrijf heeft zelf een auto die ze voor bijna alles gebruiken.
   - Leveringen wordt meestal met de auto gedaan. Soms worden leveringen zelf opgehaald.

Autovrij beleid

c. **Wanneer de gemeente dit beleid aan het maken is, waar moeten ze dan volgens u op letten?**
   - Het is heen en weer vechten. Als je de straat voetgangersgebied maakt, dan creëer je minder klanten voor lokale winkeliers, want alles is nog auto-based. Dan komen er ook meer hangjongeren problemen.
   - Als je parkeerplaatsen vervangt door fiets parkeerplekken, dan komen daar ook meer hangjongeren op af.
   - Zo wordt een nieuw probleem gecreëerd en wordt het grootste probleem van het Oude Westen [hangjongeren] alleen maar erger.

d. **Wat voor effect hoopt u dat dit beleid heeft? Wanneer zou u hier voorstander van kunnen worden?**
   - De rest van de straat moet ook aangepakt worden, in plaats van alleen maar het autobeleid. Zet bijvoorbeeld ook meer camera's en politie in (ook nadat de straat (politie)auto vrij is gemaakt).
   - Veiligheid is het belangrijkste, de West-Kruiskade moet veiliger.
   - Met autoluw gaat eigenlijk alles achteruit, veiligheid en klandizie.

e. **Door wat voor negatieve effecten zou u tegen het beleid zijn?**
   - Veiligheid en klandizie zijn het belangrijkste.

Brede Welvaart in mobiliteit

f. **Als u nu dit hele spectrum van brede welvaart ziet, zijn er dan aspecten waarvan u vindt dat de gemeente dit ook moet meenemen?**
   - Leefomgeving is al best goed - er is een park, er is genoeg groen waar je naartoe kan lopen, en je loopt makkelijk door de straat.
   - Gezondheid ligt meestal aan mensen zelf, maar dit kan wel beter.
   - Bereikbaarheid is al ideaal hier. Het station is dichtbij en je komt ook ver met de auto.
   - Veiligheid wordt steeds verbeterd.

g. **Binnen de verschillende domeinen, welke aspecten vindt u dan het meest belangrijk?**
   - Verkeersveiligheid - Mensen vertonen nog steeds patser gedrag, knallen hard met hun auto's, en negeren zebrapaden. Je ziet het zo steeds gebeuren.
   - Bereikbaarheid - bereikbaarheid van mobiliteit - dit is één van de belangrijkste dingen hier in het Oude Westen. Mensen moeten toch echt specifiek naar de wijk toe komen, anders wordt het toch snel over het hoofd gezien.
   - Gezondheid - fysieke gezondheid is het belangrijkste. Het is belangrijk om een stukje te lopen [in de wijk]. Als je gezond bent in je lichaam, dan word je vanzelf gezond in je hoofd.
   - Bij leefomgeving kan je geluidsoverlast en milieuvervuiling combineren. Geluidsoverlast hangt samen met de verkeersveiligheid [denk aan patser gedrag].
   - Milieuvervuiling - de straat wordt best goed schoongehouden, maar gedurende de dag komt er toch veel rotzooi bij wat dan het gras en de tuinen in waait voordat het weer opgeruimd wordt.

h. **Als u moet kiezen tussen deze vier domeinen, welke vindt u het meest belangrijk? Bij welke zou de prioriteit van de gemeente moeten liggen?**
   - Veiligheid mag de prioriteit krijgen.
   - Bereikbaarheid is dan tweede, al is dat al wel goed.
   - De gezondheid is al wel goed, en de leefomgeving wordt al goed onderhouden.

Afsluitend

i. **Vertrekpunt - Kunt u aangeven hoe u de huidige situatie in het Oude Westen zou beoordelen voor deze vier domeinen?**
   - Veiligheid - zeer tevreden, er is elke week wel verbetering en steeds meer goed contact met de politie.
   - Bereikbaarheid - dit is al perfect [zeer tevreden]. Je kunt er met de tram komen, Rotterdam CS is dichtbij, en auto's kunnen er ook komen.
   - Gezondheid - altijd wel goed, er wordt veel gelopen, mensen zijn lekker bezig, en in de straat is het ook een fijne levendige mix van culturen.
   - Leefomgeving is al heel goed [zeer tevreden]. Er is al een park en best veel groen, en er is al een milieuzone.

j. **Heeft u nog dingen die u nog zou willen delen over dit onderwerp of over mijn onderzoek?**
   - Ik ben best tevreden met van alles in het Oude Westen. Soms is het wat verpauperd, maar dit wordt ook veel vernieuwd nu.

Local business owner 4

Introductie

a. **Klanten**
   - Veel vaste klanten veel buurtbewoners. Ook wat toeristen en mensen uit het nabijgelegen ziekenhuis.
   - Klanten blijven gemiddeld zo'n 30 minuten, soms maar 20 minute, soms wel één of twee uur.
   - Ook horeca met zitje voor de deur en in de tuin achter. Vaak vaste klanten die wat komen drinken.

b. **Reisgedrag**
   - Klanten komen meestal met de fiets of lopend, zelden met de auto.
   - Ontwerpers komen wel vaak bijvullen met de auto.
   - De chef rijdt tussen de drie vestigingen elke week met de auto om bestellingen uit te wisselen, verder alleen post/pakket bezorgers.

Autovrij beleid

c. **Wanneer de gemeente dit beleid aan het maken is, waar moeten ze dan volgens u op letten?**
   - Zelf al eens BHV [eerste hulp] verleend op het kruispunt [van Nieuwe Binnenweg en 's Gravendijkwal]. Veiligheid staat voorop.
   - Dubbel parkeren gebeurt veel, dan moeten fietsers de tramrails op, dat is gevaarlijk. Als parkeerplekken weggehaald worden, dan zal er meer geparkeerd worden op de rijstrook, dat zou het probleem verergeren.
   - Kan me voorstellen dat het eenrichtingsverkeer wordt, maar dan moet je best een groot blok omrijden.

d. **Wat voor effect hoopt u dat dit beleid heeft? Wanneer zou u hier voorstander van kunnen worden?**
   - Een groter terras voor, en bredere stoepen, dat is altijd fijn. Maar het is ook een doorgaande weg voor hulpdiensten.

e. **Door wat voor negatieve effecten zou u tegen het beleid zijn?**
   - Geen auto's meer lijkt me qua leveren erg lastig. Welke auto/leverancier zou hier dan nog mogen komen? Dat is voor ons wel belangrijk.
   - Onze klanten komen meestal met OV of lopend, dus dat is geen probleem.

Brede Welvaart in mobiliteit

f. **Als u nu dit hele spectrum van brede welvaart ziet, zijn er dan aspecten waarvan u vindt dat de gemeente dit ook moet meenemen?**
   - Meer groen in de straat, plantenbakken om de bomen heen.
   - Minder geluidsoverlast is altijd fijn. Zeker in de zomer zijn er veel auto's met overdreven lawaai.
   - Van trillingen en ruimtegebruik geen last.
   - Verkeersveiligheid is wel belangrijk. Boetes voor dubbel parkeren zijn nu meer dan 100 euro, maar veel mensen weten dit nog niet. Het zou wel schelen voor fietsers.
   - Sociale veiligheid wordt steeds beter.
   - Bereikbaarheid met tram en metro is goed, en een parkeergarage is dichtbij. Ook zonder auto kan je hier goed komen, alleen bereikbaarheid voor leveranciers is een dingetje.
   - Minder auto's in de straat is ook fijn voor de fysieke gezondheid.

g. **Binnen de verschillende domeinen, welke aspecten vindt u dan het meest belangrijk?**
   - Leefomgeving - ruimtegebruik - hoe gaan we met de straat om? Het knapt langzaam op, maar er mist nog gezelligheid. Ander stuk van de Binnenweg is al meer groen en bredere stoepen.
   - Veiligheid - verkeersveiligheid - vooral voor fietsers, onze belangrijkste gasten komen met de fiets.
   - Bereikbaarheid - meerdere punten van bereikbaarheid - metro en tram, fietsen voor de deur parkeren zou helemaal super zijn.
   - Gezondheid - mentaal vooral, fysiek moet je zelf verzorgen hier.

h. **Als u moet kiezen tussen deze vier domeinen, welke vindt u het meest belangrijk? Bij welke zou de prioriteit van de gemeente moeten liggen?**
   - Leefomgeving en veiligheid.

Afsluitend

i. **Vertrekpunt - Kunt u aangeven hoe u de huidige situatie in het Oude Westen zou beoordelen voor deze vier domeinen?**
   - [Uit bovenstaande op te maken].

j. **Heeft u nog dingen die u nog zou willen delen over dit onderwerp of over mijn onderzoek?**

Local business owner 5

Introductie

a. **Klanten**
   - Klanten komen overal vandaan, erg divers.
   - Klanten blijven gemiddeld 2/2,5 uur.

b. **Reisgedrag**
   - Geen data over hoe klanten reizen.
   - Leveringen gebeuren met vrachtwagens voor de deur.
   - Bedrijf heeft een bedrijfsauto.

Autovrij beleid

c. **Wanneer de gemeente dit beleid aan het maken is, waar moeten ze dan volgens u op letten?**
   - Sinds je vorige bezoek let ik erop, het is erg lawaaierig in de straat. Veel asociaal gedrag met rijden en geluid. Het is echt geen leven hiermee, echt drama.
   - Er moet iets gebeuren om de overlast te beperken, maar drempels of flitspalen. Er is echt meer controle nodig, het lijkt soms wel een racebaan.

d. **Wat voor effect hoopt u dat dit beleid heeft? Wanneer zou u hier voorstander van kunnen worden?**
   - De buurman vertelde dat de tram misschien weggaat hier. Dan moeten mensen met de metro komen misschien. Ik heb weinig gehoord over die plannen.

e. **Door wat voor negatieve effecten zou u tegen het beleid zijn?**
   - Het is moeilijk. Auto's die hier rijden is geen probleem, maar de manier waarop is het probleem. Teveel overlast. Je moet erg je aandacht erbij hebben als je oversteekt want het is echt gevaarlijk.
   - [Uitleg gegeven over de drie speerpunten van de gemeente (zie interview PM1)]
   - Die drie doelen lijken me goed. De jongeren met auto's hier houden geen rekening met anderen, daarom ben ik wel voorstander van autoluw beleid.

- Mensen komen toch wel eten, de metro en parkeergarage zijn dichtbij. Misschien dat er iets minder mensen komen zonder auto's, maar dan krijg je gewoon iets ander publiek.

Brede Welvaart in mobiliteit

f. **Als u nu dit hele spectrum van brede welvaart ziet, zijn er dan aspecten waarvan u vindt dat de gemeente dit ook moet meenemen?**
   - Geluidsoverlast komt erg naar voren.
   - Van klimaat en milieu heb ik geen verstand. Er wordt gezegd dat het slecht is, maar ik ben geen expert.
   - Trillingen heb je wel, er rijden hier van die opgevoerde auto's.
   - Verkeersveiligheid, je moet echt opletten bij het oversteken, het is echt gevaarlijk.
   - Bereikbaarheid zou wel wat minder worden, maar de mensen die willen komen, doen de moeite wel.
   - Gezondheid - we ademen overal troep in, dat zou misschien wel minder worden.
   - Mentale gezondheid - ik erger me kapot aan die geluiden. Het houdt je bezig en daar wordt je gestrest van. Je kan er ook niks van zeggen tegen die gasten, dat heeft geen zin.

g. **Binnen de verschillende domeinen, welke aspecten vindt u dan het meest belangrijk?**

h. **Als u moet kiezen tussen deze vier domeinen, welke vindt u het meest belangrijk? Bij welke zou de prioriteit van de gemeente moeten liggen?**
   - Leefomgeving.

Afsluitend

i. **Vertrekpunt - Kunt u aangeven hoe u de huidige situatie in het Oude Westen zou beoordelen voor deze vier domeinen?**
   - Ik werk tot laat, maar voel me altijd veilig op straat. Het kan wel altijd beter, er is wel veel overlast van zwervers en junks. Ik heb veel maatregelen moeten nemen tegen vernielingen op mijn terras, ik was een jaar bezig om die overlast te verminderen. Dit kost allemaal geld, maar de politie heeft geen tijd hiervoor. Ik wilde aangifte doen met camerabeelden erbij, maar ze hebben geen tijd.
   - Last is er al jaren, maar je leert ermee omgaan en zoekt een oplossing om het te verminderen. Ik zit al 15 jaar hier, er is wel veel veranderd en beter geworden, maar soms voelt het alsof we wat terugzakken naar de oude situatie met overlast.

j. **Heeft u nog dingen die u nog zou willen delen over dit onderwerp of over mijn onderzoek?**

F.5. Validation interviews

The transcripts of the two interviews for the validation of the indicator selection process and the operationalised indicators are shown here. The interviews were conducted on November 15 and 16, 2023. The first interview was conducted with the two local council members who were also interviewed earlier in this research (RC1, RC2). The second interview was conducted with the policy-maker who was also interviewed earlier in the process (PM1). Both interviews took roughly 1 hour and the transcript was based on audio recordings of the interviews. The transcripts were not validated by the interviewees afterwards.

F.5.1. Local neighbourhood council members

Since this interview was conducted with two local council members, the transcript contains indications of the different persons. A is RC1, B is RC2, Int is the interviewer. The interview was conducted in Dutch, therefore the transcript is in Dutch as well to prevent any bias in the translation.

Indicator selectieproces

c. Presentatie over indicator selectieproces voor Oude Westen case.
   Stap 1: Stakeholders selecteren
   - A: Grote stakeholders (RET, ziekenhuizen, etc.) zijn al formeel uitgenodigd, bewoners en ondernemers bijvoorbeeld niet. Die wegen minder zwaar mee.
   - B: Bezoekers van de wijk zijn niet meegenomen, maar wel belangrijk.
     A: Zijn ook lastig mee te nemen, het is ook een erg diverse groep (dagelijks of maandelijkse bezoekers).
     B: Moeilijk om direct te betrekken bij onderzoek, wellicht op andere manier meenemen met een enquête.
   - A: Woningcorporaties wellicht invloedrijker dan vastgoedeigenaren. De laatste groep hebben geen formele rol in trajecten, woningcorporaties wel. Commerciële partijen willen wel grotere invloed, maar hebben het wellicht niet. Woningcorporaties kunnen door lopende afspraken wel grote stem hebben.

   Stap 2: Interviews
   Stap 3: Analyse relevante aspecten van brede welvaart

- B: Opvallend dat gezondheid zo laag scoort, want is wel belangrijk bijvoorbeeld bij drukke weg als 's Gravendijkwal.
- A: Men associeert mobiliteit vaak meer met de auto/bereikbaarheid/veiligheid dan met gezondheid. Men realiseert niet het verband met bijvoorbeeld lagere levensverwachting door uitstoot.
- A: Soms wil men ook aan bepaalde dingen bewust niet denken. Zo denkt men soms totaal niet aan nabije uitstotende industrie als ze bezig zijn met nadenken over een beslissing voor wel of geen woningbouw in een gebied.

Stap 4: Analyseren relevante indicatoren brede welvaart

- A: Stel je wil de indicatoren gebruiken, maak je dan verschillende sets voor verschillende groepen? Int: Dat is zeker mogelijk, dat is aan de beleidsmaker om in te schatten
- B: Eigenlijk zou je subjectieve indicatoren wel willen kunnen kwantificeren, ook bij ex-ante evaluatie. Gewoon een week in het gebied zijn en luisteren, zonder daadwerkelijk onderzoek te doen.
- A: Soms zijn nulmetingen ook wel lastig omdat sommige indicatoren maar sporadisch worden geregistreerd. Bijvoorbeeld: DCMR meet niet overal geluidsoverlast of politiestatistieken bevatten alleen meldingen waarbij de politie ook echt is gekomen. Dit tot frustratie van de bewoners omdat zij veel meer meldingen hadden gemaakt.

Stap 5: Selectie indicatoren

d. Vragen over validatie van ranking van aspecten en domeinen van brede welvaart en indicatoren.

d.1. Zijn deze aspecten van BW de meest relevante voor de stakeholders?

- B: Verbaasd over lage positie van gezondheid.
- A: Ik ben daar niet verbaasd over
- B: Zelfs een eigen luchtkwaliteit melder zorgde niet voor meer interesse of zorgen over gezondheid.
- A: Soms lijkt er kokervisie in participatie te zitten. Mensen worden dan uitgenodigd om over een specifiek onderwerp hun zegje te doen. Ook hebben mensen soms weinig ruimte om er over na te denken. Mensen wordt vaak een plan gepresenteerd waar ze het wel of niet mee eens kunnen zijn. Alleen soms in PWE's of kleinere burgerfora's is er meer ruimte om echt naar de omgeving te kijken.
- B: Ja je kadert soms voordat je bent begonnen al wat je antwoorden worden.
- A: Het is ook vaak de benoeming. Men associeert niet altijd gelijk luchtkwaliteit met gezondheid. Dan moet je dit heel direct duidelijk maken. Dit gebeurt vaak minder wanneer de participatie door ambtenaren georganiseerd wordt, dan wordt participatie meer voor formaliteit gedaan. In progressievere gemeenten is er wel meer ruimte voor.
- B: Vaak is er ook een houding van: wij weten allang wat goed is voor mensen, ze geven gewoon domme antwoorden.
- A: Hier moet je in participatie mensen ook de ruimte geven om over bijvoorbeeld gezondheid na te denken. Vooraf moet dan wel al door de organisatie van participatie in kaart worden gebracht wat verwachte gespreksonderwerpen zijn en wat belangrijk wordt om te weten.

e. Vragen voor validatie van selectieproces

e.1. Denken jullie dat het proces in theorie kan leiden tot relevante uitkomsten?

- A: Ja, vooral door de structuur. Dat ook achteraf laten zien kan worden wat er onderzocht is en wat er uit kwam. Dat gaat participatiemoeheid tegen. Men denkt vaak dat ze als formaliteit aan participatie meedoen.
- B: Ja of dat het onderzoeksrapport eigenlijk al geprint is.
- A: Het is niet standaard om in kaart te brengen wat uitkomsten van participatietrajecten waren. Als je een lijst met indicatoren hebt en aangeeft welke uit onderzoek belangrijker bleken te zijn, dan verdwijnt de input van mensen in ieder geval niet.
- B: Je kan ook met stakeholders gaan zitten om de vragen te maken.

e.2. Denken jullie dat het indicator selectieproces alle relevante zaken onderzoekt en meeneemt?

- B: Ik zou van tevoren (voor het traject) erg duidelijk maken wat het doel is en wat het participatieproces inhoudt.
- A: Vaak is bij participatie niet duidelijk wat de ruimte is, dit veroorzaakt vaak teleurstelling.
- A: De kaders zijn belangrijk. Het gaat soms al mis wanneer het niet duidelijk is waarom iemand een stakeholder is. Er wordt vaak een 'makkelijke' stakeholder uitgenodigd, terwijl dit niet per se de goede/representatieve stakeholder is.
- Int: Dat is dan eigenlijk vooraf al sturen wie je uitnodigt om het proces makkelijk te houden?
- A: Ja, vaak wordt er niet eens een uitgebreide stakeholder analyse gemaakt, maar worden gewoon de makkelijk vindbare of verplichte groepen gekozen, of de stakeholders met een matchende mening.

- B: Opzet van een participatiesessie kan ook de sfeer bepalen, wat het proces kan beïnvloeden. Denk aan een communicatie expert versus een aarzelende verkeersexpert met zachte stem.
- A: Dit alles gaat niet zozeer over dit proces, maar geeft wel randvoorwaarden

f. Vragen over toepasbaarheid van selectieproces

f.1. Is dit selectieproces toepasbaar in de praktijk?

- A: Wel als er meerdere potentiële keuzes zijn, niet als het in het coalitieakkoord eigenlijk al vastligt.
  - B: Dan worden participanten genegeerd, die stuur je dan negatief het bos in.
- A: Zo'n proces is vooral goed op plekken waar de ontwikkeling nog niet vaststaat, bijvoorbeeld bij zoekgebieden voor windmolens of AZC's. Dan ligt het nog open, zeker als de beslissing vanuit landelijke politiek komt, dan heeft de gemeente nog minder sturing hierin. Landelijk wil men betere uniforme processen, ook om te zorgen dat participatie over de verschillende zoekgebieden uniform is.
  - A: Meer op mobiliteit is dit bijvoorbeeld bij provinciale wegen die verlegd moeten worden door of om een dorp of natuurgebied.
- Int: Rondom autoluw ligt het in Rotterdam in het coalitieakkoord ook nog niet vast.
  - A: Dan kan dit op straatniveau toegepast worden. Straten kiezen om autoluw te maken.
  - A: Vaak is er ook weinig tijd beschikbaar, dus is het beter om dit te doen wanneer er maar weinig keuzeopties zijn, dat je uit 3 straten kan kiezen om autoluw te maken.
  - B: Hoe zou je dit doen?
  - A: Dit soort indicatoren kan helpen om inzichtelijk te maken hoe de gevolgen van maatregelen (bijvoorbeeld toegenomen intensiteit) op de beleving werken.
  - Int: Maar dan zou je eigenlijk van tevoren het aantal opties beperken om het proces haalbaar te maken.
  - A: Verschilt per niveau. Soms is er subsidie om onderzoek te doen. Soms is er geen tijd om zo'n heel proces te doorlopen, zelfs als de ambtenaar het wel zo willen. Daarom zijn randvoorwaarden nodig voor het uitvoeren van dit proces zodat het recht blijft doen.
  - Int: En als er niet kan worden voldaan aan die randvoorwaarden, dan moet je het proces niet doen?
  - A&B: Ja, slechte participatie kan slechter zijn dan geen participatie.

Geoperationaliseerde indicatoren

g. Presentatie over de geoperationaliseerde indicatoren voor de Oude Westen case.
Indicator 1: Ruimtegebruik voor parkeren
Indicator 2: Aantal mobiliteitsopties

- A: Interessant. Er wordt ons verteld dat er genoeg opties zijn, maar dit soort inzicht wordt niet met ons gedeeld, terwijl het wel erg nuttig kan zijn.
- B: Dit is ook erg nuttig voor gedragsbeïnvloeding.

Indicator 3: Mix van verkeer op de weg

h. Vragen voor de validatie van de geoperationaliseerde indicatoren.

h.1. Zijn dit inderdaad relevante indicatoren voor de gerelateerde aspecten van brede welvaart?

- B: Ik mis het gedrag, bijvoorbeeld dubbel parkeren
- A: Verkeersgedrag verschilt erg per wijk
- Int: Dit kwam ook in stakeholder gesprekken naar voren. Toevoegen van deze lokale context is een mogelijke toekomstige toevoeging. Lastig te kwantificeren in een model, maar wel bruikbaar bij interpretatie van indicator en bij de evaluatie van beleid.

h.2. Zijn deze indicatoren relevant voor de stakeholders?

- A: Ja, fietspaden zijn soms al te krap voor piekintensiteiten.
- B: Een tijdfasering zou interessant zijn.
- Int: Nu is het op ochtendspits gericht. Tijdsaspect kan ook interessant zijn voor parkeerindicator
- B: In IJsselmonde is het betaald parkeren ingevoerd op basis van piekintensiteit bij voetbalwedstrijden, terwijl dit normaal niet nodig zou zijn.

i. Vragen over de toepasbaarheid van de geoperationaliseerde indicatoren.

i.1 Kunnen deze indicatoren leiden tot relevante inzichten voor de ex-ante evaluatie van autovrij beleid?

- A: Voor bewoners en ondernemers gaat het om verschillende soorten parkeren: kort parkeren van klanten of langer parkeren voor bewoners en bezoek.

  - Int: Dus een uitsplitsing in gebruikersgroepen?
  - B: Ja
  - A: Ja zeker voor een wijk als dit waar men vaak parkeert voor nabijheid van centrum niet voor bezoek in de wijk.
  - B: Ook verschil tussen ondernemers waar klanten moeten parkeren of juist de medewerkers
- Int: Naast de uitsplitsing in groepen zou ook uitsplitsing naar parkeerplaatstype een volgende stap zijn.
  - A: Ja, veel bewonersparkeergarages staan niet altijd vol, maar er is wel een lange wachtrij voor de vergunning voor deze garages.
- B: Lastig is ook dat er een antwoord komt voor het hele gebied, waarom kan dit niet meer op maat per straat of per persoon?
  - A: Maatwerk is lastig omdat er wordt gekeken naar parkeernormen. Obv vergunningen zou je moeten kunnen parkeren, terwijl het door niet-wijkgebonden bezoekers wel vol staat.

i.3. Kunnen deze indicatoren bijdragen aan het representeren van de belangen van lokale stakeholders in de beleidsevaluatie?
- A: Als de indicatoren meegenomen worden wel. Mensen moeten eigenaarschap voelen van een bepaalde keuze. Aanvullingen als dit [indicatoren van BW] moeten dan meewegen in de keuzes.
- B: Zo laat je ook zien dat men op waarde wordt geschat en ze serieus genomen worden.
- A: Dat eigenaarschap is belangrijk in de moeilijke keuzes die soms moeten worden genomen.
- Int: Als vooraf dan deze indicatoren worden bepaald, kunnen later opties gepresenteerd worden met daarbij indicatoren van wat men belangrijk vond. Dan kunnen ze kiezen.
- B: Ja, dat geeft mensen stof tot nadenken en dat werkt.
- A: Ook mogelijk om te vragen of men dezelfde aspecten nog steeds zo belangrijk vindt.
- A: Samen aan tafel zitten kan dan meer begrip voor het proces opleveren en ook voor de verschillende stakeholders.
- B: De spelregel blijft: wees aan het begin van het proces super duidelijk: dit is het proces, dit is de ruimte, dit gaan we ermee doen, dan krijg je terugkoppeling.
- A: Kaders waarin gewerkt wordt moeten duidelijk zijn (denk aan routes voor hulpdiensten of tramnet afspraken met MRDH)

Afsluiting

k. Hebben jullie nog overige opmerkingen over dit onderzoek?
- A: Leuk onderzoek omdat het naar elementen van participatie kijkt om dit te verbeteren.
- B: Daarna wordt het interessant in hoeverre gemeenten bereid zijn om dit toe te passen.

F.5.2. Policy-maker

This interview was conducted with the policy-maker PM1 (Int is the interviewer). The interview was conducted in Dutch, therefore the transcript is in Dutch as well to prevent any bias in the translation.

Indicator selectieproces

c. Presentatie over indicator selectieproces voor Oude Westen case.
Stap 1: Stakeholders selecteren
- PM: Hoe is invloed bedoeld? Want uiteindelijk beslist de gemeenteraad, niet de bewoners.
- Int: Invloed meer bedoeld als mogelijkheid tot inspraak en mogelijkheid tot mobiliseren van groepen.

Stap 2: Interviews
- PM: Hoe zijn geïnterviewden benaderd?
- Int: Wijkraadsleden via netwerk gemeente en bewoners/ondernemers op straat.

Stap 3: Analyse relevante aspecten van brede welvaart
- PM: Zou de context van mobiliteitsbeleid de reden zijn dat in deze interviews gezondheid lager scoort? Bij onze interviews komt gezondheid sterker naar voren.
- Int: Mogelijk, al werden geïnterviewden wel specifiek voor elk domein nog gevraagd naar wat ze belangrijk vonden. Ook wordt gezondheid vaak gelinkt aan geluidsoverlast en luchtvervuiling, welke vallen onder leefomgeving. Verder zagen mensen het verband tussen mobiliteit en gezondheid soms niet.
- PM: De stemming in Rotterdam is toch wel dat gezondheid hoog scoort in het algemeen.

Stap 4: Analyseren relevante indicatoren brede welvaart
Stap 5: Selectie indicatoren

- PM: Haalbaarheid binnen 'het' model, wat is 'het' model? Zijn er geen mogelijkheden om een indicator toch haalbaar te maken als de indicator echt relevant is?
- Int: Klopt, dit ging vooral om deze studie, wat er voor mij haalbaar was in Urban Strategy.

d. Vragen over validatie van ranking van aspecten en domeinen van brede welvaart en indicatoren.

d.2. Matchen deze uitkomsten uw ervaringen van belangrijke BW aspecten in de wijk?

- PM: Wel herkenbare aspecten. Luistert wel nauw vanuit welke context mensen bevraagd worden voor welke aspecten hoog scoren. Verder wel herkenbaar: veiligheid scoort altijd hoog. Leefomgeving is erg divers en daardoor wel minder begrijpelijk voor de man op straat, bereikbaarheid is heel duidelijk en staat ook altijd hoog.
- PM: Ruimtegebruik ben ik nog wel benieuwd naar jouw uitwerking met parkeren. Wij kijken hier vaak naar [dwars]profielen, of er een straat een meter smaller kan, en de stoep breder.
- PM: Verder wel herkenbaar allemaal. Wel zie ik dat beleidsmedewerkers vaak meer op luchtkwaliteit zitten (ook door strenge normen), terwijl geluidsoverlast voor mensen op straat veel tastbaarder is. Het wordt ook steeds minder geaccepteerd dat dit gewoon hoort bij wonen in de stad.

e. Vragen voor validatie van selectieproces

e.2. Denkt u dat het indicator selectieproces alle relevante zaken onderzoekt en meeneemt?

- PM: Komt logisch op mij over, niet dat er iets vergeten is. Wel benieuwd naar de praktische toepasbaarheid. Is data altijd beschikbaar om alle aspecten op zelfde niveau te kunnen evalueren? Vaak is data slechts op stad-niveau beschikbaar terwijl je wil uitsplitsen op gebieden.
- Int: En is dit dan specifiek op indicatoren of ook op de toepasbaarheid van dit proces?
- PM: Dit is specifiek op indicatoren.

f. Vragen over toepasbaarheid van selectieproces

f.1. Is dit selectieproces toepasbaar in de praktijk?

- PM: Moeilijk te beoordelen vanuit tijdsperspectief. Vaak krijgen we voor het maken van plannen 0.5-1 jaar de tijd. Dit wordt dan vrij strak ingepland qua welke stappen gedaan moeten worden (modellen, participatie, etc.).
- Int: Dus de vraag is of dit past binnen beschikbare tijd?
- PM: Meer de vraag hoe dit proces zich verhoudt tot bestaande participatieproces.
- Int: Dit proces zou een eerste stap kunnen zijn voor het vastleggen van de evaluatiekaders. Zo kunnen stakeholders hier vroeg over meepraten waardoor latere evaluatie relevanter voor het kan zijn.
- PM: We hebben bestaande participatieprocessen, dus de vraag is hoe dit daarin aanhaakt.
- PM: Een zijstapje, maar hoe regelmatig je bepaalde producten [beleidsstukken] maakt bepaalt hoe vaak je mensen benadert. Allerlei verschillende afdelingen benaderen ook mensen. We proberen naar een wijkaanpak te gaan waarbij je vaste mensen heb die je kunt benaderen voor bepaalde onderwerpen en dus niet meer vanaf nul begint.
- Int: Ja dat is wel relevant, BW is breed genoeg om voor verschillende afdelingen te gebruiken, dus met een totale lijst met relevante indicatoren kan je dan per afdeling kiezen wat er raakt aan dat onderwerp en dan heb je dat al liggen. Dit moet dan wel soms geactualiseerd worden.
- PM: Ja. En het benaderen van buitenwereld luistert nauw, sommige groepen kan je moeilijkere keuzes voorleggen.

f.2. Zijn er bepaalde soorten maatregelen of beleid waarvoor dit proces specifiek nuttig of effectief kan zijn?

- PM: Moet wel bepaalde schaal hebben. Aan de ene kant heb je stedelijke omgevingsvisie die erg abstract is en daardoor moeilijk om grip op te krijgen. Daarvoor is dit dan niet geschikt. Om dit toe te passen op straat of plein niveau heb je weer de middelen niet. Je zou dit proces dus op gebieds- of stadsniveau moeten toepassen. Denk aan autoluw-programma, stad naar 30km/h, of woonvisie, daar kan je dit voor gebruiken.
- Int: Maar moet het beleid nog echt wijkgericht zijn dan zoals we eerder bespraken?
- PM: Bij modellen moet je flinke ingrepen doen om verschillen te zien. Een extra brug over de maas zie je wel, maar een enkele straat afsluiten niet. Daar moet je je wel bewust van zijn.

Geoperationaliseerde indicatoren

g. Presentatie over de geoperationaliseerde indicatoren voor de Oude Westen case.
Indicator 1: Ruimtegebruik voor parkeren

- PM: Dit is dan niet gebaseerd op tellingen, maar puur op modeldata? We hebben ook teldata beschikbaar. Ik ben bang dat wanneer je een zone uitsplitst naar individuele straten dat je dan grote verschillen gaat zien en de resultaten dan dus veel diverser zijn.
- Int: Dat kan inderdaad. De toedeling zou moeten kloppen door gebruik van een dataset van gemeente Rotterdam met alle parkeervakken. Het gebruik is wel inderdaad gebaseerd op modeluitkomsten. Hierbij is wel meegenomen dat mensen in een naastgelegen zone kunnen parkeren. Echter is het wel op zone niveau inderdaad, en zou het wellicht nog gevalideerd moeten worden met tellingen.
- PM: Het zegt ook iets over het type producten waar je deze indicator voor gebruikt. Als je dit bespreekt met bewoners die zeggen: maar in mijn straat is het heel anders…
- Int: Ja dan ben je snel uitgepraat. Dat is inderdaad iets wat meegenomen moet worden.

Indicator 2: Aantal mobiliteitsopties

- PM: In Urban Strategy is elke inwoner nog wel hetzelfde qua reismotieven en gedrag.
- Int: Er zitten 70 verschillende bevolkingsgroepen in het model.
- PM: Maar dit is wel over de hele stad uitgesmeerd toch, dat wijken dezelfde profielen hebben?
- Int: Dat kan kloppen inderdaad, ik weet niet of dat op wijkniveau gebeurt.
- PM: Ja als dat wel kan, gaan deze kaarten nog meer spreken.
- Int: Als je meer karakteristieken als inkomens of reismotieven meeneemt?
- PM: Ja, ik neem zelf bijvoorbeeld gewoon de metro omdat die sneller aansluit op de trein en op mijn bestemmingen. Daardoor heb ik minder last van het verdwijnen van tram 4 dan mensen die de tram gebruiken voor korte tripjes waarbij dit niet nog gekoppeld is aan een metro of trein.
- Int: Ja dus dan zou je een aspect toevoegen van waar gaat deze lijn heen of waar verbindt die mee. Dat is wel een mogelijke toekomstige ontwikkeling.

Indicator 3: Mix van verkeer op de weg

- PM: Interessante indicator. In ons RMA is het indelen van vervoersmiddelen op snelheid ook een vd speerpunten. We hebben eens gekeken naar de fietspaden met de intensiteiten, dan kleurt alles rood op basis van CROW richtlijnen, het is immers een stad. Maar als vergelijking van waar is het erger en waar moet je als eerste ingrijpen is de indicator wel interessant.
- PM: Steeds meer wordt verkeer weer gemengd, met bijbehorende eisen voor de intensiteiten. Zelf kijken we meestal alleen naar auto intensiteit en nemen we aannames voor andere modaliteiten. Inzicht in ook fietsintensiteit zou wel erg nuttig zijn.
- Int: In Urban Strategy kan je inzicht krijgen in fiets intensiteiten.
- PM: Kengetallen over welke combinaties van intensiteiten heb ik nog niet kunnen vinden.
- Int: CROW tabel omgezet naar redeneren vanuit infrastructuur naar threshold values voor intensiteiten. Lastig om echt zwart wit te kijken, maar daarom geeft de indicator ook warnings voor én auto én fiets én snelheidslimiet.
- PM: Nuttige tabel en indicator. Dit is wel actueel, nu zitten er vaak een paar kengetallen in het hoofd (rond 2000 fietsers/uur) terwijl er op straten soms wel 8000 fietsers zijn. Dan moet je heftig ingrijpen, en zo'n indicator/tabel geeft dan meer inzicht in mogelijkheden.

h. Vragen voor de validatie van de geoperationaliseerde indicatoren.

h.1. Zijn dit inderdaad relevante indicatoren voor de gerelateerde aspecten van brede welvaart?

- PM: Alle drie relevant. Niet de vraag of het compleet is toch?
- Int: Nee je kan aspecten op enorm veel manieren uitwerken in een indicator.
- PM: Oke. Alleen de parkeerindicator lijkt nog wel erg generiek. Daardoor lastig om te zien wat je er aan hebt – ik zou bijvoorbeeld niet weten met wat voor beleid ik de zones in OW van rood naar oranje kan brengen.
- Int: Je kan ook nog uitsplitsen in types parkeerplaatsen (op straat of parkeergarages)
- PM: Maatwerk is daar inderdaad de oplossing. Het is wel een flinke uitdaging om dat goed in een model te krijgen. Qua typen parkeerplaatsen kijken we veel naar gebruik door zoveel mogelijk mensen – resulterend in hoog rendement en goed ruimtegebruik. Stadsbreed zit er veel verschil tussen wie waar wel en niet gebruik van mag maken, dat zegt wat over bereikbaarheid.
- PM: De kans dat je een parkeerplek vindt bij huis is bijvoorbeeld weer een andere insteek.

h.2. Zijn deze indicatoren relevant voor de stakeholders?

- PM: Voor dit gebied wel. OW ligt tegen binnenstad dus er is wel een shift in het denken van bewoners en ondernemers. Qua bereikbaarheid is voor ondernemers laden/lossen daar belangrijker dan parkeren van klanten – die komen toch minder met de auto en aan voetgangers verdient hij meer.

- PM: Bereikbaarheid van personen stond ook in de lijst. Hier hebben we ook een tijd meer mee gewerkt. Beleidswijziging of maatregelen zijn nodig om hier een shift in te krijgen.

i. Vragen over de toepasbaarheid van de geoperationaliseerde indicatoren.

i.1 Kunnen deze indicatoren leiden tot relevante inzichten voor de ex-ante evaluatie van autovrij beleid?

- PM: Voor autoluw hebben we veel doelen, dus veel indicatoren mogelijk. Doelen nu zijn: bereikbaarheid, verkeersveiligheid en ruimte maken, dat zit wel min of meer in de indicatoren. In de doorvertaling zit een bepaalde concreetheid – dit kan per straat verschillen. Zo kan op de NBW ruimtegebruik en verkeersveiligheid meest belangrijk, terwijl voor de WKK de doorstroming en bereikbaarheid weer erg belangrijk is. Generalisatie over gebied is dan niet specifiek genoeg.
- PM: Analyse kan goed zijn, maar bij de terugkoppeling naar de doelgroep kan lastig zijn om het te projecteren naar de individuele stakeholders.

i.3. Kunnen deze indicatoren bijdragen aan het representeren van de belangen van lokale stakeholders in de beleidsevaluatie?

- PM: Vroegtijdiger in het proces bepalen wat men belangrijk vindt en waar we dan later in het proces elkaar op kunnen aanspreken. Nu in gesprekken met stakeholders gaat het meer over oplossingen, ouput, hoe ziet die oplossing eruit. Praten in outcome, effecten, is voor mensen vaak lastig. Vroegtijdig afspreken met elkaar waarop je elkaar later aan kan spreken om te bepalen of het beleid succesvol is, is dan erg belangrijk.

Int: In hoeverre verwacht u verschillen in deze toepasbaarheid tussen Rotterdam en andere steden?

- PM: Oude Westen kan worden vergeleken met andere steden. Ook ben ik benieuwd naar het dataniveau van andere, kleinere steden. Een stad als Amsterdam is al weer wat verder op het gebied van data. Maar over het algemeen hebben andere steden vergelijkbare uitdagingen.

Afsluiting

k. Heeft u nog overige opmerkingen over dit onderzoek?

- PM: Ik ben benieuwd naar je uitkomsten, vooral in de mix van verkeer indicator.

G

Interview coding

All codes used for analysing the interview transcripts are shown in the table below. They are divided over the different domains and aspects of well-being. For answers not fitting the four domains, there is the 'other' category. Also within teh four existing domains, for answers not fitting the existing aspects, there is the 'other' category within each domain.

For aspects, there are two numbers for codes. The odd numbers are used for all codes that describe positive answers about the importance of this aspect. The even numbers are used for the codes describing answers that were negative about the importance of an aspect. Note that this positive-negative divide does not cover positive or negative attitudes towards specific policies, but positive or negative attitudes regarding the importance of that aspect in policy evaluation.

Note that some codes might look similar to codes for other aspects (e.g. 'you should not live here if you do not want the nuisance' which appears as 22A, 26A, 28A, 30A, and 34A). This has to do with the fact that interviewees mentioned this argument in the context of several aspects and told it applied for all of them.

Domain	Aspect	Code	Description
Safety	Traffic safety	1A	Enough loading zones to reduce double parking and decreased safety
		1B	Busy mixed traffic reduces traffic safety, hence the need for car-free policies
		1C	Traffic safety is important (mainly for cyclists)
		1D	Traffic safety decreases due to speeding cars and speeding LEVs on mixed road
		2A	
	Social Safety	3A	Lots of junks/beggars/confused people on the street
		3B	There should be more policing and more business owners keeping an eye on the street
		3C	Do not feel safe on the streets (at night or during the day when confronting people)
		3D	Lot of harassment of women and other nuisance from cars
		3E	Lot of youth hanging around and causing trouble, this would increase with car-free
		4A	-
	External safety/ environmental safety	5A	The mixed use leads to trucks in the residential area

Table G.1: Used codes for coding the interview transcripts.

Domain	Aspect	Code	Description
		6A	-
	Other safety aspects	7A	-
		8A	-
Accessibility	Accessibility of activities	9A	People should be able to get close to their destination by car (because of transporting goods which is not always possible in other modes)
		9B	Accessibility in general is important, with all modes of transport
		9C	Everyone should be able to participate in society - they should not be dependent on someone else to reach necessary activities
		10A	Accessibility of homes is not too important, clients come more from outside the neighbourhood
	Accessibility of mobility options	11A	Parking should not be too expensive
		11B	Parking on the street should be more expensive for visitors
		11C	(P+R+)PT and parking in parking garages should be affordable (alternatives to parking on the street)
		11D	PT should remain available/no lines should be cut
		11E	There should be good cycling infrastructure
		11F	Distance to PT stops and to services is not too large
		11G	Accessibility of multiple mobility options important (think of good transfer hubs)
		11H	Delivery of goods needs to stay possible
		12A	Accessibility of PT/walking/parking garage is already good
	Inclusive accessibility	13A	Customers should be able to load heavy items in front of the store (to not carry it for longer distance)
		13B	Sidewalks should be accessible for everyone (also with walking aid)
		13C	People who are dependent on cars should not have decreased accessibility due to car-free policies
		14A	-
	Other accessibility aspects	15A	Delivery drivers on scooters or with trucks cause nuisance as well, even when replacing personal car trips
		16A	-
Health	Physical health	17A	Stress, long-term nuisance and air pollution affect physical health
		17B	More seating spaces in the street would help elderly, ill, or injured people and keep them active
		17C	Walking/cycling more keeps you healthy
		17D	More green space is good for physiscal health
		18A	-
	Mental health	19A	It is important to not be fully dependent on others - one should have the freedom to move around independently

Table G.1: Used codes for coding the interview transcripts.

Domain	Aspect	Code	Description
		19B	Personally so used to the noise that you suddenly notice silence when you are away (long-term noise pollution)
		19C	People get happier when looking at green space than at cars
		20A	Used to this noise being around
	Other health aspects	21A	Economic health benefits can be large
		22A	You should not live here if you do not want the nuisance
		22B	I personally feel good already
		22C	Electric vehicles will make car-free unnecessary
		22D	This is not highest priority
		22E	Health is your personal responsibility
Living Environment	Climate	23A	We need to deal with this in the long-term
		24A	-
	Environmental pollution	25A	Speeding and revving cars cause air pollution (PM)
		25B	Littering
		25C	Cars in general cause air pollution
		25D	Air and smell pollution of idling cars
		26A	You should not live here if you do not want the nuisance
		26B	Cars do not make a big difference, first fix other polluters
		26C	Cars will become electric, solving the problem of pollution
	Noise pollution	27A	Noise pollution from speeding/honking cars
		27B	Noise pollution on large scale from living close to road
		28A	You should not live here if you do not want the nuisance
	Vibrations	29A	Vibrations affect settlement of soil and houses/cause nuisance
		30A	You should not live here if you do not want the nuisance
	Use of space	31A	There should be enough parking space
		31B	Parking garages should be used more (than on-street parking)
		31C	There should be less parking-spots on the streets/more parking for bikes
		31D	More green and blue spaces/better esthetics
		31E	Wider sidewalks
		31F	Narrow the streets with planters to reduce speed
		31G	More space for residential development without nuisance
		31H	Less on-street parking used by visitors, it should be available for residents
		31I	More space for children to play
		31J	More space for terraces
		32A	-
	Other living environment aspects	33A	Living environment is important

Table G.1: Used codes for coding the interview transcripts.

Domain	Aspect	Code	Description
		33B	There are strict (inter)national norms for all aspects
		33C	Street is currently being used for driving for the sake of driving and showing off cars
		34A	You should not live here if you do not want the nuisance
		34B	Living environment is already good
Other	Other responses	35A	Local business income is lost with car-free policies
		35B	Should be more enforcement/higher fines
		35C	Separate through-traffic and local traffic
		35D	Alternative last-mile transport should be communicated - resulting in more relaxed street
		35E	Measures should be effective
		35F	Measures should work for everyone
		35G	Behaviour of people is important to consider, this changes in a car
		36A	Measures might not resolve the issues
		36B	I myself do not have much nuisance
	Policy-making process	37A	Not trusting the municipality with doing the right thing, need for professionals and use best-practices
		37B	Municipality should involve more locals/listen to all locals, not only the biggest voices
		37C	Focus on case or neighbourhood specific policy(evaluation)
		37D	Important to find out people's arguments to find underlying problems
		38A	Do not only punish car drivers
		38B	Phased approach should prevent street from being deserted in an instant
General well-being domain priorities		39A	All aspects of well-being are important
		39B	Safety
		39C	Accessibility
		39D	Health
		39E	Living environment

Technological overview of shortlist of indicators

1. **Quality of public space**
   This is a broad indicator, which can be specified for many different aspects of the quality of public space. In essence, this is a qualitative indicator which can only be evaluated using subjective judgement of what contributes to this quality of the public space. Gillis et al. (2015) mention multiple indicators that could serve as a proxy (e.g. area of green spaces or quality of roads), but these only cover certain aspects of the 'quality of the public space'. They conclude that this indicator can best be measured by the reported satisfaction with the public space in a survey conducted among user groups. This makes this indicator inherently difficult to evaluate in ex-ante evaluation - one would for example need a stated preference survey with different future scenarios. For evaluating this indicator in models, one would resort to the proxy indicators as mentioned by Gillis et al. (2015), which would largely be based on geographic data models.
2. **Ratio of green and grey space**
   This indicator is one of the proxy indicators that Gillis et al. (2015) mention for the quality of public space. It can be measured in percentages of green and grey spaces out of the the total case study area (Sustainable Cities International, 2012; Vonk Noordegraaf et al., 2021). Geographic data models can be used to quantify this indicator in ex-ante evaluation. This does require a dataset containing geographical data about land-use (parks, vegetation, buildings, etc.) and if relevant also about public land versus private land. The latter can be relevant if the focus should specifically be on public areas - relevant for recreation contexts - instead of the whole case study area - which might be relevant in the context of heat or water.
3. **Use of space for parking**
   Since this indicator is also related to land use, it requires similar models and data as the previous one. Using geographic data models, this indicator can be quantified - given that the necessary data is available. Specifically for this indicator, extra data regarding parking costs and availability periods is necessary to gain more insights into the usefulness of the parking spaces in the model scenarios. Also the type of parking spot, and potentially the presence of charging infrastructure could be relevant. The temporal usage of spaces for parking could be modelled by making a connection to a macroscopic transport model for aggregated statistics of parking space usage in zones, or a large-scale microscopic transport model for dis-aggregated and detailed modelling of the usage of specific parking spots.
4. **Perception of parking**
   The perception of parking is a subjective indicator. Similarly to the quality of public space, this indicator could be evaluated using proxy indicators which can be quantified. One could think of proximity of parking spaces to dwellings, amenities at the parking facilities (e.g. surveillance or charging infrastructure), or costs of parking. These proxy indicators rely mainly on geographic data, while the perception of parking also relies on input from stakeholders (e.g. in a survey)

to account for the subjectivity of the indicator. This makes it difficult to model the perception of parking for ex-ante evaluation.

5. **Price-to-quality ratio of mobility options**
   The price-to-quality ratio of mobility options relies on the one side on the objective costs of mobility options and on the other side on the subjective quality of the mobility options. This quality aspect could contain elements such as travel time and comfort, but it still needs to be further determined how to get from these (proxy) indicators to the overall quality (Vonk Noordegraaf et al., 2021). The ratio between the cost and quality of mobility options can only be quantified to some extent if the quality can be expressed in an ordinal, interval, or even ratio level of measurement[1]. Both components of this indicator could be quantified in micro- and macroscopic transport models -respectively for individual travellers and aggregated over zones.

6. **Proximity of mobility options**
   The proximity of mobility options is an objective indicator. It can be determined in geographical data models (e.g. distance between dwellings and the nearest public transport stop or parking garage). However, it could also be derived from transport models as the access or egress time/distance for public transport - or when parking is also integrated in the model, the access/egress time/distance to the parking location. Note that this might work best in microscopic (agent-based) models since one would need an individual's residential location to compute access/egress times. Also the aggregation into zones that often takes place in higher level (macroscopic) models decreases the level of detail of this indicator - e.g. there can be multiple bus stops within a zone, a nuance that is lost in macroscopic models. This could be mitigated - also in macroscopic models - by not specifying the indicator on zonal level, but on a more dis-aggregated level such as residence locations, even when the transport model does work on zonal level. This would require the data about locations and mobility options to be disaggregated as well.

7. **Number of activities within reach**
   The proximity of activities is an objective indicator that is determined using a transport model. This could either be a macroscopic model for an aggregated measurement on zonal level, or a mesoscopic[2]/microscopic model for a dis-aggregated measurement on personal or household level. This indicator can be defined for all different modes, for different acceptable travel times (which can be case-specific), and even with different acceptable travel times for each mode of transport. Note that when the acceptable travel time for a mode is lower than the intra-zonal travel time for that mode, the macroscopic model does not offer enough detail to properly quantify this indicator. In this case, one cannot travel through the whole origin zone within an acceptable travel time, so not all activities within the origin zone are within reach, leading to the need for more detail than this aggregated zonal level.

8. **Number of persons within reach**
   This indicator is similar to the previous one. It is also best determined in a transport model. The choice for a microscopic/mesoscopic or a macroscopic model depends on the level of detail of the models, on the acceptable travel times that are taken into account, and on the case-specific requirements of the policy-maker - e.g. what level of detail is preferable.

9. **Mix of traffic on the road**
   The mix of traffic on the road is an indicator that can be defined in two ways. First, it can be defined with geographic data about which roads allow which modes to enter. This results in an output indicator which only measures the realisation of policy input (Methorst et al., 2010). Secondly, it can be defined in more detail by using a transport model to obtain the intensities of the different modes on a road. This would result in an outcome indicator that measures the effects of the policy outputs (Methorst et al., 2010). The transport model used for this can be macroscopic, as

[1] If quality is expressed in an ordinal manner, price-to-quality ratios can be compared and evaluated only in qualitative ways. When an interval measurement can be determined for the quality, the price-to-quality ratio can be compared and evaluated in a more quantitative way.

[2] Mesoscopic models are the middle ground between microscopic and macroscopic models. It does have a higher level of detail than the zones of macroscopic models (e.g. households), but refrains from the detailed interaction and behaviour aspects that are common in microscopic models (Nguyen et al., 2021).

for this case, the intensities on the road are a high enough level of detail. However, a microscopic model could yield more detail about the interactions of the different modes on a road. This can be especially relevant for the traffic safety context of this indicator.

10. **Number of accidents**
The number of accidents is difficult to model and predict in an ex-ante evaluation since this is essentially an outcome indicator - where it is mainly a statistic from accident counts over a certain time. Quantifying this indicator would most likely require a combination of geographic data related to the infrastructure and a transport model to model the flows on the infrastructure. The prediction of the number of accidents can then be done in two ways. Existing accident data could be analysed and the number of accidents on a road can then be predicted using some statistical analysis model (e.g. Briz-Redón et al. (2022) use logistical regression). Another way of predicting the number of accidents would be through simulation in a microscopic transport model. For this, the interactions between traffic participants need to be modelled in detail and many parameters regarding accident probability need to be determined. There have been some efforts in performing these simulations (such as the car-following model used by Bevrani and Chung (2012)). However, there is still more research and development needed in order to be able to estimate the number of accidents in a future situation using large-scale, multimodal, microscopic simulations.

11. **Number of fatalities/injured**
The number of fatalities or injured is a similar indicator as the number of accidents. However, for this indicator, an extra modelling layer is needed. On top of the number of accidents, the impact of the accidents needs to be determined. Therefore, some accident impact model must be used. This again can be based on a statistical analysis of historical accident data (e.g. AlMamlook et al. (2019)), or on an advanced microscopic simulation.

12. **Noise exposure**
The noise exposure is an indicator of longer-term noise nuisance at certain locations. Since this mainly regards noise from traffic and transport, a transport model is the basis to calculating this indicator. Since it regards longer-term exposure, a macroscopic model can suffice for most cases. On top of a transport model, an extra tool is needed to model the noise emission and propagation. The Common Noise Assessment Methods (CNOSSOS) as developed by the EU can be used for this (Stylianos et al., 2012). For the Rotterdam case, this method should be adjusted to conform to the standardised calculation method (Dutch: Standaardrekenmethode (SRM)) that is used in the Netherlands (Rijksoverheid, 2015). As input for these calculations, not only the traffic flows are necessary input, but also data about the (average) vehicles, the infrastructure and the surrounding built up areas (Dittrich & Sliggers, 2015).

13. **Noise emissions**
For the noise emissions, the required calculation is more simplified than for the noise exposure. This indicator disregards the exposure and built up area aspects of the previous indicator, and mainly focuses on the noise produced by the vehicles in combination with the infrastructure (Dittrich & Sliggers, 2015). Therefore, less data is needed as input, and a more simplified model can be used on top of the transport model (which delivers the traffic input for the noise model).

14. **Contribution of mobility to concentrations of NOx, PM, etc.**
The contribution of mobility to concentrations of NOx, PM, etc. is again an indicator that requires a combination of two models. First, a transport model is required to model the intensities of the different modes on the network. This can be a macroscopic model - which will result in averaged emissions of overall intensities on the network - or a meso-/microscopic model - when more detail is necessary regarding acceleration and deceleration of vehicles. The second model layer is required to model the emissions of the vehicles and the resulting air quality around roads. For this second model, the Dutch government has a calculation tool with two standardised calculation methods - one for inner city roads and one for extra-urban roads (IenW, n.d.-b). Next to data regarding the infrastructure and intensities, this tool also requires the levels of congestion during a day specified for different categories of traffic (IenW, n.d.-a). This should be an output of the underlying transport model.

15. **Social safety score**
Social safety is an inherently subjective concept. It must be (partly) based on surveys because

it takes into account people's perceived levels of safety and cohesion (as also discussed by Ruijsbroek et al. (2015)). Therefore, it is difficult to model for ex-ante evaluations. Some potential proxy indicators could be specific crime and vandalism records (Gemeente Rotterdam, n.d.-b). However, since the subjective aspect is so important for this indicator, these proxies do not cover the full concept of social safety score. Therefore, in the state-of-the-art, it seems not possible to model the social safety score for policies that are not implemented yet since there remains a need for input from the public regarding their experiences and feelings. This data is difficult to gather using a stated-preference method - which would be necessary for policies that are not implemented yet.

16. **Time spent in active travel**
The main requirement to use the time spent in active travel indicator is a suitable transport model. With macroscopic models, the share of active mode travel can be determined per zone. Also the trips made by active modes and their distances/travel times can be determined. Combined, this can be used to determine average time spent in active travel on zonal level of detail. However, not all transport models include all active modes - walking behaviour is often not modelled in detail (Gillis et al., 2015). This is a requirement for this indicator, since walking is an important active mode. Also the walking component in multi-modal trips (e.g. as access or egress mode) should be considered.

Implementation issues for use of space for car parking indicator

As mentioned in section 6.2.4, the implementation of the use of space for car parking indicator yielded some unrealistic results. Some occupation rates were found to be larger than one. This means that the parking intensity exceeds the parking capacity. The Traffic+ module uses a BPR function for the calculation of the additional travel time due to parking pressure. With this function, the travel time increases exponentially when the intensity increases and continues to increase exponentially when the capacity is exceeded. This results in extremely high travel times on trips towards zones with high parking pressure. Table I.1 shows a sample of four trips in the network with their respective travel distances and travel times in reality and in the model with or without parking activated. It shows that the travel distance and time in the model are in the same order of magnitude as the real values before parking is activated (note some differences may occur due to the model network not 100% matching reality). However, when parking is activated, the travel distances all increase by 6-7 kilometres. This is remarkable since the same trip might now suddenly take a significantly longer distance. The travel times increased by a realistic amount for two OD-pairs, while the two other travel times increased to extremely high, unrealistic values.

Table I.1: Sample of four trips with their travel distance and travel time in reality, in Urban Strategy (US) without the parking aspect activated, and in US with the parking aspect activated.

		Reality (Google maps)		Urban Strategy without parking		Urban Strategy with parking	
Origin zone	Destination zone	Travel distance [km]	Travel time [h]	Travel distance [km]	Travel time [h]	Travel distance [km]	Travel time [h]
2215	1334	5.1	0.28	6.8	0.23	12.5	10135.3
2215	1340	4.2	0.23	5.9	0.21	11.9	0.27
195	1340	5.6	0.21	5.3	0.17	11.3	0.23
195	2336	14.6	0.36	11.6	0.19	20.4	6.85

These unrealistically high travel times impact the utility of cars in the mode choice model (NMM) significantly, decreasing the share of car trips to the unrealistic value of 15%. Therefore, some attempts were made to mitigate these extreme impacts of including parking in the modelling.

- The increase in the travel distance was caused by the method of simulating the parking and applying the BPR function. This added 6 kilometres to all travel distances. A constant of -6 kilometres was added to all distances to mitigate this.
- High parking times are caused by a high parking intensity compared to the parking capacity. This yields high travel times in a BPR function. Some zones had parking occupancy rates of more than one. Meanwhile, some nearby zones with large parking garages were experiencing no parking intensity at all. After manual checks, it turned out that in the entire network, over 40

zones that had a minimum parking garage capacity of 160 spaces were not correctly connected to the network. Therefore it was more difficult or impossible for cars to reach these zones, making their capacity (almost) unusable. For all these zones, the connection issues were solved manually. This ensured that these parking capacities could be used.

- Traffic+ uses a parameter for the maximum walking distance between the destination zone and the zone in which a car is parked. This parameter was increased from initially 375 metres (in line with the threshold distance used for bus stops in the number of mobility options indicator) to 500 metres and later 1000 metres. The hypothesis was that this would make more parking capacity available around high-demand destinations. However, this did not seem to have a major impact on the results.

The above-mentioned mitigation measures did not solve the unrealistic results. The travel times remained unrealistically high for many trips and this caused the model split to be unrealistic as well. There could be two explanations: the capacities are too low, or the impact of high parking intensities on the travel times and the modal split is too large.

1. Too low parking capacities could be caused by two factors: too few spaces, or too many residents' cars occupying spaces. For the first factor, the parking space data should be checked for completeness. In this case, the parking capacities of the small municipal parking garages are missing. This impacts the parking capacity negatively and increases parking pressure.

   For the second factor, there might be an overestimation of car ownership in zones. This is based on the synthetic population data in US, which might be inaccurate in representing the actual population. Another possibility is that the assumption that all these cars are parked in their own zone is not correct. If these cars are in reality parked in parking garages in other zones, the model might overestimate how many of the parking spaces in a zone are already occupied by residents.

2. If the problem is that the impact of the parking intensities on the travel times is too high, the BPR function for parking in the Traffic+ module might have to be re-calibrated. Likewise, if the problem is that the high parking times impact the mode choice model too significantly, the mode choice model might have to be re-calibrated. A possibility here is to give parking time a different weight than travel time and therefore limit the impact of parking time on the total travel time. Overall, some more research might have to be done into the combination of this parking aspect of Traffic+ and the mode choice model of the New Mobility Modeller. The implementation of this indicator allows for testing that interaction. This does need to be validated before it is used in practice.

These two options can serve as recommendations for future research for the further implementation of this indicator specifically in Urban Strategy. However, the available time and resources for this thesis, and the limited scope, did not allow for further researching these options or implementing any further recommendations.

Specification MSc Double Degree

This thesis contributes to completing an Individual Double Degree (IDD) programme at TU Delft. The IDD consists of the Transport & Planning (TP) track of the master programme of Civil Engineering (CIE) and the Projects & People specialisation of the master programme Construction Management and Engineering (CME). The thesis counts towards both master programmes. That is why the topic is also chosen to be at the crossroads between the two programmes.

In total, this thesis is worth 45 ECTS. The rough division of these credits over the four sub-questions can be seen in figure J.1. Sub-questions 1 and 2 count towards both master programmes since this part of the research is relevant for both fields. The third sub-question adds a more technical aspect to the thesis and falls solely under Transport & Planning. Sub-question four goes deeper into the applicability of the indicator selection process and the operationalised indicators in practice and therefore falls under Construction Management and Engineering. This division results in a total of 40 ECTS for T&P and 30 ECTS for CME.

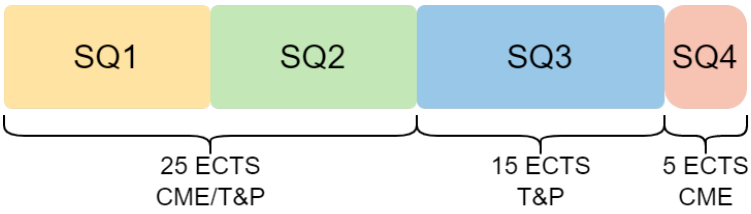

Figure J.1: Division of 45 ECTS over the different sub-questions and the two master programmes.

The common part (first two sub-questions) of this thesis combines the expertise of the two masters. With the transport policy expertise from T&P and the stakeholder management expertise from CME, this part yields integral research into the stakeholder interests in transport policy (effects) and relevant indicators to represent this. The results of this part - which can be found in chapters 4 and 5 - provide a first insight into the potential of well-being indicators in representing local stakeholders in car-free policy evaluation. The 25 ECTS that were allocated to this part represent not only the results in chapters 4 and 5, but also the other common parts such as the introduction of the research, the (multidisciplinary) literature review, the discussion and the conclusion. All these parts combined the two master programmes by approaching the topic in an integral and multidisciplinary manner.

The T&P-specific part (sub-question three) takes a technical approach to operationalising the relevant indicators. By not only concluding relevant indicators but actually quantifying and operationalising them in an existing transport model, this part adds more technical depth to the thesis and increases the potential of implementation of the indicators in practice. The results of this part can be found in chapter 6. This part was allocated 15 ECTS and included exploring the urban strategy model, researching quantification approaches for the three indicators, and the programming involved in operationalising the indicators.

The CME-specific part (sub-question four) focused on the applicability of the results - both for the developed well-being indicator selection process and the operationalised indicators. By validating the applicability of the operationalised indicators in different scenarios, and validating the method and the results with involved experts/stakeholders, this part provided practical recommendations for implementing the selection method and indicators in practice. Therefore, this part contributes to bringing the theoretical thesis results to practice and increasing the potential impact of this thesis in policy-making. The results of this part can be found in chapter 7. The five ECTS allocated to this part represent the indicator case study, the validation interviews and the analysis of the interviews.