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Mixed methods approach to assess equity in potential expansions of public transport by rail (RPT)

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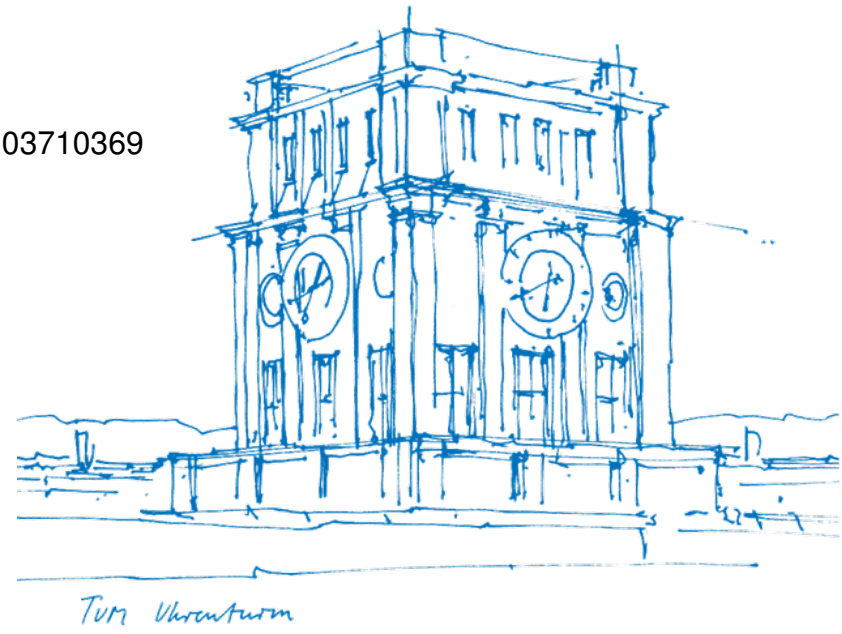

Abstract

To ensure a sustainable future of cities and avoid a collapse of transportation systems despite a constant growing number of inhabitants, public transport networks need to be expanded. In comparison to busses, public transport by rail (RPT) offers more capacity and is renowned to be more comfortable and reliable. This transportation mode does not only generate an added value for passengers but for the urban development as well, as an improved accessibility to RPT enhances the amount of social and economic opportunities residents could have. Therefore, its expansion should be planned equitably and not only based upon ridership numbers, so that underprivileged individuals might have the chance to benefit more. To achieve this, there is a need to assess how equitable potential RPT expansions are. Previous research on transport equity has either been done using quantitative deprivation indexes, or qualitative data using focus groups, while the use of both type of methods in literature is scarce. However, combining both methodologies has proven itself to be almost unavoidable when equity needs to be assessed. This is why a mixed-methods assessment will be proposed and applied on the RPT system in the German city of Munich, with the aim to enrich the landscape of equity assessment methods and highlight the importance of this type of methodology. Thus, relatively low correlation coefficients of the mean RPT station density and diverse socio-economic and demographic factors, as well as population differences in- and outside isochrones around RPT stations have been found out, whereas interview respondents revealed dispersed inequity situations. Hence, this research discloses a majorly equal allocation of RPT stations in its future system, in spite of smaller scattered inequity manifestations over the city and points out other factors that impact equity on accessibility to RPT. The chosen methods have proven themselves to be simple to reproduce and to understand without compromising the precision of the results.

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Chapter 1

Introduction

Cities population keep growing [Bundesregierung, 2018] – so does the number of inhabitants that are mobile every day [BMVI, 2022]. This growth is not only increasing traffic on street level but also on rail tracks. The German State railway (Deutsche Bahn) states that the suburban train in Munich, that was originally designed for 250.000 passengers per day is now being used by over 700.000 [DBAG, 2017]. For instance, the underground section of this service is already running at its limits [DBAG, 2017]. According to the Agenda 2030, the eleventh goal is concerning sustainable cities and communities, which includes making mobility safe, affordable and sustainable - for that, there is a need to expand rail transport infrastructures [Bundesregierung, 2018].

In comparison to busses, public transport by rail (RPT), such as trams or metros, offers more capacity and have been perceived to be a more comfortable, reliable, and a faster way to travel. RPT does not only generate an extra value for travellers in comparison to busses, it could also improve its ability to be competitive with private car commute [Bunschoten et al., 2012]. Above all, RPT stations also create centralities, where mix of use and development is compact within walking distance [Duncan, 2011]. This phenomenon, which is also called transit-oriented development (TOD), shows that living near RPT stations comes with higher property values as it provides a higher accessibility [Duncan, 2011].

Major German cities have formulated goals in a public transport action plan (Nahverkehrsplan / NVP) for the years to come. In the latest release of Munich's public transport action plan, the city decided to majorly focus on the expansion of the current tram network as well as some metro lines [München, 2021]. Numerous areas are scheduled to improve rail transport accessibility by the end of this decade. Moreover, the

"New urban Agenda" of Germany sets social inclusion as one of their main goals to strive towards a sustainable development of cities to prevent the exclusion of the underprivileged population [Bundesregierung, 2018]. For instance, Munich's action plan states the need for an evaluation whether social standards should be established for the current and future public transport action plans [München, 2021].

Some inhabitants might rely on RPT more than others; however, their stations cannot be reached by everyone yet. As access to RPT may enhance accessibility to social and economic opportunities, their stations should therefore be distributed to the neediest part of the population [Duran-Rodas et al., 2020]. This distribution criteria is also called equity and consists in allocating resources according to the greatest need. By achieving this, the RPT expansions could not only bring a greater acceptance in the population and support social inclusion [Ricciardi et al., 2015]. Previous assessments of equity done on RPT are either quantitative by using equity or deprivation indexes, or qualitative methods by implementing individual's mindsets. Furthermore, numerous assessments emphasize the exclusivity of fast and efficient mobility to a wealthier part of the population, however, these studies have not focus on the fact that mobility needs are for everyone [Duran-Rodas et al., 2020], [Ren et al., 2020]. And that is why I am going to do a mixed methods assessment, making use of both quantitative and qualitative methods, and focusing my research on the fact that mobility in general is or should be available for everyone.

Planned expansions have usually been decided upon ridership and predictable numbers of passenger growth which shows a lack of equity assessment in the planning of RPT expansions [Saif et al., 2019]. Thus, RPT expansions should be equity based to ensure the participation of underprivileged individuals in social activities of any kind and reassure a greater accessibility to opportunities. To achieve a sustainable development of cities on a social perspective, there is a need to assess whether the planned expansions of RPT are equitable.

Therefore, the objective of this research is to assess how equitable the expansion of RPT is by taking the rail transport coverage in Munich as a case study. In a first step, this should help to understand if and where there is a lack of equity in RPT coverage in Munich, while a second step will highlight the planned expansion's impact on equity in accessibility to RPT. To achieve the main objective of this research, both quantitative and qualitative methods will be used as a mixed-methods approach.

This research will start with a literature review in which socio-economic impacts of RPT systems in cities will be described, as well as the state of the art in accessi-

bility planning and equity assessment methods. After that, the methodology to assess equitability will be presented and applied on the city of Munich. This chapter will be followed by their results, and finally by a discussion in which both quantitative and qualitative data will be analysed together.

Chapter 2

Literature Review

In this chapter, the state of the art of research about the socio-economic impacts of RPT in cities as well as the principle of transit oriented development will be presented. In addition to that, accessibility planning and assessment tools will be shown and a definition of equity as well as an explanation of its assessment methods will be given.

2.1 Socio-economic impacts of RPT in cities

2.1.1 How RPT shapes cities

In a first section an explanation will be given on how RPT shape cities into centralities, where density of goods, services and opportunities are high and what the benefits for inhabitants are by accessing or having them close by. These theories will be accompanied by researches led in the United States and Europe.

Culver [2017] relates the American streetcar reincarnation (also known as tram) to a creative city project. By that, he refers to Richard Florida's work "The Rise of the Creative Class" which describes a new socioeconomic class consisting of knowledge-based "creative" workers. His research consists of a qualitative content analysis, in which he evaluates information from official websites and project documents of tram projects in the U.S. to explain where the drive to build trams in cities comes from. Culver [2017] pointed out that the concept of trams could boost economic development in a first place. According to his first results, trams could e.g., attract residents, businesses, create jobs and increase property values. Furthermore, he quotes Fort Lauderdale's documents who states that "fixed rail will anchor high-density development in a way that a bus cannot by providing a permanent infrastructure investment".

In other words, living near an RPT station strongly increases the access to goods, services, and opportunities.

The effect Culver [2017] observed on streetcars in the U.S. can be broadly defined as Transit Oriented Development. A concept that Duncan [2011] and Papa and Bertolini [2015] further explained in the following paragraphs.

Duncan [2011] defines Transit Oriented Development (TOD) as a "compact and mixed use development adjacent to a transit station". He goes on by stating that land costs will rise around each station, caused by an increased demand as the location will be highly accessible. In other words, the better the accessibility, the higher the land costs and mix of use will be. The aim of his research was to highlight the influence of TOD on the condominium market in San Diego, CA. He indeed observed the expected effect: A condominium near an RPT station in a (more or less) car-less environment has a much higher value than a similar condominium without an RPT station nearby.

However, Papa and Bertolini [2015] noted that most of research conducted on TOD have been mainly focusing on North America. In a more recent research, they decided to bring to light a correlation between TOD-based urban structure and higher rail accessibility in European cities. By analyzing both aspects separately and combining them later, they indeed found out that e.g. the city of Munich had one of the highest TOD indices - a valuable finding for my future research. In addition to this, they found out that accessibility to RPT was higher in cities with a stronger degree of TOD, which undoubtedly confirms a correlation between them. Papa and Bertolini [2015] also specified similar characteristics of TOD as Duncan [2011] and Culver [2017]. TOD would not only increase ridership, but also economic growth around its transit routes, reduce urban sprawl or create new attractive centralities [Papa and Bertolini, 2015]. Furthermore, they also underline more specific impacts such as TOD being the reason for increased property values around stations [Papa and Bertolini, 2015].

This effect has also been highlighted by Lewis-Workman and Brod [1997] in a much earlier research about neighbourhood benefits of RPT accessibility. They state that property values reflect the inhabitant's willingness to pay for the benefits of a nearby RPT station. They split those benefits into two main categories, the first being associated with resource savings. This category includes savings of time, distance, and costs. Their second benefit is associated with the creation of more opportunities, the character, and the form of neighbourhoods. In other words, an RPT station increases the quality of life and the well-being of inhabitants in their residential area. Lewis-Workman and Brod [1997] rounded out their observation with the example, that RPT

stations tend to have local commercial centres offering both goods and services. In addition to their first category of benefits, inhabitants have a significant increase of opportunities in their neighbourhood but have also a faster access to more centres and therefore services as well.

These researches have also shown that the better the accessibility, the higher the land costs [Culver, 2017, Papa and Bertolini, 2015, Duncan, 2011, Lewis-Workman and Brod, 1997]. However, not all inhabitants have the same socio-economic living circumstances and might not have the ability to choose where to live (e.g. affordability reasons). Moving further away from RPT stations could be associated with decreasing housing costs, but also decreasing accessibility [Culver, 2017, Papa and Bertolini, 2015, Duncan, 2011, Lewis-Workman and Brod, 1997]. In the following section, it will be explained how poorer accessibility affects inhabitants in a social and spatial context.

2.1.2 The effects of a poor or non-existent RPT accessibility

As seen in the previous section, a good accessibility to RPT offers a wide range of benefits. The following section aims to raise awareness on problems that might arise if accessibility to RPT is poor or non-existent, but before we start, a definition of the broader term of accessibility will be given.

Saif et al. [2019] published a literature review about public transport accessibility in which he analyses PT accessibility in different contexts such as mobility, sustainability, social opportunities or even employment rates. He defines accessibility as being "the physical access to goods, services and destinations". However, in this research, opportunities will be added to the definition as well, as it serves wider aspects of benefits such as job and social opportunities for individuals.

The importance of accessibility to opportunities has also been underlined by Geurs and van Wee [2004]. Geurs and van Wee [2004] published a research about review and research directions for the evaluation of accessibility, in which different components and perspectives of accessibility measures were given. First, they identified four types of components, which are the land-use, transportation, temporal and individual one [Geurs and van Wee, 2004]. The land-use component is defined as e.g. the amount of opportunities that can be accessed at each destination or their respective demand. Moreover, the transportation component considers all aspects of transport provision, transit time, effort and costs on a specific route. The third component is defined as the temporal one, in which some opportunities might only be available at specific times

[Geurs and van Wee, 2004]. However, this component will be of less importance for this research. Lastly, there is the individual component, that takes specific needs into consideration which depend on the individual's age, income or physical abilities [Geurs and van Wee, 2004].

After these definitions and concepts have been explained, examples on how low accessibility to RPT affects these subjects will be given.

A common and heavily discussed and disputed matter is a correlation between PT accessibility and employment rates. Sanchez [1999] further assessed this possibility in an early work making use of a GIS analysis on Portland and Atlanta. Indeed, he observes that PT access is a key factor to determine employment rates. A more recent study has been carried out by Johnson et al. [2017] in 2017, in which he used employment as a function of accessibility and added other variables in associations with labour. Similarly as Sanchez [1999], he found out that there is a significant correlation between PT accessibility and employment. Johnson et al. [2017] associates higher employment rates with shorter PT transit times. This correlation has also been discussed in the U.S. as their RPT infrastructure is scarce, non-motorized households tend to have problems finding a proper employment. Employers often require them to have a driver's license, as PT is seen as unreliable or cannot be accessed [Hesse and Scheiner, 2010, Culver, 2017].

By this example of the influence on employment rates, a negative impact of missing or poor accessibility to RPT on the labour market can be disclosed. The reasons are diverse, ranging from excessive transit times, unreliability of transport services or just a lack of this type of infrastructure.

Accessibility to public transportation can influence a wide range of aspects. Saif et al. [2019] reviewed the impact of PT accessibility on public health, mobility, sustainability, and social exclusion. However, Hesse and Scheiner [2010] stated that due to an unequal distribution of income, accessibility of PT is more and more related to the aspects of social ex- and/or inclusion. Thus, only the socio-economic aspect will be relevant in this research. In the following section we will elaborate how poor or missing accessibility to RPT affects social opportunities and therefore might lead to the process of social exclusion.

2.1.3 What defines social exclusion

An agreement on a proper definition of the term of social exclusion doesn't exist. Thus, a definition from Preston and Rajé [2007] will be used, as it is the most suitable in the context of this research:

> "Social exclusion is a constraints-based process which causes individuals or groups not to participate in the normal activities of the society in which they are residents and has important spatial manifestations."

Preston and Rajé [2007] adopted this definition in their research paper, in which they examined the rise of a social exclusion policy paradigm. They also state that social exclusion is caused by an increase in individualism due to technological developments such as cars or entertainment devices at home. They go even further and postulate the idea that this issue is not linked to missing social opportunities but rather a lack of access to them. According to Preston and Rajé [2007], policy makers should rather focus on the ease of reaching (accessibility) than the ease of moving (mobility).

Seven types of accessibility related social exclusion haven been identified by Wixey et al. [2005]. First, there is the spatial one, in which individuals have a difficulty to access places in relation to where they live. Then there is the temporal one, where people cannot access areas in a certain and desired times (e.g. early mornings or at night). This is followed by the personal one, an issue mobility impaired experience, but also individuals scared to leave their homes at certain times. The Financial aspect also plays a role, as some for some people the cost to access a place is seen as excessive. There is also an environmental aspect, which characterizes itself by the exposure to traffic pollution and accidents of vulnerable groups of inhabitants. The infrastructural aspect is the one that will be further assessed in this research as it affects the access to opportunities by transport infrastructure. Lastly, there is the institutional one where organisations or groups exclude certain groups based on a different interest. However, only the spatial accessibility aspect is fully incorporated in most and current quantitative tools to plan accessibility.

More recent research conducted by Pooley [2016] takes another approach and defines social exclusion as a "multi-dimensional process". He cites the Foundation [2000] who splits this process into four distinguished dimensions. One being an exclusion from resources and income, the other from labour market, from services and lastly from social relations. In his evidence-based research, he uses a similar postulation

about transport-related social exclusion, stating that it is not about transportation itself but much more about non-transport factors such as power, choice or accessibility.

The lack of access to opportunities and the closely related effect of social exclusion is highlighted in most of the existing research papers. Combining Pooley [2016]'s and Preston and Rajé [2007]'s or Saif et al. [2019]'s postulation, having poor access to RPT eases the process of social exclusion. Hesse and Scheiner [2010] underlines the fact, that poor accessibility to PT is a growing problem and making social inclusion even more difficult in our flexible and mobile society. In his research conducted on the city of Cologne, which will be further analysed later, he mentions that PT accessibility problems are especially affecting non-motorized households. According to him, this problem has been further discussed in the U.S. where a scarce PT infrastructure leaves non-motorized households with no alternatives and therefore no access to opportunities. Thus, he confirms that social exclusion is induced by missing accessibility to PT. Pooley [2016] goes even further and explains that it might not only reduce chances of employment and social opportunities but can go as far as ill-health due to ongoing frustration and isolation.

This section explained that social exclusion has a wide range of causes, one of them being transport induced, which means that the accessibility to RPT is poor. To counteract the effect of social exclusion, an enhanced accessibility to RPT infrastructure for those who need it the most is required. In other words, RPT infrastructure needs to be planned equitably. Therefore, these observations highlighted the fact that accessibility is a valuable indicator to assess equity. Thus, different approaches on how to plan and measure accessibility will be seen first before the issue of equity and its assessment methods will be tackled.

2.2 Accessibility planning and assessment

As accessibility is an indicator to assess indicator, it is just as important to understand how accessibility can be assessed and therefore be planned. Accessibility to RPT can be assessed in quantitative and qualitative ways to allow its planification. In this section, different methods will be showcased, starting with quantitative ones, to highlight both possibilities and limitations of selected tools.

2.2.1 Quantitative tools

Preston and Rajé [2007] enumerate different approaches for accessibility planning tools policy makers could or already make use of. In their previously cited paper, he states that one of the earliest methods is to use a GIS (Geographic Information System) based accessibility analysis with isochrones. Isochrones are lines that showcase same or equal times. In the context of this research, it is used to show e.g. a radius around an RPT station with an equal walking time. This tool will also be implemented in the research methodology, as it is a simple way to visualize which area has a rapid access to a neighbouring RPT station. Limits of this tool are that they can weakly recognize dispersed manifestations of social exclusion processes. However, this tool will be sufficient for the proposed method as it will be complemented with qualitative ones. Preston and Rajé [2007] showcases other methods such as the Accession software by MVA and Citilabs, consisting in a mapping tool including contour maps and the "Hansen and logsum measures of accessibility", a concept which is further developed in their paper. Another method could also be a quantitative analysis with surveys based on questionnaires. This method is, according to Preston and Rajé [2007], more disaggregate and helps to identify more scattered manifestations of excluded areas. There is an even more advanced methodology, in which more detailed surveys are carried out and a synthetic population based on census data is being simulated. However, these methods won't be further adressed as they are not relevant for my research. Preston and Rajé [2007] also highlights the fact, that even after their research on accessibility planning tools, the results are still too aggregate to assess issues like social exclusion.

Furthermore, Pajares et al. [2021] developed a tool called "GOAT" which stands for "Geo Open Accessibility Tool" as they wanted to address a lack of interactive accessibility planning instruments in their research. In this tool, Pajares et al. [2021] implemented both gravity and contour-based accessibility measures to calculate and visualize accessibility to any kind of infrastructure. Contour-based accessibility measurement will also be featured in this research as part of isochrones, as RPT stations are treated equally and are not weighed. GOAT aims to support the accessibility planning process by assessing accessibility situations quantitatively, which has been tested on the city of Munich with success.

Papa and Bertolini [2015] also developed an accessibility measurement tool in their aim to find a correlation with the TOD structure of selected European cities. They

created a "node index", a so-called "closeness centrality index", which consists of "the inverse of the average cumulative distance from an AZ to all the AZs in the study area" and walking distances from and to accessibility zones (AZ). After that, they summed up all jobs and inhabitants that could be reached for each accessibility zone to build their accessibility variable. Later on, they also made use of GIS software to visualize accessibility patterns over the studied area. However, Papa and Bertolini [2015] assumed a constant commuting time which might have an impact on the validity of their accessibility variable. Papa and Bertolini [2015] also stated that this tool is too aggregate and that the subjectivity in terms of accessibility is being left out.

Liu and Zhu [2004] did not include the aspect of subjectivity either. They presented an integrated GIS tool called Accessibility Analyst, which aims to put together three defined levels of accessibility: one being opportunity-based, followed by gravity-, and utility-based. However, they could not integrate constraints such as space-time or time-budget. Both of them are indicators that could be assessed qualitatively. The quantitative tools presented by Liu and Zhu [2004] and Preston and Rajé [2007] are more adapted to help local authorities to picture broader areas of deprivation as well as computing travel times of those to plan accessibility on a larger scale [Preston and Rajé, 2007]. To implement the aspect of subjectivity into accessibility planning and fill the gaps and limitations highlighted above, there might be a need to include qualitative tools. This matter will be further developed in the following section.

2.2.2 Qualitative tools

Jones [2011] developed and applied qualitative interactive visual tools to assist accessibility planning for mobility disadvantaged groups. The reason he chose a qualitative analysis over a quantitative one, is that he defines them as being "narrowly focused", and that they miss more aspects of accessibility. Therefore, he conducted a research in the area of Barnsley Dearne in South Yorkshire to identify potential accessibility problems for residents and their respective requirements for residents. His workshop-based research was carried out on both local residents and professionals (e.g., senior representatives of public transport, social services etc..). Similarly as Shay et al. [2016]'s research, schematic maps have been handed out on which participants needed to identify current travel patterns and associated accessibility problems, as well as particular types of facility they might wish to access. In light of this analysis, Jones [2011] observed that accessibility-based problems were found in various sectors affecting es-

pecially single mothers and elderly residents, many of them being part of the seven accessibility-related social exclusion sources distinguished by Wixey et al. [2005] and cited above. The results were then codified in a spreadsheet tool. In conclusion, this approach helps to identify real and local problems from a resident's eye, quantitative accessibility planning tools oversee. Therefore, a lot more dimensions of accessibility related problems can be brought to light than quantitative tools could do.

These examples showed that a much higher number of interviews and workshops would be required if accessibility would be planned with qualitative tools only. However, they point out different types of accessibility problems that can't necessarily be analysed using quantitative methods. This is why a combination of both methods might be the most favorable way to plan accessibility, an approach that will be showcased in the following section.

2.2.3 Mixed methods approach

Measurement of accessibility became more complex and specific, especially with a growing number of passenger data in public transport such as "general transit feed specification" (GTFS) ([Tiznado-Aitken et al., 2020]). Still, most of the quantitative based research is only a location-based measure. This is what Tiznado-Aitken et al. [2020] states in his mixed-methods approach to understand accessibility through the eyes of public transport users. He explains in his literature review, that this "one-dimensional" measure ignores the individual's perception. Two different persons living nearby might perceive their accessibility opportunities as different, as everyone has its own needs, abilities, or preferences [Miller, 1982]. But this limitation goes further, as this means that it assigns equal accessibility levels to different persons living in the same area. Tiznado-Aitken et al. [2020] confronts both types of assessments and comes to the point that quantitative analysis is made for a large-scale evaluation leaving out smaller individual details. On the other hand, he explains that qualitative assessments have smaller samples but richer data and therefore focuses on individual point of views. Hence, he labels both type of assessments as "hypothetically complementary". Therefore, he decided to start with a qualitative analysis where people talk about their public transport accessibility experiences, followed by a quantitative analysis of the number of public transport trips combined with the different perceptions of walking times and level of crowd. An accessibility indicator should then help to visualize the quantitative findings and later overlay it with the qualitative findings. This research

paper pointed out that both quantitative and qualitative researches are complementary [Tiznado-Aitken et al., 2020]. The first one being "one-dimensional" and implying an equal behaviour of individuals, is in contradiction with the fact that equity and not equality will be assessed during this research. Thus, in this thesis, public transport equity will be assessed based on a mixed-methods approach.

The researches cited above, highlighted the fact accessibility gives valuable insights on growing issues such as transport induced social exclusion [Bantis and Haworth, 2020]. By that, one can assume that accessibility serves as an indicator to assess equity, which is needed to prevent social exclusion. Before equity assessment methods for RPT will be tackled, a broad definition of public transport equity will be given, and insights of equity situations in Australia and in Germany will be provided.

2.3 Public transport equity

2.3.1 Defining equity

When transport equity is being discussed, it is important to differentiate between equity, equality and efficiency. These are the three main distribution rules summarized by Leventhal [1980] and Talen [1998]. Allocating resources efficiently would make it dependent on the people's contribution. Furthermore, equality implies an equal distribution of resources and would happen regardless of the people's needs. Lastly, allocating resources equitably means they are distributed according to the greatest need. Equity is then divided into spatial and social equity which stands respectively for who gets resources and to whom they are being allocated Duran-Rodas et al. [2020].

Ricciardi et al. [2015] took a different approach by assessing inequity and dividing it into three types: horizontal - in other words commonly known as equality, vertical considering socio- economic aspects and vertical considering mobility needs and ability. However, in this research won't differ between the two vertical aspects as they will be assessed together. After these brief definitions it is also important to understand how equitable current transport systems in the world are. The following sections have been split into countries known for a "poorer" and "stronger" use and implementation of RPT systems.

2.3.2 Public transport equity in the world

To further investigate the concept of equity in the public transport concept, the example of Ricciardi et al. [2015]'s study will be taken. This research consists of an investigation of the equity distribution of "three separate disadvantaged cohorts" in Perth, Western Australia. In the context of this research, Ricciardi et al. [2015] connotes elderly residents, non-motorized and low-income households as disadvantaged. Using these differentiations enumerated above and past studies that have examined transport induced social exclusion, he developed a method to identify spatial gaps in transit services as well as a measuring system to compare transport equity in different cities. To achieve this, he combined multiple tools such as the Lorenz curve and Gini coefficient, both used to analyse equality in resource distribution, as well as a public transport supply index to determine areas with better and poorer PT coverage. Applying these methods in Perth (Australia), he found out that disadvantaged social groups such as elderly individuals had the lowest equity of distribution. He also stated that individuals who commonly use PT were the most "disadvantaged by its distribution".

This research underlined the importance of an equitable access to public transport systems, which is still not the state of the art in every city as of today. However, the example above was about Perth, a city where public transport coverage is low and car ownership is high. Indeed, 723 per 1000 individuals own a car. This suggests that some countries are not yet focusing on an equitable access to PT systems. The same statement is given by Culver [2017] with the accessibility to streetcars in the U.S., where this type of transportation has been build in favour to wealthier communities.

Similar findings came also out of Griffin and Sener [2016]'s research they conducted on public transit equity in nine large cities in the U.S. on a metropolitan and local scale. They used accessibility as an indicator to assess equity and found out that changes in transit provide in general an uneven mobility and accessibility. Griffin and Sener [2016] also stated that metropolitan planning organizations in the U.S. did too little to enhance the social and spatial equity situation in major cities. It seems that RPT equity is not yet an area of interest in some countries.

There is indeed a missing or poor PT equity, especially for disadvantaged such as elderly or disabled individuals as Ricciardi et al. [2015] has shown in his research. This problem might also be induced by a certain car-dominance [Culver, 2017, Griffin and Sener, 2016], which is why this problem will be analysed in countries such as Germany, where RPT systems cover a greater area in cities.

2.3.3 Public transport equity in Germany

Hesse and Scheiner [2010] conducted a research in Cologne, one of the most populated cities in Germany, in which he tries to point out evidence of social exclusion in its suburbs. He made use of the number of kilometres and the amount of trips per day and per person. With this data he built a regression model in which he observed that the amount of time spent in public transport was a lot higher than in a car for the same trip. This result shows that point of interests are a lot more difficult to reach, and motorized households profit from a greater access to opportunities. But Hesse and Scheiner [2010] takes a turn and explains that there is also a role of subjective preferences on how and where individuals want to live. He observes that people with a higher preference for their homes and cars tend to live outside the city whereas the ones wanting to live near a higher density of goods and services tend to live in the city centre. Therefore, there supposedly is a positive correlation between car ownership and life in the suburbs and a negative one with owning season tickets for PT. This research proves that living in the suburbs is a challenge without a car, as trips are long and accessibility to RPT is poor. His research also implies, that living preferences and the amount of accessibility is being "bought", without actively taking individuals having a lower income and therefore no choice into account. This is a similar situation that Duncan [2011] pointed out earlier. Households with lower income will most likely be "pushed" towards the suburbs, therefore this will create an inequitable situation.

Literature on mobility equity in Germany is scarce [Shirmohammadli et al., 2016], however they are some interesting findings on more specific themes such as PT equity in migrant communities or working-class areas. Bartzokas-Tsiompras and Photis [2019] carried out a research on 17 European cities to compare rapid transit accessibility and therefore equity in migrant and native communities. They found out, that in major cities such as Hamburg and Berlin, native-born population had an overall poorer accessibility than all other foreign-born populations. On the other hand, this observation could be explained by the fact, that native-born individuals tend to walk or drive a bicycle more often [Shirmohammadli et al., 2016, Bartzokas-Tsiompras and Photis, 2019]. Culver [2017] did also refer to the city of Mannheim, although the research he conducted was about North American cities. His postulation was more positive, as he noted that the RPT system in Mannheim covers each of its districts. Furthermore, the expansion of an RPT service to a working-class area of the city supposedly improved the transit equity situation [Culver, 2017].

An equitable access to public transport is still difficult to find, and a problem in most of the cities. But as Hesse and Scheiner [2010] pointed out, it is difficult to measure inequity as many factors can have an influence on it [Shirmohammadli et al., 2016, Bartzokas-Tsiompras and Photis, 2019]. Because of this, there is a variety of ways to assess equity, which will be showcased in the next section.

2.4 Equity assessment

2.4.1 Quantitative methods assessment

In this first section, different quantitative methods will be showcased and their possibilities and limitations towards equity assessment will be explained. Similarly to the quantitative accessibility planning tools, most of them will be more suitable for larger-scale assessments.

The Lorenz curve has initially been developed and used to graphically represent the distribution of wealth in a population. In the context of this research, it is mostly used to visually represent equality. Delbosc and Currie [2011] implemented this tool in a research he led to assess public transport equity in Melbourne. The Lorenz curve alone cannot be used to assess equity; therefore, he combined this tool with a "public transport index" which included different parameters: he used the location of a stop and frequencies of the transport service. With that he calculated a measure of service frequency and combined it with the access distance to the station. He then mapped and compared the highest amount of Population and Employment and the respective transport supply. According to Delbosc and Currie [2011], these tools can easily help to assess equity on a macroscopic scale, across a geographical region.

Another index has also been created by Duran-Rodas et al. [2021]. In his research about bike-sharing systems (BSS), he published a method to weigh demand and equity when allocating and distributing its stations. As most BSS have never been designed with a focus on equity, the tool helps providers to be both equitable and efficient. Considering this, Duran-Rodas et al. [2021] created a deprivation index to measure the people's need in each of their zones of analysis. The Index includes a percentage of underprivileged population per zone, the level of access to opportunities and their average walking accessibility to those.

A different approach was carried out by Fransen et al. [2015] in his research about the identification of public transport gaps in Belgium. He created two indexes, one

of them being the "Index of Public Transport Needs (IPTN)" and the other being an index about the "Public Transport Provision (IPTP)". With GIS assistance, he calculated these indexes for different zones of analysis in which he included relevant socio-economic factors. Amongst others, age and employment percentage, or even vehicle ownership was taken into account. The Transport gap itself was then the result of the difference between the transport needs and the related provision.

These approaches to assess (in)equity are more on a macroscopic scale and might oversee smaller or scattered manifestations. To further investigate the matter of equity it is important to assess it qualitatively - on a smaller scale.

2.4.2 Qualitative methods assessment

A way to identify inequity on a smaller scale is to make use of quantitative analysis methods. This is what Shay et al. [2016] carried out in their research in which they identified transportation disadvantage in five rural counties in the state of North Carolina (U.S.). Their method consists of a mixed-methods analysis which combines both quantitative and qualitative tools. In this section we will first focus on the qualitative method and come back to the importance of mixed methods later. Shay et al. [2016] asked local informants to identify areas of potential transport disadvantage on a blank map and let them comment by other key informants on how well they might reflect actual circumstances. Later, groups have been recruited to further discuss their knowledge of local conditions. In the end, key informants observed that the drawn maps were useful to identify transport disadvantaged populations, especially in counties whose development pattern is more homogeneous. Shay et al. [2016] draws the conclusion that quantitative methods tend to miss specific populations that may vary by street – a knowledge gap that qualitative methodology can fill.

This research has shown the importance of qualitative analysis, especially in matters of equity and transport (dis)advantage. Gaps and local specificities can be identified by interviews with local inhabitants, an important tool that will be implemented in this methodology as well.

2.4.3 Subjectivity in equity and the advantage of mixed methods

The section above hinted a certain subjectivity on how equitable individuals perceive their accessibility to RPT. In the following section it will be investigated how a combination of both quantitative and qualitative methods help to assess equity in an optimal way, as it aims to implement the aspect of subjectivity into a larger-scale analysis.

If the core definition of equity is being considered, it is defined as the "quality of being fair and impartial". By that, equity comes back to what is considered as being fair. Assessing fairness is subjective, this is also what Duran-Rodas et al. [2020] stated in his latest research about fairness in the allocation of bike-sharing infrastructure. Hence, assessing equity is about analysing what is considered as spatially and socially fair. Duran-Rodas et al. [2020] took the aspect of subjectivity into account by making use of both quantitative and qualitative research methods. According to Goldman and Cropanzano [2015], "Fairness is a subjective assessment of whether or not justice rules are implemented in a morally worthy way". To fill this research gap, interviews might help. Duran-Rodas et al. [2020] made use of a lexicometric analysis to further investigate how inhabitants of the city of Strasbourg felt about the implementation of an existing Bike Sharing System. This subjectivity has also been considered by Shay et al. [2016] and is part of the reason why qualitative research has been implemented in their research. Local specifications tend to be missed as they can often not be measured with quantitative or mathematical approaches. As mentioned before, the interviews helped to fill gaps of knowledge mathematical instruments were not able to do. Moreover, confronting the interviewees with quantitative findings enhances reflection, analysis and optimisation of the results to enrich research findings. As an extent to the researches cited above, the SUMINI ("SUstainable Mobility INequality Indicator") approach should be showcased as well. This tool has been developed by Thomopoulos and Grant-Muller [2013] to bridge a gap between the widely used cost-benefit and the multi-criteria analysis in the assessment of overground transport projects. They later applied this methodology on two Trans-European transport infrastructure projects. It helps to transform the process of decision-making into a hierarchical structure [Thomopoulos and Grant-Muller, 2013]. They developed a scoring system in which project and scheme alternatives are weighted depending on the decision maker which allows them to quantify subjective ideas [Thomopoulos and Grant-Muller, 2013]. According to Thomopoulos and Grant-Muller [2013] this could challenge the debate between

qualitative and quantitative methods simply be making use of both.

In light of these researches, combining both quantitative and qualitative methods seems almost mandatory for a rich and precise equity assessment. Hence, both methods will be combined and used in this research. The chosen methods will be further explained in the following chapter.

Chapter 3

Methods

The objective of this research is to assess how equitable the expansion of RPT is by taking the rail transport coverage in Munich as a case study. In a first step, this should help to understand if and where there is a lack of equity in RPT coverage in Munich. Secondly, it will be assessed whether and how the planned expansions will impact equity on the accessibility to public transport by rail in Munich. To achieve the main objective of this research, a mixed-methods analysis is being proposed to assess equity, which will be applied in a first term on the current RPT system in Munich, and in a second term on the planned expansions in the city. The first section of the methodology chapter will focus on a quantitative approach including the proposed two steps using descriptive secondary data, whereas the second section aims to validate and enrich the findings with a qualitative methodology using primary (descriptive) gathered data.

3.1 Quantitative 2-Step GIS Analysis

3.1.1 RPT station density correlation

Aim and expected outcome

The first step of this quantitative research consists in disclosing which group of individuals has more or less accessibility to RPT, by correlating the mean RPT station density in an area with the different groups of individuals residing there. Based on the resulting correlation coefficients, a linear model will be built. However, before the assessment steps will be detailed, the gathered secondary data sources will be elucidated.

Used data sources

For this part of the methodology, descriptive secondary data gathered from "MiD 2017" has been used, which is an official study carried out by the Federal Ministry for Digital and Transport about the travel behaviour of German citizens [BMVI, 2017]. This will not only give information about travel habits but also demographic and socio-economic information about households per cell which are valuable to this research. This data consists of different categories of variables, in which each variable stands for the respective answer of the "MiD 2017" study [BMVI, 2017]. The data has been cropped to fit the metropolitan area of Munich and a part of its surroundings. All the available data has been used, as the amount of data beyond the borders of the city is little and could increase the precision of the findings. In addition to the information about the population, the RPT stations covering the areas of data availability are needed as well. Those have been located using the GTFS data provided by the local transport company "MVG" (Münchener Verkehrsgesellschaft mbH) [MVG, 2022]. To process the available data, the "qGIS" software has been used, which is a geographic information system application and is frequently used as it helps to analyse and visualize geographical data. Therefore, these two data-sets have then been imported as layers into the "qGIS" software for further analysis [QGIS].

Preparation of the data for the correlation process

To process the data, a heatmap raster of the RPT stations in Munich has been created using the kernel density tool provided by the "qGIS" software [QGIS]. This helps to determine the density of RPT stations in a given area. For that, the following settings have been used: the heatmap search radius of this tool has been set to 500m as the average station density in Europe is set to be at around 400-600m [König, 2013]. The pixel size of the output raster has been set to 10 m, to approximately fit the cells of the MiD data. In addition to the generated heatmap, the area has been divided into zones of analysis (ZA) which were predefined cells by the data gathered from the MiD case study.

After the heatmap is generated and the ZAs are imported, the data is ready to be processed. To identify the mean density of RPT stations per MiD data cell, the integrated zonal statistics tool has been used. This tool is set to calculate statistics of a raster layer - in this case the mean value of RPT stations density per cell. In the available calculation options, the mean value has been chosen over the median, as no

major outliers were expected in the data-set.

This output has then been saved as a table, in which all of the MiD data and the respective RPT station density per cell was listed. All the variable's data columns could then be correlated with the mean value of RPT station density per cell. However, only specific variables were of interest. In the next section, an explanation will be given on which variables have been selected as well as how they have been correlated with the mean RPT station density.

Variable choice and correlation

Based on Ricciardi et al. [2015]'s research conducted in Perth in which he defined disadvantaged inhabitants as low-income, non-motorized households or elderly people, six different categories of variables have been chosen. At first, the economical status of households has been selected. This was followed by the age of residents as well as their activities, in other words whether inhabitants are working, pensioners or students. Lastly, their car ownership and their available transportation methods per household have been considered as well. Those variables as well as 3 other categories that will be explained in the section below have been correlated using the Pearson correlation method.

Variable choice for the linear model

To ease visualisation and further assessment, a linear model has been built using the "RStudio" software. For the choice of variables, all of the available data of the MiD study has been correlated. The choice has then been made upon the highest positive correlations calculated with the mean RPT station density. To ensure that the variables were not significantly correlated to each other, the correlation value had to be under 0.30, a value that has been set empirically to avoid multicollinearity of the variables. Variables such as the frequency of long-distance bus and train usage have been left out as they were considered irrelevant for this research. Furthermore, the amount of variables chosen have been decided upon the comparison of the two previous models. If the R square difference between two models reached a number below 0.01, the R software stated that the model was significant enough to be chosen. Lastly, the variables used for the linear model have also been added to the other correlated variables cited above, as they were not necessarily the same.

3.1.2 Inhabitants living inside isochrones around RPT stations

Aim and expected outcome

To complement the findings of the first step, an assessment has been done on how many inhabitants needed respectively 5 and 10 minutes to access their nearest RPT station. These values have been empirically chosen and built on the hypothesis, that over 10 minutes walking distance might be considered "far". This could be assessed by comparing the percentages of inhabitants living inside a 5 min. isochrone, a 10 min. isochrone or in the whole city. Therefore, this method will provide a table and a bar-chart in which these percentages could be visualized for each group of individuals described below. The percentage differences of people living inside a 5 min. or 10 min. isochrone and the whole city allows to see if the access of a certain group of individuals is increasing or decreasing. This helps to see if some group of inhabitants are being treated inequitably in terms of accessibility to RPT.

Used data sources

The population data has been provided by Dr.-Ing. David Duran and contains information about age and migration divided in small predefined cells. The data-set has been cropped, so that it would only cover the city area of Munich. The exact borders of the city have been identified using postal-code shapes.

Isochrone generation

After the data has been prepared, the isochrones were built using the openrouteservice (ORS) plugin in the "qGIS" software around each RPT station within the borders of the city [ORS]. An exception has been done for the stations of Großhesselohe Isartalbahnhof, Bavariafilmplatz, Neubiberg and Gronsdorf as they provided accessibility for citizens living within the borders of the city even-though they are located outside of it. These exceptions can be visualized on fig. 4.1 on the southern and eastern borders of the city.

The isochrones were built around each RPT station using a walking speed of 5 km/h that was predefined by the ORS provider as it is a standard use in most available routing services [ORS], [Pajares et al., 2021]. All isochrones were then merged and dissolved to two respective layers (5 and 10 min.) to simplify visualization and assessment of

the results. The cells of the population data that was within each type of isochrone were then selected and exported into a table.

The output was a total of three tables: the first for the population living inside a 5 min. isochrone, the second for 10 min. and the last for the city as a whole. In a last step, for each age category and migration background, the amount of individuals have been summed and percentages of the respective total population have been calculated.

3.1.3 Quantitative analysis including the planned expansions

Used data sources

To be able to compare the current system with the future one including the planned expansions, the planned RPT stations have been gathered from press releases of the local transport company "MVG" [MVG]. The planned expansions are limited to 5 tram expansions in the city, as detailed and official plans of further projects and the exact location of their RPT stations have not been published yet [MVG].

Implementation of the data in the proposed methodology

The same procedure has been carried out as explained above including the new RPT stations, which can be visualized on fig. 4.3. However, no routes were available around the station "Bayernkaserne" in the northern of the city. This is why buffer rings were built using empirically 350 m for the 5 min. and 750 m for the 10 min. isochrone to match the size of the ones that were built using walking time.

3.1.4 Justification of the methodological choice

The proposed method is the most adapted for my type of research, as it facilitates the visualisation and interpretation of the results and therefore provides a clear portrayal of the equity situation in the city of Munich. It is also simple to use and extend, especially when the assessed system is getting expanded as it is the case in Munich. However, mainly larger-scale and no scattered inequity manifestations can be assessed by this method. To outweigh this gap, the following qualitative method will be proposed.

3.2 Qualitative Analysis

Aim of the methodology

For the second section of this mixed-methods assessment a qualitative method is being proposed, consisting of primary data collected in interviews aiming to see how fair the interviewees perceived location and frequency of current and planned RPT lines and stations. Finding out local specificities and their own perception on equity in terms of accessibility in their own circumstances, neighborhood and the city as a whole could enrich quantitative findings and complement large-scale quantitative results.

Participant selection and format choice

Therefore, a total of four participants have been selected and ensured, that they are of different age, living circumstances and reside at different locations in the city to allow more diverse point of views. The interviews were held in a semi-structured format, were voice-recorded and lasted approximately 30 minutes each. After transcribing the voice-records, a content analysis was conducted. Semi-structured interviews have been chosen so the interviewees could freely express their opinion on their equity situation concerning accessibility to RPT independently [Wholey et al., 2010]. To allow a free discussion, this type of interview builds up on open-ended and adjustable questions so that respondents have the possibility to extend their ideas [Wholey et al., 2010]. Furthermore, this helps to add depth to larger-scale quantitative results and serves as a supplement to the latter.

Interview guide

In a first step, the respondents needed to give insights on their own travel habits and transit time as well as their ease of reach of different type of infrastructures. This helped the interviewee reflect on whether his own needs are fulfilled and ease interpretation of their living circumstances. Secondly, the respondents were asked to reflect on their neighborhood, and as far as their knowledge went, on the city of Munich as well. They have been asked to reflect on how they would qualify the accessibility situation, how fair they perceived location and frequency of the RPT stations as well as where they believed an improvement could be done. This helped to point out the equity situation in some parts of the city. In a third part, similar questions have been

asked, after a map of the planned expansions has been shown to them. This allowed a direct comparison between the current and future system and answer to the main research question. Lastly, respondents were required to reflect on the quantitative results. The question was designed in a way that interviewees could express any kind of feeling they had about them. The interview guide as well as the aim and justification of each question asked and the shown map of the planned expansions can be found in the appendix.

3.3 Munich's RPT network

Before applying the explained methods above it is important to understand Munich's RPT system first. Munich's RPT network consists of 3 types of services: S-Bahn, U-Bahn and Tram, which respectively stand for suburban, subway and tram services [MVG]. Regional and long-distance services are being left out in this research as they are more an asset to the surroundings of Munich and the state of Upper-Bavaria. Suburban trains are more or less concentrated on one mainline called "Stammstrecke" in the city area that connects the district of Pasing located in the western part with the eastern of Munich via the central station. This east-west connection can also be visualized in the map shown on figure 3.1 below. The usual frequency of each of the 8 S-Bahn lines ranges from 60 to 20 minutes depending on how far the station is located from the center [MVG]. A 10 minute frequency exists on three routes. By that, a very high service frequency is provided on the S-Bahn mainline. While suburban trains run - as the name suggests - further in the suburbs of Munich, subway and tram services serve more districts in the city. With respectively 8 U-Bahn and 12 Tram lines, 177 km of tracks are being used every day [MVG]. Most services are routed through the city center with the exception of 3 tram lines which run tangentially. The frequency of service on the subway ranges from every 5 to 10 minutes (depending on the time of the day); trams generally run every 10 minutes with the exception of one line which runs every 5 minutes [MVG]. The current network can be found on the figure 3.1 on the following page (only the white centered zone is of interest) (source of the map: [MVG]). A map that is to scale can be found in the appendix, however future expansions are depicted on it as well.

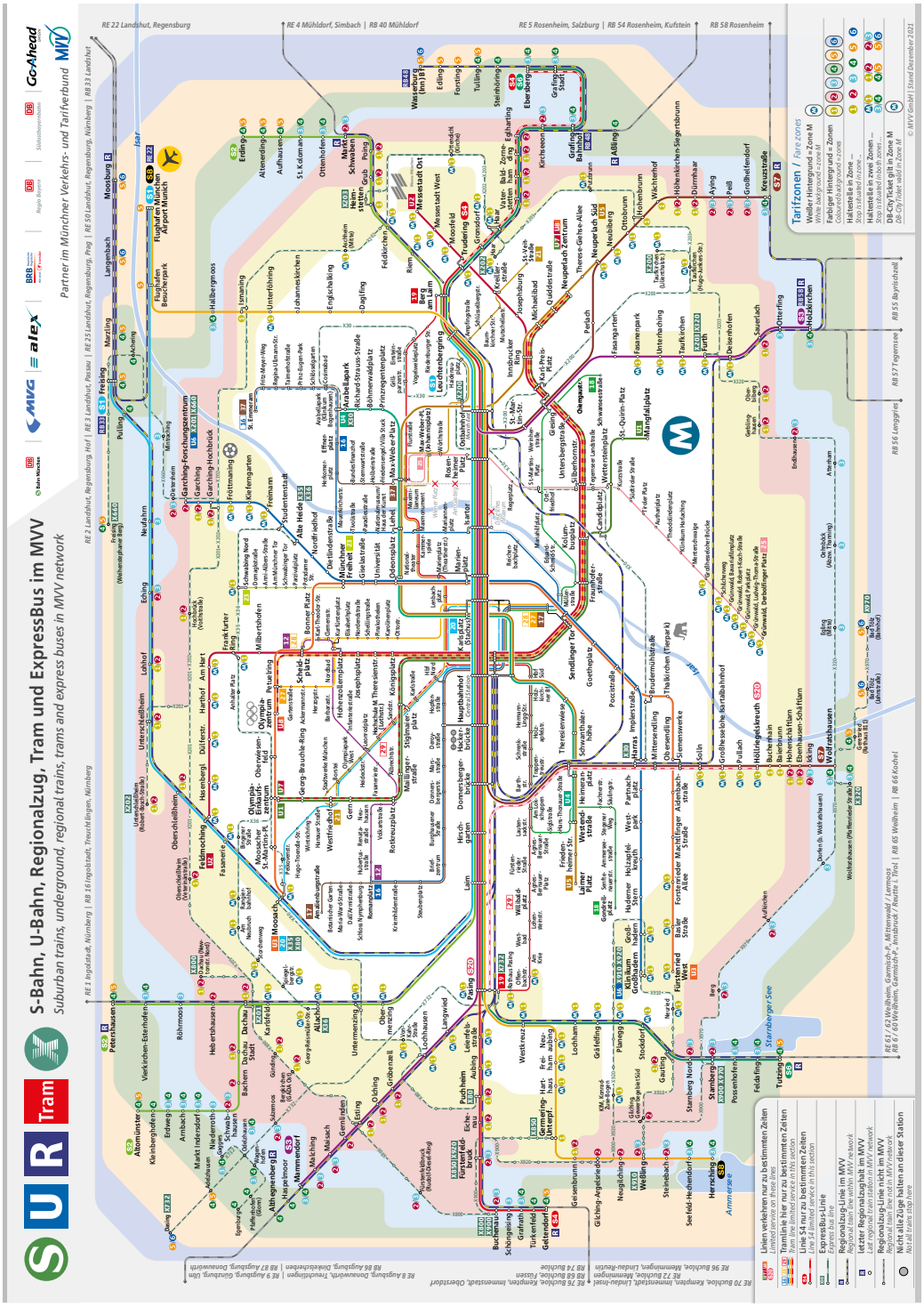


Figure 3.1: Current RPT and expressbus network in Munich

Chapter 4

Results

After the methodology has been explained and applied on the city of Munich, the results will be showcased in the following chapter. For that, the different methods have been divided into different sections.

4.1 Quantitative results of the current RPT system in Munich

4.1.1 RPT station density correlation

The results of the correlations between the mean RPT station density per cell and the chosen variables can be found in the table 4.1. In the first place, correlation coefficients have been calculated for socio-economic variables of households. The first correlation test has been carried out on the average economical status of the household in each cell. As seen in table 4.1, the very low to medium economical status of households have a negative correlation with the RPT station density, whereas the high and very high a positive one. Furthermore, the type of households have been included as well. As observable, only young households (under the age of 35) have a positive correlation. The correlated ages with the RPT station density can be found as well. Here, a positive correlation within the ages from 0 to 49 can be observed, whereas higher age groups indicate a negative correlation. After socio-economic information has been correlated, the activities and educational background were of interest as well. In this part, the first test has been carried out on the educational background of residents. German secondary school degrees both have a negative correlation, however,

the correlation coefficient for residents with a highschool, university or college degree is positive. Moreover, by correlating the activities of the inhabitants of Munich with the RPT station density a positive one is noticeable for both employees and student or apprentices, whereas housemaids or pensioner result in a negative one. Lastly, available mobility options as well as variables describing the motorization of households have been correlated. Correlations are low or negative when cars are involved in modes of transportation. Residents that have a car-sharing membership have a positive correlation towards RPT station density. Frequent car users have a negative correlation, whereas monthly and rare users have a positive one.

Besides the correlation coefficients, the results of the linear model built upon five chosen variables can be found in table 4.2 on the following page. The variables used for the linear model are also listed in the table 4.1. The highest correlating variables that have been chosen are therefore non-motorized households, young households that are under the age of 35, monthly car users, residents with a university or college degree, and individuals having more than one car-sharing membership.

Variables [%]		Mean	Standard deviation	Correlation coefficient
Economical status	Very low	0.019	0.061	-0.005
	Low	0.049	0.109	-0.003
	Medium	0.355	0.247	-0.011
	High	0.390	0.245	0.002
	Very high	0.171	0.199	**0.030**
Type of Household	**Young (under 35)**	0.075	0.122	**0.331**
	Family	0.284	0.249	-0.010
	Adult	0.365	0.242	-0.035
	over 65 years old	0.252	0.228	-0.123
Age	0-17	0.114	0.110	0.003
	18-29	0.104	0.120	0.188
	30-39	0.114	0.134	**0.194**
	40-49	0.125	0.121	0.023
	50-59	0.162	0.149	-0.086
	60-69	0.142	0.153	-0.054
	70-79	0.163	0.178	-0.116
	Over 80	0.059	0.104	-0.062
Education	No degree (yet)	0.123	0.127	0.001
	Secondary school (Hauptschulabschluss)	0.121	0.159	-0.132
	Secondary school (Realschulabschluss)	0.188	0.178	-0.183
	High school degree (Abitur)	0.133	0.125	0.041
	College / University degree	0.394	0.217	**0.254**
	Other type of degree	0.019	0.055	-0.039
Activity	**Employee**	0.458	0.201	**0.189**
	Student/Apprentice	0.132	0.125	0.038
	Housemaid	0.029	0.049	-0.084
	Pensioner	0.298	0.231	-0.159
	Other	0.066	0.086	0.014
Car ownership	Yes	0.839	0.211	-0.252
	No	0.145	0.182	**0.300**
Carsharing membership	**at one provider**	0.113	0.161	**0.259**
	at multiple providers	0.043	0.101	0.148
	no membership	0.820	0.221	-0.148
Car usage	(almost) daily	0.330	0.235	-0.300
	1-3x per week	0.338	0.202	-0.137
	1-3x per month	0.125	0.128	0.281
	less than monthly	0.054	0.084	**0.300**
	(almost) never	0.134	0.147	0.237
Available mobility options	Car	0.081	0.136	-0.022
	Car, Bike	0.638	0.276	-0.247
	Car, Carsharing	0.005	0.026	0.004
	Car, Bike, Carsharing	0.111	0.162	0.106
	Bike	0.074	0.122	0.154
	Bike, Carsharing	0.039	0.094	**0.266**
	Carsharing	0.001	0.012	0.064
	Neither of them	0.027	0.066	0.122

Table 4.1: Correlation coefficients of chosen variables with the mean RPT station density of the current system

	Dependent variable:
	mean RPT station density
Non-motorized household	0.567***
	(0.121)
Younger household (under the age of 35)	0.904***
	(0.189)
Car usage from 1 to 3 times per month	0.841***
	(0.170)
Resident has a university or college degree	0.398***
	(0.105)
Resident has more than one car-sharing membership	0.412**
	(0.203)
Constant	0.033
	(0.049)
Observations	726
R^2	0.207
Adjusted R^2	0.202
Residual Std. Error	0.552 (df = 720)
F Statistic	37.641*** (df = 5; 720)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 4.2: Linear model of the RPT station density in the current systen

4.1.2 Inhabitants living inside isochrones around RPT stations

In a second term, 5 and 10 min. walking isochrones have been built around each RPT station of the current system in the city. To help the visualization of the findings, figure 4.1 on the following page depicts a map of all the isochrones built.

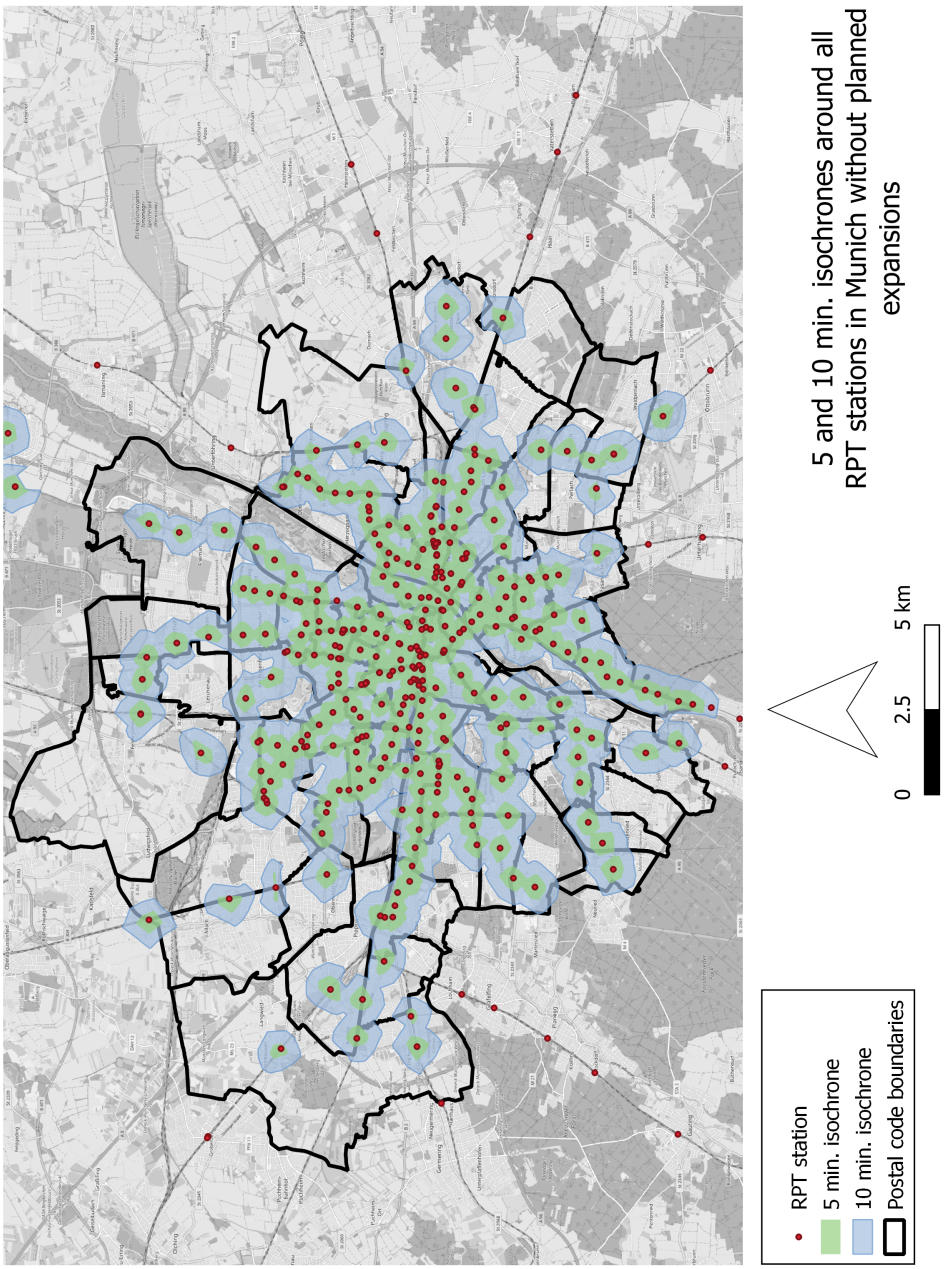


Figure 4.1: Map of 5 and 10 min. isochrones before the planned RPT expansions

The count of population living in 5 and 10 min. isochrones has then been compared to the city's population. The exact count of individuals is listed in table 4.3. To ease the visualisation of the results, the numbers have also been converted into percentages, which are depicted in the graph on fig. 4.2. Without the planned expansions, a lower percentage of inhabitants that are under 18, over 50 and native can be observed when it comes to access their nearest RPT station in both 5 and 10 min. walking distance. However, the contrary can be seen for individuals aged from 18 to 49 as well as for migrants.

Population [Pers. (%)]	Total	5 min	10 min
Total	1352553 (100.00)	737247 (54.27)	1099531 (81.28)
under 18	196206 (14.51)	95360 (12.93)	151448 (13.77)
18-29	233040 (17.23)	140630 (19.08)	198464 (18.05)
30-49	445888 (32.97)	252496 (34.25)	367376 (33.41)
50-64	234295 (17.32)	123160 (16.84)	188825 (17.17)
over 65	243117 (17.97)	124589 (16.90)	193467 (17.60)
native	1068667 (79.01)	574717 (77.95)	861250 (78.33)
migrant	283675 (20.97)	162463 (22.04)	238127 (21.66)

Table 4.3: Number and percentages of inhabitants in total, in 5 and in 10 min isochrones around RPT stations in Munich

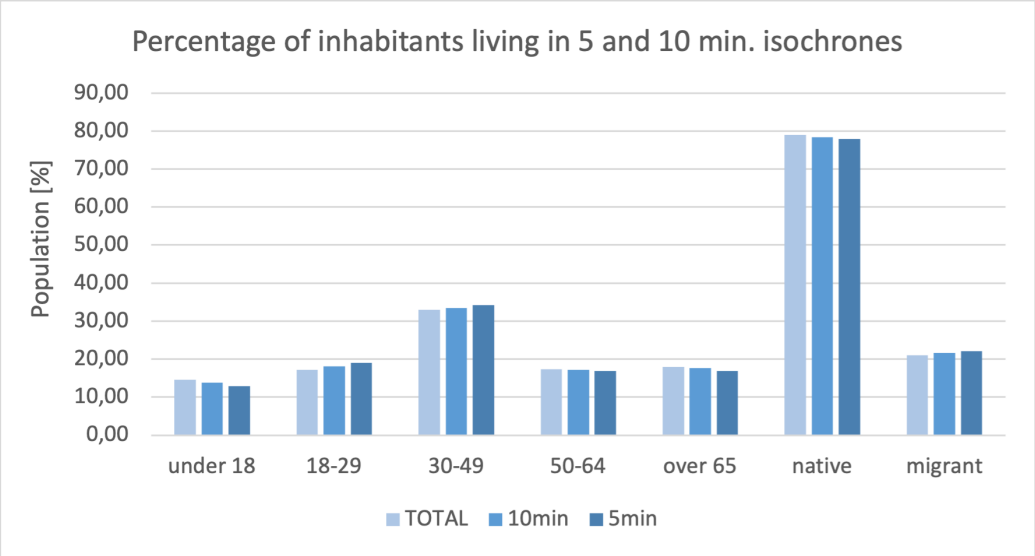


Figure 4.2: Graph of percentages of inhabitants in total, in 5 and in 10 min isochrones around RPT stations in Munich

4.2 Quantitative changes after the planned expansions

4.2.1 RPT station density correlation results including future expansions

After the current system has been quantitatively assessed, the same procedure has been carried out including the planned expansions. To achieve the research objective and a comparison with the future system, the same variables have been used again and the difference between the two correlation coefficients has been added to ease the understanding and interpretation of the results. Looking at the socio-economic indicators first, a positive difference is observable for all economical status variables as well as for young and adult households. A positive difference in the correlation coefficients before and after the expansions is also observable on the age class variables 18 to 39 as well as 50 to 79, whereas all other variables have a negative difference. Moreover, there has been a raise in the correlation coefficients for the variables representing both German secondary school degree owner, employees and pensioners. A look at the mobility section reveals that there has been an increase for motorized households and frequent car users and non-car-sharing users. All the detailed coefficient and their differences can be found under table 4.4 on the following page. Furthermore, the results of the linear model built upon the same five chosen variables can be found in table 4.5 below. However, due to different correlation coefficients, the variable "Resident has more than one car-sharing membership" could have been left out but has been kept in the model to allow a direct comparison.

Variables [%]		Mean	Standard deviation	Correlation coefficient	Difference
Economical status	**Very low**	0.019	0.061	0.012	**+0.016**
	Low	0.049	0.109	0.000	+0.003
	Medium	0.355	0.247	0.000	+0.012
	High	0.390	0.245	-0.016	-0.017
	Very high	0.171	0.199	0.035	+0.005
Type of Household	Young (under 35)	0.075	0.122	0.331	+0.001
	Family	0.284	0.249	-0.026	-0.015
	Adult	0.365	0.242	-0.017	**+0.018**
	over 65 years old	0.252	0.228	-0.127	-0.004
Age	0-17	0.114	0.110	-0.016	-0.019
	18-29	0.104	0.120	0.189	+0.000
	30-39	0.114	0.134	0.199	+0.005
	40-49	0.125	0.121	0.018	-0.005
	50-59	0.162	0.149	-0.072	**+0.015**
	60-69	0.142	0.153	-0.049	+0.004
	70-79	0.163	0.178	-0.111	+0.006
	Over 80	0.059	0.104	-0.072	-0.009
Education	No degree (yet)	0.123	0.127	-0.017	-0.018
	Secondary school (Hauptschulabschluss)	0.121	0.159	-0.087	**+0.045**
	Secondary school (Realschulabschluss)	0.188	0.178	-0.177	+0.006
	High school degree (Abitur)	0.133	0.125	0.029	-0.012
	College / University degree	0.394	0.217	0.233	-0.021
	Other type of degree	0.019	0.055	-0.022	-0.017
Activity	**Employee**	0.458	0.201	0.196	**+0.007**
	Student/Apprentice	0.132	0.125	0.029	-0.009
	Housemaid	0.029	0.049	-0.093	-0.008
	Pensioner	0.298	0.231	-0.153	+0.006
	Other	0.066	0.086	0.009	-0.004
Car ownership	**Yes**	0.839	0.211	-0.244	**+0.008**
	No	0.145	0.182	0.296	-0.005
Carsharing membership	at one provider	0.113	0.161	0.131	-0.019
	at multiple providers	0.043	0.101	0.191	-0.008
	no membership	0.820	0.221	-0.171	**+0.022**
Car usage	(almost) daily	0.330	0.235	-0.296	+0.004
	1-3x per week	0.338	0.202	-0.116	**+0.021**
	1-3x per month	0.125	0.128	0.267	-0.015
	less than monthly	0.054	0.084	0.283	-0.017
	(almost) never	0.134	0.147	0.229	-0.007
Available mobility options	Car	0.081	0.136	-0.028	-0.006
	Car, Bike	0.638	0.276	-0.230	**+0.018**
	Car, Carsharing	0.005	0.026	0.004	+0.000
	Car, Bike, Carsharing	0.111	0.162	0.092	-0.015
	Bike	0.074	0.122	0.157	+0.002
	Bike, Carsharing	0.039	0.094	0.250	-0.015
	Carsharing	0.001	0.012	0.064	-0.001
	Neither of them	0.027	0.066	0.131	+0.009

Table 4.4: Correlation coefficients of chosen variables with the mean RPT station density of the future system

	Dependent variable:
	mean RPT station density
Non-motorized household	0.616***
	(0.123)
Younger household (under the age of 35)	1.016***
	(0.193)
Car usage from 1 to 3 times per month	0.840***
	(0.174)
Resident has a university or college degree	0.380***
	(0.109)
Resident has more than one car-sharing membership	−0.074
	(0.141)
Constant	0.090*
	(0.050)
Observations	736
R^2	0.192
Adjusted R^2	0.186
Residual Std. Error	0.569 (df = 730)
F Statistic	34.618*** (df = 5; 730)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 4.5: Linear model changes after the planned expansions

4.2.2 Inhabitants living inside isochrones around RPT stations including future expansions

By repeating the first method including the planned expansion's stations, the area covered by 5 and 10 min. isochrones around RPT stations is higher. These findings can be visualised in the figure 4.3 below on a similar map including the planned expansions.

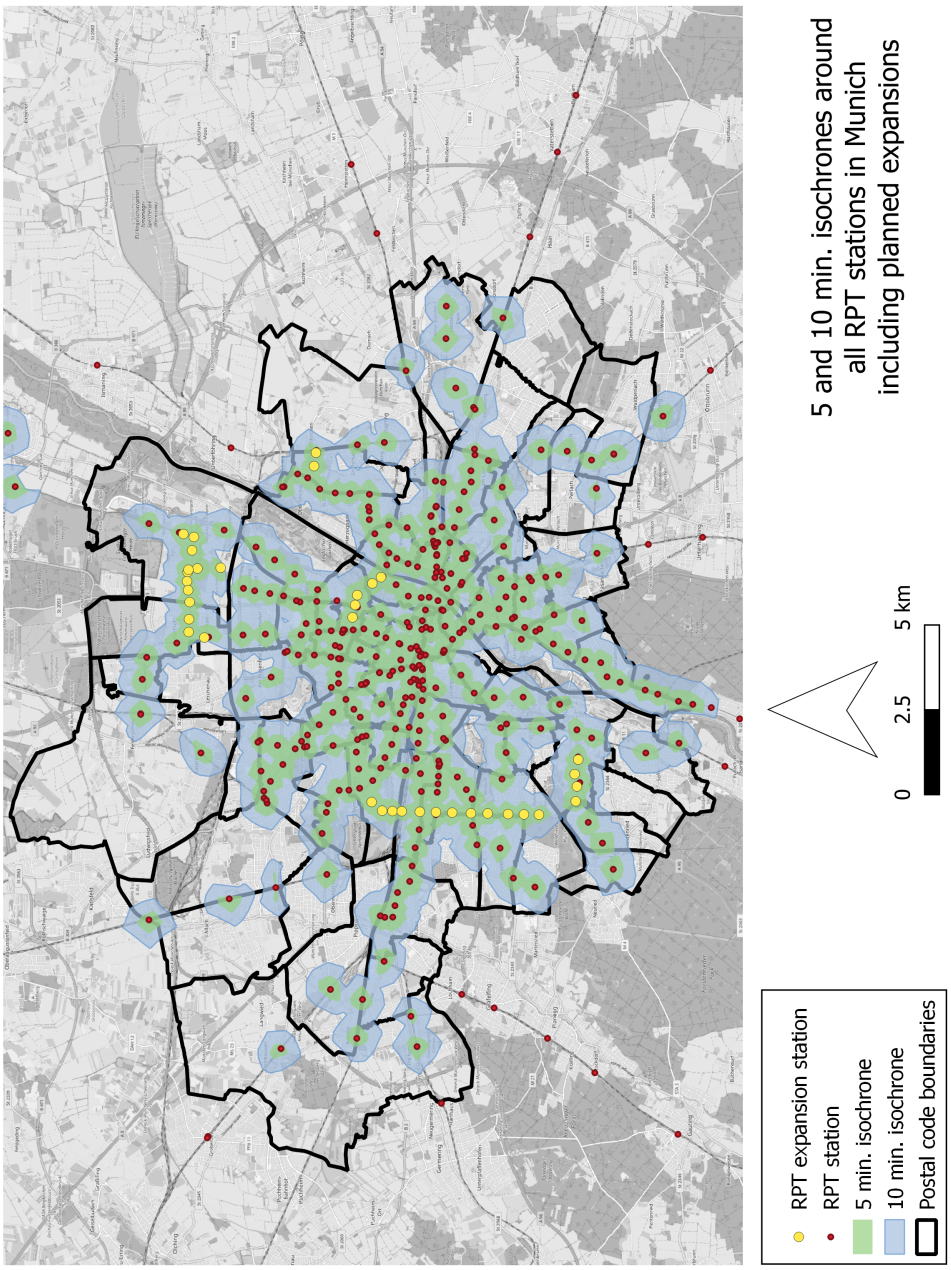


Figure 4.3: Map of 5 and 10 min. isochrones after the planned RPT expansions

As the covered area is higher, a higher amount of inhabitants having a 5 and/or 10 min. access to their nearest RPT station can be observed. The results are listed below in absolute numbers in table 4.6 for more precision and the according percentages to ease assessment and understanding. To simplify visual understanding of the results, the percentages are depicted in the graph on fig. 4.4 below.

Population [Pers. (%)]	Total	5 min	10 min
Total	1352553 (100.00)	768055 (54.27)	1116844 (81.28)
under 18	196206 (14.51)	100268 (13.05)	154706 (13.85)
18-29	233040 (17.23)	146212 (19.04)	201521 (18.04)
30-49	445888 (32.97)	262417 (34.17)	372572 (33.36)
50-64	234295 (17.32)	129720 (16.89)	191898 (17.18)
over 65	243117 (17.97)	129444 (16.85)	196203 (17.57)
native	1068667 (79.01)	598485 (77.92)	874030 (78.26)
migrant	283675 (20.97)	169497 (22.07)	242652 (21.73)

Table 4.6: Number and percentages of inhabitants in total, in 5 and in 10 min isochrones around RPT stations in Munich after the planned expansions

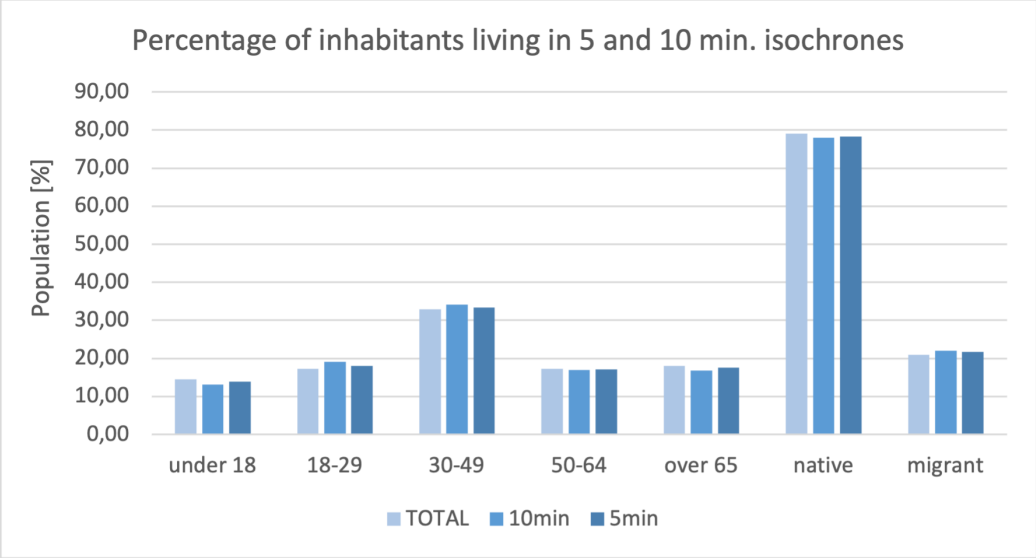


Figure 4.4: Graph of percentages of inhabitants in total, in 5 and in 10 min isochrones around RPT stations in Munich after the planned expansions

However, pointing out the same group of individuals is not yet an indicator whether there has been an improvement of the accessibility situation or not. To analyse this, the results of the difference in percentages between the current and future system have been listed in table 4.7 below. To ease the visualisation of the results, a graph of the percentage difference can be found under fig. 4.5. Therefore, there has been a percentage raise for inhabitants that are aged under 18, between 50 and 64 as well as migrants.

Population [%]	5 min	10 min
under 18	+0.12	+0.08
18-29	-0.04	-0.01
30-49	-0.08	-0.05
50-64	+0.05	+0.01
over 65	-0.05	-0.03
native	-0.03	-0.07
migrant	+0.03	+0.07

Table 4.7: Percentage difference of inhabitants living in 5 and in 10 min isochrones around RPT stations in Munich before and after the planned expansions

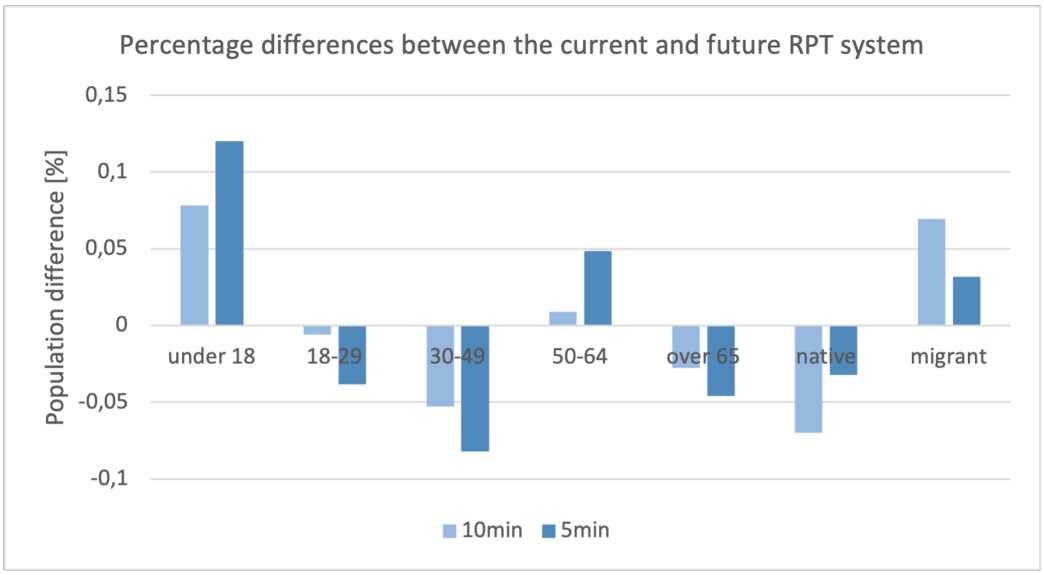


Figure 4.5: Graph of percentage differences of Inhabitants in total, in 5 and in 10 min isochrones around RPT stations in Munich before and after the planned expansions

4.3 Qualitative assessment results

4.3.1 Respondents travel patterns and transit time

Introduction of the respondents

The first respondent (I1) is a 21 year old student that lives in the area of Schwabing-Freimann. (I1) has migration background but has been living in Germany for over 10 years. (I1)'s nearest stop is a bus-stop that is a minute away from his doorstep. He also has access to a tram station that requires a 5 minute walk. The accessible tram is a feeder-line and provides no direct connection to the city center. There are also two subway stops available at a walking distance of approximately 15 minutes from his place of residency. Furthermore, his commuting time is the shortest of all respondents as he needs 25 minutes to travel to his university. He mostly relies on the nearby bus that brings him to the nearest subway station. The option to walk is only considered when the bus services are delayed or unreliable.

The second respondent (I2) is a 52 year old fully-working adult that resides with his family in the area of Pasing-Obermenzing. (I2) has a migration background too but has been living in Germany for far longer than (I1). He has access to two bus-lines at a walking distance of 10 minutes, and a nearby suburban train (S-Bahn) in under 10 minutes, that runs at a frequency of 20 to 40 minutes. (I2) has a commuting time of approximately 40 minutes to go to work. However, he has often no interchange, he prefers to walk as he misses his connecting tram service due to regular delays on the last path of his journey.

Furthermore, (I3) is a mid 50 year old working adult too that resides in the same district as (I2). However, they do not live close by and have very different accessibility opportunities. (I3) comes from a neighboring country and travels a lot for work. She only uses the bike to access her place of work. The nearest stop is a bus stop, which is accessible with a walking time of 2 minutes. The option to walk 15 minutes to the nearest train station (Pasing) is considered quite often as the bus service comes only every 10 to 20 minutes. The train station of Pasing provides a higher amount of suburban, regional and long distance services.

The last respondent (I4) is a native-born 30 year old working adult that resides alone in the area of Milbertshofen am Hart. Her nearest stop is a subway station, that is at approximately 300 m from her place of residency and provides a service frequency

of every 5 to 10 minutes. Her place of work is in the metropolitan area of Munich and requires a 50 minutes commute as tangent/cross-connection services are scarce. Therefore, an interchange is necessary at all times, even if the nearby subway line provides a direct connection to the city centre.

Moreover, the approximate place of residency and the name of the neighborhoods of the city of Munich can be found in fig. 4.6 at the end of the results chapter, as some of them will be mentioned in the following sections.

Respondents needs and to what extent they are being met

All the respondents except (I2) found their needs to be at least partly fulfilled, but expressed their wishes and limitations. (I1) qualified his accessibility situation as "not optimal", even if his needs are being met. (I3) follows a similar opinion. Both of them expressed their concern on the reliability and (I1) about the frequency of operation of the bus service.

> *"I think a bus like that should be each like ten minutes maximum. At each time of the day."* (I3, Pos. 13)

On another hand, (I4) was satisfied by the fact that the nearby subway station allows a direct access to the city centre. However, an additional "cross-connecting" service would ameliorate the situation, as the place of work is located in the northern, outside of the city and on another subway branch. (I2) stated that his needs are not being met and would wish for an additional rail connection.

> *"I would wish for a rail connection, for example a tram connection wouldn't be bad."* (I2, Pos. 19)

Respondents perception on their own neighborhood

The respondents were also asked on their perception of the travel pattern of their own neighborhood to see - in case the respondent should feel transport disadvantaged - if there might be a pattern. (I3) and (I4) shared a similar opinion and observed that the further inhabitants live away from a station, the more they will rely on their car.

> *"[...] as soon as you leave a little bit the, the, like the, let's say, 10 minutes walking from S-Bahn, I think people rely on their car."* (I3, Pos. 55)

(I2) also confirmed that his household was the only public transport user in the neighborhood. In contrary to (I2), (I1) stated that his neighborhood had a high amount of non-motorized households. This observation is only partly in line with (I4)'s perception: she states that in the northern of Milbertshofen, individuals tend to have more cars than in the southern part. (I3) made a different observation and stated on one hand, as mentioned above, that individuals do rely on their cars if they live further away from RPT stations; on the other hand, that residents don't really leave their neighborhood in the area of the city she lives in as most kind of infrastructures are provided there.

4.3.2 Fairness perception on the current system

Respondent's reflection on the current station allocation

In the following section respondents were asked to reflect on how fair the current public transport system in Munich is by qualifying the allocation of stations and what group of people currently benefit or are disadvantaged by it. At first, (I2),(I3) and (I4) agreed that the system was well developed and equally covered the whole metropolitan area of Munich. However, after deepening the questions, opinions started to differ. (I4) stated that the neighborhood of Milbertshofen in the northern of the city was quite well connected, whereas (I1) disagreed and qualified this area as especially poorly connected as many people rely on buses. (I1) justifies this by an observation on the subway system: the different lines intersect in the center which makes the center very well connected, however they start to spread out quickly in different directions.

> *"[...] everything, that's not close to the, the axes, I'd say it's not very well-connected sometimes, it could be, it can be like problematic because the axis start to separate, quite close to the center."* (I1, Pos. 40)

(I3) disagreed with (I1) and stated that the accessibility to RPT in the city center was "surprisingly bad". (I3) also said that RPT stations should be close to one another, and compared the system in Munich with the Parisian metro network:

> *"If I will compare to a city of Paris you have an U-Bahn station not further as five minutes from your place."* (I3, Pos. 13)

> *"I think, for a big city like that, it could be more, close stations from each other."* (I3, Pos. 15)

(I2) was overall satisfied with the system, however, similarly as the other respondents, started to point out areas of the city where accessibility to RPT was poor or non-existent. (I2) enumerated the newly built district of Freiham, whereas (I1) focused on the northern part of Munich as well as the south-eastern part of the city. (I1) and (I4) both stated that parts of Bogenhausen had also a poor accessibility to RPT. (I3) qualified the area of Obermenzing, located in the (north-)western part of the city as "lifeless", as it felt "far away from everything". (I3) believes that the accessibility to RPT is bad "in every four corner of the city". Indeed, all respondents enumerated districts that were mostly on the borders of the city. By that, the respondents showed that accessibility to RPT decreases the closer inhabitants are to the border of the city.

Fairness perception on the current RPT system

After the respondents were asked to evaluate the allocation of RPT stations over the city, they were required to judge how fair they perceived location and frequency of the services. At first, (I4) and (I3) both agree that the further away people live from an RPT station, the more they will rely on their car. (I4) described the situation in Milbertshofen, as the district itself has areas with better or worse accessibility to RPT:

> *"I could see that in the past five or six years, the, the amount of cars increased. But, I think in the, like, more southern part of Milbersthofen less people have cars and it's even easier to, to go to places. Because for example, at a Frankfurter Ring, you have express buses, two different directions. And the northern part of Milbertshofen is more, like, only the U2 subway connection."* (I4, Pos. 29)

(I4) also talked about Bogenhausen, a wealthier district and the north-western part of Munich where accessibility to RPT is poor and stated that inhabitants "wouldn't care" about that situation as almost everyone owns a car:

> *"[...] many of my family live in this area and I know that almost everybody has a car and it doesn't actually care that much."* (I4, Pos. 114)

On another note, (I2) raised concerns about the fact that lower-income households have more difficulties affording a car, and saw public transport as a viable alternative. However, (I2) did not evolve on the subject when speaking about the current system. (I1) went further and named amongst other areas in Munich the northern of the city, as he qualifies the current situation there as unfair:

> *"I think the north is by far the, the area that is the least connected to RPTs, and, but it's like, there are also a lot of people who live there, people who can't really afford buying cars, unlike Bogenhausen for example. So it would definitely be smart or like fair to give them a better access to transportation."* (I1, Pos. 53)

(I3) also observed that inhabitants living near the motorway ring might have a lower income and could therefore not afford a car.

Additional point of views on the current RPT system

In these first questions, most of the respondents focused more on the lack of efficiency and quality of the service than on the allocation of stations. All respondents except (I2) considered bus services as being unreliable and often delayed. (I3) also raised concern about poor frequency of some bus services.

> *"Sometimes the bus just doesn't appear or like, you'd never know 'cause the, the time plan is not digital and you just like, kind of have to look at the end of the road and see if you can spot the bus."* (I1, Pos. 27)

In contrary to them, (I2) is commuting with one of two bus lines that run through his neighborhood and is satisfied by the quality of one of the two services. However, (I2) raised concerns on the quality of the service, as busses are often delayed or don't show up at all. (I2) also criticizes the 20 minutes frequency, an issue that has already been addressed by (I3).

> *"I'm not criticising it because it's a private company, but because the service is simply weak from that point of view, i.e. it's bad. They run every 20 minutes and sometimes they don't show up at all."* (I2, Pos. 29)

Besides reliability issues, (I2) focuses on capacity limitations of bus services. This has also been partly mentioned by (I3) and (I4), as some bus lines or overcrowded during peak-hours where vehicles with a higher capacity would be necessary. (I2) cites the example of Freiham:

> *"Especially to Freiham it's not enough. The 57 bus line, for example, is sometimes so overcrowded that buses run one after the other, and yes, that's why a rail connection is absolutely necessary."* (I2 Pos. 49)

All respondents were in favor of equivalent RPT connections, as they have been considered as more reliable and would often run at higher frequencies. (I1) explained why RPT would be a better option as an equivalent bus service.

> *"I definitely prefer using the trains because they're more [...] dependable and [...] they come more often. [...] with the trains, [...] you have a timer and comes usually every five minutes."* (I1, Pos. 27)

(I2) also observed that RPT stations in his area have a better equipment, just as (I1) talked about the existing timers at RPT stations in his quote above, a service he is missing at his nearest bus stop.

Even if RPT services are appreciated by all respondents, reliability and service frequency issues have been raised as well. (I2), (I3) and (I4) stated that suburban train services (S-Bahn) have a very low frequency, especially on the outskirts of the city.

> *"[...] for example you have the S20 once an hour."* (I3, Pos. 67)

(I2) described the reliability issues its nearby S-Bahn line:

> *"[...] that's the Deutsche Bahn and their S-Bahns are not very reliable, especially in bad weather where they are usually cancelled. That's why I don't try to use the rail vehicles, especially the S-Bahn."* (I2, Pos. 17)

On another note, (I1) and (I4) recognized the benefits of having different type of services. (I1) states that some areas do only have one RPT line, and is not always an asset to inhabitants. (I4) evolves on this idea and explains that in case of disruptions, people could switch to other lines and services.

> *"[...] some areas like aren't badly connected, but like you can only reach them with one method such as the Schwanthalerhöhe which is actually quite close to the center."* (I1, Pos. 41)

4.3.3 Fairness perception on the future system

Respondents belief on who will benefit from the proposed expansions

In the following section, respondents were asked to reflect on the future RPT system of the city after they have seen a map of the proposed public transport action plan.

At first, all respondents thought, that if all planned expansions were to go through, everyone will benefit from it. At a later stage, respondents started to give further insights from a fairness perspective: (I2) believed that the city of Munich has no clustered manifestation of majorly disadvantaged or lower-income areas. He bases this assumption on his knowledge about how the city has been built. According to (I2), one third of every district consists of lower-income, another third of higher-income households and the last third of greenery.

> *"One third is inhabited by, let's say, people who earn well and one third lower income earners - so they have a low income - and one third is greenery. And if you base yourself on that system actually, as I said, everybody will benefit."* (I2, Pos. 41)

After that, all respondents gave further insights on what group of individual they think would further benefit from it. (I1) stated that in his area there are a lot of people who cannot afford cars, and adds his observation that the further expansions go into the suburbs, the more disadvantaged people would benefit from it.

> *"[...] with every RPT that goes further in the suburbs, more quote/unquote disadvantaged people will benefit from it."* (I1, Pos. 63)

(I2) agreed on these statements, as he said that low-income households will benefit much more from these expansions, and explains why. As higher-income households are more likely to use taxis to get around without their own car in his area, lower-income households will try to minimize transportation costs as much as possible. Therefore, even if everyone in his area will have an improved RPT accessibility, mostly lower-income households would benefit from it.

> *"I would say mainly the low-income households will benefit much more, that's clear."* (I2, Pos. 41)

(I3) followed up on a similar way of thinking, and believed that for example non-motorized households will benefit much more, even if a future station allocation might be equal for everyone. (I3) also confirms that the proposed expansions will be of benefit for elderly or low-income persons. Besides the respondent's perception about fairness, (I3) and (I4) set a focus on both work and school related commuters who might benefit from it on specific routes where busses serve as cross-connections between two subway or suburban train axis.

> *"People going to work [might benefit from it], because I know people who work in these areas like more on the western part, not in the eastern part, but they have the same problem. And they work in Munich and they go by car and they, they're in the traffic for a long time every day, and they don't know where to park their car."* (I4, Pos. 91)

Limitations of the proposed expansions

Respondents also expressed their concerns about the expansions. (I4), for instance, believed that her area (Milbertshofen) won't benefit from the upcoming expansions. She stated that there are many unemployed inhabitants in her area of residency who would therefore not benefit from expansions.

> *"In my exact area, they are actually many people that are not working, not working anymore or not working because they're unemployed. So they might not profit from this [...]"* (I4, Pos. 82)

On another note, (I1), (I3) and (I4) raised concerns about left out areas. (I1) thought that the expansions are connecting the center better together. (I3) and (I4) both focused more on the north-western part of the city and qualified it as "quite empty".

> *"In the north-western part it looks pretty, pretty empty. And actually the whole part in the west looks pretty empty still."* (I4, Pos. 114)

(I3) also had no understanding for the Pasing situation. The station would benefit of additional services, however neighboring districts would still be left out:

> *"I mean, this Pasing situation with U3/U4 its nice, but it's already like four S-Bahn going to Pasing, so why do they put this U-Bahn again in Pasing? I mean, it's nice for us, but look at Gräfelfing. There is nothing! And Gräfelfing is a.. it's a big... I mean, not a big city, but it's a, I mean, it's a part of the city, which is quite important."* (I3, Pos. 79)

The proposed expansions all follow a specific time-plan that includes categories of priorities. Those have been criticized by (I1) and (I2), as they both saw some projects as overdue, or priorities should be reconsidered. While (I2) was concerned that some newly built neighborhoods such as Freiham still had a poor accessibility to RPT, (I1) thought that some expansions in the northern part of the city should happen much sooner.

> *"I find some that are in the category three to be like maybe even more relevant or important than the ones that are in category one. Especially focusing on the north, where like giving the fact that I live around on Petuelring on the Leopoldstraße I kind of know which methods of transportation are there - I have taken them all."* (I1, Pos. 56)

However, (I4) did not share the same opinion as (I1). As they both live in the northern, (I4) experienced the bus services that are scheduled to be replaced by RPT in the future as almost always empty. On another note, (I4) chose bus connection on off-peak times that were not to crowded.

> *"Actually the bus is most of the time it's pretty empty. But I'm, I'm choosing, I am, I am choosing buses who are not, who are not taken by school, school students anymore. So I take the bus, like right at seven before children go to school then after eight, like when everybody is already at home."* (I4, Pos. 85-86)

Furthermore, (I2) addressed an issue on the future system that no other respondent did. He was concerned that the station allocation and network size improves, but not the quality and reliability of its service. By that, (I2) believed that stations would not be an asset to residents when the service frequency is poor:

> *"But if, for example, there is such a line, a suburban railway line, which also comes very rarely, what is this old man supposed to do at this station? he will freeze to death."* (I2, Pos. 55)

(I3) saw the system's equity on another angle, and believed that lower-income households will never be able to fully benefit from an improved RPT accessibility. (I3) bases her observation on Munich and most cities in the world, where rents will most likely go up, as the place of residency will become more attractive. Therefore, lower-income households will not be able to move closer to an RPT station. (I3) believed that this was a vicious circle most of the cities were in.

> *"I think it's a little bit like that in every city because, of course, the people who were not really good socially or they take apartments which are cheaper. And why are they cheaper? Because it has, because the connection with trans- with public transport is not so good. So it's, it's always a circle."* (I3, Pos. 91)

4.3.4 Reaction and reflection on quantitative results

In a last step, respondents were asked to react on the quantitative results of the research. All of the respondents perceived the results on the current system as being unsurprising. However, (I2) expressed his concern that a lot of bus stops have been removed as passenger numbers were little and qualified this decision as "shocking". (I3) and (I4) both agreed that lower-income households might live at more remote areas of the city where the accessibility to RPT is therefore lower, a phenomena that would explain the quantitative results. On another note, poor accessibility to RPT for elderly residents was found problematic by (I4). (I4) stated that a family member had difficulties using bus services and described other kind of accessibility matters that haven't been addressed yet. (I4) gave the example of a bike lane between the bus stop and the sidewalk, as well as an elevation between the vehicle and the stop itself:

> *"[...] for her going by Bus is always harder than going by train, the steps that are higher somehow, and then there are often bike lanes between the bus and the... [...]. And when you go up out of the bus and you are quite slow, there might be a cyclist coming, that is, almost driving you over."* (I4, Pos. 138)

(I3) gave another example for accessibility issues and thought that the amount of interchanges should be minimized for elderly people. The lack of accessibility is "unfair":

> *"Yes, that's quite unfair because of course, people are older and they need accessibility, easier to places. And not like, to get to the Bus, and wait for the subway and go down and go up the stairs and..."* (I3, Pos. 105)

Furthermore, (I2) thinks that the walking distance can be problematic for elderly residents. In light of this, (I2), (I3) and (I4) all raised awareness on new accessibility barriers that might arise, especially for physically disadvantaged individuals. However, (I3) also stated that these groups of people might have "more time" and didn't express further concerns about poorer accessibility to RPT for them.

After reflecting on the current system, respondents were also asked to express their opinion on the results of the future system, including the planned expansions. (I2) perceived the future system as "more fair" and therefore linked his opinion on the quantitative results to his own above. He stated that it would "hurt" higher-income households "less" if they are not being prioritized in the expansion of RPT. Besides

this, (I2) also came back to what he has been saying before, and expressed his wish for a higher reliability of suburban rail services.

> *"Especially for suburban railway it is very important, that they run on time, that they are very reliable. I think underground trains run very well, but suburban trains... we still have to do a lot about them."* (I2, Pos. 57)

On another note, (I4) was more surprised by the higher correlation for higher-income households on the future system, but also saw the improved accessibility for migrants as a good thing, as (I4) links migration backgrounds with a lower income. (I4) also added that a better accessibility for underage residents was a positive thing, as parents would benefit as well. (I3) had a different point of view, and pointed out that it was good if everyone would benefit from the expansions. (I3) raised awareness on environmental issues in the transportation sector and would wish that higher-income households would consider public transport in general more often - a goal that could be reached if their accessibility would be improved as well:

> *"I think it's good when everybody profit from it, because more there is expansion, less there are cars."* (I3, Pos. 113)

(I3) maintained her opinion about the vicious circle for lower-income households cited before, as she believed that an improved accessibility will raise the land costs around an RPT station.

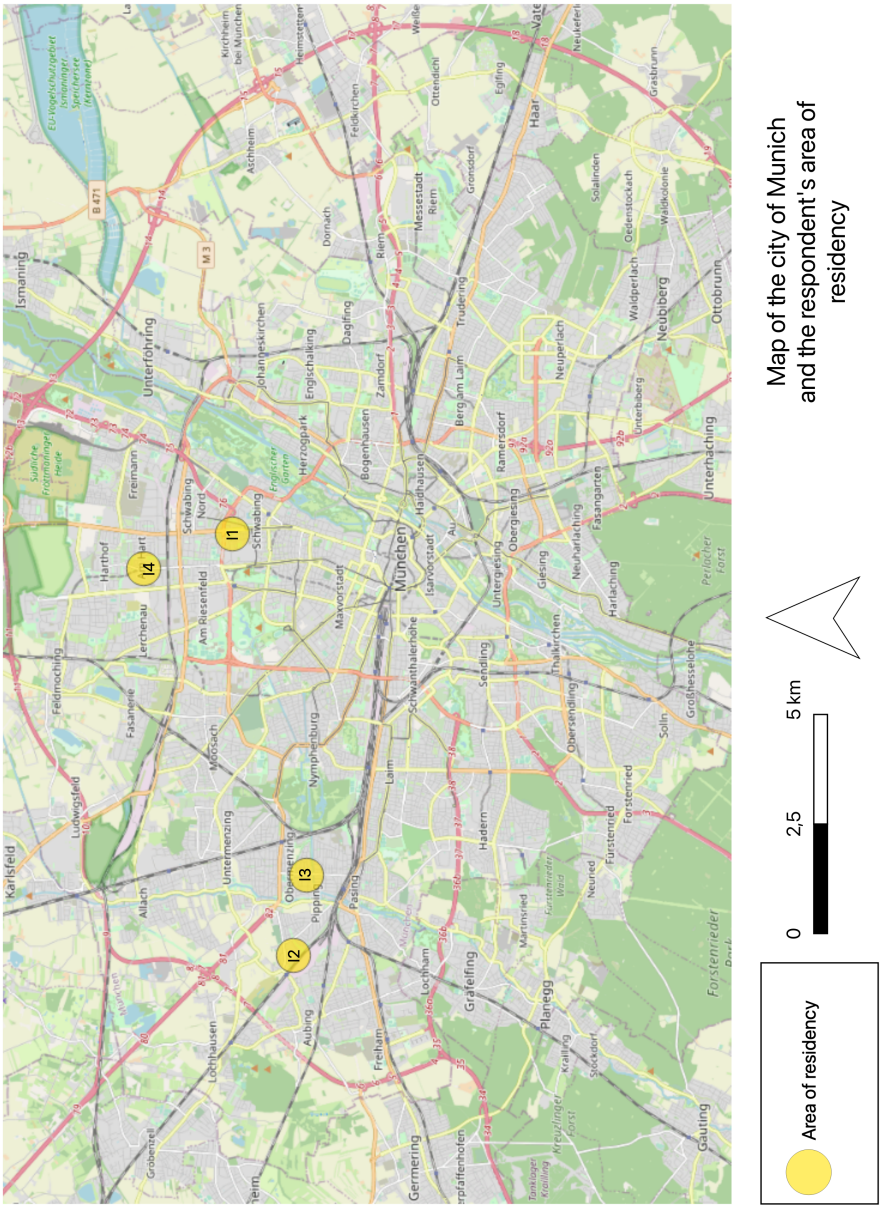


Figure 4.6: Map of the city of Munich and the respondent's approximate place of residency

Chapter 5

Discussion

The combination of both quantitative and qualitative data in this research helped to determine which allocation rules are being followed and answering the research question on how equitable potential expansions of public transport by rail are. The results of the comparison between the current and future system including the planned expansions suggests that the allocation of future RPT stations in Munich will follow the rule of equality more than the one of equity. Larger-scale or clustered inequity situations won't be ameliorated as they are non-existent in the current system, as the latter seems to have majorly equality and efficiency gaps. However, scattered inequity manifestations might be prevented as qualitative data suggests. Yet, these are broader results of this mixed-methods assessment. In the following paragraphs, a more in-depth analysis of the results will be given.

5.1 Equity assessment of the current RPT system in Munich

At first, respondents found the current RPT system in Munich equally allocated. A look at the quantitative results revealed differences, that respondents might have overseen. However, after deepening the questions, their opinions started to differ.

5.1.1 Economical status and migration related equity

The calculated correlation coefficients for different variables helps to give a first impression on how RPT stations are allocated in the city. The low correlation coefficients of

the economical status of households in the city of Munich for both the current and the future system suggests that there is an equal allocation of RPT stations over the city. However, small differences can be observed, as the correlation coefficients for very low to medium economical status households in the current system are negative, whereas households with a high and very high economical status are correlated positively with the mean RPT station density. This suggests a small but noticeable difference as lower income households might have a poorer accessibility to RPT. These tendencies have also been observed in the qualitative analysis, as respondents had difficulties pointing out areas lower-income areas where accessibility to RPT was poorer. However, some of them did: While (I1) listed areas he believed lower-income households were living and transport-disadvantaged; (I2) described missing or poor RPT accessibility for lower-income households as very problematic and evolved a lot on this subject. This suggests a more equal allocation of RPT stations but also that scattered income-related inequity situations are still present. Moreover, these findings extend and confirm researches from Duncan [2011] on a land-cost perspective, as these tendencies are well known under the principle of Transit Oriented Development. However, the results are insufficient to confirm the high TOD tendencies found by Papa and Bertolini [2015].

After the economical status of households has been assessed, migration background was taken into consideration as well. Therefore, migrants were most likely to have a better accessibility to RPT than native residents, as their percentage was higher in 5 and 10 minutes isochrones compared to the city as a whole. Qualifying whether this seems equitable or not depends on which definition is taken and how migrants are being perceived. The aspect of integration and language barriers can be considered as a possible disadvantage, as suggested by Wixey et al. [2005]. Moreover, (I4) believed that migrants tend to be lower-income households as well, another indicator for a possible disadvantage. If those aspects are considered, the enhanced accessibility to RPT for migrants would mean that the allocation is equitable. Bartzokas-Tsiompras and Photis [2019] observed a similar effect in the other German cities such as Hamburg and Berlin. However, as mentioned in the literature review, he believes that this can be due to a higher walking or biking preference of native-born residents. This hypothesis opens a new way to interpret the results, but doesn't alter the fact that a better accessibility to RPT is also an enhanced accessibility to goods, services and opportunities. Thus, it is a good setting to promote social inclusiveness for a group that is susceptible to experience social exclusion.

5.1.2 Age, education and activity related equity

Moreover, ages and the type of households have been correlated as well. These two categories of variables are in line with each other. As observable, there is a strong positive correlation for younger residents and therefore their households as well. These results can be validated by the isochrones assessment as well, as the age groups benefiting from an improved accessibility are also between 18 and 40 - and vice versa - a poorer accessibility for residents over 40. The stronger negative correlation for elderly residents has also been validated by the respondents and was found unsurprising but problematic at the same time. Respondents observed that bus feeder-lines are frequently used by elderly individuals as well and raised awareness on other type of accessibility barriers other group of individuals might not have: a physical barrier. This suggests a stronger equity problem in the city for elderly residents. However, opinions are divided: (I3) took an efficiency perspective as she thought that these group of individuals are more flexible in their time, whereas others might need faster and better accessibility more. This would contradict Wixey et al. [2005], Jones [2011] and Ricciardi et al. [2015] as they assume that elderly residents are more likely to be physically impaired, the latter being a source of accessibility-related social exclusion - in a worst case scenario.

The age-related equity results can also be linked to the resident's activities and educational background. On the current system, the correlation coefficients seem "logical" and adhere to what inhabitants would see everyday in the city: mostly 18 to 40 years old residents that have an employment as well as a university and college degree have the highest correlation with the mean density of RPT stations. Those group of individuals might have the highest revenue and could therefore afford to choose how close they want to live near an RPT station. This result also extends Sanchez [1999]'s and Johnson et al. [2017]'s findings, as they found a high correlation between employment rates and PT accessibility. While 18 to 30 year old benefit from a high correlation, student and apprentices have a much lower correlation than employees. The low correlation can also be seen in the educational section, which applies to the individuals that have no degree or a high-school degree. This is due to the fact that employees might have a higher revenue and have therefore the freedom of choice of their place of residency. Here again, a reference to the principle of TOD is possible. However, this is an example of an inequitable situation as students and apprentices in contrary to employees are also less likely to be able to afford a car. This

inequitable situation also applies to school students: even if they mostly don't rely on their own income, they often have to take public transport to go to school, as (I3) and (I4) observed it on many crowded bus lines. A situation that is difficult to qualify but surprising in its results, is the negative correlation for both lower and secondary school degrees (Haupt- and Realschulabschluss). These degrees could be linked to lower-wage jobs as much as to a different education, which brings them to use cars much more often than public transport. However, only hypotheses can be made as respondents did not evolve or confirm anything on this topic. Therefore, qualifying equitability considering these negative correlation coefficients is almost impossible.

5.1.3 Transport disadvantage and equity

Besides the age and activity of residents, the car ownership, usage and overall available mobility options have been correlated as well. The coefficients on the current system seem not surprising at first, as inhabitants having bad accessibility to RPT have a higher tendency to rely on car and might therefore own one. This has also been addressed more than once by the interviewees: two respondents were confident that many residents rely on their cars when accessibility to RPT is poor - especially on the outskirts of the city. They believe that some neighborhoods such as Bogenhausen wouldn't care about an enhanced accessibility to RPT as they rely on their cars. Hesse and Scheiner [2010] gave a similar observation, as inhabitants living on the outskirts of the city often rely on cars as suburban trains take longer, but also that residents are "buying" their living preferences, as some of them deliberately want to live in a less populated area near the city and prefer to rely on their car. This seems at first quite equitable, however (I1) claimed the contrary by stating that his neighborhood has many non-motorized households, which calls into question the equity of the current system. Indeed, non-motorized households with a poor accessibility to RPT and therefore to opportunities are more endangered by the process of social exclusion

The available mobility options allow similar observations, however the coefficient difference between the option "Car" and "Car, Bike" is more surprising. Households that have cars and bikes at their disposal have a much higher negative correlation than households having cars only. This result could probably reflect that a lot of households do own cars regardless how close they are located near an RPT station. The reason for this choice could only be speculated. The lower coefficient for bikes only in comparison to households having bikes and car-sharing options at their disposition

is also open for speculation. The main reason could therefore be a higher economical status that is linked with the need for different mobility alternatives or simply non-motorized households.

Variables that have to be analysed differently are the ones describing car-sharing memberships. It seems quite surprising at first, that residents having car-sharing subscriptions or memberships have a higher correlation and therefore a better accessibility to RPT. However, it might be logical: as alternative mobility options such as car- or bike-sharing memberships are still considered as services for more privileged residents, as Duran-Rodas et al. [2020] suggested too. A higher-income for example can then be linked to a better accessibility to RPT, as previously described above. Furthermore, this also represents the non-motorized portion of the population that relies on public transport and only uses car-sharing as an alternative, as their car usage is too low. For instance, the correlation between a monthly car usage and one car-sharing membership is very similar. This variable is also open for speculation, but suggests that a better RPT accessibility is still reserved for a more "privileged" group of the population and therefore less equitable.

In addition to the correlation coefficients, the linear model was built upon the highest correlating variables that have been analysed amongst others above. Based on those findings, the groups of people benefiting from the best accessibility to RPT are therefore under 35, have a university or college degree, are rarely using a car and instead of owning one they do have a membership at more than one car-sharing provider. This data indicates that the main beneficiaries on the current system are more privileged residents. A similar profile of what can be called a "privileged" has also been found by other researchers about groups of individuals having access to bike sharing systems [Duran-Rodas et al., 2020]. This profile has also already been mentioned by the respondent (I3) when residents of the city center have been described and matches the one provided by the linear model. This specific target group described by the linear model suggests that there is still a certain lack of equity in accessibility to RPT in Munich, as the profile of an "underprivileged" individual should have been described instead if the situation would be equitable.

5.1.4 Results that haven't been addressed by the quantitative analysis

While the quantitative approach gave a more in-depth insight into different categories of groups of inhabitant susceptible to become transport-disadvantaged, qualitative steps raised awareness on other issues that impact accessibility to RPT. An issue largely addressed was the frequency and quality of the service. This type of issue has not been addressed in this research as only the accessibility in terms of proximity to any RPT station was taken into account. (I2) raised awareness on this matter, as quality and frequency of a service affects the accessibility to it. In other words, it might seem more useful to have access to a frequently running bus, than to an hourly RPT service. This observation questions the accessibility to RPT especially on the outskirts of the city, where less frequent suburban trains might be running. Even if the accessibility to RPT is given, the accessibility to goods, services and opportunities might be heavily impacted. Therefore, underprivileged residents living on the outskirts might be treated inequitably which could represent a lack of social inclusion.

Furthermore, as the interviews were held in a semi-structured format, more freedom of expression and development of ideas was granted. A noticeable fact, was that most respondents evolved around efficiency and equality gaps. Indeed and as mentioned before, many of the respondents had difficulties to point out socio-economic differences between different neighborhoods. The latter can also be due to a lack of knowledge on the city. Yet, the chosen respondents either stated they knew the city "quite well" or have been living here for a longer period of time. Social equity was secondary and only considered after a lead or results were given. The lack of awareness on this subject, especially when rpt expansions are being discussed, is surprising. However, this could also strengthen the theory that both the current system and future RPT system in Munich are equally allocated and that there are no major inequity situation. This theory can also comes down to - once again - the very homogeneous and non-clustered distribution of different types of residents all over the city. The problematic part remains that, once a lead is given to respondents, scattered inequity manifestations especially on the outskirts can be observed. Therefore, the equity situation might be worse than both quantitative and qualitative results suggest. This issue will also be further addressed in the section about strength and limitations of the thesis.

5.2 Equity assessment of the potential RPT expansions in Munich

5.2.1 Economical status and migration related equity changes

To be able to assess changes and equity of potential expansions in the RPT system, results need to be compared. For the first variables, a positive difference could be observed for almost all economical status groups except the high one, however with a strong tendency towards zero for both low and medium economic status of households. These results come as expected, as the correlation coefficients of the current system were already quite low and suggested a more equal allocation of station over the city. (I4) expressed her interest in the raise of the correlation coefficient for very high economical households but did not comment on it. This observation reinforces the fact that allocation might be more equal but supports the principle of TOD observed and described above as well. On the other hand, (I1) and (I2) agreed with the results, stating that everyone, but mainly lower-income households will benefit from it. By that, it seems that the expansions will be more equitable to lower-income households, but will mainly follow an equal rule of allocation as both quantitative and qualitative data suggests.

The changes were more significant for residents with a migration background, as data from the isochrones assessment suggests. The planned expansions were of benefit for them, a change that is appreciated by (I4) as she believes that migration could be a potential disadvantage, following the same reasons as described above. By that, the expansions can be qualified as equitable for this group of inhabitants as the process of social inclusion is also being promoted.

5.2.2 Age, education and activity related equity

The correlation coefficients of the different age groups changed as well. At first, an improvement is observable for almost all age groups. However, a deeper look into the results shows a small raise of the correlation coefficient is noticeable for elderly residents and pensioners, a change which suggests that expansions might be a bit more equitable for them as they are part of groups declared by Ricciardi et al. [2015] as being most likely disadvantaged. Nevertheless, the correlation coefficient remains negative, a phenomena that comes as no surprise and that has already been observed

at other places in the world just as Ricciardi et al. [2015] did in the Australian Perth. Therefore, the expansions can be judged as more equitable, but not equitable yet, as situations for elderly residents described by the respondents will not be significantly improved. This can also be confirmed by the isochrone assessment on the different residents age groups, however, the difference in the results was surprising. Only the percentage of residents under 18 and between 50 and 64 increased after the expansions were included. This could mean that future expansions would specifically be a benefit to families with children, but would require a high age difference with their parents. Thus, it is difficult to judge which allocation rule the expansions are following. Age-related social exclusion could still remain a problem that is not being solved as data from the two different quantitative tools have shown, which is why equitability in terms of ages can be ruled out from possible allocation rules.

The differences between the current and future system considering activities and educational background were low, but tendencies can be observed. Thus, the correlation coefficients improved for employees but worsened for students and apprentices, a change which doesn't make the expansions equitable for students and suggests that future RPT stations will be allocated on an efficient way. This result is in conflict with (I3) and (I4) observation: They believed that the planned expansions will be of benefit for work related commuters and students (for both school and universities). However, their point of view show that these group of inhabitants will benefit on a section of their route that is supposedly further away from their place of residency, as for example in the northern of Munich feeder busses will be replaced. Thus, an improvement in their commuting time implies a better accessibility to their work place for example, rather than an improvement to their accessibility to RPT. Following up on activity related equity, I4 added a surprising observation by stating that many unemployed residents are living in her neighborhood who would therefore not benefit from expansions as they are not required to go anywhere. This statement is unexpected, as one would think that especially unemployed or retired inhabitants have a lower revenue and might be more susceptible to be socially excluded. On the other hand, it might seem true that in the case of Munich, expansions are much more needed for both school and work related commuters first as feeder bus lines reach their capacity limits. This would mean that the expansions would follow the rule of efficiency. This is also where differences of the respondents could be noticed. While I4 was more focused on a efficiency based expansion of the network, I3 couldn't understand the situation in Pasing where a redundant subway line will be built and would wish for a more equal

allocation of stations in neighborhood that have none yet. This lack of understanding in the planned expansions could suggest that a lack of efficiency of the system is being resolved, whereas equity and equality seem a secondary. Lastly, the changes in the results for the correlations with the educational background of residents is surprising as well. The only beneficiaries will be groups of inhabitants having the two types of secondary school degrees. The reason for this improvement can only be speculated, but strengthen the theory that there is a relation with income or motorization of the household.

5.2.3 Transport related equity

Moreover, the result changes after the planned expansions concerning the available mobility opportunities did not come as expected. The differences are once again very low, but a raise of the correlation coefficients for motorized households, their car usage as well as households having the option to travel by car and bike can be observed. In general, an improved correlation for non-motorized households would have been expected, as they are also susceptible to be part of the disadvantaged group of inhabitants cited by Ricciardi et al. [2015]. This result could reflect the city's will to reduce the amount of cars and increase public transport usage by providing an enhanced accessibility to motorized households. This observation has also been made by (I3), who is also driven by the environmental aspect of transportation and the will of achieving a more sustainable future. This change is also reflected by the variables describing the car-sharing memberships, in which only "non-members"- in other words probably motorized households will benefit. The planned expansions would therefore follow a more equal and efficient allocation rule. Thus, it is difficult to judge to what extent these changes are equitable, as on one side residential areas in which residents mostly rely on cars will benefit, whereas non-motorized households seem to bet left out.

5.2.4 Overall observations and tendencies

Analysing and disclosing overall patterns of changes in both qualitative and quantitative data can also help to complete and enrich the findings. As seen in the paragraphs above, the changes of the correlation coefficients are small and the judgement on the allocation rule changes for each variable. In other words, expansions might be more or less equitable depending on the group of individuals assessed. However, when

all calculated correlation coefficients are considered, a trend can be observed. There is indeed a tendency towards zero when the coefficients of the current system are being compared with the future ones, which means that correlations in general tend to decrease. This does not apply to every single coefficient, however this tendency suggests that the future system is supposedly more equal than equitable. This tendency towards more equality can be complemented by the qualitative findings: in general, planned expansions will target areas and improve the equity situation in terms of accessibility to RPT, respondents suppose; small changes that could barely be reflected in quantitative results. However, all respondents agreed that the expansions will be of everyone's benefit, just as the overall trend of percentages and correlation coefficients suggests, which means in other words that they will be equally allocated. It is yet unclear if the expansions themselves will be more equal or the city of Munich is very homogeneous, as (I2) commented on how he believes the city was built. Even if some respondents stated that especially "disadvantaged" inhabitants will benefit, it seems that it could also be meant in an equal context.

Lastly it is important to consider an issue and a limit of the expansions that has been addressed by the respondent (I3) when equity is being assessed, especially on an economical perspective. Her point of view is both pessimistic and realistic, but also based on her observation: When an RPT line is being expanded, a rise in land and living costs around their respective stations is to be expected, as the location becomes more attractive to live at. (I3) was aware of the principle of transit oriented development and believes that expansions in lower-income neighborhoods are a vicious circle cities won't be able to get out of. (I3)'s observation on that is interesting as it contradicts Culver [2017]'s observation on an other German city, where and RPT expansion improved public transport equity in a "working-class" neighborhood. An event, that is unlikely to happen if (I3)'s theory is being followed. (I3)'s perceptions reflects the supposed allocation rule that is being followed and the planning authorities' motivation: the equal allocation of RPT stations has probably more the aim to reduce the amount of cars that are being used than the will to strive for more equity in accessibility to RPT, as this motivation is probably driven by the environmental impact and traffic intensity of transportation systems in Munich. After (I3)'s statement, it seems that improving equity in terms of accessibility to RPT is a more deep-rooted challenge and can't be resolved by just allocating a new RPT station in a more disadvantaged or lower-income neighborhood.

5.3 Strength and limitations of the research

5.3.1 Limitations

The chosen methods were designed to give precise results and be simple to reuse. However, the gathered data has a major influence on the results. One of the limitations of this mixed-methods assessment, was a lack of consistency and scarcity of secondary data used for the quantitative tools. In the quantitative part, a set of 5 expansions have been used as they were the only ones where data concerning station positions were given, validated and accessible to use, whereas much more proposed expansions have been shown to the interviewees. Respondents could clearly distinguish between what has been included in the quantitative assessment and not. However, a consistent data-set with the same amount of expansions used for both methods could have increased precision. Moreover, a similar issue can be found in the quantitative analysis, where data from 2017 has been used and combined with RPT projects, that are not scheduled to be done before 2025/2026. Using data of the corresponding time frame when assessing the equitability of potential expansions would have increased significance, however, the research would be relying on predictions as new neighborhoods such as "Bayernkaserne" in the northern are not existing yet. However, tendencies can still be observed as no drastic demographic change is expected on such a short lapse of time in Munich.

The simplicity of the quantitative tools have also their drawbacks. As mentioned before, (I3) raised awareness on the fact that frequency and quality of service should be taken into consideration when planning new RPT expansions. Indeed, all stations have been treated equally in this thesis, regardless of reliability or frequency of a service. However, these are indicators that have been discussed by the respondents in the qualitative part. The semi-guided format for interviews can be, as experienced in this thesis, an asset and have drawbacks at once. On one side, this format allows the respondents to develop their ideas and the interviewer to modulate, add or remove questions as long as the guide is being followed. By that, data could be gathered on what respondents would actually wish or can criticize on the system, without necessarily leading them towards equity of accessibility to RPT. Even if giving a lead proved itself as a necessity in this case, the impression came across that respondents had difficulty to acknowledge that equity in RPT expansions can and/or should be considered as well (and is worth being assessed). Hence, it was difficult to interpret whether there

was a certain lack of knowledge of the respondents on the subject of social fairness or the situation was not being perceived as problematic.

5.3.2 Strengths

The advantage of a mixed-methods analysis is that both qualitative and quantitative data not only complemented and validated themselves, but allowed further insights on topics and issues that cannot be assessed with only one method. The chosen quantitative methods were significant and simple to understand, as correlation coefficients as well as isochrone maps are intuitive tools. Both are also flexible to use, as there are no limits on the amount and type of data used, as long as it is divided in geographical cells or a raster-map. Furthermore, qualitative methods - in this case interviews - allow a more in-depth and detailed review about the equity situation in Munich through inhabitants eyes and helped identify more scattered manifestations. It is certain that the available results might be subjective and differ from one respondent to another. But as long as living circumstances of them are being considered, their way of thinking can be understood which eases the process of interpretation. The methods have proven themselves to be more than successful: while quantitative data revealed no larger-scale inequity problems, respondents could point out scattered manifestations in areas in which they believed that the allocation of RPT station was not equitable (enough). This is in line with what Shay et al. [2016] expected from their mixed methods approach as well, as this also helped them to point out more specific areas and underlines the importance of this methodology.

Chapter 6

Conclusion

This research aimed to assess equitability in potential expansions of public transport by rail (RPT). With the utilization of mixed-methods, the equity of the accessibility to RPT in both the current and the future RPT system in Munich have been assessed. Despite smaller and scattered inequity manifestations on the current system, the expansions seem to majorly resolve equality and efficiency issues that will also enhance the equity situation for certain groups of inhabitants as their accessibility to social and economic opportunities will be improved. This research methodology did not only help to assess the equitability of future expansions but revealed socio-economic circumstances of the studied area as well. Hence, Munich's homogeneous character has been brought to light. Municipalities now have a better understanding how to assess and how equitable potential expansions of RPT are. The city of Munich seems to have larger equality and efficiency gaps rather than equity issues that need to be resolved. Thus, expansions are highly needed as some areas of the city are completely left out of the current RPT system. An expansion in those areas will not only ameliorate the equity situation but also improve equality and efficiency of the system. To enhance the quantitative part of this methodology, further research could implement an indicator of "attractiveness" for RPT stations, that could include aspects such as the frequency and amount of services that stop at a specific station, a quality index to qualify reliability of a service, how fast "hubs" could be reached in a city and the function of a line (e.g. feeder-lines). This would enrich the results and allow more precision in the qualification of equity of RPT systems. Furthermore, the subjectivity and influence of guidance has been observed in the qualitative interviews. Thus, it could be interesting to see how the respondents opinion change their opinions once they are well informed

about wider benefits of additional RPT stations in a transport disadvantaged area. In a next step, it would be interesting to carry out the same methodological approach with the proposed indicator(s) above on another city and in another country than Germany where social disparities are higher and RPT infrastructure is scarce. However, it would still be important to apply this methodology on the metropolitan area of Munich as well, as these areas are in constant growth and will be of much more importance in the years to come.

Bibliography

Thanos Bantis and James Haworth. Assessing transport related social exclusion using a capabilities approach to accessibility framework: A dynamic Bayesian network approach. *Journal of Transport Geography*, 84:102673, April 2020. ISSN 0966-6923. doi: 10.1016/j.jtrangeo.2020.102673. URL https://www.sciencedirect.com/science/article/pii/S096669231930701X.

Alexandros Bartzokas-Tsiompras and Yorgos N. Photis. Measuring rapid transit accessibility and equity in migrant communities across 17 European cities. *International Journal of Transport Development and Integration*, 3(3):245–258, July 2019. ISSN 2058-8305, 2058-8313. doi: 10.2495/TDI-V3-N3-245-258. URL http://www.witpress.com/doi/journals/TDI-V3-N3-245-258.

BMVI. Mobilität in Deutschland 2017 – Publikationen, 2017. URL http://www.mobilitaet-in-deutschland.de/publikationen2017.html.

BMVI. BMDV - Mobilität in Deutschland (MiD), January 2022. URL https://www.bmvi.de/SharedDocs/DE/Artikel/G/mobilitaet-in-deutschland.html.

Bundesregierung. Nachhaltige Städte und Gemeinden, November 2018. URL https://www.bundesregierung.de/breg-de/themen/nachhaltigkeitspolitik/nachhaltige-staedte-und-gemeinden-1006538.

Tim Bunschoten, Eric Molin, Rob van Nes, and Coffeng Goudappel. Tram or bus; does the tram bonus exist. *European transport conference 2013*, 2012.

Gregg Culver. Mobility and the making of the neoliberal "creative city": The streetcar as a creative city project? *Journal of Transport Geography*, 58:22–30, 2017. ISSN 0966-6923. doi: https://doi.org/10.1016/j.jtrangeo.2016.11.005. URL https://www.sciencedirect.com/science/article/pii/S0966692316303246.

DBAG. Projektflyer 2. Stammstrecke München, April 2017. URL https://www.deutschebahn.com/resource/blob/1299964/cc45c9dd34062c33060708ce7927b1c8/04-05-Projektflyer-2-Stammstrecke-data.pdf.

Alexa Delbosc and Graham Currie. Using Lorenz curves to assess public transport equity. *Journal of Transport Geography*, 19(6):1252–1259, 2011. ISBN: 0966-6923 Publisher: Elsevier.

Michael Duncan. The Impact of Transit-oriented Development on Housing Prices in San Diego, CA. *Urban Studies*, 48(1):101–127, January 2011. ISSN 0042-0980. doi: 10.1177/0042098009359958. URL https://doi.org/10.1177/0042098009359958. Publisher: SAGE Publications Ltd.

David Duran-Rodas, Dominic Villeneuve, Francisco C. Pereira, and Gebhard Wulfhorst. How fair is the allocation of bike-sharing infrastructure? Framework for a qualitative and quantitative spatial fairness assessment. *Transportation Research Part A: Policy and Practice*, 140:299–319, October 2020. ISSN 0965-8564. doi: 10.1016/j.tra.2020.08.007. URL https://www.sciencedirect.com/science/article/pii/S0965856420306923.

David Duran-Rodas, Benjamin Wright, Francisco C. Pereira, and Gebhard Wulfhorst. Demand And/oR Equity (DARE) method for planning bike-sharing. *Transportation Research Part D: Transport and Environment*, 97:102914, August 2021. ISSN 1361-9209. doi: 10.1016/j.trd.2021.102914. URL https://www.sciencedirect.com/science/article/pii/S1361920921002133.

Joseph Rowntree Foundation. Poverty and social exclusion in Britain, September 2000. URL https://www.jrf.org.uk/report/poverty-and-social-exclusion-britain.

Koos Fransen, Tijs Neutens, Steven Farber, Philippe De Maeyer, Greet Deruyter, and Frank Witlox. Identifying public transport gaps using time-dependent accessibility levels. *Journal of Transport Geography*, 48:176–187, 2015. ISBN: 0966-6923 Publisher: Elsevier.

Karst T. Geurs and Bert van Wee. Accessibility evaluation of land-use and transport strategies: review and research directions. *Journal of Transport Geography*, 12(2):127–140, June 2004. ISSN 0966-6923. doi: 10.1016/j.jtrangeo.

2003.10.005. URL https://www.sciencedirect.com/science/article/pii/S0966692303000607.

Barry Goldman and Russell Cropanzano. "Justice" and "fairness" are not the same thing. *Journal of Organizational Behavior*, 36(2):313–318, 2015. ISBN: 0894-3796 Publisher: Wiley Online Library.

Greg Phillip Griffin and Ipek Nese Sener. Public Transit Equity Analysis at Metropolitan and Local Scales: A Focus on Nine Large Cities in the US. *Journal of public transportation*, 19(4):126–143, 2016. ISSN 1077-291X. doi: 10.5038/2375-0901.19.4.8. URL https://pubmed.ncbi.nlm.nih.gov/28638236.

Markus Hesse and Joachim Scheiner. Mobilität, Erreichbarkeit und gesellschaftliche Teilhabe: die Rolle von strukturellen Rahmenbedingungen und subjektiven Präferenzen. *Vierteljahrshefte zur Wirtschaftsforschung*, 79(2):94–112, 2010. ISBN: 1861-1559 Publisher: Berlin: Duncker & Humblot.

Daniel Johnson, Marco Ercolani, and Peter Mackie. Econometric analysis of the link between public transport accessibility and employment. *Transport Policy*, 60:1–9, 2017. ISSN 0967-070X. doi: https://doi.org/10.1016/j.tranpol.2017.08.001. URL https://www.sciencedirect.com/science/article/pii/S0967070X16303353.

Peter Jones. Developing and applying interactive visual tools to enhance stakeholder engagement in accessibility planning for mobility disadvantaged groups. *Research in Transportation Business & Management*, 2:29–41, 2011. ISBN: 2210-5395 Publisher: Elsevier.

R. König. Zugangsstellen zum Stadtverkehr, March 2013. URL https://www.forschungsinformationssystem.de/servlet/is/408304/.

Gerald S. Leventhal. What should be done with equity theory? In *Social exchange*, pages 27–55. Springer, 1980.

Steven Lewis-Workman and Daniel Brod. Measuring the Neighborhood Benefits of Rail Transit Accessibility. *Transportation Research Record*, 1576(1):147–153, 1997. doi: 10.3141/1576-19. URL https://doi.org/10.3141/1576-19. _eprint: https://doi.org/10.3141/1576-19.

Suxia Liu and Xuan Zhu. Accessibility Analyst: An Integrated GIS Tool for Accessibility Analysis in Urban Transportation Planning. *Environment and Planning B: Planning and Design*, 31(1):105–124, February 2004. ISSN 0265-8135. doi: 10.1068/b305. URL https://doi.org/10.1068/b305. Publisher: SAGE Publications Ltd STM.

Roger Miller. Household activity patterns in nineteenth-century suburbs: A time-geographic exploration. *Annals of the Association of American Geographers*, 72(3): 355–371, 1982. ISBN: 0004-5608 Publisher: Wiley Online Library.

MVG. Münchner Verkehrsgesellschaft mbH.

MVG. GTFS-Fahrplandaten | Münchner Verkehrsgesellschaft mbH, 2022. URL https://www.mvg.de/services/fahrgastservice/fahrplandaten.html.

Landeshauptstadt München. Nahverkehrsplan der Landeshauptstadt München, March 2021. URL https://www.ris-muenchen.de/RII/RII/ris_vorlagen_detail.jsp?risid=6278313.

ORS. Openrouteservice. URL https://openrouteservice.org/.

Elias Pajares, Benjamin Büttner, Ulrike Jehle, Aaron Nichols, and Gebhard Wulfhorst. Accessibility by proximity: Addressing the lack of interactive accessibility instruments for active mobility. *Journal of Transport Geography*, 93:103080, May 2021. ISSN 0966-6923. doi: 10.1016/j.jtrangeo.2021.103080. URL https://www.sciencedirect.com/science/article/pii/S0966692321001332.

Enrica Papa and Luca Bertolini. Accessibility and transit-oriented development in European metropolitan areas. *Journal of Transport Geography*, 47:70–83, 2015. ISBN: 0966-6923 Publisher: Elsevier.

Colin Pooley. Mobility, Transport and Social Inclusion: Lessons from History. *Social Inclusion; Vol 4, No 3 (2016): Transport Policy and Social Inclusion*, 2016. doi: 10.17645/si.v4i3.461. URL https://www.cogitatiopress.com/socialinclusion/article/view/461.

John Preston and Fiona Rajé. Accessibility, mobility and transport-related social exclusion. *Journal of Transport Geography*, 15(3):151–160, May 2007. ISSN 0966-6923. doi: 10.1016/j.jtrangeo.2006.05.002. URL https://www.sciencedirect.com/science/article/pii/S0966692306000512.

QGIS. QGIS. URL https://qgis.org/de/site/.

Xiaohong Ren, Zhenhua Chen, Fang Wang, Ting Dan, Wei Wang, Xiaotong Guo, and Chunhua Liu. Impact of high-speed rail on social equity in China: Evidence from a mode choice survey. *Transportation Research Part A: Policy and Practice*, 138: 422–441, 2020. ISBN: 0965-8564 Publisher: Elsevier.

Anthony Michael Ricciardi, Jianhong(Cecilia) Xia, and Graham Currie. Exploring public transport equity between separate disadvantaged cohorts: a case study in Perth, Australia. *Journal of Transport Geography*, 43:111–122, February 2015. ISSN 0966-6923. doi: 10.1016/j.jtrangeo.2015.01.011. URL https://www.sciencedirect.com/science/article/pii/S0966692315000137.

Muhammad Atiullah Saif, Mohammad Maghrour Zefreh, and Adam Torok. Public Transport Accessibility: A Literature Review. *Periodica Polytechnica Transportation Engineering*, 47(1):36–43, 2019. doi: 10.3311/PPtr.12072. URL https://pp.bme.hu/tr/article/view/12072.

Thomas W. Sanchez. The Connection Between Public Transit and Employment. *Journal of the American Planning Association*, 65(3):284–296, September 1999. ISSN 0194-4363. doi: 10.1080/01944369908976058. URL https://doi.org/10.1080/01944369908976058. Publisher: Routledge.

Elizabeth Shay, Tabitha S. Combs, Daniel Findley, Carl Kolosna, Michelle Madeley, and David Salvesen. Identifying transportation disadvantage: Mixed-methods analysis combining GIS mapping with qualitative data. *Transport Policy*, 48:129–138, 2016. ISBN: 0967-070X Publisher: Elsevier.

Abdolmatin Shirmohammadli, Conny Louen, and Dirk Vallée. Exploring mobility equity in a society undergoing changes in travel behavior: A case study of Aachen, Germany. *Transport Policy*, 46:32–39, February 2016. ISSN 0967-070X. doi: 10.1016/j.tranpol.2015.11.006. URL https://www.sciencedirect.com/science/article/pii/S0967070X1530072X.

Emily Talen. Visualizing fairness: Equity maps for planners. *Journal of the American planning Association*, 64(1):22–38, 1998. ISBN: 0194-4363 Publisher: Taylor & Francis.

Nikolaos Thomopoulos and Susan Grant-Muller. Incorporating equity as part of the wider impacts in transport infrastructure assessment: an application of the SUMINI approach. *Transportation*, 40(2):315–345, February 2013. ISSN 1572-9435. doi: 10.1007/s11116-012-9418-5. URL https://doi.org/10.1007/s11116-012-9418-5.

Ignacio Tiznado-Aitken, Karen Lucas, Juan Carlos Muñoz, and Ricardo Hurtubia. Understanding accessibility through public transport users' experiences: A mixed methods approach. *Journal of Transport Geography*, 88:102857, 2020. ISBN: 0966-6923 Publisher: Elsevier.

Joseph S. Wholey, Harry P. Hatry, and Kathryn E. Newcomer. *Handbook of Practical Program Evaluation*. Jossey-Bass, 2010.

Sarah Wixey, Peter Jones, Karen Lucas, and Madelein Aldridge. Measuring accessibility as experienced by different socially disadvantaged groups. *London, Transit Studies Group, University of Westminster*, 2005.

Appendix A

Appendix

Interview questions

Background information

- Age, Migration background
- Job/Education

General aim of the interviews and needed information:

- Are the needs in terms of accessibility fulfilled for the interviewee? (Does he feel equitably treated?)
- How fair they perceive location and frequencies of current rpt lines and stations?
- What could be enhanced to ameliorate accessibility to rpt and therefore the equity situation in Munich.
- How fair they perceive location and frequencies of future/planned rpt lines and stations.

I. Own circumstances

Aim:
To understand if the needs in terms of accessibility to rpt are fulfilled. As accessibility is being used as an indicator for equity, we could point out if the interviewee is feeling equitably treated.

Questions	Aim
- Travel Habits Which transport mode do you use and why?	Understanding why the following modes of transport are preferred. They could hint a possible lack or good accessibility to (r)pt.
- Ease of reach Considering you could only use (r)pt, how well could you reach the different types of infrastructure*?	Aims to qualify the accessibility to rpt of the interviewee. This question helps to support and understand his travel mode decisions and point out a possible difficulty to access opportunities, goods and/or services.
- Equitability Do you think your needs in terms of accessibility to (r)pt are being met? (Possible similar question if respondent is a frequent car user): Would you use (r)pt more/less often if accessibility would be better/worse?	This relates to our research question. The aim is to see if on the current network his transport needs are being met. This will help to further investigate (at a later stage) if expansions are necessary and if they could help ameliorate the current situation.

II. Perception on current accessibility situation in its neighbourhood and the city as a whole

Aim:
To understand how fair the current system is, in his neighbourhood (where the interviewee might have more specific knowledge of living circumstances etc.) and the city of Munich. What enhancements are needed to meet the individual's needs and make the system more equitable.
The aim of asking for the city as a whole: different interviews from different perspective can be compared and point similarities or inconsistencies in their perception of equity can be pointed out.

Questions	Aim
- Travel patterns Do you know/think your neighbours follow a similar travel pattern?	Quick follow-up question to distinguish if the chosen mode of transport above is a personal choice or common for the neighbourhood the interviewee is living in. This question is an open question to investigate if there are car-free households nearby and if there is a need for a good rpt accessibility.
- Location and frequencies Is / are the rpt stations accessible for most of your neighbourhood? How would you qualify quality and frequency of its service?	To see not only if the perceived accessibility is strong/poor, but also the usefulness of the accessibility. A good accessibility to a poor (frequency of) service is e.g. not useful.
- Location and frequencies of rpt services in Munich How would you qualify the allocation of rpt stations in the city of Munich? Are there areas that have poor accessibility to rpt and are therefore disadvantaged? Where are they and why do you think so?	These questions aim to make the interviewee reflect on neighbourhoods in Munich he might (not) know and qualify their accessibility. This question helps to investigate if there are areas in the city where accessibility is poor, and if there is a chance that the affected individuals are being treated equitably.
- Enhancement Considering the fact that there is a need to fill accessibility gaps in the city, where and why could new stations and lines help to ameliorate the accessibility and transport equity situation in the city?	This question helps to find out where local inhabitants might want better rpt accessibility to meet their needs and therefore make the transportation system more equitable.

III. Perception on the future rpt system in the city of Munich

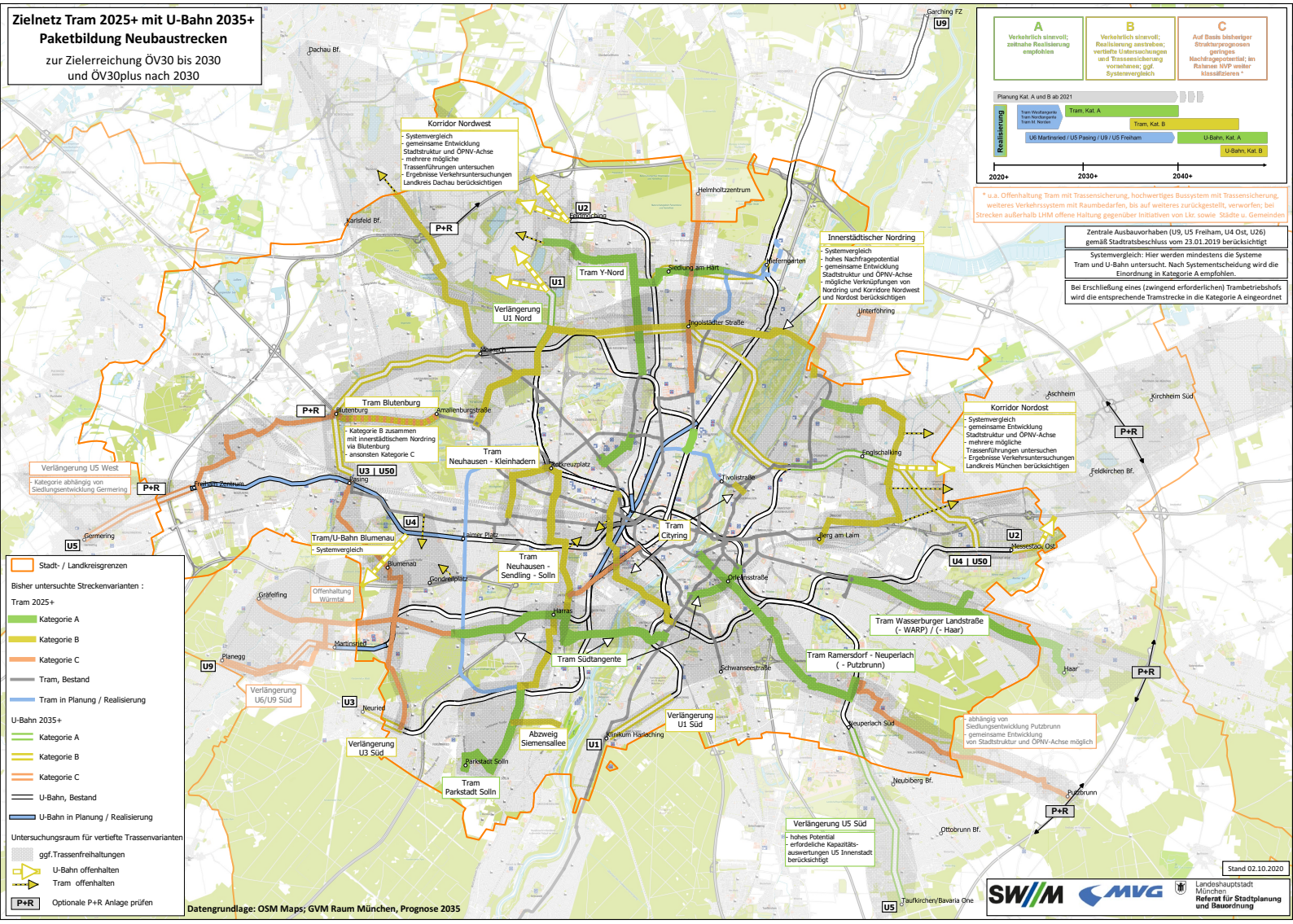
Aim:
After planned expansions are shown to the interviewee, I want to know how fair he perceives the planned expansions and if he thinks the needs of inhabitants are being met. This will help to respond to my research question on how equitable the expansions of the rpt system in Munich are.

Questions	Aim
- Who will benefit / is privileged by the expansions? Which type of areas and individuals will benefit from the proposed expansions? Extension: Do you think disadvantaged people (old, migrant, low eco status) will benefit from these expansions? Extension: Do you think these expansions meet the peoples need?	This question is a first step to investigate if the expansions are equal, equitable and/or efficient. The extended questions can help guide to interviewee to respond the question on how fair he perceives location (and frequencies) of the planned expansions.
- Neighborhood Is your area being left out? How do you qualify this decision?	This question points out if the respondent has the feeling to be treated inequitably in terms of accessibility to (r)pt. This will help in a first step to introduce and point out gaps of the planned expansions.
- Munich Where would you further expand?	This should indentify the gaps and limitations of the expansions, regardless if they are equitable or not.

IV. Confrontation with the results

Aim:
The interviewee will see the quantitative part of the results and will be confronted to them to see how he is being affected and what he thinks. It's an open-ended question that serves as a link to the quantitative part of the research.

Possible Questions (guidance):
- Does it affect you?
- What do you think of the accessibility situation for students? Migrants? Elderly residents?
- (General and free reactions on the results)


Zielnetz Tram 2025+ mit U-Bahn 2035+
Paketbildung Neubaustrecken
zur Zielerreichung ÖV30 bis 2030
und ÖV30plus nach 2030
A
Verkehrlich sinnvoll; zeitnahe Realisierung empfohlen
B
Verkehrlich sinnvoll; Realisierung anstreben; vertiefte Untersuchungen und Trassensicherung vornehmen; ggf. Systemvergleich
C
Auf Basis bisheriger Strukturprognosen geringes Nachfragepotential; im Rahmen NVP weiter klassifizieren *
Realisierung
Planung Kat. A und B ab 2021
Tram, Kat. A
Tram, Kat. B
U6 Martinsried / U5 Pasing / U9 / U5 Freiham
U-Bahn, Kat. A
U-Bahn, Kat. B
2020+
2030+
2040+
* u.a. Offenhaltung Tram mit Trassensicherung, hochwertiges Bussystem mit Trassensicherung, weiteres Verkehrssystem mit Raumbedarfen, bis auf weiteres zurückgestellt, verworfen; bei Strecken außerhalb LHM offene Haltung gegenüber Initiativen von Lkr. sowie Städte u. Gemeinden
Zentrale Ausbauvorhaben (U9, U5 Freiham, U4 Ost, U26) gemäß Stadtratsbeschluss vom 23.01.2019 berücksichtigt
Systemvergleich: Hier werden mindestens die Systeme Tram und U-Bahn untersucht. Nach Systementscheidung wird die Einordnung in Kategorie A empfohlen.
Bei Erschließung eines (zwingend erforderlichen) Trambetriebshofs wird die entsprechende Tramstrecke in die Kategorie A eingeordnet
Korridor Nordwest
- Systemvergleich
- gemeinsame Entwicklung Stadtstruktur und ÖPNV-Achse
- mehrere mögliche Trassenführungen untersuchen
- Ergebnisse Verkehrsuntersuchungen Landkreis Dachau berücksichtigen
Innerstädtischer Nordring
- Systemvergleich
- hohes Nachfragepotential
- gemeinsame Entwicklung Stadtstruktur und ÖPNV-Achse
- mögliche Verknüpfungen von Nordring und Korridore Nordwest und Nordost berücksichtigen
Tram Y-Nord
Verlängerung U1 Nord
Tram Blutenburg
- Kategorie B zusammen mit innerstädtischem Nordring via Blutenburg
- ansonsten Kategorie C
Tram Neuhausen - Kleinhadern
Verlängerung U5 West
Kategorie abhängig von Siedlungsentwicklung Germering
Tram/U-Bahn Blumenau
- Systemvergleich
Tram Neuhausen - Sendling - Solln
Offenhaltung Würmtal
Tram Südtangente
Verlängerung U6/U9 Süd
Verlängerung U3 Süd
Abzweig Siemensallee
Tram Parkstadt Solln
Verlängerung U1 Süd
Tram Citytring
Korridor Nordost
- Systemvergleich
- gemeinsame Entwicklung Stadtstruktur und ÖPNV-Achse
- mehrere mögliche Trassenführungen untersuchen
- Ergebnisse Verkehrsuntersuchungen Landkreis München berücksichtigen
Tram Wasserburger Landstraße (- WARP) / (- Haar)
Tram Ramersdorf - Neuperlach (- Putzbrunn)
- abhängig von Siedlungsentwicklung Putzbrunn
- gemeinsame Entwicklung von Stadtstruktur und ÖPNV-Achse möglich
Verlängerung U5 Süd
- hohes Potential
- erforderliche Kapazitäts-auswertungen U5 Innenstadt berücksichtigt
Stadt- / Landkreisgrenzen
Bisher untersuchte Streckenvarianten :
Tram 2025+
Kategorie A
Kategorie B
Kategorie C
Tram, Bestand
Tram in Planung / Realisierung
U-Bahn 2035+
Kategorie A
Kategorie B
Kategorie C
U-Bahn, Bestand
U-Bahn in Planung / Realisierung
Untersuchungsraum für vertiefte Trassenvarianten
ggf.Trassenfreihaltungen
U-Bahn offenhalten
Tram offenhalten
P+R
Optionale P+R Anlage prüfen
Datengrundlage: OSM Maps; GVM Raum München, Prognose 2035
Stand 02.10.2020
SW/M
MVG
Landeshauptstadt München
Referat für Stadtplanung und Bauordnung

Interview 1 (I1)

Speaker 1 Okay, so which transport mode do you use and why?

Speaker 2 on a daily basis or like..?

Speaker 1 yes, for example.

..transit time and travel pattern

Speaker 2 Usually I use, I take the bus to the nearest, train station, U-Bahn, and then I take the train, like the U-Bahn to university. I rarely use the S-Bahn, and Trams, I would say maybe every other day.

Speaker 1 And for example, for casual things - do you have the same travel habits? Do you almost only rely on these buses?

..accessibility to rpt

..transit time and travel patterı

Speaker 2 I mean, I.. It's either I walk 10 to 15 minutes to the nearest U-Bahn station or I have to take a bus. So, in bad weather, I almost always take the bus which makes me kind of dependent on it. Then the bus will take me to the nearest U-Bahn station. So if I want to get anywhere from like further from like a 1.5 kilometers kilometer radius from my apartment, I'll have to use the U-Bahn.

..good

..transit time and travel patterı

..good

I find that you can access almost all neighborhoods in Munich through the U-Bahn network. So the S-Bahn, it doesn't really.., I don't really use this one very often. And the tram, I'd say like when there's a gap in the U-Bahn I'll start choosing the tram, but preferably I'll still use the U-Bahn because it's faster.

Speaker 1 And you have a nearby Tram station as well. What is the concern with that? Like, why aren't you for example using it?

..accessibility to rpt

..transit time and travel patterı

Speaker 2 Because of the bus stop. The bus stops right in front of my house and the tram is still like a five to six minute walk. So like sometimes when I miss the bus, I take the tram, but I don't see why I should walk five to six

minutes and then take one tram station rather than just take the bus that's in front of my place.

11 **Speaker 1** Okay, and considering that you could only use, I mean, you almost also answered the question, but like how well could you reach, the different types of infrastructure - for example, if we consider leisure, like blue and green or social infrastructure, if you want to go to parks, or sport facilities or something like that, how is for example your ease of reach?

12 And that means, do you have a lot of interchanges and your travel time as well?

13 ..transit time and travel pattern **Speaker 2** So I'd say almost like 80% of my, my trips last 25 to 30 minutes, regardless how close or far it is, because it takes me already like five to 10 minutes to go from my place to the nearest U-Bahn station.

14 ..accessibility to rpt ..transit time and travel patterı And then, depending on how far it is, like the difference between like three or four U-Bahn stations and five and six, aren't like, isn't that big, so like, I'd say like half of the time I take is already from my door to the nearest U-Bahn station. Then the other half, depending on how far it is, is through the U-Bahn.

15 ..accessibility to rpt ..transit time and travel patterı ..accessibility to rpt And since I already have to change once to get to the U-Bahn station, I will try to take, because I have access to the U2, U3 and U6, I'll try to take the one that gets me the closest to my destination without having to change, even if I have to like walk 10 to 15 minutes, because having to change twice is quite annoying.

16 ..quality and frequency of serv ..transit time and travel patterı And, and you can never know, like if there's a delay and the fact that like, if you have to wait for two different trains afterwards, you might experience like a higher probability of delays. So I'll try to like avoid switching more than the one-time.

17 ..bad **Speaker 1** Do you feel like the fact that you have to change once for example - or that you are relying on this bus service is in any way an inconvenience to you?

18 **Speaker 2** Yeah. It is one of the reasons why I'm searching

..bad

for a new apartment because like, from a distance point of view, Like, I don't live out far from the center or like from university, I could take like 15 minutes by bike or 40 minutes by foot, which is like, theoretically, not that long.

19 ..transit time and travel patter

..bad

Given the fact that I take 25 minutes by transport to go to, to the university. So like from a distance point of view, I'm not that far, but, the fact that I have to always like change and take, take the bus, makes everything more of a hassle. Yeah.

20 **Speaker 1** Okay, yeah so that's actually one of the questions I wanted to go to, do you think your needs in terms of accessibility to public transport, but also to rail public transport are being met?

21 **Speaker 2** I mean, I definitely have a bus station that's not far so on that term, like I'm not in a dark zone, I could walk like five to six minutes to the nearest tram station, 10 to 15 to the nearest U-Bahn station. So like, it's not like I'm really depending on one bus and if I missed that bus, like I don't have other options.

..accessibility to rpt

22 So in that way no, I wouldn't say, like, I wouldn't say it's like problematic. I just think that it could be like easier or like made more practical?

..needs

23 Wait, what was your question again?

24 **Speaker 1** if just like your needs in terms of accessibility are being met?

25 **Speaker 2** I mean, they are being met, but like, it's just not optimal. So like I can still go wherever I want whenever I want, there's a night bus also that like goes to my place, so it's not like I can never access my place, but, but it's not like tha-.. Since I depend on the bus or I have to change at least once for any short distance trip it's like not the most ideal.

..needs

..transit time and travel patter

..bad

26 **Speaker 1** So for example, would you use public transport or rail public transport more or less often if, your accessibility would be better or worse? Do you think it would, your habits would change?

..good

..bad

..good

27 **Speaker 2** Yeah. Yeah. I mean, I definitely prefer using the trains, like the, the rail public transport more because they're more depend-, dependable and you can-.. they, they come more often. Sometimes the bus just doesn't appear or like, you'd never know ‘cause the, the time plan is not digital and you just like, kind of have to look at the end of the road and see if you can spot the bus. However, with the trains, you like, you have a timer and comes usually every five minutes.

..good

..accessibility to rpt

28 And like, in the worst case, you know, that one's going to come in like 10 minutes. And you have like the kind of guarantee you, cause there are, I mean, there aren't like traffic jams usually. So yeah, like I definitely prefer using the, the U-Bahn and S-Bahn. If I were to live closer to one, it would definitely be, I mean, I wouldn't have to use the bus, so it would be more practical.

..neighborhood & city travel patte

29 **Speaker 1** Okay, and… so let's go over to your neighbors. I mean, you know most of your neighbors or a bit of your neighborhood: Do you believe that they follow a similar travel pattern?

30 **Speaker 2** Yeah, in general.

31 **Speaker 1** Okay. So follow up question: are the RPT stations accessible for most of your neighborhood and how would you qualify the quality and frequency of its service? So like if you're analyzing or seeing your neighborhood, consider it as a whole, and not only a radius of 400 meters, for example, around your apartment, for example.

..accessibility to rpt

32 **Speaker 2** I mean, as a whole neighborhood I'd say like it's not bad cause we have, like, let's say from my point - from my place, like an, a radius from 1.5 kilometers from my place of residency, you could access at least four different rail transportation methods, like Scheidplatz, Münchner Freiheit, Nordfriedhof, or…

33 **Speaker 1** no it's okay, it’s just to give an idea.

..accessibility to rpt

34 **Speaker 2** So like it’s not bad, you know, there are like three different U-Bahns, like , so it's like, okay. I think I'm like, my point is like.., no like my place of residency is not

..accessibility to rpt

very strategic because it's like kind of equidistant from all four, but not like really close to one, so…

35 **Speaker 1** Okay. Yeah and you responded already on the quality and frequency of the service before. You said that you, you are satisfied with their reliability for instance?

..bad

..good

36 **Speaker 2** The Bus not that much, but the rail… yeah.

37 **Speaker 1** Okay. So we'll take a look at, the city as a whole-, the city of Munich as a whole.

38 How would you qualify the allocation of RPT stations in the city. Yeah, just base yourself on your knowledge, but you can also consider, or you can respond to that question to say where it's especially good, and for example, where…, if you've never heard of those places because maybe there's just no RPT going to those places - for example.

39 **Speaker 2** I mean, I think everything that's outside of the center which is like I would say, goes from Maxvorstadt to maybe the, like the Isar, and then, so Gärtnerplatz to Hackerbrücke? In this radius I'd say like, it's very well connected Like maybe like you wouldn't have to walk more than 10 minutes, the nearest U-Bahn station.

..good

40 I think once you get out of this, these areas, the U-Bahn network starts to like spread out in like specific, like specific, directions, which means like, obviously everything that's like 10 minutes away from the one train station is well connected, but like at a certain point, the, the kind of the, the raise of the transportation method, like kind of start to get further and further apart since it's kind of like, kind of like a, the center and it spreads out kind of like the sun, yeah, like everything, that's not close to the, the axes, I'd say it's not very well-connected sometimes, it could be, it can be like problematic because the axis start to separate, quite close to the center. I mean, some example would be like the north of Bogenhausen, which is like, not that far from the center from a distance from like, by Car, by foot or like bike, but the U4 stops at Arabellapark and the U5 goes to Ostbahnhof and the U3 doesn't like cross the Englischer Garten.

..bad

41 So like kind the place in between that is kind of badly

..bad

connected, lets's say, some areas like aren't badly connected, but like you can only reach them with one method such as the Schwanthalerhöhe which is actually quite close to the center. It's not like, but you can only get at, reach it with one U-Bahn, like one station.

..bad

42 There are some areas where, I mean, if you don't live there, I wouldn't see the need to like really go there because they're kind of very, like, not very well, connected, such as like the north of, Schwabing and Schwabing-Freimann. This kind of like area that is between the U2 and U6, where there is absolutely no rail transportation, neither trams or U-Bahn or S-Bahn.

..bad

43 So like you're really dependent, dependent on the bus. So like if you don't live there and you're not like willing to take the bus all the time, because you have to, I think no one outside of that neighborhood will like actually go there. And then north of Laim, Neuhausen, I'd say it's kind of like Schwanthalerhöhe where you kind of have the U1 that takes you at a certain extent into this neighborhood, to the Rotkreuzplatz, Mailingerstraße, so on.

..bad

44 And then you have like the tram that takes you a bit deeper, but like never really to the core of it. And so, yeah.

45 **Speaker 1** Okay. If you consider, for example, economical status of some neighborhoods where, or, also you could link it for example to non-motorized households, are there areas that have poor accessibility to RPT or Public transport and are therefore disadvantaged and where are they and why would you think so?

..bad

46 **Speaker 2** Well, I think that the north, Milbertshofen am Hart - it's like not very well connected Because I feel like the south, you can like the, the urbanized areas are always around the train stations or like the trains go really deep into the urbanized areas.

..bad

47 And so. I don't think you'll have to like walk that far to get to the nearest one, but between the like U6 and the U2 at Milbertshofen am Hart, even parts of Schwabing-Freimann or Hasenbergl, like mainly, you mainly have the U2 or U6, and they are quite far from each other. And so there are like some really big areas that mainly depend on buses.

..bad

48 And so if you, if you can't like take the bus or you, which like doesn't really, which sometimes doesn't always come, it would, it wouldn't be like a stupid idea to invest in a car.

49 **Speaker 1** So you feel like the people also living there have being like disadvantaged, kind of-…, - are having a kind of disadvantage in terms of accessibility to RPT, for example?

..equitable

50 **Speaker 2** Yeah definitely

51 **Speaker 1** Considering the fact that there's a need to fill gaps of accessibility, where could new stations and lines help to ameliorate the accessibility and transport equity situation in the city and why? And, I can give you a map as well if you want.

52 **Speaker 2** I'm going to stick to the north.

..bad

..target groups of who migl

..equitable

53 I think the north is by far the, the area that is the least connected to RPTs, and, but it's like, there are also a lot of people who live there, people who can't really afford buying cars, unlike Bogenhausen for example. So it would definitely be smart or like fair to give them a better access to transportation.

54 **Speaker 1**. Okay. So considering all the new planned expansions, which type of areas and individuals will take profit from the proposed expansions?

..equality

55 **Speaker 2** I mean, if all proposed expansions go through, I think everyone could really profit. I see there are like different categories of priorities for, for the planned expansions.

56 And regarding that, I don't know if I agree or find, like, find them all. I mean, I find some that are in the category three to be like maybe even more relevant or important than the ones that are in category one. Especially focusing on the north, where like giving the fact that I live around on Petuelring on the Leopoldstraße I kind of know which methods of transportation are there - I have taken them all. And I have already, I've had, I've had to take the bus on it for 140 and 141 to the north multiple times already, and I

..priority of expansions

..bad

..efficiency

..bad

..efficiency

have to say there are quite unreliable given the fact that Munich is a very traffic intense city.

..bad

..equity

57 Sometimes there are just like, they just do not come and building a tram rail on this road would help connect a lot of people. Yeah.

58 **Speaker 1** And for example, if you took the example of the like Southern of Munich a little bit, what do you think, for example, if the Westtangente could help considering the fact that they almost have no rail public transport. You just have until now the U6 over there, the white line and the U3 over there and the little gray trams over here.

59 But like the rest of it is like not interconnected So you would go have to go through to the city center or if you live like between them, you might have no connection at all. What do you think?

..target groups of who might p

..equality

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60 **Speaker 2** I mean, I think obviously all gained transportation systems would benefit everyone because even though it's not your daily path, you might sometimes need to go from this place to that place.

..efficiency

61 And if there's a direct line, it's always a plus. I, I mean, I don't know how many people who live in like this Sendling that actually work in Neuhausen so I don't know how relevant a line that would link these two parts really is. So I can't really comment on that, but I mean, if there are other people who like have to go from these two parts, then it would definitely, definitely be of benefit, yeah.

62 **Speaker 1** And if you'd like, for example, considered now more disadvantaged people, or for example, also people with a lower economical status who can't for example afford cars, or in general, like either way, disadvantage people in terms of their age, or for example…

..equity

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63 **Speaker 2** yeah, I think they would definitely benefit from it because, with every RPT that goes further in the suburbs, more quote/unquote disadvantaged people will benefit from it. So yeah, I think this is good

64 **Speaker 1** So you partly, already answered this question,

but do you think these expansions meet the people's need in general, for example, in your neighborhood, you were saying that the priority of the constructions of these expansions could be better or could be improved Yeah, how would you qualify on a, like a general term over the city? Very broadly.

65 **Speaker 2** I think if all, like, as I said, if all, proposed plans were to go through, I think people would really benefit - if only the first priority I don't know if, if really, if like the disadvantaged people will really benefit from it because looking at the map, it's kind of like, seems like it's connecting parts of the center better together and not really going further north or south where all the, the, the, like the people who can't afford the cars actually live at because the center is quite expensive.

..priority of expansions

..equity

66 **Speaker 1** Okay. And seeing the situation now and plus five years, cause this extension is not included right now in like official plans, is your area being left out and how do you like qualify this decision? Do you think it's okay for now? Do you think they should improve it at a later stage?

67 **Speaker 2** I think they should start improving as fast as possible. I'm like looking at my neighborhood, I think, which is in the priority class three. I think if it were to go through that would definitely be good for the people.

..priority of expansions

..equity

68 **Speaker 1** Okay. And, now that you have seen many expansions, where would you further expand if you were to, if you were to draw, for example, new expansions?

69 **Speaker 2** I think, I think with all the proposed plans, Munich would be very well connected, but looking at the timeline and seeing that the categorie C isn't even on it and the timeline goes to 2050, almost, I think that the priorities need to be rechecked because some should be done way before others.

..equality

..priority of expansions

70 **Speaker 1** And where would you like, for example, then further expand, like, do you have your own ideas or areas you think that they're being left out?

71 **Speaker 2** I mean, maybe the north west

..limitations

72 **Speaker 1** For example?

..limitations 73 **Speaker 2** Behind Olympiapark, yeah, like honestly I find it quite good I have to say.

74 **Speaker 1** Okay. And if you like, just see, for example, the timeline of the blue expansion. So the thing that are like being fixed What would be the urgent next step you would take?

..limitations 75 **Speaker 2** The expansion towards the north.

76 **Speaker 1** Okay. So let's stick on that. Okay.

..limitations 77 **Speaker 2** Or Southwest like Ramersdorf-Perlach.

78 **Speaker 1** Okay.

1

Interview 2 (I2)

2 **Speaker 1** Well, I started the recording. First of all: I wanted to ask how old you are and in which area of or around Munich you live. You don't have to give this information, but maybe in general, your neighbourhood or, I don't know, the closest stop, for example.

3 **Speaker 2** No, no, I agreed to do that. It's nothing personal, as long as it's anonymous, I don't have a problem. I am 52 years old and live in the western part of Munich, the area is called Pasing-Obermenzing.

4 **Speaker 1** Okay, great. Good, about the next question: the very first question is meant to be a little bit general, I would like to focus a little bit on your own, your own circumstances. I mean traffic-wise, concerning your means of transport and so on. I would like to start by asking which means of transport you use the most, for example? And why do you use it?

..transit time and travel pattern

5 **Speaker 2** Yes, I use the bus. Why? Because it's the fastest way to get me from my home to my place of work.

6 **Speaker 1** Okay, great. And you use it on a regular basis, right?

..accessibility to rpt

..transit time and travel patterı

7 **Speaker 2** Most of the time I use the bus because I don't have a tram, I don't have a metro, I only have an S-Bahn stop and a bus stop in my, in my neighbourhood. And that's why I use the bus the most because, as I said, I get to work faster and with the, with the S-Bahn it would take longer.

8 **Speaker 1** Okay, very good. Thank you. So since you are also dependent on public transport. For example, how quickly can you reach different types of infrastructure? And I'll list them for you a bit or give you a few ideas. I want to know how easily or quickly you can reach them, and I'm only referring to the time and, for example, how many interchanges you have, because depending on the situation, some places can be reached quickly, for example, but then you have three changes and then it's inconvenient again. Because of that, as you just said it with the workplace: how long, for example, is the time you spend on the bus? For a one-way journey.

..transit time and travel pattern

..bad

9 **Speaker 2** I spend about 20 minutes in the bus. 10 minutes of walk from home to the bus stop and then by bus it's 20 minutes. And then, yeah, how much.... 30 yes, it takes me about 20 minutes from the bus stop where I get off and walk to work. I could change from this stop to a tram, but I don't change to the tram, why? Because it's only one stop and I would lose too much time because the bus doesn't run on time and most of the time I miss the tram. Therefore, as soon as I get off the bus, I walk to work.

10 **Speaker 1** Ah, okay, all right. Okay, that's for example for the way to work? and what about the social infrastructure, for example? For example, if you want to meet friends or… do you have to use public transport? Or would you just, for example… or are they more in your neighbourhood, so that you don't have to go too far? The same applies, for example, if you also have family in Munich or anything that is part of the social sector.

11 **Speaker 2** Exactly, it varies, it depends on who I meet and where they live, or where we want to meet. Most of the time, I use a bus so that I can get to Pasing, for example, and then from Pasing I have several means of transport at my disposal, such as trams or several suburban trains. And then I can get everywhere. But the bus is my main mean of transport.

..transit time and travel pattern

12 **Speaker 1** Okay! good, I think I got it. But again for my understanding: do you own a car or not? That would be very important for...

..transit time and travel pattern

13 **Speaker 2** We own a car yes.

14 **Speaker 1** You own a car, okay. But the reason, for example, why you'd rather use the public transport is.... Or is there a specific reason for that? Or...

15 **Speaker 2** Yes, there is a specific reason and especially in the city area, especially in the center area there are no parking lots for a car. This is the first reason, and secondly, if I want to meet someone on my own, it's impossible to take a car. But when I'm travelling with my family, we do as following: if we want to move around in the city, it depends on the destination and whether we have parking spots there. If not, we don't try to go there by car at all, but by public transport. And with public transport it's actually advantageous as we arrive exactly at our destination. So we don't have to walk so much unnecessarily. But when I meet friends, for example, we usually meet at spots where

..transit time and travel pattern

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there are public transport stops. And that's why, considering this, I think a car is unnecessary. A car is more of interest when we travel outside the city or on the outskirts. But in the center it's really difficult because of a scarcity of parking lots, yes, the main reason is that we don't get a place to park the vehicle. And if we would get one, it would be costly. That's just unnecessary.

16 **Speaker 1** Okay, yes okay, I see. Right then, hold on sorry. Alright. Do you find that your needs in terms of accessibility to public transport or also to rail public transport - you may also compare - are fulfilled? Or would you like to have a larger offer, for example?

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17 **Speaker 2** Yes, a larger offer is of course interesting, especially the rail connection is very, very important, because trams can be boarded by many passengers at once. With buses it's, as soon as it's the rush hour, the bus is quickly full and even if they do run every 10 minutes or 15 minutes, it always gets full quickly and most of the time you can't have a seat. But it would be a lot easier with larger vehicles and I think they are more comfortable. So it's a rail vehicle, of course it's interesting. But at our place, there's a stop, an S-Bahn stop. But it's not reliable, you know? Well, that's the Deutsche Bahn and their S-Bahns are not very reliable, especially in bad weather where they are usually cancelled. That's why I don't try to use the rail vehicles, especially the S-Bahn. Our bus connection would be the more reliable alternative. And that's why I try not to take the S-Bahn at all, but always the bus.

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18 **Speaker 1** Thank you. And that's very interesting too. Thank you. And then on that note: so would you say then, that your needs are still fulfilled? Are you still, yes, are you actually satisfied? In other words, are you satisfied, do you think that your needs are met with the offer you have?

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19 **Speaker 2** No, my needs are not met. I would wish for, because our area is also very well populated, I would wish for a rail connection, for example a tram connection wouldn't be bad and of course an underground would be even nicer, but we won't get the underground so quickly, I assume. But a tram connection would be enough for us.

20 **Speaker 1** Okay, yes, great. Right, now a little bit more about your neighbourhood, because you just started talking about it. A very short question about it: do you think that your neighbours use similar means of transport or do they, for example, rely much more on cars? Or how do you

assess that? How do you see it?

21 **Speaker 2** So because I live on the outskirts, my neighbours actually use... So my direct neighbours… yes 50 percent, like 50/50, so half of them all have vehicles and some even have two vehicles, some even have three, so three family members.... No, one family, three vehicles. It's very different. There are even people who ride bicycles, actually the main users *(of public transport)* are us, my family.

..neighborhood & city travel patte

..neighborhood & city travel patte

22 **Speaker 1** Okay, thank you, that's interesting to know. Just a moment, sorry, because you had already answered one thing here, but, alright. Briefly follow-up on the one S-Bahn connection that you have there: I assume it's the S2 or something? or...

23 **Speaker 2** no, S3.

24 **Speaker 1** S3. Okay. Is this, this, this S-Bahn actually easy to reach? So now in general in your neighbourhood or is it... I don't know, for example, how would you estimate the walking distance?

25 **Speaker 2** I live-, it's very easy to get to, no problem. And in fact I live, I live right in the middle, so between the two stops. I can reach both of them in about 10 minutes.

..accessibility to rpt

26 **Speaker 1** Ah okay. That means you're there... Okay.

27 **Speaker 2** So from the time I don't have any advantages nor disadvantages, so neither takes longer or shorter, both take 10 minutes.

..accessibility to rpt

28 **Speaker 1** Yes, alright. You just said that the bus is more reliable than the S-Bahn. But now I would still be interested in how you would evaluate the quality and the frequency and the allocation of this S-Bahn connection in general? What would you…

29 **Speaker 2** Yes, the S-Bahn usually runs every 20 minutes, and if it's cancelled, 40 minutes. At the weekends it sometimes runs every 40 minutes and if a service is cancelled, then you have to wait 80 minutes. That can be very exhausting, especially in the cold season. That's why, I mean, I know the S-Bahn stories of my daughters. My daughters went to school in Olching, and they usually suffered in the morning because the S-Bahn trains came late, and when they came, they were overcrowded. And

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sometimes they didn't even stop, they just kept going and vice versa. So S-Bahn is, if I'm honest, a dilemma. Sometimes I even had to take them to school by car, because the S-Bahn didn't come at all. So S-Bahn is a, yes, difficult business. It's a difficult public transport system, but the buses... I have two bus connections, the 56, which runs quite reliably. The 143, yes, I can say that 90% of them run reliably. The 56 line, if I may judge in percentages, runs 100% reliably, it's on time and so on as well as every five to ten minutes and it also comes, but the 143 is not operated by the MVG, it's a tendered line. So it's run by a private company, and I'm not criticising it because it's a private company, but because the service is simply weak from that point of view, i.e. it's bad. They run every 20 minutes and sometimes they don't show up at all. So when I go home from work, I usually have the honour of waiting 40 minutes for a bus, even though I'm actually there on time, at the bus stop. And vice versa, when I want to go from home to work, it happens to us from time to time that we don't drive 20 minutes, but wait 40 minutes, because, as I said, it's not that little, but it rarely happens. So in terms of percentage, I would say 80%, 80% of them are reliable.

30 **Speaker 1** Those are actually very good numbers. Okay, thank you for those details. Right. Wait, there must be...

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31 **Speaker 2** If I, If I may add something. About the S-Bahn: The stop is well equipped, however the bus stop 143 has no bus shelter. I would take that as a criticism, because when it rains/snows, we stand there and it snows and it's just not nice.

32 **Speaker 1** Okay. That's also a valid point. Okay, then I'll go straight on. Right, now it's a little bit, so it's also about the similar topic, but this is a little bit more broad now. And it's about the entire city of Munich. How would you - and of course you can also look at the corner in Pasing if you now know it a bit better than the rest of the city - but in general, how would you assess Munich in terms of the, the, the, the allocation of the rpt , i.e. now only rail-bound local transport and its stations. So is the allocation of stops relatively good? or, or do you find that it's a bit unevenly distributed sometimes and that many districts perhaps don't quite benefit from it?

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33 **Speaker 2** No, I actually think... Because I rarely travel, I can't judge very well, but if I may judge anyway, I think it's well developed. The stops are well distributed. It's well

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developed, it's not an issue, so everything is fine. The only problem is that they don't run on time, and that's the problem with the S-Bahn.

34 **Speaker 1** and now, for example, also related to the underground and the tram, so not just the suburban railway. How do you judge that?

..equal

35 **Speaker 2** They are, well, they are good. The underground and trams are well developed and the stops are well distributed, I think it's well done. So I wouldn't know what to criticise. I think it's well developed, yes.

36 **Speaker 1** Okay! Allright. Okay, that's quite interesting, for example, because I'm still interested in whether there are neighbourhoods that could still benefit a little bit from it, because the underground and the tram have a relatively good image and people like this means of transport. If, for example, there was a need to expand the network in certain places - there are also some plans - but now, briefly. You know, you certainly know these plans a little bit, where something is going to happen somehow - try to forget them, it's just about your own opinion. Where would you, for example, expand or add new lines? Do you have any neighbourhoods in mind or places where you think it would really be necessary? You can also just give a very small example, depending on what's on your mind.

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37 **Speaker 2** it's actually well developed. I think all the new development areas would be important if the public transport system would be expanded in time. If I may give an example: Freiham is going to be a completely new area and there is now a new S-Bahn stop there and the bus connection has been extended. However the tram connection is not there yet, and there will be, if I read correctly, 60,000 inhabitants living there. And, so, 60,000 inhabitants, if they all take the car the traffic will certainly collapse and that's why I think it's important that you have a rail connection in time, like, an additional one, tram or underground. If it would be extended like that, it would be quite good. I think a tram is planned, but I don't think an underground is planned, but I think underground belongs there, that's my opinion. Above all, the U-Bahn should be connected to Pasing. They planned it, I think they want to start somehow at some point but I think it's almost too late. The reaction is far too late. There's been a lot of construction in the area and the people at rush hour… it's simply overcrowded.

38 **Speaker 1** Okay, no. That's exactly what I want to get to right now: the planned expansions as you have also briefly talked about Pasing. I'll share my screen for a moment, then you'll have a little overview map. You can go into more into detail about Pasing and the area that you know a little bit. So that's the target network. Perhaps you have seen this map somewhere before. The city of Munich took this decision. Can you see it a little bit in terms of quality? Alright. So have you seen this map before?

39 **Speaker 2** No, I haven't seen it.

40 **Speaker 1** Okay, well then I'll explain it very briefly. Basically they have these maps in three or four categories. The things that are now in blue are things that are actually planned for the near future. You were talking about the underground to Pasing, which somehow seems to be extended to Freiham. I didn't quite understand whether that was actually going to happen or not yet. But in any case, the things that are in blue are things they're now going to build. One is up here to Kieferngarten, the tram, I'm sure you're aware of that and you're also planning the west tangent at the moment. These are things that are imminent. The things that are in green are things that have, so to speak, priority number one after the blue one. The things that are in yellow, priority number 2 and then red, priority number three. So they are simply graded in colour, quite intuitively. I wanted to ask… Well, I mean, you can have a quick look at it first of course. Basically about Pasing: interestingly enough, in category 2 here, for example, they want to extend the underground somehow from Moosach back down to Pasing. Tram 17 also continues to Freiham as you mentioned before. And then just… Here was also the extension of the U5 and I don't know any more, that was another tram down. Theoretically, the Freiham branch would also pass by near your place. What did you mean… Lochhausen? I don't remember exactly. But... Exactly what, what do you think now? So, as I said, I'll go into a bit more detail about what you know now. Who do you think is really privileged by one of these extensions and who will benefit from it? And by that, I mean which population groups, i.e. from your knowledge, also who lives there: for example you can sort these population groups according to age or also, for example, according to their migration background, by their household status, for example, so whether households with a lower income could also benefit from these expansions. These would be a few helping paths you can lean on, for example. Exactly what kind of people do you think could benefit from this? Or is it very mixed, for example?

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41 **Speaker 2** Yes, yes. Munich was rebuilt in a way that they always, that one always divided an urban area into three, after my knowledge or my understanding of urban planning. One third is inhabited by, let's say, people who earn well and one third lower income earners - so they have a low income - and one third is greenery. And if you base yourself on that system actually, as I said, everybody will benefit. But I would say mainly the low-income households will benefit much more, that's clear.

42 **Speaker 1** Okay, that's for example, that's very good news actually.

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43 **Speaker 2** They can't afford a car. Not every family member can afford a car. A car costs a lot of money, of course, but public transport is more affordable. I would say that public transport would be more likely for them to use.

44 **Speaker 1** Okay, that's, that's very good actually. Okay. Allright. So based on that, I also wanted to ask if actually your area, so your residential area is excluded from certain rail network expansions, but as I see it's probably not the case. So if I understand it correctly now, will you still get a tram connection or will it already be too far away? I'm not so sure right now. I don't really know where you exactly live, but you can have a look on the map.

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45 **Speaker 2** It used to be a Deutsche Bahn housing estate where I live, which means that Deutsche Bahn employees used to live there. Some of them still live here, mainly Deutsche Bahn employees I mean, I assume they produce… they take the S-Bahn, but, as I said, not all of them are like that, maybe 30 percent. But the rest are just normal people, so they also earn *inaudible* as they work in different areas. And yes, it's also mixed. In my area, for example, there are low and high earners – it's mixed – and at least one family also has a car. But especially when they go in the city, they don't take their car. The car is mainly being used from time to time, but everything else is different. Some people do like to drive so it's hard to judge. My area is not too densely populated I would say, but it's different for example for Pasing-Obermenzing which is a city district. Obermenzing itself is not densely populated but Pasing is very densely populated, and therefore Pasing simply needs public transport connections, whether its the underground, tram, buses and so on.

46 **Speaker 1** Okay, yes, that actually answers the question.

Allright, because I wanted to go a little bit into whether, for example, your neighbourhood is left out, but you had already started to answer it a bit earlier with the fact that you think that the focus has to be set on Pasing because it is densely populated. Okay. Allright. Yes, well, that's quite good because they might have the chance of this underground in the near future.

47 **Speaker 2** If I could live another 50 years, I would probably see everything.

48 **Speaker 1** Yes! I mean let's hope for 50 years, because let's see how this... no, I am confident that... Yes, exactly then I will go on with the last question about it. Now that you have seen all these plans, you can also go back to the part of Munich you just talked about - or the whole part - depending on what areas you know in Munich. Despite the planned connections, would you still want to expand other transport connections there or do you think that this actually covers everything quite well? This was the first question; and question no. 2: If you also look at the order, i.e. according to priority, if you don't have any ideas, for example, where one could want… wait I'm sorry - but should the prioritisation be changed? Would something be more urgent, for example, if you also see the reds, for example, the lines, do you think that they should happen sooner?

49 **Speaker 2** Of course, I don't know the other districts, I can only say something for my area. That's where I spend most of my time, so I would say something about western Munich. As I said, I think that something should happen as soon as possible in Freiham and Pasing, because there really are masses of people and the current connections are not enough. Especially to Freiham it's not enough. The 57 bus line, for example, is sometimes so overcrowded that buses run one after the other, and yes, that's why a rail connection is absolutely necessary, like the one I'm showing here. I think that the underground should really be built, because the tram will not be able to cope with this amount *[of travellers]*.

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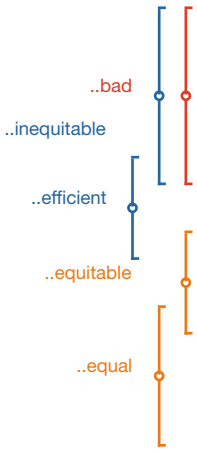
50 **Speaker 1** Okay, yes, that's a very good answer. Okay, that actually answers the question. Allright then, actually a very last question about it, I have just done some research about the network and have taken the current system and three future expansions. These three expansions were the tram to Johanneskirchen, the tram here, the northern tangent to Kieferngarten and up to Am Hart; and the third, I

think, was the western tangent. I had also taken a piece of the Tivolistraße here. These were the four connections that I implemented. And now to the current system: I'll briefly show you what I've just found out, and I'd like you to tell me what your reaction or your feelings are, whether these things shock you, for example, or whether it's to be expected, or… I'll explain you what I've done first. Basically, I looked at the density of local rail stations, i.e. trams, undergrounds and suburban trains, not buses, just the three of them, and saw how close together they were. And then I used this and looked to which extent these correlate with the economic status here, for example. These are, of course, very low correlation coefficients. A correlation coefficient usually goes from 0 to 1 or from -1 to 0. If it is negative, for example, it means that those who correlate the other way around… it means that they would have even fewer stations in their proximity. In other words, it simply means that here, for example, we have very low economic statuses, and here for example the 3-4 economic statuses. It goes from very low to very high. And here you can see, for example, in relation to the current system that, for example, households that have a middle economic status. For the middle class we could perhaps say that there is a negative correlation, i.e. that they tend to have fewer stops. With the higher economic households, it is rather positive, for example. But of course they are very low. Don't forget that they are in the "zero point zero zero" range. That is very small. Nevertheless, there is a very small tendency. I would be interested to know, for example, whether it is shocking that lower economic statuses have fewer stops or rail public transport.



51 **Speaker 2** Yes, it's obvious. Buses, for example, have been restructured and then all the bus connections changed. And some urban areas have been disadvantaged: so they have partly removed bus routes there. Of course these choices have been made with passenger numbers. So, statisticians made them and then adjusted them accordingly. It's clear that it's shocking when there are fewer bus stops. There is then less service, so to speak, and people need that. I think that if public transport is well developed and well served, people are more likely to go by public transport than by car - but they have to be reliable.

52 **Speaker 1** Yeah yeah, allright. That's going to get me in the..., but you've actually answered the question very well. I'll show you in a minute - I did this research on the future network and that's when a few things changed. That's quite interesting. You can see from the other things that the

18 to 40-year-olds have particularly good connections to the rail network. But in the older age groups, especially here between 70 and 79, you can still see that it is rather bad, that they are rather isolated from the rail network. So would you also confirm that?

53 **Speaker 2** Yes, that's right yes.

54 **Speaker 1** And how, how? So what, what does that do to you? So for example, what is... so are you affected by it? - does it affect you a little bit or do you think it's a pity that it's like that? Or do you think it's actually normal, because older people, for example, are also...

55 **Speaker 2** Yes, well, what is normal? If, for example, as a young man, I'd say, I can walk for 10 minutes, but an older man, especially a 70-year-old, 80-90-year-old, he takes twice as long, or three times as long, or maybe he can't manage it at all because it's simply too long. And there's nothing close by or if the stop is 10 minutes away, that's about 800-900 metres he has to walk. It is important that there is something nearby. He certainly won't get a rail connection right outside the door, but it should be close by. But if, for example, there is such a line, a suburban railway line, which also comes very rarely, what is this old man supposed to do at this station? he will freeze to death, yes, that is already a challenge for them…

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56 **Speaker 1** Very good input.

57 **Speaker 2** Especially for suburban railway it is very important, that they run on time, that they are very reliable. I think underground trains run very well, but suburban trains… we still have to do a lot about them.

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58 **Speaker 1** Thanks for that. Allright, I will briefly show you another thing and then you're actually done. Allright. I think that was this one. That was at least the juxtaposition, because you meant for example – wait it's loading. Ah, I have it there, exactly, as you can see for example here, the yellow part on the right is how it was before, what I just showed you. Here we are again dealing with the economic status of the household and with the new connections. You said, you already hinted a bit about Pasing, that it might also help poorer people to have better connections. Here, for example, you can see that households with very low incomes will benefit, and that middle-income earners or those with higher incomes will benefit less. Of course, this doesn't mean that stations will be removed, but it does

mean that, in percentages, that they will simply benefit less. Is it, for example… what, what do you think about it? Are you more pleased that this is the case now, for example? A step in the right direction or...?

59 **Speaker 2** Yes, it's a step in the right direction, yes. Higher-income people who can afford taxis, they usually take taxis or Uber. It doesn't matter for them. To go two kilometres by taxi, they pay 10-15 euros. But with a low income, they have no chance to pay 10-15 euros for every ride, there's no chance, so no, they can't do that. That's why I'm happy when low-income people/citizens also benefit. It's important for me because they are part of the masses.... Those who earn well - okay - there are not so many of them, so it's not like that. I don't want to say anything critical about the high-income people, that's not the point at all, but I'd say, it would hurt them less *[to not benefit from rpt as much as lower-income households]*. But the low-income and average-income earners have to watch every they spend closely, so it's not bad if they get these opportunities.

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..equity

60 **Speaker 1** Yeah okay! That's right, the...

61 **Speaker 2** Well, if you look at the Pasing area. So if I may add, for example Gräfelfing, Lochham, where there are mostly single-family houses, where you can assume that they earn a bit better than the others because they have houses and so on… - there are already bus connections, but they don't have any great interest in taking these bus connections, but rather, when they get off the S-Bahn, they get in a taxi and then they go by taxi. But a low-income person - someone who earns very little - thinks twice before he really has to take a taxi, because he simply can't afford it. It's as simple as that. That's why it's good if public transport is well developed, because poor people will be much more satisfied.

..city demographics
..equity

62 **Speaker 1** okay good, so thank you very much for that. Yeah, that's a good input, definitely. Allright. So basically I did that again with isochrones. So basically, who is able to reach the stop within 5 minutes and who can reach the stop within 10 minutes. But similar things came out of that. So just as an explanation: in fact, migrants, for example, had better accessibility to these stops and, above all, 50 to 64 year-olds and migrants also benefitted from the expansions. So what do you think? you would support this idea, is this also a step in the right direction?

..equity

..equity

Speaker 2 Yes, I can advocate.

Yeah, great. So that's actually it for the interview and I really thank you very much for taking the time.

1 **Interview 3 (I3)**

2 **Speaker 1** So I'm starting to record. Ok, first question, which transport mode do you use and why? Yeah, on a daily basis, for example.

3 **Speaker 2** On a daily basis, I use, in Munich, I use a sen-... subway

4 **Speaker 1** The subway?

..transit time and travel pattern

5 **Speaker 2** I mean, S-Bahn, S-Bahn..., S-Bahn, U-Bahn.

6 **Speaker 1** So for example, for your place of living, you're just like walking to the nearest station right?

..transit time and travel pattern

7 **Speaker 2** Station, or I take the bus if it just arrives and then get to the station to go to the city and get the S-Bahn.

8 **Speaker 1** Okay, okay. Well, considering you're using these, these modes of transport, how well can you reach different types of infrastructure? So, for example, your earlier place of work, did you go there, for example, also by, yeah, by public transport? Or for example, if you were meeting friends whats like the average time you take… or if you want to go to the city center, what's the average time? You can also include, for example, the walking time from your place of living to the nearest station

..transit time and travel patterı

..transit time and travel patterı

9 **Speaker 2** to go to… to go to my previous work place was in Pasing, so I was biking there, or taking the bus if it was that way but otherwise to get to the city, let's say, it takes around like half an hour, between 25 and 40 minutes, depending on the connection if I take the bus or not. 40 minutes, not as much, like, half an hour I'd say, more or less.

10 **Speaker 1** So if you take the bus, for example, you would take more time. Or is it like faster? If you take the bus, you don't have to walk, right?

..bad

..accessibility to rpt

11 **Speaker 2** Yeah, it's faster to take the bus if the bus is here. So probably if you miss the bus here it's like a lot of time during the day, it's each 20 minutes. So you have to wait or you walk. So walking is 12 minutes - to Pasing.

12 **Speaker 1** 12 minutes okay. okay. So do you think your needs in terms of accessibility to public transport infrastructure are being met or would you wish for more?

..bad

13 **Speaker 2** I think the bus, the bus connections are not really good. Its the bus frequency and frequen- frequency. I think a bus like that should be each like ten minutes maximum. At each time of the day. This is a-, I don't think that's very good. Like if you are a little further on Verdistraße the connection is, yeah, you have Obermenzing, but you need always like 10-12 minutes walk. If I will compare to a city of Paris you have an U-Bahn station not further as five minutes from your place. But its, of course, the overall infrastructure of the subway in Paris is different.

14 **Speaker 1** Okay! okay!

..wishes and limits

15 **Speaker 2** Yeah, yeah, I think, for a big city like that, it could be more, close stations from each other.

16 **Speaker 1** Okay, Okay. And yeah, okay, I'll come back to the Pasing station in a second. But okay, thanks for your answer on that! Well, do you think your neighbors or your neighborhood in general follow a similar travel pattern or, are they for example, more relying on this bus or more relying on cars? Or what's your impression?

..neighborhood & city travel patte

17 **Speaker 2** I think most of the old people living around here, they stay around Pasing. Because there is everything here, as doctors, shopping, and I imagine if the people want to go to a museum or to the theater then they go with the subway. But people who are working… people who are working in the city, what I see a lot: they take the bike to Pasing because the station is always full of bikes and then they take the S-Bahn to go in the city. I have a feeling that's the most used way to get in the city.

18 **Speaker 1** Hmm. Okay. Okay, so, well, follow up question on that, but you kind of already answered it: are just like rail public... are these like rail public transport stations accessible for most of your neighborhood or, as you said, they mostly need to rely on a second mode of transport, for example, the bike or anything else? Like, How would you say… a "raccordement"… they cannot all walk there right?

..neighborhood & city travel patte

19 **Speaker 2** No, no, no.

20 **Speaker 1** Okay. And yeah, so, and question about

Pasing, how would you qualify the quality and frequency of the service? Is it reliable or do you have like lots of transport options? How is it there?

21 **Speaker 2** From Pasing to go in the city?

22 **Speaker 1** Yeah.

23 **Speaker 2** It's pretty good because it's still a lot of S-Bahn, it's the last station of not all of the main line, minus two lines which goes through Laim, but it's like four or five S-Bahn coming through, plus the regional trains, which you can go to the central station directly. And it's pretty good! So frequency is, let's say each five minutes you have something between five and seven. If everything goes well, of course, I'm not talking about delays or about weekends where the... the construction of an extra thing… and they close for the... this is, this is another subject, I guess.

..good

24 **Speaker 1** Mm hmm. Yeah, okay. okay. But in general, you have a lot of options in Pasing and so on?

25 **Speaker 2** Yeah, yeah. To get it in the city, I mean you can... my husband gets in the city to work, he always goes, always, with the subway. Unless he has something to do with the subway, 20 minutes. I mean, 20 minutes, half an hour you're there.

..transit time and travel pattern

26 **Speaker 1** Okay. And if you go, for example, a bit up in your neighborhood, but away from, from the Pasing station, like, I guess more like the Pasing-Obermenzing parts, how is it there? You have another S-Bahn station there, right?

27 **Speaker 2** You have, a, if you take the Verdistraße to the, uh, city, before the basic-supermarket? You know the basic? Verdistraße before you have... this is Obermenzing. But after, I find, if you go the other side of the Verdistraße, then, really the other side you have Untermenzing, somewhere over there. I have the feeling, the other side of Verdistraße, I don't know if you were there once, it's much more, I don't know, I can't explain - less life somehow. I will never live there because I feel already far away from everything.

..bad

28 **Speaker 1** Ah okay!

29 **Speaker 2** Because, yeah, you have Untermenzing, Obermenzing, but, it's already just one. It's a S2, maybe S1 as well, but it's not, you feel it's not as deserved. And I

..bad

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have a feeling there maybe they take more, more the car to go in the city, I can imagine. I'm not sure but when I go there, I always say "oh, I would not like to live there!". I feel, although it's just the other side of Verdistraße, but this little thing makes a difference. And here you feel, it's more alive, maybe because of proximity of Pasing and the connection. And I think we clearly feel that.

..good

30 **Speaker 1** Ah okay! yeah.

31 **Speaker 2** clearly, I mean, that's my impression.

32 **Speaker 1** Yeah. Well, you think that, for example, the bus line you have that goes up the Verdistraße as well, or I don't know, like beneath where you live is like, for example… do you think that people cannot really rely on this one bus connection because of its frequency? as you told, like they come every 20 minutes after some time and maybe then come, they don't come at all. I don't know. Do you think people actually need to rely on those S-Bahn stations because the bus is actually not really an asset to them?

..bad

33 **Speaker 2** Yeah! But, I could imagine. Yeah. mhm.

34 **Speaker 1** Okay. Well, now let's have a look in general about Munich. Yeah. How would you qualify the, the allocation of the rail public transport stations in the city overall? Do you think everything is well-served or do you have, for example, neighborhoods in your head where, yeah, well, it's a bit underserved or they cannot really rely on it?

35 **Speaker 2** in the city?

36 **Speaker 1** Yeah. In general, in Munich, what's, what's inside the borders.

37 **Speaker 2** I mean, I, I think I don't know the whole city.

38 **Speaker 1** You can also take a look at your neighborhood if you want, like the Pasing region, Laim, for example.

39 **Speaker 2** Yeah, like for example in the center center, I find it's always this triangle. Isartor, Gärtnerplatz, Sendlinger Tor, there is a triangle, Müllerstraße, all of that, which I find, kind of, you must walk, I don't know, pretty long to find S-Bahn or U-Bahn. I know that I went there few

..bad

..bad

times to, to have a walk, and each time I think, oh my god but, where is a station it's so far away! But... yeah.

40 **Speaker 1** You think it's surprising because it's in the center? Or, and you wouldn't expect that...?

..bad

41 **Speaker 2** It's surprising because it's in the center.

42 **Speaker 1** Okay. Mm hmm. And okay, for example, if you, if you, for example, look a bit outside like on the the borders a bit, like the city, for example, you can also take, take the example of, for example, Pasing and what's beneath Pasing - what's up, what's, what's underneath, Pasing, for example - Blumenau, I don't know. How do you qualify it there, the allocation? Or do they even have rail public transport?

43 **Speaker 2** Yeah. You mean when you go down to all the Herrsching, Starnberg, this south of Pasing, there?

44 **Speaker 1** Yeah. But like especially what's still in the borders of Munich, you know, like not outside of Munich.

..bad

45 **Speaker 2** Like Westkreuz, for instance? Yeah, I find you pretty fast in a, in a countryside.

46 **Speaker 1** Mm hmm. Yeah, and...

47 **Speaker 2** I have this friend, for example, she doesn't live far away from Westkreuz. But it's, it's, it's complicated to get there. Cause to walk is too far. Basically, you have to go with a car.

..bad

48 **Speaker 1** Ah okay, yeah, because it's undeserved. Yeah okay. And do you think...

..neighborhood & city travel patte

49 **Speaker 2** and often, often, I mean, in Pasing around - you have Pasing and then you depend of the bus.

50 **Speaker 1** Hmm. Mm hmm. Okay, so like, you pretty much have like this S-Bahn main line, but like, with the rest of it you need to rely on the busses? Okay. Yeah.

51 **Speaker 2** I mean here a little bit of U-bahn here. Because now Pasing is part of the city basically, it's expanded so much that you can't say Pasing is outside. Pasing is Munich, really. But it's true that from here... I mean, what I find good also from Pasing to get in a city which I didn't tell

..good

..good

..good

..good

you before which we did yesterday with my daughter, which is super reliable, is a tram. You have this 19, which goes and we were like *poum* perfectly on time. You didn't need to change from like… for example to Theatinerstraße, super comfortable, no delays, of course it might happen… but rarely. And both of us we thought “was that the easy way to get in the city actually?”, maybe five minutes longer, but somehow less trouble.

52 **Speaker 1** Yeah. OK.

53 **Speaker 2** Nice way, you outside and I thought it was convenient, actually.

54 **Speaker 1** Okay. Okay. No, that's interesting. Yeah, because it actually had lots more stops, and yeah, it's good to have like a second option. Okay. Well, do you think there are areas, for example, in Munich that have, yeah, are there areas in Munich you have you think they have, for example, poor accessibility to public transport and are therefore disadvantaged by it? Or I mean. No, actually, you pretty much answered this question, but you think these areas, for example, behind Westkreuz, it's actually a kind of disadvantage to them that they that they have like this poor connection to the city, for example? Well, I mean, you could also say if, for example, they have the car option, that's totally fine, but...

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..neighborhood & city travel patte

55 **Speaker 2** I mean, it's not bad… but good deserved… I don't think it's good deserved, because there are a lot of places to live there. And as soon, like I say, as soon as you leave a little bit the, the, like the, let's say, 10 minutes walking from S-Bahn, I think people rely on their car.

56 **Speaker 1** Mm-Hmm. Okay, now, but like they're not really disadvantaged because most of the people can still afford a car probably there? Or how would you qualify?

..city demographics

57 **Speaker 2** Yeah, yeah, I think so.

58 **Speaker 1** Yeah, yeah. And do you have, for example, neighborhoods in mind, maybe in Munich, I mean, it's okay if you don't, but that have actually a disadvantage because of that, because they maybe can't afford a car?

59 **Speaker 2** Yeah. Maybe when you get, you know, like when you get to the Autobahn, is it Fürstenried? then you have all these houses alongside the, the like the “périphérique”, you know like the, you this, it's called like

this…

60 **Speaker 1** yeah, this ring road? I don't know

..inequitable

61 **Speaker 2** The ring road. Yeah, I, I can imagine there, not everybody has a car. Mm hmm. I don't know so much those neighborhoods.

62 **Speaker 1** Yes. Yeah. No, no. But it's okay, it's, it's interesting to know. Well, for example, considering the fact that there is a need to fill some gaps, some accessibility gaps in the city. I mean, you could just name one or two if you have any ideas in mind. But where and where could new stations and lines help, for example, to ameliorate the accessibility and the transport equity situation in the city and why? So yeah, you can, for example, also take a look around Pasing, if you know this neighborhood?

..bad

63 **Speaker 2** For me, it's for example, I noticed that when I took sometimes the wrong S-Bahn, and I was in Harras. In Harras, the S7 to come back to Pasing. It's a world tour.

64 **Speaker 1** Oh okay...

..bad

..bad

..inefficient

65 **Speaker 2** So which is like here you have Pasing like south, south going..., west going south. You go south then you go east, you see, Pasing, Harras here in between, if you take the wrong direction, it's a mess. To come back you have to wait for S-Bahn 20 minutes or to go down, take a bus to Laim, then take from Laim something else and here this corner. I say that because this is a corner I know, but I can imagine all these gaps between two big stops - to reach - this is complicated.

66 **Speaker 1** Okay, so for example, all the area between Pasing and Harras, for example on this side? And you think that for example...

..bad

67 **Speaker 2** Yeah, for example you have the S20 once an hour.

68 **Speaker 1** Oh wow, okay. Yeah this i...

69 **Speaker 2** like, where are we?

70 **Speaker 1** Yeah, no. So you would, for example, if you were to like, fill an accessibility gap, you would, for example, do it here because you feel this area is quite

underserved? Okay.

..bad

71 **Speaker 2** mhm. That's, that's the corner, I know, but I'm sure it's a same desert in every four corners of the city.

72 **Speaker 1** Mm hmm. Yeah. Yeah, OK. Yeah, no. But that's, that's a, that's an interesting point what you say between like two major stations to stay in between of them, it might be quite difficult. Okay, so which type of areas and individuals would profit from the proposed expansions? you can have a look, especially on the area around Pasing, for example.

..efficiency

..target groups of who migl

..equity

73 **Speaker 2** I can imagine, like the young people going also to, to, to the, to the school in the city or, or, yeah people who doesn't have a car, will be like less, less dependent of the bus traffic, which is sometimes not really, good. Like for example, I see this line red and green, and green between Blutenburg and Amalienburgstraße. Here, it's Verdistraße, a lot of people, it's always busy because people are coming from the outside area from Munich through the highway and go directly in the city through the Verdistraße. So which means like a tram here would be a very good opportunity for people who are not coming from outside, from people who are living each, each side of the Verdistraße who wants to go in the city without having to go to Pasing. Or, you know, you go here, Amalienburgstraße here you have like 17 which goes further, which goes to the station, something. I think that, that would be super necessary. You have like maybe two busses going along there and not really often. So I would see that as a very good, very good solution.

..efficiency

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..target groups of who might p

74 **Speaker 1** Okay. And do you think, for example, that disadvantaged people, for example, elderly people or, I don't know, less wealthy people will, will also benefit from this? Or is it...

75 **Speaker 2** Yeah, absolutely.

76 **Speaker 1** Okay. So you think that.. yeah okay. No follow up question.

..inequitable

..efficiency

77 **Speaker 2** Although Obermenzing there is no people which are socially disadvantaged. Obermenzing is very... wealthy.

78 **Speaker 1** Wealthy and well integrated...? okay. okay. And is your..., I mean, obviously not because you have this, this

yellow line as well. So your area is there. Actually, this question doesn't make any sense what I wanted to ask... But, where would you, for example, further expand? Like if you see this, is it for your neighborhood, it's probably quite good. Would you, for example, expand somewhere else? Or you can also have a look on the whole city of Munich if you have like other knowledge of other neighborhoods, but you can also talk about the categories of prioritization you have there, for example. I see that the tram Blutenburg line you were talking about is a red or a yellow line, which means it's not a high priority category as well. Would you, for example, qualify this as very important? Or yeah, would you prefer to like, take it... Yeah, as a high priority.

..efficiency
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..equal

79 **Speaker 2** I mean, this Pasing situation with U3/U4 its nice, but it's already like four S-Bahn going to Pasing, so why do they put this U-Bahn again in Pasing? I mean, it's nice for us, but look at Gräfelfing. There is nothing! And Gräfelfing is a.. it's a big... I mean, not a big city, but it's a, I mean, it's a part of the city, which is quite important. Yeah. Also, it should go to the north of Pasing here. It's a big hole where I don't see anything. You know what I mean? ... north of Blutenburg.

80 **Speaker 1** For example, like the... Yeah. Like above Blutenburg, right? okay. Yeah. And there's absolutely nothing but S-Bahn. Okay, so for example, you would see this as a necessity to further expand there as well?

81 **Speaker 2** Yeah.

82 **Speaker 1** And yeah, probably for commuters. And also, what about the..., the more disadvantaged people, if you like, have knowledge also of lots of, for example, non-motorized households, so households that are not owning a car - yeah. Do you think new extensions, for example, in the area above Blutenburg could help? Or...

83 **Speaker 2** Yeah, of the... I guess it's some bus I can't really see where is... I mean, in another hand they put, I see "Verlängerung U1 Nord", aber das ist grün oder yellow?

84 **Speaker 1** This is green. The...

..equity

85 **Speaker 2** I mean, that's not bad, actually.

..equity

86 **Speaker 1** Yeah, because you think they have like socially disadvantaged people living also there and it could maybe

..equity

help?

87 **Speaker 2** Yeah. Yeah.

88 **Speaker 1** Um. Yeah. Do you have? I don't know, like other places of the city, you know you, you can comment or you want to comment on? Or not.

89 **Speaker 2** No, no the other part I, I can't really say.

90 **Speaker 1** Okay, but that's, that's good. That's, that's already really enough. So during my research, I found out that people that are having a lower economic status or less likely to have a higher density of rail public transport stations beneath than, for example, higher economical status. The correlation is quite small, but still we have one that is negative for very low, low and middle income classes, but is positive for high and very high. What do you think about that? How does it make you feel to listen to this?

..vicious circle

91 **Speaker 2** Yeah. I think, I think it's a little bit like that in every city because, of course, the people who were not really good socially or they take apartments which are cheaper. And why are they cheaper? Because it has, because the connection with trans- with public transport is not so good. So it's, it's always a circle, you know?

92 **Speaker 1** Like a vicious circle?

..vicious circle

93 **Speaker 2** Yeah, if you go like, it's the same, if you go, for example, in Sao Paulo, I stayed in the center of the city, and of course there they are, it was a really wealthy area, and of course, why? Because there was Subway everywhere, you know, *inaudible*. There are other factor there, but here, of course, it you live middle of the city, or like - not Bornheim, Bornheim is in Frankfurt... Ahh, where is the uni?

94 **Speaker 1** Maxvorstadt? The universities...

95 **Speaker 2** Yeah the university, what's the, what's the name of the area there?

96 **Speaker 1** Yeah, I'd say Maxvorstadt no? Like...

97 **Speaker 2** Yeah Maxvorstadt, but the, like, where Türkenstraße and all of that. What's the name of it?

98 **Speaker 1** Yeah, for me, it's Maxvorstadt. I don't know.

..vicious circle

99 **Speaker 2** Okay, then Maxvorstadt, of course here, there're wealthy people and it's super good deserved, it's bus, it's subway. So of course, wealthy people are always advantaged, from, with public transportation.

100 **Speaker 1** Hmm. So you think they, but for you, it's like more of a vicious and normal cycle you can't really get out of or do you think you could actually do - we could actually do something against so-, something against it? And yeah, expand, for example, public transport in the places where they have like a lower income, for example?

..vicious circle

101 **Speaker 2** Yeah, I mean, of course, you can do that, but then it will not be as cheap as before.

102 **Speaker 1** Mm hmm. So you think they will rise again the prices?

103 **Speaker 2** I don't think there is a, a real solution.

104 **Speaker 1** Yeah... Hmm. Yeah, okay, no, that's a valid point. And for example, about the age, I found out that especially high correlations are, for example, with people that are from 18 to 40, but negative correlations and especially bad are between 70 and 79. What do you think about that? Is it also more something normal or is it something that's actually quite unfair? Or what does it? How does it make you feel?

..inequitable

105 **Speaker 2** Yes, that's quite unfair because of course, people are older and they need accessibility, easier to places. And not like, to get to the Bus, and wait for the subway and go down and go up the stairs and... yeah.

106 **Speaker 1** So...

..inequitable

107 **Speaker 2** Like in Pasing there is quite a lot of old people, actually. But like I said, Pasing now; Pasing is, very small. I'm talking, as soon as people who are living around our place. I see often old people taking the bus. Yeah, yeah.

108 **Speaker 1** Ah OK.

..equitable

109 **Speaker 2** They have, they have time! So they go easy, and like I said, they go to Pasing. Unless they have a

..equitable special thing to do in the city. I don't think they just go in the city for fun, they stay around here.

110 **Speaker 1** Hmm. Okay. No, that's, that's an interesting point. So you think they're like, yeah, it's, it's not like a big necessity, for example, for elderly people for them to have like a more stable connection?

111 **Speaker 2** mhm.

112 **Speaker 1** And then, yeah, I put this on. I correlated it again with some expansions, for example, the “Tram Westtangente”, between..., that goes down to Laim. And I found out that, yeah, some coefficients changed. We have all of the sudden, a positive correlation for very low economic status and lower economic status was still negative. But for example, also middle-class incomes had a higher one and still the very high economic status took profit from it as well. So it's quite mixed, actually. What do you think about it? Is it should it be, for example, that, especially lower economic status, should take profit from it? Or yeah, or do you think it's also fair that very high economic status, yeah, benefited from these expansions?

..equality 113 **Speaker 2** I think it's good when everybody profit from it, because more there is expansion, less there are cars.

114 **Speaker 1** mhm. Okay. So like you to see this more on an environmental and traffic related...

..equality 115 **Speaker 2** Environment because otherwise the rich people they take, like two cars for example. And if it's there they take the subway and they leave the cars at home? Which is for other reason, a very "plus".

116 **Speaker 1** Yeah. Yeah, yeah. Okay, well, thank you very much.

Interview 4 (I4)

Speaker 1: I just wanted to start by asking some background information about you. You don't have to give me your exact address, but like at which place, do you live, is there like a nearby RPT, rail public transport station? And, also your age class, it doesn't necessarily have to be too detailed, but yeah, just give me an idea.

Speaker 2: Okay.

..accessibility to rpt

..accessibility to rpt

So, I live in an area of Munich, which is called Milbertshofen am Hart. And there is a subway station, I think 200 meters from my flat. So pretty close. What else? The subway and buses and S-bahn is a little bit further, but, what else did you want? Like my age? I'm 30 years old, so.

Speaker 1: Yeah. Awesome. Okay, thanks!

So, we'll start like, with basic questions about your own circumstances and I'm going to start right away: Which transport mode do you use and why, or you can, if you like use many of them, what's the… which you use the most?

..transit time and travel pattern

Speaker 2: I mostly use subway and, busses, sometimes S-Bahn and just every few weeks, maybe a, a tram..

Yeah, not very often.

Speaker 1: So you mainly use the U-Bahn because you have like the station that is like really close by?

..transit time and travel pattern

Speaker 2: Yeah, and most of the places I go to like work and friends and doctors and stuff are also in the subway area.

Speaker 1: Okay, this is what I wanted to ask next. Like, what is the ease of reach? You have, like, I mean, the U-Bahn and then I guess you have like a pretty direct connection to the city center?

12 So for example, if you go to work, what's like the average time you take, for example, is it like easy to reach or is it a long travel? Do you have many interchanges and, how is it?

..transit time and travel pattern

13 **Speaker 2**: Yeah, well that's depends. I just, just a few months ago I changed my workplace. So I've been at working at TUM before, but, now I'm working in Garching actually. And that changed the, the accessibility.

..transit time and travel pattern

14 Even though I'm living in northern Munich. So it takes me like 40 to 45 minutes to get here. And I can choose between taking bus and subway or taking only subway, but then I have to change two times and, it just feels a bit weird, like, to go south two times to just then go north. So that's why I often take bus and subway, even though it takes a bit longer.

15 **Speaker 1**: Okay. So like “cross-connection” kind of, and then you go up. Okay. And for example, I guess, to meet, to meet friends, for example, in the city or, I mean, it probably depends where they are or where you meet, but, how is it like the social kind of infrastructure? Can you like reach it easily?

..transit time and travel pattern

16 **Speaker 2**: Mostly subway it's - also because I, I just know the subway system quite well.

17 And if I want to take buses, I never… often, I don't know, like what, where exactly do they go, like which side of the street do they go to, to what direction… And sometimes I prefer walking distances I could go by bus instead of going by bus. And like when I can go by subway and then walk for 10 minutes instead of going to more stations by bus, I will.

..transit time and travel pattern

18 **Speaker 1**: Okay. Yeah. So I got an idea and, other types of infrastructure, for example, basic, amenities and stuff like that. These are things you probably have in your neighborhood, or do you have to travel for it as well? Usually on…

19 **Speaker 2**: Like for example supermarkets, yeah.

20 **Speaker 1**: Everything is like, okay, close by, okay! So do you think, your needs in terms of accessibility to RPT are being met? - to rail public transport - I'm sorry I'm just using sometimes the “RPT” as a shortcut for “rail public transport”. You can use it as well, if you want to.

21 Do you, do believe your, your needs are being met? Or is there something missing for you in terms of accessibility to RPT?

22 **Speaker 2**: Well, now, since I'm working in Garching now, I would… like it would be nice to have a direct, that my connection to, to the north, of course, or like a “cross-connection” to U6 more direct.

..needs

23 But otherwise, I think it's pretty, pretty easy to get everywhere.

..good

24 I think what's also important is that like, what was the situation before? Because for me, the situation before I moved to, to that place was worse. But I was, living in the, in the S-Bahn area because I didn't have a subway connection.

..transit time and travel pattern

25 And now it's just very, very easy and comfortable having a subway right away and not to have, like… before I had to wait 20 minutes for every opportunity to go to Munich. So. Maybe that’s also why I, I think it's so easy.

..good

..bad

26 **Speaker 1**: Okay. No, yeah. That's a, that's interesting. It's a valid point. Hold on a second. What is about, like, for example, your neighborhood, do you know a bit of your neighborhood and if yes, do you know if they follow a for example, a similar travel pattern?

27 I mean, Milbertshofen is like quite a big, neighborhood, so, do you think in every area they have quite a good connection and travel pattern or, are some places were they're more relying for example, on buses or do they even need to take a car? What do you think? What do you…, what was your impression?

28 Maybe you don't know your neighborhood well enough, but like, just like out of the blue, what, what do you think?

29 **Speaker 2**: Well, what I think is that in my neighborhood, like in the northern Part of Milbertshofen, the Milbertshofen am Hart… many people have a car, many households have two cars. And I could see that in the past five or six years, the, the amount of cars increased. But, I think in the, like, more southern part of Milbersthofen less people have cars and it's even easier to, to go to places. Because for example, at a Frankfurter Ring, you have express buses, two different directions. And the northern part of Milbertshofen is more, like, only the U2 subway connection.

..neighborhood & city travel patte

..good

..bad

30 **Speaker 1**: So you think it's because of that, that many people have more cars for example? Or is it also like maybe because of their economical status and just like, or is it also like a kind of accessibility or lack of accessibility, for example, for them?

31 **Speaker 2**: I'm not sure. Maybe it's also because there's more space for having a car.

..neighborhood & city travel patte

32 **Speaker 1**: Yeah, it could be!

33 **Speaker 2**: Because it's actually not too very hard to get a parking spot somewhere. And I know that my, my direct neighbors that they go shopping by her, even though there are smaller supermarkets around, but the bigger ones are a bit further away and, might be cheaper, for example.

..neighborhood & city travel patte

34 **Speaker 1**: Okay!

35 **Speaker 2**: Some of them have children as well.

36 They have to like get their children somewhere into kindergarten and other places. So maybe that's the reason.

..neighborhood & city travel patte

37 **Speaker 1**: Yeah, like, that's more easy probably. Okay thank you! And, for the, for the RPT stations, you told me that you have this like U2 line and some places of the neighborhood have like a worse accessibility to this line, right?

38 Like this is the only, rail public transport line you have in the

area. So like the further away the will most rely for example, on buses or how is the situation for them?

39 **Speaker 2**: Well, I think so but, like a bit more to the north, there is Feldmoching, and there's an S-, an S-Bahn station. So that's then, maybe a better, a better area again, for getting two different directions with different, kinds of transport.

..good

40 **Speaker 1**: No, like that's, that's good, that's what I wanted to know. Like are the, sorry… how would you qualify quality and frequency, for example, of this service? Now, for example, you live nearby the U2, I guess - How would you qualify, Quality and frequency of the, of the service?

41 Is it pretty stable or are they often delayed or, do you have like services quite often?

42 **Speaker 2**: Well, I consider quite often because I'm used to, I was used to less frequent transport opportunities. Like it's every five minutes. Okay. During the week on the weekend, it's only every 10 minutes.

..good

43 So that's actually a like difference that I sometimes forget, like when I take the subway on the weekend and I, I hardly ever look, what time is it now when, when does the next subway leave, because I know it's every five minutes. But on the weekend, it sometimes happens that I just go there and then see that I have to wait for eight minutes.

..good

44 **Speaker 1**: But like in overall, overall, it's stable?

45 **Speaker 2**: The frequency is, is okay. And the quality is okay. Then I think that U2, or at least in the Northern part, the U2 is hardly ever much delayed. I think that the U6 I'm using now to get to work, it's delayed much more often.

..good

..bad

46 **Speaker 1**: Ah, okay. Okay. No, that's, that's some good information.

47 And if you, for example, like expand, I don't know like how well you know, but the rest of Munich, have you been living here a bit longer or what is your knowledge about the city?

Like how would you qualify for example, the allocation of rail public transport station overall in the city?

48 Do you think, like there are areas that have been left out or for example, underserved or is everything actually really good? What, what would you think, like, just out of the blue, for example, do you have anything in mind?

49 **Speaker 2**: So on how, how well I know Munich, I'm actually, I've lived in the area of Munich, like the most time of my life.

50 I moved here like from, from hardly outside Munich to Munich seven years ago and have been living in the Northern part since then. But of course I know Munich quite well as I've been living near. But overall I'd say it's, it's easy to, to go everywhere. Like when I went to visit people from, from southern part of Munich and sometimes it takes long, and then of course in the, in the evening or in the night, it's not as easy to go home. Because it would be nice to have subways and trains in the night as well.

51 **Speaker 1**: Okay. So for you, it's more about like the frequency of the system as well?

52 **Speaker 2**: mhm!

53 **Speaker 1**: But like, if you, if you, for example, look at, just like the places where RPT stations are, and for example, look at points of Munich you go for example to less often, what would you think, do you have areas in mind where they have like an especially good or a high density of stations of rail public transport stations or places where they have especially poor, poor ones, for example? do you do have anything in mind or how do you…?

54 **Speaker 2**: Well, what comes to my mind is a Bogenhausen for example. When I was at a friend who lives there, from my place, feels like much effort to go there or like she lives like in between stations and none of them is really, really very close. There's not so many subway stations.

55 I think about these, these places where there are many,

..good

..wishes

..needs

many stations around when I, for example, when I think about moving or, what, where would I want to live in Munich? Then I think that, for example, Moosach is a place where it's sure, it's not, not in the, in the center but has subway, S-Bahn and tram, and Buses, and therefore it's very well connected. This is also about a frequency because when, when something is not, not going, for example, the main line is blocked again, or, subways are not going you have many different options, like you can switch to another transportation system.

56 **Speaker 1**: Okay. Yeah, like I'm asking this because, I believe, for example, no, I'm just going, going back to the question. If, if, for example, you have, like, for example, the Bogenhausen, you just, you just told, do you think they are being, for example, they're disadvantaged, because they have less RPT stations or do you think… because they're like some areas, sometimes they have less stations, but sometimes they don't really need those stations - I don't know - because they're just using the car anyway all the time. Others might need them more. Probably they cannot afford a car, or I don't know. How do you qualify for example, this for Bogenhausen?

..equitable

..wishes and limits

..bad

57 **Speaker 2**: I don't even know if Bogenhausen really has less stations. That's just my feeling. I've never counted them. But you're right. There could be a lot of reasons for that. I don't know if Bogenhausen is really feel like they would need more stations. But I know that one friend who would, want more closer subway station because it's, I think it's like 15 minute walk to the next subway station, which is…

58 **Speaker 1**: yeah, this is like a "pain treshhold".

59 And, like if I go back… If, if you, you see areas for example, or, let's say more disadvantaged areas of Munich. Do you have some in mind, that having, that are having a poor accessibility to RPT or do you see areas for example, where there's a link, between like, I'd say disadvantaged areas and for example, a poorer RPT accessibility, do you have, for example, something in mind in Munich, or do you think it's, for example, pretty good? Like it's actually, you could go everywhere and…

60 **Speaker 2**: I'm not sure I really don't know .

61 **Speaker 1**: Okay. Oh yeah. No, but that probably also means that, it's never, how do you say, it never came to mind or something is like not as bad! And, yeah, for example, now, if we consider the fact that for example, they would be a need to have more accessibility to those stations. Are there like places in Munich where you would say, okay, like for example, we could need an expansion here and there. Or, I mean, you, you talked about, for example, the “cross connection” between, for example, Milbertshofen and the U6, like, do you have, for example, other examples for this, or, or other wishes, for example? or if someone would ask you, where would you put an extension or an expansion? What would you think?

..needs

62 **Speaker 2**: Yeah, basically all those “cross connections”. And like, if that wouldn't be a, a way like going around Munich, like not on the very outside, but maybe in the, between the center and…

63 **Speaker 1**: yeah, no, no. Yeah. I understand!

..bad

64 **Speaker 2**: I mean I know that there are Busses that, that go those ways. And, I think they are coming more and more of these express connections. I mean, Busses are fine, of course, but it always feels like a bit more effort to take the Bus and they are late more often.

65 **Speaker 1**: Yeah, no, that's, that's, that's interesting that you're saying, just because this is also why I'm focusing on rail and not buses because, inhabitants tend to like, or I don't know, they, they believe that, rail or public transport by rail is a lot more stable and also more comfortable.

66 But like, especially they have this kind of “Security” and they seem to come more often for example. So is it, is it also like your point of view on that? and you would, for example, prefer, how do you say, like a “ring connection” that is by rail for example?

..good

67 **Speaker 2**: Yeah, I would prefer that. The funny thing is I like going by Bus, because I like, like looking out the window and seeing where I'm going. But at the same time, the…

68 **Speaker 1**: and if it would be by tram, for example?

69 **Speaker 2**: Would, would be, would be a good idea, I guess, but since I've never lived in that area with, with a tram station, I think that's just, I mean, it's not a very usual thing to do.

70 **Speaker 1**: Yeah. Okay. Yeah. You probably don't have then the comparison. Okay yeah. No, that's, that's good. Like for the current system to like, get to know it a bit, but, I will show you now what the planned expansions over the city of Munich are, because maybe you've heard of it, but they like proposed a whole bunch of new connections, so I'm just going to share my screen.

71 So just as an explanation. Hold on. I'm just going to remove this. Just as an explanation. Can you see this by the way, a little bit? I'm going to zoom in a bit, but, I'll explain the, the blue lines are the ones that are actually, going to happen. And then we have like three categories.

72 They did like the green ones or just like, to like put priorities on each project. So the green ones are the ones that are going to happen as soon as possible. The yellow ones are like on the second place and the red ones you see, for example, on the sides are like number three. If we, for example, maybe you can like, whoops, for example, this is also, I can zoom into your area a little bit.

73 If you, for example, considering your neighborhood, because I guess, you know, your neighborhood more than other places in Munich, who do you think will benefit or is privileged by these expansions? So yeah, for example, which type of areas and individuals will profit from the proposed expansions? for example, more students, elderly people, or more, for example, your age or..?

..equal

74 **Speaker 2**: Well, hopefully everyone! I mean, are we talking about the blue line now?

75 **Speaker 1**: You can talk about all of them. The blue line is just that the one that's going to happen and they're actually also building a part of the green line here. But yeah. I don't know, by the way why it's green because it's actually going to happen.

76 But yeah you can also talk about, for example, the, the red one here or the yellow one here, which is kind of the ring you were also talking about.

77 **Speaker 2**: But I have to, I have to…

78 **Speaker 1**: And there's also the “cross connection” here!

79 **Speaker 2**: Okay, so. When there are more connections to Kieferngarten, where the U6 is going, of course that's a good thing for students for going to Garching. But not only Garching, Garching-Forschungszentrum, but I take the subway quite often, and I see many people who are going to Garching-Hochbrück who don't look like students, but more like normal working people.

..efficiency
..equity

80 Yeah. And also to Garching itself, like also not Garching-Forschungszentrum, but the one before, then also Freimann, but yeah, Stundentenstadt of course for students, a place where many students are going.

..efficiency
..equity

81 **Speaker 1**: So you’d, for example, believe that, people living in your area could, for example, profit from it as they might go to work and… like you, for example?

82 **Speaker 2**: That's the other thing, like I was now talking about who uses the U6 to Garching, and then the other point is that in my area, there are not so many students or they are not so many…. In my exact area, they are actually many people that are not working, not working anymore or not working because they're unemployed. So they might not profit from this, but this is only like, a small area.

..city demographics
..target groups of who might p

83 **Speaker 1**: Yeah, yeah. For example, I… and just a little follow up question for example, on that. I mean this area here between the U2 and the U6 has pretty much been underserved in the last years. There's been literally nothing but buses. And, yeah, for example, now, if they're going to build, for example, this, this tram, and this was also part, I included this in my quantitative research, this “Cross-connection-tram”, which goes from exactly Am Hart and… to Kieferngarten, and also another link, the blue line here and the part of the green and here… What kind of people do you think this will for example serve?

84 Do you think, I maybe, I don't know, maybe you don't know who exactly lives there, but like out of your idea or impression you had, for example, if you were taking the bus through this area, what was your impression and what kind of people could be more, could profit, could benefit from this?

..inefficient

85 **Speaker 2**: Actually the bus is most of the time it's pretty empty.

86 But I'm, I'm choosing, I am, I am choosing buses who are not, who are not taken by school, school students anymore. So I take the bus, like right at seven before children go to school then after eight, like when everybody is already at home, because usually these buses are full of pupils, who are going to Kieferngarten for example, or then a few stations before Kieferngarten. And then the buses are really, really full, like both buses going from Am Hart to Kieferngarten and from Harthof to Kieferngarten.

..target groups of who migl

..efficiency

..equity

87 Yeah, but, like before a quarter to seven and after eight, they're quite empty, but the people who are on those buses are yeah. I'd say like from, I'd say they would go to work.

88 **Speaker 1**: Okay. Yeah. So you're thinking it'll primarily, for example, be good for commuters?

..target groups of who migl

..efficiency

..equity

89 **Speaker 2**: Yeah!

90 **Speaker 1**: Okay, okay, that's, that's good! Do you have any other, for example, I'm not going to ask you to comment on the whole city of Munich, but, but yeah, for example… hold on I just need to get back to my guide. Like in other places of Munich, if you, for example see… if you, for example, consider the green ones that are like prioritized as number one, do you have, for example, any idea, what kind of individuals they could serve, for example, or who would benefit from it?

..target groups of who might p

..efficiency

91 **Speaker 2**: Probably again, people going to work, because I know people who work in these areas like more on the western part, not in the eastern part, but they have the same problem. And they work in Munich and they go by car and they, they're in the traffic for a long time every day, and

..efficiency

they don't know where to park their car.

92 And, I think they would go by, by train if they could, there would be like a better connection if the trains weren't, as full as they are.

93 **Speaker 1**: Okay. So again, especially commuters. If we go, for example, to, to look a bit at, for example, the economical status of households, I mean, Munich, it's pretty difficult because, I think, there are not that huge kind of, how'd you say in english just, social disparities? I'm not sure…

94 But, for example, do you think it could, enhance the situation for some, some, inhabitants that are having a lower income, for example? Or do you have any places in mind, for example, where, where, some of the proposed expansion could actually help?

95 **Speaker 2**: Like through getting to places easier or faster?

96 **Speaker 1**: Yeah exactly.

97 **Speaker 2**: so they… are we considering like they have a ticket anyway?

98 **Speaker 1**: Yeah, exactly.

99 **Speaker 2**: Or would they need to buy it first? Do they have a monthly ticket anyway?

100 **Speaker 1**: We're like… I decided to left out a little bit, like the prices of the public transport in Munich because, like that would change a lot in my research. So I decided to more just focus on the accessibility to it. And that's, that's why, for example also, yeah, there are probably some neighborhoods that are, or that have especially a high number of non-motorized households, and maybe for example, they could benefit from it. But yeah, like we are just talking about accessibility to it.

101 **Speaker 2**: Well, maybe the, it would make things easier and then deciding.

102 Yeah. Also maybe to, to, to get to the cheaper supermarket, easier to, to get to… what else?

..equity

103 Yeah, maybe to, to not stay in there to not only stay in their neighborhood, everything like to, to have more also intercultural and everything, a mix with and with other, with other neighborhoods and other…

104 **Speaker 1**: Exactly like enhance your accessibility to opportunities, to services, to goods. I mean, that's, that's the, that's the thing I believe could, could be enhanced if they have like a better RPT connection. And, do you think, sorry, I'm following up again on the question. Do you think there are neighborhoods that could… where this accessibility to opportunities for example, or services or goods could be enhanced? You can also see, for example, on age classes. I mean, there are, I don't know, maybe neighborhoods where especially lots of elderly people are living and, where a potential RPT line could, for example, enhance their accessibility to the city or to any kind of infrastructure, especially the social one, maybe. Yeah, like in general, do you think or do you know, what… do you have a feeling what kind of people could benefit when these expansions are going to happen? I don't know if I was clear in my question though. I mean, you can ask me to repeat!

105 **Speaker 2**: but obviously I'm not answering your questions and… no sorry. I think that well, different, different groups, would profit from different aspects, like elderly people would profit from maybe going to doctor's appointments or whatever, more easily, like to, to really go to a better doctor because it's accessible or…

..equality

106 **Speaker 1**: and like, like location wise, where would you think could this, for example happen?

107 If you watch -, if you look at the map, for example, for example, considered places where they just, I have been relying on the buses ever since and also like take into consideration what kind of people have been living there. And so who could have by then like have an enhanced connection?

108 Who do you think, where do you think, these people live?

Actually it’s just who and where.

109 **Speaker 2**: there are like, all around.

110 **Speaker 1**: do you think it's pretty mixed up? Like they're like no clusters?

111 **Speaker 2**: well, not in the center. Yeah. But then if you go a bit further out in every direction, there will be areas where people have these problems. I think when you think about the, those ticket regions: there's the M part in the middle. And I think everything would, what is on the, is that called like, the line? Like behind this line, this is probably where its already an area where it's harder to get to places.

112 **Speaker 1**: Yeah. okay. I was asking, I was almost asking if your area was being left out from any further expansions, but I guess as you already have the U-Bahn, it's pretty great. And as you have all these expansions as well, it's also actually enriching.

113 But if you would see Munich again like this, where, for example, would you further expand, like do you see any areas that are being underserved and also areas where we could actually help people having a better RPT connection and enhancing their accessibility to opportunities, goods, and services, for example, besides for example, the proposed ones? And, if, if you have, if you have no idea, I can give you a new.

..unequal
..equal
..equity

114 **Speaker 2**: In the north-western part it looks pretty, pretty empty. And actually the whole part in the west looks pretty empty still. But as you mentioned before, like I've been living in the, I know many people, like many of my family live in this area and I know that almost everybody has a car and it doesn't actually care that much. But from what it looks like, it looks, it looks pretty empty.

115 **Speaker 1**: Okay. Yeah. And for example, if you, I mean, these are like different categories of priorities, priority categories. Would you, for example, change, anything like to, or would you, would you see, for example, an expansion as more, how do you say, “dringlich”, like, would you, for example, really prioritize this one expansion because you were, for example, talking about like, the “ring

connection” here, which is in the second category, and as well as the “cross-connection”, the U-bahn “cross-connection”, that is behind here is also in yellow, also in the second category. For example, you can also just talk about your neighborhood or what about, for example, this tram line that goes up here right through the neighborhood.

116 As for example, you would just change the prioritization or, what do you think for example?

117 **Speaker 2**: What was green again, which priority was green?

118 **Speaker 1**: the first one is like the, the blue one is that's to actually going to happen

119 **Speaker 2**: Ah okay, then, yellow, and then orange,

120 **Speaker 1**: exactly!

121 **Speaker 2**: I mean, I'm happy that the blue one is going to happen and the green one.

122 And I personally don't like, don't, don't need the orange one. But I bet there are people who do, so its hard for me to, it's hard for me to say. But that the, the yellow one, like the one which is actually quite, quite long and connects many places for many people, I think more people would profit from this line than for example, from that little blue line.

..efficient

..efficiency

123 **Speaker 1**: Yeah. Okay. No, that's that's good. Yeah, I’ll, I’ll follow up, I, I’ll show, you know, some, some results of my quantitative research. And, I, I'm just gonna ask you to like, kind of react on that. If it surprises you, for example, if it affects you or, so hold on a second.

124 I've done two kinds of things, for example, under current system now.

125 So basically what I did is I, I correlated the density of RPT stations with, with the data I had from the “Mobilität in Deutschland” study. And, for example, now, if we look at

the economic status, we can see that, especially like the lower ones are having a negative correlation.

126 Like a really, really slight correlation, but there still is one or there's at least a tendency. So what it actually just means is that they have, for example… lower economical status households have a lower density of RPT stations nearby, than for example, very high economical status. This is for example one example, what do you think about it?

127 Is it surprising to you or does it affect you? Do you think it's unfair? Or is it like normal? You know, what's, what would be your first thought?

128 **Speaker 2**: Just to make clear that I understood it correctly. The ones with the “lower economical status” have, also have, a lower..

129 **Speaker 1**: Yeah, exactly. It just means they have like, as it's not correlating with the, with the RPT station density in the area as it's an inverse correlation almost they might even have less RPT stations nearby.

..inequitable

130 **Speaker 2**: Yeah. Well, it doesn't surprise me. In that way that they, those areas, like I mean not in the center, they are a bit more outside and everything more outside has less stations, I guess, than the center, so this is one, one thing that comes to my mind. Another thing is that, for my area, I don't know if that's, if that's true, because I think there, the situation is quite, quite good, even though there is Hasenbergl and everything right away, where this, economical status is also, a little bit lower than the average I'd say, but…

..equitable

131 No, it doesn't surprise me, but I wish it was the other way round because of course, if who has more and more income kind of can afford a car or whatever more easily.

132 **Speaker 1**: Yeah. Yeah. Yeah. I’ll show you in a second also what I found with the expansions, because I, I’ve redone the exact same thing with the expansions.

133 And yeah, for example, also on the ages, for example, as you can see, especially high is, for example, from 18 to 40

but it's also especially low for older people, 70 to 79, for example. Same again: do you consider this fair, do you think it's also maybe a normal thing that young people may be more active and elderly people just don't really care about it?

134 Or do you think that, for example, it should be more equitable and, or do the other way? Well, I don't know. What, what do, what would you say, for example, if you see this?

135 **Speaker 2**: Well, different ascpects…

..inequitable

136 On the one hand, as you said, young people are more active and need this activeness, being active, need to go to work to school, to university and, and stuff. But on the other hand, for them, it's easier to walk a distance to come to the next station or cycle or go by bus and to switch four three times or whatever… for older people, it's not that easy.

137 And they like, they need the direct access more and they, of course they have places they need to get as well, like going, shopping, going to the doctor.

..inequitable

138 Well, I know from, from my grandmother, for example, that for her going by Bus is always harder than going by train, the steps that are higher somehow, and then there are often bike lanes between the bus and the... whatever it's called where you are waiting for the bus. And when you go up out of the bus and you are quite slow, there might be a cyclist coming, that is, almost driving you over.

139 So that's something that scares her about going by bus, but she doesn't have another option actually. So she always has to go by bus, when she wants to go somewhere.

..inequitable

140 **Speaker 1**: So you would say, for example, this negative correlation would be actually quite problematic because you think that they're like more elderly people that maybe physically have more difficulties?

141 **Speaker 2**: yeah!

142 **Speaker 1**: That's an interesting aspect. I haven't been thinking about this. Okay. I would show you, I mean the rest of it, I also did, hold on, sorry, that's right here. These were the correlation coefficients before the expansion, like, does this again for the economical status. And this is for example, with the expansion.

143 So we can see that suddenly for very low economical status it's suddenly positive, again, really slight relations. Also the low one has enhanced a bit, the medium one as well, but the very high as well, the high didn't, I mean, obviously they didn't remove any stations, but it's like the "distribution", the overall.

144 For example, do you think this is overall positive or how, how would you quanlify for example, this, this change?

145 **Speaker 2**: Well, on the first side it looks positive and it looks quite positive, but for the high economical status, quite a lot right?

146 **Speaker 1**: for example, if you're, if you see this in terms of their need?

..equality

147 **Speaker 2**: in terms of their need, I think it's positive, totally positive!

148 **Speaker 1**: Okay. Yeah, no, that's that's good. I, also one last thing. I also calculated what happens like who, what the percentage of people live in isochrones like around the RPT stations in a five minutes, in a 10 minutes isochrone and in the total of the city.

149 And I got out, for example, with the fact that, there will be an improvement for the inhabitants that are under 18 and inhabitants that are from 50 to 64 and migrants. You can ignore the male female one, but especially this. These three are actually having improved accessibility.

150 Do you think it's actually needed and, again, what, what do you think about it? Do you think it's fair? Do you think… also consider the ones that are actually losing, not losing, but I mean, obviously they keep their stations, but their situation's not improving. Do you think this is fair or do you

think they, the focus should be maybe on other groups, for example?

151 **Speaker 2**: I think, I put the under 18 ones I think it's, it's fair. It's good. And it's also, actually not only they profit from this, but also their parents, like if they're able to go somewhere alone and quick and easy, they profit from this as well. 50 to 64 well…

152 **Speaker 1**: That's an interesting age, but surprising.

153 **Speaker 2**: Yeah! How, how are they so different from 30 to 39?

154 **Speaker 1**: I don't know, but, they're also fully working.

155 **Speaker 2**: Why is actually, why is the migrant green at the nature or orange?

156 **Speaker 1**: It's just, I, I put this color codes to like see whether it's negative and where it's positive. It's just a…

157 **Speaker 2**: no, I see. Okay.

158 **Speaker 1**: So, like you would say it's, it's a little bit surprising even, or…?

159 **Speaker 2**: surprising what is surprising,?

160 **Speaker 1**: like the results, for example, or you could just briefly answer. Like if you, and honestly, if you don't have any idea or comment on that, it's fine.

161 **Speaker 2**: As far the, as for the migrants, for example, it doesn't surprise me because we we've also talked about that.

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162 Like the thing you've shown me before. And of course there's, I'd say that there's a correlation between migration and economic status, and in Munich, like sadly, but, but it's there. So that's probably like the whole, like there are

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regions that are profiting now where there is a higher density of migrants. And that might be the reason for this numbers here. So it doesn't surprise me.

163 **Speaker 1**: No. Yeah. That's interesting. Cause, now… so they might be a link between the migration and for example, lower economical status. And so you would say that it's actually a good thing, for example?

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164 **Speaker 2**: Yeah, it’s a good thing!

165 **Speaker 1**: That’s it thank you very much!